

Agricultural Structural Systems

8017 36 weeks

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Acknowledgments

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The framework was edited and produced by the CTE Resource Center:

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Course Description

Suggested Grade Level: 10 or 11

The course will provide students with knowledge and skills for building agricultural structures and systems. Instruction will focus on the surveying, design, construction, plumbing, masonry, and electrical aspects of building systems. 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

8017	Tasks/Competencies
+	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.
+	Participate in an SAE.
+	Identify the benefits and responsibilities of FFA membership.
+	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
○	Apply for an FFA degree and/or an agricultural proficiency award.
+	Identify safety procedures and equipment necessary for agricultural structural systems.
+	Apply laboratory safety instructions.
+	Identify emergency first-aid procedures.
+	Identify the classifications of fires and the methods used to extinguish them.

<input checked="" type="radio"/>	Demonstrate lifting and carrying techniques.
<input checked="" type="radio"/>	Report injuries.
<input checked="" type="radio"/>	Pass safety exam.
<input checked="" type="radio"/>	Identify different types of agricultural structures.
<input type="radio"/>	Determine the purposes of various types of agricultural structures and systems.
<input type="radio"/>	Identify components of agricultural structures.
<input type="radio"/>	Describe agricultural plumbing systems.
<input checked="" type="radio"/>	Follow safety practices for performing plumbing operations.
<input checked="" type="radio"/>	Identify pipe fittings by type.
<input type="radio"/>	Select pipe threading and cutting tools.
<input checked="" type="radio"/>	Select types of pipe and tubing.
<input checked="" type="radio"/>	Calculate the length of pipe required to complete a job.
<input checked="" type="radio"/>	Assemble plastic pipe.
<input type="radio"/>	Thread steel pipe.
<input type="radio"/>	Connect flare and compression fittings.
<input checked="" type="radio"/>	Sweat solder copper fittings.
<input checked="" type="radio"/>	Follow safety practices for performing concrete and masonry operations.
<input checked="" type="radio"/>	Identify the types and uses of concrete.
<input checked="" type="radio"/>	Identify materials for concrete construction.
<input checked="" type="radio"/>	Calculate quantity and cost of materials for a job.
<input type="radio"/>	Determine the water/concrete ratio for a job.
<input type="radio"/>	Construct forms for concrete.
<input type="radio"/>	Explain the procedure for ordering ready-mixed concrete.
<input type="radio"/>	Perform a slump test.
<input type="radio"/>	Mix concrete, using base materials.
<input type="radio"/>	Place concrete in forms.

<input type="radio"/>	Finish concrete slabs.
<input type="radio"/>	Mix masonry mortar.
<input type="radio"/>	Lay concrete block and/or brick.
<input checked="" type="radio"/>	Determine building-site conditions and limitations.
<input checked="" type="radio"/>	Identify permit procedures and requirements.
<input checked="" type="radio"/>	Explain how to use different types of leveling instruments.
<input type="radio"/>	Take rod readings.
<input checked="" type="radio"/>	Determine the difference in elevation of two or more points.
<input checked="" type="radio"/>	Measure distance with steel tape.
<input checked="" type="radio"/>	Determine percent of slope.
<input checked="" type="radio"/>	Determine land area.
<input type="radio"/>	Determine elevation differences, using a hand level.
<input type="radio"/>	Describe how to use survey and site drawings.
<input type="radio"/>	Lay out foundations, footings, and batter boards.
<input checked="" type="radio"/>	Follow safety practices for performing carpentry skills.
<input checked="" type="radio"/>	Interpret plans and drawings.
<input checked="" type="radio"/>	Figure a bill of materials.
<input checked="" type="radio"/>	Select wood framing, roofing, and insulating materials.
<input checked="" type="radio"/>	Use carpentry tools and measuring instruments.
<input checked="" type="radio"/>	Apply glue, nails, bolts, screws, and construction fasteners.
<input type="radio"/>	Lay out the framing of a building.
<input type="radio"/>	Lay out and cut rafters and braces.
<input checked="" type="radio"/>	Explain safe working practices around electrical hazards.
<input checked="" type="radio"/>	Describe electrical energy and how it works.
<input checked="" type="radio"/>	Define common electrical terms and their relationships.
<input checked="" type="radio"/>	Determine the use and cost of electrical energy.

<input checked="" type="radio"/>	Interpret wiring plans.
<input checked="" type="radio"/>	Determine electrical power requirements.
<input type="radio"/>	Mark routes for small appliances, general purpose, and individual circuits.
<input checked="" type="radio"/>	Estimate wiring costs.
<input checked="" type="radio"/>	Install device boxes and outlet boxes.
<input checked="" type="radio"/>	Install branch circuits.
<input checked="" type="radio"/>	Explain the purpose of grounding electrical systems and equipment.
<input checked="" type="radio"/>	Ground electrical systems and equipment.
<input type="radio"/>	Describe the type of service entrance equipment to install.
<input type="radio"/>	Install service entrance equipment, using cable or conduit with overhead or underground connectors.
<input checked="" type="radio"/>	Describe ground fault circuit interrupters (GFCIs).
<input checked="" type="radio"/>	Troubleshoot electrical circuits.
<input type="radio"/>	Install conduit.
<input type="radio"/>	Interpret the National Electrical Code (NEC) requirements for wiring.
<input type="radio"/>	Measure electrical circuits for voltage, current flow, resistance, and wattage.
<input type="radio"/>	Determine the size of an external, independently powered generator needed to operate a home.
<input type="radio"/>	Describe the materials necessary to install a home generator in accordance with NEC requirements.

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?

