Entrepreneurship Club (Mr. Wong, Ben, Brandon, Josh)
Business Plan for our new company GrEAU

Goals

-To build a hydroponic growing station and produce organic, pesticide-free, locally grown lettuce.

Reasoning and Philosophy

There are various reasons for our decision to pursue this project as an entrepreneurial venture. Although there is potential for profit in our project this was not our main concern when developing this project. We would like to use this as a proof of concept, to demonstrate the viability of this type of farming in the lower north shore. In addition we would also like to reduce the dependence of our village on outside resources. By growing food locally we believe that we can provide fresher and healthier produce to our community. This will also reduce our environmental impact as we do not need to ship our product long distances.

Environmental Benefits of Hydroponics

Our hydroponic design has numerous environmental benefits, some of which include

- Minimal water loss
  - Reducing the water needs by almost 80% due to the minimization of evaporation and water runoff
- No fertilizer runoff
  - As it is a closed system, fertilizer will not be washed away, reducing waste and preventing fertilizer runoff from polluting local water streams. Reducing algae growth which can have a negative impact on marine life
- No need for pesticides or herbicides
  - As it is an indoor system, competing weeds cannot invade and due to the cold environment, pesticides will not be needed. Thus we do not need to worry about adverse effects of chemical treatments such as the bioaccumulation of these chemicals in our environment and in our bodies
- 30% higher yields than traditional soil based farming
  - Allowing us to reduce the ecological footprint of farming
- More plants per square ft.
  - Because plants are easily moveable throughout their development they can be packed much closer together during early growth when they take up less space.

Business Plan

Production rates

- With the current space available we are looking to produce approximately 32-48 heads of lettuce per week when everything is complete.
- Lettuce takes approximately 40-45 days to mature from germination to harvest. once our project is completed we will be able to house nearly 600 plants at any given time.
- Approximately one quarter of the space will be allocated for herbs

Price of product

- We are looking to sell each head of lettuce for $4 to $5 at our local grocery store
- This is in line with the current supply of romaine lettuce that costs $4.15 per package
- Our product is fresher completely organic and chemical free, making our product very competitive with commercially available products and potentially more profitable as we do not need to pay for transportation

Projected revenue

- $200 to $300 per week or $800 to $1200 per month

Because of the system we have chosen requires very little maintenance and monitoring once it is up and running, it will only require approximately 4-8 hours of labour per month after everything is up and running.

Projected expenses

Although the start-up cost is fairly expensive most materials in our project are reusable and thus the ongoing expenses for maintaining the system will be only 10-15% of the revenue. This maintenance cost includes the cost of electricity which is the primary ongoing expense.

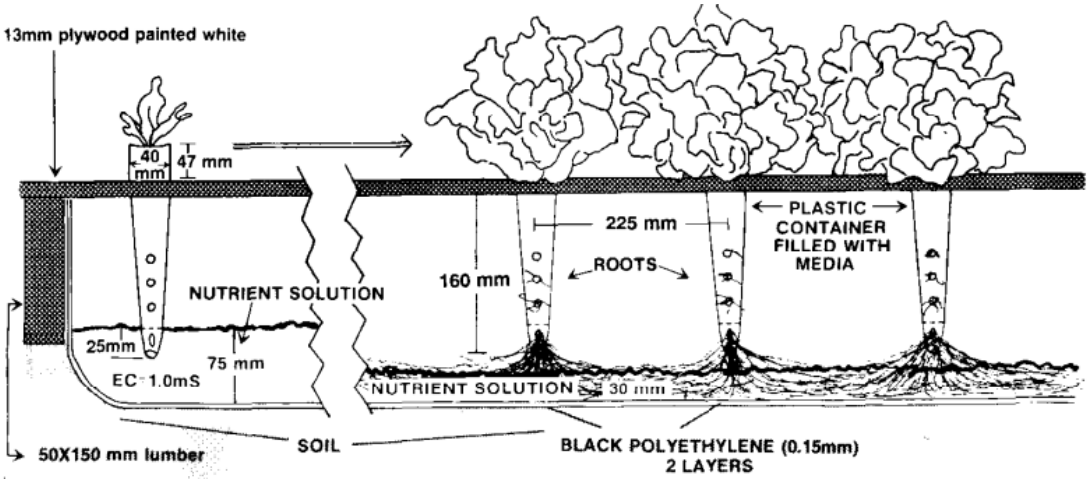
Currently our electricity bill is being subsidized by the school board so our ongoing expenses are actually closer to 2-5% of our projected revenue.

