



Topic 4: Self-Reliant Systems and Procedures

4.3 Soiless Cultivation Methods (Hydroponics)

Developed By:



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Objectives

Objective 01

Understanding hydroponic technology and historical overview of the systems.

Objective 02

Advantages of hydroponic systems.

Objective 03

Introduce essential nutrient solutions for plant growth.

Objective 04

Provide guidance on system design and environmental control including automation and monitoring.

Objective 05

Share fundamental information on crop & pest management and harvesting & yield optimization.



Soiless Cultivation Methods

Aquaponics



Aeroponics



Hydroponics



What is Hydroponics?




What is Hydroponics?


- Hydroponics is a method of growing plants without soil, using nutrient-rich water solutions instead.
- This technique allows for precise control over plant nutrition, water, and environmental conditions, resulting in faster growth rates and higher yields compared to traditional soil-based farming.




History of Hydroponic Systems



 The concept of hydroponics dates back to ancient civilizations such as the Hanging Gardens of Babylon and the Aztec floating gardens.

 However, modern hydroponic technology emerged in the 20th century with experiments conducted by scientists like William Frederick Gericke.

 Since then, hydroponics has evolved into a diverse array of systems used worldwide for commercial and hobbyist cultivation



Benefits of Hydroponic Systems

- **Efficient Water Use:** Uses up to 90% less water than traditional soil-based farming.
- **Space Efficiency:** Maximizes space utilization, ideal for urban areas.
- **Faster Plant Growth:** Controlled environment leads to quicker growth cycles.
- **Higher Yields:** Increased plant density and consistent quality.
- **Reduced Pesticide Use:** Minimizes soil-borne pests and diseases, leading to healthier plants.



