HOME HYDROPONICS HANDBOOK

ARMENIA TREE PROJECT

Contents

What is hydroponics?

Hydroponics is a broad term used to describe a non-traditional method of gardening, where plants are grown in clay, pebbles, liquid, and other non-soil grow medium. Our system focuses on nutrient film technique hydroponics, which uses a solid growth medium to support the plants placed in a constantly flowing, water based nutrient solution. Hydroponics systems can take many forms but are most commonly broken down into active and passive systems. A passive system is one that does not rely on the movement of water through pumps while an active system does. Both types can be effective and serve a purpose depending on location and budget. In most cases, however, an active system more consistently produces high yields as the circulation of water and nutrients keeps the plants in a healthier state.

Why is it important?

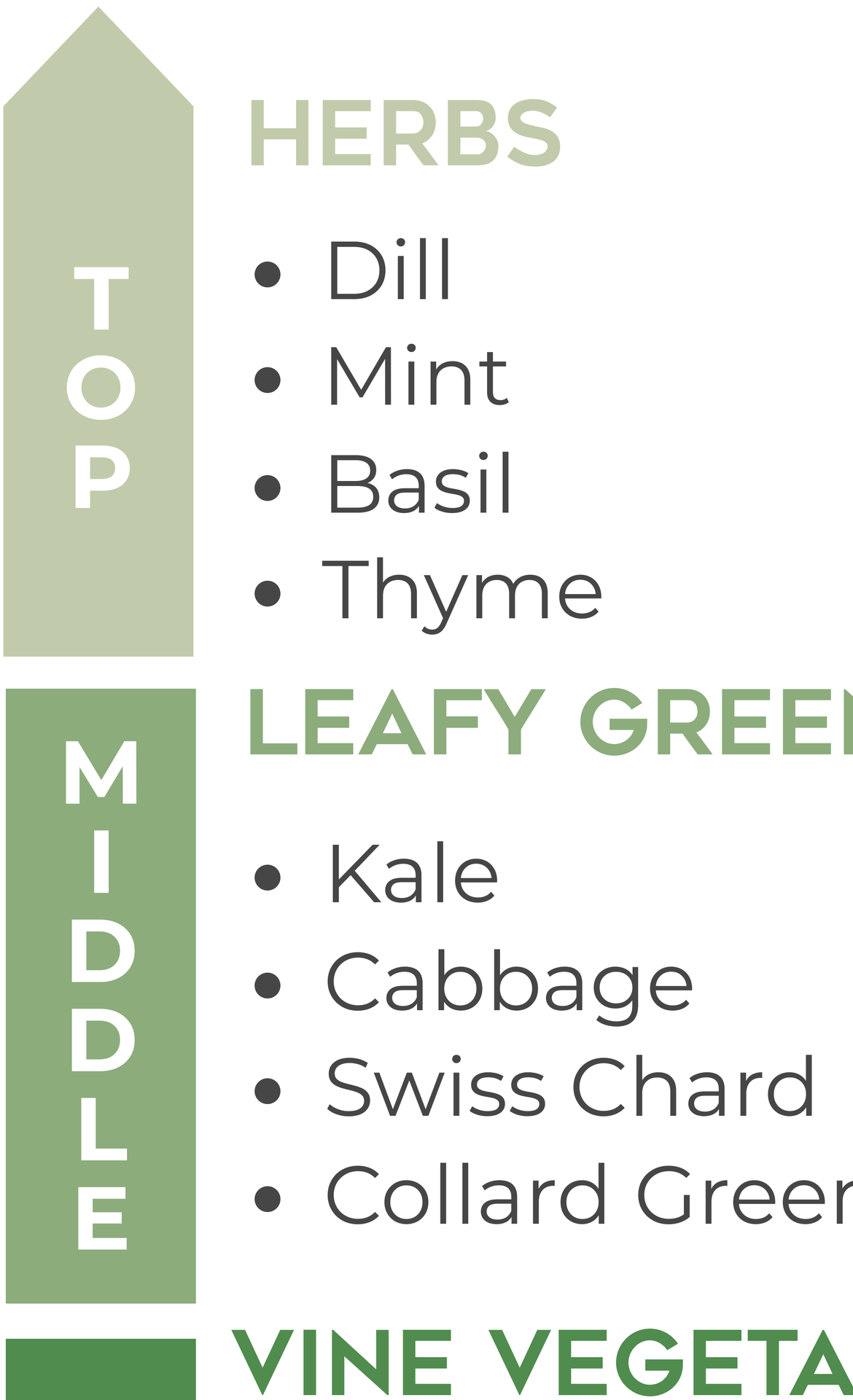
Hydroponic horticulture supports consistent and more frequent yields for a variety of crops. Small-scale hydroponics provides potential growers with much more flexibility than traditional gardening in being adaptable to a smaller space, limiting consumption of water, and facilitating a microclimate to extend the growing season. By making small-scale agriculture more accessible, overall waste and supply chain costs are reduced by hydroponic gardening, promoting a healthier economy and environment.

