

Statewide Framework Document for: 010201

Agricultural Power and Technology

Standards may be added to this document prior to submission but may not be removed from the framework to meet state credit equivalency requirements. Performance assessments and leadership alignment may be developed at the local level. In order to earn state approval, performance assessments must be submitted within this framework. **This course is eligible for one credit of lab science.** The Washington State Science Standards performance expectations for high school blend core ideas (Disciplinary Core Ideas, or DCIs) with scientific and engineering practices (SEPs) and crosscutting concepts (CCCs) to support students in developing usable knowledge that can be applied across the science disciplines. These courses are to be taught in a [three-dimensional manner](#). The details about each performance expectation can be found at [Next Generation Science Standards](#).

School District Name	
Course Title: Agricultural Power and Technology	Total Framework Hours: 180
CIP Code: 010201 <input checked="" type="checkbox"/> Exploratory <input type="checkbox"/> Preparatory	Date Last Modified: December 30, 2020
Career Cluster: Agriculture, Food and Natural Resources	Cluster Pathway: Power, Structural, and Technical Systems
<p>Course Summary:</p> <p>The focus of Agricultural Power and Technology (APT) is to expose students to mechanics, power, technology, and career options in the world of agriculture. Students participating in the APT course will have experiences in various mechanical and engineering concepts with exciting hands-on activities, projects, and problems. Student's experiences will involve the study of energy, tool operation and safety, material properties, machine operation, and structural components. Students will acquire the basic skills to operate, repair, engineer, and design agricultural tools and equipment. Throughout the course, students will apply the engineering principles to the construction of machines and structures.</p> <p>Students will explore projects and problems similar to those that a mechanic, technician, or engineer may face in their respective careers. In addition, students will understand specific connections between science, math, and technical skills applied to Supervised Agricultural Experiences and FFA components that play an important role developing an informed agricultural education student. Students will investigate, experiment, and learn about documenting a project, solving problems, and communicating their solutions to their peers and members of the professional community.</p> <p>The Agricultural Power and Technology course includes; Shop Safety, Tool Operation, Material Selection and Uses, Fabrication, Energy and Power Production, Machine Components and Design, Agricultural Structures, Engineering, Technical Applications of Math and Science As with all agriculture courses, instruction and assessment in the Supervised Agriculture Experience (SAE) is a requirement. The Supervised Agriculture Experience includes placing a student in a position where he or she will learn the practices of entrepreneurship and the fundamentals of research and experimentation in the</p>	

agricultural field. Participants in the SAE will conduct exploratory projects with the purpose of learning about and improving practices in their surroundings.

SAE.01. This course will include instruction in and Student involvement in Supervised Agriculture Experience Projects (SAE)

Eligible for Equivalent Credit in: Science

Total Number of Units: 7

Unit 1: Introduction to Ag, Power, and Tech

Total Learning Hours for Unit: 15

Unit Summary:

Competencies include:

- 1.1.1 Organization and record keeping are important to success in agricultural mechanics.
- 1.1.2 The agricultural industry uses power and technology to produce food, fiber, and fuel that are essential for everyday life.
- 1.1.3. Power and technology increase the efficiency of agriculture, food, and natural resource production.
- 1.1.4 People in agricultural power and technology use the engineering design process to increase agricultural productivity and solve problems.
- 1.2.1 Many forms of potential and kinetic energy are used in agriculture to complete tasks or work.
- 1.2.2 Machines in agriculture are designed to harness energy to perform work.
- 1.2.3 Work and power calculations are used to determine efficiencies in agricultural systems.
- 1.2.4 Communication and writing skills complement the operation of mechanical equipment used in agricultural power and technology careers.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Develop and keep an Agriscience Notebook to record and store information.
- Research systems in power and technology and explain how they are applied in agriculture
- Use mathematical and computation thinking to calculate and compare the efficiency of different tools
- Obtain, evaluate, and communicate information about how an entrepreneur in agricultural mechanics uses the engineering process to improve production of food, fiber, and fuel.
- Design a prototype using the engineering design process to solve a problem.
- Obtain, evaluate, and communicate the types of energy used and managed in agriculture.
- Make a device to convert wind energy into mechanical energy
- Use mathematical and computation thinking to calculate the work completed by a machine.
- Use mathematical and computation thinking to calculate and compare power in English and SI units.
- Obtain, evaluate, and communicate information needed for a technical manual for machines that use different forms of energy

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students access and evaluate information to research systems in power and technology and the agricultural applications.
- Students reason effectively to design a prototype specifically purposed to solve a problem.

