Spring 2010

The Design and Implementation of a Campus Community Garden

Robin Juskowiak
Carroll College, Helena, MT

Follow this and additional works at: https://scholars.carroll.edu/lifesci_theses

Part of the Horticulture Commons, Other Plant Sciences Commons, and the Urban Studies and Planning Commons

Recommended Citation
https://scholars.carroll.edu/lifesci_theses/115

This Thesis is brought to you for free and open access by the Life and Environmental Sciences at Carroll Scholars. It has been accepted for inclusion in Life and Environmental Sciences Undergraduate Theses by an authorized administrator of Carroll Scholars. For more information, please contact tkratz@carroll.edu.
The Design and Implementation of a Campus Community Garden

Submitted in partial fulfillment of the requirements for graduation with honors from the Department of Environmental Sciences at Carroll College, Helena, MT

Robin K. Juskowiak
May 6, 2010
This thesis for honors recognition has been approved for the Department of Environmental Sciences by:

Murphy Fox, Director

Dr. Grant Hokit, Professor

Dr. Chris Fuller, Professor

May 6, 2010
Acknowledgements

I would like to extend my gratitude to those who have helped me prepare this thesis and to those who have been inspirations in every aspect of my college career.

To **Murphy Fox**, my advisor and mentor these past four years, who has never let me lose my way. His infinite wisdom and stories have always provided a much needed renewal on life.

To **Dr. Hokit**, for his contagious enthusiasm of all living things and the knowledge, perspective, and stories he has shared. He has always pushed me to learn and explore all that I can.

To **Dr. Alvey**, for introducing me to the awesome world of soils, which truly made this project come to fruition, and willingly lending his advice, and keys to the greenhouse, time after time.

To **Dr. Fuller**, for allowing me to take on this remarkable project and for all the teaching, whether it be theology or pop-culture, he has provided me.

To the **Biology Department**, for graciously allowing us the use of their greenhouse.

To **Butch Biskupiak**, for always having all the tools we needed, and eagerly lending them.
# Table of Contents

Other Schools and the Movement ................................................................. 2

The Garden .................................................................................................. 8
  Slope & Sun Exposure: ........................................................................... 9
  Water: ................................................................................................. 9
  Tilth: ................................................................................................. 10
  Size: ................................................................................................. 12
  Rebuilding the Soil: ............................................................................ 12
  What we are planting: ................................................................. 21
  Starting Seeds & Transplanting: ...................................................... 23
  The Greenhouse: ............................................................................... 25

Sustainability ............................................................................................. 26
  Log: ................................................................................................. 26
  Curriculum and Community: ........................................................... 26

Funding: ................................................................................................. 27
  Management: .................................................................................. 28

Supplement ............................................................................................... 30
  Greenhouse Log ............................................................................. 30
List of Figures and Tables

Table 1. Companion Planting........................................................................................................19
Figure 1. Greenhouse Blueprint..................................................................................................22
Table 2. Seed List......................................................................................................................32
Table 3. Germination..................................................................................................................37
For my thesis, I have fashioned a design for a community garden and recorded the implementation of it as far as time allowed. I discuss what other schools have done in my same position to allow me to fully understand the situation ahead of me so that I may improve upon and learn from what they have already done. I have also researched the actual execution of a garden and how to achieve a successful crop to further my understanding of how a garden and all its natural processes function. Above all this thesis has become an outlet to allow me to think like a plant and its ecosystem so that I can become a truly successful gardener.

It must be noted that I have minimal gardening experience beyond the green beans I grew in kindergarten and the various houseplants and cacti that, with a heavy and well-meaning heart, I have over loved in my dorm room. This, combined with my recent interest in urban gardening allowed me to design a thesis that met my curiosity for sustainable agriculture, passion for all living things and their protection, and a way to improve upon my gardening skills; which will progress my involvement in both aforementioned areas. This is nothing short of a learning experience for me, and I hope it proves to be one for you as well. For, if I have learned one thing about gardening, which truly outlines the purpose of my thesis is this: that you cannot be taught how to garden, you can only learn. “My green thumb came only as a result of the mistakes I made while learning to see things from the plant's point of view.” H. Fred Dale.

And in order to learn I have to try. So while I say I have designed a plan, it really is more like a guideline. And I imagine the log I will be keeping will stray from what I researched, because I am dealing with living things and natural processes that will do as they please, despite what a book tells me. Thus, I feel the log I will be keeping is almost
more important than the plan, because the log is in the “now” and is fitting for the climate and resources we have.

I will be presenting my thesis in three parts. The first part will chronicle the successes and roadblocks that other schools have met in order to create a picture of the nationwide movement. These stories will allow me to build off what they’ve accomplished in order that we may create our own success story. The second part will include the actual garden plan and include the scientific research that will help us create a fertile plot. I will explain how we need to improve our soil and what we should grow in it, as well as the basics of gardening. The third, and final, part will be a plan for sustainability. This will include worker management, funding, and other practices that will help the garden to succeed in the future. Together, these three sections will provide a guideline and information for those, who just like me, are new to gardening and what steps can be taken to increase the fruits of one’s gardening labors. Whether the Justice Acre is a tale of triumph or failure will not be known for many years, but what I have enclosed in this thesis will be a resource that can be consulted to make sure that it is the former more so than the latter.

Other Schools and the Movement

Community gardens are sprouting across college campuses that are aiming for ultimate sustainability. In fact, you are hard pressed to call yourself sustainable if you are not able to produce your own food or compost your food back into a product that further sustains and nourishes. After talking with other students who were part of, or are continuing their garden movement, I know it is possible. Thru other’s experiences I was
able to widen my perspective and further understand that trials and successes that others have gone thru and those others foresee. Together, we were able to share ideas and plans to make sure that none of us reinvent the wheel and to further guarantee that we all succeed in the fantastic task ahead of all of us. These tales are all of hard work, disappointing downfalls, but altogether exciting stories of a rapidly spreading movement. If sustainability is a goal, it is very much so a realistic one.

Heather Ellis, from Saint Michael’s College shared with me, in depth, and with much excitement, where their recently started garden has taken them, and what went on to create a successful operation. Briefly, the garden began in 2008 with support from the student government. As a school already wealthy in land, finding a plot was not an issue, however distance from campus did prove a detriment at first. As she explained, that is where the land was more fruitful and thus the distance was a necessary evil. Originally wanting to fashion their garden as a community garden with shared plots, they quickly realized that wasn’t the best option seeing as it takes specific soil types and dedicated plot owners, and it quickly fell thru.

There was little support for the gardeners, most of which were not experienced, and no plan as for what to do with the veggies. Also, the soil quality was not the best due to it being freshly worked with. After restructuring the garden and having a hired coordinator, Heather, their success grew. She created a new garden plan taking into account the soil quality and crop rotation, tested the soil, and created a committee for support. This “Garden Advisory Committee” that was created included a local master gardener, faculty, staff, and workers for the summer.
The next growing season was a much greater success. They decided to increase their awareness by selling food on campus thru food stands on a donation basis and whatever wasn’t sold was delivered to the food bank. They also created a blog that was updated weekly to keep those interested informed.

