School District of Marshfield Course Syllabus

Course Name: ES Plant & Soil Science
Grade(s): 10-12
Length of Course: Semester
Credit: 1/2 Credit

Program Goal:

The School District of Marshfield Agriculture Education Program will provide learners the opportunity to explore and develop interests in various areas of agriculture while preparing young adults for their next steps in life. Whether it is pursuing a postsecondary education or entering the world of work, Marshfield's agriculture program offers diverse experiences for all students in agriculture, horticulture and natural resources. Marshfield's agriculture program will provide valuable learning experiences for all learners whether they want to learn more about the importance of agriculture on society, have a hobby related to agriculture or are preparing for an agriculture related career.

Course Description:

ES Plant and Soil Science is an equivalent science course that provides an in-depth look at soil origin and development, physical properties, and soil conservation. By taking cuttings of houseplants and growing vegetables with state-of-the-art hydroponics equipment, students will

explore plant structure, growth, physiology, reproduction and management. Learners will use the greenhouse to grow Poinsettias for the holidays and have the opportunity to participate in the county soils evaluation contest.

Wisconsin Standards for Agriculture, Food and Natural Resources (AFNR)	
Biotechnology Systems (BT)	
BT1: Students will recognize the historical, cultural and potential applications of biotechnology.	
Distinguish major innovators, historical developments and potential applications of biotechnology in agriculture. BT1.a	l.a.6.h: Research and report on current work being done in agricultural biotechnology. l.a.7.h: Research and report on emerging problems and issues associated with agricultural biotechnology.
Analyze the ethical, legal, social and cultural issues relating to biotechnology. BT1.b	l.b.8.h: Evaluate the benefits and risks associated with biotechnology.
Environmental Service Systems (ESS)	
ESS2: Students will apply scientific principles to environmental service systems.	
Apply soil science and microbiology principles to environmental service systems. ESS2.b	2.b.13.h: Differentiate rocks relating chemical composition of mineral matter in soils to the parent material with a connection to environmental service systems. 2.b.14.h: Relate and evaluate soil microorganism activities to environmental service systems. 2.b.15.h: Identify physical soil qualities, through testing, that determine its use for environmental service systems. 2.b.16.h: Determine land capability classes for land parcels and design a land-use management plan for a given area.
Apply hydrology principles to environmental service systems. ESS2.c	2.c.13.h: Describe and research water characteristics that influence the biosphere for life and be able to identify current environmental water issues. 2.c.14.h: Describe ground and surface water interactions with emphasis on groundwater-flow equations and Darcy's Law to explain how geology and meteorology affect groundwater and its flow. 2.c.15.h: Identify differences in groundwater potential delineate groundwater potential zones. 2.c.16.h: Describe precautions taken t to prevent/reduce groundwater contamination while testing and documenting results of related tests. 2.c.17.h: Explain, measure and document velocity of water as it influences channel morphology and stream processes.
Natural Resources (NR)	

NR1: Students will explain interrelationships between natural resources and humans necessary to conduct management activities in natural environments.	
Classify natural resources NR1.b	1.b.11.h: Compare and contrast trees and other woody plants. 1.b.12.h: Compare and contrast herbaceous plants. 1.b.15.h: Identify rock, mineral and soil types.
NR2: Students will apply scientific principles to natural resource management activities.	
Use cartographic skills to aid in developing, implementing and evaluating natural resource management plans, measure and survey for natural resource status in developing related plans with interpretation of laws related to natural resource management and protection. NR2.a	2.a.9.h: Locate natural resources using a land survey and employ a Global Positioning System and/or Geographic Information Systems technologies to inventory features in natural resource management.
Apply ecological concepts and principles to natural resource systems. NR2.d	2.d.18.h: Identify techniques used in the creation, enhancement and management of riparian zones and riparian buffers. 2.d.21.h: Discuss factors that influence the establishment and spread of invasive species.
NR4: Students will demonstrate techniques used to protect natural resources.	
Diagnose plant and wildlife diseases and follow protocol to prevent their spread while acquiring management protocol of insect infestations of natural resources. NR4.b	4.b.8.h: Report observance of insect pests to the appropriate authorities and describe techniques used to manage pests of natural resources.
Plant Systems (PS)	
PS1: Students will apply knowledge of plant classification, anatomy and physiology to the production and management of plants.	
Classify agricultural plants according to taxonomy systems. PS1.a	1.a.7.h: Classify agricultural plants according to the hierarchical classification system, life cycles, plant use and as monocotyledons or dicotyledons. 1.a.8.h: Describe the morphological characteristics used to identify agricultural plants. l.a.9.h: Identify agriculturally important plants by scientific names.
Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems. PS1.b	1.b.9.h: Compare and contrast mitosis and meiosis and apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems. l.b.10.h: Identify root tissues and explain the pathway of water and nutrients into and through the root tissues. l.b.11.h: Relate the active and passive transport of minerals into and through the vascular system to plant nutrition. l.b.12.h: Describe and apply the processes of translocation to the management of plants.