What is Nutrient Film Technique?

Nutrition film technique, or NFT for short, is a flexible subsection of hydroponic horticulture that focuses on the use of a submersible pump to provide a nutrient-rich, water-based solution to immature plants that are in smaller pots filled with solid growing medium, housed in a long tray or pipe. NFT systems are active systems, meaning there is constantly a moving part supplying power to the system so that water will continue to flow. An NFT system constantly provides oxygenated water to the roots of each plant by allowing the water to then flow down through the system via gravity, where the unused solution is then collected in the tank to be pumped through the system again.

Recommended Vegetables

The graphic below shows the intended vegetables the NFT system was designed to accommodate and their intended positions. The system is designed such that all vine vegetables should be placed on the bottom-most pipe with the trellis, moving up the side, the next three pipes can house a variety of leafy greens, and on top smaller herbs should be placed.



Major Components Overview

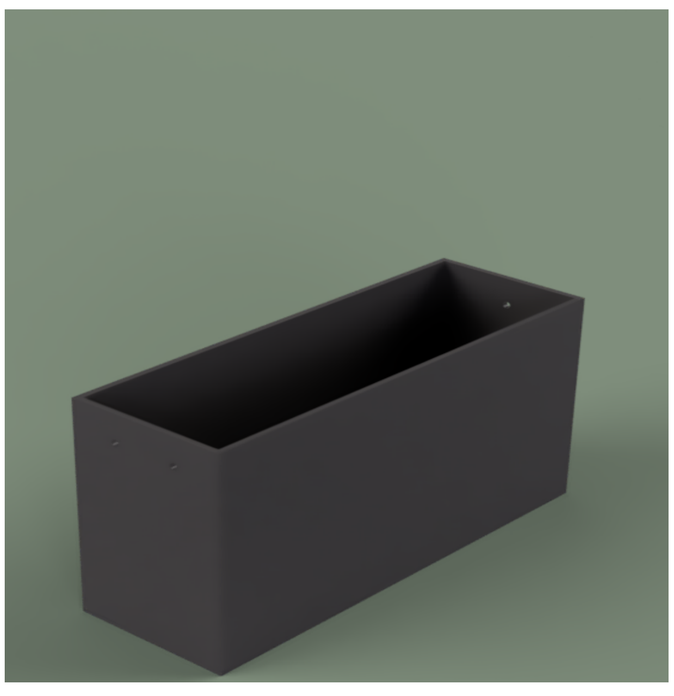
The following are brief explanations of each major component of an NFT system. In each section the requirements and important details to consider when sourcing the material are mentioned.

FRAME

The frame holds the piping for an NFT system. This particular design uses wood 2x4s and is in an A-frame shape. This shape helps expose as many lengths of piping as possible to the sun while also being stacked vertically, making the system efficient on floor space. A variety of wood can be used if the system will be inside a greenhouse, however, if the system is going to be outside or exposed to the elements, treated wood should be used to ensure the frame lasts. This design relies on wood, as it is common and cheap but other materials can be used so long as they are stable and support the weight of the system.

