



Soilless Growing Systems

*A Hydroponics Curriculum for
High School 4-H Clubs*

Student Guide

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Chapter 1

Introduction to Soilless Growing Systems

Activity 1

This initial lesson introduces the idea of growing plants without using soil and shows students what soilless production looks like and an overview of how the industry has developed.

- Define hydroponics and soilless production
- Outline the history of growing vegetables using hydroponics
- Research common plants grown in hydroponic growing systems
- Understand the need for evolution in growing practices related to hydroponics

Activity 2

The second lesson in this module covers climate and the environmental conditions that are needed to produce vegetable crops. Contrasts are made between CEA and outdoor growing environments.

- List the major fruiting crops grown in soilless growing systems
- List the major leafy crops grown in soilless growing systems
- Draw conclusions based on the influence of climate and population on the location of CEA operations
- Analyze the growing conditions needed for the major fruiting crops grown in soilless growing systems
- Group vegetable crops based on general temperature preferences and their production region in the United States- compare outdoor and CEA production locations
- Understand how soilless growing systems in controlled environments can alter the growing location for many vegetable crops

Activity 3

The final lesson in the module becomes provides a practical introduction to the most common types of soilless growing systems and provides context on why different systems are used for specific crops and situations.

- Define soilless growing systems
- Compare and contrast the advantages of each of the common growing systems
- Identify the crucial components needed for a successful hydroponic growing system
- Develop a basic layout for a hydroponic system

Plants Can Grow Without Soil?



An Introduction to Soilless Growing Systems Chapter 1, Activity 1

Learner Outcomes

- Define hydroponics and soilless production
- Outline the history of growing vegetables using hydroponics
- Research common plants grown in hydroponic growing systems
- Understand the need for evolution in growing practices related to hydroponics

Standards Supported

NGSS: HS-LS1-5, HS-LS2-5
CCTC: AG-PL-1

Concepts/Terms

Hydroponic, Hydroculture, Soilless, Aquaponic, Aeroponic, Controlled Environment Agriculture, Greenhouse Production

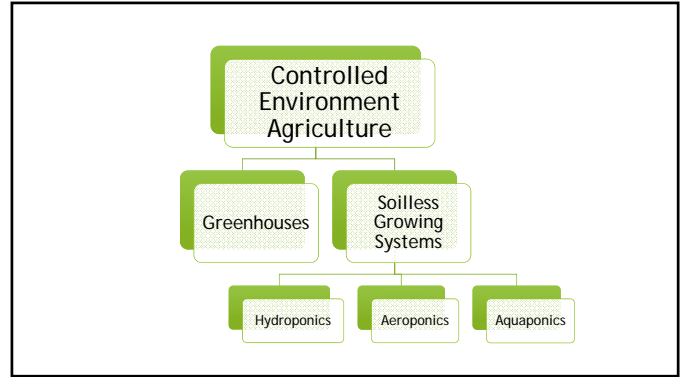
Life Skills

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9.HR.1, 9.HR.3, 9.HW.1, 9.HW.3, 9.HW.4
9.HB.1, 10.HT.1, 10.HT.2, 10.HM.2, 10.HR.3, 10.HW.1,
10.HW.3, 10.HB.1, 11.HT.2, 11.HT.3, 11.HM.2,
11.HG.1, 11.HG.2, 11.HW.1, 11.HW.3, 12.HT.2,
12.HM.2, 12.HR.2, 12.HW.1, 12.HW.3

Did you know that plants can grow without soil? In this lesson, students will learn about the basics of the soilless production industry.

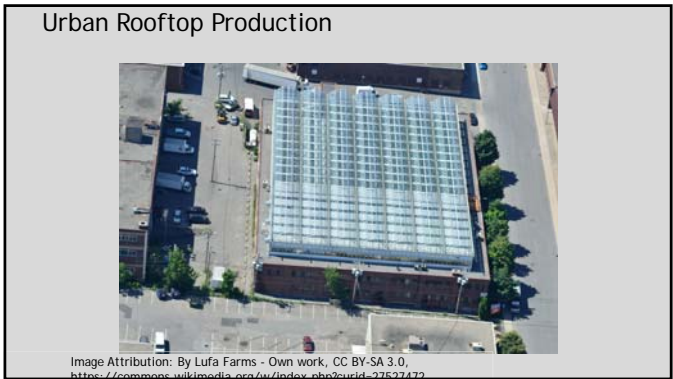
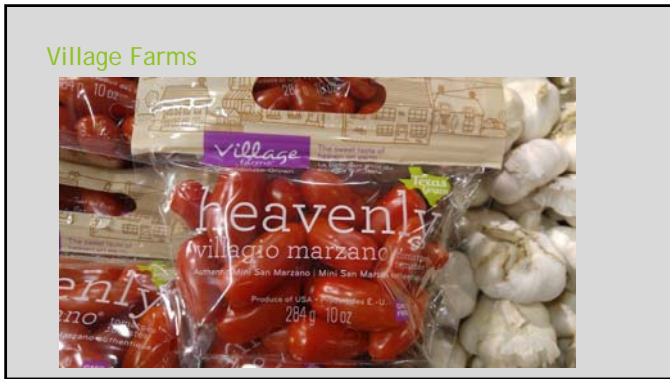
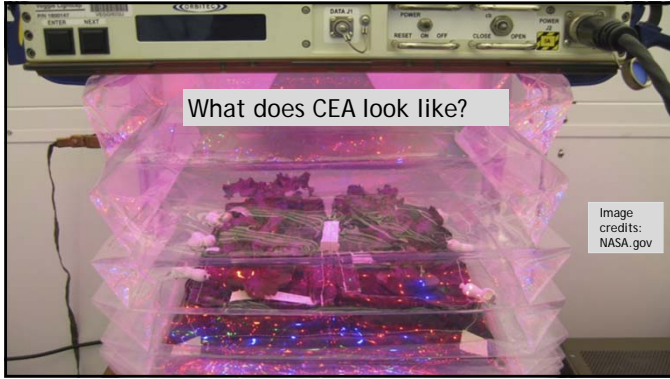
Overview

