6-30-2019

Combating Comprehensive School Garden Program Implementation Barriers in High Need Areas

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An Honors Thesis Submitted in Partial Fulfillment of the
Requirements for Graduation from the
Western Oregon University Honors Program

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Spring 2019

Acknowledgements

I would like to thank Nikki Wolff for her endless positivity that inspired me to pursue a career in education. Her love for bringing students into the outdoors is what inspired this thesis. Her students, including myself, are forever changed because of her presence in their lives. I will be forever grateful for her kindness, love, and guidance in my most crucial years.

Thank you to my parents, Bill and Tara Stempel, for being the most wonderful parents any person could hope for. I cherished every weeknight dinner, phone call, and newspaper clipping sent in the mail. You are the reason I refuse to settle for anything less than perfect. I hope this thesis makes you very proud, it could not have been completed without your love.

My higher education career, and thus this thesis, would not have been attainable without my grandparents' support. Bill and Judy Stempel were the first educators I knew and loved. Their support gave me the opportunity to pursue the career of my dreams. I hope to teach with their legacies in mind.

Finally, I would like to thank my brother, Jack, for always making me laugh and my roommates, Arden, Haylie, and Matthew, for the best four years I could have asked for. You all were there for me in the most stressful times. Thank you for the snacks, the conversations, and the BBQs. I will cherish your support forever.

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Abstract

In recent years, school gardens have taken hold in education curriculum across the country. Research has found that though these programs are becoming more popular, they are often implemented in areas of higher socioeconomic class. Low-income school districts struggle to find staff with adequate time to develop school garden programs. This project will help to open the doors for more rural areas to host school garden programs. Through an analysis of current research, compilation of a resource bundle, and creation of a guidebook, this project will provide educators with the tools that are necessary to implement a well-integrated garden. Where higher socioeconomic areas might be able to afford a garden coordinator salary, lower socioeconomic areas will be able to utilize this toolkit to self-start a well-integrated program.

I will be focusing on my hometown elementary school, Taft Elementary, as a model school. First, I will be gathering resources on outdoor classroom management, lesson and curricula planning, and a text set for literacy integration. From there I will be designing guidebook that will contain tips for seasonal care of a garden in the harsh climate of the Oregon Coast, calendars for planting in the garden, and many more sources that teachers can use to implement a school garden program. I will also be analyzing current research on the topic to make well informed decisions about resources to include.

Literature Review

Background

School garden programs (SGPs) are not new in the field of education. According to Wells (2015), the earliest documented use of gardens in elementary schools in America dates back to the late 1800s and early 1900s when they were used for aesthetic purposes. Since their inception, SGPs have gone in and out of style as the direction of education has shifted. Due to the focus on food production created by World War II, SGPs saw a boom. The focus on education shifted to technology in the 1950s and SGPs entered a period of "relative dormancy" (Wells, 2015, p. 2860).

However, Blair (2009) tells us that SGPs have resurfaced and become a nationwide movement in the last 20 years. States across the nation are constantly coming up with new initiatives to get SGPs into their schools. Hazzard (2012) explains the California Department of Education's groundbreaking *A Garden in Every School* initiative which allocated "$15 million for grants to promote, develop, and sustain instructional school gardens for 3 years (2007–2009)" (p. 379). In another unique case, the Portland region in Oregon recently surveyed 144 schools, of which, 99 had a functional SGP (Garwood, 2016). It is clear that more districts are valuing SGPs and it is easy to see why.

Outcomes of SGPs

The most recent studies of SGPs and their effect on academic achievement, environmental attitudes, and student behaviors have found nearly all positive outcomes. One study in particular compiled a synthesis of research on SGP from 1990-

2010 (Williams & Dixon. 2013). Their findings were especially interesting as a summary of best practices for SGPs. This study focused on four specific and measurable outcomes. Direct academic outcomes, indirect academic outcomes, other outcomes, and locus of control were all studied.[1] Williams & Dixon (2013) states, "the results of the studies indicate strong and frequent positive impacts in all areas studied" (p. 225). While this statement alone proves fascinating, once the individual outcomes are discussed more specifically, even more can be revealed about the benefits of SGPs.

The most often studied academic outcomes of SGPs look at science education. Wells et. al. (2015) conducted a scientific study that aimed to discover the effects of SGPs on scientific knowledge of elementary-aged children. Perhaps even more compelling is the demographics of the students selected for the study. The study chose a randomized controlled trial of low-income elementary schools. In this context, low-income was defined as "having 50% or more children qualifying for the federal school lunch program" (Wells et.al., 2009, p. 2859). This original study highlights the benefits of SGPs in a demographic that was previously forgotten or ignored.[2]

With a sample size of 151 classrooms ranging from grades two to five, Wells et al. (2015) found that "school gardens convey a fairly modest benefit to low-income children in terms of gains in science knowledge" (p. 2873). They measured science knowledge through a questionnaire about nutrition and plant science (see figure 1, Appendix C). Although they define the results as modest, another finding within the study indicated the stronger the garden intervention and use was, the more scientific learning took place (Wells et al., 2015). These finding suggest that not only should

districts be implementing garden programs, they should be integrating and using them often to see better results. Having a campus garden is nice, but real results are seen when the garden is well integrated in the curriculum.

If science knowledge was the only benefits seen from gardening, districts may be less keen to see value in the implementation of a SGP. Luckily, in recent years the education field has seen a push for content integration. With acronyms such as STEAM (science, technology, engineering, art, and math), a push for literacy integration, and NGSS's (Next Generation Science Standards) addition of CCSS (Common Core State Standards) connections, educators are being pushed to create innovative interdisciplinary lessons where their students will thrive.

Four key articles highlight the benefits of school gardens in subject areas besides science. Selmer et al. (2016) discussed how one elementary school utilized CCSS-M (Common Core State Standards - Math) with their SGP. They used the garden as a tool to discuss area and perimeter. Further, they allowed students to design their own section of the garden given a specific area and perimeter and then had them present their ideas to the class. This integrated unit touched on science, engineering, math, and ELA (English Language Arts).

Previously, Selmer et al. (2014) published a study that looked at another integrated unit. This unit combined science and math to teach students about statistical literacy through the use of a SGP. Following science, mathematics seems to be the next most natural connection that can be drawn from a SGP.

Though math and science seem to be the most intuitive connections to draw from SGPs, they are not the only research-backed curricular connections that are out there. In fact, Burt et al. (2017a) conducted a survey which found 16 different content areas that utilized a SGP (See figure 2, Appendix C). In a very interesting interdisciplinary model, Cutter-Mackenzie (2009) discuss how to utilize the garden space for cultural, language and environment learning. In this article, "garden buddies" in the form of parents and guardians were used to incorporate cultural awareness into gardening (Cutter-Mackenzie, 2009).

In another study, Wells et al. observed how SGP affect physical activity in students at low-income elementary schools (2014). They define low-income schools as those who had 50% or more of their student population that qualified for Free and Reduced-Price Meals. This study found "school gardens help to promote children's PA [physical activity] and reduce sedentary activity" (Wells et al., 2009, p. 531). This is another way that gardens can be utilized in the curriculum; physical education could easily be incorporated as students are often standing, digging, lifting, and walking in the garden space.

Finally, the last benefit looked at by research on SGPs reached beyond the curricula. Williams & Dixon found and reported that SGPs can have positive effects on student environmental empathy, locus of control, moral development, and attitude towards gardening. Reeves reported that there may even be some juvenile offender programs working on utilizing gardens as a way to rehabilitate youth. Kelley & Williams state "teaching and learning in gardens is a way to increase student engagement in

learning, and also to support different learning styles, integrate various disciplines, and revitalize schools and neighborhoods" (2014). Burt et al. discusses how the findings of their study indicate students who are behaviorally or mentally challenged or for whom English is their second language, benefit greatly from time spent in the garden. SGPs can become a place where every student is part of the community (2017a)

From the research, it is clear that SGPs have numerous benefits both academically and socially. From compiling research on this topic, there is one major component of success of SGPs and that is proper integration. In order to understand how a garden becomes successful, integration must be defined as it the key component to success.

Integration and Garden Success

The two studies from Burt et al. (2017a) and Garder et al. (2017b) use the following structure for defining a well-integrated garden: "A well-integrated garden is described as a maintained garden at or near a school, is primarily used as a learning environment to create meaningful experiences for students, is a valued part of the school's culture, and is sustained over time" (p. 428 & p. 1518). Knowing this definition, an expansion can be made to analyze what research has shown to benefit garden integration.

Burt et al., developed an evidence-based device called Garden Resources, Education, and Environment Nexus Tool or GREEN Tool (See figure 3, Appendix C) that helps with garden integration (2017b). It presents a continuum of integration that a school can work through in order to find more success in their SGP. According to this

tool, in order for a school garden to become well integrated, it must meet criteria in four categories: student experience, physical garden, resources and support, and school community. (2017b). The following paragraphs will decompose these four categories to see how they affect garden integration.

The first is student experience. This component deals with the learning interactions that will take place between the students and the garden. In nearly every study that looked at learning in a SGP, it was found that lesson plans with explicit connections to CCSS or NGSS were vital for garden success.[3] Burt (2017a) reports, "In this study, teachers reported that the most helpful resource to use the garden effectively, would be lessons that explicitly connect to core standards, which many curricula do not (particularly because academic standards vary by state)" (p. 433). The GREEN tool shows that student experience at the surface, must at least have state standard connected curricula.