	l.b.13.h: Explain how leaves capture light energy and allow for the exchange of gases. 1.b.14.h: Identify the different types of flowers and flower forms and apply the knowledge of flower structures to plant breeding, production and use. l.b.15.h: Apply the knowledge of seed and fruit structures to plant culture and use.
Apply energy conversion to plant systems. PS1.c	l.c.5.h: Explain the light- dependent and light-independent reactions that occur during photosynthesis and apply the knowledge to plant management. l.c.6.h: Explain cellular respiration and its importance to plant life. l.c.7.h: Explain factors that affect cellular respiration and identify the products and byproducts of cellular respiration.
Apply knowledge of plant physiology to plant systems. PS1.d	l.d.5.h: Define primary growth and the role of the apical meristem. l.d.6.h: Explain the process of secondary plant growth. l.d.7.h: Relate the principles of primary and secondary growth to plant systems. l.d.8.h: Identify the five groups of naturally occurring plant hormones and synthetic plant growth regulators. l.d.9.h: Identify the plant responses to plant growth regulators and different forms of tropism. l.d.l0.h: Select plant growth regulators to produce desired responses from plants.
PS2: Students will prepare and implement a plant management plan that addresses the influence of environmental factors, nutrients and soil on plant growth.	
Determine the influence of environmental factors on plant growth. PS2.a	2.a.6.h: Describe plant responses to light color, intensity and duration. 2.a.7.h: Evaluate plant responses to varied light color, intensity and duration. 2.a.8.h: Design, implement and evaluate a plan to maintain optimal conditions for plant growth.
Prepare growing media for use in plant systems. PS2.b	2.b.5.h: Describe the physical characteristics of growing media and explain the influence they have on plant growth. 2.b.6.h: Formulate and prepare growing media for specific plants or crops. 2.b.7.h: Identify the categories of soil water. 2.b.8.h: Discuss how soil drainage and water-holding capacity can be improved. 2.b.9.h: Determine the hydraulic conductivity for soil and how the results influence irrigation practices.
Develop and implement a fertilization plan for specific plants, field crops and/or greenhouse crops. PS2.c	2.c.7.h: Describe nutrient deficiency symptoms, recognize environmental causes of nutrient deficiencies and prepare a scouting report. 2.c.8.h: Discuss the influence of pH and cation exchange capacity on the availability of nutrients.