Orienting Students to Agricultural Machinery and Equipment Safety and Operation

Task Number 44

Identify safety procedures and equipment necessary for agricultural structural systems.

Definition

Identification should include

- 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 good operating condition, according to OSHA standards
- procedures for the use of appropriate safety devices (e.g., guards in place, tool rests adjusted).

Process/Skill Questions

- What PPE is necessary in agricultural structural systems?
- What are the standard color codes for laboratory safety?
- What are some ways to make sure 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 lab important?
- What is the function of OSHA?
- What are the potential dangers of working in a mechanics 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

Identify emergency first-aid procedures.

Definition

Identification should include first-aid procedures for accidents involving

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

according to standard first-aid and school policies.

Process/Skill Questions

- What are the steps that should be followed in the event of an accident?
- Why is knowing cardiopulmonary resuscitation (CPR) important within the electrical trades?
- Why is it important to be certified to administer first aid?
- What are the different classifications (degrees) of electrical burns?

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

- What is the fire triangle?
- What are the three requirements for a fire?

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

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
- getting help, if 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 injury when lifting and carrying materials and equipment?
- How does proper body positioning affect proper technique when lifting and carrying?

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 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 accident 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 safety exam.

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?

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.

Exploring Types of Agricultural Structures

Task Number 51

Identify different types of agricultural structures.

Definition

Identification should include the design attributes and structural characteristics of various structures, from simple pole barns to complex livestock systems.

Process/Skill Questions

- Why do different types of agricultural structures exist?
- How are agricultural structures categorized?
- What features can help you identify agricultural structures?
- Who should be involved in the design of an agricultural structure? Why?
- What environmental factors should be considered when designing an agricultural structure? Why?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

Task Number 52

Determine the purposes of various types of agricultural structures and systems.

Definition

Determination may include, but is not limited to

- livestock/dairy building structures
- poultry/swine building structures
- manure-management systems
- grain, storage, and drying systems
- hay and silage storage systems

- horticulture systems
- agriculture shop and machinery storage structures.

Process/Skill Questions

- How can design contribute to the function of an agricultural structure?
- How does the intended use of an agricultural structure determine its location?
- What structural features can help you identify the purpose of an agricultural structure?
- What impacts do agricultural markets have on the type of structure chosen?
- When should structures be renewed or updated? Why?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 53

Identify components of agricultural structures.

Definition

Identification should include but is not limited to

- roofing
- walls
- foundations
- supports
- plumbing (including water supply and waste removal systems)
- electrical
- heating, ventilation, and air conditioning (HVAC).

Process/Skill Questions

- What are the components of an agricultural structure?
- What components of a structure are associated with the roofing?
- How do the components of agricultural structures compare to those of typical residential structures?
- What types of permits must be obtained prior to the construction of an agricultural structure?
- What is the relationship between the building foundation and the purpose of an agricultural structure?
- How are price estimates used for determining structure selection?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Performing Plumbing Operations

Task Number 54

Describe agricultural plumbing systems.

Definition

Description should include a variety of plumbing systems used in the agriculture industry.

Process/Skill Questions

- What are the types of plumbing systems available for an agricultural structure?
- What are some types of plumbing systems used in the agriculture industry?
- How can a blueprint assist in making facilities decisions?
- What is the difference between a dairy-operations plumbing system and a beef-operations plumbing system?
- Why is irrigation considered a plumbing system?
- Why do many swine and poultry operations have showering systems at the barns?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 55

Follow safety practices for performing plumbing operations.

Definition

Following safety practices should include

- using safety equipment

- wearing proper clothing
- avoiding hazards
- following procedures.

Process/Skill Questions

- What safety equipment is used in plumbing operations?
- How does wearing proper clothing help when performing plumbing operations?
- What are the minimum PPE requirements for performing plumbing operations?
- What are some potential hazards you should be aware of when working on plumbing?
- What safety procedures should be followed when soldering pipes and fittings together?

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 56

Identify pipe fittings by type.

Definition

Identification should include the names and purposes of, and terminology applicable to, the types of pipe and fittings needed for a given application.

Process/Skill Questions

- What are the differences among plumbing fittings?
- What factors determine the type of plumbing fixture or material used?
- How are plumbing fixtures labeled for identification?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 57

Select pipe threading and cutting tools.

Definition

Selection should include pipe threading and cutting tools for a given application.

Process/Skill Questions

- What are some of the most commonly used pipe threading and cutting tools? With what materials are they used?
- What are the differences among NPT, NC, and NF threads? Explain.

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 58

Select types of pipe and tubing.

Definition

Selection should include pipe and tubing appropriate for a given application.

Process/Skill Questions

- What factors play a part in pipe material selection?
- For what applications might you choose plastic piping? Why?
- For what applications might you choose non-plastic piping? Why?
- What are the advantages and disadvantages of various types of piping and tubing?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 59

Calculate the length of pipe required to complete a job.

Definition

Calculation should be based on specific plans and cutting requirements in the Uniform Plumbing Code (UPC).

Process/Skill Questions

- What factors should be considered prior to cutting pipe for a given application?
- How are tools and equipment for cutting pipe selected?
- How do you determine how much of the pipe will be in a fitting?
- What are the formulas for determining pipe length with fittings?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 60

Assemble plastic pipe.

Definition

Assembly should include

- selecting the type of pipe material
- cutting the pipe, using appropriate methods
- selecting fittings
- selecting and applying cleaners
- selecting and applying adhesives
- soft soldering copper pipe.

Process/Skill Questions

- What types of pipe should not be used for hot water? Why?
- Why is it important to clean the pipe before assembly?
- What are the proper cleaning procedures for various materials?
- Why should you remove any burrs from the pipe before assembly?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 61

Thread steel pipe.

