NSU Florida NOVA SOUTHEASTERN UNIVERSITY

Experiential Learning & Teaching in Higher Education

Volume 1 | Number 2 Article 10

12-1-2017

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Project IICE: Inspiring Interdisciplinary Collaboration Experiences

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Abstract. Project IICE was a multi-disciplinary learning experience designed for students at Southern New Hampshire University. Students worked together in teams to communicate scientific data that was initially collected by an Introductory Botany class. Students in this course measured trees and recorded variables, including tree height, diameter, species, and canopy cover. They shared the data with students in freshman Statistics courses, who analyzed mathematically for trends. Finally, students in Graphic Design used the data to create visual representations and icons. Students collaborated in groups that were randomly assigned across all of the courses to include members of each discipline. During the process, each student was required to help others in the group understand the meaning of the data, through the collection, analysis, and design phases. In the final group poster presentations, students explained the meaning and value of each part. The emphasis was on their ability to communicate the significance of each part of the process, which helped them appreciate how the discipline they were working in contributed to the overall success of the project. The real-world data provided a context for students to experience working in cross-discipline teams, and sharpened communication skills.

Introduction to Project IICE

Interdisciplinary collaboration, although commonplace among research groups comprised of faculty or industry members, does not come easily to a typical student. Some students' collaboration and time management

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ELTHE: A Journal for Engaged Educators, Vol. 1, No. 2 (2017), pp. 71–89

skills, as well as professionalism, may fall short of academics' and employers' expectations. Yet the ability to work in a team, become an expert on a portion of a project, and communicate with people with a variety of knowledge levels is exceedingly important for today's graduates.

Our goal with the creation of Project IICE (Inspiring Interdisciplinary Collaboration Experiences) was to develop a way to marry interdisciplinary research, experiential learning, and cross-classroom experiences. IICE projects are designed to require specific skills learned in the classroom setting as well as practical skills required in the workforce. Project IICE exposes student participants to a variety of learning methods and encourages them—and in some cases requires them—to step outside of their comfort zones in order to complete their projects. This report follows our fall 2015 experience of utilizing Project IICE for the proposal of an arboretum on our campus.

Project IICE is founded on three core tenets, and IICE projects must include all three of the following items:

1. Interdisciplinary Topics: Students who see a variety of topics outside of a single course are better prepared to synthesize information.
2. Collaboration: Students who are required to collaborate on projects are better prepared for the workforce and the demands of team projects.
3. Experiential Learning: Students engaged outside of the classroom are more prepared for the "real-world" application of their course work.

The motivation behind Project IICE is the recognition that no career exists in a bubble. To prepare students for post-degree careers, as an institution, we should present post-degree tasks in a low-stakes learning environment to our students. Under the direction of faculty, students should encounter "real-world" constraints and challenges during their time in college to allow them to make mistakes and grow without the threat of job termination.

The Arboretum Proposal Project (TAPP)

Project Overview

Southern New Hampshire University (SNHU), located in the city of Manchester, is in the process of constructing residential, administrative, and academic buildings on campus. In addition to its focus on the functionality of these buildings, SNHU is also concerned with the aesthetic and environmental appeal of the campus overall, as well as the use of all facets of the campus for educational purposes.

As a way to beautify the campus while conserving some of the few remaining forested acres near Manchester and also to make a useable outdoor laboratory space for students and faculty, a student named Michael Weinstein, in 2014 approached the university about designating a portion of the campus as an arboretum. He completed an undergraduate research project to investigate the viability of an arboretum on SNHU's campus in light of future construction. Upon graduation and receiving a paid position on campus in 2015, Weinstein and several faculty members from different disciplines banded together to develop an interdisciplinary, cross-course project (The Arboretum Proposal Project, or TAPP, for short) to present data to members of SNHU Facilities and Administration in support of the creation of an arboretum on a tract of campus land.

Students from six courses—three introductory statistics courses, a botany course, a graphic design course, and an environmental ecology course—were placed in a group, with each group comprised of several statistics majors, a science major, and a graphic design major. The groups were tasked with gathering, analyzing, and presenting data as both written reports and posters throughout and at the conclusion of the semester. Each group member was considered an "expert" in their field and was responsible for being able to explain any portion of TAPP, including collection and analysis of data, and design choice, to other members within their group as well as to an outside audience.

Initial Setup

Students in the six courses were assembled so that each group contained a science student from either the botany or the environmental ecology course and a graphic design student. Each group also contained members from each of the statistics course sections.

Groups were presented with the overall problem of justifying the creation of the arboretum on campus. TAPP was designed in such a way that a course would meet its required learning outcomes while simultaneously embedding material into the other companion courses. Each course would then contribute to the overall knowledge base of the student groups, with a member of the course acting as the TAPP expert. All students were given an initial overview of the project, while each instructor was responsible for developing appropriate assignments to meet course objectives and supplementing pertinent aspects of TAPP.

Data Collection, Analysis, and Visualization

To develop a solid footing for TAPP, leading to the ultimate goal of a formal proposal, students in the botany and environmental sciences courses collected data regarding the proposed arboretum space. Within the first three weeks of the semester, students, especially those in the botany class, could be found in the proposed space gathering data using instruments (e.g., clinometers, densitometers, and tape measures) and apps (e.g., iNaturalist). Students gathered data on tree size, species, age, health, and canopy cover, and they categorized that data in tabular form. They also chose a series of plots (sections of land) in the proposed arboretum and divided each plot along transects to sample the entire proposed space. Each science student was assigned transects and a series of variables to measure.

With the collection of data completed by the third week, the science students handed their raw data to their statistics teammates. The statistics students, in collaboration across sections and using the science students' understanding of how the data were collected, developed a method to best summarize key variables. For the purpose of consistency across final projects, the instructors chose four required variables for analysis. Some groups chose to look at additional variables to supplement their findings.

In the last third of the semester, the graphic design students received results from the data analysis for incorporation into an infographic. The final design of the infographic needed to be scalable so that information could be incorporated into both the required poster and the final report. The graphics students created icons for each variable modeled, and the overall infographic was informed by the results of the analysis completed by the statistics students.

In addition to summarizing and representing the data across all plots, each group was required to choose a plot that was the best representative of the entire proposed arboretum. In the spirit of collaboration, all members of the group were required to have input into this choice, with the ultimate goal of using this decision to “tell a story” about the arboretum as a whole. Specifically, the science and statistics students were essential in describing the data collection and analysis to inform the design student’s visualization.

Final Presentation

Each team of students presented their findings at a poster session in the last week of the semester. All members of each team were required to be able to explain the data, analysis, and interpretation to an audience comprised of peers, faculty, and SNHU facilities and administration. Both faculty and peers graded the posters, and the final overall score included a self-assessment component. Included in the appendix are images of the final infographics created by design students.

