BOTANY/ HORTICULTURAL SCIENCE II

#01054

Description

These courses prepare students to produce greenhouse/nursery plants and to maintain plant growth and propagation structures. Topics include soils, plants, plant identification, and plant entomology. Courses examine the importance of plant cell structures, functions of cells, plant processes, nonvascular plants, vascular plants, roots, stems, leaves, flowers, and reproduction of plants. Students may be introduced to the biological, environmental, conservation, and ecological concepts encountered in our environment. Landscape design units will prepare students to design, construct, and maintain planted areas and devices for beautifying home grounds and other human habitation and recreation areas. These courses will reinforce and extend students' understanding of science by associating basic scientific principles and concepts with relevant applications in agriculture. Leadership development and supervised agricultural experience programs are also integral to this course.

Note: These courses can be taught for Agricultural Education credit only. For Science credit, Botany/Horticultural Science II can be found under Science.

½ to 1 credit
Max credit=1
Grades 9-12

Standard 1	***AGRICULTURE, FOOD, & NATURAL RESOURCES (AFNR) FOUNDATIONAL PATHWAY SKILLS***	
Topic 1.1	**Research, examine, and discuss issues and trends that impact AFNR systems on local, state, national, and global levels.**	
	Student Competencies	
	1.1.5	Interpret AFNR issues and their impacts to audiences with limited AFNR knowledge.
	1.1.6	Determine the opportunities emerging trends create within the AFNR systems.
Topic 1.2	**Examine technologies and analyze their impact on AFNR systems.**	
	Student Competencies	
	1.2.5	Develop solutions in AFNR workplaces or scenarios using technology.
	1.2.6	Evaluate the importance of technology use and how it impacts AFNR systems.
Topic 1.3	**Identify public policies and examine their impact on AFNR systems.**	
	Student Competencies	
	1.3.5	Defend or challenge an AFNR public policy.
	1.3.6	Create a plan for implementing a new public policy that will positively impact AFNR systems.
Topic 1.4	**Research and use geographic and economic data to solve problems in AFNR systems.**	
	Student Competencies	
	1.4.3	Interpret AFNR related geographic data using a variety of systems and technologies (e.g., GIS, GPS, etc.).
	1.4.4	Evaluate a set of economic data and explain how it impacts an AFNR system.
Topic 1.5	**Examine the impact of AFNR on the local, state, national, and global society and economy.**	
	Student Competencies	
	1.5.7	Develop a strategy for explaining the breadth of AFNR systems to audiences with limited AFNR knowledge.
	1.5.8	Evaluate how cultural traditions, customs or policies have resulted from practices with AFNR systems.
	1.5.9	Evaluate how positive or negative changes in the local, state, national or global economy impacts AFNR systems.
Topic 1.6	**Identify and explain the implications of required regulations to maintain and improve safety, health, and environmental management systems.**	
	Student Competencies	
	1.6.5	Evaluate how AFNR organizations and businesses promote improved health, safety, and environmental management.
Topic 1.7	**Develop and implement a plan to maintain and improve health, safety, and environmental compliance and performance.**	

Student Competencies		
	1.7.5	Create and implement a plan to improve safety, health, and environmental management regulations in an AFNR workplace.
	1.7.6	Develop a strategy to educate employees on environmental compliance and performance in an AFNR workplace.
Topic 1.8	**Apply health and safety practices to AFNR workplaces.**	
Student Competencies		
	1.8.6	Select appropriate responses for different levels of contamination or injury at an AFNR workplace.
	1.8.7	Create a plan to communicate appropriate responses for health and safety situations within an AFNR workplace.
	1.8.8	Evaluate AFNR workplaces to identify structure of health and safety practices and number of employees certified in first aid training.
	1.8.9	Create a plan to mitigate the level of contamination or injury identified as a risk in the workplace.
Topic 1.9	**Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.**	
Student Competencies		
	1.9.4	Demonstrate adherence to protective equipment requirements when using various AFNR tools and equipment.
	1.9.5	Demonstrate the set up and adjustment for tools and equipment related to AFNR tasks.
	1.9.6	Demonstrate appropriate operation, storage, and maintenance techniques for AFNR tools and equipment.
	1.9.7	Design plans to ensure the use of appropriate protective equipment when using various AFNR tools and equipment.
	1.9.8	Choose appropriate tools and equipment to complete AFNR tasks.
	1.9.9	Design operation, storage, and maintenance plans or schedules for AFNR tools and equipment.
Topic 1.10	**Identify and implement practices to steward natural resources in different AFNR systems.**	
Student Competencies		
	1.10.5	Create strategies for stewarding natural resources at home and within community.
	1.10.6	Recommend sustainability policies and plans for potential improvements for AFNR businesses or organizations.
Topic 1.11	**Assess and explain the natural resource related trends, technologies, and policies that impact AFNR systems.**	
Student Competencies		
	1.11.4	Compare natural resources policies impacting current AFNR systems (e.g., for water resources, land use, air quality, etc.).
	1.11.5	Predict emerging natural resource trends and technologies within AFNR systems.
	1.11.6	Propose strategies for implementing a new natural resources policy to positively impact AFNR systems.
Topic 1.12	**Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).**	
Student Competencies		
	1.12.7	Assess personal AFNR career goal progress.
	1.12.8	Design a personal plan for attaining the required education, training, and experiences for a career in an AFNR pathway.
	1.12.9	Justify personal goals, experiences, education, and skills to pursue a career in an AFNR pathway.