Definition

Threading should include

- selecting pipe
- selecting tools
- using proper threading techniques.

Process/Skill Questions

- Why is lubricant necessary when using hand threaders?
- Why is it necessary to first thread around, then back up and break the threads, as you thread ridged pipe?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 62

Connect flare and compression fittings.

Definition

Connection should include selecting tubing, fittings, and tools that will connect the tubing so that the finished assembly is free of leaks.

Process/Skill Questions

- At what angle should the flare be set for given tubing material? Why?
- What types of tubing materials can be flared?
- What type of tubing is used with compression fittings? Why?
- Why should pipe be cleaned prior to compression fitting?
- What are the parts of a compression fitting?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 63

Sweat solder copper fittings.

Definition

Sweat soldering copper tubing should include the following steps:

- Cut tubing and ream ends.
- Clean ends with sandpaper, steel wool, or approved brush.
- Clean the inside surface of the fitting.
- Flux surface where solder is to flow.
- Assemble joint.
- Heat fitting surface to be soldered.
- Allow to cool.
- Inspect soldered fitting for defects.

Process/Skill Questions

- What are the relevant safety precautions and procedures for sweat soldering copper tubing?
- What tools and materials are required for sweat soldering?
- What are some uses of sweat soldering copper tubing?
- What is the proper method for heating the tubing and fitting and applying solder?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Performing Concrete and Masonry Operations

Task Number 64

Follow safety practices for performing concrete and masonry operations.

Definition

Following safety practices should include

- using safety equipment
- wearing proper clothing
- avoiding hazards
- following applicable procedures.

Process/Skill Questions

- What are some potential hazards when performing concrete and masonry operations?
- What safety equipment is necessary for safe concrete and masonry operations?
- What are the minimum PPE requirements for performing concrete and masonry operations?
- What clothing should be worn when performing concrete and masonry operations?

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 65

Identify the types and uses of concrete.

Definition

Identification should include but is not limited to

- standard
- quick-dry
- topping mix
- reinforced.

Process/Skill Questions

- Where do you see concrete used in your daily life?
- How would you define *concrete*?
- What are the advantages and disadvantages of using concrete as a building material?

- How is concrete used in various agricultural structures?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 66

Identify materials for concrete construction.

Definition

Identification should include

- Portland cement
- sand
- gravel
- water
- reinforcing materials.

Process/Skill Questions

- What are the ingredients of concrete?
- What is the difference between Portland cement and concrete?
- What is Portland cement? What is its purpose, and in what units is it sold?
- What determines the strength of the concrete materials?
- Why is gravel not included in a sand/topping mix?
- What is the relationship of the size of gravel to the thickness of the slab or wall?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 67

Calculate quantity and cost of materials for a job.

Definition

Calculation should be based on

- building plans or drawings
- use of the formula for determining concrete volume
- cost per volume of concrete needed.

Process/Skill Questions

- What information is needed to calculate the quantity and cost of materials?
- What is the standard unit of measurement for concrete?
- What is the formula for calculating concrete volume?
- What issues might you encounter if you over-calculate the amount of concrete needed? Under-calculate?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 68

Determine the water/concrete ratio for a job.

Definition

Determination should include reading the label instructions for correct quantities.

Process/Skill Questions

- What happens if you use too much water when mixing concrete? Too little water?
- What are the different water/concrete ratios?
- Can any type of water be used for concrete mixing? Why, or why not?
- What are the different psi ratings of concrete? What are their general uses?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 69

Construct forms for concrete.

Definition

Construction should include

- reading the building plan(s)
- planning the forms, as needed
- preparing the job site and excavation, as needed
- constructing appropriate concrete forms
- bracing the form(s) into position.

Process/Skill Questions

- What factors should be considered when planning a concrete form?
- What steps must be performed to prepare the area where a concrete form will be built?
- What tools are needed to prepare an area and construct a form?
- From what materials can concrete forms be made?
- Why is slope important on sidewalks and slabs?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 70

Explain the procedure for ordering ready-mixed concrete.

Definition

Explanation should include

- determining the quantity and type of concrete mix needed
- selecting the time of delivery and psi strength desired.

Process/Skill Questions

- Why is it important to order ready-mixed concrete in advance?
- Why is it important to place the ready-mixed concrete as soon as possible after it arrives?
- What is a will-call order? When might it be used?
- How would you determine what concrete slump to order?
- What is the function of accelerants? When should they be used for a concrete mix?
- What should you do with excess concrete or overage ordered?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 71

Perform a slump test.

Definition

Performing a slump test should include

- obtaining tools and materials
- collecting a sample
- performing the slump test
- analyzing the test results.

Process/Skill Questions

- What is the purpose of a slump test?
- What is the procedure for performing a slump test?
- How do you correct a deficiency or fault, based on the results of a slump test?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 72

Mix concrete, using base materials.

Definition

Mixing concrete should include adding the correct proportions of sand, cement, water, and aggregate, and using a concrete mixer or mortar box/wheelbarrow.

Process/Skill Questions

- What are the relevant safety precautions and procedures to follow when mixing concrete in a concrete mixer?
- What are the ingredients in a concrete mix? How are they batched and mixed?
- What is proportion of materials in a given concrete mix?

- What are the characteristics of properly mixed concrete?
- What is the procedure for hand-mixing concrete in a mortar box?
- What are the similarities and differences between using a mortar box and an electric mixer?
- What is the importance of mixing concrete?
- Why and how should water be measured when mixing concrete?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 73

Place concrete in forms.