We have come to an agreement with the two stores in our village. They have agreed to sell our product but a commission % has not been agreed upon.

In the future we can get this percentage even lower by bulk ordering fertilizer and larger scale production. Also more energy efficient lighting options are available but with a much greater initial cost.

Design of hydroponic beds

We will be building our hydroponic system based on the research done by Dr. Kratky in 1993.



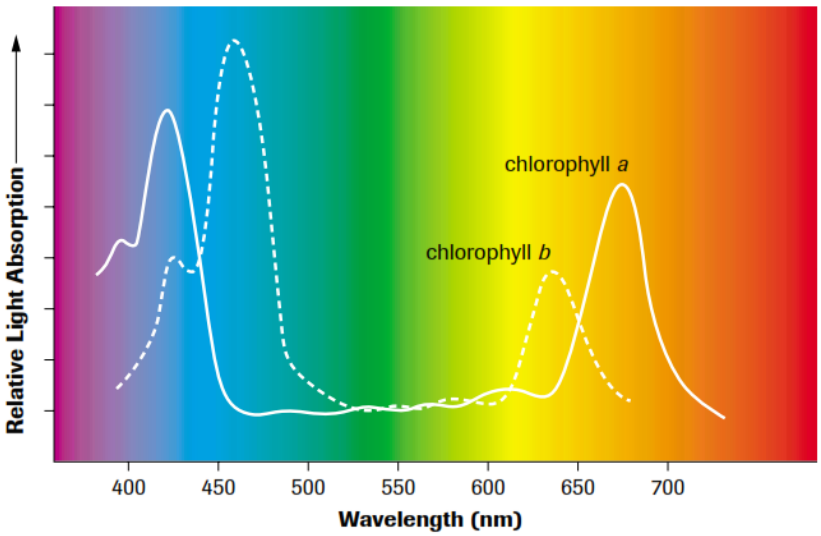
Because of this hydroponic system, we are able to stack several layers of growing beds vertically. This allows us to pack in 192 square ft. of growing space in a small 7’ by 11’ shed. This means that we will have an annual yield of 135$ to 200$ per sq ft

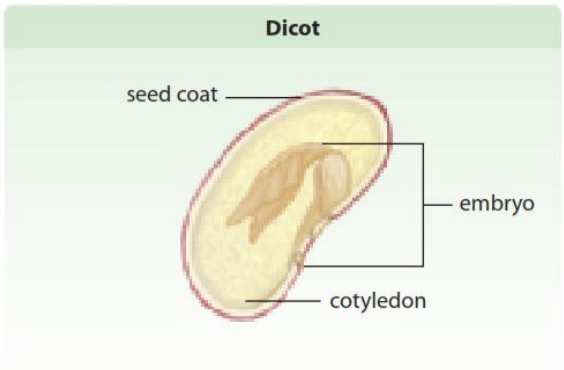
Free information packages:
with the sale of fresh herbs, we will also be making and distributing free information brochures that will show people how to use our herbs in various easy to do recipes as well as how to dry the herbs for later use. Our reasoning behind doing this service for free is to increase use of our herbs as many people are not accustomed to cooking with fresh herbs.

Plan for the future
What do we intend to do with any profits?
We intend to reinvest all profits made in our venture. We will be either investing it into other business ventures or expand our current business if it proves to be successful. By reinvesting our profits and expanding we hope to see an exponential growth of our revenue

Proposal
To raise funds for our project we would like request the use of the VCN room Fridays from 7pm to 9pm for movie nights or video game nights. Throughout the year we will also be doing other activities such as selling items on tickets to raise funds. However many of the items that we require must be ordered online and as we would like to begin production as soon as possible, we would like to request a loan of $1800 to be paid back by the end of the school year with 5% interest.

