CareerClusters®
PATHWAYS TO COLLEGE & CAREER READINESS
Agriculture, Food & Natural Resources

Learning that works for Colorado CTE®

Colorado AFNR Course Scope and Sequence

Course Name	**Greenhouse Production**		**Course Details** **Course = 0.50 Carnegie Unit Credit**	Level 3 course in the Plant Science pathway. This would be the next level course in the Horticulture/Green Industry strand after Principles of Horticulture.	
Course Description	This advanced course offers instruction in greenhouse production. Units of study include plant identification, greenhouse management, integrated pest management, propagation, growing media, growing greenhouse crops, horticulture mechanics, Agribusiness units will cover operating a horticultural business, pricing work, advertising, and sales. Participation in FFA student organization activities and Supervised Agricultural Experience (SAE) projects is an integral course component for leadership development, career exploration and reinforcement of academic concepts.				
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.				
SCED Identification #		Schedule calculation based on 60% of a semester instructional time. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.			
All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**					
Unit Number, Title and Brief Description	Suggested % of Instructional Time	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Unit 1: Careers and Industry	2%	**CS.05.** Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.	**CS.05.02.** Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.	**CS.05.02.01.a.** Examine and categorize careers in Greenhouse Production	
Unit 2: Structures and Equipment • Types of Greenhouse designs • Greenhouse structural materials and applications (Superstructures, glazing, floors & walkways, benches)	12%	**PST.04.** Plan, build and maintain AFNR structures.	**PST.04.02.** Determine structural requirements, specifications and estimate costs for AFNR structures	**PST.04.01.02.c.** Evaluate, plan and design functional and efficient facilities for use in AFNR power, structural and technical systems. **PST.04.02.02.b.** Assess and analyze local building	Land Evaluation CDE

• Environmental Control (Heating, cooling, ventilation) • Water Systems (hose, drip, spray/mist)		**PST.05** Use control, monitoring, geospatial, and other technologies in AFNR power, structural, and technical systems.	**PS.04.03** Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g. materials, selection, site preparation, and/or layout, plumbing, concrete/masonries, etc) **PST.05.01** Apply computer and other technologies (e.g. robotics, CNC, UAS, etc) to solve problems and increase efficiency of AFNR systems. *SCIENCE: SC.HS.3.9 NGSS.HS.ETS1.3* **PST.05.02** Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings **PST.05.03** Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems. *SCIENCE: SC.HS.3.9 SC.HS.3.11 NGSS.HS.ETS1.3*	code requirements for agriculture structures. **PS.04.03.07.a** Differentiate between types of insulation materials used in AFNR structures. **PST.05.01.02.a** Examine and summarize the specific intent of technologies used to solve problems and increase the efficiency of AFNR systems (e.g. robotics, UAS, CNC, etc) **PST.05.02.03.a** Research and summarize the importance of AFNR power, structural and technical control systems using programmable logic controllers (PLC) and/or other computer-based systems. **PST.05.03.02.c** Solve problems and evaluate changes in efficiency and create recommendations for the use of technologies in AFNR systems.	

Unit 3: Containers, Media, Greenhouse Crops ● Types of Greenhouse Crops ● Growing containers (ground beds, bench beds, containers) ● Growing media (components, applications, advantages and disadvantages)	6%	**PS.01**. Develop and implement a crop management plan for a given production goal that accounts for environmental factors. **PS.03.** Propagate, culture and harvest plants and plant products based on current industry standards.	**PS.01.02**. Prepare and manage growing media for use in plant systems. **PS.03.02.** Develop and implement a management plan for plant production. *ELA: RW.HS1.2.2* *RST.9-10.3* WHST.9-10.2 WHST.9-10.4 WHST.9-10.9 **PS.03.04.** Apply principles and practices of sustainable agriculture to plant production *SCIENCE:SC.HS.3.9*	**PS.01.02.01.b** Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth. **PS.01.02.01.c.** Formulate and prepare growing media for specific plants or crops. **PS.03.02.02.a.** List and summarize the reasons for preparing growing media before planting. **PS.03.04.01.c.** Research, prepare and defend plans for a plant systems enterprise that aligns with USDA sustainable practices criteria.	
Unit 4: Nutrients ● Nutritional requirements (growing stage of crops) ● Feeding programs (continuous vs. intermittent) ● Fertilizer, forms, & types ● Application methods (slow release, fertigation, foliar spray)	4%	**PS.01.** Develop and implement a crop management plan for a given production goal that accounts for environmental factors.	**PS.01.03.** Develop and implement a fertilization plan for specific plants or crops. *MATH: MA.HS.N.Q.A*	**PS.01.03.01.c.** Monitor plants for signs of nutrient deficiencies and prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse. **PS.01.03.02.a.** Discuss the influence of pH and cation exchange capacity on the availability of nutrients.	