Definition

Placement may include

- preparing the form
- calculating the amount of concrete needed
- ordering ready-mixed concrete
- placing the concrete
- consolidating concrete into a solid dense mass
- leveling and floating the concrete surface
- troweling the concrete surface
- final finishing and curing the concrete.

Process/Skill Questions

- What is the purpose of the concrete form?
- What tools are necessary for placing concrete into forms?
- Why does concrete need to be vibrated and/or tamped?
- Is all concrete poured using the same method? Why, or why not?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 74

Finish concrete slabs.

Definition

Finishing should include using different tools, including a float, finishing trowel, and edger.

Process/Skill Questions

- Why must concrete be finished after pouring?
- What is the difference between a smooth finish and a broom finish?
- What is the procedure for producing a smooth finish on a concrete slab?
- In what cases would you want a rougher concrete finish instead of a smooth one?
- What consistency should concrete be prior to floating?
- When should concrete be troweled? Why?
- What is the purpose of and procedure for edging concrete? Jointing concrete?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 75

Mix masonry mortar.

Definition

Mixing should include blending the ingredients in proper proportion, using a mortar hoe and/or power mixer, according to industry standards.

Process/Skill Questions

- Why should masonry cements be measured by volume?
- What is the ratio of masonry cement to sand? Why is this ratio important?
- What safety precautions should be taken when using a motorized mixer?
- What are the advantages and disadvantages of using a motorized mixer?
- How much water should be added per volume of dry mortar mix?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 76

Lay concrete block and/or brick.

Definition

Laying concrete block and/or brick should include

- determining the quantity of materials needed
- obtaining materials
- establishing a proper footer or footing
- following the construction plan
- establishing benchmarks or leveling reference points
- using proper quantities of mortar
- using proper procedures for laying block and/or brick
- cleaning the block and/or brick.

Process/Skill Questions

- What tools are necessary for laying block and/or brick?
- How do you estimate the quantity of materials (block) needed for a given job?
- How do you calculate the proper quantities of mortar?
- Why is it important to follow a plan for block and/or brick installation?
- How do you use a dumpy level or transit to establish benchmarks or leveling points for walls?
- Why is it important to check that each row is level as you work?
- Why is it necessary to clean the block and/or brick after installation?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Demonstrating Land Measurement and Building-Site Evaluation

Task Number 77

Determine building-site conditions and limitations.

Definition

Determination should include site-evaluation testing appropriate to the structure being built.

Process/Skill Questions

- What are the best methods for determining building-site conditions and limitations? Explain.
- What are some constraints caused by slope?
- What soil types are best for a building site? Why?
- How can zoning laws affect a design?
- What is perk testing?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

Task Number 78

Identify permit procedures and requirements.

Definition

Identification should include

- local governing agencies involved in the permitting process
- steps of the application process
- inspection requirements.

Process/Skill Questions

- How does the permit process vary by locality?
- What are some agencies whose regulations may affect your building site?
- What are the local requirements for inspections of your structure?
- Why do permit regulations vary by locality?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

Task Number 79

Explain how to use different types of leveling instruments.

Definition

Explanation should include procedures for selecting, placing, securing, leveling, and reading various types of leveling instruments.

Process/Skill Questions

- What are the different types of leveling instruments available? When should each be used?
- Why are there different types of leveling instruments?
- What are the two scales often found on leveling rods?
- Why is the placement of the leveling instrument important?
- How are leveling instruments secured?
- What is the purpose of a builder's level?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 80

Take rod readings.

Definition

Taking rod readings should include

- setting up the instrument
- pointing the instrument toward the rod
- reading the rod in the appropriate units
- recording field notes.

Process/Skill Questions

- Where are the setup procedures for a survey rod found?
- How do you read a rod?
- Why does the rod holder need to rock the rod?
- How are field notes recorded? Why are they important?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 81

Determine the difference in elevation of two or more points.

Definition

Determination should include calculating the difference between two or more rod readings.

Process/Skill Questions

- How are elevation differences calculated?
- What unit of measurement is used for elevation?
- Why are elevation differences important for agricultural building construction?
- What does the difference in rod readings indicate about the building site?
- How would you establish 90-degree corners on a building foundation, using a level or transit?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 82

Measure distance with steel tape.

Definition

Measuring should include holding and reading the tape in accordance with applicable surveying techniques.

Process/Skill Questions

- How do you read a steel tape? What units might a steel tape indicate?
- Why should the tape be held perfectly level, as opposed to following the ground contour?
- What units of measurement are used for determining distance?
- Where can you find information about surveying techniques?
- How do measuring techniques change in accordance with the land to be surveyed?

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 83

Determine percent of slope.

Definition

Determination may include the use of a

- transit
- dumpy level
- line level

to find the percent of slope.

Process/Skill Questions

- How is slope determined?
- Where is it important to determine slope?
- How can slope limit land use?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 84

Determine land area.

Definition

Determination should include using various measuring tools and methods (e.g., tape measure, handheld GPS, pacing) to calculate the area.

Process/Skill Questions

- How many square feet are in one acre?
- How do you select the appropriate tool or method to use when measuring land area?
- How can land area impact building-site capabilities?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

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 85

Determine elevation differences, using a hand level.

Definition

Determination should include holding the instrument level, reading the points, and calculating the differences.

Process/Skill Questions

- When would it be appropriate to use a hand level?
- What is the proper procedure for holding a hand level?
- How are the elevation points of a hand level read?
- How are differences between elevation points calculated?
- How does a hand level work, as compared to a mounted level?
- Why is it necessary to know the elevations of different points?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 86

Describe how to use survey and site drawings.

