



# Principles of Plant Science and Hydroculture

<b>Primary Career Cluster:</b>	Agriculture, Food, & Natural Resources
<b>Consultant:</b>	<a href="mailto:CTE.Standards@tn.gov">CTE.Standards@tn.gov</a>
<b>Course Code(s):</b>	C18H30
<b>Prerequisite(s):</b>	<i>Agriscience</i> (C18H19)
<b>Credit:</b>	1
<b>Grade Level:</b>	10
<b>Elective Focus - Graduation Requirements:</b>	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture, Food, & Natural Resources courses.
<b>POS Concentrator:</b>	This course satisfies one out of two required courses to meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
<b>Programs of Study and Sequence:</b>	This is the second course in the <i>Horticulture Science</i> program of study.
<b>Aligned Student Organization(s):</b>	FFA: <a href="http://www.tnffa.org">http://www.tnffa.org</a>
<b>Coordinating Work-Based Learning:</b>	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, teachers who hold an active WBL certificate may offer placement for credit when the requirements of the state board's WBL Framework and the Department's WBL Policy Guide are met. For information, visit <a href="https://www.tn.gov/content/tn/education/career-and-technical-education/work-based-learning.html">https://www.tn.gov/content/tn/education/career-and-technical-education/work-based-learning.html</a> .
<b>Promoted Tennessee Student Industry Credentials:</b>	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit <a href="https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html">https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html</a> .
<b>Teacher Endorsement(s):</b>	048, 150, 448, and 950
<b>Required Teacher Certifications/Training:</b>	While not required to teach the course, teachers who use a greenhouse facility or an outdoor lab (cold frame, nursery, etc.) that uses any type of chemical (with an EPA label) must have the Commercial Pesticide Applicators License for C10.
<b>Teacher Resources:</b>	<a href="https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html">https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html</a> Best for All Central: <a href="https://bestforall.tnedu.gov/">https://bestforall.tnedu.gov/</a>

## Course-At-A-Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

### Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course. This is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in FFA career and leadership events (CDE/LDE) that align with this course including Agriscience Fair, Agricultural Communications, Agricultural Issues, Agronomy, Extemporaneous Speaking, Environmental & Natural Resources, Land Judging and Evaluation, and Prepared Public Speaking.

### Using Work-based Learning (WBL) in Your Classroom (Need to update)

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 1-3** | Invite an industry representative to talk about the impact of plant science to our society and environment.
- **Standards 4-18** | Have the crop specialist or master gardener work with students on a real project.
- **Standards 19-23** | Participate in virtual or in-person tours with hydroponics and aquaponics facilities and discuss the concepts to grow plants and animals in non-traditional environments.

## Course Description

*Principles of Plant Science and Hydroculture* focuses on essential knowledge and skills related to the science of plant growth. This course covers principles of plant health, growth, reproduction, and biotechnology, as well as fundamental principles of hydroponics and aquaponics. Upon completion of this course, proficient students will be prepared for more advanced coursework in horticulture science.

## Program of Study Application

This is the second course in the *Horticulture Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, and Natural Resources website at <https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-agriculture-food-natural-resources.html>.

## Course Standards

### Safety

- 1) Differentiate general occupational safety prevention and control standards as related to the plant science and hydroculture industry. Apply concepts of safety procedures to complete safety test with 100 percent accuracy. Demonstrate the safety concepts as outlined in the Tennessee worker protection standards.

### Plants, Society, and the Environment

- 2) Investigate the roles of cultivated plants in meeting the food, fiber, fuel, medicinal, aesthetic, and occupational needs of society. Identify and describe the different domains of the horticulture industry, in an informative text. Examine current issues and trends affecting horticultural professionals in the industry. Cite specific textual evidence from government publications and reputable news media.
- 3) Summarize the impact and patterns of environmental factors on plant biodiversity by examining research from academic journals, news articles, and government publications. Describe important characteristics of the relationships between plants and other organisms, including basic plant-human interactions, plant-animal interactions, and plant adaptation.

### Principles of Soil Science

- 4) Evaluate, citing specific textual evidence, the physical and chemical properties of soils in an informative text. Perform technical procedures to classify soils by evaluating biotic and abiotic factors such as soil pH, texture, permeability, and water holding capacity. Interpret test results to identify deficiencies and formulate appropriate corrective actions.
- 5) Describing factors that influence soil quality and erosion. Assess the extent to which reasoning and evidence presented in news articles or case studies support the use of a specific soil conservation practice for maintaining healthy growing media for plants.

