**Lights:** **\*Full spectrum covers all types of lights for plants.**

<https://migrolight.com/blogs/grow-light-news/how-high-to-hang-your-grow-light-for-maximum-yield>

Light/Day cycle (Limited by plant type) 16Hr -12Hr -8Hr

**Enclosure:**

The dimensions of the enclosure (height (at least 45cm), width (at least 61cm), depth (Plant dimension)) (m) – Finial

* Materials \* things in the enclosure will help retain heat (Pots, soil, plant).
* Frame type?
* Insulation - Mylar (stretched polyester film) – reflective Insulation
* Airflow Ventilation (running-when necessary, hot air rises (exhaust here), New air near plant)
* Controlling ventilation (Fan turns on if it is too hot, fan turns off if it is too cold)
* Type of wires

**Design Considerations:** LxWxH \*Material

Wires: Gauge, Length of wires wire coloring, Connector mounts? Wire management!

Lights: USB- Argument (The distance from the plant for optimal growth) \*(Controller for)

Sensors: How will they be installed

Temperature – 10-15 cm above plant

Humidity – Can’t be facing lights (consider facing downwards)

Moister – into soil (not past line!)

Fan: Placement of fans (intake near plants, exhaust near top) \*Relay attachment

Intake – Fresh air and blows it across plants

Exhaust – blows hot air and humidity out

Pump-Water to be distributed (volume of container), how will tube be placed

\*Considerations (Heating pad, PTC Heater(150W@12v,12amps)?)

**For plants (Temperature/Humidity/Moisture sensors):**

**Water plants:**

1. **Seedlings or Young Plants**:

Check every 10-15 minutes. shallow roots and are more sensitive to drying out. Higher moister!

1. **Mature Plants in the Vegetative Stage**:

Check every 30 minutes to an hour. As roots grow deeper, the plant can access more water, reducing the need for constant checks. Moderate moister!

1. **For Flowering Plants**:

Every 30 minutes to 1 hour or adjust based on the plant's sensitivity. Flowering stages may need more moisture stability!

TYPE Soil (all-purpose potting mix)

* Type of growable plants in enclosure (Limit size of enclosure)
* VPD for plants (Limited by growth cycle) – parameter

(tomatoes, peppers, or flowering plants)

* Seedling Stage: Lower VPD
* Vegetative Stage: Moderate VPD is optimal
* Flowering Stage: Higher VPD can improve bud or fruit quality in flowering plants

A screenshot of a computer

Description automatically generated

A white paper with black text

Description automatically generated

Useful

<https://extension.okstate.edu/fact-sheets/understanding-soil-water-content-and-thresholds-for-irrigation-management.html#:~:text=Permanent%20wilting%20point%20(PWP)%20is,plant%20roots%20to%20extract%20it>.

**Temperature:**

<https://herbals.co.nz/blogs/spectrum-led-grow-lights/how-temperature-affects-plant-growth#:~:text=As%20a%20general%20rule%20of,degrees%2C%20problems%20can%20quickly%20occur>.

<https://www.aquagardening.com.au/learn/ideal-temperature-and-light-for-plants/#:~:text=Plants%20grow%20well%20in%20moderate,22%C2%B0%2D26%C2%B0C>.

<https://www.sanas.com/download/18.1715bfaf1530dc5636613aeb/1459420579402/01337%20-%20Calculation.pdf>

**Heat in enclosure (most electrical power in an enclosure will convert to heat.)**

**Hysteresis? – Time delays to prevent. \*Time delay intervals (5-10ms)**

Desired internal temperature of enclosure:

PH​=A×k×ΔT (PH a range of 20°C - 25°C or whatever we can get out)

* Seedling Stage: 18°C-24°C (64°F-75°F)
* Vegetative Stage: 20°C-26°C (68°F-78°F)
* Flowering Stage: 20°C-28°C (68°F-82°F)

**Calibration test:**

 Ice **Bath (0°C)**:

* Fill a container with crushed ice and a little water to create an ice bath. This should reach a stable temperature of 0°C.
* Insert the PT100 sensor into the ice water, making sure it doesn’t touch the container walls, and let it stabilize for a few minutes.
* Measure the resistance or voltage (if using a Wheatstone bridge) corresponding to 0°C.

