# Agricultural Fabrication and Emerging Technologies

## 8019 36 weeks

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Acknowledgments

The components of this instructional framework were developed by the following curriculum development panelists:

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Office of Career, Technical, and Adult Education
Virginia Department of Education

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Course Description
**Suggested Grade Level:** 10 or 11

Students will receive instruction in metal fabrication, including cutting, welding, and cold metalworking processes, for agricultural applications. The course will also include the investigation of emerging technologies used within the field of agriculture. Leadership and career skills will be incorporated throughout.

*As noted in Superintendent's Memo #058-17 (2-28-2017), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.*

### Task Essentials Table

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<td>Identify safety procedures and equipment necessary in agricultural fabrication and emerging technologies.</td>
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<td>Apply laboratory safety instructions.</td>
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<td>Explain emergency first-aid procedures.</td>
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<td>Identify the classifications of fires and the methods used to extinguish them.</td>
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<td>Demonstrate lifting and carrying techniques.</td>
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<td>Report injuries.</td>
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<tr>
<td>50</td>
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<td>Pass all safety exams with 100 percent accuracy.</td>
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<td>DEMONSTRATING SKILLS IN ELECTRICITY</td>
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<td>Describe scientific principles related to electricity.</td>
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<td>Identify basic electrical controls.</td>
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<td>Apply electrical terminology and measurement.</td>
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<td>Explain the electrical service system from generation to residential distribution.</td>
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**PERFORMING GAS METAL ARC WELDING (GMAW) OPERATIONS**

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<tr>
<td>72</td>
<td>✤</td>
<td>Follow safe practices in GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>73</td>
<td>✤</td>
<td>Prepare equipment and materials for GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<tr>
<td>74</td>
<td>✤</td>
<td>Demonstrate GMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<tr>
<td>75</td>
<td>✤</td>
<td>Describe procedures for welding aluminum, following all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>76</td>
<td>○</td>
<td>Demonstrate the ability to weld aluminum, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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**PERFORMING GAS TUNGSTEN ARC WELDING (GTAW) OPERATIONS**

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<td>77</td>
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<td>Follow safe practices in GTAW operations adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>✤</td>
<td>Describe GTAW operation procedures.</td>
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<td>Prepare equipment and materials for GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>Demonstrate the ability to perform GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>81</td>
<td>✤ Describe safe operation of a plasma arc cutting system.</td>
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<td>✤ Describe the components of a plasma arc cutting system.</td>
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<td>83</td>
<td>○ Demonstrate the ability to set up equipment for a plasma arc cutting task, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<tr>
<td>84</td>
<td>○ Demonstrate the ability to operate plasma arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>85</td>
<td>○ Demonstrate the ability to set up equipment for a computer numerical control (CNC) plasma arc cutting task.</td>
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<tr>
<td>86</td>
<td>○ Demonstrate the ability to operate CNC plasma-arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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**DEMONSTRATING TOOL RECONDITIONING**

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<td>Identify safe practices for tool reconditioning.</td>
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<td>Sharpen common tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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<td>Repair tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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**UNDERSTANDING PRECISION AGRICULTURAL MANAGEMENT**

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<td>Describe technologies used in precision agricultural management.</td>
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<td>Define site-specific application technology and its benefits.</td>
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<td>Define remote sensing and its applications.</td>
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<td>Describe the various types of positioning equipment.</td>
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<td>Describe the importance of developing and using maps in agricultural management.</td>
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<td>Describe the procedure for operating a GNSS receiver.</td>
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<td>Demonstrate the ability to collect data and apply that data in developing a map.</td>
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<td>Describe how GNSS data is used in agricultural management.</td>
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<td>Develop a precision-management plan.</td>
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**UTILIZING LASER TECHNOLOGIES IN AGRICULTURE**

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<td>Research the applications for laser technology in agriculture.</td>
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113  ○ Demonstrate the ability to use laser technology in agriculture, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

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<td>115  ● Research the types of drones used in agriculture.</td>
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<td>116  ● Identify safety precautions and standard operating procedures for flying drones.</td>
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<td>117  ● Describe the Federal Aviation Administration (FAA) Part 107 guidelines.</td>
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<td>118  ○ Prepare a drone for flight.</td>
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<td>119  ○ Fly a drone, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
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Legend: ●Essential ○Non-essential ○Omitted

Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf). All inquiries may be sent to cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).
Curriculum Framework

Task Number 39

Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

Definition

Identification should include

- defining an SAE program as an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment
- researching the Foundational SAE
  - career exploration and planning
  - personal financial planning and management
  - workplace safety
  - employability skills for college and career readiness
  - agricultural literacy
- researching the Immersion SAE
  - entrepreneurship/ownership
  - placement/internships
  - research (experimental, analytical, invention)
  - school business enterprises
  - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: SAE Resources, National Council for Agricultural Education

Process/Skill Questions:

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?
- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student’s Career Plan of Study?
• How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
• What are the four types of SAEs?
• What are the advantages of participating in work-based learning experiences and projects?
• How does one choose an appropriate SAE in which to participate?

Task Number 40

Participate in an SAE.

Definition

Participation should include

• developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
• documenting experience, connections, positions held, and competencies attained, using the Virginia SAE Record Book
• researching available awards and degrees, based on SAE participation.

Teacher resources:
FFA SAE
The Agricultural Experience Tracker
Virginia SAE Record Book

Process/Skill Questions:

• What are the advantages of participating in work-based learning experiences and projects?
• How do SAEs help prepare students for the workforce?
• What are some examples of SAEs in AFNR?
Exploring Leadership Opportunities through FFA

Task Number 41

Identify the benefits and responsibilities of FFA membership.

Definition

Identification should include

- **benefits**
  - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
  - exploring leadership development opportunities

- **responsibilities**
  - researching the responsibilities of FFA officers, committees, and members
  - locating resources that guide participation in FFA activities
  - explaining the FFA Creed, Motto, Salute, and mission statement
  - explaining the meaning of the FFA emblem, colors, and symbols
  - explaining significant events and the history of the organization.

Process/Skill Questions:

- How does one become an FFA member?
- What is the FFA’s mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

Task Number 42

Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
Definition

Description should include

- examples of successful leaders
- types of leadership
  - autocratic
  - participative
  - laissez-faire
  - servant
  - followership
- positive leadership qualities and traits of successful leaders
- opportunities for participating in leadership activities in FFA
- demonstrating methods for conducting an effective meeting.

Process/Skill Questions:

- Who are some successful leaders in the agriculture industry?
- What qualities make a successful leader?
- What are leadership traits?
- What is the difference between positive and negative leadership?

Task Number 43

Apply for an FFA degree and/or an agricultural proficiency award.

Definition

Application should include

- identifying types of FFA degrees
  - Greenhand
  - Chapter
  - State
  - American
- identifying proficiency award areas
  - entrepreneurship
  - placement
  - combined
  - agriscience research
- exploring CDEs and LDEs related to this course
- identifying all SAE criteria to be eligible for the award
- identifying the type of award
• applying for an FFA award.

Teacher resource: FFA Agricultural Proficiency Awards

**Process/Skill Questions:**

- Where are the awards and their application criteria located?
- What are the benefits of winning an FFA award?
- What are the benefits and requirements of an FFA degree?
- What FFA awards are available?
- How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
- What is the highest degree that can be conferred upon an FFA member at the national level?
- What are the requirements for a Greenhand FFA degree?

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**Orienting Students to Agricultural Machinery and Equipment Safety and Operation**

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**Task Number 44**

**Identify safety procedures and equipment necessary in agricultural fabrication and emerging technologies.**

**Definition**

Identification should include but is not limited to

- safety hazards
- personal protective equipment (PPE)
- Occupational Safety and Health Administration (OSHA) color codes for marking physical hazards
- procedures for verification that all equipment is in acceptable operating condition, according to OSHA standards
- procedures for application of appropriate safety devices (e.g., guards in place, tool rests adjusted).
Process/Skill Questions:

• What personal protective equipment (PPE) is necessary in agricultural fabrication?
• What are the standard color codes for laboratory safety?
• How would you describe the procedures required to ensure equipment is in good operating condition?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.

Task Number 45

Apply laboratory safety instructions.

Definition

Application should include following laboratory safety guidelines, including proper handling of tools, materials, and chemicals.