PIPING

The piping in an NFT system is used to carry the water and house the net pots. Most often a form of PVC pipe is used because it is cheap and designed for moving water, however, other similar materials can be used such as gutters, so long as they can be fitted to hold the net pots. In many cases, rectangular gutters or troughs are used. The piping must also be sealable. In this design we use end caps specifically designed for the pipes. Whatever you choose, you must make sure it can be sealed on both ends.



TANK

The tank holds water for the system and houses the pump. A variety of containers can be used to hold water so long as they are watertight and can be covered to prevent evaporation. The height of the water level must also fall below the midpoint of the lowest PVC pipe this will ensure gravity is able to carry water back into the tank and continue circulation. The formula below can be used to estimate the amount of water needed for a system and therefore what size tank to use.

$$\text{Estimated Total Liters of Water} = 1000 * (1/4 \pi r2 m) + (l * w * h)$$

r = Radius of pipe in meters
m = Total meters of pipe
l = Total length of tub in meters
w = Total width of tub in meters
h = Total height of pump

Major Components Overview

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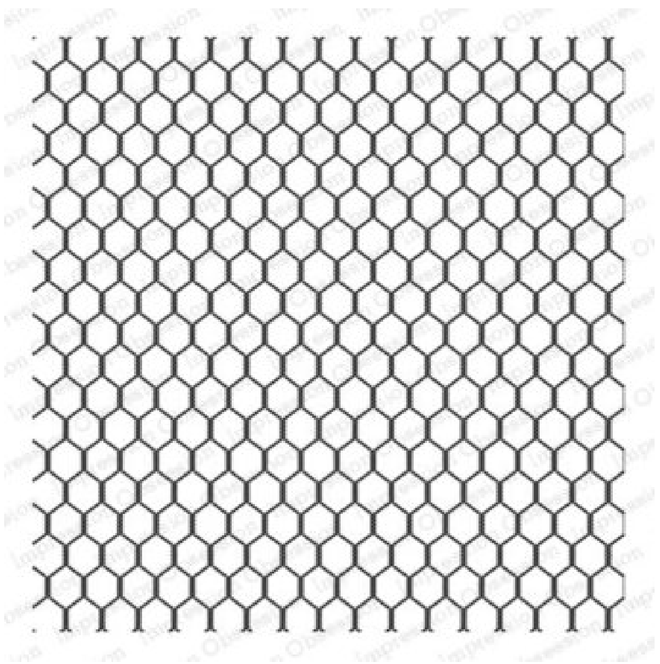
PUMP

The pump is what drives water flow through the system. A typical aquarium pump is sufficient for a system of this size. To pick a pump you need to keep in mind the max pump height, gallons per hour, and the tube fitting size. This information can usually be found in the product detail section online or listed on the box. The max pump height should be above and as close to the actual height of the system, anything below will not work and anything above may be too much and cause overflow. The gallons per hour for the pump vary depending on the pump but does not need to be above 300 GPH for this system. Lastly, you must make sure whatever fittings the pump comes with match the interior diameter of the tubing that you use.



TRELLIS

The trellis will be used to support vine vegetables on the bottom-most layer of the hydroponics system. The trellis provides a structure for the plants to grow onto. For the plants we have selected, the trellis should be at least 45cm tall measuring from the center of the pipe and span the entire length of pipe. Many different options can be used so long as there is space for the vines to grow onto and the structure does not obstruct the other plants. Make sure if you are using a wire mesh, like chicken wire, the space between wires is large enough for the vines to grow fully.

NET POT

The net pot is a plastic structure that holds the plants. A net pot is designed so that a medium can be used inside to provide a structure for the roots but also has holes so that the roots can grow beyond the container. Different plant medium can be used including, perlite, clay pebbles, or rock wool. The roots must grow beyond the pot to come in contact with the nutrient-enriched water in the pipe.

Construction of Hydroponics System

The following is a step-by-step instructional manual for building an NFT hydroponics system capable of growing the vegetables and herbs outlined earlier.

