Statewide Framework Document for: Medical Lake High School

Agricultural Systems Design & Manufacturing

Course Title: Agricultural Systems Design & Manufacturing		**Total Framework Hours: 180**
CIP Code: 010201	☐**Exploratory** ☐**Preparatory**	**Date Last Modified: 3/3/2026**
Career Cluster: Agriculture, Food, and Natural Resources		**Cluster Pathway:** Power, Structural, and Technical Systems
Eligible for Equivalent Credit in: ☐ **Math** ☐ **Science**		**Total Number of Units: 9**

Course Overview

Summary:
Agricultural Systems Design & Manufacturing is a third-year mathematics equivalent course within the Agriculture, Food, and Natural Resources (AFNR) Power, Structural, and Technical Systems pathway. This course integrates Algebra, Geometry, Statistics, and quantitative reasoning into hands-on agricultural engineering and manufacturing applications. Students apply mathematical modeling to precision measurement, construction geometry, surveying and slope analysis using Philadelphia rods, small gas engine systems (displacement, compression ratio, torque, horsepower, and gear ratios), electrical systems calculations (Ohm's Law, power, load analysis), bill of materials development, and production efficiency modeling.
Through both classroom instruction and wood/metal shop laboratory experiences, students solve real-world problems using multi-step equations, trigonometry, coordinate geometry, statistical analysis, and dimensional reasoning. Emphasis is placed on modeling with mathematics, attending to precision, and justifying solutions in technical and engineering contexts. The course culminates in a comprehensive agricultural system design project requiring students to integrate structural calculations, cost analysis, electrical modeling, and technical documentation, demonstrating mastery of advanced applied mathematics in an authentic agricultural setting.

Unit 1: Career Development & Quantitative Modeling	Total Learning Hours for Unit: 15

Unit Summary:

This unit will include instruction in agricultural career pathways and the role of mathematics in agricultural engineering, manufacturing, and construction industries. Students will explore career opportunities within the Agriculture, Food, and Natural Resources (AFNR) Power, Structural, and Technical Systems pathway while applying quantitative reasoning to wage projections, budgeting, and workforce planning. Students will analyze economic data, develop financial models, and apply algebraic equations to real-world agricultural employment scenarios.

Lessons will include:

1. AFNR Career Pathways and Industry Systems
2. Agricultural Engineering and Manufacturing Careers
3. Wage Modeling and Linear Equations
4. Budgeting and Financial Planning
5. Mathematical Decision Making in Career Development

Performance Assessments:

It is expected that students will:

• Analyze career opportunities within the AFNR Power, Structural, and Technical Systems pathway and calculate projected wages, training costs, and long-term earnings using algebraic modeling.

• Develop a personal career pathway plan that includes postsecondary training requirements, salary projections, and cost-of-living budgeting using multi-step financial calculations.

• Interpret labor market data and present findings on agricultural technical careers while using quantitative reasoning to compare employment opportunities.

• Create a written career development plan that includes financial projections, education timelines, and expected return on investment for training programs.

Leadership Alignment:

- Students will demonstrate leadership development by applying decision-making and critical thinking skills while exploring careers in agricultural engineering, manufacturing, and construction.
- Students will analyze career pathways, develop personal career plans, and communicate their goals through written and oral presentations. These activities support leadership competencies including reasoning effectively, communicating clearly, and managing goals and time.
- Students will also practice initiative and self-direction by establishing educational and career goals and evaluating the training and financial requirements associated with those pathways.
- Activities align with Washington CTE leadership standards related to critical thinking, communication, productivity, and leadership development in career preparation.

Industry Standards and Competencies

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

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

CRP.01.01. Model personal responsibility in the workplace and community.

