



# **Ledyard Agri-Science & Technology Program**



## **Ag III & IV Power, Structural and Technical Systems Curriculum**

# Agri-Science III & IV

## POWER, STRUCTURAL AND TECHNICAL SYSTEMS (PST)

Agri-Science III & IV students will focus on those areas of interest they have developed over the previous two or three years and concentrate on developing skills more specific to those areas of interest.

**Power, Structural and Technical Systems (PST):** encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in Agriculture, Food, and Natural Resources (AFNR) settings.

Students are expected to follow a specific course of study related to their career interests and goals that will prepare them for further study after high school or direct entry into the workplace. Some students may elect to pursue study in two diverse areas. Course selection is developed with the assistance of the Supervised Agricultural Experience (SAE) advisors and classroom teachers. Agri-Science III & IV students will continue to have opportunities to further develop leadership skills through participation in the FFA. Students are encouraged to participate in FFA Career Development Events (CDEs) in order to further develop skills.

### POWER, STRUCTURAL AND TECHNICAL SYSTEMS COURSES

<a href="#"><u>Supervised Agricultural Experience (SAE)</u></a>
<a href="#"><u>Power Equipment in Agriculture</u></a>
<a href="#"><u>Power and Controls</u></a>
<a href="#"><u>Agricultural Mechanics Senior Projects</u></a>
<a href="#"><u>Agricultural Structures</u></a>

<b>Course Title</b>	<b>Supervised Agricultural Experience (SAE)</b>
<b>Agriculture Pathway</b>	All agricultural pathways
<b>Length of Course</b>	On-Going
<b>Ledyard High School Vision of the Graduate</b>	<p>Demonstrate an ability to work effectively with others, sharing ideas, acknowledging one another's strengths, and collaborating to produce presentations, projects, performances, or events.</p> <p>Demonstrate an ability to solve problems of varying complexity across a variety of content areas.</p> <p>Demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas</p>
<b>Course Overview</b>	<p>SAE is a vital aspect of agricultural education. During Agri-Science I students begin to develop a plan for supervised work experience relating to their interests and career goals. All Agri-Science students must have an approved SAE program in place by July 1 at the start of the Agri-Science II year.</p> <p>SAE advisors work with individual students, parents, work-site mentors, and employers to ensure student activities are appropriate, meet student needs, and are in compliance with state labor laws. All students work with their SAE advisors to complete the Universal Structured Work-Based Learning Plan. In addition, some students must complete the Connecticut Department of Labor forms LED 75-1 (Workplace Learning Experiences for Minor Students in Hazardous Occupations) or the LED 31-23 (Workplace Learning Experiences for Minor Students Ages 14 or 15 in Non-Hazardous Occupations), or Unpaid Work Experience forms.</p>
<b>Units of Study</b>	<ol style="list-style-type: none"> <li>1. Develop an Approved Supervised Agricultural Experience (SAE) Program</li> <li>2. Record Keeping</li> <li>3. Employability Skills</li> </ol>

<b>Unit 1</b>	Develop an Approved Supervised Agricultural Experience (SAE) Program
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. What is an SAE and why is it important?</li> <li>2. What are the benefits of gaining employability skills for career growth?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.10.01.02.c. Match potential career opportunities in career clusters with personal interests, talents, goals and preferences.</p> <p>CRP.10.02.02.a. Identify methods for setting goals for personal improvement and continuous growth in a career area (e.g., SMART goals, training, professional development, etc.).</p> <p>CRP.10.03.02.a. Identify trusted individuals to consult with on setting and achieving career and personal goals (e.g., counselors, teachers, mentors, coaches, community leaders, etc.).</p> <p>CS.03.01.02.a. Summarize the importance of safety, health and environmental management in the workplace.</p>
<b>Common Core State Standards</b>	<p>WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose and audience</p> <p>SL.11-12.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.04.02.01.a. Research and summarize the purpose of different forms of written and visual communication in formal and informal settings (e.g., letters, emails, reports, social media, graphics, diagrams, etc.).</p> <p>CRP.10.02.01.a. Categorize career advancement requirements for potential careers (e.g., degrees, certification, training, etc.).</p> <p>CS.03.03.04.c. Create a plan to mitigate the level of contamination or injury identified as a risk in the workplace.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.4 Determine the meaning of words and phrases as they are used in text, including analyzing how an author uses and refines the meaning of a key term over the course of a text.</p>

Learning Objectives	Activities	CT AFNR, NGSS, CCSS
Identify local agricultural work experiences	<ul style="list-style-type: none"> <li>● Research and identify local 501(c)3 non profit organizations</li> <li>● Locate local agricultural businesses</li> <li>● Determine qualifications needed for employment</li> <li>● Call to inquire about agricultural position</li> </ul>	CRP.04.02.01.a. CRP.10.02.01.a. CRP.10.03.02.a. SL.11-12.4 RST.11-12.4
Develop an appropriate SAE work experience	<ul style="list-style-type: none"> <li>● Identify agricultural interests</li> <li>● Develop work experience activities/projects in line with career goals</li> <li>● Write SMART goals for SAE growth and improvement</li> <li>● Obtain approval from parents/guardians and SAE advisor</li> <li>● Meet with SAE advisor during the school year and at least once during the summer</li> </ul>	CRP.10.01.02.c. CRP.10.02.02.a. CS.03.03.04.c. WHST.11-12.4 RST.11-12.4 SL.11-12.4
Complete appropriate work experience forms utilizing <a href="#">AFNR standards</a>	<ul style="list-style-type: none"> <li>● Identify key skills necessary to complete the Structured Work-Based Learning Form</li> <li>● Complete appropriate CT Departments of Labor and Education forms for student work experience</li> </ul>	CS.03.01.02.a. WHST.11-12.4 RST.11-12.4

<b>Unit 2</b>	Record Keeping
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. Why is record keeping essential to an SAE experience?</li> <li>2. Why is documenting SAE experiences beneficial to a student?</li> </ol>

**Priority Standards Assessed in Learning**

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.03.02.01.a. Research and examine components in a personal financial management plan (e.g., income, expense, budgeting, savings, credit, etc.).</p> <p>CRP.09.02.01.a. Identify and summarize personal management skills necessary to function effectively in the workplace (e.g., time management, planning, prioritizing, etc.).</p> <p>CRP.13.03.01.c. Apply for a chapter, state and national proficiency award that corresponds with an SAE program.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.4 Determine the meaning of words and phrases as they are used in text, including analyzing how an author uses and refines the meaning of a key term over the course of a text.</p> <p>WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose and audience</p> <p>MP4 Model with mathematics</p>

**Supporting Standards**

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>ABS.02.02.01.a. Compare and contrast the different types of financial reports (e.g., income statements, cash flow statements, equity statements, etc.) and their frequency of use (e.g., daily, weekly, monthly, quarterly, annual) for monitoring AFNR business performance.</p>
<b>Common Core State Standards</b>	<p>MP6 Attend to precision</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
Develop and maintain SAE records	<ul style="list-style-type: none"> <li>● Document time spent in SAE &amp; FFA activities, skills learned, income, and expenses</li> <li>● Utilize online record keeping program (<a href="#">AET</a>) to document records</li> <li>● Provide evidence of work using photographs, videos, and journals</li> </ul>	CRP.03.02.01.a. CRP.09.02.01.a. ABS.02.02.01.a. RST.11-12.4 WHST.11-12.4 MP4
Apply for <a href="#">SAE and FFA awards</a>	<ul style="list-style-type: none"> <li>● Research SAE and FFA awards applicable to SAE experiences</li> <li>● Calculate SAE hours worked, income and expenses</li> <li>● Complete local, state, and national degree and award applications as applicable</li> </ul>	CRP.13.03.01.c. RST.11-12.4 WHST.11-12.4 MP6