	2.c.10.h: Determine the nutrient content of soil using appropriate laboratory procedures and prescribe fertilization based on results. 2.c.12.h: Calculate the amount of fertilizer to be applied and calibrate equipment to apply the prescribed amount of fertilizer.
PS3: Students will propagate, culture and harvest plants.	
Demonstrate plant propagation techniques. PS3.a	3.a.9.h: Demonstrate proper procedures in budding or grafting selected materials. 3.a.10.h: Evaluate asexual propagation practices based on productivity and efficiency. 3.a.11.h: Define micropropagation, discuss advantages associated with the practice and outline the four main stages of the process. 3.a.12.h: Propagate plants by micropropagation using aseptic techniques. 3.a.13.h: Explain the principles behind recombinant DNA technology and the basic steps in the process. 3.a.14.h: Evaluate the performance of genetically modified crops.
Develop and implement a plant management plan for crop production. PS3.b	3.b.11.h: Produce pest- and disease-free propagation material. 3.b.13.h: Prepare and implement a plant production schedule based on predicted environmental conditions. 3.b.14.h: Explain the reasons for controlling plant growth. 3.b.15.h: Demonstrate proper techniques to control and manage plant growth through mechanical, cultural or chemical means. 3.b.16.h: Create and implement a plan to control and manage plant growth.
Develop and implement a plan for integrated pest management. PS3.c	3.c.8.h: Predict pest and disease problems based on environmental conditions and life cycles. 3.c.9.h: Describe pest control strategies associated with integrated pest management. 3.c.10.h: Describe types of pesticide controls and formulations. 3.c.11.h: Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed. 3.c.12.h: Explain risks and benefits associated with the materials and methods used in plant pest management. 3.c.13.h: Explain procedures for the safe handling, use and storage of pesticides. 3.c.14.h: Evaluate environmental and consumer concerns regarding pest management strategies.
Apply principles and practices of sustainable agriculture to plant production. PS3.d	3.d.3.h: Prepare and implement a plan for an agricultural enterprise that involves practices in support of sustainable agriculture.
PS5: Students will recognize different systems in which plants grow.	

Investigate various means to grow plants. PS5.a	5.a.3.h: Compare and contrast various plant growing systems including, but not limited to greenhouse, hydroponics, and aquaponics.
Wisconsin Common Career Technical Standards (WCCTS)	
Creativity, Critical Thinking, Communication and Collaboration (4C)	
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.	
Develop effective resolutions for a given problem, decision or opportunity using available information. 4C2.a	2.a.11.h: Determine the information needed to address an identified problem. 2.a.13.h: Predict how an action could result in unintended consequences, both positive and negative.
Develop and implement a resolution for a new situation using personal knowledge and experience. 4C2.b	2.b.5.h: Apply past experience to develop a course of action for a new situation. 2.b.6.h: Use existing knowledge to develop a resolution for a new situation, problem or opportunity.
4C3: Students will communicate and collaborate with others to accomplish tasks and develop solutions to problems and opportunities.	
Communicate thoughts and feelings with others using verbal and non-verbal language. 4C3.a	3.a.12.h: Utilize effective listening skills in creating consensus in a group.
Work collaboratively with others. 4C3.b	3.b.7.h: Participate in group processes to generate consensus. 3.b.8.h: Lead group processes to generate consensus. 3.b.9.h: Incorporate the use of technology to productively plan, implement and evaluate a solution, process or procedure.
Use interpersonal skills to resolve conflicts with others in an ethical manner. 4C3.c	3.c.7.h: Resolve conflicts productively with individuals as they arise. 3.c.8.h: Lead a team or group through a conflict resolution process to reach a productive outcome.
Career Development (CD)	
CD1: Students will consider, analyze and apply an awareness of self, identity and culture to identify skills and talents.	
Identify person strengths, aptitudes and passions. CD1.a	1.a.3.h: Evaluate various occupations and career pathways to identify personal, academic and career goals based on personal strengths, aptitudes and passions.
CD2: Students will identify the connection between educational achievement and work opportunities in order to reach personal and career goals.	
Assess attitudes and skills that contribute to successful learning in school and across the life span. CD2.b	2.b.7.h: Interpret and analyze the impact of current education, training and work trends on life, learning and career plans. 2.b.8.h: Assess education and training opportunities to acquire new skills necessary for career advancement. 2.b.9.h: Analyze local and regional labor market and job

