

A Thesis Presented to  
The Faculty and Staff of Alfred University

Transforming the Campus Greenhouse into a Horticulturally Therapeutic Space

by

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## **Abstract**

The goal of this project was to deliver a review of literature covering horticultural therapy, propose the benefits and implications of horticultural therapy for college students, and implement a trial that tests the hypothesis that the operation of a horticulturally therapeutic space can be functionally affordable, sustainable, and beneficial to an institution. A comprehensive literature search was conducted throughout the spring of 2019. Horticultural therapy has been found to provide a positive influence on stressed individuals. A field test was attempted at the main campus of Alfred University in Alfred, New York throughout the 2018–2019 academic year. The field test was conducted using a variety of spring blooming bulbous plants and recording the observed flowering time-frame of the selected plants with comparison to their expected flowering time-frame. Upon test conclusion, it is believed that horticultural therapy can be implemented on campus and bulbous flora can be grown successfully as an alternative method for students to discover relief from stress. Recommendations are made to improve the greenhouse even further and promote alternative plants that may provide earlier growth for college students to fully gain any benefit. Further research in this topic may be necessary with quantitative data gathered to provide links that support student benefit.

## Introduction

First, observe these daisies:



**Figure 1.** An image of daisies. Photographed by Desiree Bojanowski.

White petals with yellow pollen; a simple flower. The scientific name for the white English daisy is *Bellis perennis*. It is classified as a weed<sup>1</sup>. Many people spend time plucking them out of their gardens or maybe making flower crowns. Some say the daisy symbolizes innocence and purity as well as new beginnings<sup>2</sup>. Upon my arrival at Alfred University's student's acceptance day, my mother and I were first seated with a bouquet of daisies at our table. My mother pointed out that her mother, my late grandmother, loved daisies. "It was meant to be!" she proclaimed, in regard to my arrival at Alfred University. That was one of my first memories made at Alfred University. Touring the campus that same day, I was introduced to the diverse and beautiful College in Alfred, New York. This place would be my home for four years. I was a young adult brimming with excitement for the college life. Boy an adventure it has been! Throughout these past four years, I have encountered so many different trials and experiences which have molded me as an individual. For my honors thesis, I wanted to do something different, unique and interesting to me.

I started my Alfred University adventure in the fall of 2015 as an undecided major in the College of Liberal Arts and Sciences. One of the many clubs I joined was the Forest People, an outdoor club on campus. We went out hiking and camping constantly. Many of the individuals in the Forest People are kind-hearted, giving, and witty folks who have a passion for the outdoors. I decided to pursue a major in biology because of my love for nature. Soon after, a minor in family business management and entrepreneurship was added because one day I would like to run my own business. I aspired to be the leader of my life.

During the summer of 2018 I was the Alfred Farmers Market manager, an intern at Living Acres Farm, and shift manager/barista at the Terra Cotta coffee shop. Nearly three years passed since I first arrived at Alfred and I kept myself busy as a college student! At Living Acres farm I experienced the life of a small family farm business and learned about proper soil care, vegetable propagation and crop management. As the dawning of my final year was approaching, I had to figure out what type of honors thesis I would do. I spent many hours weeding rows of vegetables at Living Acres. During that time, I thought constantly about different topics. Then, when realizing I did not have much greenhouse management experience, I developed the idea to utilize the campus greenhouse located at the Environmental Studies House. At the time, I knew the greenhouse was in a dilapidated state, and many people on campus were not aware of its existence. I wanted to change that. I was inspired and driven by my hard-working peers to fix up the greenhouse. My goal became to revitalize the space and make it user friendly to anybody on campus. I hoped that more than just environmental studies majors or biology majors can use the space. We have the psychology students, art students, and so many young minds who can use the space. My goal was to transform our campus greenhouse into a universally appreciated space

everybody could use, and it would take minimal care to maintain: a horticulturally therapeutic space.

To share some history about Alfred University I learned during my research, in 1908 the School of Agriculture opened bringing functioning greenhouses on campus (figure 2)<sup>3</sup>. These greenhouses were built for the new program dedicated to agricultural education. Back in the early 1900s, people primarily valued farming and agricultural education. As time progressed the focus of Alfred University was shifted towards engineering and art over agriculture. Eventually, the agriculture program was cut, and the greenhouses were torn down to make way for the current standing Harder Hall and Binns-Merrill Hall which, holds a combination of engineering and art related equipment used for teaching.