<b>Unit 3</b>	Employability Skills
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. Why is it important to develop agricultural employability skills?</li> <li>2. What types of skills are needed for an entry level agricultural position?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p> <p>CS.03.04.01.a. Identify and differentiate the appropriate protective equipment for the safe use and operation of specific tools and equipment (e.g. PPE, etc.).</p> <p>CS.03.04.02.a. Identify standard tools, equipment and safety procedures related to AFNR tasks.</p> <p>CS.03.04.03.a. Read and interpret operating instructions related to operation, storage and maintenance of tools and equipment related AFNR tasks.</p> <p>CS.05.01.03.a. Research and summarize specific tools (e.g., resumes, portfolios, cover letters, etc.) and processes (e.g., interviews, applications, etc.) needed to pursue a career in an AFNR pathway.</p>
<b>Common Core State Standards</b>	<p>WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose and audience</p> <p>SL.11-12.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.01.01.02.a. Distinguish personal levels of responsibility, which can be applied in the workplace and community.</p> <p>CRP.10.03.01.a. Summarize ways that input and/or advice from career area experts could assist in planning personal career goals.</p> <p>CS.05.01.01.b. Create a personal plan outlining goals and steps to obtain a career in an AFNR pathway.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.4 Determine the meaning of words and phrases as they are used in text, including analyzing how an author uses and refines the meaning of a key term over the course of a text.</p>



Objectives	Activities	CT AFNR, NGSS, CCSS
Demonstrate effective and appropriate agricultural employability skills	<ul style="list-style-type: none"> <li>● Work safely and effectively in an SAE experience</li> <li>● Select and use appropriate PPE for SAE experiences</li> <li>● Report broken, chipped or cracked PPE to manager</li> <li>● Select and use appropriate tools and equipment for SAE experiences according to manufacturer's directions</li> <li>● Maintain professionalism and confidentiality in the workplace</li> <li>● Model listening and problem solving skills</li> </ul>	CRP.01.01.02.a. CRP.08.02.02.b. CRP.09.03.02.c. CS.03.04.01.a. CS.03.04.02.a. CS.03.04.03.a. WHST.11-12.4 RST.11-12.4 SL.11-12.4
Demonstrate improvement and growth in career skills	<ul style="list-style-type: none"> <li>● Provide evidence of work using photographs, videos, and journals</li> <li>● Write an annual summary of activities</li> <li>● Create quarterly and yearly SAE goals to grow or improve SAE experience</li> <li>● Share SAE experiences to educate others about additional options for SAE projects</li> </ul>	CRP.08.02.02.b. CRP.09.03.02.c. CRP.10.03.01.a. CS.05.01.01.b. WHST.11-12.4 RST.11-12.4 SL.11-12.4
Complete job application documents	<ul style="list-style-type: none"> <li>● Research agricultural job openings</li> <li>● Create a cover letter and a resume</li> <li>● Complete a job application</li> <li>● Participate in a job interview</li> </ul>	CRP.09.03.02.c. CRP.10.03.01.a. CS.05.01.03.a. WHST.11-12.4 RST.11-12.4 SL.11-12.4

**Vocabulary:**

501 (c) 3	Paid Placement
Community Service	Placement
Entrepreneurship	SAE
Expenses	Scope
Hazardous Occupations	Structured Work-Based Learning Plan
Income	Volunteer
Liability	Work-site Mentor
Non-Profit Entity	

**Assessments:**

Record checks  
Annual summaries  
[On-site visits by advisor](#)  
[SAE rubric](#)

**Connections to College/Career Readiness:**

Hands-on agricultural skills and knowledge for job placement

**Resources/Materials:**

[SAE Manual](#)  
Online record keeping program- [www.theaet.com](http://www.theaet.com)  
SDE/SDOL employment forms [LED 75-1](#), [LED 31-23](#), [Unpaid](#)

<b>Course Title</b>	<b>Power Equipment in Agriculture</b>
<b>Agriculture Pathway</b>	Power, Structural and Technical Systems
<b>Length of Course</b>	One Semester
<b>Ledyard High School Vision of the Graduate</b>	Demonstrate an ability to solve problems of varying complexity across a variety of content areas. Demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas
<b>Course Overview</b>	This unit is an introduction to the design, operation and maintenance of power equipment used in agriculture and allied fields. An emphasis is given to internal combustion engines as power units. Concepts of mechanical power transmission as well as fluid power are explored. Students will also learn to operate and maintain practical equipment used on the landscape.
<b>Units of Study</b>	<ol style="list-style-type: none"> <li>1. Internal Combustion Engines</li> <li>2. Operation and Maintenance of Engine-Powered Equipment</li> <li>3. Electrical Systems in Power Equipment</li> </ol>

<b>Unit 1</b>	Internal Combustion Engines
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How do internal combustion engines work?</li> <li>2. What are the technical and practical differences of 4-stroke, 2-stroke and diesel engines?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.02.03.b. Select, maintain and demonstrate the proper use of tools, machines and equipment used in different AFNR related mechanical systems.</p> <p>PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality.</p> <p>PST.02.01.02.a. Examine operator’s manuals to determine recommendations for servicing filtration systems and maintaining fluid levels on equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.02.02.01.c. Perform pre-operation inspections, start-up &amp; shut-down procedures on equipment, machinery and power units as specified in owners’ manuals.</p> <p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.03.01.01.a. Identify and classify components of internal combustion engines used in AFNR power, structural and technical systems.</p> <p>PST.03.01.01.c. Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).</p> <p>PST.03.01.02.a. Distinguish the characteristics of spark and compression internal combustion engines used in AFNR power, structural and technical systems.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</p>

**Supporting Standards**

<p><b>Connecticut Agriculture, Food, and Natural Resources Standards</b></p>	<p>PST.03.01.02.b. Utilize technical manuals and diagnostic tools to determine service and repair needs of spark and compression internal combustion engines used in AFNR power, structural and technical systems.          CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.          CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.          CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).          CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area.          CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
<p><b>Next Generation Science Standards</b></p>	<p>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.</p>
<p><b>Common Core State Standards</b></p>	<p>RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.          RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.          SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.          MP6. Attend to precision.</p>

Learning Objectives	Activities	CT AFNR, NGSS, CCSS
<p>Describe the 2-stroke, 4-stroke and diesel engine cycles.</p>	<ul style="list-style-type: none"> <li>Using printed materials and online animations of engine cycles (eg. those at <a href="http://animatedengines.com">animatedengines.com</a>) to study the operation of a selected engine cycle; fill in a table or graphic organizer of key events that occur throughout the cycle.</li> <li>Develop a dramatization, poem or rap that summarizes the events of a specified engine cycle.</li> <li>Given <a href="#">images depicting different events in an engine cycle</a> and the corresponding descriptions, pair the images with their descriptions, place them in correct order and identify the stroke being depicted and described.</li> </ul>	<p>PST.03.01.01.a.          PST.03.01.02.a.          RST.11-12.4.</p>

	<ul style="list-style-type: none"> <li>Specify a type and size of engine for the design of a piece of agricultural or natural resource equipment, providing rationale for the decision based on general characteristics of the engine.</li> </ul>	
Identify the key components of 4-stroke engines and describe their roles.	<ul style="list-style-type: none"> <li>Disassemble and reassemble a small engine, returning it to operating condition. Maintain a journal of activities and observations.</li> <li>Develop a <a href="#">visual catalog</a> of engine components with pictures, diagrams and descriptions of key components.</li> </ul>	PST.01.02.03.b. PST.02.01.01.a. PST.02.01.02.a. PST.02.02.02.b. PST.03.01.01.a. PST.03.01.02.a RST.11-12.4.
Evaluate the operation of an internal combustion engine and, if necessary, diagnose and correct problems.	<ul style="list-style-type: none"> <li>Mount an engine on an appropriate base, evaluate it for compression, spark and presence of fuel and lubricant. Start the engine and adjust it for smooth operation.</li> </ul>	PST.01.02.03.b. PST.02.01.01.a. PST.02.01.02.a. PST.02.02.01.c. PST.02.02.02.b. PST.03.01.01.c. RST.11-12.3.