Lighting
The type of lighting is very important for plant growth. As you can see in the chart to the right, the two main pigment molecules responsible for absorbing light energy are good at taking in low and high frequency light but not 550nm or green light. There are many good lighting options such as High Pressure Sodium lights of Red/Blue LED grow lights. Unfortunately many of these options are out of price range. Instead we have found that Compact Fluorescent Lights or CFLs are a cheap yet effective alternative to commercial grow lights. The colour temperature of these is measured in kelvin and we will be using 5000K lights as they produce a large amount of light in the 400-450 nm range which is ideal for vegetative growth and will prevent the plants from going to seed unlike “warmer” lights with more red frequencies. (Giuseppe et. al., 2003)





Seed Anatomy

Seed coat - this protective layer allows the seed to be dormant and will slowly dissolve in favorable conditions (i.e. water and temperature). To speed up the germination process we will be scarifying the seed coats with light sand paper to speed up production by a day or so (Sandner et. al., 2011).

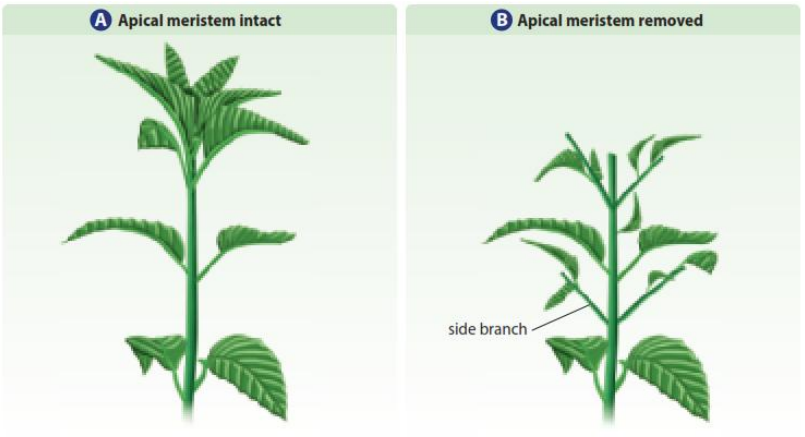
Cotyledon - this yellowish material inside the seed provides energy and nutrients to the developing plant embryo. This means that during germination (the sprouting of the seed) there is not much need for fertilizer which may end up "burning" the plant (Sandner et. al., 2011).

Schedule of lighting (24 hours or 16 hours a day?)

For vegetative growth it has been found that 24 hour lighting is optimal whereas budding and flowering stages of development benefit from a 16 hour lighting schedule (Skrubis and Markakis, 1976).

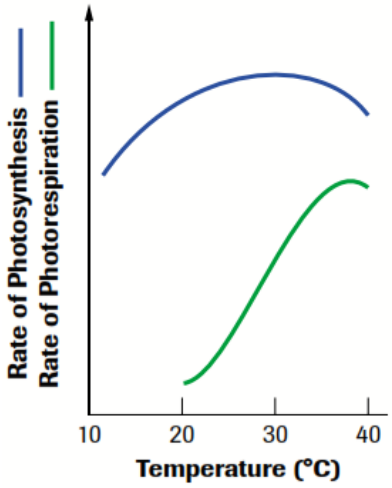
Cutting/Pruning

Some of the plants that we intend to grow such as basil, chives and dill can be continually harvested. Such plants will actually benefit from proper cutting as it will stimulate more side growth as seen in the figure to the right. The meristems are like the stem cells for plants. This is where most growth occurs. However by cutting the apical meristem, this signals other meristems to grow causing side branching and thus fuller growth (Sandner et. al., 2011).



Temperature Control

Because we will be growing indoors, we will be able to control to temperature and keep it within the optimal range for the C3 plants that we will be growing. C3 plants are more temperature sensitive than C4 plants or CAM plants as they will begin to break down glucose (sugar) at temperatures above 25^{o}C. This is bad because the whole point of photosynthesis is to produce glucose for energy (Giuseppe et. al., 2003).



pH and Nutrients ion concentration maintenance

Throughout the growth cycles we will not be changing the water merely adding water as it is used up in photosynthesis or evaporated through the process of transpiration. Thus we will need to carefully monitor the pH and ion concentration. We will be Maintaining the pH at an optimal level of 5.8 $\pm$0.8with sulfuric acid (H_2SO_4). Ion concentration will be maintained at 1200$\pm$200 ppm (Bugbee, 2004).