Saint Michael’s has expanded their school involvement by holding volunteer days, having the freshman do a service project, and allowing the biology students to test their soil and the effects of the vegetables on it.

In their third year they are still proudly succeeding and growing! They are still struggling for funding and are looking towards a permanent intern position to have a constant mentor tending to the garden and gardeners.

That is only one of the many success stories that I was privy to. All the other schools I chatted with had grand stories of ever-expanding success, even despite the odds and a few foul years in the process. It is these odds and foul years that really helped me to realize what I am up against and what to expect. They also give me a healthy dose of reality, as I often have a large imagination and little patience. After attending a conference in the spring which brought together all the schools from the northwest who are trying to help their schools become more sustainable, we were able to discuss and brainstorm ways out of the largest problems and set-backs we were all facing; those being location, support, and workforce. While all the advice they gave me I still keep in my head, filed away, the next part includes a look into and a discussion about how Carroll can address and possibly avoid the same problems.
To begin with, location: Is it close to campus? Is the soil fertile? Is it in the master plans? As observed with Saint Michael’s, their site was off campus, but that was where the soil was fertile, so it seemed a worthy sacrifice. They kept the garden close to campus by providing a stand to sell and give away their crops. Whitman College also succeeded in having a garden on a school-owned plot of land nestled in a neighborhood, which allowed them more involvement with their neighbors and students had no issues commuting. Carroll College’s first community garden was in a place that was designated in the master planning for a dormitory and it got demolished. Our task, then, is to make sure whatever plot of land we are given is secure and out of the way of any more buildings.

While we have the greenhouse to depend on for the summertime, we need to locate a plot of land that is conducive to successful growing and is easily accessible, and hopefully viewable to those on campus. We will fight for it to be on campus as much as possible so that we can keep it attached to the greenhouse and continue to use that as a resource every year. We are hoping to have help from a local nursery owner who will have the best judgment of what land works best in this area. A lot of the schools simply aren’t given any land and if they are, it is not always the best land.. However, we need to prepare to work with whatever land we are given, which could very well mean we won’t be able to start a growing season until next year, after we have improved the land. Whichever way we obtain the land, there are a few important criteria that need to be met.

The next issue addressed was support; whether it is monetary, from the administration, or from the school’s community. It is rather hard to create a garden when you do not have the approval of all necessary parties, nor the money to start the project.
Whitman College gets $20,000 each semester thru their Student Government, but rarely is a school that lucky. They also have to apply for that grant every year, so the amount of funding they receive depends on the success and involvement of the last year. A lot of grant writing and fundraising was what got many of the gardens started. Portland Community College already had multiple gardens and thus support and a search for land were not their biggest issues.

Administration is always a tough group to tackle and there are usually lots of hurdles to get over and proposals to write. Simply proving that the garden will be a beneficial asset to a campus in the long run and that it will be aesthetically pleasing at all times can prove a difficult task. Quite a few colleges truly had a rough time proving that a garden is a benefit to the academic community, but once that was approved things seemed slightly more accessible to those starting the garden. By being able to incorporate the garden into as many areas of the academic and local community, schools like Whitman, PCC, and St. Michael’s were able to garner support from the administration.

Many people found it important that the community itself support the school in its endeavor. Whether it be thru hiring a local master gardener, fundraising, or having volunteers come to it, having those additional members and that additional outreach created a further backbone to the process. Donations and connections help the garden grow and guarantee its success. This is why having the garden off campus can also be a benefit if the community members are able to get involved.

As for Carroll, the Hunthausen Foundation for Peace and Justice, the sponsor of the garden, has $1,000 to work with. At this point in the planning stage, which has been
since late Fall 2009, starting out with $1,000 is quite something to be proud of. Since we are making this garden under an endowment, it has allowed us an outlet, and a name that people will soon become familiar with for doing great things. The goal will be to start a Student Club, which will allow us support from our student government and a stable working crew, both topics of which I will go into detail later. With those $1,000 dollars we plan to start our garden in the greenhouse, a greenhouse which is in vast need of repair. We plan to strip the paint and repaint the interior and exterior door, not only for aesthetics but so that we may be taken seriously. A few of the windows have shattered, and a lot of organizing needs to be done.

Since this so far has been hardly a six-month long project, most students are not aware of the garden’s existence except thru my outreach to fellow environmental studies students and those involved in the other sustainable initiatives. Thru a greenhouse cleaning party and fundraising, we hope this spring to be put on the map as a project Carroll is proud of and can support. Eventually hoping to incorporate it into curriculum and a student club, we hope to extend the longevity and usefulness of the garden.

In regards to the administration we have been truly blessed with their support. The only restriction placed on us was a year trial period to show that the garden is a worthy addition to the campus before we are given a stable plot. The Green Team, which is the sustainability committee supports our cause and many of the members are part of the committee we formed. We have members from grounds and facilities, faculty, staff, and administration on the committee so all interested parties are present and involved. We would like to add a master gardener or an employee of a nursery in town as part of the committee as well. With the formation of the Green Team, Carroll has already vowed to
to turn sustainable and thus the community garden is an important part of Carroll sustaining itself and Helena.

In the end, the biggest problem we face is one that just about every school addressed, and that is having an all-year round workforce. Summertime is the prime timeslot to begin most of the year’s growing and that is the time you are least likely to find students. The student club would hopefully allow us to find the students that would be most interested in such a job, but a benefit of having a constant income would be that we could hire some work-study students to work on it over the summertime. All these ideas will be addressed further on, but all lie within the realm of garnering support, respect, and a rapport with the Carroll and Helena community.

A lot can be taken from these shared experiences and the stories I have collected from others. The main point is that we all have faced the same problems and have all found solutions to some of them. In this thesis I will incorporate what I have learned from other campuses, what I have read from established gardeners, and my own insights to formulate a plan to help Carroll’s own Victory Acre so that we may help ourselves and other campuses the way we have been helped. Sustainability is a united movement and support from others, whether monetarily, physically, or orally will make all the difference in the survival and success of our endeavor.

The Garden

In this section I will be reviewing the important aspects of soil and gardening to further inform myself and others what steps need to be taken to ensure healthy land and crops. With the goal of an organic plot, I will address this issue when necessary.
Slope & Sun Exposure: As mentioned earlier, the current slope that the greenhouse is on does not get enough sun. However, we want to make sure that the plot we choose does not get overheated. Given that it most likely will have at least six hours of direct sunlight, we would want to consider a mulch. Since the plot of land is expected to be chosen in August, mulch would be beneficial as it will keep the soil cold in the hot summer, but as we transition into fall, it will insulate and keep the roots warm. In the greenhouse there are lots of dead flowers that have been left in there that we can keep to use as a mulch. Mulching also extends water infiltration as it won’t evaporate as much and provides a good barrier against weeds.

Water: The greenhouse is already hooked up to a water line and we will be able to water plants that way. There are no plans for creating a watering system since the greenhouse is a only a transitional phase and in the beginning stages you only want to mist the seedlings so the water line will be used to fill up watering vessels. We have a pressure sprayer with an adjustable nozzle to allow us to control watering, and allows us flexibility and movement.