Definition

Description should include

- markings and measurements
- elevation changes
- orientation
- limiting factors.

Process/Skill Questions

- How is a survey drawing beneficial to a builder?
- What are some markings that would need to be on a survey or site drawing?
- What resources can you use to help interpret markings and measurements on a survey or site drawing?
- How are survey and site drawings oriented?
- What limiting factors can be determined from a site drawing?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 87

Lay out foundations, footings, and batter boards.

Definition

Laying out should include

- following the plan
- incorporating lay-out techniques
- using survey equipment
- checking for accuracy.

Process/Skill Questions

- What is the function of a foundation?
- Why must foundations be level?
- How are the dimensions for a foundation determined?
- How deep should footers/foundations be placed?
- What are the procedures for laying out a building foundation?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Performing Carpentry Skills

Task Number 88

Follow safety practices for performing carpentry skills.

Definition

Following safety practices should include

- using safety equipment
- wearing proper clothing
- avoiding potential hazards
- following procedures.

Process/Skill Questions

- What PPE is necessary for performing carpentry skills?
- How does proper clothing help in performing carpentry skills?
- Who is responsible for safety? 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.

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

Task Number 89

Interpret plans and drawings.

Definition

Interpretation should include identifying

- equipment and supplies

- specifications
- potential issues and needs

based on the plan or drawing.

Process/Skill Questions

- What is the purpose of a project plan?
- What details should be included in a project plan?
- How can potential issues be identified by interpreting a building plan?

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

PST.04.01. Create sketches and plans for AFNR structures.

Task Number 90

Figure a bill of materials.

Definition

Figuring should include calculating board feet, fasteners, metal, and hardware.

Process/Skill Questions

- What information does a bill of materials include?
- Why is a bill of materials important?
- In what units is lumber sold?
- In what units is metal sold?
- What are the different types of fasteners for wood and metal?
- What are the steps in estimating a bill of materials?
- Why is it important to calculate the cost of a project?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

Task Number 91

Select wood framing, roofing, and insulating materials.

Definition

Selection of construction materials should include consideration of

- design
- codes
- costs
- maintenance requirements.

Process/Skill Questions

- What resources should be examined for applicable building codes prior to selecting materials?
- How do different types of building materials affect project cost?
- What factors contribute to the cost of materials?
- What are some types of roofing materials?
- What are some methods for insulating a building?
- What maintenance tasks must be considered for framing, roofing, and insulating materials?

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.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 92

Use carpentry tools and measuring instruments.

Definition

Demonstration may include

- reading a ruler/tape with graduations in standard and metric units
- performing calculations related to measurement (e.g., calculating volume and area, using conversion factors)
- using layout tools, including framing square, speed square, try square, and dumpy level
- using power tools.

Process/Skill Questions

- What is the difference between the metric and English system of linear measurement?
- What are the uses of the different types of squares?
- What are the types of hammers? Saws?
- Why is important to understand the selection and use of various tools?
- When might you use conversion factors?

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 93

Apply glue, nails, bolts, screws, and construction fasteners.

Definition

Application may include

- various types of adhesives
- various types and classes of nails, bolts, and screws

and how and when to use each type.

Process/Skill Questions

- How are bolts classified?
- What determines the type of nail to be used?
- How are screws sized?
- What are the advantages and disadvantages of using nails? Screws?
- Why are adhesives used in place of or in addition to other fasteners?

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

Lay out the framing of a building.

Definition

Laying out should include

- determining materials, according to the plan
- following applicable building codes
- cutting materials.

Process/Skill Questions

- What tools are needed to lay out a building frame?
- How are materials organized for the layout of a building frame?
- What building codes must be followed when laying out a building frame? Where can those codes be found?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Task Number 95

Lay out and cut rafters and braces.

Definition

Laying out should include

- using and designing templates
- determining the type of rafters needed
- determining materials, according to the plan
- following applicable building codes
- calculating rafter length
- cutting materials.

Process/Skill Questions

- What tools and equipment are used to cut materials for a building rafter/brace?
- Why are rafters cut differently than other building materials?
- When would you choose to use rafters instead of trusses? Trusses instead of rafters?
- Why is important to check relevant codes before designing a rafter? Where can those codes be found?

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

PST.04.03. Follow architectural and mechanical plans to construct, maintain, and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

Demonstrating Skills in Electricity

Task Number 96

Explain safe working practices around electrical hazards.

Definition

Explanation should include

- identifying equipment used to test electrical circuits
- describing safe working conditions when working with electricity
- demonstrating safe work habits when working with electricity

according to industry standards and instructor's guidelines.

Process/Skill Questions

- What is the definition of *proximity work*?
- What are safe working clearances according to the NEC?
- What are considered safe working conditions and safe working habits?
- What is the unseen hazard with electrical work?

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 97

Describe electrical energy and how it works.

Definition

Description should include explanation of

- how electricity is produced
- how electricity is made available for the consumer
- volts, amps, and watts
- how to calculate current usage
- Ohm's law
- Watt's law.

Process/Skill Questions

- What is the correlation among volts, amps, and watts?
- How is current measured? Sold?
- What is the purpose of a transformer?
- What is voltage drop?
- How does resistance affect a circuit?

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

PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.

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 98

Define common electrical terms and their relationships.