Student Feedback

A major goal of the introduction, completion, and overall success of Project IICE is student/faculty buy-in. With TAPP, the goal was no different. The ideas behind TAPP were conceived over the summer before the fall semester it was implemented, but details about the project were developed as the semester progressed. This timeline led to significant frustration for some students, namely those who were first-year students taking statistics as a required course for their (non-mathematics) major. Feedback from these students included the concern that they were doing “too much work” compared to students in other sections of statistics classes. All statistics sections at SNHU required projects as part of the final course grade, but many of the non-TAPP projects were done individually and did not require the degree of collaboration or “outside-the-box” thinking associated with TAPP.

The graphics design and science students were typically sophomore-level and above, and the objectives of TAPP aligned more closely with their majors. Many science students remarked that the process of gathering data was “one of the best class experiences [they] have had so far” and that the process affirmed their choice of major (in one case, a middle-school science education major). In a survey gathered before the final poster presentation, a divide between these groups of students—those who could immediately see applications of skills learned in TAPP and through the Project IICE process, and those who could not—became very apparent. Common student comments included, "Overall, I liked the idea," and "The project is for a good cause," but some students found group collaboration difficult: "I don't know why I was doing what I was doing."

This points to an important lesson learned by the TAPP team throughout the semester: unless the professors were on the same page going into a portion of the assignment, the students would not see the value of the assignment. Many students commented on the apparent lack of cohesion among faculty members; even if the faculty understood the overall project, students felt it wasn't communicated clearly. The TAPP team, in some cases, was developing particular assignments during the course of the semester in response to feedback from students, and this led to some inconsistency and miscommunication.

Even though the post-semester surveys indicated that students held, overall, a neutral position on the project (with the exception of the apparent lack of cohesion discussed above), anecdotal evidence gathered in the final poster session suggested otherwise. For some groups, the final poster session was the first time the students understood what other members of the group contributed, and more importantly, how those contributions had an impact on their own tasks. The presence at the poster session of the director of SNHU facilities and the Provost, among others, visually indicated to students that TAPP was important to the university, and more directly, that people cared about the work they did. Several students expressed regret that they didn't meet with their groups earlier or visit the data collection sites with the science students to understand where the data came from and why the site was important.

Lessons Learned and Future Directions

The most ubiquitous student feedback about TAPP was about the perception of organization and cohesion. Students in each class understood their individual assignments but did not always see the larger implications of TAPP as a whole. Although the discrepancy between lower and upper level students was most apparent in the understanding of the "bigger picture" of TAPP, we think the final "aha" moment was worth it for the first-year students. The incorporation of upper-level courses, specifically statistics, would change the flavor of the final result; students may be able to go deeper into the analysis to tease out a different picture of the arboretum. However, the first iteration of TAPP showed us—both as faculty and as an institution—that if you expect great things of students, great things can result.

Through the tireless efforts of Michael Weinstein and several others on campus, SNHU has been awarded a Level I Arboretum designation for a tract of land utilized in TAPP. The arboretum is already the subject of numerous classroom assignments, with courses including science, graphic design, game design, and information technology. Specific assignments include using the space as inspiration for an augmented reality project and as a nature backdrop for video projects.

Project IICE: Steps for Application

Those wanting to propose a Project IICE idea must follow four steps in the application process. The primary and most important step is to determine the logistics necessary to aid completion of the project. In the case of TAPP, use of the proposed arboretum land tract required permission from individuals in administration and facilities. In addition, the project required that one of the instructors assume the role of project manager for the data collection portion of TAPP so that questions about the arboretum could be funneled to a single person rather than having them directed to multiple people.

Second, interdisciplinary collaboration requires that courses be paired. If at all possible, learning communities or courses with a similar meeting time are best for IICE projects, as students placed in groups across classes can then have a common schedule. Coordinating schedules is not always possible or essential, however; most courses in TAPP were not scheduled in the same time block, or even on the same day, and this did present some difficulties for students in TAPP. However, IICE is designed to mimic "real-world" experiences in which not everyone can meet at the same time and location. TAPP students quickly discovered alternate ways to meet or discuss ideas, specifically through the use of online forums.

Third, the desired project must be planned thoroughly and in detail. Roadblocks should be anticipated, and preparation should be made to work around them. Also, faculty involved in each class serve students better if each course instructor understands not only the larger interdisciplinary idea but also the specific assignments that other instructors are giving to students. With the implementation of TAPP, it was essential that the botany professor was aware that the graphic design students needed to know the type of data that was collected in order for them to create icons; likewise, the graphic design professor needed to be aware of what the science students were expected to know regarding the project. Although neither faculty member is required to disseminate the cross-information to their students, as knowledge of all course information is ultimately the responsibility of the student groups, each faculty member could use the background knowledge to encourage and guide students in their individual classes to participate more fully and successfully in their groups.

Finally, a successful IICE project must have meaning for the students. If students can see the immediate applicability of the project and how it relates to their interests, they are more likely to be invested in it. Previous SNHU projects in the IICE program included a weeklong competition for the design of an environmentally friendly aspect of a future residence hall on campus. With this project, the winning team presented at Undergraduate Research Day, and they presented to leading members of the SNHU facilities and architectural design team. Students involved in this project were able to see immediately why the project was relevant—it had a "real-world" application—and were invested in the project because it related directly to their future aspirations. TAPP was created in a similar vein. Although many of the TAPP students will graduate before the arboretum becomes fully functional, the recognition of the arboretum by a national organization gave credibility to the project.