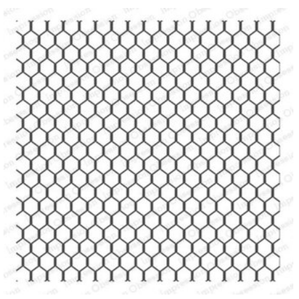
TOOLS

- [ ] Pencil
- [ ] Paper
- [ ] Tape Measure
- [ ] Speed Square
- [ ] Miter Saw
- [ ] Cordless Drill
- [ ] Dremel
- [ ] Drill Bit
- [ ] Philips Head Drill Bit
- [ ] Heavy Duty Staple Gun
- [ ] Plumber's Cement

MATERIALS

16m Wood 2x4

- 2x4 boards can be replaced with comprable boards.

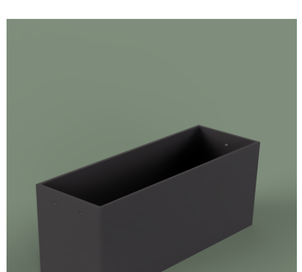


2m Chicken Wire

- Any variety of wire mesh may be used.
- A simple wooden structure can replace the wire

x1 Submersable Pump

- Match strength to the maximum high of the system



x1 65 Liter Tank

- Use the water estimation formula based on length of pipe to get correct size

x30 Net Pot

- Net pots should be around 7.5 cm in diameter

27m 4" Diameter PVC Pipe

- Different diameter pipe can be used so long as it is large enough to allow net pot to rest without touching the bottom.

x18 4" Diameter Pipe Cap

- Caps must be made for, and match the diameter of, the pipe used.

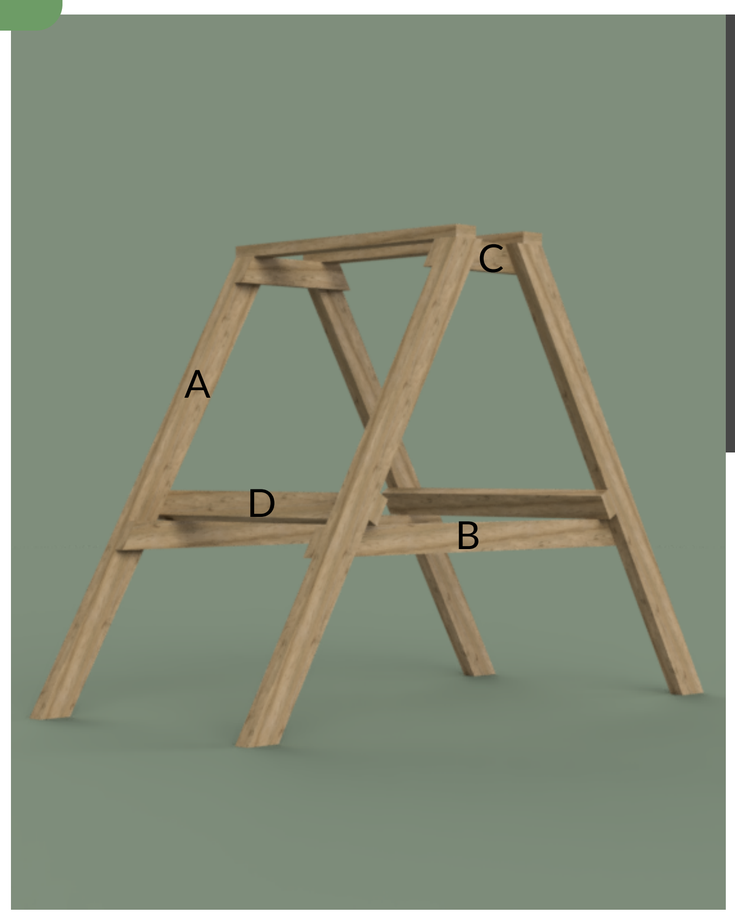
8m 3/4" Vinyl Tubing

- Tubing should be flexible and match the diameter of the drill bit used

x50 2 1/2" Wood Screws

- Screws can be varying sizes but must be able to secure two boards together

1



Tools:

- Miter Saw
- Speed Square

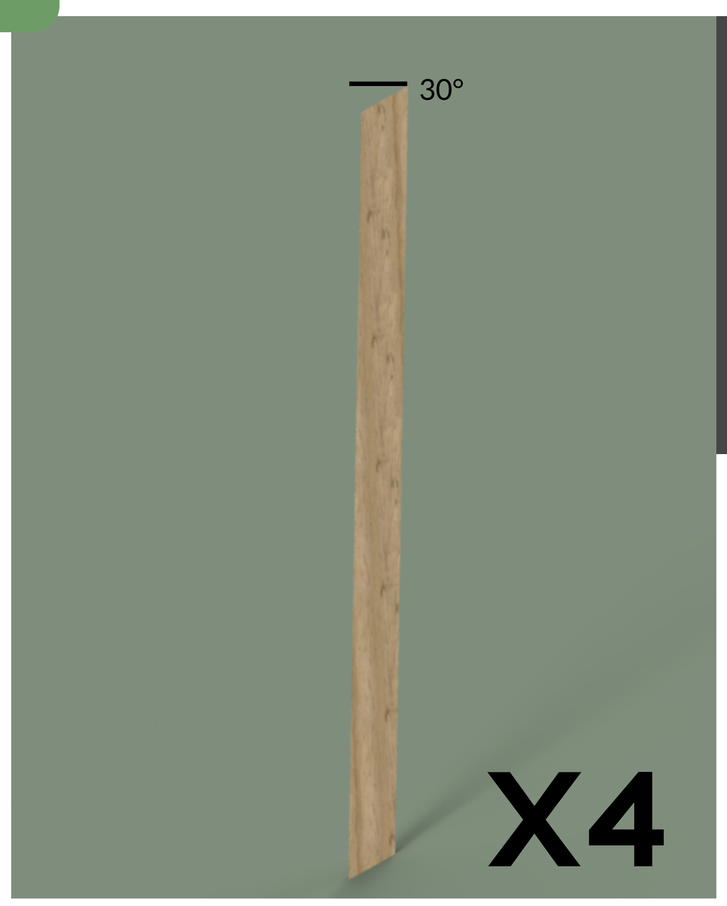
Materials:

- Wood Boards (2x4)

Cut the following:

PART A: 4 boards to 1.75 meters
PART B: 2 boards to 1.5 meters
PART C: 2 boards to 0.5 meters
PART D: 4 boards to 1.0 meter

2



Tools:

- Miter Saw
- Speed Square

Materials:

- Wood Boards (2x4)

Cut 30-degree angles on both ends of the 1.75-meter-long boards (PART A).

Repeat for all 4 boards.

3

Tools:

- Miter Saw
- Speed Square

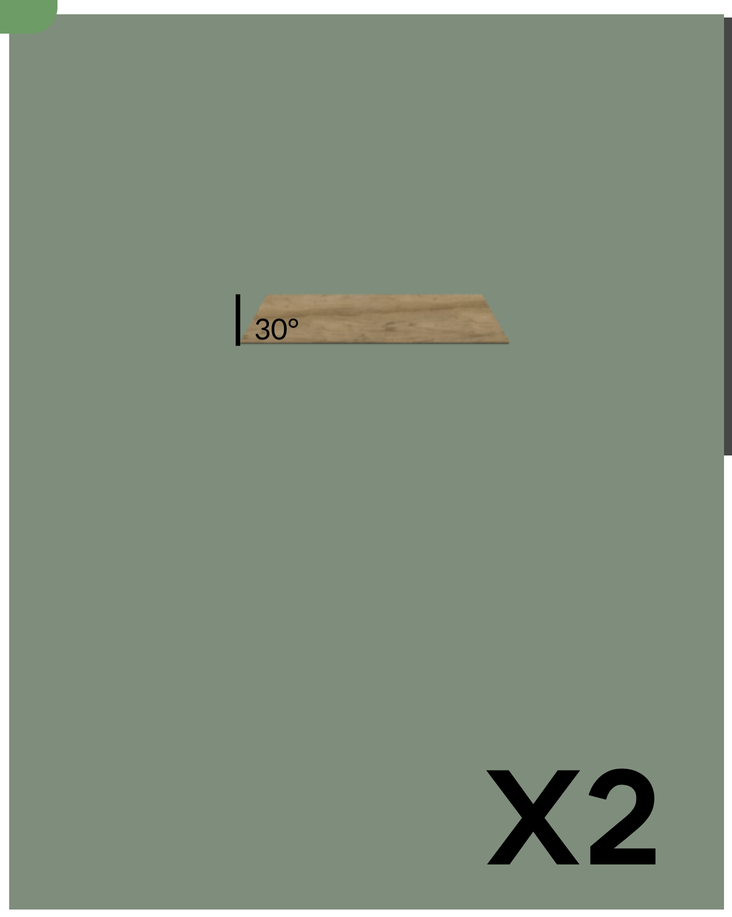
Materials:

- Wood Boards (2x4)

Cut 30-degree angles on both ends of the 1.5-meter-long boards (PART B).

Repeat for 2 boards.

4



Tools:

- Miter Saw
- Speed Square

Materials:

- Wood Boards (2x4)

Cut 30-degree angles on both ends of the .45-meter-long boards (PART C).

Repeat for 2 boards.

5

Tools:

- Miter Saw
- Speed Square

Materials:

- Wood Boards (2x4)

Cut a square out of the 2x4 plus a 45° right triangle added to the end. Dimensions are shown on the left (PART E).

Repeat 16 times.

6

Tools:

- Cordless drill

Materials:

- 4 PART A
- 2 PART B
- 2 PART C
- 16 Screws

Align the boards on the floor as shown and use two screws to secure each place the boards meet.

Repeat 2 times.

7

Tools:

- Cordless drill

Materials:

- Wood Frame
- Part E
- 32 Screws

Attach Part E to hold the PVC using 2 screws for each piece place them as shown. Make sure the lowest PVC pipe will sit higher than the tub.

Repeat for both frames.

8

Tools:

- Cordless drill

Materials:

- Wood Frame
- 4 Part D
- 8 Screws

With the frame on the floor, place all 4 Part Ds as shown and use two screws to secure them to the frame.

9

Tools:

- Cordless drill

Materials:

- Wood Frame
- 8 Screws

Connect the remaining wood frame at the end of Part D as shown. Use two screws at each point to secure.

10

Tools:

- Cordless drill
- 3/4'' Drill Bit
- Jig Saw

Materials:

- PVC pipe
- Net Pot

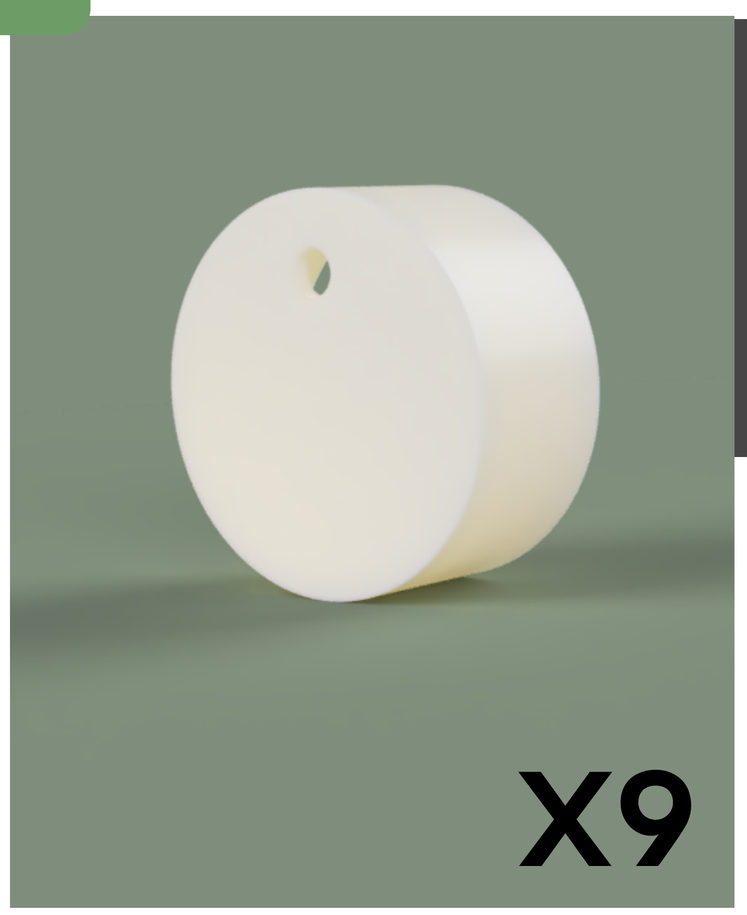
Measure out equally spaced points on your PVC by drawing a straight line down the pipe.