This lesson introduces students to soilless vegetable production. Learners view and taste vegetables to identify similarities and differences between crops grown in soil and crops grown without soil. The leader introduces students to soilless growing systems and the crops they produce for grocery stores. Students will learn key terms and history to explain how much these systems have improved over time, and they will identify advantages and disadvantages of the systems. Learners will understand that food production efficiency will continue to improve, but that agriculture will most likely need a mix of production systems to feed the world in the future.



- ▶ Controlled Environment Agriculture (CEA)- using technology to grow plants and plant products
- ▶ Greenhouse- a structure that can provide an optimum growing environment for plants
- ▶ Soilless Growing Systems
 - ▶ Hydroponics- growing plants using a nutrient solution
 - ▶ Aeroponic- mist is sprayed on roots rather
 - ▶ Aquaponic- fish and hydroponic plant production

- ▶ Hydroponics- growing plants using a nutrient solution
- ▶ Aquaponic- a combination of fish and hydroponic plant production
- ▶ Aeroponic- a subset of hydroponics where a mist is sprayed on roots rather than roots suspended in or watered with a liquid nutrient solution



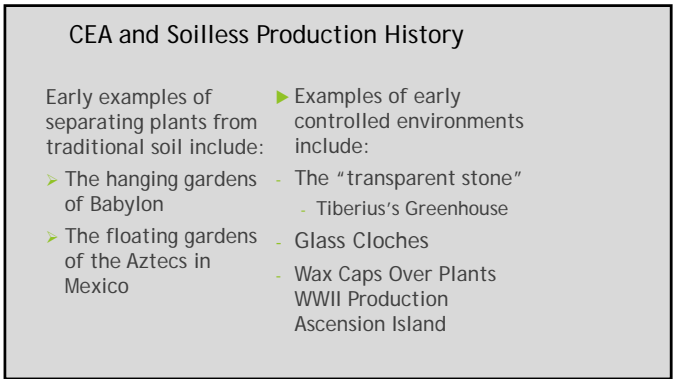


What are the main crops of soilless production?

Fruiting Crops

- Tomatoes and cucumbers are common
- Peppers and eggplants are also grown in some facilities as well

Images courtesy CropKing, Inc. Lodi, OH



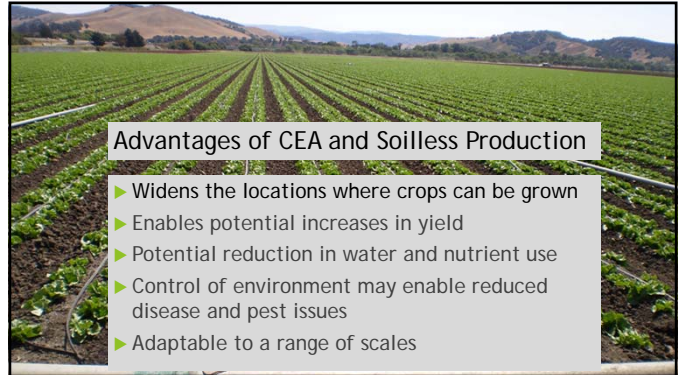
Technology Advances

Growing Environments

- ▶ Oiled Paper
- ▶ Glass Greenhouses
- ▶ Plastic Greenhouse Covering
 - ▶ (UK) 1948 - Emery Emmert
- ▶ Energy Costs

Nutrient Solutions

- ▶ Beginning in 1925
- ▶ Sand and Gravel Culture
- ▶ Concrete Beds
- ▶ Channels and Drip Irrigation



Disadvantages

- ▶ High cost to build
- ▶ High cost to operate
- ▶ Pest and disease reproduction
- ▶ Things can go wrong quickly because there is no buffer of soil
- ▶ Scientists are still researching best operating practices