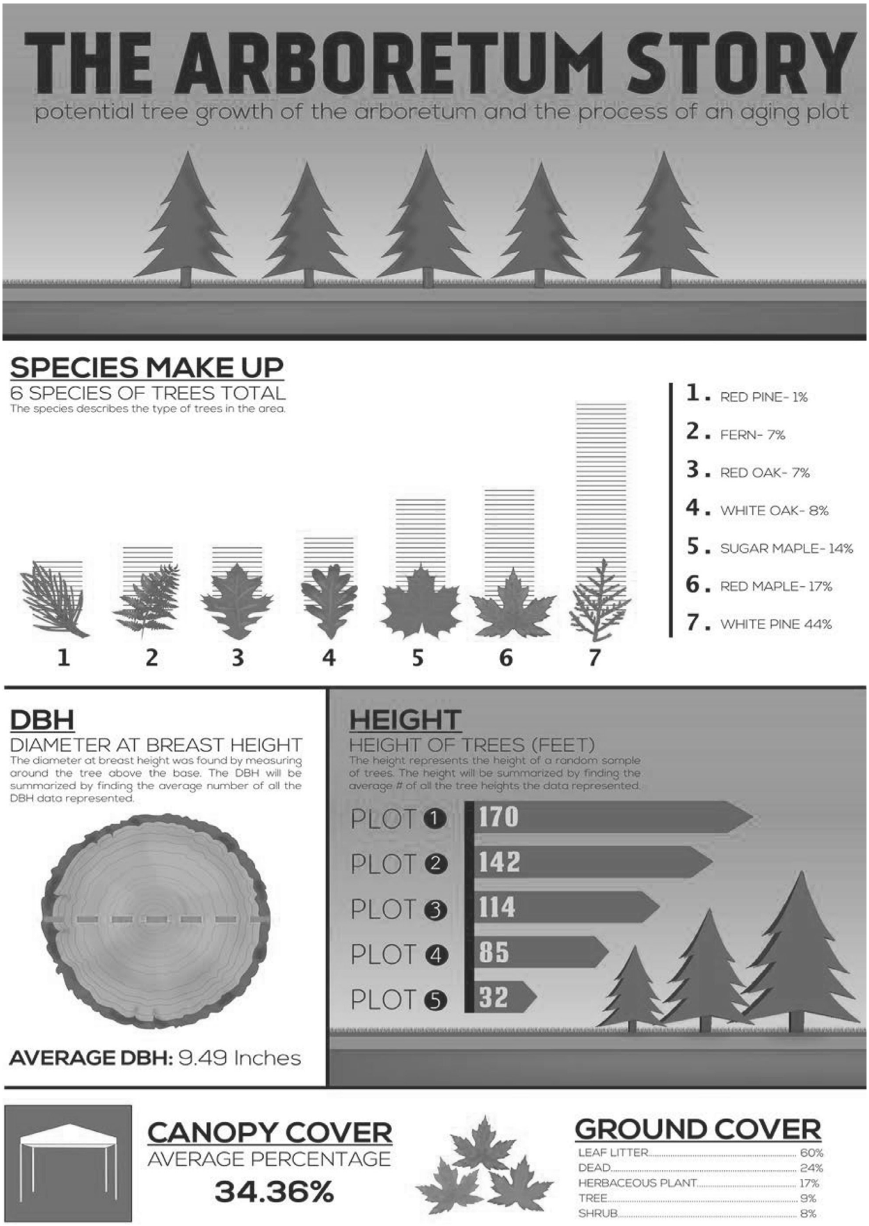
Conclusion

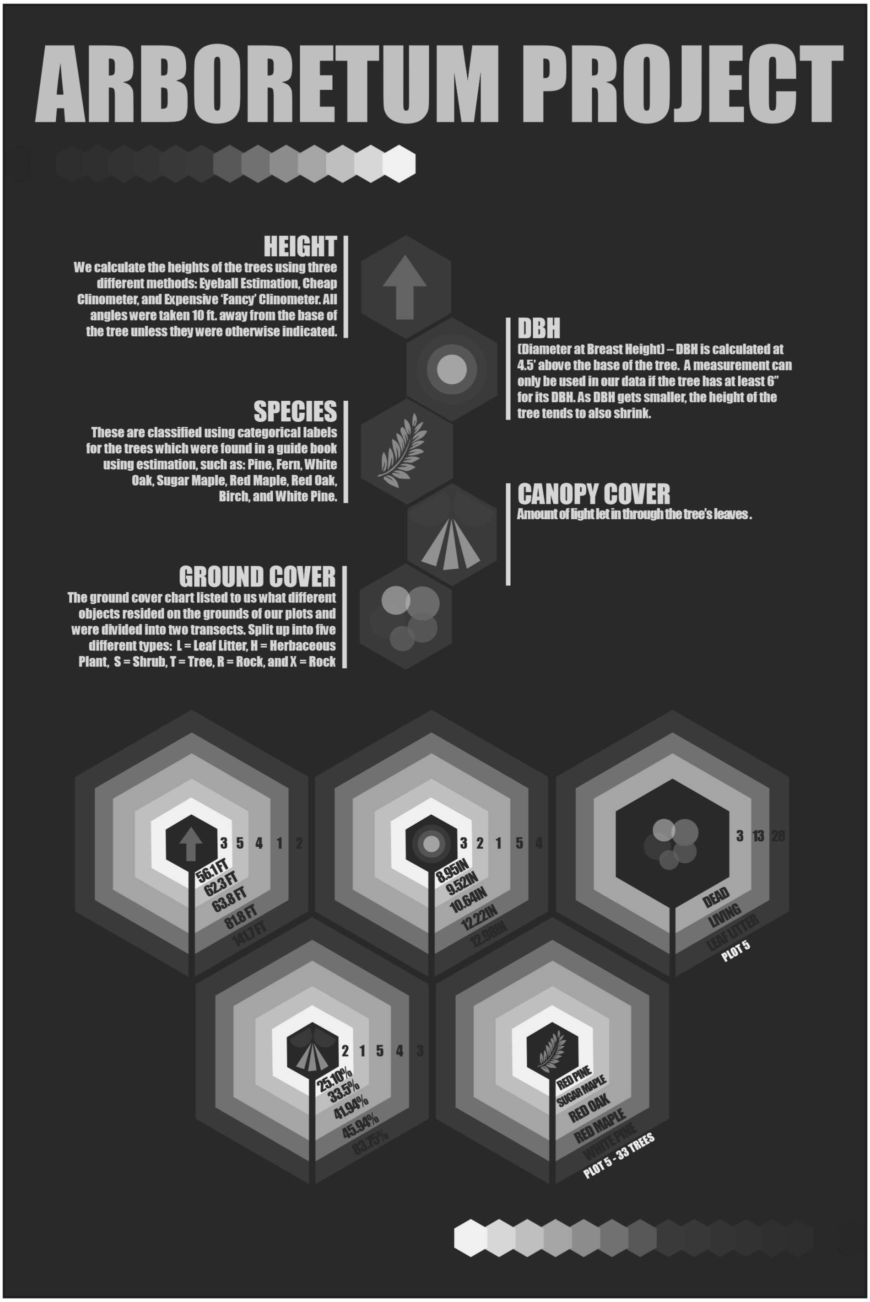
The Project IICE framework pilot resulted in several substantial and constructive takeaways. First, while faculty and staff buy-in is high, student buy-in is not necessarily guaranteed. Feedback from the pilot program indicated student confusion and lack of understanding about the "big picture" of the project. Future application of the IICE framework should thus incorporate additional student training and team building mechanisms for the purposes of enhancing understanding of overall project goals and class contributions to those goals.