To make the hole to hold the net pots, drill holes about ⅛” smaller than the diameter of the net pot.

Then use a saw to connect the holes to create a hole big enough to hold your net pot

File holes to fit the net pots snugly

11



Tools:

- Cordless drill
- 3/4" Drill Bit
- Dremel

Materials:

- PVC End Cap

Drill a hole using the 3/4" drill bit. The center of the hole should approximately 3 cm from the outside edge of the cap.

Repeat on 9 end caps.

12

Tools:

- Cordless drill
- 3/4" Drill Bit
- Dremel

Materials:

- P PVC End Cap

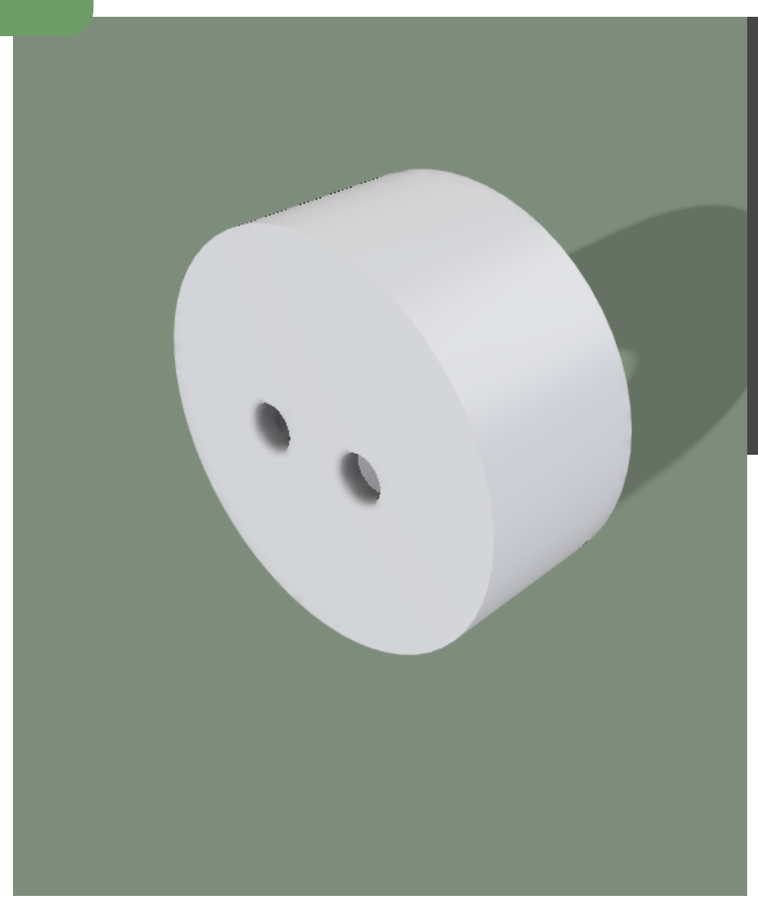
Drill a hole in an end cap using 3/4" drill bit.