**Figure 2.** Image of old Alfred University obtained from “*Images of America: Alfred and Alfred Station*” P.87.

On November 11th, 2003 the Fiat Lux published an article about Chris Sanford's greenhouse<sup>3</sup>. Chris Sanford built the greenhouse in 2003/04 as an Environmental Studies senior project and gained over \$900 in funding to build it next to the Environmental Studies House at 16 Park Street, Alfred, New York 14802. She also had to receive the town's approval of this project. Back then, you could visit Chris at her greenhouse, where she primarily grew cold hardy vegetables such as cabbage, broccoli, and kale. She has since graduated and gone forward with her life, but what remains of the greenhouse? Greenhouses can take a lot of work to maintain with succession planning, irrigation, pest control, weeding, planting, fertilizing, and so much more. Growing plants can require a lot of time, energy, and money. Nobody was taking proper care of the space. Nobody had been as passionate as Chris was to devote enough energy or time in order to maintain a full running greenhouse.

Therefore, I took up the initiative to change the future of the only student-built greenhouse we have on campus. My objective was to utilize the greenhouse to plant and successfully grow spring flora. With this initiative, the greenhouse would be used during the time students are present at Alfred. During the fall semester, bulbs can be planted. While students are away in the winter months, the bulbs will be in dormancy. During the spring semester, flowers can bloom, and students can enjoy the vibrant spring colors. I wanted to bring in the concept of horticultural therapy to change the greenhouse function from crop production into a therapeutic location where students, faculty, and even community members can walk by, sit down, and enjoy a moment in the greenhouse. Horticultural therapy can provide a positive influence on stressed individuals. The operation of a horticulturally therapeutic space can be functionally affordable, sustainable, and beneficial to an institution like Alfred University.

### *Horticultural Therapy*

Anxiety, stress, depression and sleep difficulties are primary factors affecting academic performance<sup>4</sup>. In response to the difficulties many students experience when balancing mental health and class responsibilities, many Health Centers offer therapeutic options for relief. The importance of treatment and prevention are continuously being studied among college-age individuals<sup>5</sup>. An important aspect of depression prevention and treatment includes conducting higher quality treatment studies among college students. Different types of treatment might be optimal for different students<sup>6,7,8</sup>. Such types of treatment include psychotherapy, medication, building a support group, as well as complementary and alternative medicine<sup>9</sup>. Many different methods of socially recognized alternative therapeutic approaches exist such as acupuncture or aromatherapy. Horticultural therapy is not as widely recognized as other alternative methods for mental health treatment. Students may be able to find a sense of satisfaction and joy in the growth of plants. Vibrant colors and smells from flowers may further aid in the relief and therapy of students. Therefore, the use of bulbous plant propagation for horticultural therapeutic use would be beneficial for students on college campuses.

The American Horticultural Therapy Association, or AHTA, exists to define the profession of horticultural therapy and increase professional identity as well as recognition<sup>10</sup>. Studies on the elderly and preschool children have been completed which provide real assessments of horticulturally therapeutic programs<sup>11</sup>. Factors such as participation, social interaction, and intergenerational interactions were observed in those studies. The elderly has been worked with to visualize brain stimulation when engaging in nature-based activities<sup>12</sup>. Stress management courses incorporating horticultural therapy are provided in some workplaces to aid in the prevention of stress related symptoms that may result in sick leave or less



workability<sup>13</sup>. Outcomes from another study in similar focus on helping employees indicate that nature-based rehabilitation does increase the likelihood of employees returning to work<sup>14</sup>.

Additional studies have been made to test horticultural therapy and its influences on high school students<sup>15</sup>. In order to achieve strong effects in many studies however, a suggestion is that rehabilitation needs to be carried out over a longer period. Therefore, further studies continue to analyze horticultural therapeutic programs and spaces as well as their benefits to individuals over longer periods<sup>16</sup>. Redirecting a space that may not receive much use into a horticulturally therapeutic space could be beneficial for any institution.

In order to implement the idea of a horticulturally therapeutic space in an institution, such as a college, a trial must be done to test if it is possible that during the fall semester, students can plant bulbous plants such as tulips, daffodils, crocuses, and irises, then in the spring semester they can interact with their plants through simple maintenance jobs such as weeding and watering. The reason behind choosing spring time blooming flowers is because these plants will remain dormant over winter and during the spring semester they will grow with minimal effort. Springtime blooming flowers are planted in the fall and undergo a period of dormancy during the winter, which is necessary for their physiological processes to store the energy required to bloom when the weather warms up in the spring<sup>17-23</sup>. Growing spring flowers can introduce a therapeutic sense for stressed individuals. It is important to learn about the necessities of greenhouse management as well as project management for redeveloping a space into a sustainable botanical and therapeutic location for future students.