Definition

Defining terms may include

- *amp/amperage*
- *conductor*
- *continuity*
- *duplex receptacle*
- *gauge*
- *generator*
- *ground*

- *ground-fault circuit interrupter (GFCI)*
- *"hot"*
- *insulator*
- *neutral*
- *Ohm's law*
- *parallel circuit*
- *receptacle*
- *resistance/Ohms*
- *series circuit*
- *switch*
- *transformer*
- *volt/voltage*
- *watt/wattage.*

Process/Skill Questions

- Why is it important to know the names of common electrical components?
- How is wire sized?
- What is the purpose of the neutral wire in the circuit?
- What is the purpose of a GFCI in a circuit?

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

PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.

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 99

Determine the use and cost of electrical energy.

Definition

Determination should include the ability to interpret an electric meter, account for cost per kilowatt hour and the number of kilowatt hours used, and determine the increase or decrease in cost over time.

Process/Skill Questions

- Where is the electric meter located on your property?
- What factors are necessary for determining the cost of electricity used for your home?
- How might your electricity costs be reduced?

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

PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 100

Interpret wiring plans.

Definition

Interpretation should include explaining drawings, including symbols, using appropriate terminology.

Process/Skill Questions

- What is an electrical schematic?
- What is the difference between a schematic and a diagram?
- What is used to represent the components in each schematic?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 101

Determine electrical power requirements.

Definition

Determination should include

- voltage of circuit
- number of electrical devices
- total wattage of connected devices
- total amperage of circuit.

Process/Skill Questions

- Where can you find the power requirements for a given tool?
- What resources are used to determine the types of fixtures to be used for a structure?
- How do you determine where the main power control box/fixture should be located within a given structure?
- How do you determine what size wire is needed to carry a given load of current?
- What limits are there to the amount of current to be made available for a circuit?

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

PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 102

Mark routes for small appliances, general purpose, and individual circuits.

Definition

Marking routes should include

- identification of equipment locations
- location of the service entrance panel (SEP)
- location of exits
- practical placement of lighting and outlets
- location of exterior electrical needs.

Process/Skill Questions

- Why is it important to plan the route of wires?
- Why is it important to plan the location of appliances and lights?
- How are exit locations determined?
- What dictates the location of lighting and outlets?
- What is the differentiation between small and large appliances?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 103

Estimate wiring costs.

Definition

Estimation should include

- circuit length
- number of electrical devices
- costs of wiring components.

Process/Skill Questions

- Where can you find the costs of wires and supplies?
- How is the length of a circuit determined?
- What dictates the number of electrical devices to be installed?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 104

Install device boxes and outlet boxes.

Definition

Installation should include

- location of boxes based on electrical plan
- procedures based on local electrical code.

Process/Skill Questions

- What supplies are needed to install device boxes and outlet boxes?
- What factors are used to determine the location of the service entrance panel (SEP)?

- What factors are used to determine box and outlet location?
- What tools and equipment are used to install boxes and outlets?
- What installation procedures are used to install boxes and outlets?
- Why is important to follow an approved plan when installing boxes?

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

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 105

Install branch circuits.

Definition

Installation may include

- a single-pole breaker in a service panel
- a double-pole breaker in a service panel
- switches
- receptacles
- light fixtures

to meet local electrical code.

Process/Skill Questions

- Why should local and national electrical codes be followed?
- What are the steps in wiring a branch circuit in a home?
- What determines the amperage load that can be placed on each branch circuit?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 106

Explain the purpose of grounding electrical systems and equipment.

Definition

Explanation should include

- safety aspects of electrical grounding systems
- equipment protection.

Process/Skill Questions

- What are some safety aspects to be considered when grounding?
- What fixtures are available to help protect systems and equipment?
- When is a ground wire needed?
- Why do some appliances and tools not have a ground wire?

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.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 107

Ground electrical systems and equipment.

Definition

Grounding should include

- locating all necessary grounds
- attaching all necessary grounds.

Process/Skill Questions

- What factors are considered when grounding electrical systems and equipment?
- What fixtures help to properly ground electrical systems and equipment?
- How does grounding protect electrical systems and equipment?
- What is a ground rod, and what does it do?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 108

Describe the type of service entrance equipment to install.

Definition

Description should include

- types of service equipment
- locations of service equipment
- amperage needed
- number of services (i.e., different locations)
- service changes
- service upgrades
- clearances
- service grounding and bonding
- generator backup/emergency panel systems

according to NEC standards and authority having jurisdiction (AHJ).

Process/Skill Questions

- What is a service entrance?
- What are some factors to consider when locating a service entrance?
- How often is the NEC revised? Why is revision necessary?
- Who is involved in reviewing and updating the NEC?
- Where can an NEC manual be found?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 109

Install service entrance equipment, using cable or conduit with overhead or underground connectors.

Definition

Installation should include

- types of service equipment
- locations of service equipment
- number of services (i.e., different locations)
- service changes
- service upgrades
- clearances
- service grounding and bonding
- generator backup/emergency panel systems

according to NEC standards and AHJ.

Process/Skill Questions

- What is a transfer switch?
- What is the difference between a manual transfer switch and an automatic transfer switch?
- What is the difference between a main breaker panel and a main lug panel?
- What is the difference between a single-phase and a three-phase distribution system?
- How is color coding used in identifying phase conductors?

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.

PST.04.04. Apply electrical wiring principles in AFNR structures.

PST.05.02. Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings.

Task Number 110

Describe ground fault circuit interrupters (GFCIs).

Definition

Description should include

- identifying a breaker-type and receptacle-type GFCI
- identifying a feed-through GFCI receptacle
- identifying an arc-fault breaker type

as well as procedures for

- connecting a GCFI and an arc-fault breaker in single-phase service panel
- connecting a GFCI receptacle as feed-through and in-line on specified circuits.