	growth information to select a career pathway for potential advancement.
CD3: Students will create and manage a flexible and responsive individualized learning plan to meet their career goals.	
Investigate the world of work in order to gain knowledge of self in order to make informed career decisions. CD3.a	3.a.10.h: Analyze how career plans may be affected by personal growth, external events and changes in motivations and aspirations. 3.a.12.h: Evaluate changes in local, national and global employment trends, societal needs and economic conditions related to career planning. 3.a.14.h: Implement an individual learning plan to maximize academic ability and achievement.
Examine and evaluate opportunities that could enhance life and career plans and articulate plan to guide decisions and actions. CD3.b	3.b.5.h: Evaluate the relationship between educational achievement and career development.
CD4: Students will identify and apply employability skills.	
Identify and demonstrate positive work behaviors and personal qualities needed to be employable. CD4.a	4.a.8.h: Apply communication strategies when adapting to a culturally diverse environment. 4.a.9.h: Use positive work-qualities typically desired in each of the career cluster's pathways.
Demonstrate skills related to seeking and applying for employment to find and obtain a desired job. CD4.b	4.b.5.h: Use multiple resources to locate job opportunities.
Identify and exhibit traits for retaining employment. CD4.c	4.c.4.h: Model behaviors that demonstrate reliability and dependability.
Environment, Health and Safety (EHS)	
EHS1: Students will identify the importance and interrelationships of health, safety and environmental systems and evaluate the impacts of these systems on organizational performance for continuous improvement.	
Develop solutions to social, economic and ecological problems without compromising the ability of future generations to meet their needs. EHS1.c	1.b.7.h: Predict how a recent global event could affect community and self.
Information, Media and Technology Skills (IMT)	
IMT1: Students will access, interpret and evaluate information from a variety of sources in order to inform and support premises, arguments, decisions, ideas and initiatives.	
Determine the relevance, validity and timeliness of data and information. IMT1.b	l.b.9.h: Defend a position or decision using relevant, valid and timely data and information.

Select relevant information necessary for making decisions and solving problems. IMT1.c	l.c.5.h: Defend a solution or conclusion using appropriate data and information. l.c.6.h: Interpret and select appropriate information to develop a resolution for a given situation.
Apply data and information to communicate ideas and create new opportunities. IMT1.d	l.d.8.h: Manage and share stored data and information for a specific purpose.
IMT2: Students will apply information literacy skills to access and evaluate media to design and produce media products.	
Analyze media messages to determine biases and objectivity. IMT2.a	2.a.9.h: Portray information in different ways to account for different audiences.
Prepare media products in order to communicate a specific message. IMT2.b	2.b.4.h: Create media products to communicate a given message to different audiences.
Leadership (LE)	
LE1: Students will apply leadership skills in real-world, family, community and business and industry applications.	
Implement leadership skills to accomplish team goals and objectives. LE1.a	1.a.10.h: Exhibit skills such as compassion, service, listening, coaching, developing others, team development. 1.a.11.h: Demonstrate skills such as enthusiasm, creativity, conviction, mission, courage, concept, focus, principle-centered living and change when interacting with others in general. 1.a.12.h: Exhibit skills such as innovation, intuition, adaptation, life-long learning and coach-ability to develop leadership potential over time. 1.a.13.h: Create a sense of trust, positive attitude, integrity, willingness and commitment in order to accept key responsibilities in a group project.
Employ teamwork skills to achieve collective goals and use team members/ talents effectively. LE1.b	1.b.7.h: Capitalize on team members' individual talents and skills in a project. 1.b.9.h: Evaluate and apply teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability and conflict resolution. 1.b.10.h: Demonstrate the ability to negotiate and adapt effectively to changes in projects and work activities to meet timelines.
Identify the role of community service and service learning in family, community and business and industry. LE1.c	1.c.6.h: Assess the roles and responsibilities of citizenship and formulate an activity or event to showcase community service. 1.c.7.h: Plan a community service event, participate in the event and evaluate its impact. 1.c.8.h: Plan and participate in activities that rate skills necessary to be a successful leader and citizen.

	1.c.11.h: Participate in the development of a program of work/strategic plan and work to implement the organization's goals.
Wisconsin Standards for Science (SCI)	
Crosscutting Concepts (CC)	
CC4: Students use science and engineering practices, disciplinary core ideas, and an understanding of ***systems and models*** to make sense of phenomena and solve problems.	
System and System Models	CC4.h: Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.
CC6: Students use science and engineering practices, disciplinary core ideas, and an understanding of ***structure and function*** to make sense of phenomena and solve problems.	
Structure and Function	CC6.h: Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the systems' function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Life Science (LS)	
LS1: Students use science and engineering practices, crosscutting concepts, and an understanding of ***structures and processes (on a scale from molecules to organisms)*** to make sense of phenomena and solve problems.	
Structure and Function LS1.A	LS1.A.h: Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.
Growth and Development of Organisms LS1.B	LS1.B.h: Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
Organization for Matter and Energy Flow in Organisms LS1.C	LS1.C.h: The molecules produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.