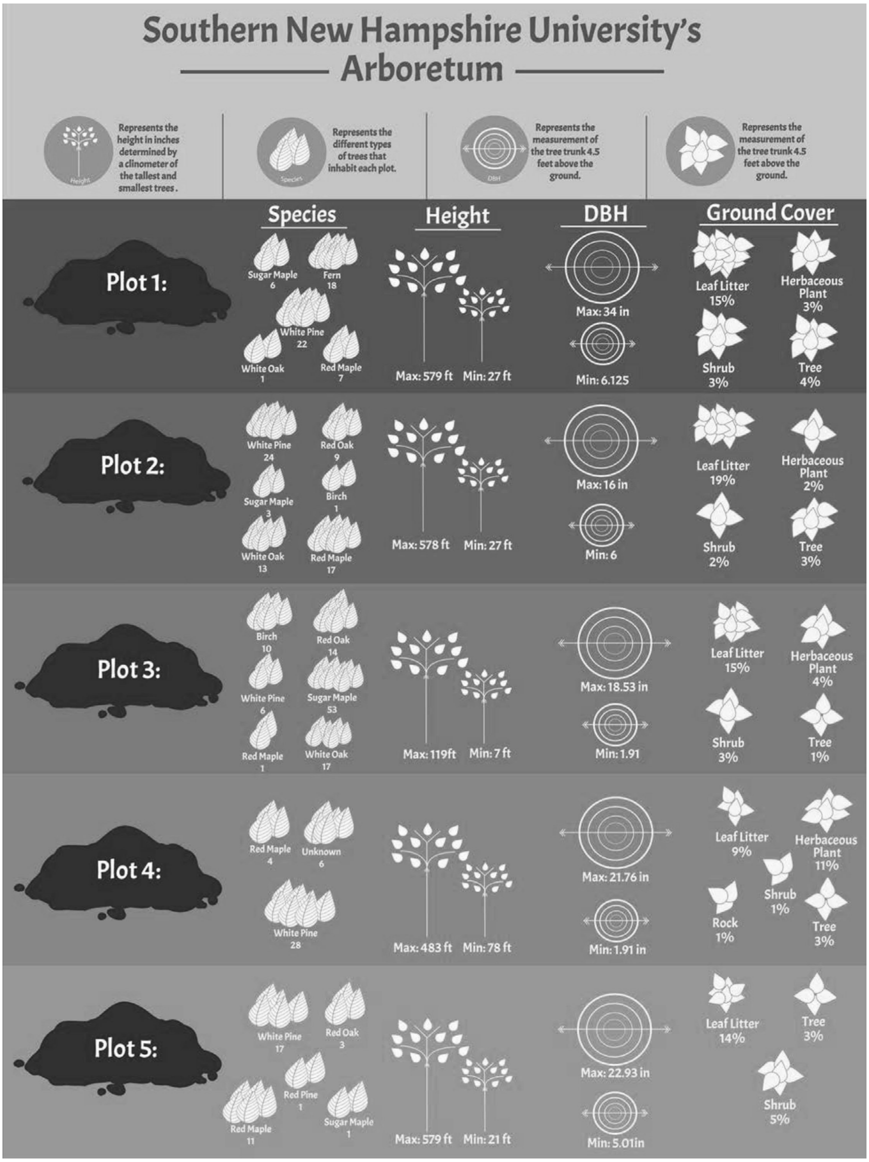
Second, the pilot program demonstrated that outcomes from initiatives are indeed impactful to the on-campus community and administration. Highly visible and meaningful results can be expected from application of the Project IICE framework to initiatives for which these results are desired.

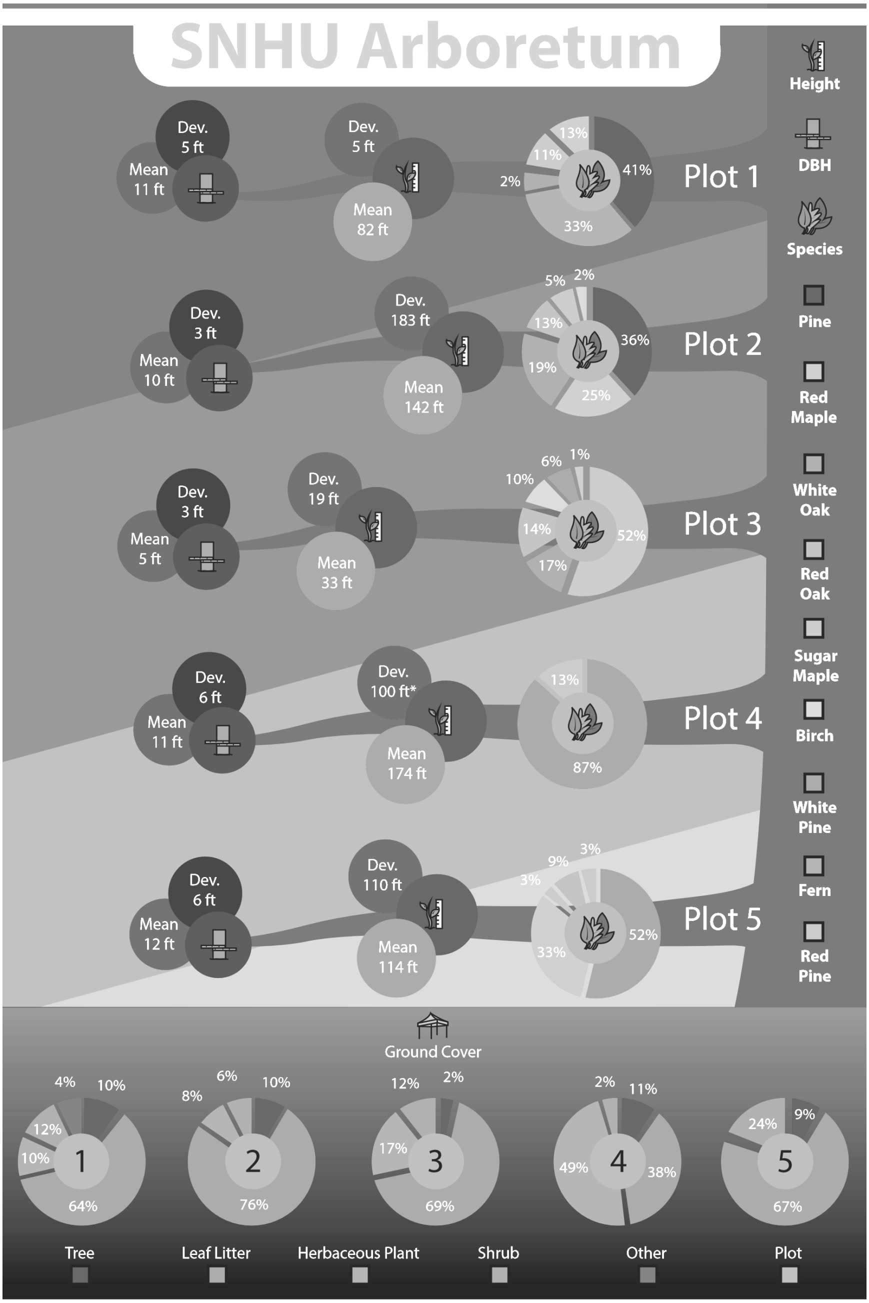
Finally, outcomes have shown that Project IICE applications can and should be agile, robust projects that utilize best practices and incorporate lessons learned from previous undertakings. While no two projects can be expected to have similar outcomes, the framework's adaptability can, with proper application, result in truly meaningful outcomes.