Industry Standards and/or Competencies:**Agriculture, Food, and Natural Resources (AFNR) Standards:**

CRP.02. Apply appropriate academic and technical skills.

CRP.03. Attend to personal health and financial well-being.

CRP.04. Communicate clearly, effectively and with reason.

CRP.05. Consider the environmental, social and economic impacts of decisions.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.

CS.02. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical

Aligned Washington State Academic Standards**Science**

Washington Science Standards (Next Generation Science Standards):

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs

Science and Engineering Practice**Disciplinary Core Idea****Crosscutting Concept**

Asking Questions and Defining Problems Developing and Using Models Planning and Carrying Out Investigations Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Analyzing and Interpreting Data	PS3.A. Definitions of Energy PS3.B. Conservation of Energy and Energy Transfer PS3.D. Energy in Chemical Processes and Everyday Life ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions	Patterns Cause and Effect: Mechanism and Prediction Systems and System Models Energy and Matter: Flows, Cycles, and Conservation
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Unit 2: Safety and Measurement	Total Learning Hours for Unit: 15
<p>Unit Summary: Competencies include:</p> <p>2.1.1 Site-specific safety policies and procedures are in place for agricultural mechanic shops and labs</p> <p>2.1.2 Safety must be planned and systematic for effective identification and lean management strategies in a laboratory or shop.</p> <p>2.1.3 Personal protective equipment is the last line of defense against injury.</p> <p>2.1.4 The purpose of first aid is to treat injuries or accidents in order to sustain life until professional medical attention can be received.</p> <p>2.2.1 Tools are designed for specific applications.</p> <p>2.2.2 The function of tools and machines will affect how they are operated.</p> <p>2.2.3 Operating procedures for machines and tools keep the operator/by-standers safe and the machine or tool in good working order.</p> <p>2.3.1 Precise and accurate measurements are important for fabrication of materials.</p> <p>2.3.2. Technical measurements are expressed in different forms and units.</p> <p>2.3.3 Estimation is used for completing a project or activity.</p> <p>2.3.4 Technical application of the Pythagorean Theorem can be used to determine if a corner is square.</p> <p>2.3.5 Areas are calculated using mathematical formulas.</p> <p>Performance Assessments: (Districts to complete for each unit)</p> <p><i>Example assessments for this unit include:</i></p> <ul style="list-style-type: none"> • Identify workplace hazards and the causes for accidents. • Develop a standard set of safety requirements for an agricultural shop. • Assess a shop to determine if safety standards are being met and make recommendations for changes. • Identify types of Personal Protective Equipment (PPE) and their uses in the shop. • Prepare an emergency first aid booklet. • Select correct hand tools for a specific job. • Identify the components of a power tool and determine any hazards present by using a safety evaluation form • Write an operating procedure for using a power tool safely. 	

- Compare precise and accurate measurements using a combination square and caliper.
- Computational thinking and accurate measurement requires the conversion between fractions and decimals.
- Use pacing to estimate the distance between two points.
- Use the Pythagorean Theorem to determine if a structure is square and square a wall corner using a 3-4-5 triangle.
- Use mathematical formulas to measure an area of land.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students reason effectively to determine hazards, establish safety procedures, and select appropriate PPE for needs in the agricultural shop setting.
- Students work independently to select the correct tools for the appropriate tasks. Students will communicate clearly to create an operating procedure for power related equipment.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards:

CRP.01. Act as a responsible and contributing citizen and employee.

CRP.02. Apply appropriate academic and technical skills.

CRP.04. Communicate clearly, effectively and with reason.

CRP.06. Demonstrate creativity and innovation.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.11. Use technology to enhance productivity.

CS.01. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

CS.03. Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.02. Operate and maintain AFNR mechanical equipment and power systems.