Hydroponic Systems Nutrient Solutions

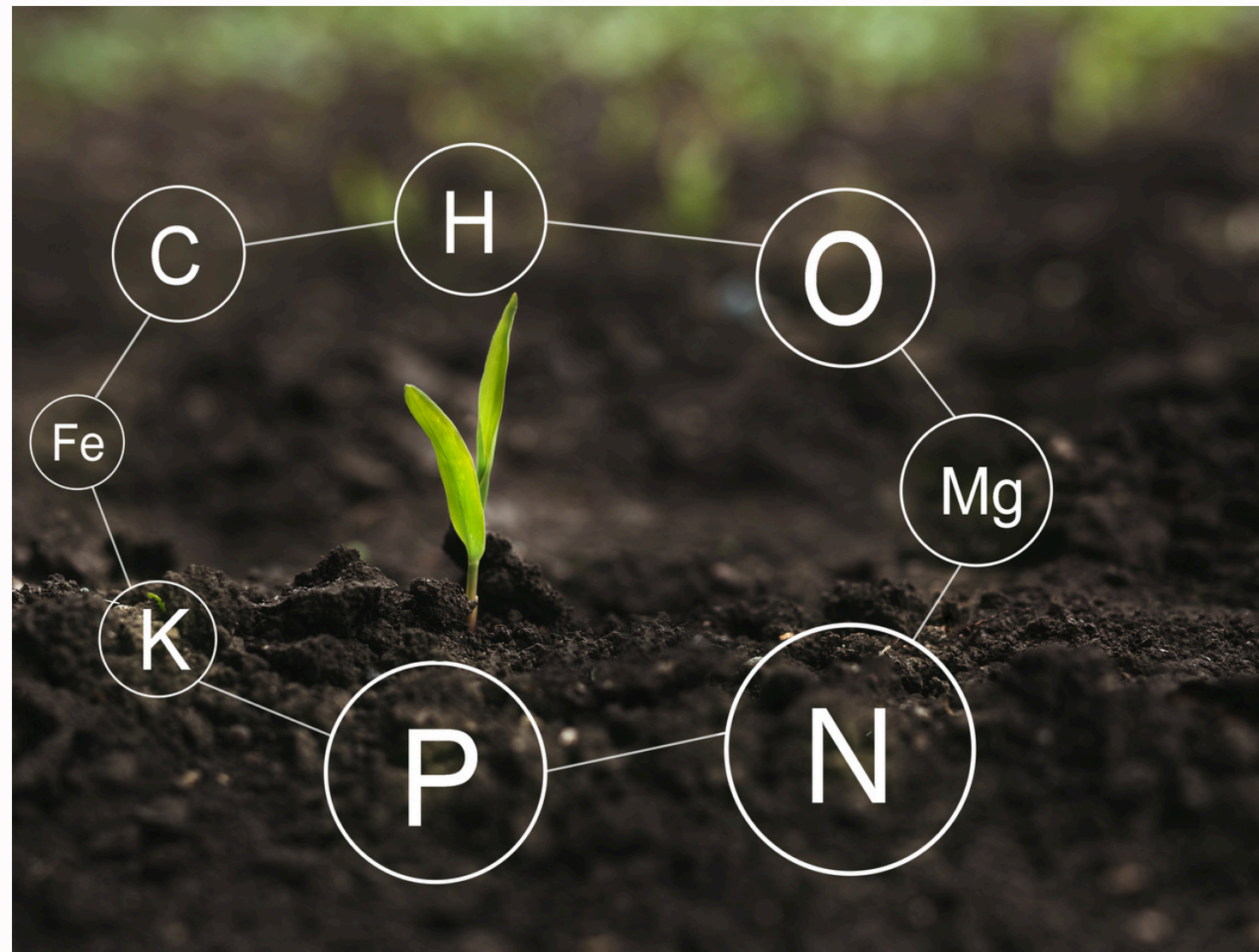
Essential Nutrients for Plant Growth

Plants require a range of essential nutrients to thrive, including macronutrients such as