CRP.01.02. Explain the short-term and long-term impacts of personal and professional decisions on employers and community before taking

action.
CRP.01.03. Identify and act upon opportunities for professional and community service at the workplace.
CRP.02. Apply appropriate academic and technical skills.
CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.04. Communicate clearly, effectively and with reason.
CRP.04.01. Communicate using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
CRP.04.02. Produce clear, reasoned, and coherent written and visual communication in formal and informal settings.
CRP.04.03. Model active listening strategies when interacting with others in formal and informal settings.
CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
CRP.08.02. Investigate, prioritize and select solutions to solve problems in the workplace and community.
CRP.08.03. Establish plans to solve workplace and community problems and execute them with resiliency.
CRP.10. Plan education and career path aligned to personal goals.
CRP.10.01. Identify career opportunities within a career pathway.
CRP.10.02. Develop a personal career plan aligned to career goals.
FPS.05. Examine career opportunities and professional development within AFNR pathways.
FPS.05.01. Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways.
FPS.05.02. Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Specific Project Title(s):
- AFNR Career Pathway Financial Modeling Project
- Agricultural Career Budget & Wage Analysis Portfolio

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting Engineering Problems	Systems and System Models
Using Mathematics and Computational Thinking	ETS1.B: Developing Possible Solutions	Influence of Science, Engineering, and Technology on Society
Obtaining, Evaluating, and Communicating Information		

Constructing Explanations and Designing Solutions		

Common Core: Mathematics- Algebra

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Unit 2: Precision Measurement & Dimensional Analysis | Total Learning Hours for Unit: 20

Unit Summary:

This unit will include instruction in precision measurement techniques and dimensional analysis used in agricultural manufacturing, fabrication, and construction systems. Students will develop skills in unit conversions, tolerance calculations, percent error analysis, and precision tool usage. Instruction will focus on the use of measurement tools such as dial calipers, micrometers, feeler gauges, and tape measures to collect accurate data used in manufacturing and engineering calculations.
Lessons will include:

1. Measurement Systems and Unit Conversions
2. Fraction, Decimal, and Metric Relationships
3. Precision Measurement Tools and Applications
4. Tolerance and Error Analysis
5. Dimensional Analysis in Agricultural Manufacturing

Performance Assessments:

It is expected that students will:

• Demonstrate accurate use of precision measurement tools including dial calipers, micrometers, feeler gauges, and measuring tapes to collect dimensional data from fabricated components.
• Perform dimensional analysis and convert between measurement systems including fractional, decimal, and metric units used in agricultural manufacturing.
• Calculate tolerance ranges and percent error using measured data from shop projects and evaluate whether components meet required specifications.

• Apply measurement data to create a technical measurement report documenting dimensional accuracy of fabricated materials.

Leadership Alignment:

- Students will develop leadership and responsibility by demonstrating attention to detail, accountability, and precision while working with measurement tools and engineering specifications.
- Students will work collaboratively to verify measurements, analyze errors, and ensure quality standards are met during fabrication activities.
- Through collaborative lab work and technical reporting, students will practice communication, teamwork, and accountability while solving real-world measurement problems.
- These experiences reinforce leadership competencies related to collaboration, productivity, problem solving, and professional responsibility within technical environments.

Industry Standards and Competencies

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

CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
CRP.08.02. Investigate, prioritize and select solutions to solve problems in the workplace and community.
PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.
PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.
PST.01.02. Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
PST.05. Use tools, equipment and technical systems to complete tasks in AFNR power, structural and technical systems.
PST.05.01. Select and use tools, equipment, and technical systems to complete tasks in AFNR power, structural and technical systems.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
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-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for cost, safety, reliability, and aesthetics.

Specific Project Title(s):

- Precision Measurement Lab & Dimensional Accuracy Report
- Tolerance and Error Analysis in Fabricated Components

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Planning and Carrying Out Investigations	PS1.A: Structure and Properties of Matter	Scale, Proportion, and Quantity
Using Mathematics and Computational Thinking	ETS1.C: Optimizing the Design Solution	Patterns
Analyzing and Interpreting Data		
Using Tools Strategically		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 3: Small Gas Engine Mathematical Systems | Total Learning Hours for Unit: 20

Unit Summary:

This unit will include instruction in the mathematical principles used to analyze and understand small gas engine systems commonly used in agricultural equipment. Students will apply algebraic formulas and geometric calculations to determine engine displacement, compression ratios, torque, horsepower, and gear ratios. Instruction will emphasize the relationship between mechanical design and mathematical modeling used in engine performance and power transmission systems.