A drip system is ideal for the garden plot. It is a fairly cheap process and takes only one major set up. Once it is in place, it will drip water directly onto the soil, instead of say, a sprinkler which scatters water everywhere. By slowly dripping water directly on the soil and roots it greatly decreases evaporation and further guarantees that the water gets where it needs to go. Water on the plants itself can damage the plant either thru its weight or sun damage, and is also not taken in by the plant and evaporates.
**Tilth:** Is the structure and quality of soil which is the result of the combined effects of parent material, biological activity and management practices. High quality soil is well aerated, retains moisture and is rich in humus. Thus, in order to have a high quality soil we need to make sure our parent material is appropriate for our purposes meaning it contains enough organic matter and enough weathered minerals which promote biological activity and improve the soil texture which in turn makes management practices easier.

Keeping that in mind, when we receive our plot we will have to do a lot of tilling and addition of organic matter to make the soil healthy and fertile. We will also need to measure the pH, and consider what soil texture we have. Different textures imply different porosities, different compaction levels, and different nutrient adsorption capacities. Clay is made up of small particles that bind together with small pores which cause compaction and less air and water infiltration, but adsorb nutrients readily. Sand has larger pores which allow for better aeration, water infiltration and less compaction, but also for leaching of nutrients. Ideally, a loam is a good planting medium since it is a mixture of sand and clay.

However, we are given what we are given and different amenities can be added to alter and improve upon the texture. Clay soils can be improved with calcium, which allows the particles to flocculate and form particles, which improves aeration. Organic matter added to sandy soils will also help it to form particles that better hold nutrients, water, and air.
The soil pH should be between 6.5 and 7.5. This pH condition is most productive for growing and allows microorganisms to thrive, which allows for nutrient release and decomposition of organic matter. Different nutrients are available at different levels but the highest abundance of nutrients can be found in that optimal range. If the soil is too acidic, nutrient levels will be greatly diminished due to the hydrogen ions taking up the spots where nutrients, or cations, can be held on the soil particles allowing the roots to take them up.

Upon testing the soil we may have to add some specific minerals or organic matter to make the soil more or less acidic. If the soil is too acidic, or below 7, adding limestone or ash will make it more alkaline. Conversely, if the soil is too basic, or above 7, adding manure, gypsum or pine needles will help lower the alkalinity. For the actual pH testing, we will be able to utilize the natural sciences department’s pH tester, which will give us an accurate reading.

Testing for macronutrients would also be in our best interest since nutrients are pH dependent, meaning that each pH level is a productive environment for different nutrients. The three most important nutrients for plant growth and success are Potassium (K), Nitrogen (N), and Phosphorous (P). If we are too deficient in one, we can turn to natural amendments such as manure, or nitrogen fixing plants, such as legumes, which will help add nitrogen. Also a consideration of natural fertilizers such as blood and bone meal is a good for when our nutrient levels falls. It also may be that we have to plant this year and let the plants decompose until next year. Adding organic matter in general benefits the soil by helping to improve any soil texture by adding more aeration and
water infiltration, thus nutrient and organism diversity will also increase\textsuperscript{viii}. As I mentioned earlier, preparing the soil may take numerous growing seasons.

To keep our needed amendment list low, we can also start out by using crops that enjoy whatever soil type we have, instead of altering the soil to fit to the crop’s needs. Eventually we would need to add amendments, but if, say, we are cut short on time or resources, it could be a great way to establish our plot without too much alteration to the land.

**Size:** We are not planning on starting on anything larger than an acre, but maybe one day our garden will be able to reach that size. Ideally we want to start out small and get ourselves established. Given that our workforce will be small, it is best to not overwhelm ourselves to guarantee a fruitful season. We are grateful for whatever plot of land we get, so we will work with what we have, understanding we won’t be able to feed the whole school in a year’s time. To further our production within a small space both within the greenhouse and outside on our land we plan on using polyculture, or intensive gardening, and raised beds, a process I will discuss further on.

**Rebuilding the Soil:** Now that I have discussed what is necessary to have good tilth, and I’ve demonstrated some short term, faster fixes, it is time to see the bigger picture. When rebuilding the soil it is good to think of it holistically and see ways in which we can improve many aspects of the soil with one amendment as opposed to adding one amendment to improve one specific area. It is said that mulch and compost are one in the same since they both maintain nature’s complete soil processes, “This fact is important: composting and mulching go hand-in-hand and are, in many instances
inseparable. Remember that in dealing with your soil. The aim is to build and maintain nature’s complete soil pattern as far as possible. That demands a good organic mulch.”

Soil is a complex medium full of microorganisms and nutrients, and it is pertinent that we keep it that way, it is also inevitable that we will deplete those resources. Just like all things around us, it is an ecosystem that rises and falls and has its own needs and requirements. By adding plants we are disrupting that ecosystem and have to make sure we keep it as close to where we found it to keep both the soil and plants healthy. In so many words, “Soil is not a neutral growing medium. It is packed with nutrients and minerals, worms and other insects, microbes, fungi---more stuff than we understand. Growing food depletes the soil over time. Bad soil causes weak plants. Weak plants attract disease. Disease infects the soil. To prevent this all you have to do is give back to your soil what you take out”.

Coyne & Knutzen (2008) recommend five steps to build the soil organically and holistically: compost, mulch, no-till, crop rotation, and avoidance of chemicals. I will go into further detail on all of those topics and explain why they are beneficial and successful. Alright, let’s build some soil:

1. **Composting**

   The original goal of composting at Carroll is that it will be school wide, with the majority of the additions coming from the cafetera; that being so, the cafetera is across campus from the greenhouse. Luckily, this transportation setback is really all we have to reconsider. To begin with, we plan to have a small compost bin inside the greenhouse, one that can be turned and transported easily. The Green Team has also decided to go
grassroots and outfit faculty and staff with personal compost bins in their offices and vow
to go ‘trash the can’ meaning eliminating trash and what cannot be recycled should be
compostable or reusable. While in the beginning stages this certainly is not enough to
sustain a garden, it will certainly advance our greenhouse soil. But, what is it about
compost that will improve our soil, and why do many gardeners swear by the process?

Compost is a mixture organic material broken down by aerobic bacteria so that
the humus produced provides the living soil organisms with concentrated food and
energy and moisture-retaining capabilities.\textsuperscript{i} Scientifically, compost’s success is backed
by hard soil science facts. As I mentioned earlier, soil structure, or size of each individual
soil particle, is a highly determinate factor in the soil’s success. According to Michael
Pollan author of \textit{Second Nature}. “An ideal, friable garden soil consists of airy crumbs in
which particles of sand, clay, and silt are held together by humic acid. Compost helps
these particles form.” And precisely so. To clarify, if a soil is friable, it means it is able to
crumble more easily when cultivated and humic acid refers to humus, which is organic
matter, just like compost. When a soil is able to readily crumble it means there are more
macropores that allow infiltration and cycling of air and water as well as more surface
area for minerals and nutrients to be adsorbed and taken up by the plant. This also implies
then, a less compact soil and is a process that tilling tries to mimic on a larger scale.