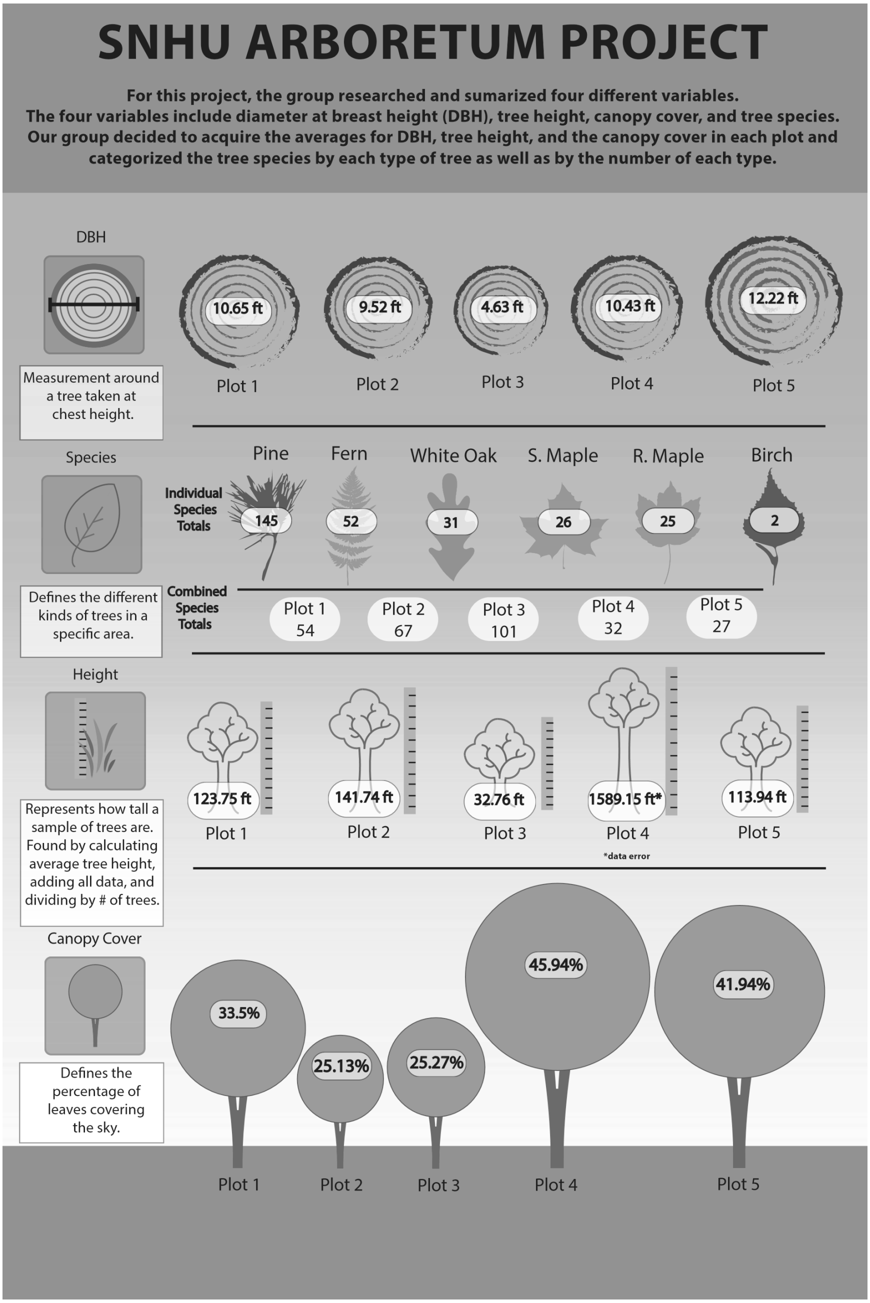
Appendix

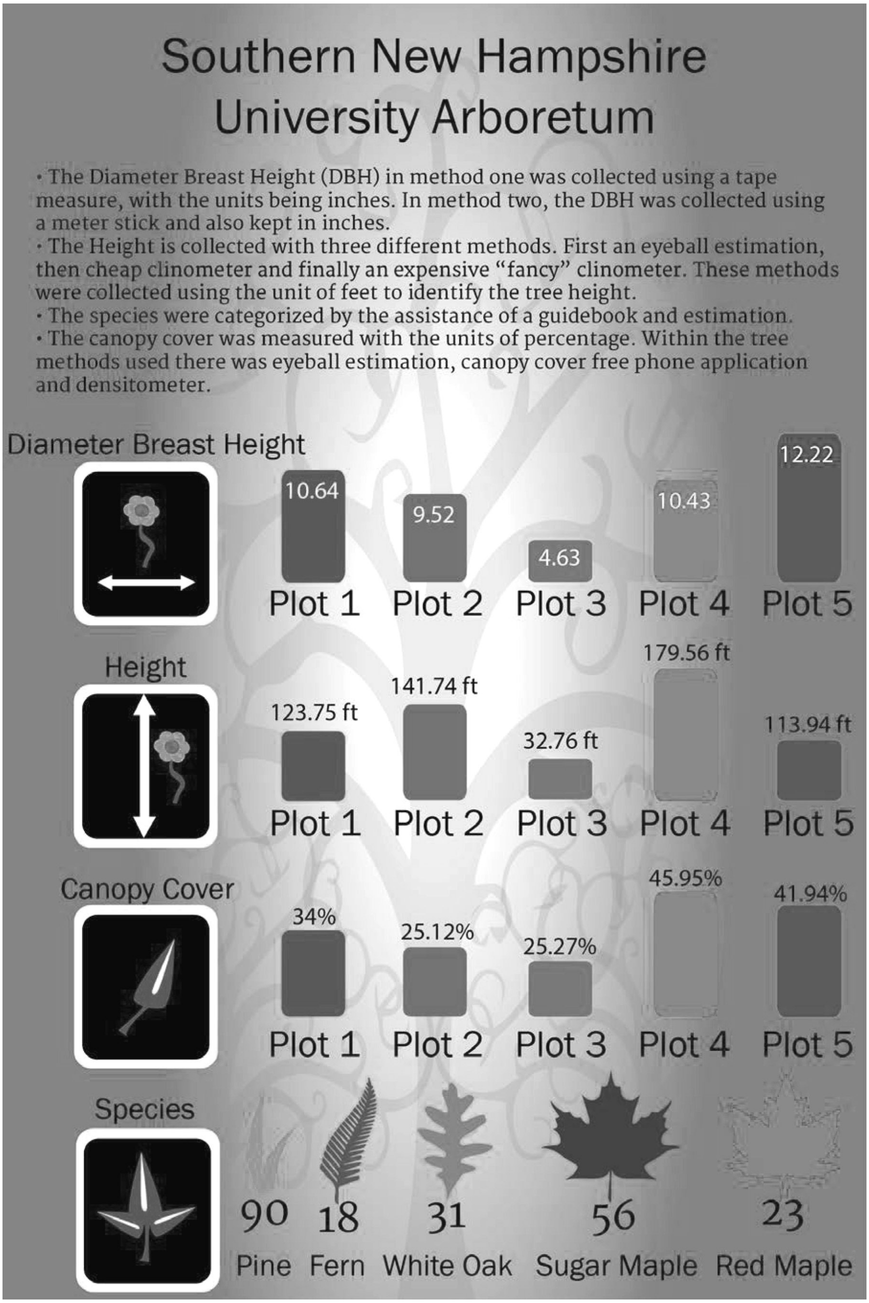

THE ARBORETUM STORY
potential tree growth of the arboretum and the process of an aging plot
SPECIES MAKE UP
6 SPECIES OF TREES TOTAL
The species describes the type of trees in the area.
1 2 3 4 5 6 7
1. RED PINE- 1%
2. FERN- 7%
3. RED OAK- 7%
4. WHITE OAK- 8%
5. SUGAR MAPLE- 14%
6. RED MAPLE- 17%
7. WHITE PINE 44%
DBH
DIAMETER AT BREAST HEIGHT
The diameter at breast height was found by measuring around the tree above the base. The DBH will be summarized by finding the average number of all the DBH data represented.
AVERAGE DBH: 9.49 Inches
HEIGHT
HEIGHT OF TREES (FEET)
The height represents the height of a random sample of trees. The height will be summarized by finding the average # of all the tree heights the data represented.
PLOT 1 170
PLOT 2 142
PLOT 3 114
PLOT 4 85
PLOT 5 32
CANOPY COVER
AVERAGE PERCENTAGE
34.36%
GROUND COVER
LEAF LITTER 60%
DEAD 24%
HERBACEOUS PLANT 17%
TREE 9%
SHRUB 8%


ARBORETUM PROJECT
HEIGHT
We calculate the heights of the trees using three different methods: Eyeball Estimation, Cheap Clinometer, and Expensive 'Fancy' Clinometer. All angles were taken 10 ft. away from the base of the tree unless they were otherwise indicated.
DBH
(Diameter at Breast Height) – DBH is calculated at 4.5' above the base of the tree. A measurement can only be used in our data if the tree has at least 6" for its DBH. As DBH gets smaller, the height of the tree tends to also shrink.
SPECIES
These are classified using categorical labels for the trees which were found in a guide book using estimation, such as: Pine, Fern, White Oak, Sugar Maple, Red Maple, Red Oak, Birch, and White Pine.
CANOPY COVER
Amount of light let in through the tree's leaves.
GROUND COVER
The ground cover chart listed to us what different objects resided on the grounds of our plots and were divided into two transects. Split up into five different types: L = Leaf Litter, H = Herbaceous Plant, S = Shrub, T = Tree, R = Rock, and X = Rock
3 5 4 1 2
56.1 FT