Student experience also can be extended beyond curriculum connections to reach a deeper level of integration. Time spent in the garden and activities relating to the garden are the next level of integration. It is one thing to have students learn about gardening and another to have them interacting with the garden. The final three steps of integration within student experience include engagement, tasting, and additional learning. If all of these stages of student experience are met, the garden will be well integrated within this domain.

Next, we can look at physical garden space. The four subcategories to master for integration under this domain include characteristics, garden care and upkeep,

evaluation and feedback, and crop vitality and diversity. Physical garden space has had a lot of research both in the field of education and for people's personal garden use. Later in this section, the topic of best practices for physical garden spaces on the Oregon Coast will be explored.

The third domain is resources and support. No one teacher can handle an entire garden by themselves. Burt et al (2017b) found that "all of the schools included in this study partnered with organizations before establishing a garden" (p. 1521). Under the domain of resources and support, subcategories include networks and partner organizations, budget and funding, administrative support, professional development, and organizational structure. This domain can be critical for the success of a SGP as teachers often site lack of knowledge, funding, and support from school as barriers to implementation of a garden. These barriers and others will be discussed in depth later.

Finally, school community becomes the last domain of the GREEN Tool. This domain helps sustain the garden and integrate it into the surrounding community. Subcategories include volunteer & parent involvement, social events, and school food environment and policies. Cutter-Mackenzie presented a great example of how to reach out to parents/volunteers to bring the community closer to the garden space (2009). Anytime involvement of the community and families can be implemented in education is a great opportunity to make students and parents/guardians more at ease with the school system and it alleviates pressure from school personnel from total responsibility of the garden.

At the start, for a garden to be integrated it must at least fall into the first ring of the GREEN Tool by having standards based curricular connections to the garden, have the physical garden established, find networks/partners and develop a budget, and have parent/volunteer involvement. The nice thing is, from this level the SGP can grow deeper towards the center of the GREEN Tool to become more integrated. In the California State Garden Network (CSGN) book titled Gardens for Learning, it states "dream big, but start with a plan that is manageable for your school. Consider developing a three- or five-year plan, adding a few components each year" (Pounders, 2006, p. 39). In other words, begin with the first ring of the GREEN Tool and in following years, make changes to the SGP so that the garden can work towards integration and ultimately, success.

Barriers to Implementation: School-Wide View

Even though there are numerous tools that tell us how to properly integrate and implement a new SGP, many schools are still without garden programs. In a study by Turner et al., there are certain factors that may affect a school's likelihood to have a school garden (2016). They report that despite the fact that a growing number of schools have implemented SGPs, there are still two-thirds of US public elementary schools that do not have SGPs. Of those two-thirds, there is a good chance they share some similar characteristics.

Turner et al. describe five different school-wide indicators that make a school less likely to implement a garden program: Region of school, size of school, locale of school, demographics of student population, and socioeconomic status (SES) of student

population (2016). In total, this study received 5061 survey responses, an impressive sample size. Unless otherwise indicated, the following paragraphs use the data reported in the study from the compilation of school years 2006-2007 to 2013-2014.

Region was the first indicating factor identified by Turner et al. The regions of the United States were based on the census region (West, Northeast, Midwest, and South) that the school was located in. The finding was that schools in the West region were more likely to have a school garden present. 28.4 percent of schools surveyed in the West reported having a garden, which is 7.2 percent higher than the next most likely region: The Northeast. The authors cite that the prevalence of gardens in the West may be due to unique initiatives taken in the state of California as previously mentioned in this essay (Turner et al. 2016).

The second indicator focused on size of the school, measured by student population. Data was collected from the National Center for Education Statistics' Common Core of Data (CCD). They split the schools into two categories based on student population. Large school which had more than 450 students or small school which had fewer than 450 students. The likelihood of having a school garden program favored larger schools, though not by much. 22 percent of larger elementary schools did have a school garden compared to 17.5 percent of smaller schools (Turner et al., 2016).

Locale of the school was another interesting factor that may contribute to the prevalence of gardens in the area. The four identified locales were also taken from the CCD. They are urban/city, suburb, town, and rural (see Appendix C, figure 4 for definitions). It was found that the likelihood of having a SGP was much higher in

urban/city locales. The local category of town was least likely to have a SGP present with just 12 percent of schools reporting the use of a garden. The authors do not try to speculate as to why this may be a barrier for schools to obtain garden programs. Perhaps it is assumed that smaller communities may have a student population that is already exposed to agriculture or gardening at home. Blair (2009) argues that the locale of an area doesn't matter because the landscape that children play in still contributes to their sense of the world, imagination, and more (p.17).

Demographics were also shown to have an effect on garden programs. Again, the data was taken from the CCD. This study divided schools into two groups, diverse or predominantly white. For a school to be considered predominantly white it must have a student body comprised of at least 66 percent white students. Interestingly, the study found that diverse schools were 5 percent more likely to have a garden program than predominantly white schools.

Looking at data from the last year of the study only, 2013-2014, the separation grew. In the most recent collected data diverse schools reported 36.2 percent as having a garden while predominantly white schools reported 23.9 percent (Turner et al., 2016). Though the author does not explore this further, there is a chance this could be due to the higher diversity in urban areas - which are more likely to have a garden due to higher availability of, and closer proximity to, garden supporting resources.

Finally, this study looked at the disparities of schools with lower SES compared to middle/higher SES. The SES of the student population was determined by the percentage of students qualifying for free/reduced priced lunch (FRPL). Schools with

more than 66 percent of their population qualifying for FRPL were considered lower SES, middle SES was defined by having between 66 percent and 33 percent qualifying, and high SES have student populations with less than 33 percent qualifying for FRPL. Lower SES schools reported 17.3 percent of schools with SGPs while higher SES schools reported 23.5 percent with SGPs.

The study states that "this is perhaps not surprising, given the many competing issued demanding attention at high-need schools" (Turner et al., 2016, p. 910). The author goes on to cite lack of parent/volunteer availability, focus of academic matters, and low staffing resources as other contributing factors to the disparities between the SES of schools. They also state that gardens could potentially benefit these communities as they promote academic and health outcomes of youth while enhancing the community (Turner et al. 2016).

A summary of this information is best stated by the following excerpt from Turner et al. (2016):

> Gardens were most common at schools in the west, followed by those in the northeast, but significantly less common at schools in the south and Midwest. This pattern was seen across all years, as well as in the 2013-2014 year only. School gardens were most common at urban elementary schools and least common at schools in small towns. Gardens were less common at smaller schools than at larger schools. Gardens were significantly less common at schools in which more students were eligible for free or reduced priced meals

(lower-SES schools), with an adjusted prevalence of 23.5% of higher-SES schools versus 17.3% of lower-SES schools. (p. 909)

Barriers to Implementation: An Educator's View

Though school wide factors have an impact on the overall likelihood of a SGP being implemented into a school, there are more factors at the individual level that make it difficult for teachers to fully commit to new garden programs. Diaz et al. (2018) focused a study around published academic research to compile 5 main factors that impede garden success (see Appendix C, figure 5). Then, research was done by collecting responses from garden personnel in Florida school districts to see if they felt that the same factors applied.

Diaz et al. (2018) discovered that two of the five research-based factors were among the top barriers identified by school garden personnel who participated in the study. These personnel also identified three additional barriers that they felt impeded the process of adding a SGP to their specific site. The five factors that this study produced are: time shortages among teachers, current structure of the education sector, difficulties in sustaining continuity in leadership and garden maintenance, the complexity of the school systems, and challenges associated with volunteer management and retention (p. 9).

This study was not the only one to report these barriers as impediments to SGP progress. Burt et al. (2017a) states, "lack of time was one of the most frequent challenges for school gardeners" (p. 431). Hazzard et al. (2012) states that when

principals of schools with SGPs were asked about barriers, they said time constraints on teachers was the primary barrier.

Burt et al. (2017a) reports that teachers thought the most helpful resource for a garden would be lessons that connect to core state standards, this is also what is meant by current structure of the education sector from the Diaz et al article. The current structure of the education sector focuses on standards-based education with a focus on assessment. This is why it is so crucial for lessons used in the garden to be connected to state standards.

The complexity of the school system deals with the difficulties teachers, administrators, and other garden personnel face when attempting to have meaningful policy discussions and implement change. It can be especially challenging to implement a SGP if the initiators lack administrative support. Luckily, with new research favoring SGPs as an academic tool, administration may be more likely to support new initiatives.

Volunteers can be a challenge in any new initiative. They can help to support the garden program so that one person does not have to be the only one in charge of the garden. The CSGN book suggests a few ways to make the process of selecting and recruiting volunteers a little easier. Pounders (2006) suggests looking into school site neighbors as a healthy, thriving garden can also enhance the surrounding community, reaching out to parents who may have horticulture knowledge, researching local extension services and master gardeners programs, and finding one dedicated volunteer to be the volunteer coordinator so the stress of volunteer management is alleviated from the school staff.

Continuity of leadership and garden maintenance are, indeed, a struggle most SGPs face. A few tips in the CSGN book may help to alleviate this stress on the garden. Creating a maintenance schedule can be extremely helpful. If it is detailed and well organized, then anyone who is in charge of maintenance that day can easily complete the needed tasks. As far as continuity of leadership, the CSGN book reinforces the idea of having a school garden management team rather than one very passionate individual. By creating a team and support network around the garden, it is less likely to become dependent on any one person (Pounders, 2006).