<b>Unit 2</b>	Operation and Maintenance of Power Equipment
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>How does one safely and effectively operate power equipment?</li> <li>How does one maintain power equipment for safe and effective operation?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	PST.01.02.03.b. Select, maintain and demonstrate the proper use of tools, machines and equipment used in different AFNR related mechanical systems. PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality.
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	<p>PST.02.01.02.a. Examine operator’s manuals to determine recommendations for servicing filtration systems and maintaining fluid levels on equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.02.02.01.c. Perform pre-operation inspections, start-up &amp; shut-down procedures on equipment, machinery and power units as specified in owners’ manuals.</p> <p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.03.01.01.c. Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).</p> <p>PST.03.01.02.b. Utilize technical manuals and diagnostic tools to determine service and repair needs of spark and compression internal combustion engines used in AFNR power, structural and technical systems.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p>
<b>Next Generation Science Standards</b>	<p>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.</p>
<b>Common Core State Standards</b>	<p>SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>MP6. Attend to precision.</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
Safely operate power equipment in the shop and on the landscape.	<ul style="list-style-type: none"> <li>● Perform a pre-operation safety check on a piece of power equipment; identify and correct any safety concerns.</li> <li>● Develop a safety presentation or brochure (<a href="#">template</a>) that communicates the causes, symptoms and ways to prevent CO exposure when operating internal combustion engines. (<a href="#">Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines &amp; Tools (96-118)   NIOSH   CDC</a>)  <a href="#">Carbon Monoxide Poisoning: Garages (AEN-207) - Department of Agricultural and Biosystems Engineering</a></li> <li>● Study the operator’s manual of a piece of equipment; use information gathered to demonstrate start-up and operation of that piece of equipment.</li> <li>● Participate in guided practice in the use of power equipment in the shop and on the landscape, demonstrating appropriate practices to achieve desired outcomes</li> </ul>	PST.01.02.03.b. PST.02.01.01.a. PST.02.01.02.a. PST.02.02.01.c. PST.02.02.02.b. RST.11-12.3. RST.11-12.4.
Perform routine maintenance and troubleshooting procedures on power equipment.	<ul style="list-style-type: none"> <li>● Using manufacturer’s specifications, perform an oil and filter change on a piece of equipment such as a lawnmower or tractor (<a href="#">Kubota L4060</a>).</li> <li>● Mix gasoline with 2-stroke oil according to specifications and use it to fuel a piece of equipment.</li> <li>● Measure and compare the viscosity of motor oil and other commonly available liquids using a viscosity cup or <a href="#">other viscosity measurement tool</a>.</li> <li>● <a href="#">Measure compression</a> of an internal combustion engine cylinder; comparing the measured value to the manufacturer’s specifications.</li> <li>● Maintain levels of coolant and hydraulic fluid on power equipment such as a tractor.</li> <li>● Use a grease gun to lubricate bearings on power equipment such as a tractor.</li> <li>● Sharpen chainsaw and pole pruner chains.</li> <li>● Winterize power equipment such as lawnmowers</li> </ul>	PST.01.02.03.b. PST.02.01.01.a. PST.02.01.02.a. PST.03.01.01.c. PST.03.01.02.b. RST.11-12.3. RST.11-12.4. .
Identify and select tools used in the repair and	<ul style="list-style-type: none"> <li>● Select appropriate tool types and sizes to disassemble,</li> </ul>	PST.01.02.03.b.



maintenance of internal combustion engines.	assemble or adjust a piece of power equipment such as a small engine or a lawnmower. <ul style="list-style-type: none"> <li>• Demonstrate the use of vane and click-type <a href="#">torque wrenches</a> to tighten a fastener to a specified torque.</li> <li>• Compare the use of a pneumatic or electric impact driver to hand tools for such operations as removing lug nuts.</li> </ul>	RST.11-12.4.
Use precision measuring instruments to make accurate and precise measurements.	<ul style="list-style-type: none"> <li>• Use diagrams or pictures of vernier micrometer dials (<a href="#">like these from Linn-Benton Community College</a>) to practice reading vernier micrometers.</li> <li>• Use a vernier or digital caliper to make repeated measurements of a standard; adjust technique to achieve a repeatable accurate measurement.</li> <li>• Construct simple objects with precise dimensions using wood or metal.</li> <li>• Measure equipment journals and bushings; compare measurements to <a href="#">published data</a> in order to determine wear.</li> <li>• Measure the bore and stroke of an engine to calculate the engine displacement and determine wear.</li> <li>• Use a feeler gauge to measure valve clearance and ring gaps; compare your measurements to published specifications.</li> <li>• Measure and adjust the spark gap of a spark plug using a feeler gauge or gapping tool.</li> </ul>	PST.01.02.03.b. RST.11-12.3. RST.11-12.4. MP6.

<b>Unit 3</b>	Electrical Systems in Power Equipment
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How do electrical systems support and control mechanical systems in power equipment?</li> <li>2. How are power equipment electrical systems diagnosed?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources</b>	PST.03.02.01.c. Analyze and design electrical circuits for AFNR power, structural and technical systems using knowledge of the basic units of electricity. PST.03.02.02.b. Analyze and interpret electrical system symbols and diagrams.
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<b>Standards</b>	PST.03.02.02.c. Conduct testing procedures to evaluate and repair malfunctioning electrical components and systems used in AFNR power, structural and technical systems. PST.03.02.03.a. Classify the uses of electrical sensors and controls in AFNR power, structural and technical systems. PST.03.02.03.b. Distinguish and select materials and tools used in electrical control circuit installation.
<b>Common Core State Standards</b>	

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality. PST.03.02.01.a. Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm’s Law, Power Law, etc.). PST.03.02.01.b. Assess the tools used to measure the basic units of electrical circuits in AFNR power, structural and technical systems, and perform the measurements. CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement. CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area. CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.
<b>Next Generation Science Standards</b>	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.
<b>Common Core State Standards</b>	

<b>Objectives</b>	<b>Activities</b>	<b>CT AFNR, NGSS, CCSS</b>
Use test equipment to diagnose and correct electrical system problems in power equipment.	<ul style="list-style-type: none"> <li>• Read an article on the <a href="#">relationship between electricity and magnetism</a> to better understand how small engines generate their spark.</li> <li>• Use a digital multimeter (<a href="#">rubric</a>) to take voltage and current measurements in order to evaluate the condition of storage batteries in power equipment.</li> </ul>	PST.03.02.01.c. PST.03.02.02.c. PST.03.02.03.b.

	<ul style="list-style-type: none"> <li>• Demonstrate the use of jumper cables, a battery charger or “jump pack” to <a href="#">provide starting voltage</a> for a piece of power equipment.</li> <li>• Use a digital multimeter or continuity tester to locate and replace blown fuses or faulty components such as switches and relays in power equipment.</li> </ul>	
Interpret wiring diagrams of equipment to diagnose and correct electrical system problems.	<ul style="list-style-type: none"> <li>• Draw a simplified schematic diagram of a lawn tractor electrical system, identifying key components and their functions.</li> <li>• Read the wiring diagram of a piece of power equipment such as a lawn tractor and trace control and power voltages in the circuits.</li> <li>• Use a simulation program such as <a href="#">Tinkercad</a> (free) to model the use of switches and relays to control lights or LEDs.</li> </ul>	PST.03.02.01.c. PST.03.02.02.b. PST.03.02.02.c. PST.03.02.03.a. PST.03.02.03.b.