Topic 1.13	**Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.**	
	Student Competencies	
	1.13.3	Evaluate the results of a personal career assessment related to potential careers in AFNR pathways.
Topic 1.14	**Examine and explain foundational cycles and systems of AFNR.**	
	Student Competencies	
	1.14.3	Analyze how life cycles affect production, processing, and management of food, feed, fiber, and fuel.
	1.14.4	Analyze the impact of producing and processing food, feed, fiber, and fuel within AFNR systems.
	1.14.6	Predict how AFNR systems may change or adapt in the future of food, feed, fiber, and fuel production based on current trends and data.

Standard 2	*AGRIBUSINESS SYSTEMS*	
Topic 2.1	**Apply economic principles to plan and manage inputs and outputs in an AFNR business.**	
	Student Competencies	
	2.1.4	Apply microeconomic principles to calculate values associated with different inputs and outputs in AFNR businesses (e.g., price, point of equilibrium, opportunity costs, marginal costs, etc.).
	2.1.5	Analyze the relationship between AFNR business and industry outputs and domestic and global macroeconomic trends (e.g., Gross Domestic Product, national income, rate of growth, price levels, etc.).
Topic 2.5	**Apply fundamental accounting principles, systems, tools, and applicable laws and regulations to record, track, and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).**	
	Student Competencies	
	2.5.3	Evaluate the implementation and appropriateness of accounting systems and procedures used for record keeping in AFNR businesses.
	2.5.4	Compare and contrast the benefits and limitations of different tools and services for recording, tracking, and auditing AFNR business transactions (e.g., convenience, costs, data security, etc.).
	2.5.6	Recommend tools and services to track, record, and audit AFNR business transactions that meet business needs and priorities (e.g., electronic and paper-based systems, etc.).
Topic 2.9	**Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.**	
	Student Competencies	
	2.9.5	Analyze business plans for different types of ownership structures used in AFNR businesses (e.g., sole proprietorships, cooperatives, partnerships, Limited Liability Companies, and corporations).
	2.9.6	Prepare a business plan for an AFNR business.
	2.9.7	Demonstrate the application of entrepreneurial skills to conceptualize an AFNR business (e.g., idea generation, opportunity analysis, risk assessment, etc.).
Topic 2.10	**Develop production and operational plans for an AFNR business.**	
	Student Competencies	
	2.10.3	Compare and contrast the strengths and weaknesses of operational plans from different AFNR businesses to determine best practices.
	2.10.4	Assess alternative production systems for a specific agricultural product.
	2.10.5	Make recommendations to improve operational plans for an AFNR business based on best practices.
Topic 2.11	**Identify and apply strategies to manage or mitigate risk.**	
	Student Competencies	
	2.11.1	Describe sources of risk for an AFNR business (e.g., financial risk, public perception of company, etc.).

Topic 2.12	**Determine the role of markets, trade, competition, and price in relation to an AFNR business sales and marketing plans.**	
	Student Competencies	
	2.12.3	Analyze the role of trade and price in the market structure as it relates to AFNR businesses.
	2.12.4	Compare and contrast different forms of market competition and how they can be applied to different AFNR businesses.
Topic 2.13	**Assess and apply sales principles and skills to accomplish AFNR business objectives.**	
	Student Competencies	
	2.13.3	Apply the sales process to accomplish the goals and objectives of an AFNR business.
	2.13.4	Prepare an appropriate response to customer reactions that could be encountered during different types of sales calls used in AFNR businesses (e.g., objections, competitor prices, competing products, post-sale service, complaints about product, etc.).
Topic 2.14	**Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.**	
	Student Competencies	
	2.14.4	Assess appropriate alternative marketing strategies (e.g. value-adding, branding, niche marketing, etc.) for AFNR businesses using established marketing principles.
	2.14.5	Compare and contrast the strategies of marketing for products and services used in AFNR businesses (e.g., direct marketing, commodities, etc.).
	2.14.6	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.).