## Methods

### I. *Location of the Trial*

The Alfred University main campus has one cold-frame greenhouse built by A.U. alum Chris Sanford at the Environmental Studies House lot on 16 Park Street. Alfred, New York 14802. This greenhouse was not receiving much use at the time prior to this trial, it was unkept and overgrown (Figure 3). Someone was trying to build a raised bed out of treated wood, and the ground was covered in a black mesh-like layer. This greenhouse is located conveniently across from the campus Wellness Center, where students are encouraged to go if they want to build upon their health, personal growth, and success at Alfred University.



**Figure 3.** *Initial state of the interior of the greenhouse. This photo was taken in the late summer of 2018. Initial photo of the Alfred University cold-frame greenhouse at the Environmental Studies House taken in the late summer of 2018. Photographed by Desiree Bojanowski*

## II. *Trial Beginning: Fall Semester*

The process was organized into two stages: fall semester and spring semester. During the fall semester, I had to assess the greenhouse and plan for research, communication, and change to the greenhouse. Different factors such as light, temperature, and soil quality play a role in the successful growth of spring bulbous flowers. It is recommended that spring blooming flowers such as tulips and daffodils are planted in a well-drained area with loamy soil receiving full sun and partial shade<sup>1,24</sup>. The greenhouse did not have desired soil and water drainage. The soil had clay components in it, which caused water to pool on top of the soil during rainy days. The only small addition I incorporated to the soil composition was by adding a little potting mix in hope that more nutrients would be available for the plants. Otherwise, I did not add any fertilizer or other components to change soil quality.

I began to refurbish the greenhouse by cleaning out unnecessary materials and collecting all the mesh covering. Once uncovering the mesh, I noticed the layout of the greenhouse was designed where two beds of rocks took up space on the north and south side of the greenhouse vertically; they ran parallel to the middle cement path. I decided to remove the cement block path and create a new walking path made of the large rocks found in those trenches. I hand weeded, tilled and reorganized the layout to give it a fresh start. Once I had the greenhouse mostly cleared out, I met with Amanda Khodorkovskaya, Health and Wellness Coordinator, to plan out potential horticultural benefits of the greenhouse and possible future events for the spring. Lastly, I decided on what plants would be put in the greenhouse.

The decision was made to plant a variety of spring-time blooming bulbs in during the fall semester and observe the growth progress in the spring semester. When deciding which plants to choose, factors such as expected flowering, purchase accessibility, and recommended light, soil,

and care requirements were all considered. The greenhouse provides full sun throughout most of the day in the spring, and when trees fully develop leaves, there is partial shade later in the year. Ground temperature was always colder than air temperature inside the greenhouse. However, since the greenhouse trapped heat, the air temperature inside the greenhouse is typically warmer than the air outside the greenhouse. Therefore, I decided to leave one wall of the greenhouse open for more airflow throughout. This would reduce uncomfortable levels of heat when anyone would like to be inside the greenhouse.

### III. *Plant Collection*

In the beginning, I wanted to try incorporating native flowers to the area, which is why Dr. Emmons donated some plants from her backyard for support. The plants she excavated locally and donated include *Aconitum napellus* “Monkshood,” *Dicentra canadensis* “Squirrel corn,” and *Sanguinaria canadensis* “Bloodroot.” It wasn’t enough to fill the space with color, so purchasing bulbs was my next option. There was a focus on most commonly known flowers such as tulips and daffodils because many people might be more familiar with them and enjoy their presence. To demonstrate an easy and commonplace method of acquiring the plants, I purchased the bulbs from a local retailer, Lowe’s, rather than online. The plants that are readily available to people in the area felt appropriate to me. Lowe’s was also having a good sale late in the season to clear out the plants. A variety of plants were chosen to grow within partial or full sunlight, and with expected flowering between February to May. A total of 546 Bulbs were purchased at the Lowe’s retail store (Table 1). I purchased 546 bulbs of different species and varieties in order to spread out the trial and compare natural growth in the greenhouse against suggested growth

timing on the plant packaging as well as growth of spring flowers around campus. Planting began the last two weeks of November and was finished before December.