There are many challenges that individuals face when starting a garden program. Things like asking for help, building a support schedule, and becoming diligently organized are just a few ways that experts have suggested combating some of these barriers to success.

Best Practices for Gardening on the Oregon Coast

The model school for this project is Taft Elementary School in Lincoln City, Oregon. Lincoln City, OR is located on the Central Oregon Coast. This location poses unique challenges for implementation of a SGP due to the harsh weather, cool climate, and short growing season. In order for this garden to be successful, the best practices for gardening on the Oregon Coast must be explored.

Oregon State University Extension Services (OSU-ES) offers a guide titled *Growing Your Own* which is a handbook for gardening in Oregon. The information that applies to the coastal region will be analyzed and adapted to best fit the gardening needs on school grounds. Another resource from Robbins & Colt offer information on

short-season vegetable gardening, a key to success on the Oregon Coast. These and other resources are compiled to discover the best practices for gardening in the harsh climate of the Oregon Coast.

The first concern when gardening on the Oregon Coast is location of the garden. Due to the cool climates and frequent winds the garden must be placed in a protected location. OSU-ES and Robbins & Colt suggest planting on the south side of a wall or building to make the most of available heat (2011). The sun's heat will reflect off of the building creating a slightly warmer area in this location. This would be ideal for a school who is starting from scratch with their garden. The school I have chosen, unfortunately, will be planting on the north side of the building. However, the area chosen for the garden is well protected from harsh west winds, a common detriment to many gardens on the Oregon Coast. Robbins & Colt suggest planting rows in a north to south direction so that the sun rays hit all angles of the leaf canopy throughout the day (2000).

In a cool climate, the key to a successful harvest is to be able to warm the soil quickly. Robbins & Cult suggest planting in raised beds with plants in mounds with southern exposure (see Appendix C, figure 6 for diagram). This technique allows soil to warm quickly. Another suggestion to increase warmth in soil is to cover the ground with plastic before the planting season. This helps the soil retain heat before the planting season begins.

To protect from certain unique coastal climate features such as wind, rain, and fog, the following suggestions are made. To protect from wind, OSU-ES suggests placing a barrier around plants or garden to break the wind. These objects could include large,

sturdy coastal plants, fencing, tires, or any other object you may have available. To help with excessive rain issues, it is suggested that organic material be added to the soil to help with drainage. Covering crops that need less water and more heat is also a good option.

A big part of gardening on the Oregon Coast, especially at a school garden location, is to choose low-maintenance, durable, and early maturing short-season crops. Even though the Oregon Coast has a longer growing season due to the unlikelihood of frost, the school year is short, and the climate is cool which means choosing short-season crops can produce higher yields during the school year when cared for correctly. A complete list of suggested crops can be found in Appendix B. Another option is to choose cool-season vegetables that can germinate in soil that is less than 40 degrees Fahrenheit.

One unique option that was discussed for heat retention by Robbins & Colt was the use of a water store. Water has a high heat capacity which means it stores heat from the sun well and cools slowly. So as the land temperature drops, water will typically be slightly warmer still. This feature will be added to the guidebook as a suggestion to increase warmth of soil near plants.

Soil quality can also have a huge impact on the success of a garden on the Oregon Coast. Typically, coastal soils are higher in sand content, so the soil does not hold water in the dryer months but also does not do well in rainy months either. The solution to improve soil quality is to add organic matter to the soil with aids in drainage,

water distribution, and warming in early months. Lists of suggested soil additives can be found in Appendix B.

Composting is another great option to improve soil quality. It can act as a fertilizer and soil conditioner when it is worked into soil but can also be used as a mulch when applied to the soil's surface. Whatever is chosen to improve soil quality, there is one uniform suggestion and that is to have the soil tested by a local master gardeners service to find out its exact needs. Robbins & Colt say that a soil test can be helpful in determining levels of pH, nitrogen, phosphorus, and potassium; all of which are required for a healthy harvest (2000).

Once the garden is planted, the work is not over. Pests, bugs, and disease can all occur if the gardener(s) are not proactive. OSU-ES suggest rotating crops as a defense against disease. Proper fertilization can also aid in the crop's defense against disease. An important factor in school gardening is to find alternatives to chemical insecticides and pesticides so that the garden space is still safe for everyone. One of the simplest ways to do this is to attract beneficial insects to the garden by planting flowering plants. Complete suggestions for pest and disease management will be listed in Appendix B.

Finally, the last consideration for a bountiful school garden on the Oregon Coast is to know when and what to plant. OSU-ES has suggestions for fall and winter gardening which can be extremely useful during the school year. Seasonal gardening allows the garden to be useful all year round. One suggestion is to leave more space between plants that will remain through winter. If the plants are more spaced out, they are less

susceptible to rots and slug damage. They also propose a formula to know when to plant in the fall (see Appendix C, figure 7).

In Summary

The research is clear, SGPs benefit students in countless ways. From academics to personal health to environmental awareness, these spaces provide an experiential learning opportunity for students. They must be done correctly though; connections to state specific standards, integration of content areas, and implementation at a school wide level are all important parts of establishing and maintaining a school garden.

The disparities of SGPs across the United States are real. The number of gardens has grown but schools with high needs are often left without the opportunities for such programs. Population socioeconomic status, locale, region, demographics, and school size are all factors that may impact the likelihood of a school having a garden program.

Gardening on the Oregon Coast also poses major challenges since the climate is not ideal for gardening. However, understanding the best practices for gardening in coastal climates is key to creating a well-producing garden. Low maintenance, early maturing, cold climate crops all are great for a SGP on the Oregon Coast.

Taft Elementary is one school that has a need for a garden. With a supportive administration, a willing team of educators, and a well-protected garden site, this school is ideal for the implementation of a new SGP. In the following pages, the knowledge gained from the research presented will be applied to this unique school setting and a plan will be formulated to create a SGP that is well-integrated and successful for years to come.

Endnotes

[1] For the entire list of outcomes and subcategories studied, refer to pages 220-221 of Williams & Dixon 2013.

[2] "Moreover, few studies have examined the role of school gardens among low-income students - a group of particular interest due to disparities in academic achievement based on social class" (Wells et al., 2015, p. 2861) This, to me, is a fascinating field of study and is particularly interesting for my project because the demographic of this study aligns with the demographic of the model school I chose to use.

[3] Burt et al. (2017a), Burt et al. (2017b), Diaz et al. (2018), Kelley & Williams (2014), Hazzard et al. (2012),

Taft Elementary School: A Model for Others

The school chosen to develop a SGP is located on the Oregon Coast in Lincoln City. It is one of two public elementary schools in Lincoln City and is part of the Lincoln County School District. They serve students in third through sixth grade. Taft Elementary School faces challenges that makes garden program implementation difficult. As listed in the previous literature review, some of the barriers to implementation include school wide indicators such as region, size of school, locale, demographics, and socioeconomic status as well as indicators at the educator level which include time shortages, the structure of the education sector, sustaining leaders, the complexity of school systems, and challenges that come with volunteer management and retention.

The biggest school wide indicator for lack of a SGP was socioeconomic status of students. According to the Oregon Department of Education's Oregon At-A-Glance School Profile of Taft Elementary, over 95% of students qualify for free or reduced priced lunch. This more than qualifies this school as a low socioeconomic status school. This barrier alone indicates that they are less likely to have a well maintained and functional SGP.

Additionally, another indicator that suggested a school would be less likely to have a SGP was the locale of the school. Locale, as stated previously, is determined by the CCD. Taft Elementary School is identified as a town according to the CCD. This indicates that they are far less likely to have a SGP. Only 12% of schools in the locale of town reported having a SGP. Demographics also played a role in likelihood of a SGP. Much to my surprise, the research found that predominantly white schools, meaning 66% or higher of students reported white as their primary ethnicity, were less likely to

have a SGP. This is likely due to the fact that urban areas, which tend to have more diverse populations, are more likely than rural areas to have a SGP. Taft Elementary School's student population is 65% percent white. According to the research demographics was not as strong of an indicator as locale and SES, but was worth noting, nonetheless.

Finally, after having numerous conversations with educators at this school, I found that they almost unanimously reported lack of time as the reason why they had not implemented a school garden program. From the research, it is clear that they are not alone. As discussed in previous pages, numerous studies surveying educators and administrators alike reported that time constraints on teachers was the number one reason why SGPs were not being utilized. As with any new initiative in public education, much of the responsibility for implementing programs falls on the laps of the teachers.

One of the barriers to access identified was complexity of school systems. This, in short, means that teachers, administrators, or other garden personnel felt that there was lack of meaningful discussion around SGPs. They felt they could not successfully advocate for policy change that would favor SGP implementation. Also, many teachers reported feeling a lack of administrator support. This is one barrier that Taft Elementary is not facing. After my initial contact with the principal at Taft Elementary, I felt complete support and willingness for participation in this project from administration and teachers. A few of my notes from the first phone conversation with the administration at Taft Elementary include "they are very excited for the project" and

“teachers will be in contact very soon to begin the project”. Supportive administration made this school an excellent candidate for a SGP.