Lessons will include:

1. Small Gas Engine Components and Systems
2. Cylinder Volume and Engine Displacement Calculations
3. Compression Ratio and Engine Performance Modeling
4. Torque and Horsepower Calculations
5. Gear Ratios and Mechanical Advantage

Performance Assessments:

It is expected that students will:

• Calculate engine displacement using cylinder measurements and apply geometric formulas to determine engine volume.
• Determine compression ratios, torque values, and horsepower using algebraic formulas and engine performance data.
• Analyze gear ratios and mechanical advantage in small engine systems and predict resulting changes in speed and torque.
• Complete a mechanical systems analysis where students evaluate engine performance data and mathematically model the relationship between engine components and power output.

Leadership Alignment:

- Students will develop leadership skills by applying problem-solving strategies and technical reasoning to mechanical systems used in agricultural equipment.
- Students will work in teams to diagnose mechanical systems, analyze engine performance data, and present mathematical explanations of engine operation.
- Students will also demonstrate systems thinking by analyzing how mechanical components interact within an engine system.
- Through group discussions and technical analysis, students will practice leadership competencies such as critical thinking, collaboration, and the ability to communicate complex technical concepts to others.

Industry Standards and Competencies

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

CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
CRP.08.02. Investigate, prioritize and select solutions to solve problems in the workplace and community.
PST.02. Operate and maintain AFNR mechanical equipment and power systems.
PST.02.01. Perform preventative maintenance and scheduled service to maintain equipment, machinery, and power units used in AFNR settings.
PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.
PST.03. Service and repair AFNR mechanical equipment and power systems.
PST.03.01. Troubleshoot, service, and repair components of internal combustion engines using manufacturers' guidelines.
PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems.

Aligned Washington State Standards

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 either motions of particles or energy stored in fields.
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Specific Project Title(s):

- Engine Performance Analysis & Mathematical Modeling Project
- Gear Ratio and Mechanical Advantage Investigation

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Using Mathematics and Computational Thinking	PS3.A: Definitions of Energy	Energy and Matter
Analyzing and Interpreting Data	PS3.B: Conservation of Energy and Energy Transfer	Cause and Effect
Developing and Using Models	PS2.A: Forces and Motion	
Constructing Explanations		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 4: Construction Geometry & Structural Layout | Total Learning Hours for Unit: 25

Unit Summary:

This unit will include instruction in geometric principles used in agricultural construction and structural design. Students will apply concepts of slope, rise and run, right triangle relationships, trigonometry, and structural layout to real-world agricultural building applications. Students will use mathematical modeling to determine rafter lengths, roof pitch, structural angles, and material dimensions required for agricultural structures. Lessons will include:

1. Introduction to Construction Geometry

2. Rise, Run, and Slope Calculations
3. Right Triangle Applications in Construction
4. Rafter Layout and Structural Design
5. Area and Volume Calculations for Structural Components

Performance Assessments:
It is expected that students will:
• Apply geometric principles to calculate slope, rise, run, and rafter lengths used in agricultural construction projects.
• Solve structural layout problems using right triangle relationships and trigonometric calculations to determine angles and structural dimensions.
• Develop a scaled layout plan for an agricultural structure including material dimensions, angles, and area calculations.
• Construct or model a structural component while demonstrating accurate mathematical calculations for layout and design.

Leadership Alignment:
- Students will develop leadership and teamwork skills while planning and constructing structural layouts used in agricultural buildings and facilities.
- Students will collaborate to solve construction layout problems, apply geometric reasoning, and evaluate multiple design solutions.
- Through project planning and design activities, students will demonstrate creativity, innovation, and systems thinking while working toward common project goals.
- These activities reinforce leadership competencies such as collaboration, communication, problem solving, and the ability to guide project planning efforts within a team environment.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards -
CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
PST.04. Plan, build and maintain AFNR structures.
PST.04.01. Plan AFNR structures according to construction plans, specifications, and building codes.
PST.04.02. Construct AFNR structures using appropriate materials, tools, and equipment.
PST.04.03. Maintain and repair AFNR structures according to industry standards.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Specific Project Title(s):
- Structural Layout & Rafter Design Project