Aligned Washington State Academic Standards

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems Developing and Using Models Analyzing and Interpreting Data Using Mathematics and Computational Thinking	PS3.B. Conservation of Energy and Energy Transfer PS3.C. Relationship Between Energy and Forces ETS1.C. Optimizing the Design Solution	Patterns Cause and Effect: Mechanism and Prediction Systems and System Models

Unit 3: Material Properties

Total Learning Hours for Unit: 25

Unit Summary:

Competencies include:

- 3.1.1 Metals used in agriculture can be classified using physical properties.
- 3.1.2 Chemical properties of metal will determine how it reacts with other metals in the environment.
- 3.1.3 The structure and function of metal will determine its service life and applications.
- 3.1.4 Metals will physically change based upon environmental factors.
- 3.2.1 Wood is selected based upon their physical and mechanical properties.
- 3.2.2 Environmental factors determine the type of wood used for a project.
- 3.2.3 Plastics used in agriculture are designed for a specific purpose.
- 3.2.4 The chemical makeup of plastics will determine their mechanical properties.
- 3.3.1 Fluids cool and lubricate agricultural machines and equipment.
- 3.3.2 Solutions need to be mixed with the correct proportions to function correctly.
- 3.3.3 Temperature can change the physical properties of fluids.
- 3.3.4 Machines use gases, such as air, to produce power.
- 3.4.1 Water and land are material that are mechanically managed and conserved.
- 3.4.2 Slope has an impact on the mechanics and design of materials.
- 3.4.3 The strength of concrete is dependent upon proper mixing and curing of materials.
- 3.4.4 Volume calculations and proportions are used for properly mixing concrete.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Plan and conduct an investigation to classify metals based upon their physical properties.
- Construct an explanation of how metals chemically react in certain environmental conditions.
- Construct an explanation of how metals react with each other.
- Compare and contrast tensile strength, ductility, brittleness, and hardness of common metals used in agriculture.
- Use mathematics and computational thinking to measure the thermal conductivity and thermal expansion of different metals.
- Conduct an investigation to determine the effect of heat treating various metals to compare physical changes.
- Conduct an investigation to determine the relationship between density and tensile strength of species of wood.
- Plan and conduct an investigation to test the effect moisture has on the dimensional stability of different wood species.
- Plan and conduct an investigation to identify different types of plastics and their uses.
- Synthesize plastics to investigate the resulting mechanical properties.
- Plan and conduct an investigation to determine how lubrication can reduce the friction produced in a machine.
- Prepare solutions of water and antifreeze and compare their physical properties.
- Use mathematics and computational thinking to calculate the viscosity of different oils at varying temperatures.
- Observe and demonstrate the relationship between airflow and air pressure.
- Construct a windmill using Bernoulli's Principle as a basis for design.
- Measure the relationship between slope and velocity of water and observe management techniques to control erosion on sloped land.
- Use mathematics and computational thinking to calculate the slope of land between two points using surveying equipment.
- Obtain information through an investigation to observe the chemical and physical changes of concrete.

- Plan and conduct an investigation to test the compression strength of different mixtures of concrete.
- Using mathematical and computation thinking, complete mathematical calculations to mix concrete using proportions and volume calculations.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students think creatively and use and manage information to plan and conduct investigations related to metals, woods, and mechanical properties.
- Students produce results through completion of student investigation projects.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards:

CRP.02. Apply appropriate academic and technical skills.

CRP.04. Communicate clearly, effectively and with reason.

CRP.06. Demonstrate creativity and innovation.

CRP.11. Use technology to enhance productivity.

CS.03. Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.02. Operate and maintain AFNR mechanical equipment and power systems.

PST.03. Service and repair AFNR mechanical equipment and power systems.

PST.04. Plan, build and maintain AFNR structures.

Aligned Washington State Academic Standards

Science

Washington Science Standards (Next Generation Science Standards):

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting

	Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs.	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems Developing and Using Models Analyzing and Interpreting Data Using Mathematics and Computational Thinking Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	PS1.A. Structure and Properties of Matter PS1.B. Chemical Reactions PS2.B. Types of Interactions PS3.D. Energy in Chemical Processes and Everyday Life ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions ETS1.C. Optimizing the Design Solution	Patterns Cause and Effect: Mechanism and Prediction Systems and System Models Scale, Proportion, and Quantity Energy and Matter: Flows, Cycles, and Conservation Structure and Function Stability and Change