Physical location of the garden plays a role in the success of the garden as well. Especially in the harsh Oregon Coast climate. Taft Elementary School had established a location for the garden that was near ideal for success. The space was once used for a garden and had excellent bones to work with including raised garden beds, key to a successful garden on the Oregon Coast. The space had not been used in several years, save for a few individual teachers who tried to integrate some artwork into the space with their classes. Though they were not able to place the garden along a south-facing wall as suggested in the research, they were able to use a location that was very well protected from the elements.

The garden is situated in a small alcove on the northeast side of the building. The area is well protected from harsh west winds that are typical for the Coast. It is also secluded from the roads and sidewalks that lead to the building. This makes it a safe location for students to enjoy the garden and protects the garden from the public. The area had seven established garden beds made with wood that had been treated for outdoor use. Overall, the space just needed some fine tuning and logistical changes in order to be useful for the school. For images of the garden space before any work was done, see Appendix C, Figure 7.

By far the most compelling reason that Taft Elementary was selected as a model school for this project was the willingness of the staff to participate in the project. After viewing some of the research, they determined that a SGP would be a great addition to

their curriculum. The Community Curriculum Resource Liaison for Lincoln County School District works very closely with Taft Elementary School teachers to provide optimal science education for the students. When they heard that this project was happening, they were able to pull in additional supports for myself and for teachers. As the research from CSGN shows, a SGP is best run by a team of people rather than an individual. I believed that this site would see success in their new SGP due to the willingness of their staff to work together on this project.

While Taft Elementary did have an established garden space that would require little effort to become functional, they were lacking in the systems that would make it possible to utilize the garden space in a meaningful and integrated way. Individual teachers had been trying to get their students out to the garden for short science lessons or art projects, but there was a lack of connection between the everyday curriculum and what was being taught in the garden. After meeting with teachers, they informed me of the three biggest things that they wanted to be able to become successful at in the garden. Those were classroom management in the outdoor space, teaching integrated and cross-disciplinary lessons with the garden, and establishing a big buddy program between the third and sixth grade classrooms in the garden. In addition to establishing a SGP that would allow for more purposeful use of the garden space, the teachers and other staff members wanted to see the space come back to life. They wanted their students to be part of bringing the not-so-lively space back to a functioning and beautiful garden for everyone to enjoy.

While Taft Elementary is unique in many ways, it was also a top choice for this project because there are many schools across Oregon that are similar in characteristics. For example, the Oregon Department of Education Media Gallery RC Schools Aggregate Data reported that there were 427 schools that qualified as low SES (66% of students or greater qualifying for free or reduced lunch) in the 2017-2018 school year (ODE, 2019). This is just one of the many indicators that Taft Elementary had that would impede successful implementation of a SGP. These schools, and many more, could use this project as a starting point to overcome their own institutional barriers to implementation of a SGP.

Taft had a space that was intended to be used as a garden, but beyond this they were starting from the ground up in creating a SGP. This project is intended to a model for other sites to use and follow in creating their own SGP. The hope is that by utilizing similar methods and materials, other schools of similar characteristics could find success in creating their own SGP. In the following section I will discuss the challenges and successes that we faced as a team while building the SGP at Taft Elementary.

Implementation Plan Notes and Reflections

The first step towards implementing a SGP at Taft Elementary was to meet with people that were interested in the project developing and growing. I met first with the Community Curriculum Resources Liaisons for Lincoln County School District. Their primary role is supporting the districts STEM initiatives and provide teachers with resources and trainings. They also have access to the Oregon Coast STEM Hub, a group that supports STEM Education in schools on the Oregon Coast. After our initial meetings, we were very energized and ready to make the SGP happen.

Ideas that emerged from these initial conversations included the utilizing native species in the garden rather than more traditional garden species. This would reduce the amount of maintenance and care needed for the garden to be successful as these plants already thrived with little human intervention in the surrounding habitats. We also made lists of possible resources that we could reach out to for donations and support. We devised a list of native species that we thought would be most ideal for the garden space. Included in the list are both edible and nonedible plants. For a brief sample of the wish list of native species that we created as well as a link to the full list of species, see figure 8 in Appendix C.

We also decided that we needed to meet with the teachers who were most interested in this project to gain their input and devise a more concrete plan. Together we sat down, and the teachers told me everything that they thought they would need to run a SGP. We discussed the many possibilities but ultimately decided that small steps to get the garden up and running would be the best place to start. Each of these

teachers and the Community Curriculum Resource Liaison sat down and create one feasible goal to try to accomplish each month of the remaining school year. We met in December of 2018 so that gave us January of 2019 through June of 2019 to try out a few things in the garden.

After discussing, we decided the best way to delegate tasks would be for teachers and students to take on the responsibility of completing garden goals that were established at the meeting and I would work to develop the logistical tools needed to a successful garden. I decided to develop a resource bundle, found in Appendix A, and a guidebook, found in Appendix B, that would be full of resources, educational materials, and further learning for their new garden program. The three sections of the resource bundle are sample lesson plans that are aligned to state standards, outdoor classroom management techniques, and a garden text set with various grade appropriate literary resources. The guidebook includes seasonal care and maintenance of the garden, an Oregon Coast planting guide, future additions and suggestions for the SGP, and additional resources for further information.

These three sections of the resource bundle were developed to support the things that teachers felt they needed most. Both the research and the conversations I had with the staff lead me to want to compile a sample of lesson plans that could be used in the garden that were cross-disciplinary and aligned to state standards including the Common Core State Standards for Mathematics and English Language Arts and the Next Generation Science Standards. The teachers expressed that the one thing that they felt more uncomfortable with was classroom management in the garden. This led me to

add a section the resource bundle full of techniques for outdoor classroom management. Finally, the last section of the resource bundle includes a text set. A text set is a list of literary tools such as books, websites, videos, or other forms of media, all centered around a common theme or topic. Teachers at Taft Elementary felt somewhat sure that they would be able to teach science in the garden, but they wanted to be able to integrate literacy into their garden lessons as well. This tool was designed to support them through that integration.

As I designed the resource bundle, I found that there was no use in reinventing the wheel. There are thousands of high-quality resources out there for integrated, standards-based lessons in the garden. Rather than taking the time to design my lesson plans from scratch, I decided to create a compilation of the best resources that I could find. This way, teachers had the freedom and the access to many lessons and curricular options to find what worked best in their classroom. This would also mean the document was living and able to adjust and improve as time went on. As teacher find new resources or discover that some of them simply don't work for their classrooms, they could add and remove resources as they saw fit. You can see this table of lessons and curricula in the Lesson Plan and Curricula section in Appendix A.

Similarly, there are many guides and approaches to outdoor classroom management. As a young teacher, I felt that I knew even less about classroom management than the teachers that I was working with on this project. For this reason, I felt it was best to include a document of resources where classroom management techniques could be found. This will be a document that will work much like a self-paced

course for teachers to go through to improve their classroom management skills. As time is a precious resource, my goal was to find the best, most succinct way for teachers to brush up on outdoor classroom management techniques. A teacher should be able to go through this one-pager and its contents in about 30-45 minutes for an overview of management techniques with the option to dedicate more time by exploring the additional linked resources, or less time by looking into the quick tips resources. You can find the document under the Outdoor Classroom Management section in Appendix A.

The guidebook, found in Appendix B, was perhaps the most challenging part of this project. I wanted an easy to use, comprehensive, and research-based guide for teachers to refer to for garden maintenance, Oregon Coast gardening considerations, and future suggestions for expanding the SGP. This was difficult to compile because of the breadth of materials available for SGPs. Though this was challenging, I was committed to developing a resource that would support the sustainability of the program as my review of the research indicated that this was a major determiner in SGP success. The information needed to continue the program needed to be documented in one place and not tied to an individual. We agreed that a Google Drive Folder shared with all of the teachers involved with the project would be the best possible way to deliver both the resource bundle and the guidebook. To view snapshots of the materials in the resource bundle and the guidebook, see Appendix A and Appendix B. At the beginning of each Appendix you can find a link to view the resources in full on Google Drive.

Once all of the roles of the team were established, we were able to hit the ground running. Teachers and their students began working on the goals established by the team. You can see these goals listed in Figure 9, Appendix C. In January, we needed to focus on finding out what we already had available in the run-down garden that could still be used. The teachers and students used an inventory sheet that I created to make a record of available tools and supplies. There was a surprising amount of resources available. In a meeting with one of the Curriculum Resource Liaisons, she shared that the Oregon Coast STEM Hub had a traveling STEM trailer with materials and tools that could be utilized in the garden. In addition to what was already available at the school site, the teachers knew they could also reach out the STEM Hub to supply any more materials needed. For the inventory list, see Figure 10, Appendix C.

February and March brought terrible weather to the Oregon Coast. One of the biggest challenges faced was fighting mother nature. There is no way to control this variable, but the team pushed forward. One suggestion that I would make to others trying to implement a SGP is to have a rainy-day plan. If you plan to take students into the garden, be sure you have an additional plan for weather related delays or for students who simply could not access the garden well outdoors. You can read more about this in the Classroom Management section of Appendix A. Though there were delays, the team at Taft Elementary did make time to clean up the garden space and bring it back to life.

The goal for February was to clean up the garden. Even though this goal was not completed in a single month, you can clearly see from the images in Figure 11, Appendix

C, that the garden space has been transformed from its original state. In our initial meeting, we had discussed doing a garden cleanup day on a weekend with some of the staff members as well as a team of high school students. However, as the school year went on, the teachers at Taft Elementary had their students become part of the process instead. They worked together to make the space beautiful again. This also gave students more ownership in the garden.