- Agricultural Structure Geometry Modeling Task

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and Using Models	ETS1.A: Defining Engineering Problems	Scale, Proportion, and Quantity
Using Mathematics and Computational Thinking	ETS1.B: Developing Solutions	Structure and Function
Constructing Explanations and Designing Solutions		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 5: Surveying, Slope & Elevation Analysis | Total Learning Hours for Unit: 20

Unit Summary:

This unit will include instruction in land surveying techniques and mathematical analysis used to measure slope, elevation change, and land area in agricultural systems. Students will use surveying tools such as Philadelphia rods and transits to collect field data and apply algebraic calculations to determine elevation differences, slope percentages, and land measurements. Emphasis will be placed on applying mathematical reasoning to real-world agricultural land management and construction planning.

Lessons will include:

1. Introduction to Surveying Equipment and Methods
2. Reading a Philadelphia Rod
3. Back Sight and Fore Sight Calculations

4. Slope and Grade Calculations
5. Acreage and Land Measurement Applications

Performance Assessments:
It is expected that students will:
• Use surveying equipment such as Philadelphia rods and leveling instruments to collect field elevation data.
• Calculate slope percentage, elevation changes, and grade using collected field measurements.
• Determine land area and acreage using geometric formulas and coordinate measurements from field surveys.
• Produce a field survey report documenting measurements, calculations, and analysis of land slope and elevation for an agricultural site.

Leadership Alignment:
- Students will demonstrate leadership and teamwork through field-based surveying activities that require collaboration, communication, and shared responsibility for accurate data collection.
- Students will work in teams to operate surveying equipment, record field data, and analyze results used in agricultural land management.
- Students will practice decision-making and problem-solving while interpreting survey data and evaluating land measurements.
- These activities support leadership competencies related to systems thinking, collaboration, communication, and responsible participation in technical team environments.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards -
CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.
PST.01.02. Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):
HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems
HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios

Specific Project Title(s):
- Land Survey Project Using Philadelphia Rod
- Slope, Grade, and Elevation Field Analysis Report

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Planning and Carrying Out Investigations	ESS2.C: The Roles of Water in Earth's Surface Processes	Scale, Proportion, and Quantity
Using Mathematics and Computational Thinking	ETS1.A: Defining Engineering Problems	Patterns

Developing and Using Models		
Analyzing and Interpreting Data		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 6: Bill of Materials & Construction Management | Total Learning Hours for Unit: 20

Unit Summary:

This unit will include instruction in material estimation, project planning, and financial calculations used in agricultural construction and manufacturing projects. Students will develop bill of materials (BOM) documents, calculate material quantities, estimate project costs, and analyze labor requirements. Algebraic modeling and multi-step calculations will be used to determine project budgets, waste factors, and profit margins.
Lessons will include:

1. Introduction to Bill of Materials (BOM)
2. Material Quantity Calculations
3. Waste Factor and Resource Planning
4. Project Cost Estimation
5. Construction Budgeting and Financial Modeling

Performance Assessments:

It is expected that students will:

• Develop a complete bill of materials (BOM) for an agricultural construction or fabrication project including quantities, dimensions, and material specifications.
• Calculate total project costs including materials, labor, and waste factors using algebraic modeling.

• Analyze project budgets and determine break-even points and profit margins for fabricated products.
• Present a construction management plan that includes material estimates, cost projections, and project scheduling calculations.

Leadership Alignment:

- Students will demonstrate leadership and organizational skills through project planning and resource management activities.
- Students will work collaboratively to develop bills of materials, estimate project costs, and allocate materials and labor resources effectively.
- Students will apply decision-making skills while evaluating multiple construction planning strategies and presenting their project management plans to peers.
- These experiences support leadership competencies related to productivity, accountability, financial literacy, and effective communication in professional technical settings.