Compost also increases microorganism activity, which breaks down the
organic matter faster, allowing more available nutrients for plant root uptake.\textsuperscript{ii}
Microbes and worms belong in the soil and further improve it by feeding them
they feed the soil. Mulch is similar to compost in providing organic matter once it
decomposes, except that it is decomposed on the surface as opposed to in a controlled, hot environment.

But, as Pollan is quick to point out, humus is not hard to come by, and there are many other options, assuredly much faster and convenient, than composting. He suggests that gardeners compost not only for the health of their land, but for the virtuosity it brings. In a sense, by composting we are returning to the land what we have taken from it, thus freeing ourselves of an attachment to it and remaining independent from it, while still feeling like we have improved the land.

"At least in a metaphorical way, compost restores the gardener’s independence---if only from the garden center and the petrochemical industry. With the whole of the natural cycle reproduced in this garden, the gardener no longer has to depend on anyone else (save perhaps the seed merchant) to grow his own food. And because it makes the soil more fertile, composting flatters the old American belief that improving the land strengthens one’s claim to it."

This thought held by Pollan was reflected in some form in nearly all the other gardening books I referenced. It seems, as Pollan was also quick to point out, that the success of a gardener relies on his ability to understand the ground a functioning ecosystem. Once a gardener has realized he has the potential to alter the land, he also quickly realizes the danger of that power.

Whatever way you look at composting, it is important to consider that decomposition is a natural and inevitable process of life, so it seems in our best interests to use it to our benefit.
2. Mulching

Mulch provides a buffer for the roots and soil from drastic heat and moisture change. By placing organic mulch, such as hay, on top of the soil near the end of winter and into the summer, it will keep the ground cool. The same effect will be had if you place mulch at the end of summer and into the winter; keeping the heat in. It also keeps moisture in and keeps weeds out. To top it off, mulch will eventually decompose into humus and return nutrients back to the soil and improve the texture. However, it must also be noted that many mulches, more specifically the microbes breaking it down may take nitrogen out of the soil during the process of decomposition so it is important that the mulching medium stays on the surface and is rather large in particle size so that it breaks down more slowly, thus avoiding nitrogen removal. Some mulches, such as alfalfa will actually return nitrogen to the soil. That being said, different mulches will give different nutrients, such as phosphorus and nitrogen, back into the soil, so it is unknown what mulch will work best until we measure the pH. For example, sawdust which is cheap and often accessible is rather acidic so it would only work well in alkaline soils. Perrin also suggested using newspaper, as it won’t affect the soil either way and simply break down. As suggested by the authors of The Organic Way to Mulching, Zone 4 residents should start mulching in May, after some planting has already occurred. When the plants have reached four to five inches in height, apply mulch three inches deep.

3. Tilling

Tilling is the process of turning over the soil in the ground to bring in oxygen and “fluff” it up so that is easier to work with and less compact. It mixes the top layers with
the lower layers so that nutrients can be better dispersed. However, Coyne & Knutzen, and other organic farmers shy away from this process as an annual addition simply for the fact that it does more damage in the long run.

If you’ll think back to an earlier discussion we had on soil texture and all the properties associated with it, then you’ll understand why no-till makes sense. Every soil particle, whether it be clay, sand, or silt has a given particle size. The larger the particle size, the less likely it is to compact because it contains more macropores that allow water and air to cycle thru. Smaller sized particles have smaller, micropores that contain water more so than air and are more easily affected by compaction. However, in theory, there are a lot of micropores in comparison to the macropores found in larger particles so compaction can occur just in any soil type.

Compaction, or the process of removing pore space, is a huge detriment to the plants because it lessens a plant’s abilities to absorb nutrients and water, since roots have a harder time penetrating smaller pores. When soil is compacted water cannot get thru and will often puddle on the surface and eventually turn into runoff which takes all the nutrients with it. Whatever way you look at it, compaction is a negative aspect and should be avoided. That being said, tilling over the long run compacts the soil. While the soil you actually till will appear well aerated and friable, the soil beneath it will slowly become more compact as the weight of you and your tilling tools pushes on it. It is for this reason that it is suggested that your beds have a small enough width that you could reach across and around them as to avoid contact. Also, building furrows in-between your rows would provide an area for movement around your beds.

To summarize ever so eloquently,
Tilling your soil is like a cheap high. First there is a buzz, but after that it is all downhill. By tilling the soil you are releasing a quick surge of nutrients by causing the death of large amounts of soil organisms...tilling also disrupts the complex symbiotic relationships that exist in healthy soil.”

However, we cannot possibly prepare our soil the first season without deep tillage so that all our organic matter and amendments can be mixed in. We cannot start all our processes without some assistance. But after that creating furrows and minimally adding in fresh organic matter each season should be all we do.

You could also view no-tilling in another light. It is one more way that we are allowing nature to continue on its own course. However, it should be noted that if your soil if too dispersed, or too compromised it would be beneficial to add in some amendments thru tilling.

4. Polyculture and Crop Rotating:

As I’ve discussed rather consistently, planting crops depletes the soil of certain nutrients and minerals, and naturally so, but it also adds them. If we have more plants that adsorb nitrogen than fix it, we will find a large decrease in nitrogen from year to year, and so on and so forth. Also by adding nitrogen to the soil via these plants, we increase the pH, thus lowering the acidity. By growing multiple plants together, we increase the odds of plants living synergistically and helping each other, and the soil, thrive. If we are able to plant crops like tomatoes, which grow well with herbs, we can add another layer of success. While many consider ‘companion planting’ garden voodoo not backed by much science, the proof is there; some plants simply work better with others and will often thrive.
Our garden the first year is more to prove that we can grow things in order that we may earn our plot of land. That being said, we are going to focus on companion planting much more so than full on polyculture, which allows you not only to have companion plants, but to rotate plants in and out that still work together and can take on different types of weather. We are thinking that we will have plenty of room, so we may end up consolidating the crops into polyculture sections. Either way, thru observation and years of experience, gardeners have sworn by this process, and I will make sure I take this into consideration when I discuss what we ought to plant. Below is a chart I’ve compiled after consulting all the charts; which happened to be identical no matter where I found them. Luckily a lot of our crops will do just fine, and none are opposed to each other. Herbs, in general seem to be the most versatile.

Table 3. Companion Planting

<table>
<thead>
<tr>
<th>Crop</th>
<th>Lettuce</th>
<th>Tomatoes</th>
<th>Peas</th>
<th>Radishes</th>
<th>Basil</th>
<th>Rosemary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companions</td>
<td>Radishes</td>
<td>Parsley</td>
<td>Radishes</td>
<td>Peas</td>
<td>Tomatoes</td>
<td>Beans</td>
</tr>
<tr>
<td></td>
<td>Basil</td>
<td>Beans</td>
<td>Lettuce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Herbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Polyculture also works well as an herbicide, often blocking out weeds. Many plants in polyculture plots are positioned rather close to each other and often protect each other from outside, unwanted weeds. Crop rotation also keeps certain bacterial and fungal infections from proliferating every season by putting crops that they aren’t attracted to in between seasons. Or having the companion crops together could also affect how interested the parasites and pests are in the roots.
Beyond polyculture, rotating crops is good for the soil because it allows the soil to regenerate if left dormant or simply experience an addition of nutrients from one plant one year, and the removal of the same nutrient the next year by another. Rotating crops allows the soil to fend for itself. If one crop stays too many years in one spot, pests, fungus, and disease will also stay with it.