Standard 4		***BIOTECHNOLOGY SYSTEMS***
Topic 4.1	**Investigate and explain the relationships in the timeline of developing biotechnology applications and techniques in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).**	
	Student Competencies	
	4.1.5	Compare and contrast the benefits and risks associated with using biotechnology to improve agriculture.
	4.1.6	Assess personal skill sets compared to the skills needed for entry level careers in biotechnology.
	4.1.7	Design a potential application of biotechnology to meet emerging agricultural and societal needs.
	4.1.8	Evaluate the short-term and long-term benefits and risks of applying biotechnology to agriculture.
	4.1.9	Create an individualized student experience that applies basic lab skills to lead to one of the identified jobs and careers.
Topic 4.2	**Evaluate the roles, scope, and implications of regulatory agencies on applications of biotechnology in agriculture and the protection of public interests (e.g., health, safety, environmental issues, etc.).**	
	Student Competencies	
	4.2.4	Compare and contrast biotechnology regulatory systems (e.g., local, state, national, international).
	4.2.5	Analyze the impact regulatory issues have on both the agricultural industry and on public acceptance of biotechnology in agriculture.
	4.2.6	Examine factors and data that regulatory agencies use to evaluate the potential risks a new application of biotechnology may pose to health, safety, and the environment.
	4.2.7	Evaluate how countries with different biotechnology regulatory systems impact trade and innovation.
	4.2.8	Propose a plan to address a regulatory issue pertaining to biotechnology in agriculture.
Topic 4.3	**Analyze the relationship and implications of bioethics, laws, and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).**	
	Student Competencies	
	4.3.4	Analyze the implications bioethics may have on future advancements in biotechnology and associated science fields.
	4.3.5	Determine the significance and impacts of legal issues related to biotechnology in agriculture.
	4.3.6	Analyze the impact of public perceptions on the application of biotechnology in different AFNR systems.
	4.3.7	Devise an argument for or against an ethical issue associated with biotechnology in agriculture.
Topic 4.4	**Read, document, evaluate, and secure accurate laboratory records of experimental protocols, observations, and results.**	
	Student Competencies	
	4.4.4	Maintain laboratory records documented in a laboratory to ensure data accuracy and integrity (e.g., avoid bias, record any conflicts of interest, avoid misinterpreted results, etc.).
	4.4.5	Determine when security procedures for data and information collected in a laboratory should be implemented.
Topic 4.5	**Identify and apply standard laboratory procedures and equipment maintenance to create and maintain reliable data.**	
	Student Competencies	

	4.5.4	Perform ongoing maintenance of laboratory equipment according to the standard operating procedures (e.g., calibration, testing, etc.).
	4.5.5	Operate laboratory equipment and measurement devices to get accurate and repeatable results.
	4.5.6	Perform sterilization techniques for equipment in a laboratory using standard operating procedures.
	4.5.7	Develop a maintenance program for laboratory equipment based upon the standard operating procedures.
	4.5.8	Develop a proposal for new laboratory equipment or measurement devices.
	4.5.9	Create a plan for sterilizing equipment in a laboratory according to standard operating procedures.
Topic 4.6	**Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.**	
	Student Competencies	
	4.6.1	Classify different types of personal protective equipment and demonstrate how to properly utilize the equipment.
	4.6.2	Describe aseptic techniques in the laboratory (e.g., sterile work area, sterile handling, personal hygiene, etc.).
	4.6.3	Categorize the types of solutions that are commonly prepared in a laboratory (e.g., buffers, reagents, media, etc.).
	4.6.4	Assess the need for personal protective equipment in a variety of situations and select the appropriate equipment to wear when working with biological and chemical materials.
	4.6.5	Demonstrate aseptic techniques in the laboratory.
	4.6.6	Formulate solutions using standard operating procedures (e.g. proper labeling, dilution, etc.).
	4.6.7	Evaluate the benefits and limitations of personal protective equipment.
	4.6.8	Create a standard operating procedure for working with biological materials based upon their classification.
	4.6.9	Create a plan for the storage of solutions (e.g., temperature, volatility, neighboring solutions, light sensitivity, etc.).
Topic 4.8	**Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.**	
	Student Competencies	
	4.8.5	Apply appropriate aseptic techniques for isolating different organisms.
Topic 4.9	**Apply biotechnology principles, techniques, and processes to modify a species.**	
	Student Competencies	
	4.9.1	Describe the techniques used to produce transgenic organisms (e.g., microbial synthetic biology, gene knockout therapy, traditional gene insertion, etc.).
	4.9.3	Analyze the processes and techniques used to produce transgenic eukaryotes (e.g., microbial synthetic biology, gene knockout therapy, traditional gene insertion, etc.).
	4.9.4	Transform plant or animal cells by performing a cellular transformation.
	4.9.5	Design experiments to evaluate an existing transgenic organism.

