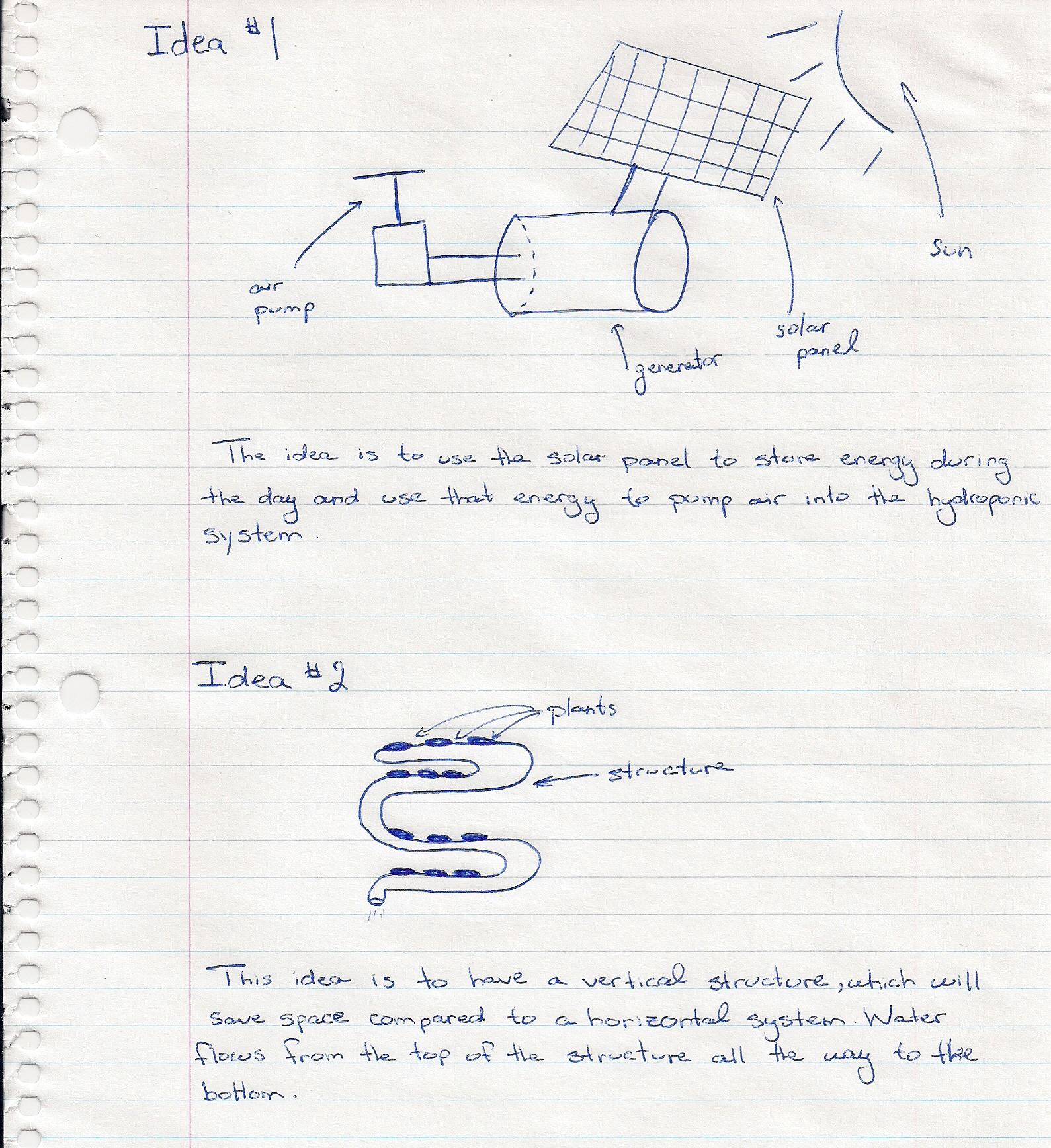
**Conceptual Design**

**Introduction:**

This deliverable explores concepts and ideas of each team member. Each member has chosen their respective subsystems and has come up with an “ideal” representation of that subsystem. The objective of this deliverable is to generate numerous ideas for each subsystem, converge on our ideas so that we will be able to decide the best ideas of each subsystem for our “ideal” system design. As you continue to read through this deliverable, our reasoning behind our selection and our definition of an ideal system will be stated.

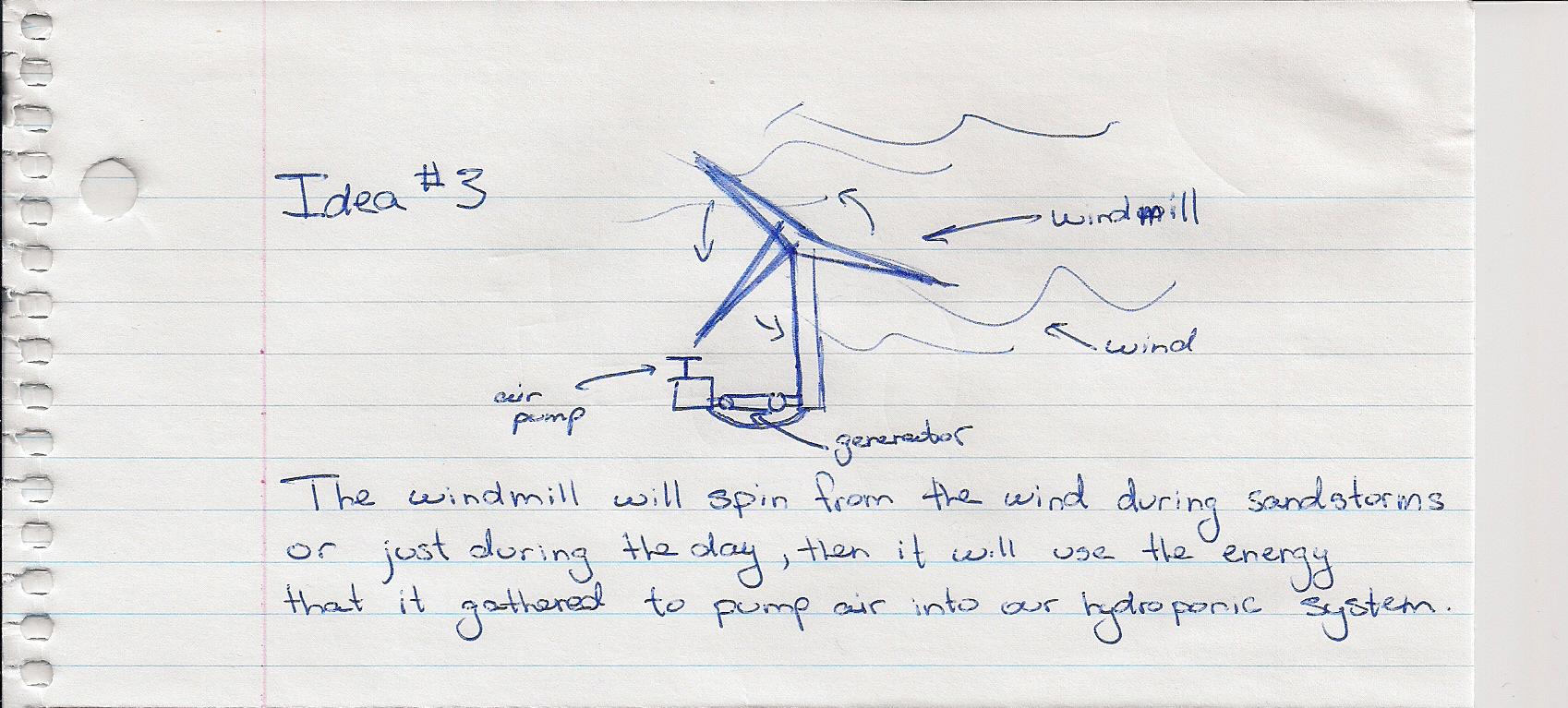
**Concept Ideas:**

Shadman:

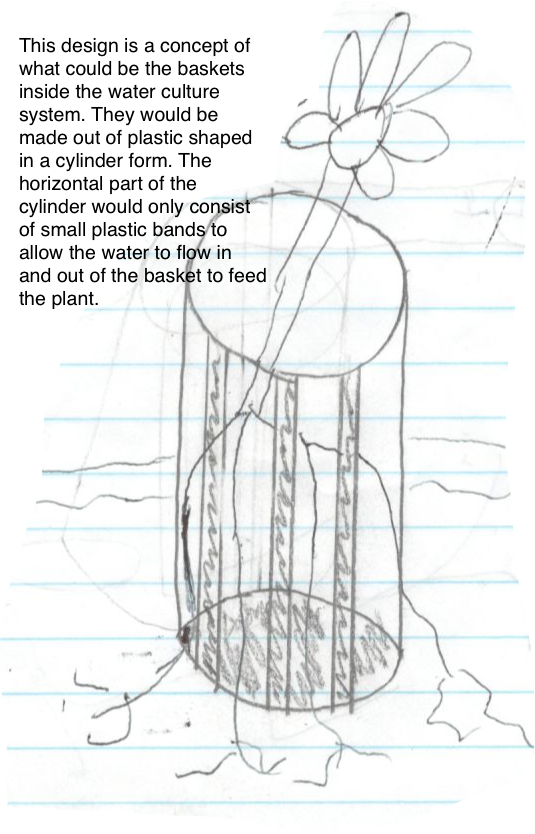


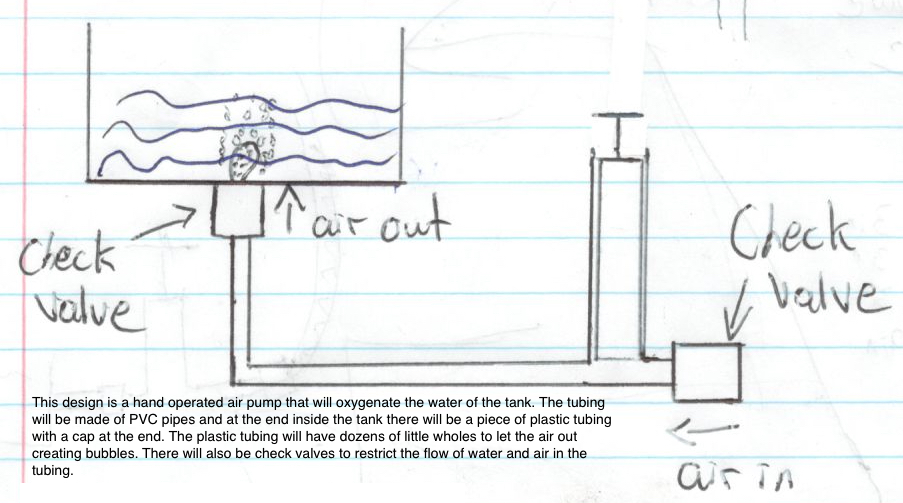
The idea of a solar powered air pump was chosen because it generates renewable energy that will store its energy during the day and use that power to operate the air pump during the night. The major drawback of this idea is that it’s very expensive.

The benefits of a vertical hydroponic system is that requires relatively less space than other system designs. The vertical system also allows more plants to be grown at once. A drawback of a vertical system would be that it requires continuous pumping of water because as the water is pumped to the top it flows back down, leaving the plants without any water.



The benefits of a windmill is that it provides renewable energy but the drawback is that it’s very expensive.

Nicolas:

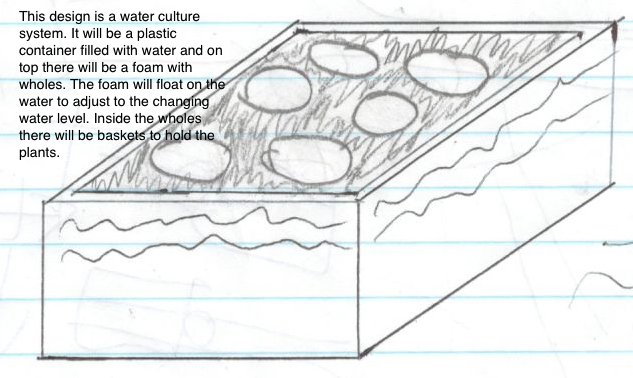


Using an air pump to oxygenate the water inside the water tank has its advantages and its draw backs. On the positive side it is cheap to do and use, it is easy to maintain and repair and is effective to maintain a garden healthy. Considering the down side, someone