Process/Skill Questions:

• Why is a clean, organized mechanics laboratory important?
• What is the purpose and function of OSHA safety standards?
• What are the potential dangers of working in a laboratory?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.
Task Number 46

Explain emergency first-aid procedures.

Definition

Identification should include first-aid procedures for accidents involving

- bodily fluids
- electrical injuries
- eye injuries
- falls
- burns
- chemicals
- livestock
- cuts

according to current first-aid procedures and school policies.


Process/Skill Questions:

- What are the steps that should be followed in the event of an accident?
- Why is cardiopulmonary resuscitation (CPR) important?
- Why is it important to be certified to administer first aid?
- What are the three different classifications (degrees) of burns?
- What are the four basic classifications of fire extinguishers?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.

Task Number 47

Identify the classifications of fires and the methods used to extinguish them.

Definition
Identification should include the classifications of fires (A, B, C, and D), causes and prevention of fires, types of extinguishers, and the procedure for using a fire extinguisher, in accordance with government regulations and instructor's guidelines.

**Process/Skill Questions:**

- Why do fires have different classifications, and what are they?
- What is the fire triangle?
- What are the three requirements for a fire?
- Why is it important to know the classification of a fire when trying to extinguish it?
- Why and how often should fire extinguishers be inspected?
- What are the classifications of fire extinguishers?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.

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**Task Number 48**

**Demonstrate lifting and carrying techniques.**

**Definition**

Demonstration involves lifting and carrying materials and equipment based on the principles of

- lifting with legs
- keeping back straight
- holding load close to the body
- securing help when necessary

in accordance with government regulations and instructor's guidelines.

**Process/Skill Questions:**

- What are common injuries associated with improper lifting techniques?
- What can one do to prevent back injuries?
- How does proper positioning of the body affect proper technique?
The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Task Number 49

Report injuries.

Definition

Report should consist of an immediate oral statement of the job-related or non-job-related injury to the instructor or supervisor, and may be followed by a written confirmation reporting the date, extent of injury, and circumstances of the accident.

Process/Skill Questions:

• Why is it important to report all injuries?
• What are common reporting procedures?
• Why is it important to report an injury promptly, before leaving the job site?
• What are the key components of an injury report?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.

Task Number 50

Pass all safety exams with 100 percent accuracy.

Definition
Assessment should measure participation in safety training programs, including attending safety meetings and completing periodic demonstration of knowledge and skills gained from program topics (e.g., interpretation of Safety Data Sheets [SDS]). A perfect score is required, and a copy of the exam will be kept on file.

**Process/Skill Questions:**

- How often should one participate in safety training programs? Why?
- How does insurance impact the requirement of continuous retraining for safety?
- What is workers’ compensation?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

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**Demonstrating Skills in Electricity**

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**Task Number 51**

**Describe scientific principles related to electricity.**

**Definition**

Description should include

- basic atomic structure (i.e., electrons), as it relates to electricity
- the differences among conductors, insulators, and semiconductors
- amperage (current), including its unit of measure and symbol
- voltage, including its unit of measure and symbol
- wattage, including its unit of measure and symbol
- electrical resistance, including its unit of measure and symbol.

**Process/Skill Questions:**

- Who is credited with discovering the law of charges?
• According to the law of charges, how should objects with similar charges behave with each other?
• What is meant by the term amperage?
• What letter symbol is used to represent current?
• What is meant by the term volt?
• What letter symbol is used to represent voltage?
• What is meant by the term resistance?
• What letter symbol is used to represent resistance?
• How does resistance affect the movement of free electrons?
• What are the mathematical relationships of Ohm’s law?
• What are the mathematical relationships of Watt’s law?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

Task Number 52

Identify basic electrical controls.

Definition

Identification should include

• thermostats
• sensors
• timers.

Process/Skill Questions:

• Where are thermostats used?
• What is the purpose of a sensor? Of a timer?
• How are electrical controls used in agricultural systems?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
Task Number 53

Apply electrical terminology and measurement.

Definition

Application should include the terms watts, amps, volts, ohms, and other terminology and measures, according to the National Electrical Code, Electrical Testing Laboratory, Factory Mutual, Underwriters Laboratory (UL), and Occupational Safety and Health Administration (OSHA).

Process/Skill Questions:

- How would you describe the relationship among watts, amps, volts, and ohms?
- How would you explain the interrelationship of current, voltage, and resistance?
- What are potential and electromotive forces?
- How can Ohm’s law be used to calculate for the unknown?
- How can Watt’s law be used to calculate for the unknown?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

Task Number 54

Explain the electrical service system from generation to residential distribution.

Definition

Description should include

- sources of power generation
- types of power plants
- methods of electrical distribution
- functions of transformers.
Process/Skill Questions:

- What are the sources of electricity?
- What components are necessary to complete the circuit from generation to distribution? How would you describe each component?
- What is the purpose and function of a transformer?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

Creating Metal Fabrication Plans

Task Number 55

Identify welding symbols and weld symbols, according to the American Welding Society (AWS).

Definition

Identification should include

- reference line
- arrow
- basic weld symbol
- dimensions
- supplementary symbols
- finished symbols.

Process/Skill Questions:

- How does a welding symbol distinguish arrow side from other side?
- What is the difference between a welding symbol and a weld symbol?
- What are the most common weld symbols?
PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 56

Interpret drawings.

Definition

Interpretation should include reading the drawing for

- symbols
- materials
- measurements
- instructions.

Process/Skill Questions:

- Determine an actual size based on the drawing’s scale.
- What instructions might be included in a drawing? Where are the instructions found?

Task Number 57

Calculate the costs for a welding project.

Definition

Calculation should include
• cost of consumables (e.g., electrode [wire or stick], shielding gas, flux)
• cost of base metal(s)
• cost of supplies and materials
• cost of labor and overhead.

Process/Skill Questions:

• Where are prices found?
• How is the cost of base metal calculated?
• What factors are included in the cost of welding supplies?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 58

Lay out a project.

Definition

Layout may include

• planning the project by hand or digitally
• measuring.

Process/Skill Questions:

• How does laying out a project increase efficiency?
• When should layout of a project occur in the process of building or fabricating?
• How is the project tacked together?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Performing Shielded Metal Arc Welding (SMAW) Operations

Task Number 59

Discuss important safety considerations related to the welding environment prior to welding.

Definition

Discussion should include

- keeping the welding environment free from flammable materials
- keeping a fire extinguisher accessible to your welding environment
- ensuring a qualified person install and operate this equipment
- ensuring the welding area is clean, dry and ventilated
- ensuring one never operates the welder in humid, wet, or poorly ventilated area
- ensuring the welder has been maintained by a qualified technician in accordance with local, state and national codes
- being aware of the work environment to ensure others are away from the welding area while welding
- keeping harmful arc rays shielded from the view of others
- mounting the welder on a secure bench or cart that will keep the welder secure and prevent it from tipping over or falling
- checking ground cable, power cord and welding cable to be sure the insulation is not damaged
- replacing or ensuring damaged components are replaced prior to using the welder
- checking all components to ensure they are clean and in good operating condition prior to use.


Process/Skill Questions:

- Why is it important to follow the instructions in a welding manual?
• Why is it important to keep the welder in the off position when not in use?
• Why should one connect the ground lead as close to the area being welded as possible to ensure a good ground?
• Why should one prevent body contact with the welding wire, if one is in contact with the material being welded, ground or electrode from another welder?
• Why should one not weld if in an awkward position?
• Why should one always have a secure stance while welding to prevent accidents?
• What is the importance of wearing a safety harness if working above ground?
• Why should one never drape cables over or around one’s body?
• What is the importance of wearing a full coverage helmet with appropriate shade (see ANSI Z87.1 safety standard) and safety glasses while welding?
• How does wearing the proper gloves and protective clothing help prevent one’s skin from being exposed to hot metals, UV and IR rays?
• Why is it important to not overuse or overheat your welder and allow proper cooling time between duty cycles?
• Why should one keep one’s hands and fingers away from moving parts and stay away from the drive rolls?
• Why should one never point the torch at any body part of yourself or anyone else?
• Why should one always use the welder in the rated duty cycle to prevent excessive heat and failure?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 60

Observe specific areas of danger, caution, and warning.