Process/Skill Questions

- Where are GFCIs required?
- In what areas of a dwelling are arc-fault circuits required?
- What is the function of a GFCI?
- How is a GFCI tested?
- What is the function of an arc fault?

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.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 111

Troubleshoot electrical circuits.

Definition

Troubleshooting should include

- determining the cause of the problem, using diagnostic tools and/or equipment
- isolating the cause
- taking necessary steps to ensure reduction or elimination of the chance of electrical fire or other danger.

Process/Skill Questions

- What precautions should be taken before beginning the troubleshooting process?
- How do you determine which diagnostic tool or equipment to use for troubleshooting?

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.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 112

Install conduit.

Definition

Installation should include determining the angle of bend, fabricating the bend with the appropriate tool, and mounting the conduit, using appropriate fasteners, in accordance with NEC and common trade practices.

Process/Skill Questions

- What is the difference between an EMT (electrical metallic tubing) and a hickey bender?
- What is the largest-sized hand bender? When might it be used?
- How is a multiplier used for conduit bends?
- What is take-up?

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

PST.04.01. Create sketches and plans for AFNR structures.

Task Number 113

Interpret the National Electrical Code (NEC) requirements for wiring.

Definition

Interpretation should include the use of the NEC book (e.g., to locate definitions, to identify code markings) and use of NEC to calculate general job requirements, including residential, commercial, and industrial wiring methods.

Process/Skill Questions

- What is Article 250, and why is it important?
- Who enforces the NEC?
- Who designs and writes the code?

- What is an FPN?

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

PST.04.02. Determine structural requirements, specifications, and estimate costs for AFNR structures.

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 114

Measure electrical circuits for voltage, current flow, resistance, and wattage.

Definition

Measuring should include configuring meter and applying settings for voltage (electrical potential), current (flow of charge), resistance (opposition to flow of charge), and wattage.

Process/Skill Questions

- What is the comparison of the amps, current, voltage, and resistance measures between a series and parallel circuit?
- How do volts change when measuring a series vs. a parallel circuit configuration?
- How are amps affected when comparing a series and a parallel circuit?

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

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 115

Determine the size of an external, independently powered generator needed to operate a home.

Definition

Determination should include

- components required for operation
- total power consumption of the components

- wattage capacity of the generator
- available fuel supply.

Process/Skill Questions

- How is generator capacity calculated?
- How is total power consumption of the components determined?
- How do you determine which home components should receive emergency power?
- What items are essential when the power is out in a home or agricultural building?

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

PST.04.04. Apply electrical wiring principles in AFNR structures.

Task Number 116

Describe the materials necessary to install a home generator in accordance with NEC requirements.

Definition

Description should include

- location of the generator
- location of the electrical connection
- type of electrical connection
- materials and tools.

Process/Skill Questions

- What factors should be considered when locating a generator?
- What materials and tools are needed to install a generator?
- How are generators connected to a home for emergency power?
- Why should you not back-feed a generator into a home or building electrical box?

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

PST.04.04. Apply electrical wiring principles in AFNR structures.

SOL Correlation by Task

39	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.	English: 10.3, 10.5, 11.3, 11.5
40	Participate in an SAE.	English: 10.5, 10.8, 11.5, 11.8
41	Identify the benefits and responsibilities of FFA membership.	English: 10.5, 10.6, 10.7, 10.8, 11.5, 11.6, 11.7, 11.8
42	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.	English: 10.5, 11.5 History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11
43	Apply for an FFA degree and/or an agricultural proficiency award.	English: 10.5, 11.5
44	Identify safety procedures and equipment necessary for agricultural structural systems.	English: 10.5, 10.8, 11.5, 11.8 History and Social Science: GOVT.8
45	Apply laboratory safety instructions.	History and Social Science: GOVT.16
46	Identify emergency first-aid procedures.	English: 10.5, 11.5
47	Identify the classifications of fires and the methods used to extinguish them.	English: 10.5, 11.5
48	Demonstrate lifting and carrying techniques.	
49	Report injuries.	
50	Pass safety exam.	
51	Identify different types of agricultural structures.	
52	Determine the purposes of various types of agricultural structures and systems.	
53	Identify components of agricultural structures.	
54	Describe agricultural plumbing systems.	English: 10.5, 11.5
55	Follow safety practices for performing plumbing operations.	
56	Identify pipe fittings by type.	
57	Select pipe threading and cutting tools.	
58	Select types of pipe and tubing.	
59	Calculate the length of pipe required to complete a job.	Mathematics: A.1, G.14
60	Assemble plastic pipe.	
61	Thread steel pipe.	
62	Connect flare and compression fittings.	
63	Sweat solder copper fittings.	
64	Follow safety practices for performing concrete and masonry operations.	
65	Identify the types and uses of concrete.	English: 10.5, 11.5
66	Identify materials for concrete construction.	
67	Calculate quantity and cost of materials for a job.	Mathematics: A.1, A.4, G.13
68	Determine the water/concrete ratio for a job.	English: 10.5, 11.5
69	Construct forms for concrete.	English: 10.5, 11.5