Standard 8	*NATURAL RESOURCES SYSTEMS*	
Topic 8.1	**Examine natural resource availability and ecosystem function in a particular region.**	
	Student Competencies	
	8.1.1	Describe the process for classifying the different kinds of natural resources using common classification schemes (e.g., abiotic/biotic, renewable versus nonrenewable, native versus introduced, etc.).
	8.1.5	Analyze the interdependence of organisms within an ecosystem (e.g., food webs, niches, impact of keystone species, etc.).
	8.1.6	Analyze how species evolve, are naturally selected, and adapt.
Topic 8.2	**Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.**	
	Student Competencies	
	8.2.1	Define the characteristics used to identify trees and woody plants.
	8.2.2	Define the characteristics used to identify herbaceous plants.
	8.2.7	Apply identification techniques to determine the species of a tree or woody plant.
	8.2.8	Apply identification techniques to determine the species of an herbaceous plant.

Standard 9	***PLANT SYSTEMS***	
Topic 9.1	**Determine the influence of environmental factors on plant growth.**	
	Student Competencies	
	9.1.7	Recommend modifications to light for desired plant growth.
	9.1.8	Evaluate a plan to maintain optimal environmental conditions for plant growth (e.g., day length, light, humidity, moisture, temperature, etc.).
	9.1.9	Recommend modifications to water for desired plant growth.
Topic 9.2	**Prepare and adjust growing media for use in plant systems.**	
	Student Competencies	
	9.2.5	Recommend a plan for managing crop growth in different growing media.
	9.2.6	Determine the electroconductivity and pH for soil and how the results influence practices (e.g., irrigation, etc.).
Topic 9.4	**Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.**	
	Student Competencies	
	9.4.11	Prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse.
	9.4.12	Recommend a plan of action to adjust the electric conductivity (EC, soluble salts) and pH of growing media given soil tests for specific plants or crops.
	9.4.13	Prescribe fertilizer applications based on the results of a laboratory analysis of soil and plant tissue samples.
	9.4.14	Recommend a fertilizer application method (e.g., liquid, dry, variable rate, manure, etc.).
	9.4.15	Devise a plan for sustainable soil management for a selected cropping system.
Topic 9.5	**Classify plants according to taxonomic systems.**	
	Student Competencies	
	9.5.1	Identify plants based on visual characteristics (e.g., seedling stages, fully grown, etc.).
	9.5.2	Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants (e.g., life cycles, growth habit, plant use and as monocotyledons, or dicotyledons, woody, herbaceous, etc.) by common and scientific names.
Topic 9.6	**Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.**	
	Student Competencies	
	9.6.7	Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems.
	9.6.8	Analyze root tissues and explain the pathway of water and nutrients into and through root tissues.
	9.6.9	Contrast the difference in arrangement of vascular tissue between monocot and dicot plant stems.
	9.6.10	Analyze how leaves capture light energy and exchange gasses.
	9.6.11	Differentiate between the types of flowers and flower inflorescence (e.g., complete, incomplete, perfect, imperfect).
	9.6.12	Categorize the major types of seeds and fruits.
	9.6.17	Evaluate the impact of plant and flower structure on plant breeding, production, and use.
	9.6.18	Evaluate the impact of different seed and fruit structures to plant culture and use.