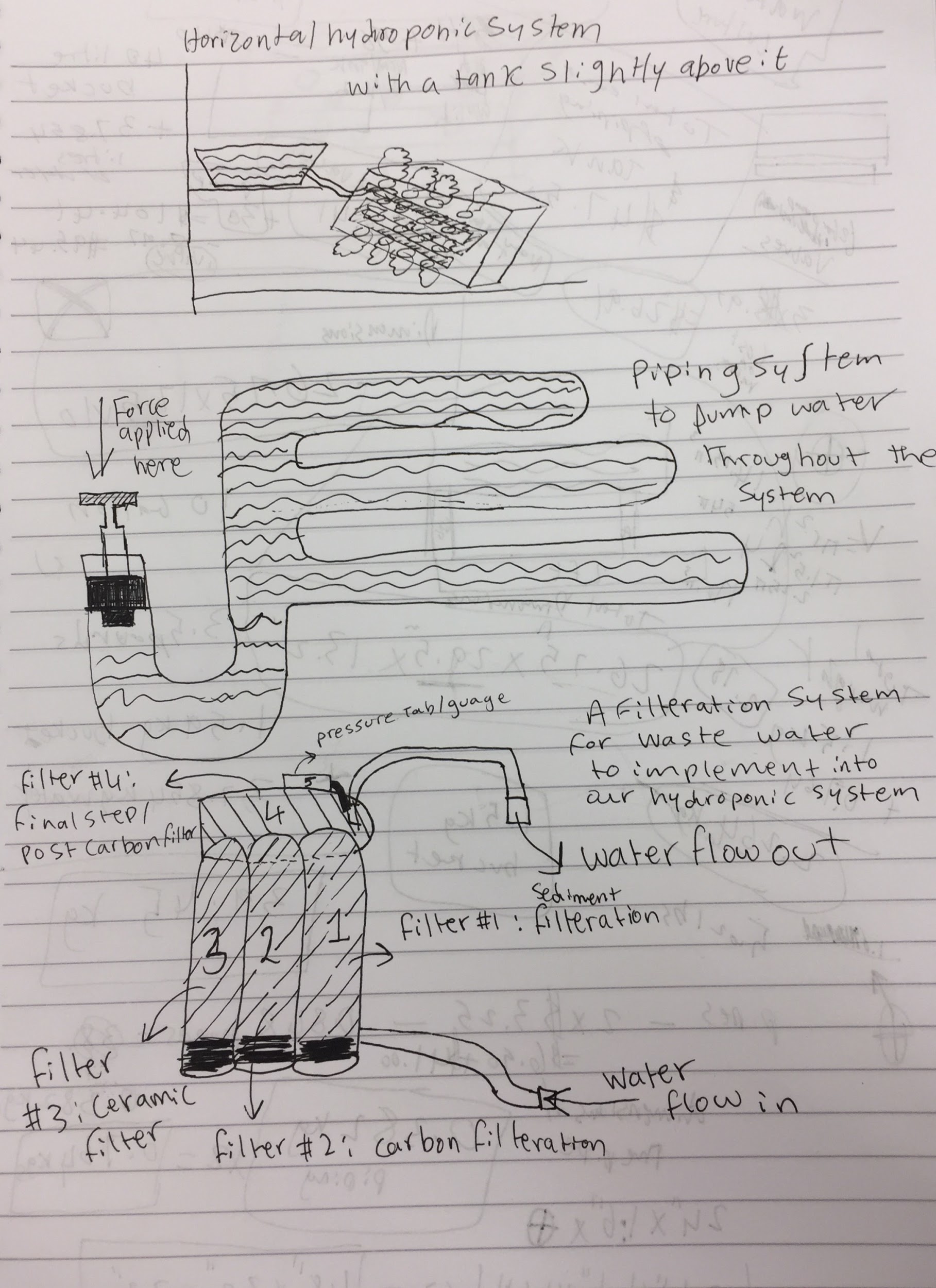
has to always pump to create oxygen. During the night someone

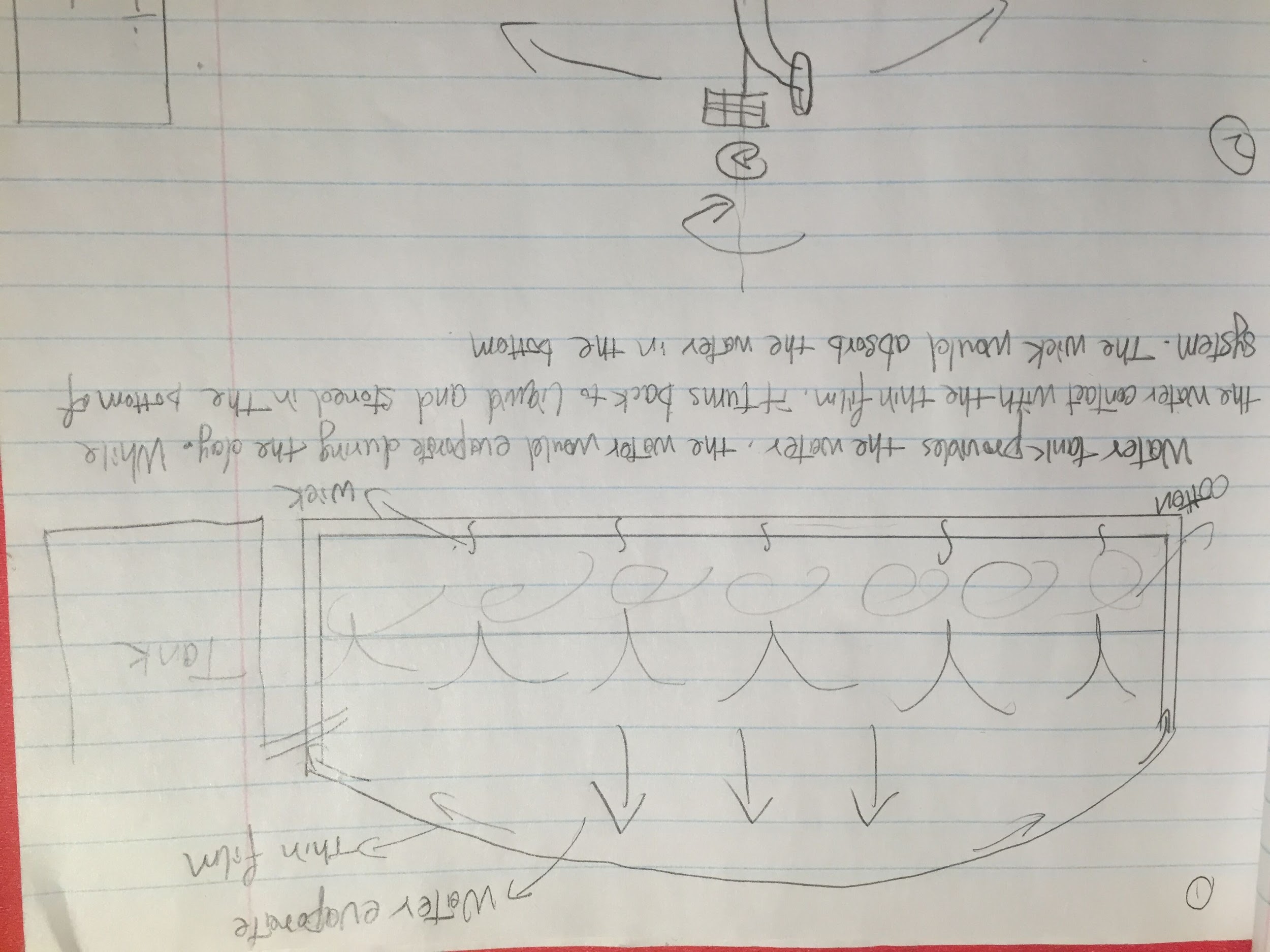
‘will have to get up and oxygenate the plants.

This basket is a very simple design that it fail-proof. It is made out of plastic so it will not disintegrate due to the water. The roots of the plant are able to grow freely and absorb as much water as they need. It is cheap and has very few downsides. One disadvantage is that the plant is always in the water which can be bad for certain kind of vegetation.



The use of a box as a hydroponic system is a good idea since it is very simple. The plants are held by a block of foam which floats over the water so you don’t need to worry about the water level changing. Also foam does not disintegrate which is good. The maintenance on this design is very easy and there is very minimal water evaporation since the foam on top acts as a lid. A drawback is that the plants are once again always in the water. Also their is no kind of water circulation which makes stagnant water.