- nitrogen (N),
- phosphorus (P),
- potassium (K),

as well as micronutrients like

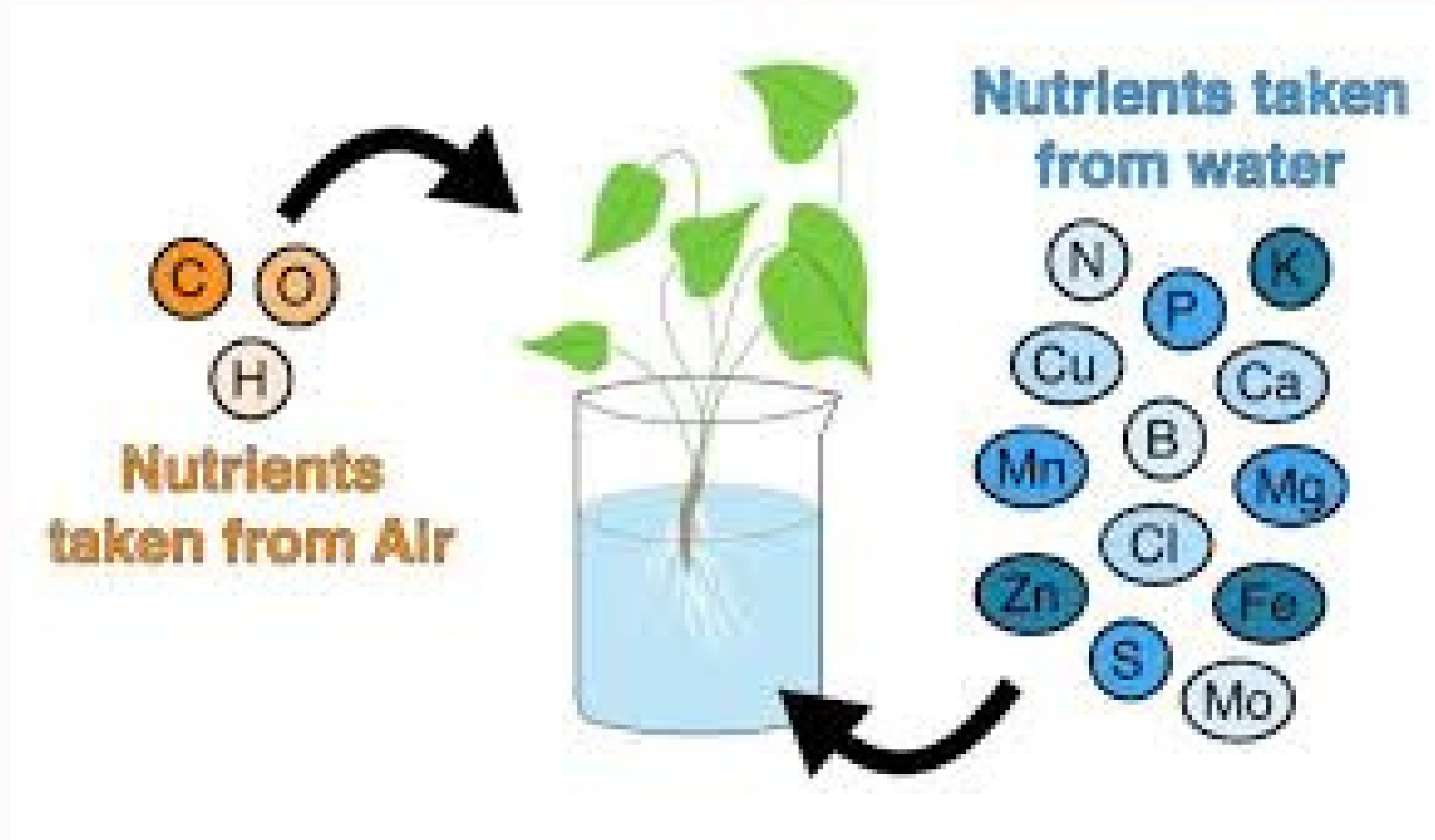
- iron (Fe),
- magnesium (Mg),
- calcium (Ca).



Hydroponic Systems Nutrient Solutions

Essential Nutrients for Plant Growth

- In hydroponic systems, these nutrients are dissolved in water and delivered directly to the plant roots.



Hydroponic Systems Nutrient Solutions

Formulating Nutrient Solutions

- Creating a balanced nutrient solution is crucial for optimal plant growth and development.
- Commercial hydroponic fertilizers are available in various formulations tailored to different stages of plant growth.
- Alternatively, growers can mix their own nutrient solutions using water-soluble fertilizers and supplements, adjusting the nutrient concentrations according to plant needs and water quality.



Hydroponic Systems Nutrient Solutions

pH and EC Management

- pH levels and Electrical Conductivity (EC) play vital roles in nutrient uptake and plant health.
- Most plants prefer slightly acidic conditions, with a pH range of 5.5 to 6.5.



- EC measures the concentration of dissolved salts in the nutrient solution, indicating its strength.
- Monitoring and adjusting pH and EC levels regularly help maintain optimal growing conditions and prevent nutrient imbalances.

Hydroponic Systems Design

Components of a Hydroponic System

A typical hydroponic system consists of several components, including:

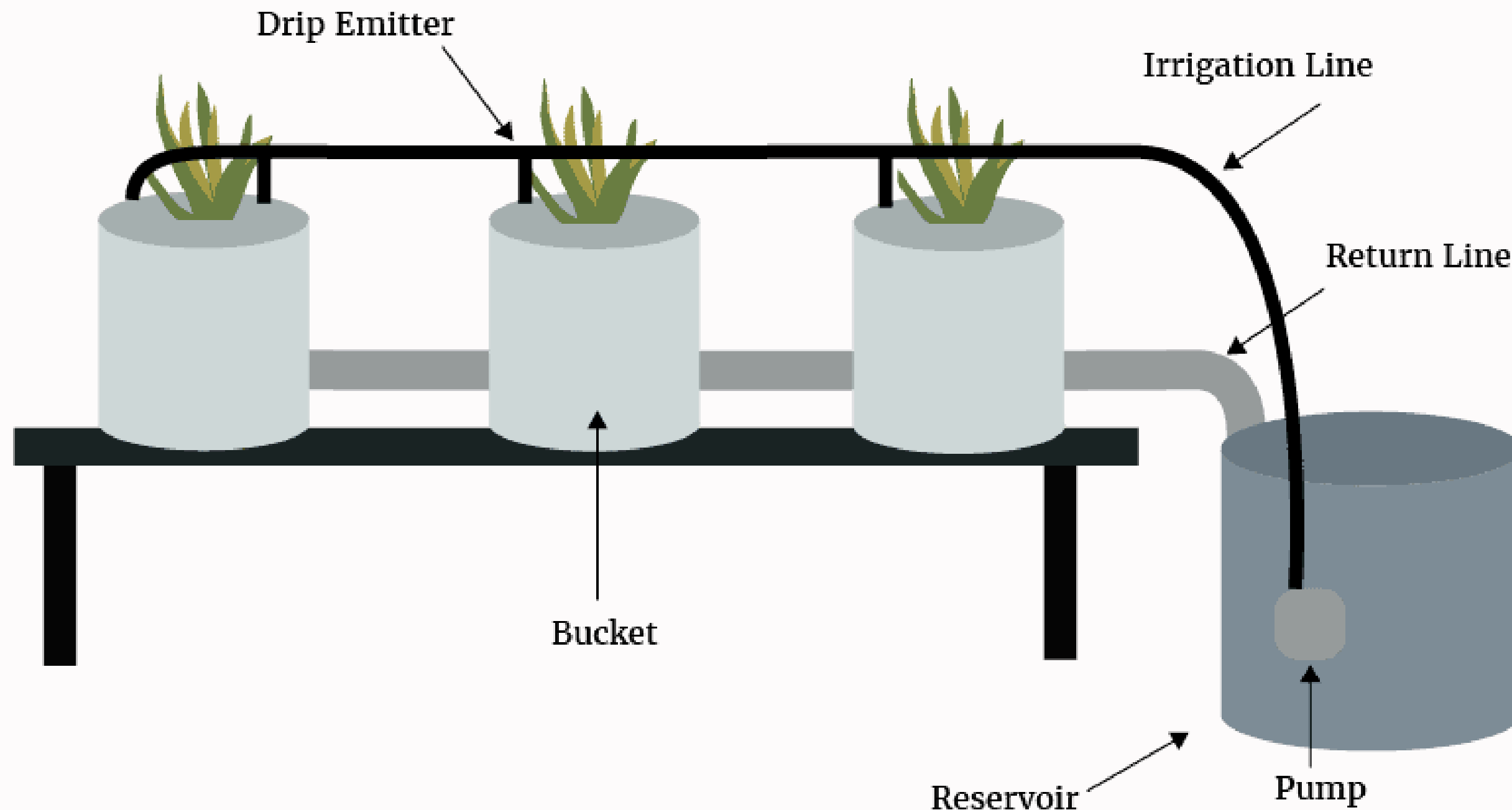
- Reservoir for holding the nutrient solution,
- Pump for circulating water to the plants,
- Growing medium to support the roots,
- Delivery system for distributing water and nutrients.

The choice of components depends on factors such as crop type, system size, and available resources.