**Table 1. Plant Inventory**

*Different varieties of bulbous plants obtained for the trial. The bulb count and expected vs. observed bloom time is also presented.*

Species	Variant	Bulb Count	Expected Bloom Time <sup>a</sup>	Observed Bloom Time <sup>b</sup>
<i>Tulipa</i>	Triumph Happy Generation	15	Mid Spring	-
	Fosteriana Emperor Mix	30	Early spring	6-May
	Darwin Hybrid Oxford Elite	15	Mid Spring	-
	Triumph Violet mix	30	Mid Spring	-
	Triumph Garden Party Mix	30	Mid spring	-
	Darwin Hybrid Mix	45	Mid spring	6-May
	Darwin Hybrid Red	45	Mid Spring	6-May
<i>Narcissus</i>	Daffodils Trumpet Mix	45	Mid spring	-
	Daffodils Double Golden Ducat	15	Mid Spring	-
	Daffodils Large Cupped Pink Charm	15	Mid Spring	-
	Paperwhites tazetta Ziva	8	Mid Spring	-
<i>Allium</i>	Large Flowering mix	3	Late Spring	-
	Purple sensation	15	Late Spring	-
<i>Anemone</i>	Blanda mix	50	Early spring	-
	coronaria De Caen Large flowering mix	30	Late Spring	-
<i>Ranunculous</i>	asiaticus Mix	50	Late Spring	-
<i>Iris</i>	reticulata & danfordiaea Mix	30	Early Spring	18-Apr
<i>Crocus</i>	vernus & flavus Large Flowering Mix	75	Early Spring	18-Apr

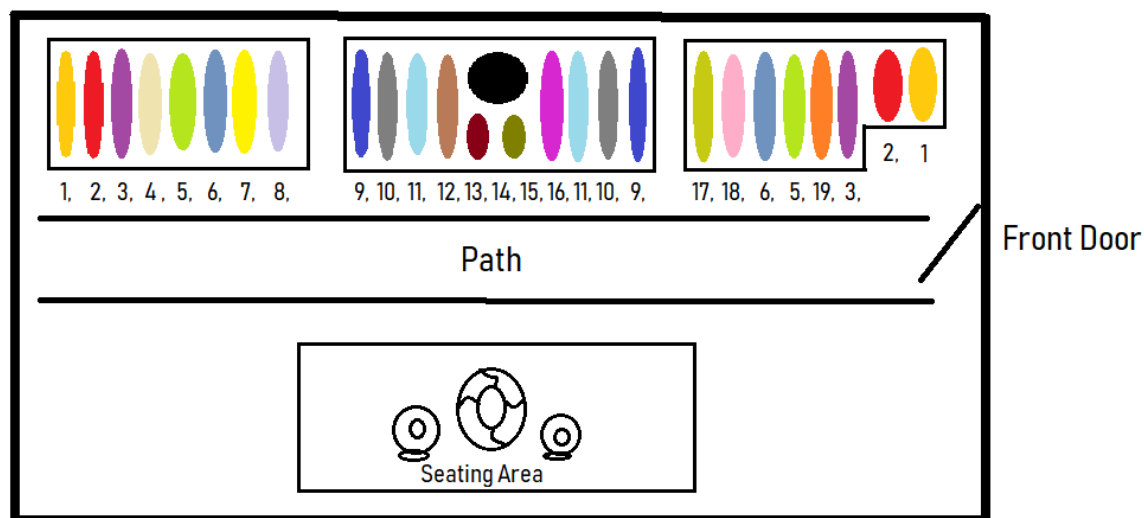
*Note.* The total amount of purchased bulbs is 546. This table does not include donated plants.

<sup>a</sup> Early, mid and late spring was listed by the supplier Lowe's on their packaging of these plants. Actual spring dates may vary depending on region and time of year.

<sup>b</sup> – means that no plants were observed to have bloomed by the end of this field trial. Some plants may have still been growing at the time.