5. Fertilizers

Being an organic plot, the use of fertilizers is an important topic to discuss. Fertilizers are the act of adding nutrients removed from the soil either thru natural processes or leaching due to heavy agricultural practices. Synthetic fertilizers increase yields and the growth times, but greatly deplete the soil and everything, and I mean everything, around it. Also, by relying on fertilizers, farmers will tend to ignore the need to replenish the soil and soils will grow dormant and weak faster. Chemicals are only a short-term fix to what becomes a long term problem: nutrient and soil depletion. By relying on natural processes we can avoid a dependence on chemical fertilizers. Since we are gardening on such a small scale, it is much more doable, then if we were a commercial farm. In the long run, fertilizer will come from our manure and compost, but for a quicker fix of nutrients, there are many recipes for something called “fertilizer tea”. According to Coyne, “Fertilizer tea is just organic fertilizer steeped in water for a day or so. The resulting liquid is super nutritious and easily applied. Any solids left over from the brewing can be mulched around the base of the plant, or added to the compost pile.” It is rather amazing how everything in gardening comes back full circle. Compost can be used for just about anything and just about anything you grow can be turned back into...
compost. There are many different tea ‘recipes’ which include a shovelful of compost, worm castings, manure, weeds & garden trimmings.

Beyond the convenient and cheap fertilizer tea, there are plenty of amendments that improve the soil and give the plants what they need. Based on the mineral deficiency, there are many different additions to choose from. These include different types of “meal” or ground up solids such as bone meal, blood meal, and feather meal. Unlike things like compost and manure, these amendments tend to be very specific and are used in smaller amounts as they provide more than one mineral over the other.

Obviously the three main minerals: nitrogen, phosphorus, and potassium are a big deal, but why?

Nitrogen assists in the above-ground growth of the plant. It, possibly most importantly, helps the plant produce proteins and chlorophyll, thus making the plant green and strong. Phosphorus is important in the beginning stages of a plant’s life by improving root and leaf growth. Phosphorus is the rarest of the three elements, due to its pH dependence. Proper amounts of phosphorus are found in soils with a pH range of about 6-7.5. This sweet spot is often the suggested range for any garden, partially due to this fact. Nitrogen and potassium are easier to come by as long as the soil pH is about five. Finally, potassium ensures good protein and starch production as well as boosts the plants defenses against disease.

What we are planting: After looking at various pre-designed plots, often with themes such as “salsa” or “salad” gardens that take into account companion planting and raised beds, my partner Laura D’Esterre and I decided to pick crops that are not only
fairly easy to start, but would be used and similar enough to be open as to their use. We also considered crops that are hardier and have longer growing seasons, such as lettuce. The specific crops that we chose are listed in the supplemental logs. Below is a crude outline of the layout we plan to use for the crops when we transport them into the greenhouse.

Figure 2. Greenhouse Blueprint

Plots A and B represent the shelves already in the greenhouse that are about four inches deep. Plots 1 and 2 represent the two raised beds we will be adding to the center of the greenhouse. To create a clearer image, the greenhouse is built on a cement slab with a very fine layer, not more than an inch deep, of soil covering the ground. We removed the bricks that were put in there and will relay them around our raised beds to create a walkway. These raised beds will allow us to create more space and allow for deeper rooting. We bought hanging gardens for our tomatoes so each kind of tomato will have its
own planter. We have more space than we truly need, so with any luck we will be able to utilize it all. However, many of the plants we’ve chosen work well together, in a companion planting sense, so it would be wonderful if we can scatter them about.

**Starting Seeds & Transplanting:** This is where the greenhouse comes into the picture. Once it is fully renovated, or at least far enough along that we can grow without interruption, we will add fresh soil to the planting beds and begin the process. The greenhouse itself gets fairly warm, but it is missing a few windows, so how much heat it retains at night is non-quantifiable. Therefore, we will be starting our seeds in the Fortin greenhouse which provides a constant climate for the seedlings to germinate in. We have saved plenty of starting containers that we left inside the greenhouse that range from multi-seed flats, to six-packs, and finally a single 4x4 inch container in which we can sell them. We will then fill the containers with organic starting mix and add seeds and water. Seed packets themselves contain a lot of information about the planting procedure for each seed, but it is recommended that seeds need a hole that is four times as deep as the seed is wide. An exception can be made for smaller seeds, which can often just be sprinkled on top. In the instance of a flat, putting at least a two-inch space between each seed is suggested. In the flats it is also a possibility to create mini-furrows, which mimic an actual garden plot. We have 16x8 trays which are good for single seeds and larger 4x6 trays for seeds that germinate and take root much faster, such as the peas. Whichever way we decide to plant the seeds, the next step is to sprinkle soil on top of the seed so that they are buried at the depth suggested. As a general rule of (green) thumb, having seeds too shallow is better than too deep.
Next is labeling! The last thing we want to do is sell the wrong product. I personally color-coded each plant with a different color, a regime that might prove handy for further organizational purposes, or if nothing else, adds color. It might be beneficial to sketch the seedlings to help future gardeners become familiar with what to expect and to help in cases when crops go unlabeled. Using popsicle sticks or any plastic surface that can stand upright would work just fine, and a permanent marker for longevity's sake. The first initial watering should be with a spray bottle so that the soil has time to settle. Larger drops of water can create crevices and alter the soil surface, in turn affecting the seeds' placement. Misting is advised until they have developed their true leaves.

If keeping the soil wet is proving too constant of a task, a closed watering system can help eliminate constant watering. A simple zip-lock baggie or plastic container put over the top would do, that way the condensation will fall back down and keep the plants moist. It is pertinent that the soil stay moist, as any of the other two extremes will greatly impede the seed's germination and continued growth. When a soil is oversaturated it means all its pores are filled with water and thus leaving no room for air circulation. Pores either hold water or air, so when a pore is filled with one, it will not contain the other.\textsuperscript{xxi} Therefore, we need to make sure the soil is wet to the touch but capable of air circulation, and thus we should only re-water the soil when it is dry to the touch.

It has also been suggested that putting a fan on the seedlings once they sprout will make the stems hardier. Growing in a greenhouse tends to make plants weaker since they are not forced to adapt to the elements and are in a constant environment. By placing a gentle breeze on the seedlings, they will harden their stems, making them much more viable and apt for survival outside.
This point brings me to the idea of hardening off, which is something we need to do when moving from the Fortin greenhouse to the outside greenhouse. Inside the Fortin greenhouse, the plants do not experience a change in temperature, only a change in light exposure. While the summertime will not experience a drastic change in temperature from day to night, it is still a change that the plants aren't used to. By placing the plants outside for a few hours each day in the evening, the plants can slowly acclimate to the different temperatures. Given that there is a window or two missing in the greenhouse, we aren't quite sure how cold it can get during the nighttime.