				PS.01.03.04.a. Identify fertilizer sources of essential plant nutrients; explain fertilizer formulations, including organic and inorganic; and describe different methods of fertilizer application.	
Unit 5: Propagation ● Propagation methods ● Propagation Production processes (equipment, growing management)	12%	**PS.03.** Propagate, culture and harvest plants and plant products based on current industry standards.	**PS.03.02.** Develop and implement a management plan for plant production. ELA: HS1.2.2	**PS.03.02.04.c.** Prepare and implement a plant production schedule based on predicted environmental conditions and desired market target (e.g., having plants ready to market on a specific day such as Mother's Day, organic production, low maintenance landscape plants, etc.). **PS.03.02.05.c.** Prepare plant production schedules utilizing plant growth knowledge to get plants to their optimal growth stage at a given time. **PS.03.02.06.c.** Research, select and defend technology for use in controlled atmosphere production.	
Unit 6: Growth Factors ● Control of growth factors to manage crop timing (temperature, CO2 enrichment, hardening,	15%	**PS.01.** Develop and implement a crop management plan for a given production goal that accounts for environmental factors.	**PS.01.01.** Determine the influence of environmental factors on plant growth. *SCIENCE: SC.HS.2.6*	**PS.01.01.01.c.** Analyze plant responses to varied light color, intensity and duration and recommend modifications to light for desired plant growth.	

photoperiod control, PGRs)				**PS.01.01.02.c.** Design, implement and evaluate a plan to maintain optimal air and temperature conditions for plant growth. **PS.01.01.03.c.** Analyze plant responses to water conditions and recommend modifications to water for desired plant growth.	
Unit 7: Integrated Pest Management • Common pest identification • Pest scouting • Pest control techniques	5%	**PS.03.** Propagate, culture and harvest plants and plant products based on current industry standards.	**PS.03.02.** Develop and implement a management plan for plant production. *ELA: RW.HS1.2.2* **PS.03.03.** Develop and implement a plan for integrated pest management for plant production	**PS.03.02.01.c.** Produce pest- and disease-free propagation material. **PS.03.03.01.c.** Devise solutions for plant pests, diseases and disorders. **.03.03.02.c.** Design and implement a crop scouting program. **PS.03.03.03.c.** Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed. **PS.03.03.04.b.** Examine and apply procedures for the safe handling, use and storage of pesticides including personal protective equipment and reentry interval.	

Unit 8: Aquaponics/Hydroponics ● System requirements ● System designs (NFT, aero, water bed, ebb & flow)	2%	**PS.03.** Propagate, culture and harvest plants and plant products based on current industry standards.	**PS.03.02.** Develop and implement a management plan for plant production.	**PS.03.02.06.c.** Research, select and defend technology for use in controlled atmosphere production. **PS.03.02.07.c.** Research, select and defend the use of a hydroponic or aquaponic plant system.	
Unit 9: Marketing & Business	2%	**ABS.03**. Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles **ABS.05.** Use sales and marketing principles to accomplish AFNR business objectives. .	**ABS.03.01.** Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals. **ABS.05.01.** Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.	**ABS.03.01.01.a**. Compare and contrast components of cash budgets (e.g., anticipated revenue, production costs, overhead costs, profit, etc.) and identify the appropriate components to include in a budget given the nature of the AFNR enterprise. **ABS.03.01.02.a**. Research and summarize factors that impact management of cash budgets in AFNR businesses (e.g., changes in price of inputs/outputs, financial investment performance, capital purchases, human resources, etc.). **ABS. 05.01.02.a**. Research and summarize different forms of market competition found in AFNR businesses (e.g., direct competitors, indirect competitors, replacement competitors, etc).	