Definition

Observation should include the following areas and precautions:

• Electrical shock
  o wearing dry protective apparel: coat, shirt, gloves and insulated footwear
  o insulating oneself from the work piece
  o avoiding contacting the work piece or ground
  o never attempting to repair or maintain the welder while the power is on
o inspecting all cables and cords for any exposed wire and replace immediately if found
o using only recommended replacement cables and cords
o always attaching ground clamp to the work piece or worktable as close to the weld area as possible
o never touching the welding wire and the ground or grounded work piece at the same time

• Fumes and gases
  o recognizing fumes emitted from the welding process displace clean air and can result in injury or death
  o never breathing in fumes emitted by the welding process
  o ensuring the air is clean and safe and that one is working in a well-ventilated area or using a ventilation device to remove welding fumes from the environment where one is working
  o never welding on coated materials (galvanized, cadmium plated, or containing zinc, mercury, or barium) given they emit harmful fumes that are dangerous to breathe
  o never welding near materials that will emit toxic fumes when heated (e.g., cleaners, chemical sprays, and degreasers)

• UV and IR Arc Rays
  o always using a helmet that covers the face from the neck to top of head and to the back of each ear
  o using safety glasses and a lens that meets ANSI standards
  o covering all bare skin areas exposed to the arc with protective clothing and shoes
  o wearing flame-retardant cloth or leather shirts, coats, pants, or coveralls for protection
  o using screens or other barriers to protect other people from the arc rays emitted from welding
  o warning others in or near the welding area when one is going to strike an arc so they can protect themselves

• Fire Hazards
  o never welding on containers or pipes that contain or have had flammable, gaseous or liquid combustibles in them
  o never operating any electric arc welder in areas where flammable or explosive materials are present
  o always removing all flammable materials within 35 feet of the welding arc
  o taking precautions to ensure that flying sparks do not cause fires or explosions in hidden areas, cracks, or areas you cannot see
  o keeping a fire extinguisher close in the case of fire
  o always wearing garments that are oil-free with no pockets or cuffs that will collect sparks
  o never having any items that are combustible, such as lighters or matches
• keeping the work lead connected as close to the weld area as possible to prevent any unknown, unintended paths of electrical current from causing electrical shock and fire hazards
• cutting wire back to ¼" stick out after welding to prevent any unintended arcs

• Hot Materials
  • never touching welded materials with bare hands
  • never touching a MIG gun nozzle after welding

• Sparks and Flying Debris
  • wearing protective apparel at all times (i.e., ANSI-approved safety glasses or shield and a welder’s hat and ear plugs to keep sparks and slag out of hair and ears)

• Electromagnetic Fields

• Shielding Gas Cylinders
  • treating carefully high-pressure cylinders, which can explode if damaged
  • never exposing cylinders to high heat, sparks, open flames, mechanical shocks, or arcs
  • never touching a cylinder with a MIG gun
  • never welding on the cylinder
  • always securing cylinders in an upright position secured to a cart or stationary object
  • keeping cylinders away from welding or electrical circuits
  • using the proper regulators, gas hoses, and fittings for the specific application
  • never looking into the valve when opening it
  • using the protective cylinder cap whenever possible.


Process/Skill Questions:

• What types of fumes are emitted from the welding process that can result in injury or death?
• Why should one never weld on coated materials?
• Why is it important to refer to the safety data sheet for the manufacturer’s instructions?
• What can happen if one welds near materials such as cleaners, chemical sprays, and degreasers?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 61

Follow safe practices in SMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Following safe practices should include

- describing and wearing appropriate personal protective equipment (PPE) for SMAW operations (e.g., proper clothing, ear and eye protection, respiratory protection)
- explaining and guarding against hazards (e.g., electrical, heat, light, fumes)
- discussing and implementing the proper methods for ventilating the welding area
- explaining and demonstrating how to prevent and extinguish different types of fires (e.g., type A, B, C, and D fire extinguishers)
- discussing the safety requirements, selection, and proper usage of hand and power tools
- implementing hand and power tool safety requirements (e.g., metal files, chipping hammers, portable and stationary grinders, portable and stationary drills, metal cutting machines)
- explaining and discussing SDS literature
- explaining and demonstrating the proper procedures for SMAW operations.

Process/Skill Questions:

- What are the hazards associated with SMAW operations? What PPE would address each of these hazards, and how?
- What is the purpose of a welding helmet?
- What shade lenses should be used for arc welding up to the 250-amp rating?
- What is meant by the term flash in welding?
- Why should synthetic fibers not be worn while welding?
- Why is it important to remove flammable materials and fumes from the work area?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 62

Identify types of electrodes.

Definition

Identification may include

- basic applications for general production rods such as
  - E6010
  - E6011
  - E6013
  - E7014
  - E7018
  - E7024
- explanation of the AWS classification system for welding rods.

Process/Skill Questions:

- What does the term tensile strength mean?
- What number(s) reveal(s) the tensile strength of a weld made by an electrode (in thousands of pounds per square inch)?
- Which number represents the welding positions? What is the number for each position?
- What does the final number of the electrode indicate?
- Why are there multiple types of rods available?
- Which electrodes require direct current with reverse polarity?
- Which electrodes can be welded with an alternating current machine?
- What materials are used in the flux coating of an electrode?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 63

Prepare equipment and materials for SMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Preparation should include

- inspecting welding leads and electrode holders for safety
- ensuring the material is properly grounded
- preparing and cleaning the metal by filing, grinding, or using a wire brush
- inspecting electrodes
- determining the welder type and electrode to be used
- setting up welding equipment
- adjusting the welder for voltage and polarity for the material being welded
- determining ground clamp positioning and attachment.

Process/Skill Questions:

- Why is metal preparation important to ensure a good weld?
- How does the electrode selection affect the way the metal is prepared?
- How can frayed welding leads be a hazard?
- How do you properly store welding supplies, including electrodes?
- How can you determine if you will be able to perform a weld with your welder, or if you should select another machine?
- Why do you have to clean metal to ensure a proper ground?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 64

Demonstrate machine setup for SMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include selecting the appropriate polarity and amperage for the metal (i.e., type, thickness) and electrode (i.e., type, diameter).

Process/Skill Questions:

• How is machine setup affected by the type of metal you are welding? By the thickness of the metal? By the purpose of your weld (e.g., new construction vs. repair)?
• How do you determine which electrode is best suited for your weld?
• What national system is in place for determining electrode type?
• How does changing the amperage affect the weld?
• How does changing the polarity affect the weld?
• When should you change the amperage and polarity on the machine?
• What is the difference between DC+ and DC-?
• Where can you find the recommended settings for the polarity and amperage for various types of steel?
• How does the diameter of the electrode affect the appearance of the bead?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 65

Demonstrate SMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration may include

- stringer bead welding
- groove welding
- fillet welding
- out-of-position welding

with various electrodes.

Process/Skill Questions:

- What are the characteristics of a proper weld?
- What are the basic operating procedures to produce a proper SMAW bead?
- What determines the rate of travel when performing SMAW operations?
- What is undercutting?
- What does excessive spatter indicate when performing SMAW operations?
- When might a fillet weld be used?
- How do you determine if an electrode is suitable for out-of-position welding?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 66

Test welds for quality and strength of joint as outlined by AWS standards.

Definition

Testing should include nondestructive examination, nondestructive testing, or destructive testing techniques (e.g., bend test).

Note: Additional guidelines can be found in AWS Schools Excelling through National Skills Education (SENSE) program guidelines.

Process/Skill Questions:

- When is weld testing required?
- What are some techniques for inspecting welds?
- How do you determine which testing technique to use?
- How do you perform a bend test on a groove weld?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Performing Oxy-fuel Welding and Cutting

Task Number 67

Follow safe practices in oxy-fuel gas welding and cutting, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
Definition

Following safe practices should include

- identifying and explaining how to maintain the major components of oxy-fuel welding equipment (e.g., cylinders, regulators, regulator gauges, hoses and fittings, reverse flow valves and flashback arrestors, welding, cutting, and heating tips, torch assembly)
- describing and wearing appropriate PPE for oxy-fuel operations (e.g., proper clothing, ear and eye protection, respiratory protection)
- describing and implementing the proper method for handling, storing, and setting up oxy-fuel welding and cutting equipment
- explaining and guarding against hazards associated with oxy-fuel welding and cutting (e.g., heat, light, fumes)
- discussing and implementing the proper methods for ventilating the welding area.