Hydroponic Systems Design

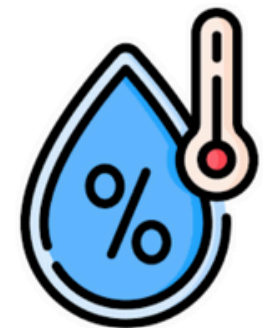
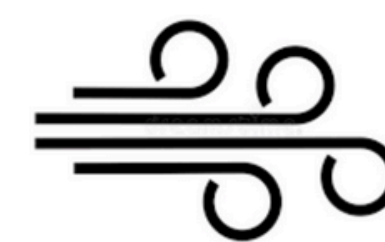
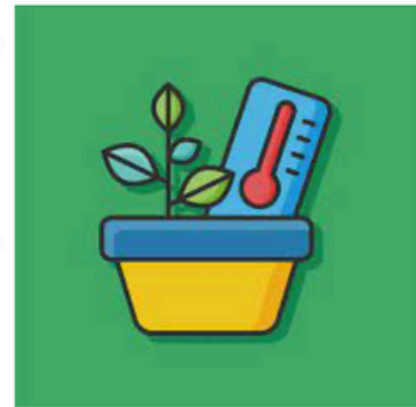
Components of a Hydroponic System



Hydroponic Systems Design

Environmental Control

- Controlling environmental factors such as temperature, humidity, and lighting is essential for successful hydroponic cultivation.
- Temperature affects plant metabolism and nutrient uptake, while humidity levels influence transpiration and disease susceptibility.
- Providing adequate lighting, either natural sunlight or artificial grow lights, ensures proper photosynthesis and plant growth.



Hydroponic Systems Design

What to Consider When designing a Hydroponic Setup

- Available space
- Budget
- Desired crop production



- ✓ Larger-scale operations may incorporate advanced technologies such as climate control systems, automated nutrient dosing, and remote monitoring for enhanced efficiency and productivity.

Hydroponic Systems Design

Importance of Automation and Monitoring

Enhancing tasks such as :

- nutrient delivery
- irrigation
- environmental control

Automated systems can be programmed to adjust nutrient levels based on plant requirements, monitor:

- Water pH
- EC
- Detect environmental anomalies

This real-time data monitoring allows growers to respond promptly to changes and optimize crop growth.



Hydroponic Growing Solutions

Crop Selection

You can grow a wide variety of crops, including:

- leafy greens
- herbs
- tomatoes
- strawberries
- exotic plants.



Hydroponic Growing Solutions

Crop Selection

- When selecting crops for hydroponic cultivation, consider factors such as growth habits, nutrient requirements, and market demand.
- Some crops may thrive in certain hydroponic systems, while others may require specialized growing conditions.



Hydroponic Growing Solutions



Crop Management

Proper crop management practices are essential for maximizing yields and maintaining plant health in hydroponic systems. Including:

- Selecting healthy seedlings
- Spacing plants appropriately to allow for air circulation and light penetration
- Pruning to remove diseased or damaged foliage
- Providing adequate support for vining crops.

Regular monitoring for pests and diseases helps prevent outbreaks and ensures early intervention if problems arise.



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Hydroponic Growing Solutions

Pests and Diseases Management

► Hydroponic systems are less susceptible to soil-borne pests and diseases.

BUT

They are still vulnerable to issues such as:

- Aphids
- Thrips
- Powdery mildew
- Root rot.



Hydroponic Growing Solutions

Pests and Diseases Management

- ▶ Integrated Pest Management (IPM) strategies, including biological controls, cultural practices, and physical barriers, can help prevent and manage pest infestations without resorting to chemical pesticides.
 - ▶ Other effective measures for disease control
 - Maintaining proper sanitation
 - Avoiding over-crowding
 - quarantining infected plants



Hydroponic Growing Solutions

Harvesting and Yield Optimization

- ▶ Harvesting crops at the right stage of maturity ensures:
 - optimal flavor
 - texture
 - nutritional quality
- ▶ Leafy greens and herbs can be harvested multiple times by selectively harvesting outer leaves or stems while allowing the plant to continue growing.
- ▶ Tomatoes, peppers, and other fruiting crops should be harvested when fully ripe for the best flavor and yield



Hydroponic Systems

Hydroponic System Design



Hydroponic System





s.m.a.r.t.
greenhouse

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