62.3 FT
63.8 FT
81.8 FT
141.7 FT
3 2 1 5 4
8.95IN
9.52IN
10.64IN
12.22IN
12.98IN
3 13 28
DEAD
LIVING
LEAF LITTER
PLOT 5
2 1 5 4 3
25.10%
33.5%
41.94%
45.94%
83.75%
RED PINE
SUGAR MAPLE
RED OAK
RED MAPLE
WHITE PINE
PLOT 5 - 33 TREES


Southern New Hampshire University's
Arboretum
Represents the height in inches determined by a clinometer of the tallest and smallest trees.
Height
Represents the different types of trees that inhabit each plot.
Species
Represents the measurement of the tree trunk 4.5 feet above the ground.
DBH
Represents the measurement of the tree trunk 4.5 feet above the ground.
Species
Height
DBH
Ground Cover
Plot 1:
Sugar Maple 6
Fern 18
White Pine 22
White Oak 1
Red Maple 7
Max: 579 ft
Min: 27 ft
Max: 34 in
Min: 6.125
Leaf Litter 15%
Herbaceous Plant 3%
Shrub 3%
Tree 4%
Plot 2:
White Pine 24
Red Oak 9
Sugar Maple 3
Birch 1
White Oak 13
Red Maple 17
Max: 578 ft
Min: 27 ft
Max: 16 in
Min: 6
Leaf Litter 19%
Herbaceous Plant 2%
Shrub 2%
Tree 3%
Plot 3:
Birch 10
Red Oak 14
White Pine 6
Sugar Maple 53
Red Maple 1
White Oak 17
Max: 119ft
Min: 7 ft
Max: 18.53 in
Min: 1.91
Leaf Litter 15%
Herbaceous Plant 4%
Shrub 3%
Tree 1%
Plot 4:
Red Maple 4
Unknown 6
White Pine 28
Max: 483 ft
Min: 78 ft
Max: 21.76 in
Min: 1.91 in
Leaf Litter 9%
Herbaceous Plant 11%
Shrub 1%
Rock 1%
Tree 3%
Plot 5:
White Pine 17
Red Oak 3
Red Pine 1
Red Maple 11
Sugar Maple 1
Max: 579 ft
Min: 21 ft
Max: 22.93 in
Min: 5.01in
Leaf Litter 14%
Tree 3%
Shrub 5%


SNHU Arboretum
Height
DBH
Species
Pine
Red Maple
White Oak
Red Oak
Sugar Maple
Birch
White Pine
Fern
Red Pine
Plot 1
Dev. 5 ft
Mean 11 ft
Dev. 5 ft
Mean 82 ft
13%
11%
2%
41%
33%
Plot 2
Dev. 3 ft
Mean 10 ft
Dev. 183 ft
Mean 142 ft
5%
2%
13%
36%
19%
25%
Plot 3
Dev. 3 ft
Mean 5 ft
Dev. 19 ft
Mean 33 ft
6%
1%
10%
14%
52%
17%
Plot 4
Dev. 6 ft
Mean 11 ft
Dev. 100 ft*
Mean 174 ft
13%
87%
Plot 5
Dev. 6 ft
Mean 12 ft
Dev. 110 ft
Mean 114 ft
9%
3%
3%
52%
33%
Ground Cover
1
4%
10%
12%
10%
64%
2
6%
10%
8%
76%
3
12%
2%
17%
69%
4
2%
11%
49%
38%
5
24%
9%
67%
Tree
Leaf Litter
Herbaceous Plant
Shrub
Other
Plot