Process/Skill Questions:

- Why is it important to follow safety procedures when using equipment?
- How are the hazards associated with oxy-fuel welding and cutting different from those associated with electrical welding processes?
- What safety equipment should you wear when using a gas welder?
- How does PPE mitigate hazards associated with oxy-fuel processes?
- How would you identify components used on oxygen and fuel-gas cylinders and related equipment?
- Why is it important to report any damage or broken equipment to the instructor?
- Why do reactive (flammable) gases have an odor?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 68

Set up gas welding and cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
**Definition**

Setup should include

- storing, handling, and installing high-pressure gas cylinders
- demonstrating how to assemble regulators, hoses, and torches
- performing a leak test
- setting line pressure in the correct order
- demonstrating how to light, adjust, and extinguish the flame
- recognizing the various types of flames (e.g., oxidizing, carburizing, neutral)
- demonstrating how to shut down the oxy-fuel gas welding unit and bleed the lines in the correct order
- demonstrating how to disassemble the oxy-fuel gas-welding unit.

**Process/Skill Questions:**

- Why do fuel and oxygen hoses have different types of threads?
- What safety precautions should be followed when assembling gas welding and cutting equipment to the cylinders?
- What is the procedure for performing a leak test on welding and cutting equipment?
- How do you determine the tip size for performing a welding operation?
- What is the procedure for determining and setting line pressures?
- At what PSI does acetylene become unstable?
- In what order should gauges and line pressures be adjusted?
- What is the procedure for cleaning the welding tip?
- What are the steps for shutting down line pressures and disengaging the gauges?
- What could happen if the wrong type of regulator is used when performing gas welding and cutting operations?

**The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards**

**PST.01.03.** Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 69

Demonstrate oxy-fuel welding, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

- selecting the correct filler metals
- fusion welding without a filler rod
- fusion welding with a filler rod.

Process/Skill Questions:

- What are the characteristics of a good weld?
- What corrections should be made if a poor weld is produced?
- How can you determine if the metal is hot enough for proper fusion?
- How can you determine if the fillet is large enough to provide sufficient strength to the joint?
- What happens to your fusion weld if your torch tip is the wrong size?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 70

Braze weld mild steel, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Braze welding should include
• cleaning the metals to be joined
• ensuring proper fit and clearance
• fluxing the welding area
• assembling the metal to be brazed
• lighting and adjusting the heat source to a neutral flame, following all safety precautions
• heating and brazing the filler metal
• cleaning the newly brazed joint.

Process/Skill Questions:

• What is the purpose of braze welding?
• What safety precautions should be followed when braze welding?
• Why is clean metal critical for good adhesion when braze welding?
• What are methods to determine the quality of the braze weld?
• What corrections can be made if the quality of the weld is not sufficient?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 71

Cut mild steel with an oxy-fuel cutting torch, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Cutting should include

• using various cutting techniques
• examining cut surfaces for proper results
• shutting down the equipment.

Process/Skill Questions:

• What are some commonly used fuels for a cutting torch?
• What are some uses for the oxy-fuel cutting torch?
• Why is it important to always perform a leak test before using the oxy-fuel torch?
• What types of metal can you cut with the oxy-fuel torch?
• How do you determine proper operating line pressures for the oxy-fuel torch when cutting metal of a specific thickness?
• How can you prevent hot molten from blowing back into your torch tip?
• How should the cut surface look after a successful cut?
• What are some characteristics of the kerf of a properly cut piece of metal?
• How do you identify mistakes on the cut surface?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Performing Gas Metal Arc Welding (GMAW) Operations

Task Number 72

Follow safe practices in GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Following safe practices should include

• describing and wearing appropriate PPE for GMAW operations (e.g., proper clothing, ear and eye protection, respiratory protection)
• describing and implementing the proper method for handling, storing, and setting up cylinders
• explaining and guarding against hazards (e.g., electrical, heat, light, fumes)
• discussing and implementing the proper methods for ventilating the welding area
• explaining and discussing SDS literature
• explaining and demonstrating the proper procedures for GMAW operations.

Process/Skill Questions:

• What is MIG welding and is it the same as GMAW?
• What is the GMAW process and why would one select this welding process over SMAW?
• What are some common safety measures that are required prior to MIG welding?
• Why would one need to use a skullcap under a welding helmet, and if so, what material should it be made of?
• How do surface contaminants adversely affect the welding current, reduce wire-feeding performance, and reduce weld quality?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 73

Prepare equipment and materials for GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Preparation should include

• storing, handling, and installing high-pressure gas cylinders
• determining the welder type, electrode, wire type, diameter, and gas to be used
• setting up welding equipment
• adjusting the welder for proper electrode stick-out, voltage, polarity, flow rate, and wire-feed speed required for the material being welded
• determining ground clamp positioning and attachment.

Process/Skill Questions:

• How is GMAW wire classified?
- Why is GMAW wire copper in color?
- What is the line pressure for gas shielding when welding steel?
- What resources are available to determine voltage and wire-feed speed?
- When you increase voltage, what else will need to be increased? Why?
- What is the proper gun angle to the metal when performing GMAW operations?
- What are common problems to look for if the wire does not feed properly?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

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Task Number 74

Demonstrate GMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

- selecting the correct shielding gas to get the best result from your filler metal
- ensuring the work-piece is as clean as possible
- setting the power source according to the manufacturer’s instructions for wire polarity
- following wire electrode specifications to set the proper wire feed speed (amperage) and voltage
- aligning the proper electrode stick-out with the wire diameter being used
- positioning the wire electrode properly over the weld joint for maximum coverage based on the type of weld joint
- manipulating the welding gun effectively based on the type of weld joint
- controlling travel speed

and may include

- stringer bead welding
- groove welding
- fillet welding
• out-of-position welding.

Process/Skill Questions:

• How do you select the appropriate wire and burn angle when performing GMAW operations?
• How does the wire feed speed affect your weld?
• What is the difference between pushing and pulling the spool gun?
• Should you push or pull the weld? Why?
• What are the characteristics of a proper weld?
• What corrections can be made if the weld is of poor quality?
• How should a proper weld sound?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 75

Describe procedures for welding aluminum, following all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Description should include

• determining the welder type, electrode, wire type, diameter, and gas to be used
• setting up welding equipment
• adjusting the welder for proper electrode stick-out, voltage, polarity, flow rate, and wire-feed speed required for the material being welded
• cleaning aluminum oxide surface
• determining ground clamp positioning and attachment.

Process/Skill Questions:

• What are the alternative methods for cutting aluminum?
• What types of welders are used for welding aluminum?
- What shielding gas would you use for performing GMAW operations on aluminum?
- What polarity is needed to weld aluminum?
- Why is a separate spool gun usually required for welding aluminum?
- How is the aluminum oxide surface removed?
- Why is it important to clean aluminum thoroughly before welding?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 76

Demonstrate the ability to weld aluminum, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

- stringer bead welding
- groove welding
- fillet welding.

Process/Skill Questions:

- What are the alternative methods for cutting aluminum?
- What types of welders are used for welding aluminum?
- What shielding gas would you select when performing GMAW operations on aluminum?
- What are the potential consequences of not properly cleaning your base metal?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Performing Gas Tungsten Arc Welding (GTAW) Operations

Task Number 77

Follow safe practices in GTAW operations adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Following safe practices should include identification of cylinders, parts, and torch assembly:

- use of PPE
- selection and use of hand tools
- selecting the correct shielding gas to get the best result
- ensuring the work-piece is as clean as possible
- setting the power source according to the manufacturer’s instructions for electrode polarity
- following electrode specifications to set the amperage and voltage
- determining ground clamp positioning and attachment
- positioning the electrode properly over the weld joint
- manipulating the welding gun effectively based on the type of weld joint
- controlling travel speed.

Process/Skill Questions:

- What PPE should be used when performing GTAW operations?
- What inspections should be performed regularly to ensure safety?
The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 78

Describe GTAW operation procedures.

Definition

Description should include procedures for adhering to all safety requirements, industry recommended practices, and instructor guidelines related to

- storing, handling, and installing high-pressure gas cylinders
- setting up equipment and materials
- selecting the current
- selecting the shielding gas
- selecting the shielding gas flow rate
- selecting and preparing a tungsten electrode
- selecting the torch nozzle
- selecting the filler metal
- preparing the metal for welding
- starting the arc
- using welding techniques
- shutting down the equipment.

