# Goals and Plans:

***Goals:***

* Create a vertical farming system that will expedite the growth of a legume, Chickpea, to prove the legumes can be grown in such a system and provide a potential solution to hunger. A prototype should be completed by June 12th, 2022 at the BYU ECEn 240 Inventor’s Fair.

***Plans:***

* Develop the concept of what we need in order to track the growth of the plant under several conditions
* Record this data in some form that is readily available
* Grow the plant till we can harvest it
* Test several conditions to optimize the solution.

# Developing:

**What I need it to do:**

* Water the roots at specific intervals (turn on the pump at specific times)
* Check the water balance (nitrate, phosphate, potassium).
* Adjust the water balance
* Maintain a specific temperature and cycle through it (day and night)
* Manage the light cycle
  + Probably will just need to use a programmable grow light
* Maintain a controlled environment
  + The more isolated it is the better
  + We can get some indoor greenhouse or build our own.

**What I want it to do:**

* Weigh the plants
* Update the information of the growth (calculate the average growth of the day, depending on things like the water balance, light, and/or time) to some source online
  + The source would likely be a google sheet or an excel document
  + I would like to render this data in a 3D graph
* Update information on the system itself
  + Did any errors occur
  + Is anything wrong?
* Have some display where we can manually change the ppm for the system (we don’t need to reprogram the whole system).

**Components that we need:**

* Microprocessor that can manage all of the computation
* Thermometer
* Heater
* Pump
* Atomizer
* S
* Timer
* Scale that can measure al connection to write data
  + Wifi for Google sheets
  + USB to write the information on a predefined sheet
* Display with multiple buttons to navigate options
* Some sort of spectrometer to measure the contents of the water.
  + From what I can tell there isn’t one thing for all so we will need to get a device for each thing we want to measure.
* Values to maintain the water level and chemical levels.
* Look into an electric valve!!!
* Find some sort of bubble switch or a bobber to set the water level.

**Where I will buy what:**

* **Amazon:**
  + Tubing
  + Fertilizer
  + Water pump
  + Air pump
  + Soil
  + Seeds
  + Nets
  + Ceramic air heater
  + 4 load measures, I do not anticipate needing more right now.
  + Grow tent
  + ~$235
  + May need to get some tubing like this: [Amazon.com : wire tubing](https://www.amazon.com/s?k=wire+tubing&i=industrial&crid=OXXB3YDP9GSH&sprefix=wire+tubing%2Cindustrial%2C119&ref=nb_sb_noss_1)
* **Newark:**
  + Temperature Sensor IC, Programmable Resolution, Digital, ± 0.5°C, -55 °C, +125 °C, TO-92, 3 Pins
  + ~$12
* **EC shop:**
  + 3 Motors
    - We will need to design or find a design that will turn something like this:
    - One will be used to power a fan
* **Aliexpress:**
  + Everything from this website I might be able to allocate everything.
  + [DIY Grow LED Light | Designing a Better Sun - Arduino Project Hub](https://create.arduino.cc/projecthub/dymonxd/diy-grow-led-light-designing-a-better-sun-1adec1)
  + ~$60
* **Everything right now sits at 307, not including shipping.**

Links to Carts:

[Your AliExpress shopping cart - Buy directly from China](https://shoppingcart.aliexpress.com/shopcart/shopcartDetail.htm?spm=a2g0o.detail.0.0.18714285V99H24)

[Newark](https://www.newark.com/webapp/wcs/stores/servlet/AjaxOrderItemDisplayView?catalogId=15003&storeId=10194&langId=-1&krypto=LgMJFPakeQXNBxYhfx5sNCfoRSXFnAUhgb9weanKGSjYTgZXpM2Orgc%2FVeQxb3GBGhHAgTebJwJASE0H0dK714K3YfErT7cZFvMqTevSRO1FCni4ffH77oKJYogIXCC5t0uc02TfKNWZf1LflluiYhu577xnSE7rNRBvwAHtBoSJO6LTG7enpKW9YmWHbOeb&ddkey=https%3AOrderCalculate)

[Amazon.com Shopping Cart](https://www.amazon.com/gp/cart/view.html/ref=dp_atch_dss_cart?)