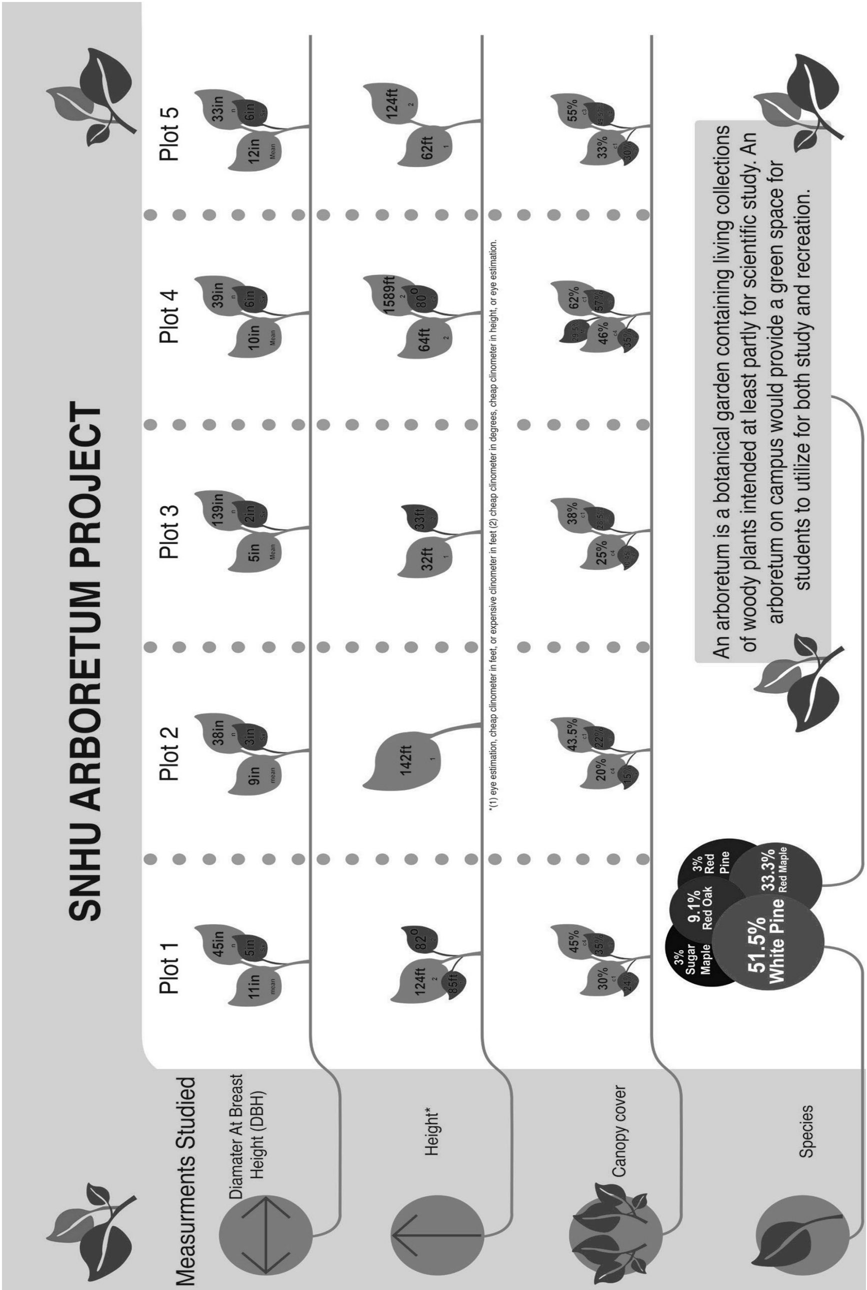

SNHU ARBORETUM PROJECT
For this project, the group researched and sumarized four different variables.
The four variables include diameter at breast height (DBH), tree height, canopy cover, and tree species.
Our group decided to acquire the averages for DBH, tree height, and the canopy cover in each plot and
categorized the tree species by each type of tree as well as by the number of each type.
DBH
Measurement around a tree taken at chest height.
10.65 ft
Plot 1
9.52 ft
Plot 2
4.63 ft
Plot 3
10.43 ft
Plot 4
12.22 ft
Plot 5
Species
Defines the different kinds of trees in a specific area.
Individual Species Totals
Pine
145
Fern
52
White Oak
31
S. Maple
26
R. Maple
25
Birch
2
Combined Species Totals
Plot 1
54
Plot 2
67
Plot 3
101
Plot 4
32
Plot 5
27
Height
Represents how tall a sample of trees are. Found by calculating average tree height, adding all data, and dividing by # of trees.
123.75 ft
Plot 1
141.74 ft
Plot 2
32.76 ft
Plot 3
1589.15 ft*
Plot 4
*data error
113.94 ft
Plot 5
Canopy Cover
Defines the percentage of leaves covering the sky.
33.5%
Plot 1
25.13%
Plot 2
25.27%
Plot 3
45.94%
Plot 4
41.94%
Plot 5