<b>Vocabulary:</b>		
air filter	external combustion engine	pneumatic driver
bore	flywheel	pneumatic governor
bottom dead center	fuse	power stroke
breather	head gasket	reed valve
bamshaft	heat engine	reject size
carbon monoxide	intake Stroke	relay
carburetor	internal combustion engine	solenoid
chassis ground	lead-acid battery	solid-state ignition system
cold cranking amps	magneto	spark gap
compression ignition	mechanical governor	spark ignition engine
compression stroke	muffler	starter motor
crankcase	octane rating	stoichiometric
crankshaft	oil slinger	top dead center
cylinder	piston	torque wrench
displacement	piston ring	viscosity

<b>Assessments:</b>
<ul style="list-style-type: none"> <li>• Written quizzes and tests <ul style="list-style-type: none"> <li><a href="#">Previous Small Engines Exam</a></li> <li><a href="#">Engine Basics and 4-Stroke Quiz</a></li> </ul> </li> <li>• Skill assessments for individual skills</li> <li>• Catalog assessment</li> </ul>

- Disassembly and restoration of engine to operation

### Connections to College/Career Readiness:

#### Resources/Materials:

Text: Agricultural Mechanics: Fundamentals and Applications, Delmar, multiple editions

Text: Small Gas Engines, Goodheart-Willcox

Text: Small Engines, American Technical Publishers

Digital Resource: Online Octane Calculator at <http://www.csgnetwork.com/octaneratecalc.html>

Digital Resource: [Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines & Tools \(96-118\) | NIOSH | CDC](#)

Digital Resource: [Carbon Monoxide Poisoning: Garages \(AEN-207\) - Department of Agricultural and Biosystems Engineering](#)

Digital Resource: <https://www.tinkercad.com> - An excellent free resource for simulating electronics and building 3-D models

Digital Resource: Newsela.com article on [electricity and magnetism](#)

Printed Matter: Briggs and Stratton Repair Manual for Single Cylinder 4-Cycle Engines, multiple editions as appropriate to the engine.

#### Materials:

Small single-cylinder gasoline engines, fuel, engine oil, 2-stroke oil, dry absorbent material such as oi-dry or kitty litter

Standard hand tools, compression tester, valve spring compressor, piston ring compressor, digital caliper, feeler gauge

<b>Course Title</b>	<b>Power and Controls</b>
<b>Agriculture Pathway</b>	Power, Structural and Technical Systems
<b>Length of Course</b>	One Semester
<b>Ledyard High School Vision of the Graduate</b>	Demonstrate an ability to solve problems of varying complexity across a variety of content areas. Demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas
<b>Course Overview</b>	Power and Controls provides students with an understanding of how energy is measured, transformed and used in agricultural power equipment. Emphasis is given to key concepts for the measurement and expression of work and power and the application of these concepts to understanding and working with mechanical and fluid power transmission systems.
<b>Units of Study</b>	1. Energy, Work and Power 2. Mechanical Power Transmission 3. Fluid Power Transmission

<b>Unit 1</b>	Energy, Work and Power
<b>Essential Questions</b>	1. How are energy, work and power related? 2. How are energy, work and power measured and expressed?

### Priority Standards Assessed in Learning

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.01.01.c. Design and implement methods to evaluate the efficiency of renewable and nonrenewable energy sources used in AFNR.</p> <p>PST.01.01.03.a. Summarize methods and compare and contrast units used to benchmark energy use of AFNR structures (e.g., EUIs, BTUs, etc.).</p> <p>PST.03.03.02.b. Utilize speed, torque and power measurements to calculate efficiency in power transmission systems used in AFNR power, structural and technical systems.</p>
<b>Next Generation Science Standards</b>	<p>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).</p>
<b>Common Core State Standards</b>	<p>MP.1. Make sense of problems and persevere in solving them.</p> <p>MP.4. Model with mathematics.</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p>

### Supporting Standards

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality.</p> <p>CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p>
<b>Next Generation Science Standards</b>	<p>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.</p> <p>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.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p> <p>RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem</p>

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Objectives	Activities	CT AFNR, NGSS, CCSS
Describe and analyze mechanical systems using physical concepts of force, work, power and torque.	<ul style="list-style-type: none"> <li>Analyze real and simulated mechanical systems for force, work, power and efficiency.</li> <li>Compete in a <a href="#">human power activity</a> such as lifting a weight on a string by winding the string around a piece of broom handle. Students calculate the rate of work produced by members of their team.</li> <li>Use a <a href="#">torque wrench</a> to adjust nuts and bolts to a specified torque.</li> <li>Compare the effort required to remove lug nuts from a wheel using a standard wrench to that required when using a device such as a breaker bar or “cheater.”</li> <li><a href="#">Construct a prony brake</a> and use it to measure the power output of a motor or engine.</li> <li>Drag a sled across the ground using a spring scale to measure pulling force. Calculate work and power.</li> <li>Use published <a href="#">tables of friction coefficients</a> to calculate friction forces in mechanical systems.</li> </ul>	PST.01.01.01.c. PST.01.01.03.a. PST.03.03.02.b. HS-PS3-2. MP.1. MP.4. RST.11-12.4.
Convert between different measures of energy, work and power.	<ul style="list-style-type: none"> <li>Measure the power input (electric power or fuel consumption) to a power unit. Use a dynamometer to measure power output. Compute the efficiency of the power unit.</li> <li>Use an electric heating element to heat water. Calculate input power to estimate time required to achieve a desired temperature change.</li> <li>Use a portable propane stove to heat water. Determine the fuel consumed by weight difference and calculate an estimate of the energy value of the fuel.</li> <li><a href="#">Construct a rocket stove</a> and use it to heat water. Use published energy values of wood to determine the fuel energy consumed in the process and estimate efficiency.</li> </ul>	PST.01.01.03.a. HS-PS3-2. MP.1. MP.4. RST.11-12.4.
Calculate efficiency of systems that convert energy from one form to another.	<ul style="list-style-type: none"> <li>Measure performance of a real simple machine, such as an incline, and compare the results to the theoretical results with an ideal</li> </ul>	PST.03.03.02.b. MP.1.

	<p>one. Calculate the efficiency of the real device.</p> <ul style="list-style-type: none"> <li>• Construct a simple device to convert one form of energy to another (e.g. a miniature <a href="#">trebuchet</a>). Measure the work in and the work out to <a href="#">calculate efficiency</a>.</li> <li>• <a href="#">Calculate the energy value of a fuel</a>.</li> <li>• Use electric motor faceplate data to <a href="#">calculate the efficiency of a motor</a>.</li> </ul>	MP.4. RST.11-12.4.
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<b>Unit 2</b>	Mechanical Power Transmission
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How are simple machines incorporated into complex machines?</li> <li>2. How is mechanical energy transmitted and transformed?</li> </ol>

**Priority Standards Assessed in Learning**

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.02.01.a. Compare and contrast applications of simple machines in AFNR related mechanical systems.</p> <p>PST.01.02.01.b. Perform mathematical calculations to determine the mechanical advantage of simple machines in AFNR related mechanical systems.</p> <p>PST.03.03.02.a. Compare and contrast operation principles and features of mechanical transmission systems used in AFNR power, structural and technical systems (e.g., belts, chains, gears, bearings, seals, universals, drive shafts, etc.).</p> <p>PST.03.03.02.b. Utilize speed, torque and power measurements to calculate efficiency in power transmission systems used in AFNR power, structural and technical systems.</p>
<b>Next Generation Science Standards</b>	<p>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).</p>
<b>Common Core State Standards</b>	<p>MP.4. Model with mathematics.</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p>