As the weather became more cooperative in April and May, the team was able to begin planting both crops and a few native species. Some native species had grown in the garden during the period of time when it was unused. Rather than getting rid of these plants, many of them were preserved during the cleanup process. Additionally, some crop plants were planted in the garden beds. In the images in Figure 11, Appendix C, there are several garden beds that appear empty. However, below the surface of the soil there are small seeds, waiting to sprout.

As May came, the goal was to put together a fundraiser for the garden program. The students were going to create an art project to be sold at a STEAM Night event. In the future, this will be a great opportunity for sustainability of the garden program. The funds raised these STEAM Night events will go directly back to the SGP. Funds will be used to maintain the garden, improve already existing features, and potentially create new additions to the garden space.

Funding is a major barrier for many programs. If your site struggles to receive funding for additional programs, try to utilize what is already functional at your school and piggy-back off of programs that are already in place. For example, if your school has

athletic events where concessions are sold, ask if you can volunteer with students to run the stand for a home game and split the proceeds with the athletic department. Reach out to your local gardening clubs and specialists to see if they have extra supplies that could be donated. Oregon State University Extension Services is another resource that may be in your area that could substantially help kick start your program.

This brings us to June 2019. Currently, the garden is semi-functional. Students and teachers are utilizing the improved space, but there is still a long way to go before the program is fully integrated, cross-disciplinary, and sustainable. The biggest takeaway that I had throughout this project was to take small steps. One tiny improvement is better than none at all. A functional and maintainable SGP takes time to build and grow. If you are thinking about starting a SGP at your own site, I urge you to look at what is already available, even if that is simply paper cups and a few pea seeds in the window sill of your classroom. Start small and set yourself reasonable goals. Chip away a little at a time and the program will slowly grow into something more obtainable.

It is key that the responsibility and plan for the garden does not lie with an individual. Gather a team of dedicated people including community members, teachers, administrators, instructional assistance, and families to be part of the process. This will be a major indicator of success in your SGP. This ensures the continuity and sustainability of the program. If an individual leaves, the garden can still continue.

Another barrier faced by many locations is lack of administrator support. This was not an issue we faced at Taft Elementary. A large factor for administrators to consider when putting resources towards something new is the student outcomes that

will result in the new program. If you are in a location with little support from administration, I recommend coming prepared with the research that supports student learning in the garden. Specifically, take a look more in depth at the work of Wells et. all, 2015, and Williams and Dixon, 2013, for extensive research on both academic achievements due to SGPs and socioemotional gains due to SGPs.

Not only was this project done as a graduation requirement at WOU, but it is also reflective of a valuable experience that could be used in my future career aspirations. In order for a garden program to be successful, you will want it to be designed with research based best-practices. One of the number one barriers for access to gardens is that schools and educators do not have the time to work through the process of integrating a garden. This gives me a feeling of validity for my project because after completion, I know that there will be a toolkit readily available for educators to use as a starting point to implement a program without having to spend the countless hours compiling the best practices.

I will take this experience with me as I continue my love for integrated, hands-on learning. In the following year, I will be a middle school science teacher in a school with very similar characteristics and demographics as Taft Elementary. I am excited at the possibility of bringing this research and plan to a new location to see if it can be implemented in a new location.

Appendix A – Resource Bundle

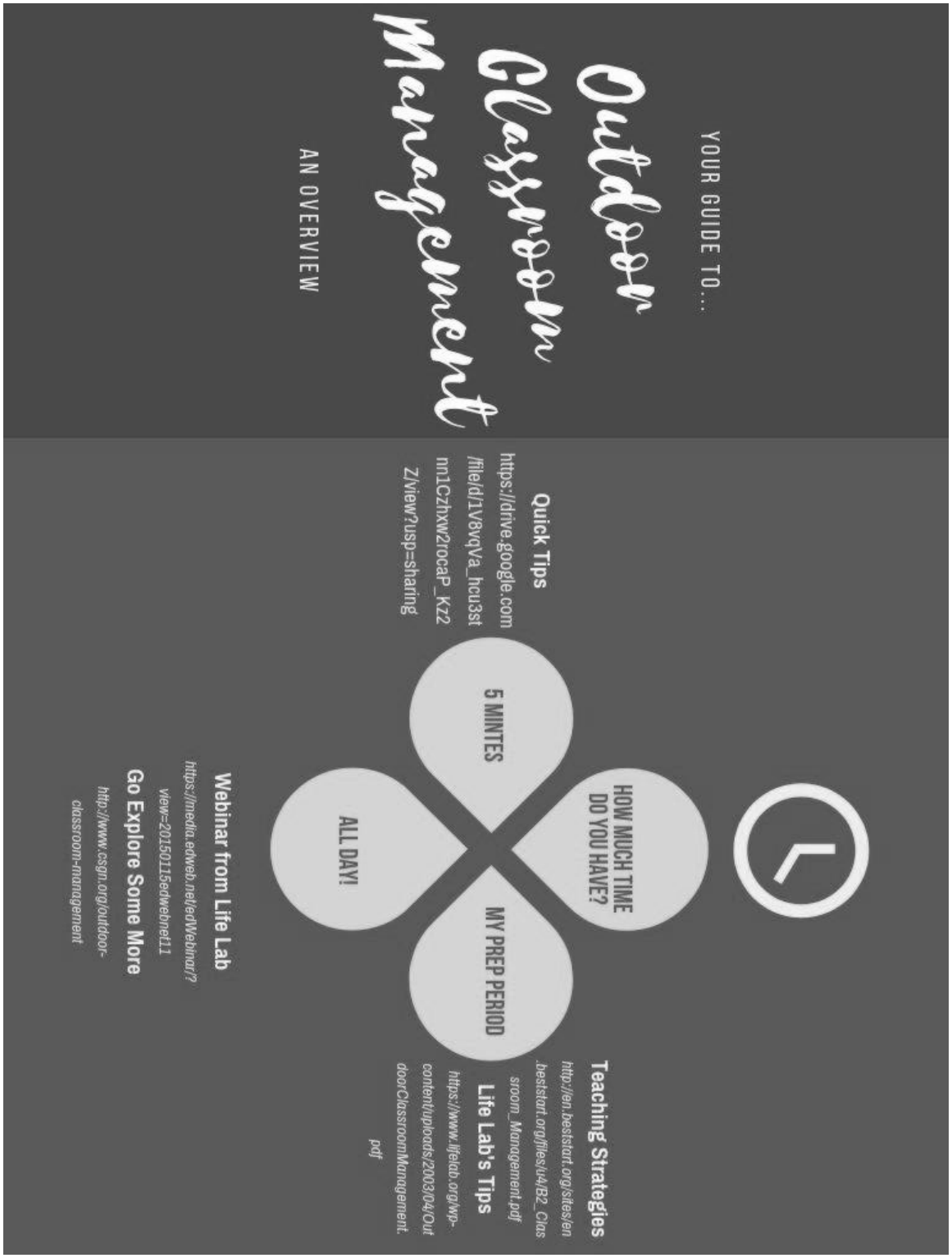
School Garden Lesson Plans and Curricula

Each of these resources contain multiple additional resources for lesson plans in a school garden. If you are in a pinch for time and know what you want to teach in the garden, visit the sites in bold first as they are searchable and much easier to find specific lessons in a hurry.

Resource	Subject/Standards Addressed	Location of Resource
Collective School Garden Network Curriculum Database	Multiple	http://www.csgn.org/curriculum
National Education Association School Garden Curriculum	Multiple	http://www.nea.org/tools/lessons/61378.htm
Slow Food USA Curriculum	Multiple	https://www.slowfoodusa.org/school-garden-curriculum
Oregon Department of Education School Garden Curricula	Multiple	https://www.oregon.gov/ode/students-and-family/childnutrition/F2S/Pages/School-Garden-Curricula.aspx
Oregon Farm to School and School Garden Curricular Resources	Multiple	https://www.oregon.gov/ode/students-and-family/childnutrition/F2S/Documents/oregon-farm-to-school-and-school-garden-curriculum_5-15-14.pdf

School Garden Project of Lane County - Oregon	NGSS aligned	https://www.schoolgardenproject.org/resources/curriculum/
Kids Gardening Lesson Plans	Multiple	https://kidsgardening.org/lesson-plans/
Oregon School Garden Resource Guide	Multiple	https://www.oregon.gov/ode/students-and-family/childnutrition/F2S/Documents/OregonSchoolGardenResourceGuide_July2017.docx

Outdoor Classroom Management



Text Set: Gardens

This text set is a collection of texts focused on education in the garden. The primary content covered is science, though there are some cross disciplinary materials as well. The age that this text set targets is upper elementary school. Some of the texts may be slightly advanced for this age group but could be used as challenges for advanced students or presented with scaffolds for the entire class. Ideally this text set would be used in unison with trips to a school garden. Other options for garden exposure could be to travel to a local community garden, look at live webcams of gardens, or view images of gardens. The key to a successful school garden program is integration of education with the garden. Science is the most natural connection to a garden program. However, literacy can be easily integrated as well. These resources will get educators started on their journey to cross-disciplinary connections to the SGP.

Note: One-page summary of anchor text located at the bottom of this text set.