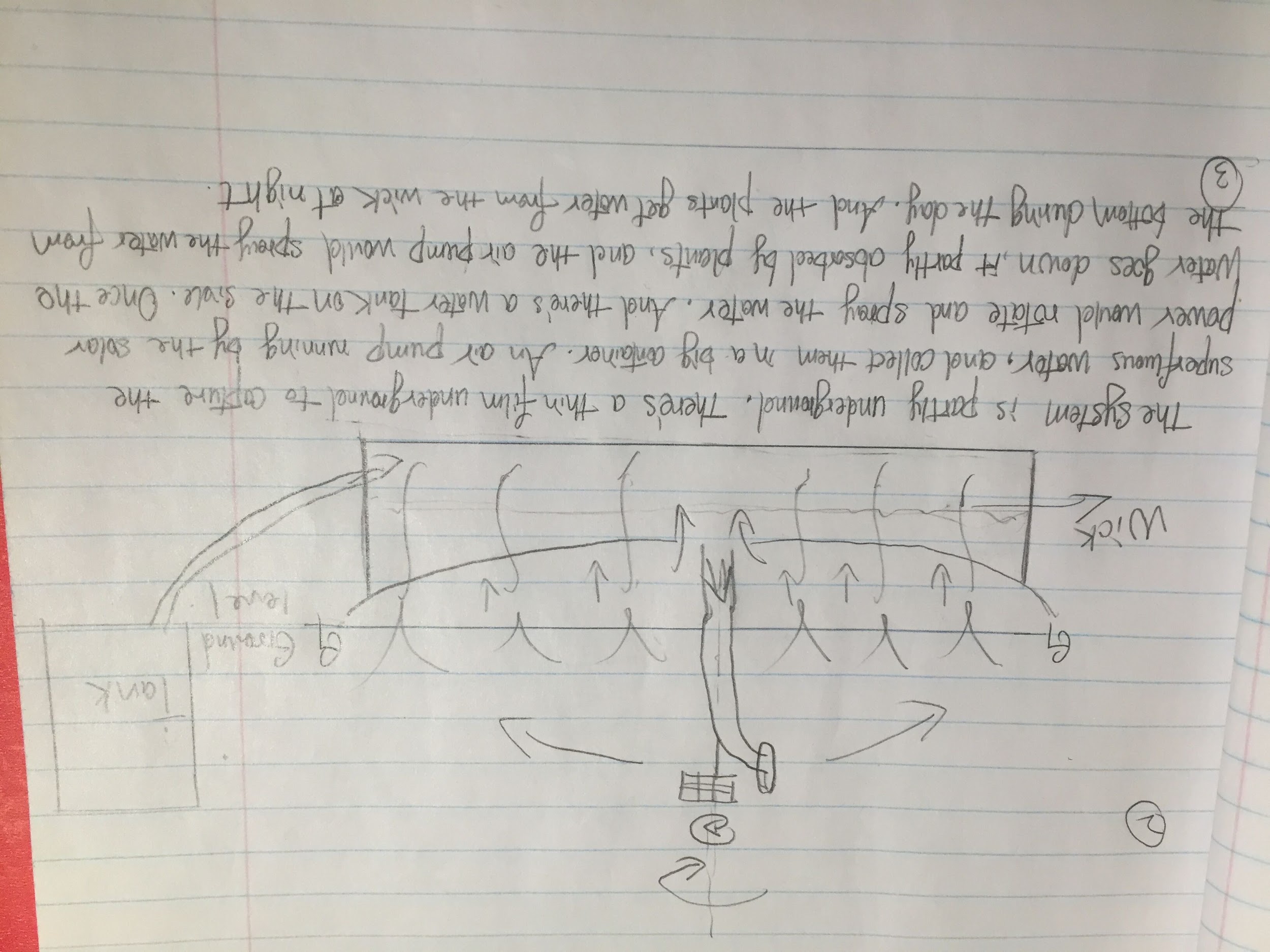
Omar:Hanguang:



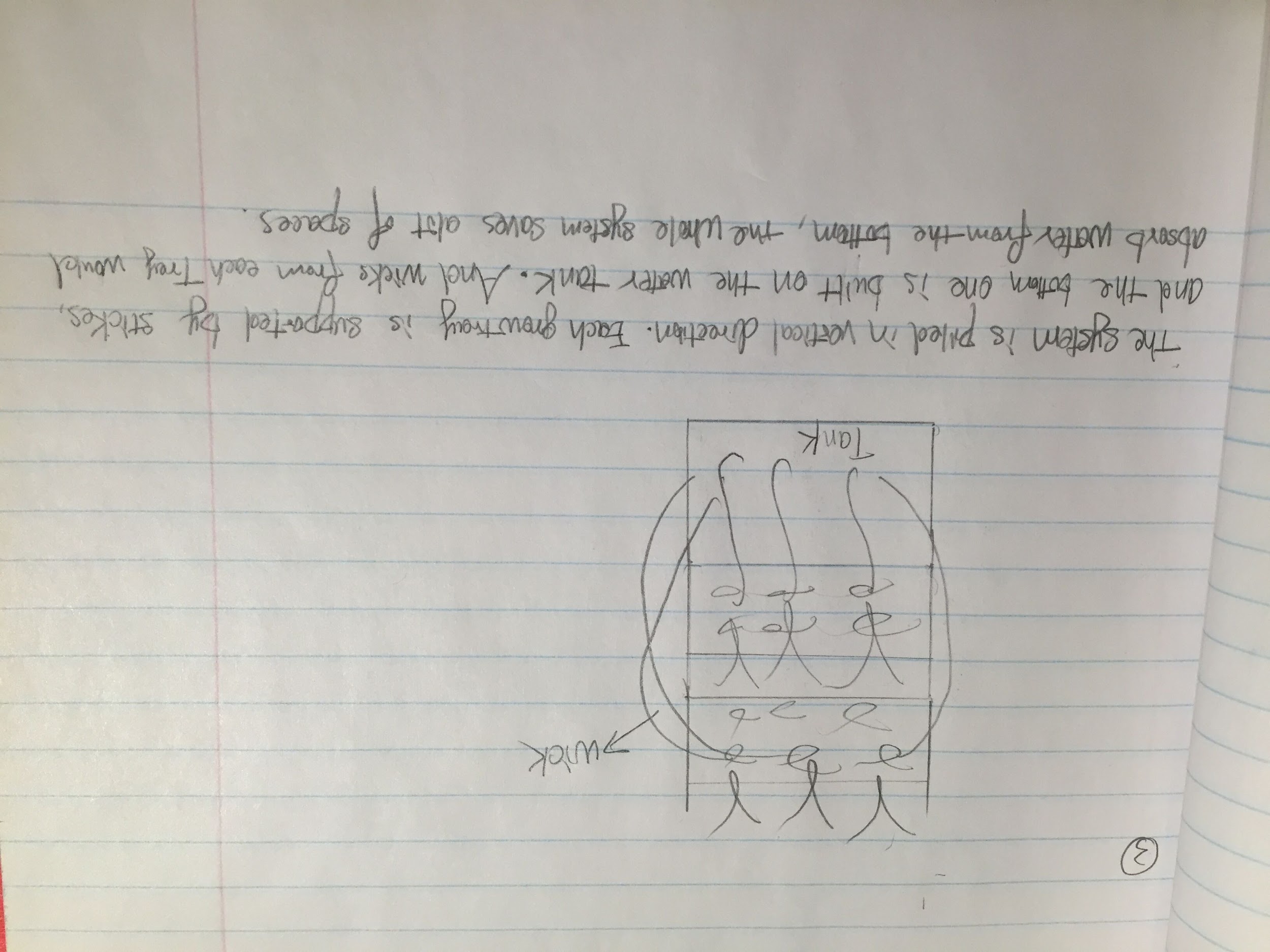
This system is an ideal closed system, the only two water source in the system are the tank and

the evaporated water. The benefits of this system is it can save a lot of water. Due to the fact that there is a thin film on the top of the grow tray, the water evaporated from the plants would reform liquid water on the film, and goes down to the bottom. The water in the bottom of the system would be absorbed by the wick system, which decreases the loss of water.