**Supporting Standards**

<p><b>Connecticut Agriculture, Food, and Natural Resources Standards</b></p>	<p>PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power; structural and technical systems to assure proper functionality.            CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.            CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.            CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area.            CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
<p><b>Next Generation Science Standards</b></p>	<p>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-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</p>
<p><b>Common Core State Standards</b></p>	<p>RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem            RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.            MP.1. Make sense of problems and persevere in solving them.</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
<p>Identify and describe the use of simple machines in agricultural equipment.</p>	<ul style="list-style-type: none"> <li>Analyze the operation of practical <a href="#">compound machines</a>. Identify simple machines that are used in the design, determine the transformation they proved and calculate the mechanical advantage provided.</li> <li>Measure performance of a real simple machine, such as an inclined plane, and compare the results to the theoretical results with an ideal one. Calculate the efficiency of the real device.</li> <li>Participate in a lesson and demonstrate the firefighter use of rope</li> </ul>	<p>PST.01.02.01.a.            PST.01.02.01.b.            PST.03.03.02.a.            PST.03.03.02.b.            HS-PS3-2.            MP.4.            RST.11-12.4.</p>

	rescue techniques to provide mechanical advantage	
Describe and calculate mechanical advantage of simple machines.	<ul style="list-style-type: none"> <li>• Construct class 1,2 and 3 levers and use them to accomplish tasks. Use data to confirm <a href="#">accepted formulas for mechanical advantage of levers</a>.</li> <li>• Construct and demonstrate a working display of a simple machine that explains the concept of how that device provides mechanical advantage.</li> </ul>	PST.01.02.01.a. PST.01.02.01.b. MP.1. MP.4. RST.11-12.4.
Calculate the speed and torque transformations from systems of gears or pulleys.	<ul style="list-style-type: none"> <li>• Construct assemblies of <a href="#">gears or pulleys</a> of different sizes and study the transformations that result from different combinations.</li> <li>• Study a piece of equipment that uses a belt and pulley system to change speed and torque (e.g. a drill press or a horizontal band saw). Calculate output speed for different settings and compare to the manufacturer's specifications.</li> <li>• Measure the input and output speeds of a gearbox or transaxle and calculate its gear ratio.</li> <li>• Analyze the drive system on a belt-driven mower deck.</li> <li>• Construct a <a href="#">pedal-powered device</a> that uses mechanical transmission (sprocket and chain, pulley and belt).</li> <li>• Analyze performance of actual pulley systems and quantify losses from friction and slippage.</li> <li>• Use a hand drill as the driver and a large wheel or disc as the driven disk; use the gear ratio to determine the speed of the drill. Compare results to published data for the drill.</li> </ul>	PST.03.03.02.b. MP.1. MP.4. RST.11-12.4.

<b>Unit 3</b>	Fluid Power Transmission
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How can fluids be used to transmit and transform mechanical power?</li> <li>2. What are best practices for using and maintaining fluid power systems?</li> </ol>

**Priority Standards Assessed in Learning**

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.02.03.b. Select, maintain and demonstrate the proper use of tools, machines and equipment used in different AFNR related mechanical systems.</p> <p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.</p> <p>PST.03.03.01.b. Analyze and interpret hydraulic and pneumatic system symbols and diagrams used in AFNR power, structural and technical systems.</p> <p>PST.03.03.01.c. Inspect, analyze and repair hydraulic and pneumatic system components used in AFNR power, structural and technical systems.</p>
<b>Common Core State Standards</b>	<p>MP.4. Model with mathematics.</p> <p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p>

## Supporting Standards

<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality.</p> <p>CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p> <p>CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area.</p> <p>CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
<b>Next Generation Science Standards</b>	<p>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.</p>
<b>Common Core State Standards</b>	<p>MP.1. Make sense of problems and persevere in solving them.</p> <p>RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem</p> <p>RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p>SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
<p>Describe and calculate principles of fluid power systems.</p>	<ul style="list-style-type: none"> <li>Describe and demonstrate the liquid and gas laws that govern the use of hydraulic and pneumatic systems.</li> <li><a href="#">Demonstrate the ability of fluid power systems to multiply force</a> using the outlet air from a vacuum cleaner and a plastic bag bladder to lift a heavy object.</li> <li>Construct <a href="#">soda bottle rockets</a> to demonstrate storage of energy by compressing a gas.</li> <li>Use concepts of conservation of mass and liquid laws to calculate pressures and forces in ideal hydraulic systems.</li> <li>Measure the flow rate and pressure output of a small water</li> </ul>	<p>PST.01.02.03.b.</p> <p>PST.02.02.02.b.</p> <p>PST.03.03.01.c.</p> <p>MP.4.</p> <p>RST.11-12.3.</p> <p>RST.11-12.4.</p>

	<p>pump and graph its performance curve.</p> <ul style="list-style-type: none"> <li>Analyze the hydraulic system used to operate a tractor bucket, calculating the force multiplication obtained by combinations of hydraulic cylinders and levers.</li> <li>Operate and study the function of a sandblasting cabinet</li> </ul>	
Identify and describe the functions of components in fluid power systems.	<ul style="list-style-type: none"> <li>Construct a <a href="#">simple device that uses medical syringes</a> as either pneumatic or hydraulic cylinders. Use the device to perform a task such as lifting or moving a small object. (<a href="#">Scoresheet</a>)</li> <li>Disassemble and analyze the functioning of a <a href="#">bottle jack</a>. Sketch the jack, showing the levers and hydraulic cylinders that contribute to the total mechanical advantage.</li> <li>Assemble <a href="#">hydraulic circuits</a> on a hydraulic trainer or as part of a complete system such as that of a tractor.</li> <li>Design and construct working hydraulic or pneumatic systems and analyze their performance.</li> </ul>	PST.01.02.03.b. PST.02.02.02.b. PST.03.03.01.b. RST.11-12.3. RST.11-12.4
Read and interpret fluid power system schematic diagrams.	<ul style="list-style-type: none"> <li><a href="#">Analyze schematic diagrams</a> of fluid power systems. Identify components and their functions. Determine the overall function of the system.</li> <li>Follow a schematic diagram to assemble a circuit on a hydraulic trainer.</li> </ul>	PST.03.03.01.b. RST.11-12.4.
Maintain fluid power systems.	<ul style="list-style-type: none"> <li>Perform an oil and filter change on a hydraulic system according to manufacturer directions.</li> <li>Perform routine maintenance on an air compressor system.</li> <li>Perform routine maintenance on pneumatic shop tools.</li> <li>Disassemble, <a href="#">repack</a> and reassemble hydraulic cylinders</li> <li>Disassemble controls such as <a href="#">spool valves</a> to analyze their function or repair them.</li> <li><a href="#">Identify and correct trouble conditions</a> in a working hydraulic or pneumatic system.</li> </ul>	PST.01.02.03.b. PST.02.02.02.b. PST.03.03.01.c. RST.11-12.3. RST.11-12.4.

<b>Vocabulary:</b>		
accumulator	fulcrum	pitch
british thermal unit	gear ratio	single acting cylinder
check valve	horsepower	slug
cracking pressure	ideal gas law	spool Valve

double acting cylinder	Idler	static head
dynamic head	kilowatt-hour	turbulent flow
efficiency	laminar flow	torque
float center spool	mechanical advantage	watt
friction coefficient	normal force	
ft-lb	Pascal's Law	

### Assessments:

- Written quizzes and tests
  - [Previous Power and Controls Unit Quiz](#)
- Skill assessments
  - [HydraulicsCircuitBrainteaser](#)
- Project reports
  - [Syringe Robot Project](#) Scoresheet

### Resources/Materials:

Text: Agricultural Mechanics: Fundamentals and Applications, Delmar, multiple editions

Text: Agricultural Power and Machinery, Jacobs and Harrell, McGraw-Hill.