Industry Standards and Competencies

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

CRP.05. Consider the environmental, social and economic impacts of decisions.
CRP.05.01. Assess, identify, and synthesize the information and resources needed to make decisions that positively impact the workplace and community.
CRP.05.02. Make, defend, and evaluate decisions at work and in the community using information about the potential environmental, social, and economic impacts.
PST.04.01. Plan AFNR structures according to construction plans, specifications, and building codes.
PST.04.02. Construct AFNR structures using appropriate materials, tools, and equipment.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Specific Project Title(s):

- Bill of Materials (BOM) Development & Cost Analysis Project
- Agricultural Construction Management Plan

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Using Mathematics and Computational Thinking	ETS1.B: Developing Possible Solutions	Systems and System Models
Analyzing and Interpreting Data	ETS1.C: Optimizing Design Solutions	Scale, Proportion, and Quantity
Obtaining, Evaluating, and Communicating Information		
Designing Solutions		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 7: Fabrication, Production Rate & Statistical Modeling	**Total Learning Hours for Unit: 20**

Unit Summary:

This unit will include instruction in production efficiency, rate calculations, and statistical analysis used in agricultural manufacturing and fabrication processes. Students will analyze production systems by calculating production rates, cycle times, and efficiency percentages. Statistical tools such as mean, range, and variation will be used to evaluate manufacturing processes and improve production performance.
Lessons will include:

1. Manufacturing and Fabrication Production Systems
2. Rate, Work, and Time Calculations
3. Production Efficiency and Productivity Analysis
4. Statistical Analysis of Manufacturing Data
5. Process Optimization and Problem Solving

Performance Assessments:

It is expected that students will:

• Calculate production rates and cycle times for fabrication tasks using work and time equations.
• Analyze production efficiency using statistical measurements including mean, range, and variation.
• Evaluate manufacturing processes and recommend improvements based on quantitative analysis of production data.
• Create a production efficiency report that includes statistical calculations and proposed improvements to manufacturing workflow.

Leadership Alignment:

- Students will demonstrate leadership and accountability by analyzing production processes and identifying ways to improve efficiency and productivity in manufacturing environments.
- Students will evaluate production data, collaborate with peers to identify improvements, and present recommendations based on quantitative analysis.
- These activities strengthen leadership competencies related to problem solving, systems thinking, productivity, and accountability.
- Students will also practice collaboration and communication skills while working in teams to analyze production performance and develop solutions to improve manufacturing processes.

Industry Standards and Competencies

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

CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.

CRP.06.01. Synthesize information, knowledge, and experience to generate original ideas and challenge assumptions in the workplace and community.

PST.01.03. Apply physical science and engineering principles to metal fabrication using a variety of welding and cutting processes and equipment. This includes processes such as SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Specific Project Title(s):

- Manufacturing Production Efficiency Analysis Project
- Statistical Process Improvement Report

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Using Mathematics and Computational Thinking	ETS1.C: Optimizing the Design Solution	Systems and System Models
Analyzing and Interpreting Data	PS3.B: Conservation of Energy and Efficiency	Stability and Change
Constructing Explanations		
Engaging in Argument from Evidence		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 8: Agricultural Electrical Systems Mathematics	**Total Learning Hours for Unit: 20**

Unit Summary:
This unit will include instruction in the mathematical principles used to analyze electrical systems commonly found in agricultural facilities and equipment. Students will apply algebraic equations and quantitative reasoning to electrical calculations including Ohm's Law, power formulas, resistance calculations, and electrical load analysis. Students will model electrical circuits and determine safe operating conditions for tools and equipment used in agricultural manufacturing environments.
Lessons will include:

1. Electrical Units and Measurement Systems
2. Ohm's Law Applications
3. Electrical Power Calculations
4. Series and Parallel Circuit Calculations
5. Electrical Load and Safety Analysis

Performance Assessments:
It is expected that students will:
• Apply Ohm's Law to calculate voltage, current, and resistance within agricultural electrical circuits.
• Determine electrical power requirements for agricultural equipment using power formulas and load calculations.
• Analyze series and parallel circuits to determine total resistance and current flow.
• Design and evaluate an electrical circuit used in an agricultural facility while calculating safe electrical loads and power consumption.

Leadership Alignment:

- Students will demonstrate leadership and responsibility by analyzing electrical systems used in agricultural facilities and ensuring safe operation of electrical equipment.
- Students will collaborate to design electrical circuits, evaluate power requirements, and apply safety standards during electrical system planning.
- Through technical problem solving and group collaboration, students will practice leadership competencies related to communication, teamwork, and responsible decision making when working with electrical systems.