Process/Skill Questions:

- What are some methods for starting the arc when performing GTAW operations?
- What are the steps for preparing metal for GTAW operations?
- What resources are available to determine the appropriate current, polarity, shielding gas, shielding gas flow rate, tungsten electrode, torch nozzle, and filler metal?
- What is the shape of a properly prepared tungsten electrode?
- Why is GTAW considered to be the most precise welding operation?
- How are GMAW and GTAW similar? Different?
PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 79

Prepare equipment and materials for GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Preparation should include equipment and materials such as

- power source
- shielding gas supply
- shielding gas regulator
- gas flow meter
- shielding gas hoses and fittings
- electrode lead, workpiece lead, hoses
- welding torch
- tungsten electrodes.

Process/Skill Questions:

- What safety precautions should be taken when preparing equipment and materials for GTAW operations?
- What types of power sources can be used for GTAW operations?
- Why do some systems use water in the welder?
- What types of metal are typically welded using GTAW?
- How do you determine what type of tungsten is used for a given weld?
- What does a clean welding surface look like?
The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 80

Demonstrate the ability to perform GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include adhering to all safety requirements, procedures, and instructor guidelines for

- stringer bead welding
- groove welding
- fillet welding.

Process/Skill Questions:

- What are similarities and differences among SMAW, GMAW, and GTAW operations?
- What safety precautions should be taken when welding?
- How can you tell if your base metal is heated to a molten state?
- What might happen if you add a filler rod before your base metal is heated to a molten state?
- What are the types of weld positions, and where are they most beneficial?
- How can the size of a weld be manipulated?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Performing Plasma Arc Cutting Operations

Task Number 72

Describe safe operation of a plasma arc cutting system.

Definition

Description should include procedures for adhering to all safety requirements, industry recommended practices, and instructor guidelines for

- using PPE in the operation of the plasma arc cutting system
- setting up the system
- preparing to cut
- making cuts
- shutting down the system.

Process/Skill Questions:

- What safety precautions should be taken before using a plasma arc cutting system? During? After?
- What hazards are associated with plasma-arc cutting?
- What type of eye protection is required when using the plasma arc cutting system?
- How does each piece of PPE protect you from the hazards of plasma arc cutting?
- Along with electricity, what else is used to operate the plasma arc cutter?
- What is the procedure for shutting down a plasma arc cutting system?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).
Task Number 82

Describe the components of a plasma arc cutting system.

Definition

Description should include

- power supply
- torch
- supply of gas or gases and regulator(s)
- safety equipment.

Process/Skill Questions:

- What is the function of the torch in a plasma arc cutting system?
- What safety equipment is required when using a plasma arc cutting system?
- What gases can be used when operating a plasma arc cutting system?
- What does a defective component look like?
- What parts of a plasma cutter are disposable and must be replaced occasionally?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 83

Demonstrate the ability to set up equipment for a plasma arc cutting task, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

- assembling components, including setting correct air compressor pressure and shielding, as it pertains to metal thickness
• selecting amperage or machine setting
• setting grounding on power source
• installing torch head parts
• applying principles of plasma arc cutting operation.

Process/Skill Questions:

• What resources are available to determine amperage and air pressure?
• What steps should be followed when setting up the equipment for a plasma arc cutting task?
• Why is placement of the ground wire critical in plasma arc cutting?
• What determines the power output settings for a plasma arc cutter?
• How is travel speed determined when using a plasma arc cutter?
• What factors affect travel speed when using a plasma arc cutter?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 84

Demonstrate the ability to operate plasma arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

• using various cutting techniques
• examining cut surfaces
• shutting down equipment.

Process/Skill Questions:

• What are the various ways to cut metal? Why are there so many?
• Why is it important to perform a leak test before using a torch?
• What types of metal can be cut with the plasma cutter?
• What mistakes can be evident on a cut surface?
• How can you cut straight edges?
• How does metal cut with a plasma arc cutter compare to metal cut with an oxy-fuel torch?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

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Task Number 85

Demonstrate the ability to set up equipment for a computer numerical control (CNC) plasma arc cutting task.

Definition

Demonstration should include following all safety requirements, industry recommended practices, instructor guidelines, and

• using a computer-aided design (CAD) program to read, draw, or modify a cut file
• interpreting the cut sheet
• assembling components, including setting correct air compressor pressure and shielding, as it pertains to metal thickness
• selecting amperage or machine setting
• selecting computer settings
• setting grounding on power source
• installing torch head parts
• applying principles of plasma arc cutting operation.

Process/Skill Questions:

• What are the advantages of a CNC plasma arc cutting machine?
• How can the machine be set to reduce dross?
• How do the variables on the cut sheet affect the cut?
Task Number 86

Demonstrate the ability to operate CNC plasma arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

- examining cut surfaces
- shutting down equipment.

Process/Skill Questions:

- Why is jogging the cut important?
- How can nesting parts prevent waste?
- What are the benefits of nesting parts?
Task Number 87

Describe safe practices in hot metalworking operations.

Definition

Description should include procedures for adhering to all safety requirements, industry recommended practices, instructor guidelines, and

- setting up the system, if applicable
- identifying cylinders, parts, and torch assembly, if applicable
- using PPE
- selecting and using hand tools
- shutting down the system, if applicable.

Process/Skill Questions:

- What PPE should be used when performing hot metalworking operations?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

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Task Number 88

Identify metals.

Definition

Identification should include metals commonly used in the agriculture industry and their characteristics, including

- ferrous vs. non-ferrous
- hardness
- malleability
- ductility.
Process/Skill Questions:

- What are some resources for identifying metals?
- What types of metal are commonly used in the agriculture industry?
- How do you determine metal type?
- How can a magnet and grinder help you identify metal type?
- What are methods to determine if a metal is ferrous?
- What are methods to determine metal hardness?
- What are some common solder alloys?
- Why is soft soldering the preferred method for joining some metals, but not others?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 89

Describe the procedures for shaping, hardening, and tempering common tools.

Definition

Description should include adhering to all safety requirements, industry recommended practices, instructor guidelines and

- heating techniques when working with metal
- cooling techniques when working with hot metal
- tools and equipment for shaping, hardening, and tempering common tools.

Process/Skill Questions:

- Why is tempering necessary?
- What tools are necessary for shaping metal?
- What are some methods for determining metal temperature? Explain.
- How is metal surface color associated with various heating techniques?
- What are some methods for shaping metal?
Task Number 90

Select soldering equipment and tools.

Definition

Selection should include

- fuel type
- torch assembly
- friction lighter
- solder
- fluxes.

Process/Skill Questions:

- Which equipment and tools are commonly associated with soldering?
- How do you determine the appropriate equipment for a soldering task?
- Why is flux necessary when soft soldering?
- How does soldering differ from brazing? How is it similar?

Task Number 91

Prepare metals for soft soldering.
Definition

Preparation should include adhering to all safety requirements, industry recommended practices, and instructor guidelines and

• cleaning the metal, using a mechanical process (e.g., wire brush, wire wheel, grinder, sander)
• using chemicals to remove any impurities.

Process/Skill Questions:

• How do you determine which mechanical process to use when cleaning metal?
• What safety precautions should be followed when preparing metal for soldering?
• What are fluxes?
• How should metal be prepared for soldering?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Task Number 92

Demonstrate soldering skills, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Demonstration should include

• obtaining and preparing the necessary materials
• using specified soldering technique(s)
• shutting down tools and/or equipment.

Process/Skill Questions:

• How are soldering skills similar to welding skills? How are they different?
• What risks are associated with using lead solder?
• How is soldering equipment stored when not in use?
• What characteristics should you look for when inspecting a soldered joint?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.03. Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

Performing Cold Metalworking Operations

Task Number 93

Describe safe practices for metal striking and machine tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Description should include

• all safety requirements
• industry recommended practices
• instructor guidelines
• tool-care and tool-fitting procedures.

Process/Skill Questions:

• How is the proper angle to sharpen a specific tool determined?
• What parts of the body need to be protected when using striking tools?
• What safety equipment is needed when using striking tools?
• What is the potential result of using a dull tool? Will striking or machining fix the problem? Why, or why not?
• What are common injuries sustained while metal striking and/or using machine tools? How can they be avoided?
• What causes a mushroomed top on a chisel?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Task Number 94

Identify metalworking hand tools by type and use.

Definition

Identification may include striking, turning, and cutting tools.