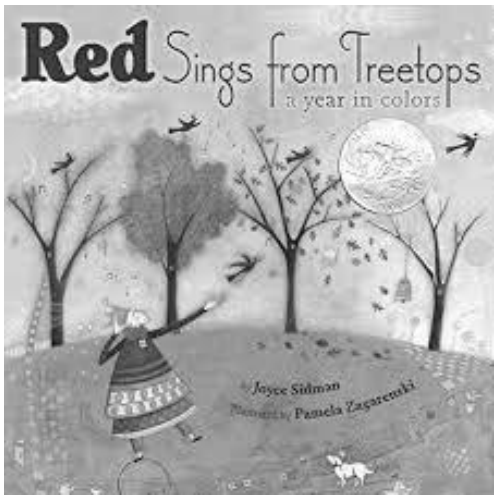
Novels

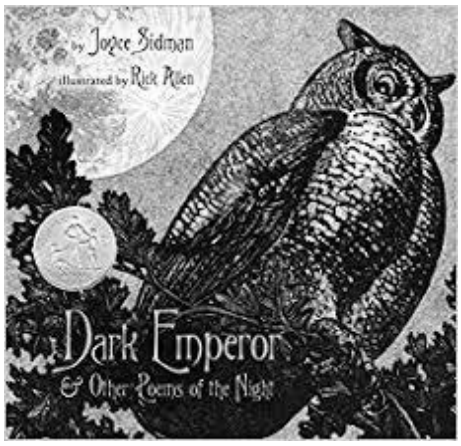
Ellie's Log: Exploring the Forest Where the Great Tree Fell **By Judith L. Li** See one page write up at the bottom of this text set.	
Ricky's Atlas: Mapping a Land on Fire **By Judith L. Li** This is the sequel to the novel listed above, Ellie's Log. This time, Ricky explores land East of the Cascade Mountains in Oregon as a wildfire rips across the land. He uses his mapmaking skills to record information about the area to discover how fire has shaped the landscape here. This book includes ecology, history, geology, and more. To use this text for this garden text set I would challenge students to create their own maps of their school campus using Ricky's maps as a model. It could lead to great discussions about what factors influence ecology in the school's area.	

What can we learn about the history of the area and how might that information help us know what to plant and when? This book would be a great way to discuss different kinds of data that can be collected other than just numbers such as anecdotal or observations.	

Poetry

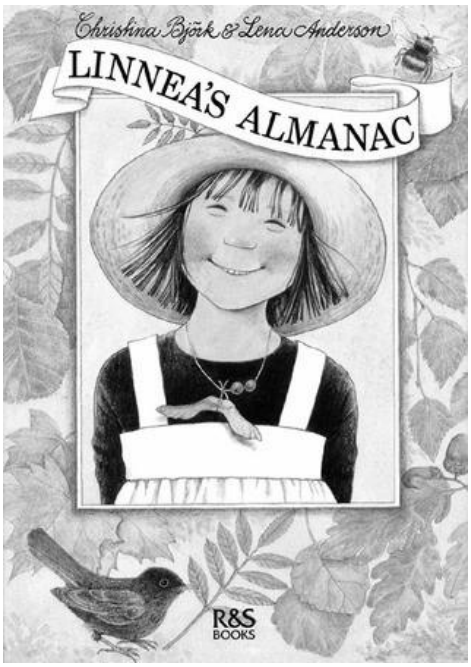
Gathering the Sun: An Alphabet in Spanish and English **By Alma Flor Ada** This text has side by side poems in Spanish and English for each letter of the Spanish alphabet. Each poem is about some aspect of working in the field during the harvest season. The poems also touch on history, family, and heritage. The illustrations are really stunning in this book as well, each page looks as if the sun is shining on it. I would use this book to incorporate culture into the garden. It would be a great way to start a discussion or study on gardening and farming in different	

countries. I could also see this book used before going out to harvest crops from the garden. I could imagine it being used to integrate social studies in the garden as well.	
Red Sings from Treetops: a year in colors **By Joyce Sidman** This book of poems takes readers through the seasons and the different colors that become more prevalent in each season. I think this book could be really amazing for use in the garden. I imagine reading this book as a mentor text for poetry to my students. I would then take them out into the garden and have them sit quietly and write down observations using their five senses. When we return to the classroom, I could have students write poems about what they observed in the garden. I could also see this text being used as a way to introduce a unit on seasons. We could talk about how our garden might change throughout the seasons and make	

observations throughout the school year, referring back to this book frequently. I like this book because it uses simple words that most upper elementary students know the meaning of so that the only challenge is the poem itself rather than the act of reading the words. It's a great way to introduce a new style of writing using the garden as an anchor for the writing.	
Dark Emperor & Other Poems of the Night **By Joyce Sidman** This book is filled with poems about different plants, animals, and insects that are nocturnal. Each page has one poem and some accompanying informational text about the organism. I think this would be a great way to get students to do a similar kind of writing. Have each student pick an organism from the garden to study. They will write a short bit of informational text about the organism and then write a poem to go with it. They can	

illustrate their page and the class could create their own book with each student's writing and drawings. The book would then be all about their garden. This book could be used as the mentor text for this project.	

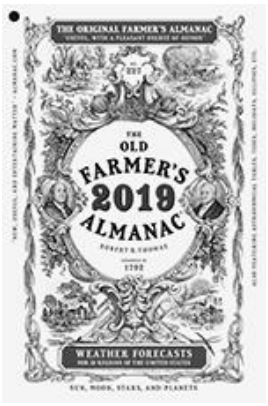
Fictional Picture Books

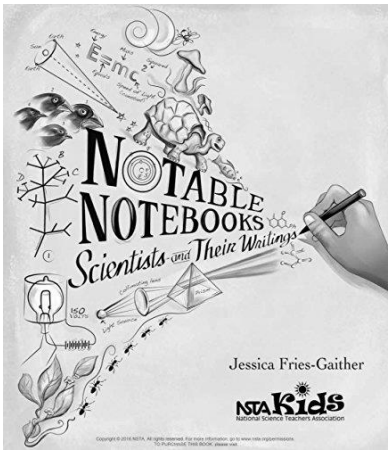
Linnea's Almanac **By Christina Bjork and Lena Anderson** This picture book is longer in length and may even be considered a graphic novel. The story follows Linnea through the seasons in her hometown. Linnea is a city girl who loves nature. She realizes through careful observation that nature is all around here, even in the bustling city. Linnea shows how she records observations and collects data about nature in her city. She also shows readers the many projects that she completes using nature near her house. She gives recipes, art projects, science experiments, games, and so much more	

that the reader can do alongside her. This book would be a great way to introduce certain garden projects like building a bird feeder or pressing flowers. I would use this book also as a model for data collection and careful observation in the garden. The uses for this book are really endless as there is practically a new challenge on every page.	
The Gardener **By Sarah Stewart** This Caldecott Honor Book is set in the depression era. Lydia Grace is sent to live with her uncle in the city until her family can get back up on their feet in the country. She loves to garden and finds it difficult to adjust to the gray city. She brings plants and flowers and begins to decorate her uncle's bakery with greenery. This is a really cute story that could be used as a read aloud. I imagine students could even write short stories about how plants make them feel or places where they think more plants could be	

seeded. I think it would be really fun to do a short art project and make paper with wildflower seeds in it for students to take home and plant somewhere.	

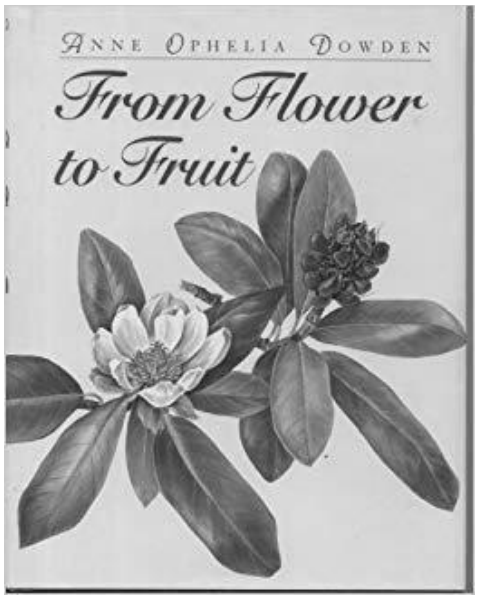
Nonfiction Texts/Picture Books

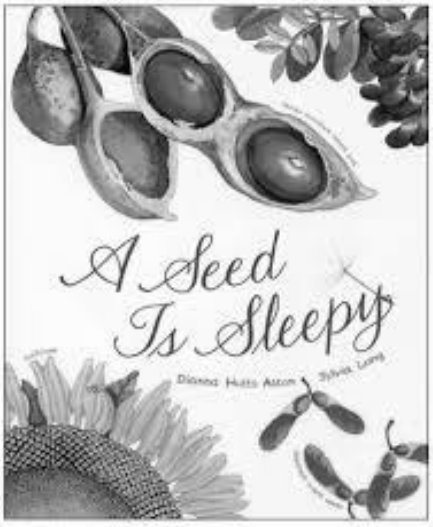
Farmer's Almanac (2019) & Garden Guide (2019) **From: *The Old Farmer's Almanac*** The Farmer's Almanac is the oldest running publication in America. It was founded in 1792 and has been used by farmers and gardeners for years. Students could use this book to analyze data and make prediction about when the ideal planting and harvesting seasons would be for their area. Through Farmer's Almanac they will have access to decades of weather and climate data as well as anecdotal evidence. I would use bits and pieces of the Farmer's Almanac publications to get students	 

studying data and making evidence-based decisions about their garden. The Almanac is written for adults, so the teacher should be intentional about the pieces chosen for students as well as the scaffolds provided so students can be successful as they interact with this text.	
Notable Notebooks: Scientists and Their Writings **By Jessica Fries-Gaither** This short nonfiction text takes students through the process of creating a scientist notebook. It includes real images of notable scientists' notebooks such as Galileo, Newton, and Potter. Students can look at the many different ways that scientists interpret what they see in the world and think though their observations. To use this book, I might read it to students before taking them into the garden. Part of the garden unit I have in mind is for students to record observations and data	

about the garden in their field notebooks. This book could be used as a model for how to do that. The back matter of this book includes four steps on creating your own science notebook. I might take students through these steps in preparation for going into the garden.	
The Reason for a Flower **By Ruth Heller** This text is written in rhyming verse and takes the reader on a journey through plant reproduction. It introduces terms like stamen, pollen, seeds, and more. The book explains why plants need flowers to reproduce. I can see this book being used as an introduction to the plant life cycle. After reading this book and studying plant sex organs, students could go out into the garden and identify how each of the plants reproduces in the garden. It could also lead to studying the animals and insects that help pollinate plants. Students could talk about the benefits of bees, butterflies, and	