The center of hole should be 5.715cm down from the top of the cap

This will be on the bottom half of the end caps which are used for the outflow of water.

Repeat on 8 end caps.

13



Tools:

- Cordless drill
- 3/4" Drill Bit
- Dremel

Materials:

- P PVC End Cap

Take one end cap that will be the outflow cap for the top pipe of the system.

Mark 2 holes that will be centered at 5.715cm down from the top of the cap and make sure they are on the same horizontal plane.

Drill holes with a ½” drill bit. This will create two outputs that will lead water down both sides of the A-frame design.

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Tools:

- Plumber's Cement

Materials:

- PVC pipe
- End Caps

Place the end caps on the PVC pipes and seal using plumber's cement.

Make sure that each pipe has one input cap and one output cap.

Set aside the pipe with the end cap with two holes as the top.

15

Tools:

Materials:

- Wood Frame
- 9 PVC Pipes with end caps

Place all 9 PVC Pipes on the frame as shown.

Make sure the pipe with two holes in one end cap is on top.

16

Tools:

- Cordless drill

Materials:

- 2 x 2 Wood pieces or scrap
- 8 Screws

Using scrap wood attach the 2x2 wood posts to the outside side of the frame close to the PVC pipe that your plants will be growing in as shown.

Repeat for both sides

17

Tools:

- Heavy Duty Staple gun

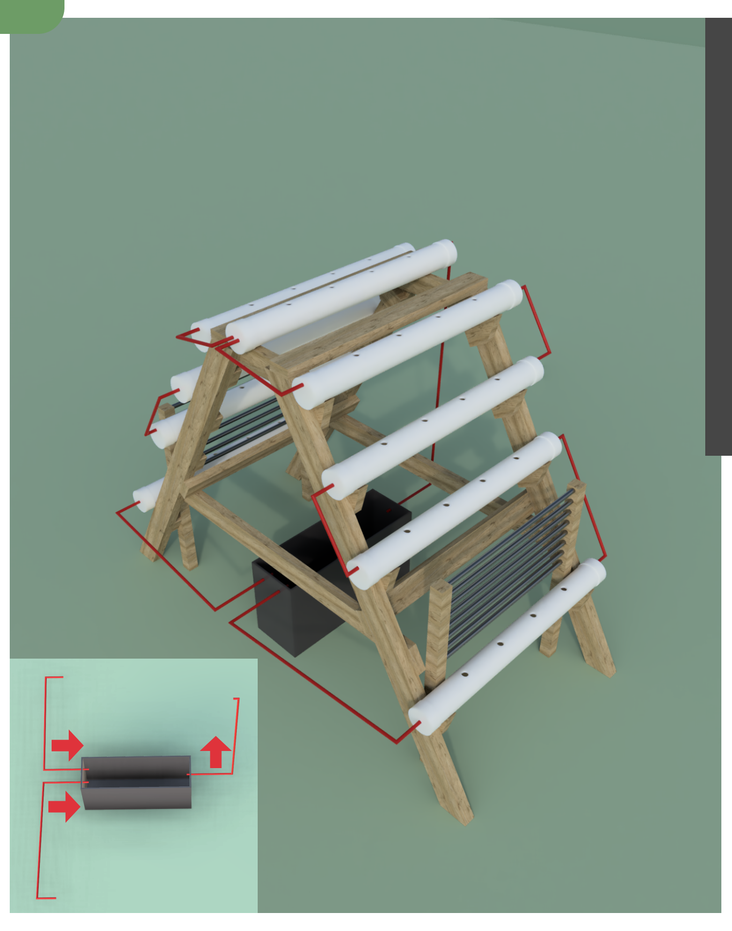
Materials:

- Chicken Wire

Run the trellis material, such as dowels or chicken wire, across the two posts and staple it in place.

Repeat for both sides.

18



Tools:

- Scissors or knife

Materials:

- 8m of 3/4" tubing

Connect the tubing as shown by approximating the length needed to connect one hole to the next. Cut then fit into the pipe input or output hole.

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