**The Greenhouse:** As mentioned earlier, the greenhouse has high potential to be starting, and permanent, grounds for our garden. Upon inspection, the greenhouse needs a lot of work for us to get the full benefit out of it. While in the first year we do not plan on fully re-vamping it, we will make the necessary upgrades so that we do not use up all our funds. The paint job was the most pressing because we want it to be a welcoming, public environment. Facilities has offered us the use of their power washer which will allow us to strip the paint on the inside and on the door outside, as well as any dirt that as accumulated in unwanted places, such as the ceiling. After that we will prime, and paint the inside white and the door a dark green, keeping true to the colors that were already there. Given that the paint job will be the most man-power and quite assuredly the messiest, that is the job we wish to tackle first.

For further discussion of what actually occurred during the renovating and growing processes, please refer to the supplement at the back of this paper for a complete log.
Sustainability

Now that the garden design and mechanisms have been put into place, a plan for sustainability and a guarantee of future existence is important. While this first year may prove more of a learning experience than a fruitful harvest, we are off to a good start and our sprouts have been growing well. Thus, our expectations are sober but nonetheless enthusiastic. Also, as I discussed earlier, the quality of the soil takes time and resources to nurture and improve. The gumption to actually go thru with a summer garden should prove a good indicator of our capabilities in regards to getting our plot.

Log: Another key to sustainability is making sure we track everything we do. As suggested by other students, keeping a log is key. Not only does it teach new gardeners what to can expect from the land, but also keeps them from reinventing the wheel. It also allows an opportunity to keep tasks organized, further guaranteeing their completion. The log, most importantly, will let us know what we can do during the next season to further our success. We purchased a waterproof notebook that can be taken everywhere and will be protected from damage. This thesis I have compiled is the first big step in keeping a log and will hopefully keep it going. It allows me to say exactly what went on and what could be repeated and what might need some tweaking.

Curriculum and Community: The second key to sustainability is to incorporate it into our curriculum to keep it in sight and mind of the student body. There are many opportunities for all of the departments to get involved in some fashion. The natural sciences can test and work with the soil, the social sciences can question the importance of a community garden, and the theology department can take the grown food to the bank
and discuss poverty. Truly, the garden could open doors for so many academic opportunities, even just as a service learning project for freshman to do. It may even start a horticulture branch or a small agriculture one; the opportunities really are endless.

Most people do not know about the greenhouse because it is never brought up, even in campus tours. It is thus, out of sight and mind. Refurbishing the greenhouse is also important for this reason. If we create a welcoming atmosphere that students feel like they can be a part of, the greenhouse and garden will further succeed thru their attachment.

**Funding:** As proud of that thousand dollar starting budget as we are, we need to have a way to sustain the garden and have a fund that does not diminish quickly. It is also a reserved endowment which means we can only access whatever interest we accrue, and if it is a poor fiscal year, we have no money, thus we cannot be solely dependent on this fund. Our first big step, which will also be our introduction to the Helena community, is a plan to throw a seedling fundraiser in the spring for our cause. The goal would be to have it as a yearly event that the community can get used to and support.

Beyond the fundraising, becoming a student club is the best way to guarantee a steady fund. Each student club at Carroll is allotted $300 per semester, and thus $600 per year. The idea being that once we get the garden going, less and less money will be needed every year once we have established a place, acquire tools, and have improved the soil.

Laura and I will also apply for grants this summer in hopes of building up as much funds as we can while we are here.
Management: The biggest aspect of keeping this garden afoot is having an in-depth plan to maintain a workforce and keep student interest. While many colleges had hired managers or work-study students, we are not at the stage where we can do that. The goal would be to have a year-round student who could overlook the grounds, i.e. a garden manager. But assuming that we won’t have one, we need to design a plan for current students who are volunteering their time.

For this current work year, myself and Laura D'Esterre, both AmeriCorps members are overseeing the garden with help from fellow AmeriCorps members and interested students. There will be four to five of us working over the summer to get this plan in action. I will be staying two months into the summer in student living which will be sponsored by the Hunthausen Center; a position we hope to reprise each year to provide incentive for a student to stay over the summer and work. Laura and I will be filling the management roles, roles that will hopefully be elected each year thru the student club. A president and Co-President make sense as well as a secretary to keep track of all the logs and information. Weekly to bi-monthly meetings would be a required task because a garden is a constantly growing and changing entity that needs to be monitored properly. As for divvying out the tasks, the most important thing would be to have a yearly and weekly calendar created. The yearly would be a fairly stable one that might change by a few weeks depending on current climate and conditions. The weekly one would be a check-off sheet so volunteers would know what needs to be done and what has already been done, plus we could also track the hours invested into the garden. Having a very detailed log would keep us from reinventing the wheel and foresee any problems from one year to the next. We will have all levels of gardening experience so it
would be beneficial to have a resource for students to turn to when they are in need of gardening assistance.

With the help of the community, whether it is Carroll’s, Helena’s or all the campuses nationwide, our garden has such great potential to become something meaningful and engaging. After discussing setbacks and solutions and creating a plan backed with a log, the garden is off to a good start. It already has a basis and backing for a second season and many to come as long as management can be kept up and the community engaged. All the hard work that has already gone into this project ensures that it will do well in this first season. The log books are getting more full and the seedlings are flowing with beautiful root systems and green foliage. As long as the purpose of this garden remains evident it will continue to succeed thru those who believe in all the garden is capable of. Whether it is to engage, educate, or enrich, the Justice Acre will bring the community together in multiple ways.

If I could embody the sentiment of this garden, I believe it is well said in the following Ralph Waldo Emerson quote, “To appreciate beauty, to find the best in others; To leave the world a bit better, whether by a healthy child, a garden patch, or a redeemed social condition; To know even one life has breathed easier because you have lived. This is to have succeeded.” The Justice Acre will become much more than a garden; it will improve livelihoods and spirits and benefit all involved, whether it is a person, a plot of land, or a community. And in that instance, the garden, and all it touches, will always be a success.
Supplement

Greenhouse Log
Friday March 26th/Day 1

And so it begins! Today was devoted to power washing the inside in hopes of removing all the paint so that it could be primed and painted anew. However, the cold, windy weather was not really conducive to being soaked to the bone. There was quite the turnout so we were able to take turns washing the inside while organizing outside. We removed everything from the inside and started weeding thru what we could use and what was broken, outdated, etc. We were able to save many of the small planting containers, in fact I’d say we have more than we need, but they will be useful in the coming years. Between the power washing and the organizing we were spent, cold, and wet after about four hours. The greenhouse, being older than many things on campus, is turning out to be a larger project than expected. We weren’t able to get nearly enough paint off to get any painting done, and really made more of a mess than we cleaned out! For now we would just let the place dry overnight and get back on it in the morning.