Growing Medium

Initially we were going to use vermiculite as a growing medium as it is expanded volcanic rock that retains water and nutrients very well. However after using it we have developed a new method of planting the seeds. For herbs that will are only cut occasionally for harvest we will be using Rockwool cubes which are almost like a mineral based fibreglass. For the lettuce we will be recycling Styrofoam cut outs with small amounts of vermiculite.

Power Use

Energy use will be high as we will need to provide the artificial lighting for photosynthesis we will be using 141 23 watt 5000K CFL bulbs

Power consumption

Lighting

P = 23W x 141

P = 3243W

Heater

P = 500W

Power supply

There is currently a 15 amp circuit running to the shed

Power provided by a 15 amp circuit

$P = I \times V$

P = 15A x 120V

P = 1800W

For continuous we will only use 80% of the total prevent the circuit breaker from tripping

P = 1440W = 62.6 lights

Power supply vs. power use

3243W + 500W - 1440W

= 2303W

Therefore we will need to add a 30 amp circuit to supply the remaining power

P = I x V

P = 30A x 120V x 80%

P = 2880W

We will be adding a 30 amp breaker to code using a 10 awg wire to prevent overheating

Power Use (revised for new plan)

UPDATE Now that we will be building in the school we will not need a heater and we will be using 150 23W lights rather than 141 lights. We will split the load of the 3450W lighting on to 3 separate 15 amp circuit breakers. This means the load on an individual circuit will only be 1150W much lower than 1440W maximum allowable for continuous use.

Power consumption

Lighting

P = 23W x 150

P = 3450W

Power supply

Power provided by a 15 amp circuit

P = I x V

P = 15A x 120V

P = 1800W

For continuous we will only use 80% of the total prevent the circuit breaker from tripping

P = 1440W = 62.6 lights

Therefore we will need to use three separate 15 amp breakers to provide the current

50 lights per circuit

P = 23W x 50

P = 1150W

1150W < 1440W

Revisions to Initial Plan/Diversification:

After reviewing our initial business proposal with the governing board, we have decided to diversify our business by growing fresh herbs alongside the lettuce. This will provide our community with fresh herbs which has never been available due to the remoteness of our village. Our overall yields will be lower due to the longer maturation period of herbs, we will have a monopoly over this particular market while also addressing a community need.

Cost of Power

Electricity rates = 0.08$ KWh

$$\text{Power consumption} = 3450\text{W} \times \frac{1\ \text{KW}}{1000\ \text{W}} \times \frac{16\ \text{h}}{1\ \text{day}}$$

$$= 55.20\ \text{KWh/day}$$

Cost = 55.20 KWh/day x 0.08$

Cost = $4.42/day

Mechanical Constraints

What needs to be taken into consideration before construction? Compression is going to be the main constraint that needs to be accounted for. Due to the large volume of water the weight of the structure will be fairly significant.

Weight of Water

Volume = L x W x H

= 45inches x 45 inches x 5.5 inches

$$= 11137.5\ \text{cubic inches} \times \frac{1\ \text{L}}{61.02\ \text{cubic inches}}$$