Text: Hydraulics, John Deere Fundamentals of Service Series (LHS Ag-Sci library)

Digital Resource: Energy Skate Park Simulation at <https://phet.colorado.edu/en/simulations/energy-skate-park>

Digital Resource: VEX Robotics Curriculum at <https://curriculum.vexrobotics.com/curriculum.html>

Digital Resource: Newsela.com [Types of Energy](#)

Digital Resource :Newsela.com, [Six Kinds of Simple Machines](#)

#### Materials:

Hydraulic components and lines appropriate to projects

Hydraulic trainer with pump, controls, actuators and gauges; bottle jacks, sandblasting cabinet, air compressor

Standard hand tools, hydraulic oil and filters as needed for maintenance

Source of low pressure air such as a shop vacuum

Medical syringes of various sizes and 3/16 nylon air hose for hydraulic robots

<b>Course Title</b>	<b>Agricultural Mechanics Senior Projects</b>
<b>Agriculture Pathway</b>	Power, Structural and Technical Systems
<b>Length of Course</b>	One Semester
<b>Ledyard High School Vision of the Graduate</b>	Demonstrate an ability to communicate information clearly and effectively through a variety of media, including written, oral, visual, musical, and/or video productions. Demonstrate an ability to solve problems of varying complexity across a variety of content areas. Demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas
<b>Course Overview</b>	The Ag Mechanics Senior Project unit provides students with the opportunity to apply skills from previous units in the maintenance, restoration, or construction of a working device to solve a real-world problem. Students will research, plan, implement and report on their project over the course of the semester.
<b>Units of Study</b>	1. Senior Project

<b>Unit 1</b>	Senior Project
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How are AFNR projects planned, implemented, and evaluated?</li> <li>2. How is AFNR project work presented?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01. Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems</p> <p>PST.02.01.01.a. Maintain the cleanliness and appearance of equipment, machinery and power units used in AFNR power, structural and technical systems to assure proper functionality</p>
<b>Next Generation Science Standards</b>	<p>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</p>
<b>Common Core State Standards</b>	<p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p> <p>WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS3-4),(HS-PS3-5)</p> <p>SL 11-12.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions</p> <p>SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.</p> <p>MP.1. Make sense of problems and persevere in solving them</p> <p>MP.2 Reason abstractly and quantitatively</p>



<b>Supporting Standards</b>	
<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p>
<b>Next Generation Science Standards</b>	<p>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.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p>SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.</p> <p>MP.3 Construct viable arguments and critique the reasoning of others.</p> <p>MP.4. Model with mathematics.</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
Develop a plan for an independent, AFNR-related project.	<ul style="list-style-type: none"> <li>● With assistance from the instructor, identify a suitable topic to meet the established requirements for the senior project</li> <li>● Submit a formal <a href="#">project proposal</a> delineating goals, activities, procedures, and materials</li> <li>● Conduct necessary background research to develop a plan.</li> </ul>	PST.01. HS-ETS1-2. RST.11-12.3. RST.11-12.4. RST.11-12.9 SL 11-12.1. SL 11-12.2. MP.1. MP.2.
Execute a project plan in order to meet established goals. Assess progress and modify plans as needed.	<ul style="list-style-type: none"> <li>● Maintain a <a href="#">journal</a> to record successes and challenges</li> <li>● Discuss issues with advisor, peers and outside resource persons in order to solve problems</li> <li>● Conduct research as needed to identify and solve problems</li> <li>● Make adjustments to the plan as needed.</li> </ul>	PST.01. PST.02.01.01.a. PST.02.02.02.b. HS-ETS1-2. HS-ETS1-3. RST.11-12.3. RST.11-12.4. RST.11-12.9 SL 11-12.1. SL 11-12.2. MP.1. MP.2.
Present a project summary.	<ul style="list-style-type: none"> <li>● Prepare and present a summary of the work goals, accomplishments, challenges, and final outcome.</li> <li>● Prepare an as-built drawing or other appropriate visual documentation of the work accomplished.</li> <li>● Prepare a bill of materials and costing for the work accomplished</li> <li>● Present to the finished work for final assessment.</li> </ul>	RST.11-12.4. SL 11-12.1. SL.11-12.5 HS-ETS1-3. MP.1. MP.2.

**Course Vocabulary:**

Varies - as appropriate to the individual project.

**Assessments:**

[Plans and Journals](#)

[Work evaluations](#)

Completed project

Summary Presentation

**Connections to College/Career Readiness:****Resources/Materials:**

As appropriate to the individual project.

Text: [Agricultural Mechanics: Fundamentals and Applications](#), Cooper.

Text: [Metal Fabrication Technology for Agriculture](#), Jeffus

Text: [Modern Carpentry](#), Wagner

<b>Course Title</b>	<b>Agricultural Structures</b>
<b>Agriculture Pathway</b>	Power, Structural and Technical Systems
<b>Length of Course</b>	One Semester
<b>Ledyard High School Vision of the Graduate</b>	Demonstrate an ability to solve problems of varying complexity across a variety of content areas.
<b>Course Overview</b>	The Agricultural Structures unit introduces students to the concepts and skills used in planning, layout and construction of agricultural structures. Emphasis is placed on wood-framed and concrete structures.
<b>Units of Study</b>	<ol style="list-style-type: none"> <li>1. Land Evaluation and Management</li> <li>2. Site Surveying and Layout</li> <li>3. Framing</li> <li>4. Concrete</li> <li>5. Environmental Control</li> </ol>

<b>Unit 1</b>	Land Evaluation. How does one evaluate land for different possible uses?  2. What are practical ways that one can manage land of varying capability classes for different uses?n and Management
<b>Essential Questions</b>	

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	ESS.03.02.01.b. Use a soil survey to determine the land capability classes for different parcels of land in an area. NRS.01.05.04.b. Analyze a plot of land in order to determine which soil management techniques would be most applicable. NRS.03.03.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources.
<b>Next Generation Science Standards</b>	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.
<b>Common Core State Standards</b>	RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics. WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems. PST.04.03.02.a. Summarize the characteristics needed for an ideal building site. CRP.08.02.02.b. Apply decision-making processes to generate possible solutions to solve workplace and community problems. CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement. CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.). CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area. CS.02.01.01.c. Evaluate geographic data and select necessary data sets to solve problems within AFNR systems.
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	CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.
<b>Next Generation Science Standards</b>	HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
<b>Common Core State Standards</b>	RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem

<b>Learning Objectives</b>	<b>Activities</b>	<b>CT AFNR, NGSS, CCSS</b>
Identify the characteristics of land that impact how it should be used and managed.	<ul style="list-style-type: none"> <li>• Use a soil survey such as the <a href="#">Web Soil Survey</a> to identify soil types at a given tract of land, their different characteristics and suitability for different purposes..</li> <li>• Perform <a href="#">tests</a> of engineering <a href="#">characteristics</a> of land and interpret the results</li> </ul>	PST.02.02.02.b. ESS.03.02.01.b NRS.01.05.04.b NRS.03.03.01.b PST.04.03.02.a HS-ETS1-3 RST.11-12.4 RST.11-12.7 WHST.9-12.9
Evaluate the possible uses of a tract of land and management techniques to address limitations.	<ul style="list-style-type: none"> <li>• Use the <a href="#">RUSLE</a> or similar models to make decisions about use and management of a tract of land.</li> </ul>	ESS.03.02.01.b NRS.01.05.04.b NRS.03.03.01.b HS-ESS3-5 HS-ETS1-3 RST.11-12.4 RST.11-12.7

<b>Unit 2</b>	Site Surveying and Layout
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How does one measure a tract of land for purposes of land-use planning or construction?</li> <li>2. How does one identify and lay out boundaries for the purpose of land-use planning or construction?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>ESS.05.01.01.c. Demonstrate surveying and cartographic skills to make site measurements in order to address concerns and needs within an environmental service systems situation.</p> <p>PST.04.03.02.c. Assess site characteristics, identify adjustments, and demonstrate procedures for preparing a building site.</p>
<b>Next Generation Science Standards</b>	<p>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.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p> <p>MP.2 Reason abstractly and quantitatively.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>ESS.05.01.01.b. Apply surveying and mapping principles to a situation involving environmental service systems and identify and explain the use of equipment for surveying and mapping.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
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<b>Next Generation Science Standards</b>	HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems
<b>Common Core State Standards</b>	SL 11-12.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. MP.4. Model with mathematics.