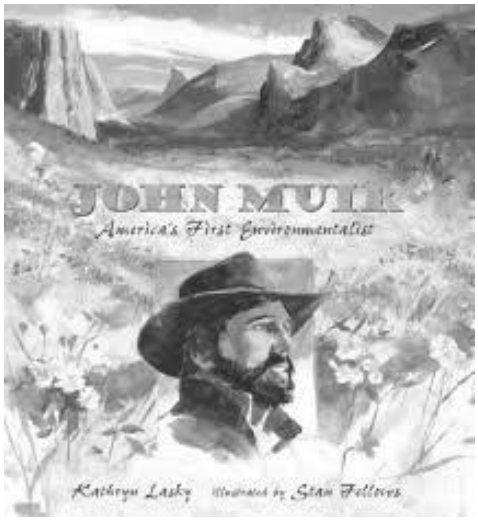
hummingbirds and come up with ways to attract them to the garden. This could even lead to an awesome engineering project as well where students would build hummingbird feeders.	
Plant Projects for Young Scientists **By Salvatore Tocci** This text is of book length and covers several ways that students can learn about plants and interact with nature. This text is written for students, but I can see it being used as a teacher resource as well. There are several projects outlined including step by step instructions, scientific concepts, and lists of materials needed to complete each project. If I were going to use this, I might use it as a teacher resource and pick a few projects out that I wanted to use with my students. Each chapter covers a different concept such as plant reproduction or photosynthesis. I also really liked the resource section in the back of	

the book that gave ideas for further reading or online sites to extend learning.	
From Flower to Fruit **By Anne Ophelia Dowden** This is another book length text that is slightly older (1994). Though it is aged a bit, I believe it still has really good information and could be useful for discussing plant reproduction. The illustrations that accompany the text were the real selling point for me. I would use bits and pieces of the text along with the images in the book to introduce students to plant reproduction. I would then have students go collect samples of plants from the garden and identify the different reproducing organs on the plants. They could use this book as a resource to do this.	

A Seed is Sleepy **By Dianna Aston and Sylvia Long** This nonfiction picture book is wonderfully illustrated showing reading the many different kinds of seeds. The text shows readers that seeds come in all different shapes and sizes and need different things to flourish into adult fauna. I would use this text to introduce seeds and discuss what they are and how they grow. We might read this right before we plant our garden seeds for the year. I would have students make observations about the seeds before telling them what plant they belong to and have them make predictions about what the plant that will grow from the seed might look like. After the plants have grown, students could revisit their predictions and observations and write a reflection about what they now understand about seeds.	

John Muir: America's First Environmentalist

By Kathryn Lasky



This biography is about John Muir who was born in Scotland but eventually became one of America's most influential environmentalist. He focused on conserving America's forests and meadows and would eventually form the Sierra Club. This book includes pieces of text from Muir's diaries as well. I would use this text as a way to talk about humans and their impact on the environment. It would be a great way to introduce some history into a garden unit and talk about how America's nature conservation laws came to be. This would have to be a supplement to a larger collection of information about conservation and environmentalism. I think it could lead to great discussion with students about ways we could incorporate conservation or environmentalism into the garden such as composting daily snack

scraps or using recycled materials to create garden art.	

Online Resources

Link: http://www.glencoe.com/sites/common_assets/science/virtual_labs/LS12/LS12.html This online simulation explores what colors of light are most important for plants to photosynthesize. There is some text that accompanies the simulation so that students can build background knowledge before running the experiment. If I were to use this, I would have some guiding questions that students could work towards answering. I then might ask them to talk about ways we can take what we learned from the simulation and apply it to the garden we have so that plants have the best chance of growth.	

Other

How Photosynthesis Works **Google Expedition** Through Google Expeditions students can explore photosynthesis through Augmented Reality. If students have access to iPads, this simulation could be used for students to read and view various plant parts responsible for photosynthesis. This expedition places the plant parts in your view of reality through your phone/tablet screen. Students can then explore the scene by moving their phone/iPad around.	
Plant Adaptations **Google Expedition** This expedition brings plant adaptations from around the world into the classroom. Students can view various plans in augmented reality through their tablet or phone screen. This would be a great way to get students thinking about the structure of plants and then go into the garden to see if they could identify any plant adaptations that are present in the garden.	

Ellie's Log: Exploring the Forest Where the Great Tree Fell (2013)

By Judith L. Lee - Illustrations by M. L. Herring

Ellie's Log is a short novel about a young girl, Ellie, and her friend, Ricky. Together they start off on an adventure after a huge tree falls down in an Oregon winter storm. Ellie lives near the forest and together they begin an exploration of the forest where they will discover habitats, plants, animals, and ecosystems. This book is based in the HJ Andrews Experimental Forest in the Cascade Mountains of Oregon.

The best part about this book is that it is applicable to students in Oregon. It was written at Oregon State University and is based at a real location in Oregon. The plants, animals, and habitats that are shown in the book will mirror what students are used to seeing in their own lives. The book is a great combination of storytelling and science. I chose to use this for a garden text set not because it discusses plants but because it provides an excellent model for students on how to keep a field notebook.

A big part of science at the upper elementary level is learning to record observations and data. Throughout this novel, there are inserts of Ellie's Field Notebook. She records sketches of plants, animals, and habitat as well as data she and Ricky

collect. These pages from her notebook can be used as a model for students learning to keep their own field notebook. It is the perfect blend of storytelling and science.

To entice students to read this book I would start by sharing an excerpt from the text. I would start by reading the first few pages aloud for students. I would stop at the second paragraph on page 15 because it leaves a cliffhanger that I think would get students interested in reading the book. I would also show some of the illustrations in the book including an example of Ellie's field notebook.

To use this book as part of a garden unit, I would start by reading and analyzing this text as a whole class. After each chapter, when we get a glimpse of Ellie's field notebook, I would challenge students to go out into the garden and create their own page in their field notebook. We might do the first one together but through this text I would like to gradually release students to setting up their own pages and writing in their own observations in their field notebooks.

The final bonus that this text has to offer is the back matter. Here we find some of Ellie's notes and advice about how to keep a field notebook. Additionally, the authors have given students a text set within the book itself. In the back they list "Ellie's Book Suggestions" which include a list of fiction, nonfiction, and further reading about field notebooks that students can explore. This book also gives a link to an online site, ellieslog.org, where teachers and students can explore more information about Ellie's Log as well as see what other books are in the same serious such as Ellie's Strand and Ricky's Atlas. Overall this is a great text for students and teachers.

Appendix B - Guidebook

Seasonal Care and Maintenance of a Coastal Garden

The following pages are snapshots of various resources that I compiled from many sources. This appendix is designed to give you an idea of what is contained within the complete resource guide. Each resource provides information on how to maintain a school garden and how to take care of it seasonally. Below is the link to the complete google folder, which contains all of the sources in full. This digital folder was given to Taft Elementary staff as a resource guide to continue improving the SGP.

The resources within the folder were found and compiled by me. However, none of these sources are of my own creation. They are the work of many dedicated professionals and experts. All credits for the sources can be found in my works cited page. My intention is not to claim any of these resources as my own, but rather to provide them all in one location for ease of access for the educators who wish to use them in the development of their SGP. It has taken me many hours to compile this folder to contain these sources. As stated multiple times in this thesis, time is a major barrier to implementation of SGPs. By compiling these resources, I am reducing the amount of time that educators will need to spend searching for quality materials.