#### IV. *Organization within the Greenhouse*

The greenhouse was measured to be 22 ft long and approximately 16.5 ft wide. I chose to focus on planting in only one half of the greenhouse I will call the upper half. I estimated the upper half could hold approximately 154ft<sup>2</sup> of space for planting bulbs. When deciding the new layout, I wanted to change the direction of the flowerbeds to face horizontally and make beds on the upper half of the greenhouse where they would receive the most sunlight. Bulbs were planted in rows along the upper half of the greenhouse according two product instructions (Appendix, Table 2). The layout of planting was decided to be symmetrically distributed for increased appeal (Figure 4). I had the greatest number of tulips, so I started planting with tulips on the ends and worked towards the middle planting different varieties and species until the middle holds the donated local plants. Two trenches were dug when discovering, as mentioned previously, that the clay soil causes water to pool. The trenches also serve as pathways to reach further in the beds for weeding. Obtaining patio furniture such as two chairs and a table was important for the ability to sit down and enjoy the space comfortably. The seating area will allow for people to have a space to interact with other people, coloring books, potting material, crafts, homework and more.



- |                           |   |                           |                          |
|---------------------------|---|---------------------------|--------------------------|
| 1 ● Darwin H Mix          | 9 ● Crocus  | 9 ● Crocus                | 17 ● Anemone Large       |
| 2 ● Red                   | 10 ● Daffodil Trumpet Mix                               | 10 ● Daffodil Trumpet Mix | 18 ● Daffodil Pink Charm |
| 3 ● Violet                | 11 ● Ranunculus   | 11 ● Ranunculus           | 6 ● Emperor              |
| 4 ● Oxford                | 12 ● Allium (15)  | 16 ● Iris                 | 5 ● Garden               |
| 5 ● Garden                | 13 ● Allium (3)   | 15 ● Paperwhite Ziva      | 19 ● Happy               |
| 6 ● Emperor               | 14 ● Donated Plants<br>(Squirrel Corn, Monkshood, etc.) |                           | 3 ● Violet               |
| 7 ● Daffodil Golden Ducat |   |                           | 2 ● Red                  |
| 8 ● Anemone Blanda        |   |                           | 1 ● Darwin H Mix         |

**Figure 4.** Color-coded & numbered layout of plants within the greenhouse. Image created by Desiree Bojanowski

The structure of the greenhouse was intentionally left open-aired for optimal natural growth. Many of the ornamental species selected require a typically cool temperature when grown in greenhouses<sup>25</sup>. Directions were followed as instructed to plant each bulb approximately twice its height in depth and space them out enough so each bulb would have enough room to grow (Figure 5).

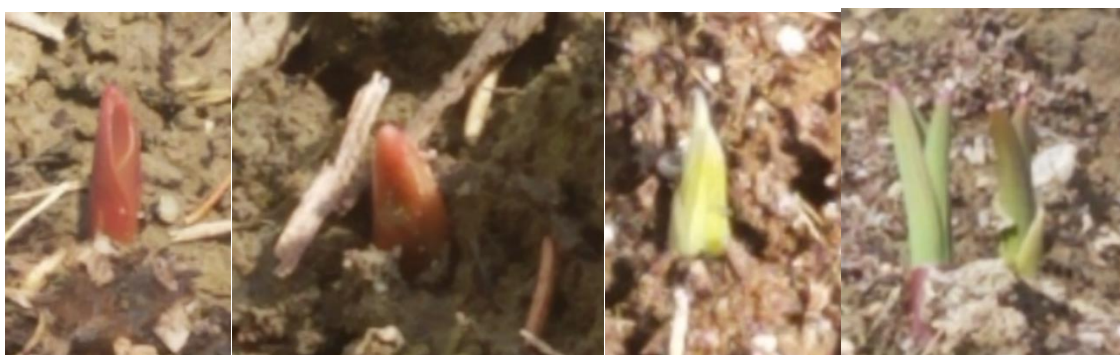


**Figure 5.** A display of one tulip variety that was planted in rows. Photographed by Desiree Bojanowski



## V. *Trial End: Spring Semester*

After planting all bulbs, the greenhouse was left alone for the winter months. Upon return in the spring, no fertilizer was added to influence the growth of the bulbs. They were monitored until the end of the spring 2019 semester. Monitoring consisted of using a digital thermometer to gauge temperature changes in alignment with the growth of plants. The ground temperature was typically five to ten or more degrees below the air temperature. It wasn't until April 3<sup>rd</sup>, 2019 when the outside air temperature was 53-56 °F, inside the greenhouse air was nearly 65 °F, while the greenhouse ground was 42-45 °F, shoots could be spotted popping out of the ground at that time (Figure 6).