			ABS.05.03. Assess marketing principles and develop marketing plans to accomplish AFNR business objectives. *ELA: RW.HS1.2.3* *RW.HS2.2.3* *RW.HS1.3.2* *RW.HS2.3.2* *RW.HS1.1.2* *RW.HS2.1.2*	**ABS.05.01.02.b.** Compare and contrast different forms of market competition and how they can be applied to different AFNR businesses. **ABS.05.03.01.a.** Identify and explain marketing principles used in AFNR businesses (e.g., 4 P's-product, place, price, promotion; attention, interest, desire, action, etc.). **ABS.05.03.02.a**. Research and categorize different strategies used in marketing programs for AFNR businesses (e.g., Internet, direct to customer, social media, etc.). **ABS.05.03.03.b**. Perform a market analysis to gather information for marketing plans for AFNR businesses (e.g., evaluation of competitors, customers, domestic and international policy, regulations and rules, standards, etc.).	

Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

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CO CTE Academic Standards Resources (Rubrics, integration strategies, etc)
CDE Colorado Academic Standards Online (Online standards lookup tool)

Standard 1: Oral Expression and Listening

Prepared Graduate 1: *Collaborate effectively as group members or leaders who listen actively and respectfully; pose thoughtful questions, acknowledge the ideas of others; and contribute ideas to further the group's attainment of an objective.*

Students collaborate to design and manage greenhouse production systems, evaluate environmental controls, implement integrated pest management strategies, propagate plants, and solve greenhouse production challenges through laboratory activities, greenhouse operations, and project-based learning.

Standard 2: Reading for All Purposes

Prepared Graduate 4: *Read a wide range of informational texts to build knowledge and to better understand the human experience.*

Students analyze greenhouse production manuals, plant identification resources, integrated pest management recommendations, growing media specifications, greenhouse environmental control guidelines, horticultural business resources, and industry publications to understand commercial greenhouse production systems.

Prepared Graduate 5: *Understand how language functions in different contexts, command a variety of word-learning strategies to assist comprehension, and make effective choices for meaning or style when writing and speaking.*

Students develop and apply specialized vocabulary related to greenhouse structures, environmental controls, propagation, growing media, irrigation systems, integrated pest management, greenhouse crop production, horticultural mechanics, and agribusiness to communicate effectively in greenhouse production settings.

Standard 3: Writing and Composition

Prepared Graduate 6: *Craft arguments using techniques specific to the genre.*

Students evaluate greenhouse management practices, crop production methods, environmental control strategies, pest management programs, and business decisions, defending recommendations using scientific evidence, production records, and greenhouse data.

Prepared Graduate 7: *Craft informational/explanatory texts using techniques specific to the genre.*

Students develop greenhouse production plans, crop schedules, integrated pest management plans, greenhouse management procedures, business plans, and technical reports explaining greenhouse production practices using scientific evidence.

Standard 4: Research Inquiry and Design

Prepared Graduate 10: *Gather information from a variety of sources; analyze and evaluate its quality and relevance; and use it ethically to answer complex questions.*

Students research greenhouse technologies, plant propagation methods, environmental control systems, integrated pest management strategies, greenhouse crop production techniques, and horticultural business practices to develop evidence-based solutions that improve greenhouse efficiency, plant health, and profitability.

***Note**: Mathematics and Science standards will be added in the future. Visit the Colorado Academic Standards page for the most current version.*