Unit 4: Fabrication	Total Learning Hours for Unit: 30
<p>Unit Summary: Competencies include:</p> <p>4.1.1 Construct and design accurate plans and scaled drawings that are essential for project success.</p> <p>4.1.2 A bill of materials accounts for all items needed to complete a project and assists in determining the budget.</p> <p>4.2.1 A variety of tools are used to process bulk materials into useable parts.</p> <p>4.2.2 Proper measurements and efficient use of materials are essential when manufacturing useable parts.</p> <p>4.2.3 Quality products are produced by following procedural steps.</p> <p>4.3.1 Torque is a factor considered when fastening material together.</p> <p>4.3.2 Fasteners are selected based upon strength and durability when joining machine and structural parts.</p> <p>4.3.3 A variety of welding processes are used to fuse metal.</p> <p>4.3.4 Metals are welded together for a strong fit using a combination of materials.</p> <p>4.3.4 Fabrication involves forming and fastening multiple types of materials together to make a useable product.</p>	
<p>Performance Assessments: (Districts to complete for each unit)</p> <p><i>Example assessments for this unit include:</i></p> <ul style="list-style-type: none"> • Design a floor plan of a shop to scale. • Draft isometric and orthographic depictions of three-dimensional objects. • Complete a bill of materials for the construction of a fabricated project. • Identify by name and describe the functionality the different types of cutting tools and blades. • Fabricate a nut and bolt with a tap and die. • Using mathematics and computational thinking demonstrate how the kerf must be considered when cutting material. • Develop and write a detailed procedure to cut pieces of metal. 	

- Ask questions to understand the effect of torque on fastener performance.
- Carry out an investigation to test the strength and durability of different fasteners and determine and define where they should be used.
- Obtain, evaluate, and communicate basic techniques for different welding processes.
- Ask questions and define problems when identifying materials, consumables, and processes used to various metal.
- Construct explanations and design solutions for creating and selecting a welding electrode for a specific job.
- Fabricate a doorstep using concrete, metal, and wood.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students use systems thinking to determine the cost of materials for a designed project.
- Students collaborate with others and work creatively with others while designing and completing projects.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards:

CRP.02. Apply appropriate academic and technical skills.

CRP.04. Communicate clearly, effectively and with reason.

CRP.06. Demonstrate creativity and innovation.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.02. Operate and maintain AFNR mechanical equipment and power systems.

PST.03. Service and repair AFNR mechanical equipment and power systems.

PST.04. Plan, build and maintain AFNR structures.

Aligned Washington State Academic Standards

Science

Washington Science Standards (Next Generation Science Standards):

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs.

Science and Engineering Practice

Disciplinary Core Idea

Crosscutting Concept

Asking Questions and Defining Problems Developing and Using Models Analyzing and Interpreting Data Using Mathematics and Computational Thinking Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions ETS1.C. Optimizing the Design Solution	Patterns Cause and Effect: Mechanism and Prediction Systems and System Models Structure and Function Energy and Matter: Flows, Cycles, and Conservation Structure and Function
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Unit 5: Energy	Total Learning Hours for Unit: 40
<p>Unit Summary: Competencies include:</p> <p>5.1.1 Chemical reactions release and absorb thermal energy. 5.1.2 Electrical energy can be harnessed and transferred through chemical reactions. 5.1.3 Chemical energy can be converted into mechanical movement. 5.1.4 Agriculture is a producer of renewable forms of fuel. 5.1.5 Fossil and bio-fuels release energy and chemical bi-products when they combust. 5.1.6 Many factors influence the choice of an energy source. 5.2.1 Electricity must flow in a complete loop from the source and to the source with no breaks for a circuit to operate correctly. 5.2.2 The relationship between amps, volts, and ohms can be defined using Ohm's Law. 5.2.3 Two types of electrical circuits used in agriculture are series and parallel. 5.2.4 The use of electricity requires a knowledge and understanding of relationships between voltage, current, and resistance. 5.2.5 Circuits are designed to provide electrical power for a specific job or application. 5.3.1 Electromagnetic fields are a source of mechanical energy used to produce rotational movement. 5.3.2 Mechanical energy can be converted into electrical power. 5.3.3 The force produced in a fluid power system is measured using Pascal's Law. 5.3.4 Controlled movements of fluids under pressure produce mechanical energy.</p>	
<p>Performance Assessments: (Districts to complete for each unit) <i>Example assessments for this unit include:</i></p> <ul style="list-style-type: none"> • Design and construct a hand warmer using elements that chemically react. • Plan and carry out an investigation to create a wet cell battery to power an electric motor. • Design and construct a steam engine that propels a boat and explain the transfer of energy. • Design and construct ethanol from agricultural products. 	