Things to make with thingiverse:

[Easy Pump arduino stepper by mochr - Thingiverse](https://www.thingiverse.com/thing:2219695)

[Load Cell fixture case (HX711 half bridge) optimized by ThomDietrich - Thingiverse](https://www.thingiverse.com/thing:4594801)

**Links to Arduino projects that will be useful in building this**

[Arduino Electrical Conductivity (EC - PPM - TDS) Meter - Arduino Project Hub](https://create.arduino.cc/projecthub/mircemk/arduino-electrical-conductivity-ec-ppm-tds-meter-c48201)

[Three Dollar EC - PPM Meter [Arduino] | Details | Hackaday.io](https://hackaday.io/project/7008-hacking-the-way-to-growing-food/log/24646-three-dollar-ec-ppm-meter-arduino)

[Climate Control - Arduino Project Hub](https://create.arduino.cc/projecthub/achraf-oukheir/climate-control-e22810)

[Climate Control - Arduino Project Hub](https://create.arduino.cc/projecthub/achraf-oukheir/climate-control-e22810)

[DIY Grow LED Light | Designing a Better Sun - Arduino Project Hub](https://create.arduino.cc/projecthub/dymonxd/diy-grow-led-light-designing-a-better-sun-1adec1)

# Plot:

The main thing I have been trying to detect how much or specific chemicals are in the water. Using a spectrometer or some other meter seems to be very difficult and while NPK sensors exist they are meant to be used to test soil not water. It is likely that the NPK soil sensors are dependent on some resistance from the soil and as a consequence would not work. Our second option is to check for the Electrical Conductivity.

From what I have found about what level of NPK Chickpea’s need we are looking at a 3-⅓-1 mixture with an additional 0.2 for sulfur[[1]](#footnote-0). We will have to break the data given on the website to ppm for the amount of water that we will need.

From what I have found from research most chickpeas grown in soil start with a 5-10-10 mixture, additionally I found this resource for growing beans in a hydroponic situation: [Hydroponic Beans Farming - Yield, pH, Nutrients | Agri Farming](https://www.agrifarming.in/hydroponic-beans-farming-yield-ph-nutrients). While there are a few resources that I have found that say different things the key thing is that they need a list of basic nutrients that are listed in the link above. And we need to make sure they do not have too much nitrogen as chickpeas perform nitrogen fixation. I believe my best option when it comes to nutrients is to us a 5-10-10[[2]](#footnote-1) with some compost that we leave in jar for a few days. The compost will consist of garlic, orange peel, banana peel, and egg shell.

I am thinking I will need 400gph, though I am not sure the hard part is that I need the tank pressure before it goes into the tube and the exit pressure.

I got this idea while I was brushing my teeth and looking at how much water each plant needs. Instead of a strictly aero or hydroponic setup we could do a hybrid. Have a spout trained to each root base and the water will run down each of them similar to how water flows from the surface downward. Another idea to consider is having a circular spray that does not require as dramatic psi to atomize the water.

Tubing will probably be best for me.

Lettuce needs about the same amount of water so Hydroponic system would be an option but having the root system free would probably be for the best because of how long the roots get.[[3]](#footnote-2)

# Calculations:

A chickpea is roughly 2g.

1. [Chickpea crop requirements | Haifa Group (haifa-group.com)](https://www.haifa-group.com/chickpea-crop-requirements) [↑](#footnote-ref-0)
2. [Amazon.com: Lilly Miller Morcrop Tomato & Vegetable Food 5-10-10 4lb : Everything Else](https://www.amazon.com/Lilly-Miller-Morcrop-Vegetable-5-10-10/dp/B000OVCHQA/ref=sr_1_5?keywords=5%2B10%2B10%2Bfertilizer&qid=1651789144&sr=8-5&th=1) (will need to use something that is liquid [↑](#footnote-ref-1)
3. [How Much Water Does Lettuce Need? | Pepper's Home & Garden (peppershomeandgarden.com)](https://peppershomeandgarden.com/how-much-water-lettuce-need/) [↑](#footnote-ref-2)