Information Processing LS1.D	LS1.D.h: Organisms can process and store a variety of information through specific chemicals and interconnected networks.
Example Three-Dimensional Performance Indicators LS1	HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stores chemical energy. HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
LS2: Students use science and engineering practices, crosscutting concepts, and an understanding of the ***interactions, energy, and dynamics within ecosystems*** to make sense of phenomena and solve problems.	
Cycles of Matter and Energy Transfer in Ecosystems LS2.B	LS2.B.h: Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways, and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
Example Three-Dimensional Performance Indicators LS2	HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
Earth and Space Science (ESS)	
ESS2: Students use science and engineering practices, crosscutting concepts, and an understanding of ***Earth's Systems*** to make sense of phenomena and solve problems.	
Earth Materials and Systems ESS2.A	ESS2.A.h: Feedback effects exist within and among Earth's systems.
The Roles of Water in Earth's Surface Processes ESS2.C	ESS2.C.h: The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
Example Three-Dimensional Performance Indicators ESS2	HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effect on Earth materials and surface processes.
ESS3: Students use science and engineering practices, crosscutting concepts, and an understanding of the ***Earth and human activity*** to make sense of phenomena and solve problems.	

Human Impacts on Earth Systems ESS3.C	ESS3.C.h: Sustainability of human societies and he biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
Engineering, Technology, and the Application of Science (ETS)	
ETS2: Students use science and engineering practices, crosscutting concepts, and an understanding of the ***links among Engineering, Technology, Science, and Society*** to make sense of phenomena and solve problems.	
Influence of Engineering, Technology, and Science on Society and the Natural World. ETS2.B	ETS2.B.h: Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications. Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
Example Three-Dimensional Performance Indicators ETS2	HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Key Vocabulary:			
angiosperms	annual	asexual reproduction	apical dominance
auxins	biennial	broadleaf plants	cambium
cellular respiration	chloroplast	complete flower	cotyledon
deciduous	fibrous root	germination	hybrid
hydroponics	integrated pest management	pesticide	phloem
photosynthesis	perennial	pollination	precision farming
stomata	sustainable agriculture	terminal bud	tissue culture
transpiration	xylem	tropism	humus
conservation tillage	contour tillage	crop rotation	mottling
land capability class	parent material	soil horizon	soil profile
soil survey	weathering	soil structure	

Topics/Content Outline- Units and Themes:

Plant Science:

- Introduction to Plant Science:
  - Importance
  - Origin and Classification
  - Identification
- Soils
- Growth and Reproduction
  - Composition
  - Reproduction
  - Germination
  - Growth and Longevity
  - Manufacture, Use, and Storage of Food
  - Uptake of Nutrients
  - Use of Water
  - Effects of Air Pollution
  - Nature of Plant Diseases
- Improvements of Plants
  - Reasons for Improving
  - Objectives of Plant Breeding
  - Biotechnology
- Fertilizers
- Student Project
  - Corn
  - Wheat
  - Oats
  - Barley
  - Rye
  - Soybeans
  - Alfalfa
  - Ginseng
  - Sunflower
  - Flowers

Soil Science:

- The Importance of Soil
  - Agricultural Uses
  - Non-Agricultural Uses
- Soil Origin and Development
  - Parent Materials
  - Soil Organisms
  - Topography
  - The Soil Profile
- Physical Properties of Soil

    - Texture
    - Density
    - Structure
    - Tilth
    - Color
- Soil Water
    - Water Conservation
    - Irrigation and Drainage
- Life in the Soil
- Organic Matter
- Soil Fertility
- Soil pH
- Plant Nutrition
- Soil Sampling and Testing
- Fertilizers
    - Organic
    - Inorganic
- Tillage and Cropping Systems
    - Conventional
    - Conservation
- Soil Classification and Survey
- Soil Conservation
    - Erosion
    - Predicting Soil Loss

Primary Resource(s):

Introduction to Agronomy: Food, Crops, and the Environment, 2nd Edition
Cengage Learning
ISBN: 978-11113-123-36