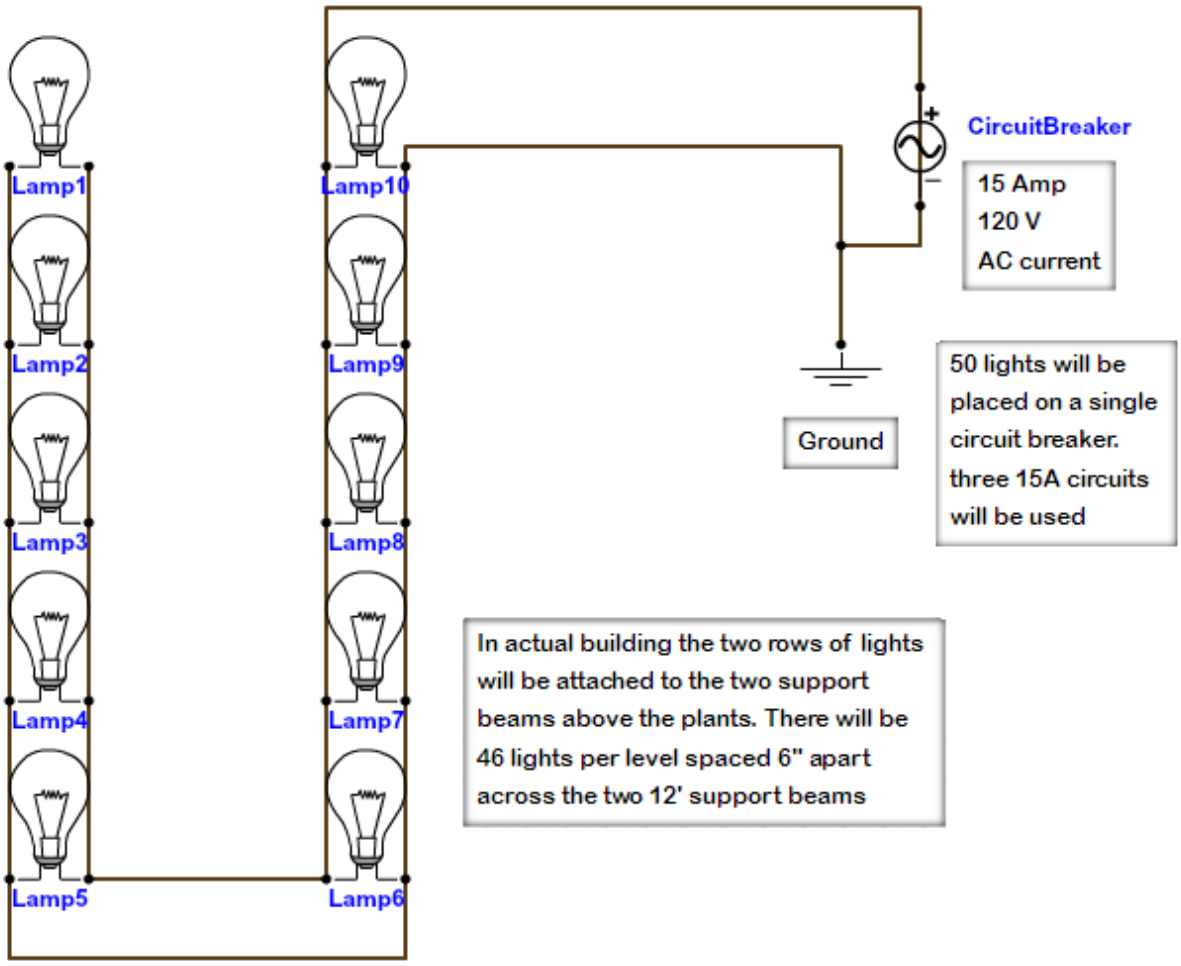
$$= 182.51\text{L of water} \times \frac{1\ \text{Kg of water}}{1\ \text{L of water at } 4^{o}\text{C}}$$

= 182 Kg per tray x 12 trays

= 2184 Kg or **4814 lbs** at maximum capacity

Material Selection

For the base of each tray we will be using 5/8th sheets of aspenite (OSB) which will be able to support the weight of the water according to the TECO building association. The aspenite should be able to withstand at least 84 lbs per sq. ft. without bending. This is when the support beams are spaced 16 inches on center. In our construction the spacing between beams is only 12 inches on center making our build even stronger. This would allow each box to hold more than four times the weight that is required of them.



Wiring

Plants being grown as of now

Basil- Basil is a favorite and grows great in hydroponics. Keep the tip pinched off to keep it bushy and productive. Fresh basil provides a sweet and tangy flavor to foods that is a real treat. It is excellent for Italian cuisine and tomato-based dishes, pesto butter. Try chopping fresh basil leaves and sprinkle it on tomato salad or pizza. In a protected environment, growing basil can be accomplished throughout the year. Once mature, it can be harvested and trimmed weekly. It

responds extremely well to hydroponic growing.

Chives- With a subtle onion flavor, chives are one of the best culinary herbs. Saute it in melted butter or chopped in sour cream to top potatoes. One taste of fresh chives makes you realize how tasteless dried, bottled chives are (true for most of the herbs). Try it chopped on your scrambled eggs.