Process/Skill Questions:

• What are some common metalworking hand tools?
• What are some more specialized less common metalworking hand tools?
• What metalworking tools are associated with cutting?
• Which tools are better for light or fine work? Why?
• Which tools are better for heavy or coarse work? Why?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Task Number 95

Drill holes in metal, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
Definition

Drilling should include

- measuring and marking the metal for drilling using a center punch
- selecting the correct bit
- selecting and applying necessary cooling lubricants.

Process/Skill Questions:

- How do you lay out a hole to be drilled?
- What are the different types of drill bit shanks?
- What determines the size of the bit to use when drilling a hole in metal?
- What is the purpose of center-punch marking before drilling?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Task Number 96

Determine tap drill sizes.

Definition

Determination should include

- use of a tap and drill chart
- selecting thread type(s) (e.g., NPT, NF, NC, metric).

Process/Skill Questions:

- How is a tap and drill chart used?
- Why are there different types of taps?
- What determines the type of threads that are needed?
- Why is the size of drill important for getting good threads?
- How do NPT, NF, NC, and metric threads differ?
The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

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Task Number 97

Cut threads with tap and die, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Cutting threads should include using various tap and die handles and types of metal.

Process/Skill Questions:

- Why is it important to bevel the end of the rod?
- What is the purpose of lubricant when cutting threads?
- What determines if the threads are long enough?
- Why is it important to hold the diestock/tap wrench level when cutting threads?
- What is cross-threading?
- What happens if you do not back up regularly as you thread?

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The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

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Task Number 98

Use files and saws, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
Definition

Use should include

- identifying types of files and saws
- handling files and saws
- cleaning files (e.g., with a file card and brush)
- selecting sawing and filing techniques.

Process/Skill Questions:

- What is the difference between a single- and double-cut file?
- What determines the type of file to use for a specific operation?
- What types of saws can be used to cut metal?
- What factors determine which sawing or filing technique should be used?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Demonstrating Tool Reconditioning

Task Number 99

Identify safe practices for tool reconditioning.

Definition

Identification should include

- protective equipment
- procedures for handling sharp instruments
- types of portable and bench grinders
- procedures for the safe use of grinders
- importance of inspecting and adjusting the tool rest on a bench grinder.
Process/Skill Questions:

• What precautions should be taken when using keen edge tools and grinders?
• What PPE should be used when reconditioning tools?
• What injuries may occur during tool-reconditioning activities? How can they be avoided?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

Task Number 100

Sharpen common tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Sharpening should include identification of proper shapes and angles of tools (e.g., chisels, punches, drill bits) and adhering to all safety requirements, procedures, and instructor guidelines.

Process/Skill Questions:

• What are the advantages of keeping tools sharp?
• Which is more dangerous, a sharp tool or a dull tool? Explain.
• What tools can be used to sharpen other tools?
• Why does cutting angle affect the function of a tool?
• What angles are common to drill bits?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.
Task Number 101

Repair tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.

Definition

Repairing tools should include

- determining when to repair vs. replace
- identifying hazards related to tools
- replacing, maintaining, or repairing handles
- reshaping tools (e.g., hammer heads, chisel ends, striking surfaces).

Process/Skill Questions:

- Why is important to be able to repair and maintain tools?
- What factors are used to determine whether a tool needs to be repaired or replaced?
- What are the procedures for refitting a mushroomed head of a cold chisel or other cutting tool?
- What can be applied to wooden handles when they become dry and cracked? Why?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.01.02. Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situations.

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Understanding Precision Agricultural Management

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Task Number 102

Describe technologies used in precision agricultural management.
Definition

Description should include

- new technologies in land mapping
- global navigation satellite system (GNSS), formerly global positioning system (GPS)
- self-steering systems on farm machinery
- computer-guided systems
- remotely operated equipment (e.g., drones)
- robotics and automation.

Process/Skill Questions:

- What new precision technologies are available in agriculture production that were not available five years ago?
- How does GNSS acquire its signal?
- How is GNSS being used with robotics in the agriculture industry?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 103

Define site-specific application technology and its benefits.

Definition

Definition should include

- types of application equipment
- purpose of application
- benefits of application.

Process/Skill Questions:

- What is an example of site-specific application equipment used in agriculture? How does it work?
- What are some benefits of site-specific application equipment for an agricultural field?
- How can site-specific application reduce the use of fertilizer or chemicals?
• What are the environmental benefits of site-specific application?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

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Task Number 104

Define remote sensing and its applications.

Definition

Definition should include

• types of sensing equipment
• types of data collected
• application of data collected.

Process/Skill Questions:

• What is an example of data collected from remote-sensing equipment? How is that data used?
• What are some benefits of gathering data from remote-sensing equipment?
• How can remote sensing be used in sustainable agriculture?
• Why is remote sensing valuable to producers?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

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Task Number 105

Describe the various types of positioning equipment.

Definition
Definition should include

- types of GNSS equipment
- types of position-correction systems
- types of computer software (e.g., ArcGIS).

Process/Skill Questions:

- What is your experience is using GNSS? For what purposes have you used it?
- What is an example of computer software that is used in agricultural applications? For what purpose(s) is it used?
- What level of accuracy is needed in GNSS equipment for agricultural applications?
- How do position-correction systems work?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 106

Describe the importance of developing and using maps in agricultural management.

Definition

Description should include

- types of agriculture-related maps (e.g., yield, soil, scouting)
- purposes of agriculture-related maps.

Process/Skill Questions:

- Where can maps for agricultural systems be found?
- Why do maps require legends?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.
Task Number 107

Describe the procedure for operating a GNSS receiver.

Definition

Description should include how to use a handheld or vehicle-mounted GNSS unit to plot points, measure distances, and calculate area.

Process/Skill Questions:

• What are the steps to determine the area of a field, using GNSS?
• How has precision technology helped make production agriculture more efficient?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 108

Demonstrate the ability to collect data and apply that data in developing a map.

Definition

Demonstration should include

• plotting points
• determining distance
• calculating area, using specific given points at a location.

Process/Skill Questions:

• What is the procedure for developing a map of a given area?
• How is area calculated?
The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 109

Describe how GNSS data is used in agricultural management.

Definition

Description should include

- examples of computer software used with GNSS data
- geographic information systems (GIS)
- examples of agriculture-related maps (e.g., yield, soil, scouting).

Process/Skill Questions:

- What types of decisions are made using GNSS data?
- How can the use of GNSS data save money in agricultural management?
- What is an example of an agricultural map that would be used when applying fertilizers to a field?
- How can GIS be used outside of agriculture?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 110

Describe the purpose and uses of variable-rate technology.

Definition
Description should include

- types of products applied
- types of application equipment
- methods of rate calculation.

Process/Skill Questions:

- When applying product to a field, why should only the necessary amount be used?
- How can variable-rate technology affect the environment?
- What are some products that are applied at a variable rate?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

Task Number 111

Develop a precision-management plan.

Definition

Development should include

- purpose and goal of the plan
- resources required
- technologies used
- steps for implementation.

Process/Skill Questions:

- What are the main components of a precision-management plan?
- What are the steps in creating a precision-management plan?
- How can a precision-management plan affect production costs?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.
Utilizing Laser Technologies in Agriculture

Task Number 112

Research the applications for laser technology in agriculture.

Definition

Research should include

- types of lasers (e.g., cutting, sensing)
- uses of lasers in agriculture
- safety concerns associated with the use of lasers.

Process/Skill Questions:

- What is a laser?
- Why is it important to take safety precautions when operating lasers?
- What can lasers do that normal light cannot?
- How are lasers used in everyday life?
- Where are lasers used in agriculture? How are they used?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 113

Demonstrate the ability to use laser technology in agriculture, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
Definition

Demonstration should include

- selection of an appropriate laser
- setup and calibration of equipment
- operation of equipment
- analysis of results.

Process/Skill Questions:

- How would you go about selecting the appropriate laser for a job?
- Why is it important to calibrate and properly locate a laser?
- When might lasers be unsafe? Explain.
- What level of accuracy can be expected with laser measurement?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Exploring the Use of Drones for Agriculture

Task Number 114

Explain uses of drones in agriculture.

Definition

Explanation should include how drones are used for

- crop production
- livestock production.

Process/Skill Questions:
• What are some ways drones are used for crop production?
• What are some ways drones are used for livestock production?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 115

Research the types of drones used in agriculture.