**Figure 6.** *Compilation of four images that show shoot growth in the beginning of April.*

Promotion of the spot as a wellness location any student can visit was done by tabling in the main Powell Campus Center during the last week of classes. While tabling, I would encourage passerby students to take an origami tulip or make an origami tulip. The Wellness Center also acquired spring floral coloring books, so coloring was an additional option people had. This is an adaptive refurbishing project, meaning I would discover new variables or difficulties along the way and make changes, if needed, while adapting to them. A problem arose from my decision on having the back wall open for free air flow to keep the plants cool. On April

30<sup>th</sup>, 2019, the greenhouse was invaded by roaming deer. The deer consumed many of the growing tulip varieties on both ends of the greenhouse. To prevent the possibility of deer strolling in again, I put up a fence on the end of the greenhouse. Placing the fence was one of the last few tasks I did besides weeding, until the end of the spring 2019 semester.

## Results and Discussion

Many of these bulbous plants were expected to bloom in late March/early April, however growth did not officially begin until mid/late April (Table 1). Some of the varieties such as *crocus* and *iris* showed growth at the end of April (Figure 7, Figure 8). Two varieties of tulips officially bloomed in May (Figure 9, Figure 10).



**Figure 7.** Successful bloom of a white crocus. Photographed by Desiree Bojanowski.



**Figure 8.** Successful bloom of several irises. Photographed by Desiree Bojanowski.



**Figure 9.** Two Darwin Hybrid tulips in bloom. Photographed by Desiree Bojanowski.





**Figure 10.** One Fosteriana Emperor tulip in bloom. Photographed by Desiree Bojanowski.

This trial provided results of growth around the end of the spring semester, the time when final exams and projects may be causing the most stress for students. When reviewing upon the alignment of seasonal dormancy and college semesters, it may almost be too late to enjoy some species of plants if they bloom in late May and the majority of students are gone by the beginning of May.

One result to note was that the daffodil varieties of *narcissus* were not as successful as daffodils planted around campus. The greenhouse did not have ideal water drainage, therefore plants that did not show immediate spring growth such as the daffodils are believed to have suffered from bulb rot, or it is possible they may just need more time to fully establish and grow. Deer were drawn to the tulips, so more fencing may be necessary to prevent destruction by animals. On the other hand, deer were not drawn to the growing *Allium* varieties. The plant packaging does indicate *Alliums* to be deer resistant. Based on what I observed, spring blooming flora such as tulips, alliums, crocuses, and irises, show the best overall growth within the greenhouse.

## Recommendations

Further collection and analysis of quantitative data could provide more connections to therapeutic benefits. It would be interesting if a psychology student picked this project up and surveyed students after spending some time in the greenhouse to gain quantitative data about the effects of horticultural therapy on mental health and wellbeing. A study about a peony-viewing program described promising therapeutic methods for improving physiological functions as well as an effective psychological relaxation strategy<sup>26</sup>. In a psychosocial rehabilitation pilot study, a small group of schizophrenic patients interacted with a flower workshop<sup>27</sup>. A psychology student could conduct a study similarly to these where a test group is brought into the greenhouse and given a questionnaire on their emotional status with any changes. The campus greenhouse could be a location where a Wellness Center therapy session can take place outdoors. Amanda and I discussed the idea of having tea in the greenhouse, or even possibly growing tea leaves and procuring tea in the greenhouse. More hands-on events can be planned over time with potting plants or maintaining plants within the space.

This trial has demonstrated that successful qualitative data infers the growth of bulbous plants can be achieved in an institution (figure 9). Further improvements can be made to upgrade the greenhouse with possibly more plants, real raised beds, and even a french drain or better irrigation system. *Galanthus nivalis*, or the snowdrop, and *Hyacinthus*, or Hyacinths are two other flowers I noticed blooming early on campus for a short time. Potentially the growth of shrubs or small bushes could be more enhancements. When purchasing plants at Lowe's, I even considered the thought of purchasing a rose bush and planting bushes next to the seating area. Another possible expansion of this space may be to make it more user-friendly for all types of individuals such as the young and the old. This could include adding a ramp to the exterior when

approaching the door, so individuals don't have to tread on uneven ground in order to get inside the greenhouse. Even more work can be done to clean up the space and make it kid friendly as well as safe like removing small rocks and sharp objects. Adding windchimes or light fixtures can improve the appeal of the greenhouse and make it a location people will want to spend time in.