<b>Objectives</b>	<b>Activities</b>	<b>CT AFNR, NGSS, CCSS</b>
Measure and Estimate distances using a variety of techniques.	<ul style="list-style-type: none"> <li>● Measure distances using a surveyor's chain, nylon tape or measuring wheel (<a href="#">skill assessment</a>).</li> <li>● Estimate distance using pacing or stadia</li> </ul>	ESS.05.01.01.b ESS.05.01.01.c PST.02.02.02.b. HS-ETS1-2 RST.11-12.4 MP.2
Establish level using a variety of techniques	<ul style="list-style-type: none"> <li>● Use a laser or optical level, hand level or water level to level a parcel of land.</li> <li>● Use <a href="#">differential leveling</a> to calculate elevations.</li> </ul>	ESS.05.01.01.b ESS.05.01.01.c PST.02.02.02.b. RST.11-12.3 RST.11-12.4 MP.2
Determine the contours of land.	<ul style="list-style-type: none"> <li>● Use a topographic map to <a href="#">calculate slope</a>.</li> <li>● Use differential leveling to calculate slope.</li> <li>● <a href="#">Draw a topographic profile</a> from a topographic map or field data.</li> <li>● Estimate cut and fill for a site based on a topographic map or profile.</li> </ul>	ESS.05.01.01.b ESS.05.01.01.c PST.02.02.02.b. PST.04.03.02.c HS-ETS1-2 HS-ESS3-4 RST.11-12.3 RST.11-12.4 MP.2
Layout a construction site.	<ul style="list-style-type: none"> <li>● Use the <a href="#">3-4-5 method</a> to lay out the corners of a rectangular area.</li> <li>● Set up <a href="#">batter boards</a> to mark the perimeter of a foundation.</li> <li>● <a href="#">Set up grade stakes</a> for a drain line or waterway.</li> </ul>	ESS.05.01.01.b ESS.05.01.01.c PST.04.03.02.c



		RST.11-12.3 RST.11-12.4 MP.2
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<b>Unit 3</b>	Framing
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How does one construct wood-framed structures?</li> <li>2. How does one ensure that wooden structures can support forces from structural and external loads such as snow and wind.</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.04.02.01.c. Create a project cost estimate, including materials, labor and management for an AFNR structure</p> <p>PST.04.03.03.c. Construct AFNR structures using wood and/or metal materials.</p>
<b>Next Generation Science Standards</b>	<p>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.</p>
<b>Common Core State Standards</b>	<p>RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text</p> <p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.04.01.02.a. Read and interpret the parts and/or views of plans for agricultural structures.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p>
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	CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area. CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.
<b>Next Generation Science Standards</b>	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.
<b>Common Core State Standards</b>	RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (oneon-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively. SL 11-12.4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. MP.2 Reason abstractly and quantitatively. MP.4. Model with mathematics..

<b>Objectives</b>	<b>Activities</b>	<b>CT AFNR, NGSS, CCSS</b>
Construct wooden structures	<ul style="list-style-type: none"> <li>● Construct a wooden shed or similar structure.</li> <li>● Construct stairs (<a href="#">rubric</a>)</li> <li>● Construct <a href="#">rafters</a> for a specific span using the <a href="#">step-off method</a></li> <li>● Construct scale model framing of a shed or similar structure.</li> <li>● Observe the construction of building components in the field, virtually or <a href="#">through video</a>.</li> </ul>	PST.02.02.02.b. PST.04.01.02.a. PST.04.03.03.c. HS-ETS1-2. HS-ETS1-3. RST.11-12.3. RST.11-12.4. SL 11-12.1. SL 11-12.4. RST.11-12.7. MP.2
Evaluate loads and strength of wooden structures.	<ul style="list-style-type: none"> <li>● Use print or online resources (MWPS Structures and Environment Handbook in Ag Library, <a href="#">Agricultural Waste Management Building Design Handbook</a>, etc..) to determine the live and dead loads that a building would experience under varying conditions.</li> <li>● <a href="#">Evaluate structures</a> for their ability to withstand predicted changes in</li> </ul>	HS-ETS1-2. HS-ETS1-3. RST.11-12.4. RST.11-12.7. SL 11-12.4.

	<p><a href="#">wind</a> and <a href="#">snow</a> loads as the result of climate change.</p> <ul style="list-style-type: none"> <li>● Use print or <a href="#">online resources</a> to select rafter or truss designs for a structure.</li> <li>● Build scale model trusses and rafter systems and load-test them.</li> <li>● Observe the construction of building components in the field or virtually.</li> </ul>	<p>MP.2 MP.4</p>
<p>Plan construction and estimate costs for wooden structures.</p>	<ul style="list-style-type: none"> <li>● Develop a bill of materials for a wooden structure.</li> <li>● Compare the cost of building a structure from scratch to that for a comparable kit.</li> </ul>	<p>PST.04.01.02.a. PST.04.02.01.c. HS-ETS1-2.HS-ETS1-3. RST.11-12.4. RST.11-12.7. SL 11-12.4. MP.2 MP.4</p>

<b>Unit 4</b>	Concrete
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How are concrete and masonry units used to repair and build?</li> <li>2. How is concrete formulated, mixed, and cured?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.04.01.02.a. Read and interpret the parts and/or views of plans for agricultural structures.</p> <p>PST.04.02.01.c. Create a project cost estimate, including materials, labor and management for an AFNR structure</p> <p>PST.04.03.06.b. Calculate volume for concrete projects.</p> <p>PST.04.03.06.c. Construct, maintain and/or repair AFNR structures with concrete, brick, stone or masonry.</p>
<b>Next Generation Science Standards</b>	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
<b>Common Core State Standards</b>	<p>RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics</p> <p>MP.2 Reason abstractly and quantitatively.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.02.02.02.b. Apply safety principles and applicable regulations to operate equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.04.03.01.c. Select materials for a project based upon an analysis of the project and the quality of the materials</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CRP.09.03.02.c. Model respectful and purposeful behaviors that contribute to positive morale and culture in the workplace and community (e.g., effectively communicating, recognizing accomplishments of others, etc.).</p> <p>CRP.10.02.02.b. Create goals for personal improvement and continuous growth in a career area.</p> <p>CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
<b>Next Generation Science Standards</b>	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><b>Common Core State Standards</b></p>	<p>RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>MP.1. Make sense of problems and persevere in solving them.</p>
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Objectives	Activities	CT AFNR, NGSS, CCSS
<p>Demonstrate construction using concrete and masonry units.</p>	<ul style="list-style-type: none"> <li>Construct structures such as walls or small buildings using masonry units. If constructing temporary structures, use <a href="#">lime putty</a> or other removable cement, to allow easy disassembly.</li> <li>Make, cure and use masonry units such as concrete blocks or rammed earth bricks.</li> <li>Make hardscape such as pavers, benches and decorative pieces.</li> </ul>	<p>PST.02.02.02.b. PST.04.01.02.a. PST.04.03.01.c. PST.04.03.06.c. HS-ETS1-3. RST.11-12.4. RST.11-12.7. SL 11-12.1.</p>
<p>Formulate, mix and cure concrete.</p>	<ul style="list-style-type: none"> <li>Perform experiments to evaluate the impact of concrete mixes and curing conditions on curing time and final strength.</li> <li>Prepare and evaluate performance of specialty concrete products using different cements and additives such as waterproofers, retardants and special-purpose aggregates.</li> </ul>	<p>PST.02.02.02.b. PST.04.03.01.c. PST.04.03.06.c. HS-ETS1-3. HS-PS1-5. RST.11-12.4. RST.11-12.7. RST.11-12.9. WHST.9-12.7. SL 11-12.1.</p>
<p>Estimate costs associated with building concrete</p>	<ul style="list-style-type: none"> <li>Estimate the <a href="#">volume of concrete</a> or mortar needed for a project.</li> </ul>	<p>PST.04.03.06.b.</p>

structures.	<ul style="list-style-type: none"> <li>• Calculate the amount of aggregate, cement and water needed to produce a given volume of concrete</li> <li>• Compare costs of completing a project using delivered pre-mixed concrete with those for the same project mixing concrete on-site.</li> </ul>	MP.1. MP.2.
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<b>Unit 5</b>	Heating and Cooling
<b>Essential Questions</b>	<ol style="list-style-type: none"> <li>1. How does one determine the heating requirements of a structure?</li> <li>2. How does one reduce the heating or cooling requirements of a structure?</li> </ol>