Definition

Research should include gathering information about

• fixed-wing drones
• rotor drones.

Process/Skill Questions:

• What are some examples of fixed-wing drones? Of rotor drones?
• What are the advantages of each?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 116

Identify safety precautions and standard operating procedures for flying drones.

Definition

Identification should include
• flying only one drone at a time
• flying the drone within visual line of sight
  o flying only during the day
  o avoiding flying in cloud, fog or heavy rain
  o viewing the drone with eyes at all times, rather than by using binoculars or watching a video screen
  o avoiding anything that would obstruct the line of sight (e.g., trees, buildings)
• ensuring compliance with drone flying requirements for the area
• ensuring batteries are fully charged
• checking the UAV weather forecast prior to flight, specifically regarding safe wind conditions, cloud cover, fog, or heavy rain
• being familiar with the flight location (e.g., off-limits spaces, building structures, local law prohibiting flight in specific areas, air traffic control contact when in the vicinity of an airport) and planning the range of flight
• establishing the take-off and landing location and a backup plan prior to flight.

Process/Skill Questions:

• What weather concerns should one investigate prior to drone flight?
• What is the maximum safe wind speed when flying a drone?
• Why should one have a visual line-of-sight on the drone at all times?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 117

Describe the Federal Aviation Administration (FAA) Part 107 guidelines.

Definition

Description should include

• rules under Part 107
• operations not covered by Part 107.
Process/Skill Questions:

• What is a FAA Part 107 license?
• How would one obtain the FAA Part 107 license?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 118

Prepare a drone for flight.

Definition

Preparation should include

• preparing the battery
• checking or installing propellers
• syncing the controller with a phone or tablet.

Process/Skill Questions:

• Why should drones not be flown in cold weather?
• What type of material should propellers be made of?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

Task Number 119

Fly a drone, adhering to all safety requirements, industry recommended practices, and instructor guidelines.
Definition

Flying should include

- preflight preparation
- flight controls
- syncing with the controller.

Process/Skill Questions:

- Why is a take-off and landing pad necessary?
- How is the controller linked with a phone or tablet?
- What are the basic flight controls for a drone?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

SOL Correlation by Task

<table>
<thead>
<tr>
<th>Task/Competency</th>
<th>Standards of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Identify the role of supervised agricultural experiences (SAEs) in agricultural education.</td>
</tr>
<tr>
<td>40</td>
<td>Participate in an SAE.</td>
</tr>
<tr>
<td>41</td>
<td>Identify the benefits and responsibilities of FFA membership.</td>
</tr>
<tr>
<td>42</td>
<td>Describe leadership characteristics and opportunities as they relate to agriculture and FFA.</td>
</tr>
<tr>
<td>43</td>
<td>Apply for an FFA degree and/or an agricultural proficiency award.</td>
</tr>
<tr>
<td>44</td>
<td>Identify safety procedures and equipment necessary in agricultural fabrication and emerging technologies.</td>
</tr>
<tr>
<td>45</td>
<td>Apply laboratory safety instructions.</td>
</tr>
<tr>
<td>Task/Competency</td>
<td>Standards of Learning</td>
</tr>
<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>46</td>
<td>Explain emergency first-aid procedures.</td>
</tr>
<tr>
<td>47</td>
<td>Identify the classifications of fires and the methods used to extinguish them.</td>
</tr>
<tr>
<td>48</td>
<td>Demonstrate lifting and carrying techniques.</td>
</tr>
<tr>
<td>49</td>
<td>Report injuries.</td>
</tr>
<tr>
<td>50</td>
<td>Pass all safety exams with 100 percent accuracy.</td>
</tr>
<tr>
<td>51</td>
<td>Describe scientific principles related to electricity. English: 10.5, 11.5 Science: PH.11</td>
</tr>
<tr>
<td>52</td>
<td>Identify basic electrical controls. English: 10.5, 11.5 Science: PH.11</td>
</tr>
<tr>
<td>53</td>
<td>Apply electrical terminology and measurement. English: 10.5, 11.5 Science: PH.11</td>
</tr>
<tr>
<td>54</td>
<td>Explain the electrical service system from generation to residential distribution. English: 10.5, 11.5 Science: PH.11</td>
</tr>
<tr>
<td>55</td>
<td>Identify welding symbols and weld symbols, according to the American Welding Society (AWS). English: 10.5, 11.5</td>
</tr>
<tr>
<td>56</td>
<td>Interpret drawings. English: 10.5, 11.5</td>
</tr>
<tr>
<td>57</td>
<td>Calculate the costs for a welding project. English: 10.5, 11.5</td>
</tr>
<tr>
<td>58</td>
<td>Lay out a project.</td>
</tr>
<tr>
<td>59</td>
<td>Discuss important safety considerations related to the welding environment prior to welding. English: 10.1, 10.5, 11.1, 11.5</td>
</tr>
<tr>
<td>60</td>
<td>Observe specific areas of danger, caution, and warning.</td>
</tr>
<tr>
<td>61</td>
<td>Follow safe practices in SMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines. English: 10.5, 11.5 History and Social Science:</td>
</tr>
<tr>
<td>Task/Competency</td>
<td>Standards of Learning</td>
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<tr>
<td>-------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Identify types of electrodes.</td>
<td>WHII 8; VUS 8</td>
</tr>
<tr>
<td></td>
<td>Science: CH.1</td>
</tr>
<tr>
<td>Prepare equipment and materials for SMAW operations, following all safety</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>requirements, industry recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Demonstrate machine setup for SMAW operations, following all safety</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>requirements, industry recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Demonstrate SMAW operations, following all safety requirements, industry</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Test welds for quality and strength of joint as outlined by AWS standards.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Follow safe practices in oxy-fuel gas welding and cutting, adhering to all</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>safety requirements, industry recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Set up gas welding and cutting equipment, adhering to all safety</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>requirements, industry recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Demonstrate oxy-fuel welding, following all safety requirements, industry</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Braze weld mild steel, following all safety requirements, industry</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>recommended practices, and instructor guidelines.</td>
<td></td>
</tr>
<tr>
<td>Cut mild steel with an oxy-fuel cutting torch, following all safety</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>requirements, industry recommended practices, and instructor guidelines.</td>
<td></td>
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<tr>
<td>Task/Competency</td>
<td>Standards of Learning</td>
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<tr>
<td>--------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>72 Follow safe practices in GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td></td>
<td>Science: CH.1</td>
</tr>
<tr>
<td>73 Prepare equipment and materials for GMAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>74 Demonstrate GMAW operations, following all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>75 Describe procedures for welding aluminum, following all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>76 Demonstrate the ability to weld aluminum, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>77 Follow safe practices in GTAW operations adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>78 Describe GTAW operation procedures.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>79 Prepare equipment and materials for GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>80 Demonstrate the ability to perform GTAW operations, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>81 Describe safe operation of a plasma arc cutting system.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>82 Describe the components of a plasma arc cutting system.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Task/Competency</td>
<td>Standards of Learning</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Demonstrate the ability to set up equipment for a plasma arc cutting task, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Demonstrate the ability to operate plasma arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Demonstrate the ability to set up equipment for a computer numerical control (CNC) plasma arc cutting task.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Demonstrate the ability to operate CNC plasma-arc cutting equipment, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Describe safe practices in hot metalworking operations.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Identify metals.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Describe the procedures for shaping, hardening, and tempering common tools.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Select soldering equipment and tools.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Prepare metals for soft soldering.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Demonstrate soldering skills, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Describe safe practices for metal striking and machine tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Identify metalworking hand tools by type and use.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Task/Competency</td>
<td>Standards of Learning</td>
</tr>
<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>95 Drill holes in metal, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>96 Determine tap drill sizes.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>97 Cut threads with tap and die, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>98 Use files and saws, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>99 Identify safe practices for tool reconditioning.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>100 Sharpen common tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>101 Repair tools, adhering to all safety requirements, industry recommended practices, and instructor guidelines.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>102 Describe technologies used in precision agricultural management.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>103 Define site-specific application technology and its benefits.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>104 Define remote sensing and its applications.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>105 Describe the various types of positioning equipment.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>106 Describe the importance of developing and using maps in agricultural management.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>107 Describe the procedure for operating a GNSS receiver.</td>
<td>English: 10.5, 11.5</td>
</tr>
</tbody>
</table>