## **Conclusion**

Development of a proper location for bulb cultivation is necessary for horticultural therapy to have a grounded application. Bulbous plants do not require an extensive amount of attention in their management. By the end of this trial it can be noted that the space would only provide a therapeutic benefit to students by the end of the academic spring semester when many may be struggling with final exams and projects. Student interest is also vital for any therapy to be successful. It wasn't until late April, but there were finally flowers beginning to bloom. I had felt successful in the rejuvenation of this greenhouse. Even after doubt, plants were growing, and students could visit the flowers during the final week of classes. This thesis may be over now, but the flowers continue to live after I have written my piece and, hopefully, they will continue to return next year for future students to enjoy. I leave the future of the campus greenhouse in the capable hands of the people at Alfred University. Student clubs such as the Forest People, Biology Club or Green Alfred may continue to visit, maintain, and organize this space. The future may take the greenhouse in a new direction or have it become fixed up even further than what I have accomplished. In the end, it can serve the community as a horticulturally therapeutic space if the community reaches back and interacts with it. Successful therapeutic effects may vary depending on the quality of the service given at any institution. No students were directly

surveyed in this trial. The focus on the trial was primarily to test the potential of the space with successful growth of spring flora. Ultimately, the operation of a horticulturally therapeutic space has potential to become a functionally affordable, sustainable, and beneficial asset to an institution like Alfred University.



**Figure 11.** Final photo of the greenhouse taken in April of 2019 portrays controlled growth in an organized space. Photographed by Desiree Bojanowski.

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## References

1. Bradley FM, Trevor JC. The all-new illustrated guide to gardening: planning, selection, propagation, organic solutions. White Plains; New York: Adult Trade Publishing/Reader's Digest Association; 2009. p. 551.
2. Daisy flower – meaning, symbolism and colors [Internet]. [place unknown]: WordPress and HitMag; c2019 [updated 2019; cited 2019]. Available from: <https://flowermeanings.org/daisy-flower-meaning/>.
3. McFadden L. "Images of America Alfred and Alfred Station." Arcadia Publishing. Charleston SC, Chicago IL, Portsmouth NH, San Francisco CA. 2007. p.87.
4. Savett A. Greenhouse unique to AU. Fiat Lux. 2003 November; 98 (1): p.5.
5. American College Health Association. American College Health Association-National College Health Assessment II: Reference Group Executive Summary Spring 2018. Silver Spring, MD: American College Health Association; 2018.
6. Blanco C, Okuda M, Wright C, Hasin DS, Grant BF, Liu S, Olfson M. Mental health of college students and their non-college attending peers: results from the national epidemiologic study on alcohol and related conditions. Arch Gen Psychiatry. 2008; 65(12): 1429–1437.
7. Pedrelli P, Nyer M, Yeung A, Zulauf C, Wilens T, College Students: Mental Health Problems and Treatment Considerations. Acad Psychiatry. 2015; 39(5): 503–511.
8. Cuijpers P, Cristea IA, Ebert DD, Koot HM, Auerbach RP, Bruffaerts R, Kessler RC. Psychological treatment of depression in college students: a metanalysis. Depress Anxiety. 2016; 33(5): 400–414.
9. Mental health treatments. [Internet] [place unknown]: Mental Health America; 2019 [updated 2019; cited 2019]. Available from: <https://www.mentalhealthamerica.net/types-mental-health-treatments>.