Topic 9.7	**Apply knowledge of plant physiology and energy conversion to plant systems.**	
	Student Competencies	
	9.7.11	Evaluate the factors that affect photosynthesis and the impact those factors have on plant management and production problems.
	9.7.12	Evaluate the impact of plant respiration on plant growth, crop management, and post-harvest handling decisions.
	9.7.13	Relate the principles of primary and secondary growth to plant systems.
	9.7.14	Recommend the use of specific plant growth regulators to produce desired responses from plants (e.g., adding PGRs to a spray solution, etc.).
	9.7.15	Recommend plant management strategies that apply knowledge of transpiration, translocation, and assimilation on plant growth.
Topic 9.8	**Demonstrate plant propagation techniques in plant system activities.**	
	Student Competencies	
	9.8.6	Apply the process of plant pollination and/or fertilization.
	9.8.7	Examine factors that affect seed viability, vigor, and germination rates.
	9.8.8	Demonstrate plant propagation techniques (e.g., cuttings, division, separation, layering, budding and grafting, etc.).
	9.8.9	Examine aseptic micropropagation techniques.
	9.8.10	Compare and contrast the potential risks and advantages associated with genetically modified agricultural and ornamental plants.
	9.8.11	Justify the use of pollination methods and practices used to maximize crop pollination (e.g., honey bee, leaf cutter bee, wind, ratio of males to females planted, etc.).
	9.8.12	Conduct tests associated with seed germination rates, viability, and vigor.
	9.8.13	Evaluate asexual propagation practices comparing productivity, efficiency, and cost.
	9.8.14	Recommend micropropagation techniques in a given scenario.
	9.8.15	Evaluate the impact of using genetically modified agricultural and ornamental crops on other production practices.
Topic 9.9	**Develop and implement a management plan for plant production.**	
	Student Competencies	
	9.9.15	Demonstrate ways to produce pest- and disease-free propagation material.
	9.9.16	Assess how mechanical planting equipment performs soil preparation and seed placement.
	9.9.17	Recommend the calibration for mechanized seeding and/or planting equipment for a desired seed application rate.
	9.9.18	Prepare 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.).
	9.9.19	Prepare plant production schedules utilizing plant growth knowledge to get plants to their optimal growth stage at a given time.
	9.9.20	Recommend technology for use in controlled atmosphere production.
	9.9.21	Recommend the use of a hydroponic or aquaponic plant system.
Topic 9.10	**Develop and implement a plan for integrated pest management for plant production.**	

Student Competencies		
	9.10.7	Calculate pesticide formulations including organic and synthetic active ingredients and selection of pesticides to control specific pests.
	9.10.8	Apply procedures for the safe handling, use, and storage of pesticides including personal protective equipment and Restricted Entry Interval.
	9.10.9	Devise solutions for plant pests, diseases, and disorders.
	9.10.10	Design a crop scouting program.
	9.10.11	Employ pest management strategies to manage pest populations, assess the effectiveness of the plan, and adjust the plan as needed.
	9.10.12	Evaluate environmental and consumer concerns regarding pest management strategies.
Topic 9.11	**Apply principles and practices of sustainable agriculture to plant production.**	
Student Competencies		
	9.11.4	Analyze the alignment of modern technologies used in production systems (e.g., precision agriculture, GE crops, etc.) with USDA sustainable practices criteria.
	9.11.5	Examine the environmental impacts (e.g., carbon footprint, greenhouse gas, sustainability, food security, etc.) of the national/international production system on local/regional production system markets.
	9.11.6	Examine differing research conclusions related to environmental factors and their effect on plant production.
Topic 9.12	**Harvest crops according to industry standards.**	
Student Competencies		
	9.12.2	Explain the reasons for calculating crop loss and or damage.
	9.12.3	Assess the stage of growth to determine crop maturity or marketability.
	9.12.5	Demonstrate mechanical harvesting practices used to process plant crops.
Topic 9.13	**Haul and store crops according to industry standards.**	
Student Competencies		
	9.13.2	Identify plant preparation methods for storing and shipping plants and plant products.
	9.13.3	Describe the techniques used to prepare plants and plant products for distribution.
	9.13.5	Analyze the proper conditions required to maintain the quality of plants and plant products held in storage and during shipping.
	9.13.6	Demonstrate techniques for grading, handling, and packaging plants and plant products for distribution.
	9.13.8	Evaluate environmental conditions in storage facilities for plants and plant products.
	9.13.9	Evaluate techniques for grading, handling, and packaging plants and plant products.
Topic 9.14	**Evaluate, identify, and prepare plants to enhance an environment.**	
Student Competencies		
	9.14.3	Create a design plan by selecting plants based on design elements and environmental conditions.
Topic 9.15	**Create designs using plants.**	
Student Competencies		

	9.15.7	Propose suggestions for improvement of a design (e.g., a floral arrangement, a landscape or a landscape plan, turfgrass management, etc.).
	9.15.8	Recommend appropriate tools to create a desired design.
	9.15.9	Utilize green technologies and sustainable practices that prevent or limit negative environmental impacts.