Science: PH.4
<table>
<thead>
<tr>
<th>Task/Competency</th>
<th>Standards of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>108</td>
<td>Demonstrate the ability to collect data and apply that data in developing a map. English: 10.5, 11.5 Mathematics: G.8, P.8*, PS.9*, AFDA.8</td>
</tr>
<tr>
<td>109</td>
<td>Describe how GNSS data is used in agricultural management. English: 10.5, 11.5</td>
</tr>
<tr>
<td>110</td>
<td>Describe the purpose and uses of variable-rate technology. English: 10.5, 11.5</td>
</tr>
<tr>
<td>111</td>
<td>Develop a precision-management plan. English: 10.5, 11.5</td>
</tr>
<tr>
<td>112</td>
<td>Research the applications for laser technology in agriculture. English: 10.5, 11.5</td>
</tr>
<tr>
<td>113</td>
<td>Demonstrate the ability to use laser technology in agriculture, adhering to all safety requirements, industry recommended practices, and instructor guidelines. English: 10.5, 11.5</td>
</tr>
<tr>
<td>114</td>
<td>Explain uses of drones in agriculture. English: 10.5, 11.5</td>
</tr>
<tr>
<td>115</td>
<td>Research the types of drones used in agriculture. English: 10.5, 11.5</td>
</tr>
<tr>
<td>116</td>
<td>Identify safety precautions and standard operating procedures for flying drones. English: 10.5, 11.5</td>
</tr>
<tr>
<td>117</td>
<td>Describe the Federal Aviation Administration (FAA) Part 107 guidelines. English: 10.5, 11.5 History and Social Science: GOVT. 7, 9</td>
</tr>
<tr>
<td>118</td>
<td>Prepare a drone for flight. English: 10.5, 11.5</td>
</tr>
<tr>
<td>119</td>
<td>Fly a drone, adhering to all safety requirements, industry recommended practices, and instructor guidelines. English: 10.5, 11.5</td>
</tr>
</tbody>
</table>
FFA Information

The National FFA is an organization dedicated to preparing members for leadership and careers in the science, business, and technology of agriculture. Local, state, and national activities and award programs provide opportunities to apply knowledge and skills acquired through agriculture education.

For additional information about the student organization, see the National FFA website and the Virginia FFA Association website.

The following leadership development events are available for this course:

- Agricultural Issues
- Employment Skills
- Extemporaneous Public Speaking
- Parliamentary Procedure
- Prepared Public Speaking

The following career development events are available for this course:

- Agricultural Technology and Mechanical Systems
- Environmental & Natural Resources
- Forestry
- Nursery/Landscape

Green Building Infusion Units

The Green Building Infusion Unit (GBIU) was designed to encourage teachers to infuse instructional units on green building knowledge and skills into designated CTE courses. The infusion unit is not mandatory, and, as such, the tasks/competencies are marked as “optional,” to be taught at the instructor’s discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Agriculture Mechanics Assessment
- College and Work Readiness Assessment (CWRA+)
- Customer Service Specialist (CSS) Examination
- Flux Core Arc Welding (FCAW) Examination
- Gas Metal Arc Welding Examination
- Gas Tungsten Arc Welding (GTAW) Examination
- National Career Readiness Certificate Assessment
- SENSE Training Program Certification Examination (Level 1, Entry-Level Welder)
- Shielded Metal Arc Welding (SMAW) Examination
- Small Unmanned Aircraft Systems (UAS) Safety Certification Examination
- Welding Assessment
- Welding Examination
- Welding Level One Entry-Level Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.

- Agricultural Business Fundamentals I (8022/36 weeks)
- Agricultural Power Systems (8018/36 weeks)
- Agricultural Power Systems, Advanced (8020/36 weeks)
- Agricultural Structural Systems (8017/36 weeks)
- Applied Agricultural Concepts (8073/36 weeks)
- Applied Agricultural Concepts (8072/18 weeks)
- Introduction to Power, Structural, and Technical Systems (8016/36 weeks)
- Livestock Production Management (8012/36 weeks)
- Small Engine Repair (8021/18 weeks)
- Small Engine Repair (8082/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agribusiness Systems</td>
<td>Agricultural Products Sales Representative</td>
</tr>
<tr>
<td></td>
<td>Farm Products Purchasing Agent and Buyer</td>
</tr>
<tr>
<td></td>
<td>Farm, Ranch Manager</td>
</tr>
<tr>
<td></td>
<td>Farmer/Rancher</td>
</tr>
<tr>
<td></td>
<td>Feed, Farm Supply Store Sales Manager</td>
</tr>
<tr>
<td></td>
<td>Sales Manager</td>
</tr>
<tr>
<td>Animal Systems</td>
<td>Agricultural Products Sales Representative</td>
</tr>
</tbody>
</table>
### Career Cluster: Agriculture, Food and Natural Resources

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Service Systems</td>
<td>Animal Breeder, Husbandry&lt;br&gt;Aquacultural Manager&lt;br&gt;Poultry Manager</td>
</tr>
<tr>
<td></td>
<td>Agricultural Products Sales Representative&lt;br&gt;Environmental Compliance Inspector&lt;br&gt;Environmental Sampling and Analysis Technician&lt;br&gt;Hazardous Materials Handler&lt;br&gt;Recycling Coordinator&lt;br&gt;Secondary School Teacher&lt;br&gt;Toxicologist&lt;br&gt;Turf Farmer&lt;br&gt;Water Conservationist</td>
</tr>
<tr>
<td>Natural Resources Systems</td>
<td>Forest Manager, Forester&lt;br&gt;Forest Technician&lt;br&gt;Geological Technician&lt;br&gt;Logging Equipment Operator&lt;br&gt;Park Manager&lt;br&gt;Park Technician&lt;br&gt;Range Technician</td>
</tr>
<tr>
<td>Plant Systems</td>
<td>Agricultural Products Sales Representative&lt;br&gt;Crop Grower&lt;br&gt;Custom Harvester&lt;br&gt;Farm, Ranch Manager&lt;br&gt;Farmer/Rancher&lt;br&gt;Golf Course Superintendent&lt;br&gt;Machine Setter, Operator&lt;br&gt;Nursery and Greenhouse Manager&lt;br&gt;Ornamental Horticulturist&lt;br&gt;Secondary School Teacher&lt;br&gt;Tree Surgeon&lt;br&gt;Turf Farmer</td>
</tr>
<tr>
<td>Power, Structural, and Technical Systems</td>
<td>Agricultural Engineer&lt;br&gt;Agricultural Equipment Operator&lt;br&gt;Agricultural Equipment Parts Manager&lt;br&gt;Agricultural Equipment Parts Salesperson&lt;br&gt;Machinist&lt;br&gt;Parts Manager&lt;br&gt;Welder</td>
</tr>
</tbody>
</table>

### Career Cluster: Science, Technology, Engineering and Mathematics

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering and Technology</td>
<td>Agricultural Engineer&lt;br&gt;Architect&lt;br&gt;Assembler&lt;br&gt;Civil Engineer&lt;br&gt;Civil Engineering Technician&lt;br&gt;Commercial and Industrial Designer&lt;br&gt;Electrical Drafter</td>
</tr>
</tbody>
</table>
## Career Cluster: Science, Technology, Engineering and Mathematics

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
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<tbody>
<tr>
<td></td>
<td>Electrical Engineer</td>
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<tr>
<td></td>
<td>Electrical Engineering Technician</td>
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<tr>
<td></td>
<td>Electro-Mechanical Technician</td>
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<tr>
<td></td>
<td>Environmental Engineer</td>
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<tr>
<td></td>
<td>Industrial Engineer</td>
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<tr>
<td></td>
<td>Industrial Engineering Technician</td>
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<td></td>
<td>Landscape Architect</td>
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<td></td>
<td>Machine Setter, Operator</td>
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<td>Manufacturing Systems Engineer</td>
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<td>Marine Engineer</td>
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<td>Materials Engineer</td>
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<td></td>
<td>Mechanical Drafter</td>
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<td></td>
<td>Mechanical Engineer</td>
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<tr>
<td></td>
<td>Mechanical Engineering Technician</td>
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<tr>
<td></td>
<td>Stockroom, Warehouse, or Storage Yard Stock Clerk</td>
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<tr>
<td></td>
<td>Technical Writer</td>
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</tbody>
</table>