- 6) Cite specific textual evidence for the analysis of land selection and conservation practices that ensure optimal productivity and stewardship. Identify factors that affect site selection for plant growth and draw evidence from multiple authoritative sources to appraise and justify management practices that ensure appropriate use of land resources.

### **Plant Structure and Function**

- 7) Integrate print and digital sources to create a model depicting the parts of plant cells. Examine the structure and outline the functions of plant cell organelles.
- 8) Analyze plant anatomy and physiology and relate key concepts to the processes and requirements involved in plant growth and productivity.

### **Plant Nutrition**

- 9) Analyze the nutrient requirements of plants and assess the importance of essential plant nutrients to plant growth and development. Use visual representations to illustrate the chemical and biological processes, including photosynthesis, that make nutrients available to plants for growth and maintenance.
- 10) Justify the use of fertilizers as a source of essential plant nutrients. Calculate fertilizer formulations and perform different methods of fertilizer application.
- 11) Research the nutritional factors that influence plant health to identify nutritional deficiencies and disorders. Compile observations to distinguish between the signs of nutrient deficiency in plants and defend recommendations for appropriate treatments.

### **Plant Diseases and Pests**

- 12) Research the principles of disease and pest control to plant health, growth, and maintenance. Analyze the effects of different types of plant pests and diseases; prescribe methods for pest and disease prevention and treatment.
- 13) Demonstrate understanding of common classes of chemicals used for pest management. Gather and evaluate information regarding PPE (Personal Protective Equipment) for chemical application and demonstrate appropriate use of PPE. Create a checklist for safe storage and handling of pesticides.

### **Plant Breeding, Genetics, and Genomics**

- 14) Analyze the reproductive structures in plants and describe how they function in both sexual and asexual plant reproduction.
- 15) Investigate the role of DNA, heritability, and genetic applications in plant breeding and compose an informative essay that describes how mutation, gene flow, and adaptation influence plant populations. Identify desirable traits in various plant species and predict the probable outcome of genetic crosses based on Mendel's laws.

- 16) Using graphic representation and descriptive text, explain how the principles of genetics and genomic apply to the advances in plant science including the acceleration of genetic selection, mapping of complex traits, and mapping of disease structures.

### **Plant Biotechnology**

- 17) Distinguish the branches of science that influence plant biotechnology and summarize important historical achievements. Examine the role and importance of genetic principles to improving plant characteristics and perform basic plant DNA extraction procedures.
- 18) Research current and emerging plant biotechnologies and construct an argumentative essay to support a claim supporting or opposing the use of a specific biotechnology in horticulture. Justify and debate ethical, legal, and economic issues surrounding plant biotechnology.

### **Fundamentals of Hydroponics and Aquaponics**

- 19) Evaluate the significance of hydroponics and aquaponics technology as related to sustainable practices and principles. Compare and contrast production systems and techniques utilized in the hydroponics and aquaponics fields, including structures and equipment, production methods, and common crops.
- 20) Assess the functions, attributes, and desirable properties of soilless growing media. Write an informative essay to describe the major components of soilless media, identifying basic physical and chemical characteristics.
- 21) Apply concepts learned in this course to visually identify common plant and animal species used for hydroponic and aquaponic production, and distinguish between their structural and physiological differences, as well as their specific production applications.
- 22) Examine the role that water chemistry plays in the development of water quality for plant production. Demonstrate the ability to perform common tests to evaluate water quality factors including pH, hardness, ammonium, nitrate, nitrite, dissolved oxygen, and ammonia levels.
- 23) Analyze the effects of environmental conditions on aquatic plant and animal life. Adjust water quality factors by using quantitative reasoning and appropriate units to calculate proper formulations of chemicals based upon label directions.

### **Standards Alignment Notes**

References to other standards include:

- SAE: [Supervised Agricultural Experience](#): All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- AFNR: [National Agriculture, Food, & Natural Resources \(AFNR\) Career Cluster Content Standards](#): Students engaged in activities outlined above should be able to demonstrate fluency in Standards BS and PS at the conclusion of the course.

- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.