10. Definitions and Positions [Internet]. Seattle (WA): American Horticultural Therapy Association; c2019 [updated 2019; cited 2019]. Available from: <https://www.ahta.org/ahta-definitions-and-positions>
11. Predny ML, Relf D. Interactions between Elderly Adults and Preschool Children in a Horticultural Therapy Research Program. *Hort technology*. 2000; 10(1).
12. Sin-Ae Park, A-Young Lee, Hee-Geun Park and Wang-Lok Lee. Benefits of Gardening Activities for Cognitive Function According to Measurement of Brain Nerve Growth Factor Levels. *Int. J. Environ. Res. Public Health*. 2019; 16: p760.
13. Eva Sahlin, Gunnar Ahlborg Jr., Josefa Vega Matuszczyk and Patrik Grahn. Nature-based stress management course for individuals at risk of adverse health effects from work-related stress—effects on stress related symptoms, workability and sick leave. *Int. J. Environ. Res. Public Health*. 2014; 11: 6586-6611.
14. Patrik Grahn, Anna María Pálsdóttir, Johan Ottosson and Ingibjörg H. Jonsdottir. Longer nature-based rehabilitation may contribute to a faster return to work in patients with reactions to severe stress and/or depression. *Int. J. Environ. Res. Public Health*. 2017; 14: 1310.
15. Igarashi M, Aga M, Ikei H, Namekawa T, Miyazaki Y. Physiological and psychological effects on high school students of viewing real and artificial pansies. *Int. J. Environ. Res. Public Health* 2015; 12: 2521-2531.
16. Soderback I, Soderstrom M, Schalander E. Horticultural therapy: the ‘healing garden’ and gardening in rehabilitation measures at Danderyd Hospital Rehabilitation Clinic, Sweden. *Pediatr. Rehabil*. 2004; 7(4): 245–260.
17. Rees AR. The Physiology of Ornamental Bulbous Plants. *Bot Rev*. 1966; 32(1): 1-23.
18. Vandeloos F, Van Asschie JA. Temperature requirements for seed germination and seedling development determine timing of seedling emergence of three monocotyledonous temperate forest spring geophytes. *Ann Bot*. 2008;102: 865–875.
19. Khodorova NV, Boitel-Conti M. The role of temperature in the growth and flowering of geophytes. *Plants (Basel)*. 2013; 2: 699-711.
20. Horvath D. Common mechanisms regulate flowering and dormancy. *Plant Sci*. 2009; 177: 523–531.
21. Fu Z, Tan D, Baskin JM, Baskin CC. Seed dormancy and germination of the subalpine geophyte *Crocus alata* (Iridaceae). *Aust J Bot*. 2013; 61: 376–382.
22. Baskin CC, Zackrisson O, Baskin JM. Role of warm stratification in promoting germination of seeds of *Empetrum hermaphroditum* (empetraceae), a circumboreal species with a stony endocarp. *Am J Bot*. 2002; 89(3): 486–493.

23. Jones HG. Plants and microclimate: a quantitative approach to environmental plant physiology. Cambridge University Press. 2014; 3: 239-242.
24. Hessayon DG. The bulb expert. Expert Books, 1999.
25. Rice LW, Rice RP. Practical Horticulture. Prentice Hall, Upper Saddle River, New Jersey. 2011; 4: p. 402-403.
26. Zhao R, Zhang G, Wang X, Zhang B, Guo L, Niu L, Zhang Y. Psycho-physiological effects of a peony-viewing program on middle-aged and elderly individuals at different phenological stages. *Int J Environ Res Public Health*. 2019; 16: 439.
27. Pereira A, Pereira MAO. The flower workshop in psychosocial rehabilitation: a pilot study. *Ment Health Nurs*. 2009; 30:47–50.

## Appendix

**Table 2. Product Details**

Species	Variant	Sun Exposure	Depth (in.)	Bulbs (per Sq Ft.)	Height (in.)	Cold Hardiness (°F)
<u>Tulipa</u>	Tulips Triumph Happy Generation	Full Sun, partial shade	5	9	18-20	-50
	Tulips Fosteriana Emperor Mix	Full Sun, partial shade	5	9	14-18	-50
	Tulips Darwin Hybrid Oxford Elite	Full Sun, partial shade	5	9	20-24	-50
	Triumph Violet mix	Full Sun, partial shade	5	9	18-20	-50
	Triumph Garden Party Mix	Full Sun, partial shade	5	9	18-20	-50
	Darwin Hybrid Mix	Full Sun, partial shade	5	9	20-22	-50
	Darwin Hybrid Red	Full Sun, partial shade	5	9	20-22	-50
Narcissus	Daffodils Trumpet Mix	Full Sun, partial shade	6	6	14-16	-50
	Daffodils Double Golden Ducat	Full Sun, partial shade	6	6	14-16	-50
	Daffodils Large Cupped Pink Charm	Full Sun, partial shade	6	6	14-16	-50
	Paperwhites tazetta Ziva	Full Sun	6	6	16-20	-20
Allium	Large Flowering mix	Full Sun	8	3	32-40	-20
	Purple sensation	Full Sun	5	9	28-32	-50
Anemone	<u>Blanda</u> mix	Full Sun, partial shade	3	12	4-6	-30
	<u>coronaria</u> De Caen Large flowering mix	Full Sun, partial shade	3	12	10-12	0
<u>Ranunculous</u>	<u>asiaticus</u> Mix	Full Sun	3	12	12-16	10
Iris	<u>reticulata</u> & <u>danfordiaea</u> Mix	Full Sun, partial shade	3	12	4-6	-50
Crocus	<u>Crocus vernus</u> & <u>flavus</u> Large					
	Flowering Mix	Full Sun, partial shade	3	12	4-6	-40

*Note.* All Information was obtained from plant packaging.