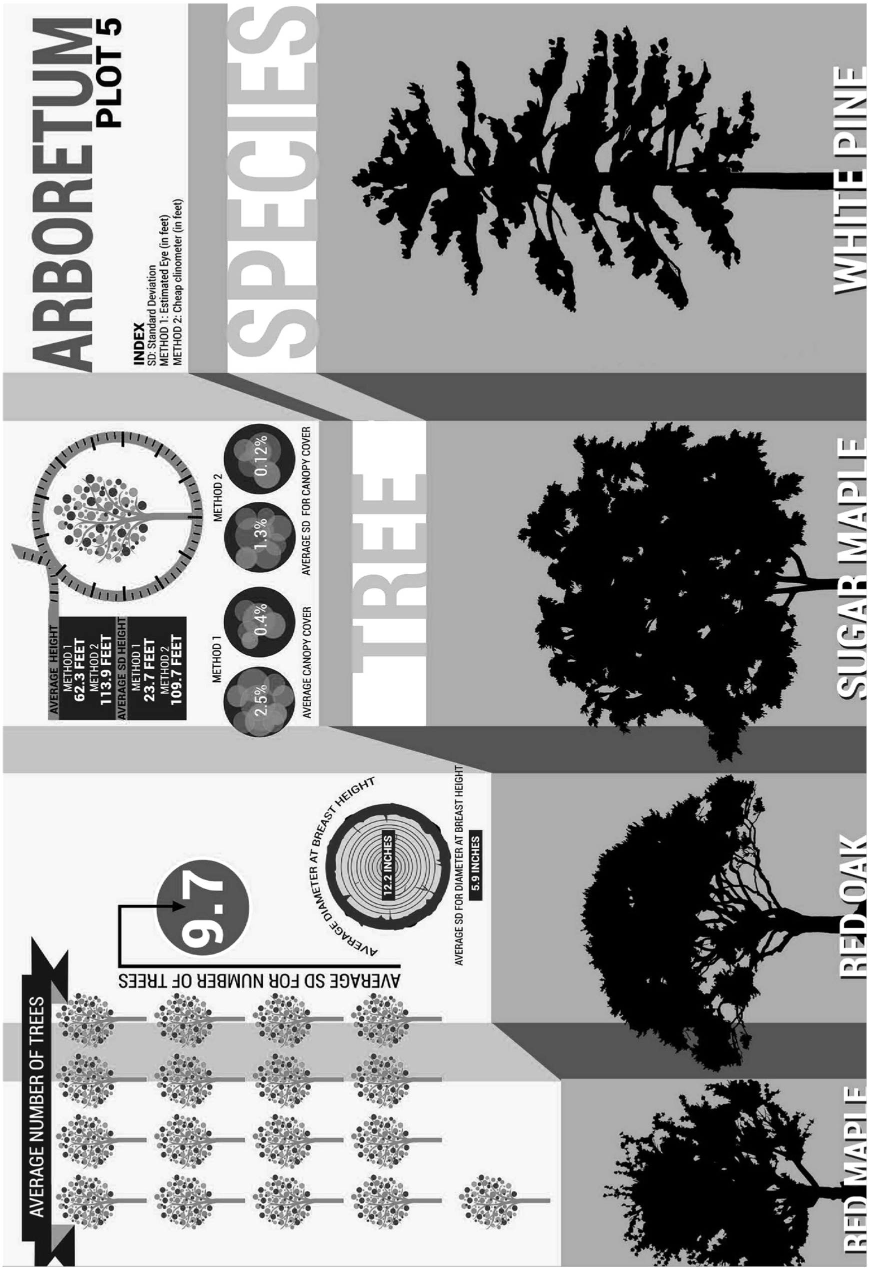

Southern New Hampshire University Arboretum
• The Diameter Breast Height (DBH) in method one was collected using a tape measure, with the units being inches. In method two, the DBH was collected using a meter stick and also kept in inches.
• The Height is collected with three different methods. First an eyeball estimation, then cheap clinometer and finally an expensive "fancy" clinometer. These methods were collected using the unit of feet to identify the tree height.
• The species were categorized by the assistance of a guidebook and estimation.
• The canopy cover was measured with the units of percentage. Within the tree methods used there was eyeball estimation, canopy cover free phone application and densitometer.
Diameter Breast Height
10.64
9.52
4.63
10.43
12.22
Plot 1
Plot 2
Plot 3
Plot 4
Plot 5
Height
123.75 ft
141.74 ft
32.76 ft
179.56 ft
113.94 ft
Plot 1
Plot 2
Plot 3
Plot 4
Plot 5
Canopy Cover
34%
25.12%
25.27%
45.95%
41.94%
Plot 1
Plot 2
Plot 3
Plot 4
Plot 5
Species
90 Pine
18 Fern
31 White Oak
56 Sugar Maple
23 Red Maple


ARBORETUM PROJECT
SNHU
Species
Pines
White Pines
Red Maples
Qualitative data will also be examined in this experiment. Tree species is one of the more obvious quantitative variables. Tree species cannot be averaged out, only placed into certain categories or groups, making them categorical.
Plot 1:
22
Plot 2:
24
Plot 3:
53
Plot 4:
28
Plot 5:
17
Plot 2:
Plot 4:
Plot 5:
Average:
9.52
10.43
12.22
Standard Deviation:
2.80
5.69
5.90
Average:
141.73
80.45
62.33
Standard Deviation:
184.65
13.91
109.71
Diameter At Breast Height
Quantitative data will be examined in this experiment. The first quantitative variable is tree diameter at breast height (DBH), the diameter of the tree 4.5 feet off the ground. (Oregon State University) It is a numerical continuous variable because it can be averaged out and it can have an infinite number of values. The next variable is the height of the tree, which would be considered a numerical continuous variable because it can also be averaged out and infinite.
Height
The tree's age is also considered a quantitative variable, because it's a numerical continuous variable that can be averaged out. Mean basal area is the mean of the cross-sectional area of a tree's trunk at breast height, which is the next quantitative variable.

	Canopy Cover	Diameter (of trees)	Height (of trees)	Ground Cover
Plot 1	18%	18in	18ft	18%
Plot 2	37%	37in	37ft	37%
Plot 3	25%	25in	25ft	25%
Plot 4	46%	46in	46ft	46%
Plot 5	87%	87in	87ft	87%

The Arboretum Project turned out to be not only educational, but also fun. The science class spent around five weeks outside in SNHU'S very own arboretum, digging, measuring, plotting, and hammering away. We were able to collect real life data from five plots created by us. We took data of canopy height, diameter and height of trees, ground cover, and more. We then were able to transfer the data to the stats class who took it away from there, turning the data into usable numbers. Getting to go out and work with a real arboretum was an incredible experience that transferred all the skills we learned in the classroom, to real life experiences up to par with what we will work on in our future jobs as scientists. After the data was collected and compressed into averages we were able to transfer it into visuals that viewers would be able to follow themselves through our designs.


SNHU ARBORETUM PROJECT
Measurments Studied
Diamater At Breast Height (DBH)
Height*
Canopy cover
Species
Plot 1
Plot 2
Plot 3
Plot 4
Plot 5
11in
45in
9in
38in
5in
139in
10in
39in
12in
33in
124ft
142ft
32ft
64ft
1589ft
62ft
124ft
30%
45%
20%
43.5%
25%
38%
46%
62%
33%
55%
*(1) eye estimation, cheap clinometer in feet, or expensive clinometer in feet (2) cheap clinometer in degrees, cheap clinometer in height, or eye estimation.
3% Sugar Maple
9.1% Red Oak
3% Red Pine
51.5% White Pine
33.3% Red Maple
An arboretum is a botanical garden containing living collections of woody plants intended at least partly for scientific study. An arboretum on campus would provide a green space for students to utilize for both study and recreation.


ARBORETUM
PLOT 5
INDEX
SD: Standard Deviation
METHOD 1: Estimated Eye (in feet)
METHOD 2: Cheap clinometer (in feet)
SPECIES
WHITE PINE
TREE
AVERAGE HEIGHT
METHOD 1
62.3 FEET
METHOD 2
113.9 FEET
AVERAGE SD HEIGHT
METHOD 1
23.7 FEET
METHOD 2
109.7 FEET
METHOD 1
2.5%
0.4%
AVERAGE CANOPY COVER
METHOD 2
1.3%
0.12%
AVERAGE SD FOR CANOPY COVER
SUGAR MAPLE
AVERAGE DIAMETER AT BREAST HEIGHT
12.2 INCHES
AVERAGE SD FOR DIAMETER AT BREAST HEIGHT
5.9 INCHES
RED OAK
9.7
AVERAGE SD FOR NUMBER OF TREES
AVERAGE NUMBER OF TREES
RED MAPLE