<b>Priority Standards Assessed in Learning</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.01.03.b. Convert energy utilized in an AFNR structure to an energy utilization index (e.g., convert CCF, KWH, etc. to Btu consumption per square foot, etc.).</p> <p>PST.04.03.07.b. Calculate BTU loss in an AFNR structure.</p> <p>PST.04.03.07.c. Insulate a structure and estimate reduced BTU loss.</p>
<b>Next Generation Science Standards</b>	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.
<b>Common Core State Standards</b>	<p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p> <p>MP.1. Make sense of problems and persevere in solving them.</p>

<b>Supporting Standards</b>
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<b>Connecticut Agriculture, Food, and Natural Resources Standards</b>	<p>PST.01.01.03.a. Summarize methods and compare and contrast units used to benchmark energy use of AFNR structures (e.g., EUIs, BTUs, etc.).</p> <p>PST.04.03.07.a. Differentiate between types of insulation materials used in AFNR structures.</p> <p>CRP.09.02.02.c. Model personal management skills and identify opportunities for continuous improvement.</p> <p>CS.05.02.01.b. Assess personal skills and align them with potential career opportunities in AFNR pathways.</p>
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<b>Next Generation Science Standards</b>	<p>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.</p> <p>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.</p>
<b>Common Core State Standards</b>	<p>WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>SL 11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p>

Objectives	Activities	CT AFNR, NGSS, CCSS
Determine the heating or cooling requirements for a structure.	<ul style="list-style-type: none"> <li>● Use published data to calculate the conduction heat loss or gain through building components such as a roof or windows.</li> <li>● <a href="#">Determine the size of heater required</a> for a conventional <a href="#">greenhouse</a>, incorporating conduction, air-exchange and radiation heat losses.</li> <li>● Calculate <a href="#">heat balances for an AFNR structure</a> such as a livestock facility.</li> </ul>	PST.01.01.03.b PST.04.03.07.b. HS-ETS1-2. RST.11-12.9 MP.1. SL 11-12.1.
Evaluate the impact of insulation and other measures to reduce heating and cooling loads of a building.	<ul style="list-style-type: none"> <li>● <a href="#">Install insulation</a> and employ other techniques to improve heating or cooling performance of a structure.</li> <li>● Perform experiments evaluating the impact of greenhouse curtains or a greenhouse within a greenhouse on temperature change in a cold greenhouse.</li> <li>● Perform a cost-benefit analysis from heat-saving measures such as adding insulation to a roof , reducing air leakage or installing film inside residential windows.</li> <li>● Perform experiments to determine the impact of passive heat storage on temperature changes in a greenhouse.</li> </ul>	PST.01.01.03.b PST.04.03.07.a. PST.04.03.07.b. PST.04.03.07.c. HS-ETS1-2. HS-ETS1-3. RST.11-12.9 WHST.9-12.7 MP.1. SL 11-12.1.
Evaluate the costs associated with different energy sources for heating and cooling a	<ul style="list-style-type: none"> <li>● Employ energy costs and efficiencies to calculate the costs of heating or cooling using different energy sources.</li> </ul>	PST.01.01.03.a PST.01.01.03.b

structure.	<ul style="list-style-type: none"> <li>Construct an alternative heating source such as a solar hot water heater or <a href="#">compost heat collector</a> and determine its effectiveness and efficiency.</li> </ul>	HS-ETS1-2. HS-ETS1-3. HS-PS3-3. RST.11-12.9 WHST.9-12.7 MP.1. SL 11-12.1.
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<b>Course Vocabulary:</b>				
Aggregate	Cord	Height of Instrument	Recurrence Interval	Total Heat
Backsight	Cure	Jack Stud	Rough Sill	Trimmer Stud
Benchmark	Dead Load	Joist	Sheathing	Truss
Birdsmouth	Fascia	King Stud	Soffit	Wet Bulb Temperature
Brea Chain	Flush Cut	Live Load	Sole Plate	
BTU	Fly rafter	Monument	Specific Heat	
Building Unit	Foresight	Mortar	Stadia Lines	
Chord	Gable	Plumb Cut	Stud	
Common Rafter	Gusset Plate	Purlin	Therm	
Contour Interval	Header	R-Value	Thermal Mass	

<b>Assessments:</b>	
Written assessments	
<a href="#">Previous Ag Structures Exam</a>	
<a href="#">Previous Ag Structures Exam (more masonry)</a>	
<a href="#">Wall Frame Quiz</a>	
Practical skill assessments	
<a href="#">Taping Skills Assessment Rubric</a>	
<a href="#">Transit Level Skills Rubric</a>	
Project work and final project assessments	
<a href="#">StairConstructionRubric</a>	



**Resources/Materials:**

Text: Modern Carpentry, Wagner

Text: Design and Control of Concrete Mixtures, The Portland Cement Association (available as a download from UMass Lowell at <https://faculty.uml.edu/ehajduk/Teaching/14.310/documents/PCADesignandControlofConcreteMixtures14thEdition.pdf>) (12/9/2020)

Reference: Structures and Environment Handbook 11th edition, Midwest Plan Service

Digital Resource: Web Soil Survey, USDA NRCS <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> (12/9/2020)

Digital Resource: A Builders Guide to Trusses, ITW Building Components Group, <http://www.cascade-mfg-co.com/media/a-builders-guide-to-trusses.pdf> (12/9/2020)

Digital Resource: Knowledge is Power: Wood Trusses, Cascade Manufacturing, <http://www.cascade-mfg-co.com/products/wood-trusses/knowledge-is-power-wood/> (12/9/2020)

Digital Resource: Working in Concrete, The Portland Cement Association, <https://www.cement.org/cement-concrete-applications/working-with-concrete> (12/9/2020)

Digital Resource: Newsela.com, [3-D-printed homes could provide shelter to world's most vulnerable people](#)

Printable Reference: Roof Truss Span Chart, Cascade Manufacturing, <http://www.cascade-mfg-co.com/files/media/rooftrussspanchart.pdf> (12/9/2020)

Downloadable Reference: MWPS-23 Solar Livestock Housing Handbook, Midwest Plan Service, <https://www-mwps.sws.iastate.edu/sites/default/files/imported/free/solarlivestockhousing.pdf> (12/9/2020)

**Materials and Tools:**

Lumber, plywood, fasteners, gusset plates and hanging clips

Concrete block, sand, mason's lime, Portland cement, builder's sand, coarse aggregate

Survey and Layout tools to include cloth tapes, plumb bobs, framing and speed squares, string, stakes and water, laser or builder's levels, survey rods

Carpentry tools to include saws, hammers, drills and drivers

Masonry tools to include trowels, pointing tools, string blocks, brick sets and brick hammers