70	Explain the procedure for ordering ready-mixed concrete.	
71	Perform a slump test.	
72	Mix concrete, using base materials.	
73	Place concrete in forms.	
74	Finish concrete slabs.	
75	Mix masonry mortar.	
76	Lay concrete block and/or brick.	
77	Determine building-site conditions and limitations.	
78	Identify permit procedures and requirements.	English: 10.5, 11.5 History and Social Science: GOVT.8, GOVT.15
79	Explain how to use different types of leveling instruments.	
80	Take rod readings.	
81	Determine the difference in elevation of two or more points.	
82	Measure distance with steel tape.	
83	Determine percent of slope.	Mathematics: A.6
84	Determine land area.	
85	Determine elevation differences, using a hand level.	
86	Describe how to use survey and site drawings.	English: 10.5, 11.5 History and Social Science: WG.1
87	Lay out foundations, footings, and batter boards.	
88	Follow safety practices for performing carpentry skills.	
89	Interpret plans and drawings.	English: 10.5, 11.5 History and Social Science: WG.1 Mathematics: G.14
90	Figure a bill of materials.	
91	Select wood framing, roofing, and insulating materials.	
92	Use carpentry tools and measuring instruments.	
93	Apply glue, nails, bolts, screws, and construction fasteners.	
94	Lay out the framing of a building.	
95	Lay out and cut rafters and braces.	
96	Explain safe working practices around electrical hazards.	
97	Describe electrical energy and how it works.	Science: PH.11
98	Define common electrical terms and their relationships.	English: 10.3, 10.5, 11.3, 11.5 Science: PH.7, PH.11
99	Determine the use and cost of electrical energy.	Mathematics: A.1, A.4

100	Interpret wiring plans.	English: 10.5, 11.5
101	Determine electrical power requirements.	
102	Mark routes for small appliances, general purpose, and individual circuits.	
103	Estimate wiring costs.	
104	Install device boxes and outlet boxes.	
105	Install branch circuits.	
106	Explain the purpose of grounding electrical systems and equipment.	English: 10.5, 11.5 Science: PH.11
107	Ground electrical systems and equipment.	
108	Describe the type of service entrance equipment to install.	English: 10.5, 10.8, 11.5, 11.8
109	Install service entrance equipment, using cable or conduit with overhead or underground connectors.	
110	Describe ground fault circuit interrupters (GFCIs).	English: 10.5, 11.5
111	Troubleshoot electrical circuits.	
112	Install conduit.	Mathematics: G.10
113	Interpret the National Electrical Code (NEC) requirements for wiring.	English: 10.5, 11.5 History and Social Science: GOVT.8, GOVT.15
114	Measure electrical circuits for voltage, current flow, resistance, and wattage.	Science: PH.11
115	Determine the size of an external, independently powered generator needed to operate a home.	
116	Describe the materials necessary to install a home generator in accordance with NEC requirements.	

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](#)

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
- National Career Readiness Certificate 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 Business Management III (8026/36 weeks)
- Agricultural Business Operations II (8024/36 weeks)
- Agricultural Fabrication and Emerging Technologies (8019/36 weeks)
- Agricultural Power Systems (8018/36 weeks)
- Agricultural Power Systems, Advanced (8020/36 weeks)
- Applied Agricultural Concepts (8073/36 weeks)
- Applied Agricultural Concepts (8072/18 weeks)
- Energy and Power (8495/18 weeks)
- Introduction to Animal Systems (8008/36 weeks)
- Introduction to Power, Structural, and Technical Systems (8016/36 weeks)
- Livestock Production Management (8012/36 weeks)
- Operating the Farm Business (8014/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Agribusiness Systems	Agricultural Products Sales Representative Farm Products Purchasing Agent and Buyer Farm, Ranch Manager Farmer/Rancher Feed, Farm Supply Store Sales Manager Sales Manager
Animal Systems	Agricultural Products Sales Representative Animal Breeder, Husbandry Aquacultural Manager Poultry Manager
Environmental Service Systems	Agricultural Products Sales Representative Environmental Compliance Inspector Environmental Sampling and Analysis Technician Hazardous Materials Handler Recycling Coordinator

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
	Secondary School Teacher Toxicologist Turf Farmer Water Conservationist
Natural Resources Systems	Fisheries Technician Forest Manager, Forester Forest Technician Geological Technician Logging Equipment Operator Park Manager Park Technician Range Technician
Plant Systems	Agricultural Products Sales Representative Crop Grower Custom Harvester Farm, Ranch Manager Farmer/Rancher Golf Course Superintendent Machine Setter, Operator Nursery and Greenhouse Manager Ornamental Horticulturist Secondary School Teacher Tree Surgeon Turf Farmer
Power, Structural, and Technical Systems	Agricultural Engineer Agricultural Equipment Operator Agricultural Equipment Parts Manager Agricultural Equipment Parts Salesperson Machinist Parts Manager Welder

Career Cluster: Architecture and Construction	
Pathway	Occupations
Construction	Cabinetmaker Carpenter Construction and Building Inspector Construction Manager Electrician General Contractor Mason Plumber, Pipefitter Project Manager Roofer
Design/Pre-Construction	Architect Architectural Drafter Building Code Inspector Civil Engineer Cost Estimator Electrical Engineering Technician Landscape Architect Mechanical Drafter

Career Cluster: Architecture and Construction	
Pathway	Occupations
	Mechanical Engineer Survey Technician Surveyor
Maintenance and Operations	Cabinetmaker Carpenter Construction and Building Inspector Construction Manager Electrician General Contractor Mason Plumber, Pipefitter Project Manager Restoration Technician Roofer

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	Occupations
Engineering and Technology	Agricultural Engineer Architect Assembler Civil Engineer Civil Engineering Technician Commercial and Industrial Designer Electrical Drafter Electrical Engineer Electrical Engineering Technician Environmental Engineer Industrial Engineer Industrial Engineering Technician Landscape Architect Machine Setter, Operator Manufacturing Systems Engineer Marine Engineer Materials Engineer Mechanical Drafter Mechanical Engineer Mechanical Engineering Technician Power Systems Engineer Stockroom, Warehouse, or Storage Yard Stock Clerk Technical Writer