



# 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, note 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.

For more ideas and information, view <https://tnffa.org/>.

### Using Work-based Learning in Your Classroom

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 1.1-2.3** | Invite an industry representative site to talk about the impact of plant science on our society and environment.
- **Standard 3.1-8.2** | Have the crop specialist or master gardener work with students on a real project.
- **Standard 9.1-9.5** | 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* focus 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.

## Course Standards

### 1. Safety

- 1.1 Safety: 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.

### 2. Plants, Society, and the Environment

- 2.1 Plants' Role in Society: 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. Examine **current issues and trends affecting horticultural professionals** in the industry.
- 2.2 Human Impact: Distinguish between the **psychological and physiological benefits of plants** on humans.
- 2.3 Environmental Impacts: Summarize the impact and patterns of **environmental factors on plant biodiversity**. Describe important characteristics of the **relationships between plants and other organisms**, including basic plant-human interactions, plant-animal interactions, and plant adaptation.

### 3. Plant Structure and Function

- 3.1 Plant Cells: Depict the **parts of plant cells**. Examine the **structure and outline the functions** of plant cell wall, chloroplast, central vacuole, and plasmodesmata.
- 3.2 Plant Anatomy: Analyze **plant anatomy and physiology** and relate key concepts to the **processes and requirements** involved in plant growth and productivity.
- 3.3 Vegetable Plants: Differentiate between **monocot and dicot vegetable plants** including but not limited to root, stem, and leaf modifications.

## 4. Plant Nutrition

- 4.1 Essential nutrients: Analyze the **nutrient requirements of plants** and assess the importance of **essential plant nutrients** to plant growth and development. Illustrate the **chemical and biological processes**, including photosynthesis and nitrogen fixation by bacteria, that make nutrients available to plants for growth and maintenance.
- 4.2 Fertilizers: Describe the use of **fertilizers as a source of essential plant nutrients**. Describing the **advantages and limitations of various fertilizer application methods**. Calculate **fertilizer formulations** and perform different methods of fertilizer applications.
- 4.3 Nutritional Plant Health: Research the **nutritional factors that influence plant health** to identify **nutritional deficiencies and disorders**. Distinguish between the signs of different nutrient deficiencies in plants and recommend appropriate treatments.

## 5. Principles of Soil Science

- 5.1 Classify soils: Evaluate the **physical and chemical properties of soils**. 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.
- 5.2 Soil Quality: Describe factors that influence **soil quality and erosion**. Assess the extent to which reasoning and evidence support the use of a **specific soil conservation practice** for maintaining healthy growing media for plants.
- 5.3 Land Selection and Practices: Cite specific 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 the appropriate use of land resources.

## 6. Plant Diseases and Pests

- 6.1 Plant Diseases and Pest Control: 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.
- 6.2 Chemical Use: 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.

## 7. Plant Breeding, Genetics, and Genomics

- 7.1 Plant Sexual Reproduction: Analyze the **stages of sexual reproductive stages in plants** as it pertains to
- a plant's life cycle,
  - development of male and female gametophytes (reproductive structures),
  - explain the significance of mitosis and meiosis in the development of reproductive structures, and
  - pollination and the process of self-pollination and cross-pollination.
- 7.2 Vegetative Plant Propagation: Evaluate **vegetative plant propagation techniques** utilized in both agriculture and horticulture production in the following area:
- plant characteristics,
  - natural and artificial asexual methods of reproduction, and
  - advantages and disadvantages of each method.
- 7.3 Basic Genetics in Plant Breeding: Investigate the role of DNA, heritability, and **genetic applications in plant breeding** and compose an informative essay that describes how mutation, gene flow, and adaption influence plant populations. Identify **desirable traits in various plant species** and predict the probable outcome of genetic crosses based on Mendel's laws.
- 7.4 Genomics in Plant Science: Explain how the **principles of genetics and genomics** apply to the advances in plant science including the acceleration of genetic selection, mapping of complex traits, and mapping of disease structures.

## 8. Plant Biotechnology

- 8.1 Historical Achievements: Distinguish the branches of science that influence **plant biotechnology** and summarize **important historical achievements**. Examine the **role and importance of genetic principles** to improve plant characteristics and perform basic plant DNA extraction procedures.
- 8.2 Plant Biotechnologies: Research **current and emerging plant biotechnologies** 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**.

## 9. Fundamentals of Hydroponics and Aquaponics

- 9.1 Technologies: 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.

- 9.2 Soilless Growing: Assess the functions, attributes, and **desirable properties of soilless growing media**. Describe the **major components of soilless media**, identifying basic physical and chemical characteristics.
- 9.3 Hydroponic and Aquaponics Production: 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.
- 9.4 Water Quality: Examine the role that water chemistry plays in the development of **water quality for plant and animal production**. Demonstrate the ability to perform **common tests to evaluate water quality factors** including pH, hardness, ammonium, nitrate, nitrite, dissolved oxygen, and ammonia levels.
- 9.5 Environmental Conditions: Analyze the effects of **environmental conditions on aquatic plant and animal life**. Calculate **proper formulations of chemicals** based upon label directions to adjust water quality factors.

## 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.