Dill- Dill is a flavorful addition for hydroponic herb gardens and it produces new growth when harvested. Replacing spent plants with new seedlings every three to four weeks will insure a constant supply of dill. The compact fern leaf variety produces an abundance of lush growth thereby allowing for numerous cuttings from a single plant.

Cilantro- Cilantro (a relative of parsley) is a very successful hydroponic herb...it tolerates various pH conditions and lower light conditions. It requires little maintenance and reaches harvest stage within six weeks. It must be regularly trimmed or it will go to seed. The heights of these plants reach up to 50 cm.

Potential plants to be gown

Chervil

Chervil is a low light cool temperature crop. The plant will grow slowly and bolt to flower at an early age. Cool roots are critical to ensure good growth. Unless shade and special cooling is used, chervil is difficult to grow in the summer. Growing time to harvest is 4 weeks. It is the perfect winter crop. Best grown under low lights.

Mint- Awesome crushed into fresh brewed ice tea and exotic mixed drinks.

Possible extension for next year

Using the fresh basil to make pesto for bottling or pasta to be sold in or out of school.

recipe:

http://www.foodnetwork.com/recipes/food-network-kitchens/basil-pesto-recipe2/index.html

things to make with pesto:

http://www.foodnetwork.com/recipes-and-cooking/things-to-make-with-pesto/pictures/index.html?ic1=obnetwork

video:

https://www.youtube.com/watch?v=n5kLc_3WJQM

Reference list

Both, A.J., Albright, L.D., Langhans, R.W., Reiser, R.A. And Vinzant, B.G. (1997). *Hydroponic lettuce production influenced by integrated supplemental light levels in a controlled environment agriculture facility: experimental results*. ACTA horticulture. 418:pp. 45-52

Bugbee, B. (2004). *Nutrient management in recirculating hydroponic culture*.. ACTA Horticulture. 648: pp. 99-112

Giuseppe, M.D., Vavitsas, A., Ritter, B., Fraser D., Arora, A., and Lisser, B. (2003). *Biology 12*, Nelson Thomson. pp. 136-178

Kratky, B.A. (1993). *A Capillary,Noncirculating Hydroponic Method for Leaf and Semi-head Lettuce.* Horticultural Technology and Products. pp 206-207

Kratky, B.A., J.E. Bowen, and H. Imai. (1988). *Observations on a noncirculating hydroponic system for tomato production*. HortScience. 23:906-907.

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Sandner, L., Ellis, C., Muller, M.R., Panayiotou, H.E., Sharp, J.C., Webb, P. (2011). *Pearson investigating science: Biology Source 11.* Pearson Education. pp. 381-406

Skrubis, B., Markakis, P. (1976). *The effect of photoperiodism on the growth and the essential Oil of Ocimum basilicum (Sweet Basil)*. Economic Botany. (Vol 30 issue 4). pp 389-393

TECO building association. (2005). *Design Capacities for Oriented Strand Board Allowable Stress Design (ASD).* Retrieved on Nov, 15, 2013 from http://www.tecotested.com/techtips/pdf/tt_osbdesigncapacities

Resources:

How it's made (lettuce):
https://www.youtube.com/watch?v=Wmq9SPPgUpc

Ideas for plan:
http://www.bdc.ca/EN/advice_centre/tools/business_plan/Pages/default.aspx

Online supplier of commercial grade products:
https://www.morgancountyseeds.com/store/

Kratky method:
http://horttech.ashspublications.org/content/3/2/206.full.pdf
http://www.youtube.com/watch?v=r3tz5LVVR_o

Fertilizer video:
http://www.youtube.com/watch?v=TQzgMve9hoA
http://www.youtube.com/watch?v=oeLd2SP0c6U
http://www.youtube.com/watch?v=vYv9iu2NI3M

Building hydroponic beds:
http://www.youtube.com/watch?v=8W_3ydRA3OY
http://www.johnnyseeds.com/c-34-lettuce.aspx
http://modularhydro.com/ArticleLibrary/WhatCanYouGrowHydroponically.html

Herb growing instruction:
http://www.hydroponics101.com/sw58028.php
http://myfolia.com/plants/1-basil-ocimum-basilicum/varieties/130821-profumo-di-genova