The drawback is that the system takes a lot of time to evaporate the water from the plants. Also, the evaporate efficiency is mainly dependent on the weather. Besides, the system is hard to work under a low temperature, once the evaporated water is in contact with the film in a low temperature, it would become solid, which brings the efficiency down.



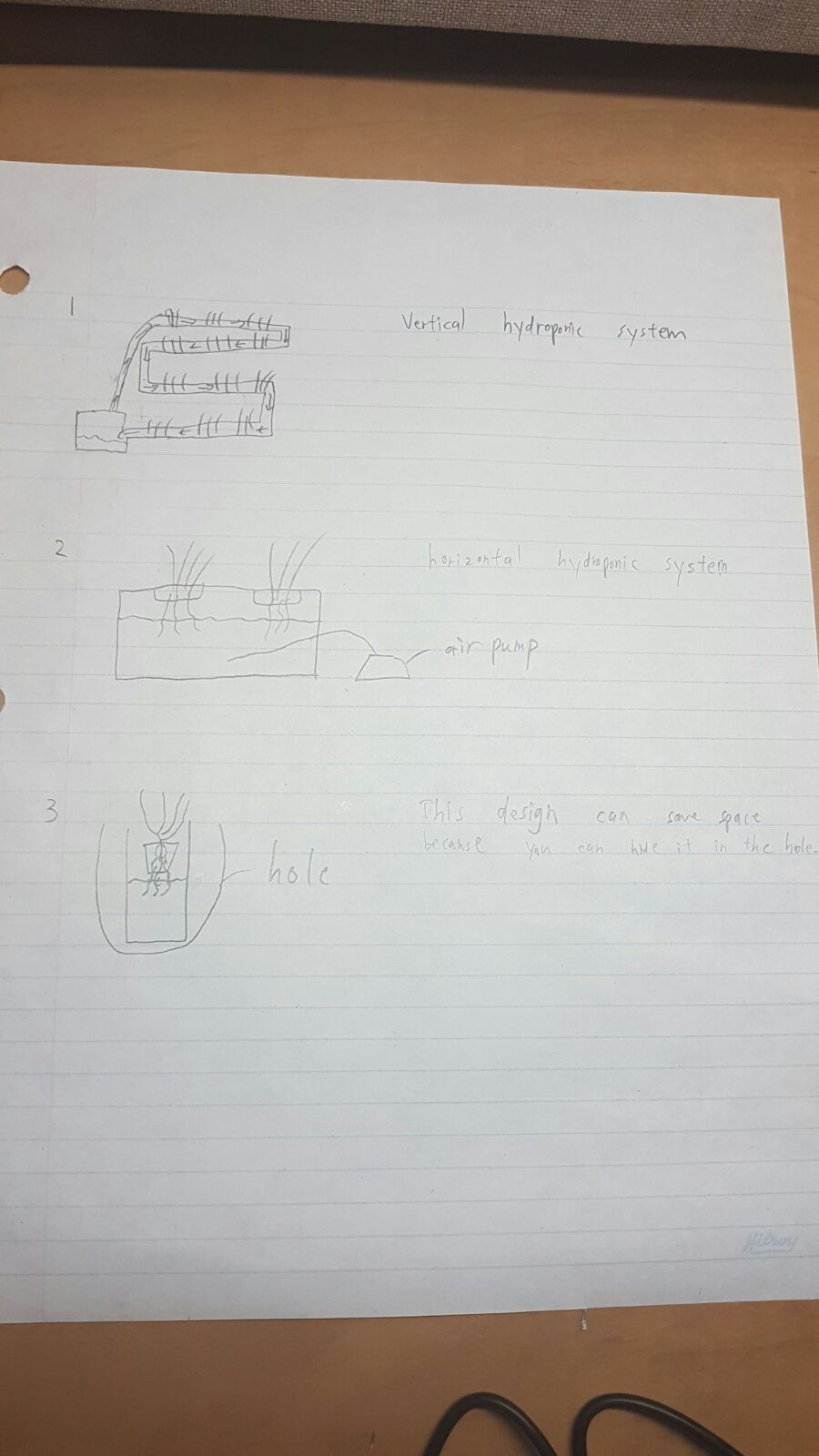
The advantage of the system is that it can save nutrient and water, and it can work during the whole day. Due to the thin film that is underground, it can capture the reluctant water and nutrients. And the wick system would absorb those substance, and the water taint can also provide water. During the day, the water tank can provide the water, and the wick system works better during the night. The low temperature won’t affect the efficiency because the system is partly under ground. The drawback is the system is hard to build and move. The thin film is underground, so that it would cost a lot to put it into the ground, and it’s hard to move the system.



The advantage of the vertical wick system is it saves a lot of space. It can pile several grow trays on the top of the tank, it saves a lot of space comparing to a horizontal one.

The drawback is the wick would take a long time to transfer the water from the bottom, which leads to a low efficiency. Also, the water and nutrients are hard to recycle, so that it would cost a lot on the water supply. And this system can’t deal with low temperature.

Joshua:

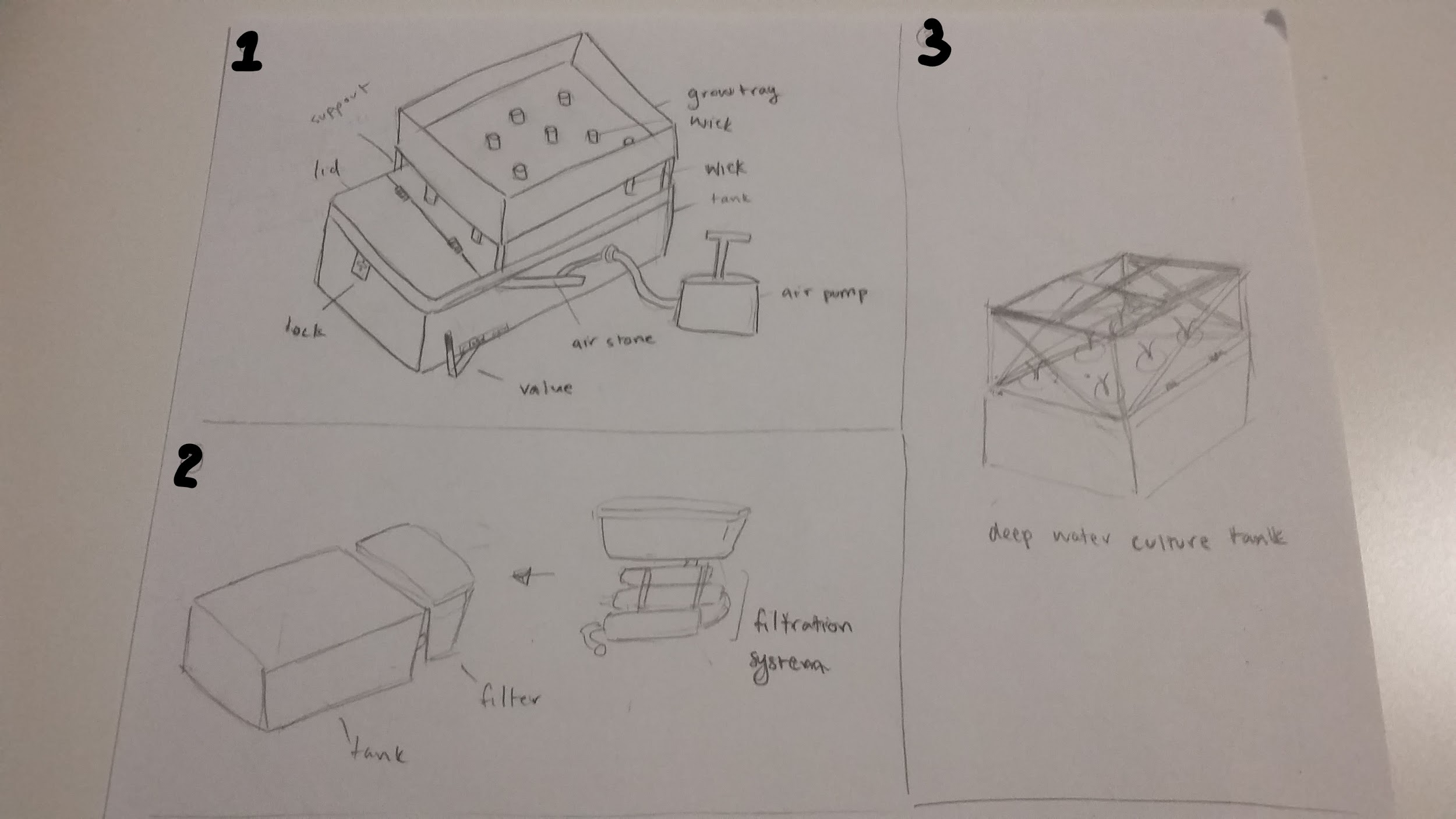


1.The vertical set up means that more plants can be put in a smaller space. The disadvantage of the system is that the water needs to be constantly pumped which can be expensive and bad for the plant if the water is not set up properly.

2. The advantage of horizontal hydroponic system can be grown anywhere, so harsh climate makes no difference. The water will also be reused which will save much more water.

3. Having the deep wick system in a hole means that it takes up less horizontal space and the environment can be controlled. Keeping the environment control will ensure the system operates efficiently and maintenance will be less expensive.

Edwin:

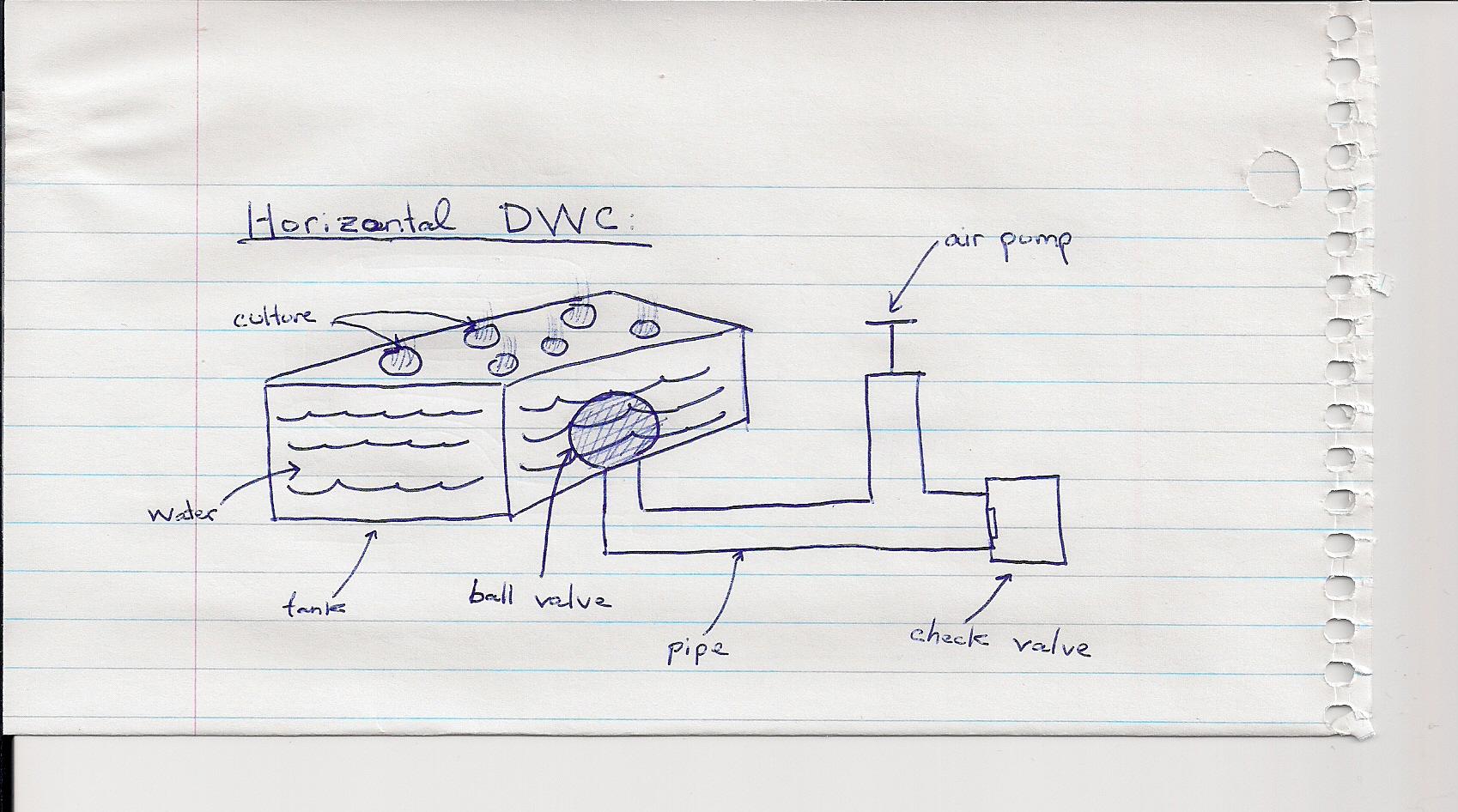


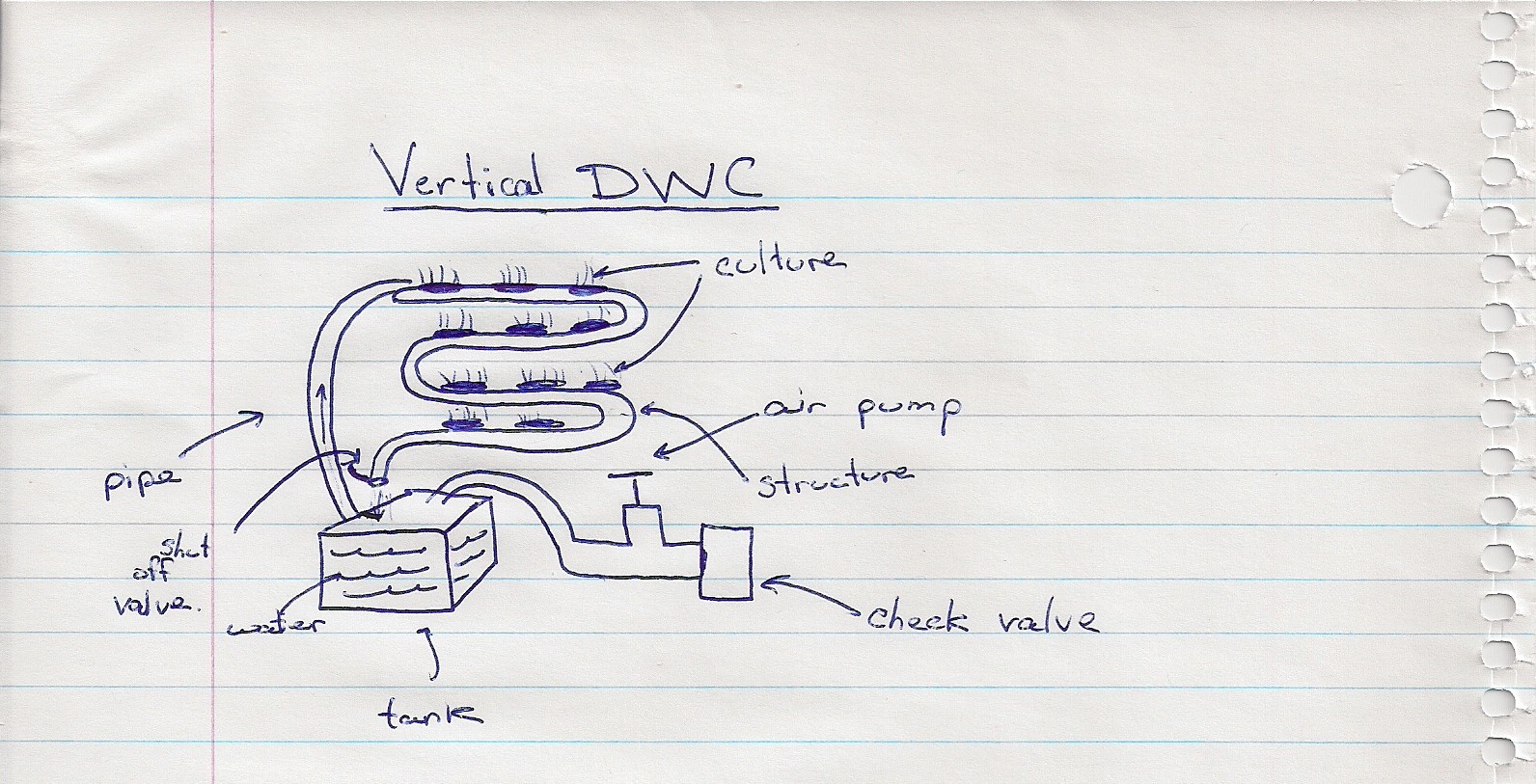
1.) This design features a simple wick system that has a valve, a lid, and a lock. For this system the grow tray is supported directly above the tank to save space. A valve is included in this design to easily remove water from the tank. The lid provides easy access to the water tank without taking apart the whole system. This allows the user to add water, nutrients, or check the water conditions. Lastly, the lock is used to keep the lid of the tank secured while it is closed.

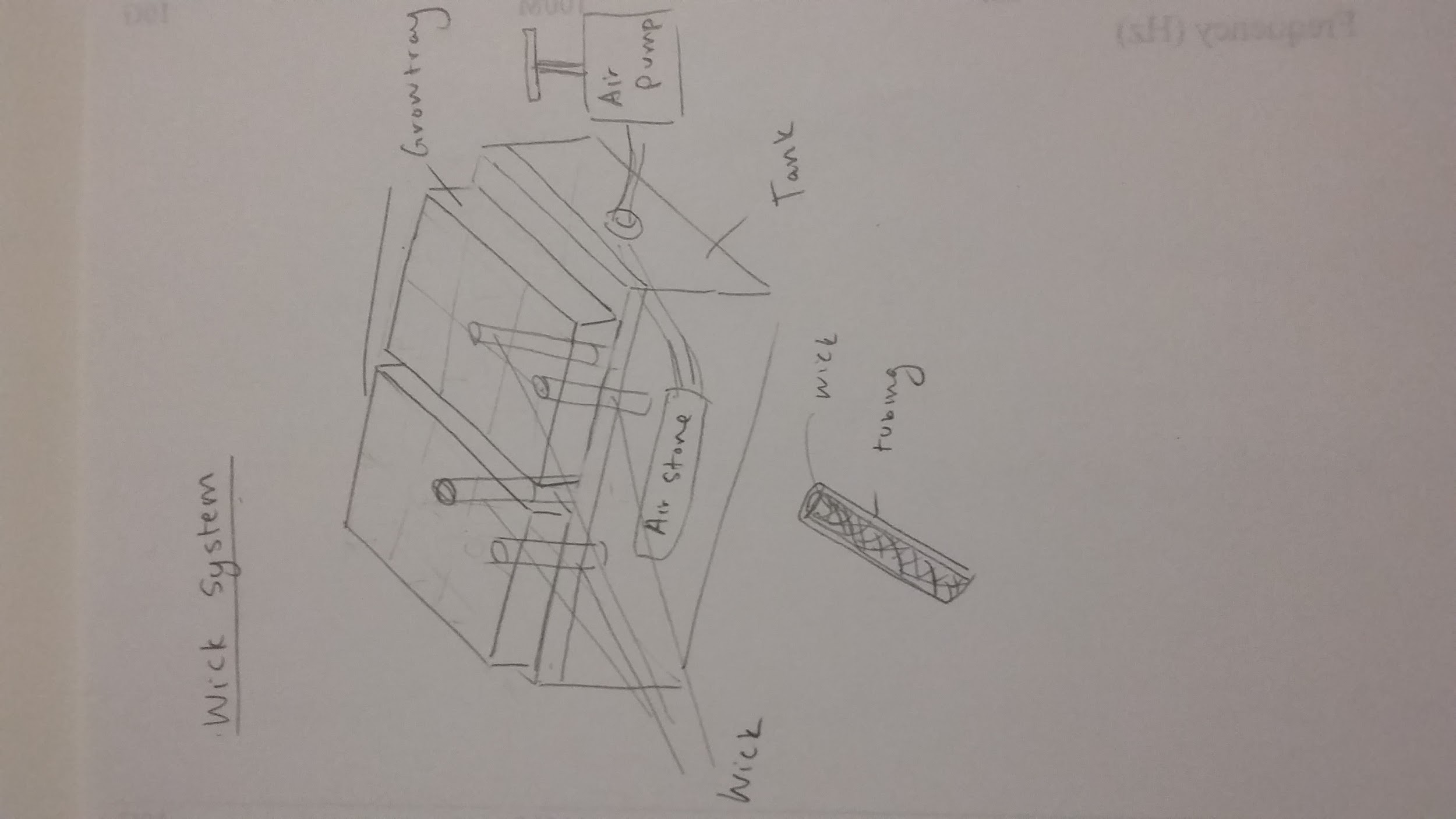
2.) This design features a filtration system built into the system. This design is easy to use as the user only has to pour unfiltered water into the tank of the filtration system. The filtration system is also built closely to the tank to save space and it is detachable to allow easy maintenance

3.) This design features a cage that encloses the deep water culture hydroponic system. The cage provides an ease when applying a shade cloth to protect the plants from heat. It will use minimal amounts of material to stay lightweight, cheap, and continue to provide easy access to the plants. The cage is fitted onto the tank through a snap mechanism which allows it to be easily attached and detached.