- Develop and test a model to demonstrate the combustion of hydrocarbons and ethanol.
- Obtain, evaluate and communicate the advantages and disadvantages of renewable and nonrenewable fuels.
- Analyze and interpret data to measure the energy output of renewable and nonrenewable fuels.
- Develop and construct a complete electrical circuit.
- Obtain and evaluate information to distinguish between an open and closed circuit.
- Using mathematical and computational thinking to determine amps, volts, and ohms in a circuit using Ohm's Law.
- Construct a parallel and series circuit to show the effects on Ohm's Law.
- Analyze and communicate how a resistor affects the electrical current in circuit.
- Design, construct, and test an electrical circuit that meets certain specifications.
- Construct an electric motor and identify the parts and their functions.
- Generate electrical energy with a windmill and evaluate factors optimize the power produced.
- Using mathematics and computational thinking to determine the force of fluids under pressure.
- Planning and carrying out an investigation to create a hydraulic lift that can perform a specified amount of work.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students manage projects, and produce results in designing and constructing a steam engine.
- Students work creatively with others and solve problems to distinguish between open and closed circuits.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards:

CRP.02. Apply appropriate academic and technical skills.

CRP.04. Communicate clearly, effectively and with reason.

CRP.05. Consider the environmental, social and economic impacts of decisions.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.

CS.01. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

CS.06. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.03. Service and repair AFNR mechanical equipment and power systems.

Aligned Washington State Academic Standards

Science

Washington Science Standards (Next Generation Science Standards):

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms

	<p>HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p>HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p>HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p>HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p>HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium</p> <p>HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p> <p>HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*</p> <p>HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.</p> <p>Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
<p>Asking Questions and Defining Problems</p> <p>Developing and Using Models</p> <p>Analyzing and Interpreting Data</p> <p>Using Mathematics and Computational Thinking</p> <p>Planning and Carrying Out Investigations</p> <p>Constructing Explanations and Designing Solutions</p> <p>Engaging in Argument from Evidence</p> <p>Obtaining, Evaluating, and Communicating Information</p>	<p>PS1.A. Structure and Properties of Matter</p> <p>PS1.B. Chemical Reactions</p> <p>PS2.B. Types of Interactions</p> <p>PS3.A. Definitions of Energy</p> <p>PS3.B. Conservation of Energy and Energy Transfer</p> <p>PS3.C. Relationship Between Energy and Forces</p> <p>PS3.D. Energy in Chemical Processes and Everyday Life</p> <p>ETS1.A. Defining and Delimiting Engineering Problems</p> <p>ETS1.B. Developing Possible Solutions</p> <p>ETS1.C. Optimizing the Design Solution</p>	<p>Patterns</p> <p>Cause and Effect: Mechanism and Prediction</p> <p>Systems and System Models</p> <p>Stability and Change</p> <p>Energy and Matter: Flows, Cycles, and Conservation</p> <p>Scale, Proportion, Quantity</p>

Unit Summary:

Competencies include:

- 6.1.1 Agricultural machines consist of one or more simple machines that produce linear and/or rotational movement.
- 6.1.2 Simple machines provide a mechanical advantage.
- 6.1.3 The amount of work to operate a machine will be greater than the work done by the machine.
- 6.1.4 The power and speed of a machine is dependent upon proper design.
- 6.2.1 Technical reading involves interpreting and applying information from manuals, schematics, diagnostic tools, and measuring tools.
- 6.2.2 Preventive maintenance requires a systematic periodic schedule.
- 6.2.3 Troubleshooting includes identifying the problem, researching solutions, and applying the possible solutions.
- 6.2.4 Machines are calibrated to perform at specific efficiencies.
- 6.3.1 Requirements of a project need to abide by code, laws, or rules governing such project.
- 6.3.2 Structures provide a controlled environment to protect agricultural commodities and equipment.
- 6.3.3 Agricultural structures contain joints and assemblies that withstand multiple types of forces.
- 6.3.4 Agricultural structures need to be well planned, to meet a specific need or purpose.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Analyze and interpret the simple machines and types of motions found in agricultural equipment.
- Using mathematics and computational thinking measure the mechanical advantage of different classes of levers and identify where levers are used in agriculture.
- Using mathematics and computational thinking, calculate the efficiency of work completed by a pulley system to lift an object.
- Use ratios to calculate speed and torque of multiple systems of gears.
- Read and obtain information from an operation manual.
- Design a maintenance schedule for a small engine using a technical manual.
- Develop and use a model flow chart for solving a problem for a machine and analyze the model for troubleshooting.
- Calibrate a water pump to perform a task at a specific rate.
- Design a model of a windmill that produces electricity used to pump water at a specified rate.
- Obtain, evaluate, and communicate codes and laws for constructing an agricultural structure.
- Analyze and interpret data about the insulating properties of building materials.
- Design and evaluate test truss designs for strength.
- Define a plan for constructing an agricultural building with a specific purpose.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students implement innovations while designing and calibrating a water pump to perform a specific task.
- Students interact effectively with others and working in diverse teams while working in pairs and small groups to complete unit projects.

Industry Standards and/or Competencies:**Agriculture, Food, and Natural Resources (AFNR) Standards:**

CRP.02. Apply appropriate academic and technical skills.

CRP.04. Communicate clearly, effectively and with reason.

CRP.05. Consider the environmental, social and economic impacts of decisions.

CRP.06. Demonstrate creativity and innovation.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.

CS.01. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

CS.03. Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

CS.06. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.02. Operate and maintain AFNR mechanical equipment and power systems.

PST.03. Service and repair AFNR mechanical equipment and power systems.

PST.04. Plan, build and maintain AFNR structures.

PST.05. Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

Aligned Washington State Academic Standards**Science**

Washington Science Standards (Next Generation Science Standards):

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

	HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs.	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems Developing and Using Models Analyzing and Interpreting Data Using Mathematics and Computational Thinking Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	PS3.A. Definitions of Energy PS3.B. Conservation of Energy and Energy Transfer PS3.C. Relationship Between Energy and Forces ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions ETS1.C. Optimizing the Design Solution	Patterns Cause and Effect: Mechanism and Prediction Systems and System Models Structure and Function Energy and Matter: Flows, Cycles, and Conservation Scale, Proportion, Quantity

Unit 7: Mechanical Applications	Total Learning Hours for Unit: 25
Unit Summary: Competencies include: 7.1.1 Communication and writing skills complement the operation of mechanical equipment used in agricultural power and technology careers. 7.1.2 Careers in agricultural mechanics require the application of technical skill combined with material knowledge. 7.1.3 Agricultural mechanics design and calibrate equipment to produce food, fiber, and fuel.	
Performance Assessments: (Districts to complete for each unit) <i>Example assessments for this unit include:</i> <ul style="list-style-type: none"> Complete a final draft of a technical manual for chosen tools and share the operational information about the tools with the class. Students will identify technical skills, careers, and knowledge needed in mechanical systems. Asking questions about needs and defining problems to design a planter/seeder/drill that meets the needs of a specific crop. 	
Leadership Alignment: (Districts to complete for each unit) <i>Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.</i> <i>Example:</i> <ul style="list-style-type: none"> Students implement innovations while designing a planter to address specifications for crop production. Students create media products while finalized the technical manual cumulative course project. 	
Industry Standards and/or Competencies: Agriculture, Food, and Natural Resources (AFNR) Standards: CRP.04. Communicate clearly, effectively and with reason.	

CRP.05. Consider the environmental, social and economic impacts of decisions.

CRP.06. Demonstrate creativity and innovation.

CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.10. Plan education and career path aligned to personal goals.

CS.05. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

Aligned Washington State Academic Standards		
Science	Washington Science Standards (Next Generation Science Standards): Additional Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs): The local level must list one or more projects to be completed in this unit that will cumulatively address all of the following additional SEPs, DCIs, and CCCs	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems Developing and Using Models Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information	ETS1.A. Defining and Delimiting Engineering Problems ETS1.B. Developing Possible Solutions	Systems and System Models