 Boiling **Water (100°C at Sea Level)**:

* Boil a pot of water and place the PT100 sensor in the water, avoiding contact with the container walls.
* Boiling water reaches around 100°C
* Measure the resistance or output voltage corresponding to 100°C.

 Room **Temperature (~20-25°C)** (Optional):

* thermometer to check room temperature. Measure the PT100’s resistance at this ambient temperature for an additional calibration point if available.

**Humidity sensor:**

Calibration test:

 Low **Humidity Reference (~10-20% RH)**:

* Create a low-humidity environment by placing the sensor in a sealed bag with **dry rice** or **silica gel packets** (often found in packaging).
* Leave the sensor in this environment for about 15–30 minutes to let it stabilize. This won't reach 0% RH exactly, but it will give you a repeatable low humidity point around 10-20% RH.

 High **Humidity Reference (75% RH)**:

* Use a saturated salt solution. Dissolve **table salt** (sodium chloride) in a small, shallow container of water until it no longer dissolves, and you see undissolved salt at the bottom.
* Place the container and sensor in a sealed plastic container or large zip-lock bag and let it sit for several hours. This should create a stable environment of around 75% RH at room temperature.

VPD**:**

[**https://pulsegrow.com/blogs/learn/vpd?srsltid=AfmBOorSSYhbycFWfy5A9qgju2ixNzs0szY2wOCrmBSAFGlglVT4jLdl#calculate**](https://pulsegrow.com/blogs/learn/vpd?srsltid=AfmBOorSSYhbycFWfy5A9qgju2ixNzs0szY2wOCrmBSAFGlglVT4jLdl#calculate) **– Everything about VPD**

Table 1 All Plants grow cycle VDP

|  |  |  |  |
| --- | --- | --- | --- |
| **Temperature (°C)** | **Saturation Vapor Pressure (kPa)** | **VPD = 0.6 kPa (RH %)** | **VPD = 1.5 kPa (RH %)** |
| 20 | 2.34 | 74.4 | 35.9 |
| 21 | 2.49 | 76.4 | 39.2 |
| 22 | 2.65 | 78.2 | 42.5 |
| 23 | 2.84 | 80.1 | 45.9 |
| 24 | 3.02 | 81.8 | 49.3 |
| 25 | 3.17 | 80.9 | 52.7 |
| 26 | 3.37 | 83.4 | 55.5 |
| 27 | 3.58 | 84.9 | 58.7 |
| 28 | 3.78 | 86.3 | 62.0 |
| 29 | 3.99 | 87.6 | 65.0 |
| 30 | 4.24 | 85.9 | 64.5 |

Table 2 Vegetative Cycle VDP

|  |  |  |  |
| --- | --- | --- | --- |
| **Temperature (°C)** | **Saturation Vapor Pressure (kPa)** | **VPD = 0.8 kPa (RH %)** | **VPD = 1.2 kPa (RH %)** |
| 20 | 2.34 | 65.3 | 42.7 |
| 21 | 2.49 | 67.0 | 44.8 |
| 22 | 2.65 | 68.6 | 46.6 |
| 23 | 2.84 | 70.5 | 48.9 |
| 24 | 3.02 | 72.4 | 51.1 |
| 25 | 3.17 | 74.0 | 52.9 |
| 26 | 3.37 | 75.8 | 55.0 |
| 27 | 3.58 | 77.4 | 57.1 |
| 28 | 3.78 | 78.9 | 59.4 |
| 29 | 3.99 | 80.2 | 61.4 |
| 30 | 4.24 | 79.5 | 60.4 |