Even if we didn’t get as far as expected, the turn-out was great and people got a chance to see what was going on. The greenhouse may be a project larger than we can chew, but it will be worth it if we are able to get it cleaned out.

Saturday March 27th/ Day 2

Today was more power washing and much more organizing. We attempted to scrape some paint off, but that didn’t get too far, and we had some technical difficulties with the power washer, which was also out of gas. But, the sun was shining and provided
inspiration for our hard work. We organized the ground outside of the greenhouse so that we could plant flowers there once it got warm again. We outlined the garden plots with the brick debris that was buried underneath the ground. We also removed the bricks on the inside so that we could reorganize them.

**Saturday April 10th/Day Three.**

Sanding. And lots of it. I spent two hours using a small orbital sander to remove the traces of paint left after power washing. It was rather hit and miss, which some areas working more smoothly than others. It still remains a large task, and I worry about its completion by Earth Day. The age of greenhouse it making it seem that building a new one would be a better use of time and money. But, we will keep working on it, being that the goal is to reuse what we already have.

**Wednesday April 14th/Day Four**

With a special thanks to the Biology Department, we were able to start some seedlings up in their greenhouse! It was a great success. Laura and I went and bought eighteen different types of seeds of herbs and vegetables we know that do well and are popular. The majority of the seeds were organic, save for a few. Target and Lowes were our seed providers and the brands are listed below. The Sean Conway seeds were Target specific, but the rest of the seeds should be fairly easy to find at any home improvement store. We bought organic starting mix and reclaimed some of the growing trays from the outside greenhouse. We also bought a mister and some label sticks. After carrying all the supplies to the inside greenhouse we planted them! There was some method to our madness, however a lot of it was guess and go—yet another learning experience! Below I
have the list of seeds with various information in case this planting experiment is to be repeated.

Table 2. Seed List

<table>
<thead>
<tr>
<th>Seed Name</th>
<th>Vegetable Type</th>
<th>Brand</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cherry Belle</td>
<td>radish</td>
<td>Sean Conway Organic Garden</td>
<td>Y</td>
</tr>
<tr>
<td>Beefsteak</td>
<td>tomato</td>
<td>SCOG</td>
<td>Y</td>
</tr>
<tr>
<td>San Marzano</td>
<td>tomato</td>
<td>SCOG</td>
<td>Y</td>
</tr>
<tr>
<td>Zucchini Dark Green</td>
<td>summer squash</td>
<td>SCOG</td>
<td>Y</td>
</tr>
<tr>
<td>Delicata</td>
<td>lettuce</td>
<td>SCOG</td>
<td>Y</td>
</tr>
<tr>
<td>Bloomsdale Long</td>
<td>spinach</td>
<td>SCOG</td>
<td>Y</td>
</tr>
<tr>
<td>Standing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oregon Sugar Pod</td>
<td>pea</td>
<td>Burpee Organic-Signature</td>
<td>Y</td>
</tr>
<tr>
<td>Roma</td>
<td>tomato</td>
<td>BO-S</td>
<td>Y</td>
</tr>
<tr>
<td>Ruby Red</td>
<td>swiss chard</td>
<td>BO-S</td>
<td>Y</td>
</tr>
<tr>
<td>Maxi Bean</td>
<td>garden bean</td>
<td>Burpee Organic-Fordhook</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collection</td>
<td></td>
</tr>
<tr>
<td>Sweetie</td>
<td>tomato</td>
<td>BO-FC</td>
<td>Y</td>
</tr>
<tr>
<td>Purple Dark Opal</td>
<td>basil</td>
<td>BO-FC</td>
<td>Y</td>
</tr>
<tr>
<td>Green Oakleaf</td>
<td>lettuce</td>
<td>BO-FC</td>
<td>Y</td>
</tr>
<tr>
<td>Green Pearl</td>
<td>parsley</td>
<td>BO-FC</td>
<td>Y</td>
</tr>
<tr>
<td>Cinnamon Basil</td>
<td>basil</td>
<td>Burpee-Fordhook Collection</td>
<td>N</td>
</tr>
<tr>
<td>Rosemary</td>
<td>rosemary</td>
<td>B-FC</td>
<td>N</td>
</tr>
<tr>
<td>Cilantro</td>
<td>cilantro</td>
<td>B-FC</td>
<td>N</td>
</tr>
</tbody>
</table>

As for basic planting practices, we based it off the seed size and how many were contained in a packet. I can promise you this was purely based off Laura’s past garden experiences and there is not scientific logic behind it, at least that I found. We figure that
with the smaller seed sizes, which tended to come with many more per packet, if we put multiple ones in the hole, then it increases our chances of successful sprouts. Once the sprouts germinate, we will thin them and move them out of the smaller germination plots into larger containers where they can flourish on their own. I have also provided a chart to represent what types of sowing liberties were taken so that the process may or may not be repeated next year. I have also outlined how we organized the seeds, which is not entirely important but seems appropriate to note. In general, we tried to bunch together the seeds that had similar germination times. They all had full sun light requirements, so we didn’t take that into consideration. We divided them among four trays, and I will further go into detail about each one. Laura suggested we soak the peas and beans before hand, as in her experience they germinate more successfully that way. The idea behind soaking peas and beans is that it will soften the hard outer coat. But as I am finding with many gardening tips, they are all based on experience and work for some and not for other. So, as of today, the peas and beans are pre-soaking and are not currently planted. In case the pre-soaking does not work to our benefit, we still have unsoaked seeds to plant if need be. To end, we have sixteen of our eighteen crops planted. Below are the specs for the trays:
Tray One:

This tray is 16x8

<table>
<thead>
<tr>
<th>L</th>
<th>L</th>
<th>L</th>
<th>S</th>
<th>S</th>
<th>S</th>
<th>S</th>
<th>R</th>
<th>R</th>
<th>R</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>C</th>
<th>C</th>
<th>C</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

L=**Green Oakleaf Lettuce**: There were an abundance of these seeds so we simply sprinkled them in each plot for all of the 16 holes. Even so, we still had plenty of left over. *Germination time* = 7-10 days.

S=**Bloomsdale Long Standing Spinach**: About three per hole, with plenty left over. These seeds were larger than the lettuce, thus we rationed ourselves to three. *Germination time* = 7-14 days.

R=**Ruby Red Swiss Chard**: Large seeds, used all with one per hole. *Germination time* = 7-14 days.

P=**Purple Dark Opal Basil**: Used all the seeds, one per hole. *Germination time* = 7-14 days.

C=**Cinnamon Basil**: Used all the seeds, one per hole. *Germination time* = 7-14 days.
Tray Three:

16x8

**Roma Tomatoes:** About three seeds in each. None left. *Germination time* = 7-10 days

**Sweetie Tomatoes:** About three seeds in each. None left. *Germination time* = 7-10 days.

**Valerie Lettuce:** Similar procedure to other lettuce, small seeds so a pinch in each hole. *Germination time* = 7-10 days.

**Delicata Squash:** Used all the seeds, one per hole. *Germination time* = 7-10 days.

**Beefsteak Tomatoes:** Used all the seeds, two per hole. *Germination time* = 7-10 days.

---

Tray Three.