**System Ideas:**







**Evaluation:**

(3 = Green, 2 = Yellow, 1 = Red)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Design | Importance  (weight) | Vertical Water Culture | Horizontal Water Culture | Vertical Wick System |
| Cost $ | 5 | 160 | 110.44 | 65 |
| Dimensions  (LxWxH)  (in) | 4 | 120.00 x 16.00 x 48.00 | 26.75 x 17.50 x 10.00 | Grow Tray  10.98 x 22.01 x 4.02  Tank  13.75 x 32.00 x 19.0t0 |
| Weight (lbs) | 3 | 62 | 5.02 | 8 |
| Recyclability | 5 | Yes | No | No |
| Filtration | 2 | No | No | No |
| Capacity (L) | 3 | 130 | 37.9 | 100 |
| Estimated Capacity (Plants) | 5 | 60 | 10 | 12 |
| Material | 3 | PVC/Plastic | Plastic | Plastic |
| Total |  | 70 | 47 | 61 |

**Analysis:**

The first design criteria that we have focused on were cost. Since, the cost of the system determines if the refugees or NGOs will be able to afford it or even consider to purchase it. Another criteria that we have chosen was weight because it is important that the system light. Since, our client mentioned during the interview that the camp faces sandstorms and if the system is too heavy then it will be difficult to move the system indoors. The standard of recyclability of the water was chosen because the Syrian refugees are struggling with water shortage, so the ability to reuse the existing water is a key aspect for our hydroponic system. Filtration is a very important concept for our system but unfortunately in order to maintain the other criterias such as cost we were unable to incorporate it into our system ideas. In our previous deliverable we had benchmarked a product which included a filtration system and the cost was relatively cheap, we are trying to understand how the company managed to keep their prices low with a filtration system which was found to be expensive in the market. We conducted research on the product and found that the material that was used was cheap plastic and the product life was 2 years maximum. Even though none of our designs incorporate a filtration system we think that the criteria itself is very important. The criteria of capacity of the tank is important because it determines how much water the system can hold and implicitly how many plants it can grow. Plant capacity is an important criteria because if a system can hold more plants that means that the users are able to grow more crops and save time. Lastly, the material of the system is one of our design criteria because the type of material determines the price of the system, how long it will last and other non-functional requirements as mentioned in our previous deliverable.

Using the design criteria mentioned above we created three global concepts using the group's ideas of an ideal subsystem. Those three concepts were different from each other to be able to see what are the advantages and drawbacks of each different design.

The horizontal system allows a capacity of approximately 10 plants and weighs about 5 lbs which is ideal because it will be easier to bring indoors during bad weathers such as sandstorms. The horizontal system is based on a traditional hydroponic system which encompasses a few plants and is easy to maintain because it does not require continuous pumping of water or air into the system. Once the water is in the system, it is only a matter of time when the water is required to be changed so it requires little attention which is good, although the system has major drawbacks. The drawbacks are that it can only hold approximately 10 plants and the cost when considering its capacity to the other systems such as the vertical system or the wick system is relatively high. The dimensions of the system is also very small compared to the other system that we had benchmarked and also compared to our two other systems. The evaluation of the horizontal system shows that the system failed to in many of our design criterias mentioned above which is why it received the lowest score. The system could be improved by increasing the plant capacity which would also increase its dimensions but the cost would have to stay low. An alternative would be a change in material which would decrease the cost of the system.

The vertical water culture system is the largest system of all three concepts. It can hold up to 60 plants which will be able to feed more than one caravan or tent. Having a larger system requires more space but, to address this issue this hydroponic system is vertical. It will be made of PVC which is an affordable and solid material so it will be able to stay vertical with very minimal support. Since weight is an important design criterion we had to figure a way to make it lighter. That is why this structure can be disassembled into pieces. The water tank can be separated and the support for the system can be removed which will make the product lighter and easier to transport. Even though all the pieces separated might not be heavy it is still inconvenient to do multiple trips to move the entire system. Another important design criterion that was taken into consideration while designing this concept was the cost. While comparing our three concepts the vertical water culture is the most expensive but is also the most effective. Even though it is almost 100 dollars more than the cheapest system it is still the most effective. One very important feature of this design is that the water can be recycled through the system. The pump will be able to pump water up the system which will then flow back down due to gravity. This oxygenates the water and avoids creation of bacteria in the water by always keeping it moving. The only downside with that idea is that there must always be someone pumping to keep the water flowing. Also the water tank will be sealed so evaporation of the water will be very minimal. Unfortunately, this design does not have a filtration system which does not affect the design overall by much since as a group we decided that the filtration system was something we would compromise to fulfill other design criteria. Finally this design was able to accommodate a large water tank that can hold 130 L since the container is separate from where the plants grow which means that it does not have to be very complex. A simple plastic box is cheap and effective for what it needs to do.

The wick system prioritizes the use of simples, cheap and easily obtainable material. Thus, the wick system is the cheapest of the three system ideas. This system has two grow trays and a tank that holds 100L, with these numbers we estimated that the system would be able to grow up to 12 plants. With 12 plants per system and at a cost of roughly $65.00 it will be possible for each tent to own one. The lid a top of the tank is capable of supporting the grow trays which allows us to save a lot of space. Since all the materials are plastic, it’s light and easy to transport and build. In addition to the system, there’s an air pump connected to an airstone in the tank to supply oxygen to the water. The air pump requires manual labour to allow the system to run completely without electricity. The system also works throughout the night, because the wick is wrapped with rubber tube, the system can survive in low temperatures and the wick won’t be frozen. The drawback of this system is that it can not produce many plants compared to the vertical system. It has a relatively low cost while also a relatively low yield. This is a huge drawback since the customer requires a large amount of plants.

**Conclusion:**

Therefore, after considering our design criterias such as cost, weight, dimensions, capacity, material, filtration and recyclability system; as a team we determined that our global concept is the vertical deep water culture. The vertical deep water system was ranked highest in our selection matrix as it incorporated most of our design criterias and it was found to be the most practical system for our case. As our client mentioned, the weather is very hot and there are chances for sandstorms. The vertical system can withstand the harsh heat and due to its weight it is also able to withstand heavy winds. It is the cost effective for the price compared to the amount of plants it can grow. It has a large water capacity to store additional water. It is the only model that can recycle the water, which saves on wasted inputs. The group decision is to pursue the vertical system as our global concept and we will continue to look to improve our system. The next step is to develop our prototype and ensure we cover all our steps. We will also need to do more research about which material would better suit our concept.