- These activities reinforce the importance of ethical behavior, safety, and accountability in technical professions.

Industry Standards and Competencies

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

CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.08.01. Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):

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-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Specific Project Title(s):

- Electrical Circuit Design & Ohm's Law Application Project
- Electrical Load Analysis for Agricultural Systems

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and Using Models	PS3.C: Relationship Between Energy and Forces	Systems and System Models
Using Mathematics and Computational Thinking	PS2.B: Types of Interactions	Energy and Matter
Constructing Explanations		
Designing Solutions		

Common Core: Mathematics- Algebra

HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Unit 9: CAD Modeling & Coordinate Geometry	**Total Learning Hours for Unit: 20**

Unit Summary:
This unit will include instruction in computer-aided design (CAD) and coordinate geometry used in modern agricultural manufacturing and engineering design. Students will apply mathematical principles of the coordinate plane, geometric transformations, scaling, and dimensioning to create digital models of components and structures. Emphasis will be placed on the use of mathematical precision in technical drawing and engineering design.
Lessons will include:

1. Introduction to CAD Systems and Technical Drawing
2. Cartesian Coordinate Systems
3. Geometric Shapes and Transformations
4. Scale, Dimensioning, and Technical Precision
5. CAD Modeling for Agricultural Systems Design

Performance Assessments:
It is expected that students will:
• Apply coordinate geometry concepts to construct technical drawings and digital models using CAD software.
• Calculate dimensions, distances, and angles using coordinate geometry and geometric formulas.
• Develop a scaled CAD model of an agricultural component or structure with accurate dimensions and design specifications.
• Present a completed digital design project that includes mathematical justification of measurements, scale, and geometric relationships.

Leadership Alignment:

- Students will develop leadership and innovation skills by designing technical solutions using computer-aided design (CAD) software.
- Students will collaborate with peers to create digital models, evaluate design improvements, and present engineering solutions.
- Students will practice creativity, communication, and systems thinking while developing design solutions to agricultural engineering problems.
- These activities support leadership competencies related to innovation, collaboration, technology literacy, and professional communication within technical industries.

Industry Standards and Competencies

Agriculture, Food, and Natural Resources (AFNR) Standards –
CRP.02.01. Use strategic thinking to connect and apply academic learning, technical knowledge, and skills to solve problems in the workplace and community.
CRP.04.01. Communicate using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.06.01. Synthesize information, knowledge, and experience to generate original ideas and challenge assumptions in the workplace and community.
PST.01.01. Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.
PST.01.02. Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

Aligned Washington State Standards

Washington Science Standards (Next Generation Science Standards):
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
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.

Specific Project Title(s):
- CAD Design & Coordinate Geometry Modeling Project
- Agricultural Systems Digital Design Portfolio

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Developing and Using Models	ETS1.B: Developing Possible Solutions	Scale, Proportion, and Quantity
Using Mathematics and Computational Thinking	ETS1.C: Optimizing Design Solutions	Structure and Function
Designing Solutions		
Obtaining, Evaluating, and Communicating Information		

Common Core: Mathematics- Algebra
HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

21st Century Skills

Students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation
☐Think Creatively
☐Work Creatively with Others
☐Implement Innovations

Critical Thinking and Problem Solving
☐Reason Effectively
☐Use Systems Thinking
☐Make Judgments and Decisions
☐Solve Problems

Communication and Collaboration
☐Communicate Clearly
☐Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy
☐Access and Evaluate Information
☐Use and Manage Information

Media Literacy
☐Analyze Media
☐Create Media Products

Information, Communications and Technology (ICT Literacy)
☐Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability
☐Adapt to Change
☐Be Flexible

Initiative and Self-Direction
☐Manage Goals and Time
☐Work Independently
☐Be Self-Directed Learners

Social and Cross-Cultural
☐Interact Effectively with Others
☐Work Effectively in Diverse Teams

Productivity and Accountability
☐Manage Projects
☐Produce Results

Leadership and Responsibility
☐Guide and Lead Others
☐Be Responsible to Others