**Cilantro:** Used all seeds, 2-3 per hole. *Germination time* = 14-21 days

**Rosemary:** Used all seeds, 2-3 per hole. *Germination time* = 14-21 days

**Parsley:** Used all seeds, pinched into hole. *Germination time* = 14-21 days

**San Marzano Tomatoes:** Used all seeds, one per hole. *Germination time* = 7-14 days

---

**Thursday April 15th/Day Five**

After checking in our seedlings after their first evening in the greenhouse, the soil was fairly dry. I went in early afternoon after they had just gotten some direct sunlight. I deeply watered them, making sure that it was soaked all the way thru, whereas last night I’m not sure the water was deep enough. The beans and peas were bloated so I decided to plant those. We put those in larger germination cups because they require a deeper sowing hole and tend to grown faster and deeper. I put two seeds in each hole to guarantee that one would sprout. The zucchini were also planted this way.
Monday April 19\textsuperscript{th}/Day Six

Today, being Monday, is the first day of sprouting. The beets, which are quickest to germinate, are showing sprouts that haven’t yet reached the surface, but are nonetheless there! We have had issues with our starting medium, as it does not adsorb water as much as we had thought and so our sprouts have been having more dry spells than they should be. Even when the soil is saturated, the top is only wet and the middle stays dry. We left for the weekend so we left water in the bottom of the trays to initiate capillary watering. When we came back the soil was mostly dry. However, realizing our mistake we greatly soaked the soil, lifting the top layer off and watering the center, and we did this twice today and we are not seeing our first sprouts. Over the weekend we also moved them into the shade as the water is rapidly evaporating. So, as you can tell it has been a HUGH learning curve for us both. Also, unknowingly, we didn’t water the mix before planting, which is probably our biggest mistake as we are having a hard time keeping the soil wet. We were also only going in once a day, and by going in three times in one day, being today, we have noticed a huge improvement. So, we have learned our two biggest mistakes: not wetting the mix beforehand and not tending to them enough. With this knowledge we have hope that our little sprouts will still succeed!

April 20\textsuperscript{th}-25\textsuperscript{th}/Days 7-11

I have compiled a chart to show when all the seedlings have sprouted compared to their expected germination time, and have also included when we expect them to be ripe for the pickin’! You’ll notice there is not a harvest time for herbs, as I’m assuming this is
due to the fact that herbs should be picked when ready and often to keep replenishing the crop.

Table 3. Germination

<table>
<thead>
<tr>
<th>Crop</th>
<th>Ex. Germ (days)</th>
<th>Act. Germ (of first)</th>
<th>Ex Harvest (days)</th>
<th>Act Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valerie</td>
<td>7 to 10</td>
<td>7</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Sweetie</td>
<td>7 to 10</td>
<td>11</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Green Pearl</td>
<td>14 to 21</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloomsdale</td>
<td>7 to 14</td>
<td>9</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Green Oakleaf</td>
<td>7 to 10</td>
<td>8</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Ruby Red</td>
<td>7 to 14</td>
<td>9</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Roma</td>
<td>7 to 10</td>
<td>10</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Beefsteak</td>
<td>7 to 10</td>
<td>11</td>
<td>80-96</td>
<td></td>
</tr>
<tr>
<td>Rosemary</td>
<td>14-21</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple Dark</td>
<td>7 to 14</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delicata</td>
<td>7 to 10</td>
<td>12</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Cilantro</td>
<td>14 to 21</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Squash</td>
<td>10 to 14</td>
<td>9</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Cinnamon Basil</td>
<td>7 to 14</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxi Bean</td>
<td>7 to 14</td>
<td>7</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Cherry Belle</td>
<td>4 to 6</td>
<td>6</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>San Marzano</td>
<td>7 to 14</td>
<td>9</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>OR Sugar Pod</td>
<td>7 to 14</td>
<td>7</td>
<td>68</td>
<td></td>
</tr>
</tbody>
</table>

So far it looks like we are doing rather well time wise, which is very exciting!

Still no sign of rosemary and it looks like the Delicata, Sweetie, and Beefsteak were a little late, whereas the Cilantro and Green Pearl were a little early. As the seedlings sprout the capillary action works more efficiently as the roots are now assisting in pulling up the water. With a lot of the cells there are actually tap roots growing out of the bottom and into the water. Whereas in the beginning only the 3x6 trays with the larger, quicker-to-sprout seeds were absorbing water from the tray, the 8x16 are now doing the same!

The soil, then, is now staying constantly moist for the most part. Spots that do not quite have seedlings dry out faster seeing as the roots are not bringing in water.
Wednesday April 28th

All but our rosemary have sprouted! If there is one thing I have learned from the sowing process is that, in general, one seed is plenty. We were very successful in our greenhouse germination process and now each little cell is getting rather crowded, especially the herbs. Normally at that point I would thin them, but it is hard to pull a plant knowing the potential it holds and how much space we truly have. With the other plants such as the tomatoes, I have thinned simply because we have so many kinds and not so much space for such large plants. The plants, like radishes, which had multiple sprouts in each cell, I didn’t thin out but transplanted them into new cells because they are quick growing and we will be ready before all the other plants will be and we will be on our next round. It was these kinds of aspects that I took into consideration when thinning or transplanting. When I did thin, I dropped the sprouts in the water tray so that they may work as a fertilizer tea, even if in a little capacity.

I had to put wooden stakes in with the beans as they were growing so tall and heavy that they were having a hard time staying up right. They have developed their sticky stems, which help them crawl up poles. Laura has gone to work on the raised beds because it seems our radishes and beans will need to be transplanted soon. The peas seem slightly stunted, but all the other sprouts seem to be doing just fine. The herbs and tomatoes seem very happy.

Wednesday//May 5th

Plants continue to thrive, especially the summer squash. The bean plants seem to have some disease so I have removed the damaged leaves. I first sprayed the leaves with
a soap/water mixture to kill any bugs that might be on there. The soap was an eco-friendly variety and the chemicals in the soap provide nutrients for the crops. The beans continue to grow even with the removal of leaves. The peas are growing slowly but surely. The tomatoes continue to thrive. I have tried transplanting the chard multiple times with very little success. Their root systems simply aren’t that strong despite their 2” height. The tomatoes have transplanted well and the lettuce is hit or miss. Capillary action continues to work smoothly. We purchased bone meal and blood meal amendments and I have been sprinkling it in the new pots as I transplant the large plants such as the zucchini, at least 5” tall.

i (Tilth)
ii (Tetrault)
iii (Perrin)
iv (Brady)
v (Tetrault)
vi (Perrin)
vii (Brady)
viii (Brady)
ine (Rodale)
x (Coyne)
xii (Hills)
xiii (Brady)
xiv (Pollan)
xv (Perrin)
xvi (Rodale)
xvii (Coyne)
xviii (Brady)
xix (Birds & Blooms)
x (Coyne)
xx (Coyne)
xxi (Brady)
References


Zone 4, Fall 2009: 5-7, 51-53.