Link to the folder

https://drive.google.com/drive/folders/1oOQ6V8R4_AnDbVDE9P83W7CXWo3vqiQB?usp=sharing

Planting Guide for Oregon

OSU Extension Services, Growing Your Own (2011)

Dates for planting vegetables in Oregon

Vegetable	Start plans indoors this long before planting date	Planting dates				Amount to plant for family of four[b]	Distance between rows[c]	Distance apart in the row
		Region 1. Coast, Astoria to Brookings	Region 2. Western valleys, Portland to Roseburg[a]	Region 3. High elevations, mountains, and plateaus of central & eastern Oregon	Region 4. Columbia and Snake valleys, Hermiston, Pendleton, Ontario			
Artichokes (globe)	crown pieces	Aug.-Oct., May-June	Aug.-Nov., April-June	not suitable	not suitable	3-4 plants	48-60"	48-60"
Asparagus	1 year	March-April	Feb.-March	Feb.-March	Feb.-March	30-40 plants	60"	12"
Beans (lima)	not suitable	not suitable	May-June	May-June	April 15-June	15-25' of row	12-24"	4-6" bush, 12-24" pole
Beans (snap)	not suitable	May-June	May-July	April-June	April 15-June	15-25' of row	12-24"	2-6" bush, 12-24" pole
Beets	not suitable	March-June	March-June	April-June	March-July	10-15' of row	12"	1-2"
Broccoli	6 weeks	May-June	March-Aug.	April-June	April-July	10-20' of row	12-24"	12-24"
Brussels sprouts	6 weeks	May-June	May-July	April-June	April-July	15-20' of row	24"	24"
Cabbage	6 weeks	Jan.-April, July-Sept.	April-June	April-June	April-July	10-15 plants	24"	24"
Cantaloupes	4 weeks	not suitable	May	not suitable	May	5-10 hills	48"	48"
Carrots	not suitable	Jan.-June	March-July 15	April-June	March-July	20-30' of row	12"	2"
Cauliflower	6 weeks	Jan. & June	April-July 15	April-May	April & July	10-15 plants	24"	24"
Celery	9 weeks	March-June	March-July	May-June	June-August	20-30' of row	24"	5"
Chard	not suitable	Feb.-May	April-July	March-June	Feb.-May	3-4 plants	24"	12 inches
Chinese cabbage	4 weeks	July-Aug.	August	April-June	August	10-15' of row	30"	6"
Chives	6 weeks	April-May	March-May	April-July	Feb.-March	1 clump	Needs 4 sq ft	Scatter
Corn (sweet)	not suitable	April-May	April-June	May-June	April 15-June	4 rows, 20-30' long	36"	15"
Cucumbers (slicing)	4 weeks	April-June	May-June	May-June	April 15-June	6 plants	48"	24"
Cucumbers (pickling)	4 weeks	May	May-June	May-June	April 15-June	25' of row	48"	6-12"
Dill	not suitable	May	May	May	May	25' of row	24"	6-9"
Eggplants	9 weeks	not suitable	May	not suitable	May	4-6 plants	24"	24"
Endive	6 weeks	March-July	April-Aug. 15	April-July	August	10-15' of row	12"	10"
Garlic	not suitable	Sept.-Oct.	Sept.-Feb.	Aug.-Sept.	Nov.-Feb.	10-20' of row	18"	3"
Kale	not suitable	May-July	May-July	May-July	May-July	20-30' of row	24"	24"
Kohlrabi	not suitable	July-Aug.	April-Aug. 15	May	April-Aug.	10-15' of row	24"	3"
Leeks	not suitable	Feb.-April	March-May	April-June	Jan.-April	10' of row	24"	2"
Lettuce (head)	5 weeks	Feb.-July	April-July	April-Aug.	Feb.-April	10-15' of row	12"	12"
Lettuce (leaf)	5 weeks	Feb.-Aug.	April-Aug.	April-Aug.	Feb.-April	10-15' of row	12"	6"
Okra	8 weeks	not suitable	not suitable	not suitable	May	10-20' of row	24"	18"
Onions	10 weeks	Jan.-May	Mar.-May	May-June	Feb.-April	30-40' of row	12"	3"
Parsley	10 weeks	Dec.-May	Mar.-June	May-July	Feb.-May	1-2 plants	12"	8"
Parsnips	not suitable	May-June	April-May	May	Mar.-June	10-15' of row	24"	3"
Peas	not suitable	Jan.-Aug.	Feb.-May	April-June	Mar.-April	30-40' of row	36" bush, 48" vine	2"
Peppers	10 weeks	May	May-June	May-June	May	5-10 plants	24"	12-18"
Potatoes (sweet)	6 weeks	not suitable	not suitable	not suitable	May	50-100' of row	48"	12"
Potatoes (white)	not suitable	Feb.-May	April-June	May-June	Mar.-June	50-100' of row	30"	12"
Pumpkins	4 weeks	May	May	June	April 15-June	1-3 plants	72"	48"
Radish	not suitable	All year	March-Sept.	April-July	Mar.-Sept.	4' of row	12"	1"
Rhubarb	crown pieces	Dec.-Jan.	March-April	April	Feb.-March	2-3 plants	48"	36"
Rutabagas	not suitable	June-July	June-July	April-May	Mar.-July	10-15' of row	24"	3"
Spinach	not suitable	Aug.-Feb.	April & Sept.	April & July	Sept.-Jan.	10-20' of row	12"	3"
Squash (summer)	4 weeks	May	May-June	May-June	April 15-June	2-4 plants	48"	24"
Squash (winter)	4 weeks	May	May	May	April 15-May	2-4 plants	72"	48"
Tomatoes	8 weeks	May-June	May	May	May	10-15 plants	36-48", closer if supported	24-36"
Turnips	not suitable	Jan. & Aug.	Apr.-Sept.	April-May	Feb. & Aug.	10-15' of row	24"	2"
Watermelons	4 weeks	not suitable	May	not suitable	May	6 plants	72"	60"

[a] Medford area planting dates may be 7-10 days earlier and extend 7-10 days later than dates indicated for western valleys.
[b] For many of the crops, the amount to plant should be divided into several plantings, 1 or 2 weeks apart.
[c] Use narrower spacings for small gardens.

Monthly Planting Guide from School Garden Project of Lane County

School Garden Project of Lane County (2017)

Year Round Gardening: Monthly Planting and Garden Activities

MONTH	CROP	SOIL TEMP.	APPOX. PLANT DATE	SPACING	DEPTH	METHOD	TIME SEED TO HARVEST	NOTES
OCTOBER	Australian Field Peas	45-75		Broadcast seed		seed		Fixes Nitrogen
	Arugula	40-75	1st	4"	¼ "- ½ "	Either	4-8 weeks	Use cloche. For fall harvest
	Barley – Cover Crop	55-75	1st	Broadcast seed		seed		Helps control weeds.
	Broccoli (purple sprouting)	55-75	1st	15"	N/A	Transplant	24-32 weeks	Use Cloche. For spring harvest
	Chard	55-75	1st	10" – 12"	¾ "	transplant	4-8 weeks	Harvest through April.
	Cilantro	60-75	1st	4"	1"	Seed	4-12 weeks	Harvest continually through December
	Crimson Clover – Cover Crop	60-75	1st	Broadcast seed		Seed		Fixes Nitrogen
	Fava Beans (belle) Cover Crop	45-75	1st	2" – 3"	¾ "	seed		Fixes Nitrogen
	Garlic	40-65	15th	4"	1"-2"	Seed Cloves		Harvest in July
	Lettuce	40-75	1st	8"	¼ " – ½ "	Either	6-8 weeks	Use Cloche. For fall harvest.
	Onions	55-75	1st	3" – 5"	½"	Starts	180+ days	Harvest May-June
	Winter Wheat-Cover Crop	40-75	1st	Broadcast seed		seeds		Helps control weeds.
	Winter Peas-Cover Crop	45-75	1st	Broadcast seed		seeds		Fixes Nitrogen

OCTOBER GARDEN TASKS :

- Pull out summer crops as they finish up. Plant Cover Crops (earlier is better)
- Save seeds from the garden for next year.

OCTOBER ACTIVITIES:

- Focus on seeds. Talk about seed dispersal and save seeds from the garden.
- Look at underground plant parts and discuss the difference between annuals and perennials and their differing survival methods

SGP Curriculum Link: "Seed Dispersal" (R1F3), "Seed Saving" (R1F4), "Annuals and Perennials (R2F3)," Underground Plant Parts" (R3F2)

School Garden Friendly Crops

School Garden Project of Lane County (2017)

School Garden Friendly Crops

These 23 crops all pass the test of our garden educators as winners for school gardens! Over the years, we have refined what crops really are the best fit for a school garden setting in the Willamette Valley of Oregon. These are crops that are: fairly easy to grow, can handle a little neglect (think inconsistent watering), are culturally significant, lend themselves nicely to science exploration, support the garden ecosystem and are harvestable during school months.

Crops in blue are crops you can plant in the fall. Some of them you harvest in the fall and some in the spring. Crops in orange are crops you must plant in the late spring. They all grow over the summer and will be harvestable in the fall. Flower crops are in purple. These can all self-seed or can be planted in the spring and sometimes even in the fall.

Winter-Spring	Summer-Fall	Flowers
Kale	Cherry or currant tomatoes (Sungold is one delicious variety)	Nasturium
Radish	Lemon Cucumbers	Bachelor Buttons
Lettuce	Potatoes	Calendula
Arugula	Beans- Dry Beans (Bush) (dragon tongue, tiger eye, Orca beans and more)	Fennel
Mustard (Red Giant, Green Wave; Mizuna)	Beans- Fresh (Pole, Runner Beans or Red Yard Long)	Pansies and violas
Green onions, Garlic tops or Chives	Mini-pumpkins	Marigold
Winter Grains: oats, barley and wheat	Popcorn (Calico or Early Pink or Tom Thumb- a miniature popcorn)	Sunflowers
Broad Windsor Fava Bean		Borage

Ideas for Plant Protection in Short Season Climates

Short Season Vegetable Gardening (Robbins & Colt, 2000)

Figure 5.

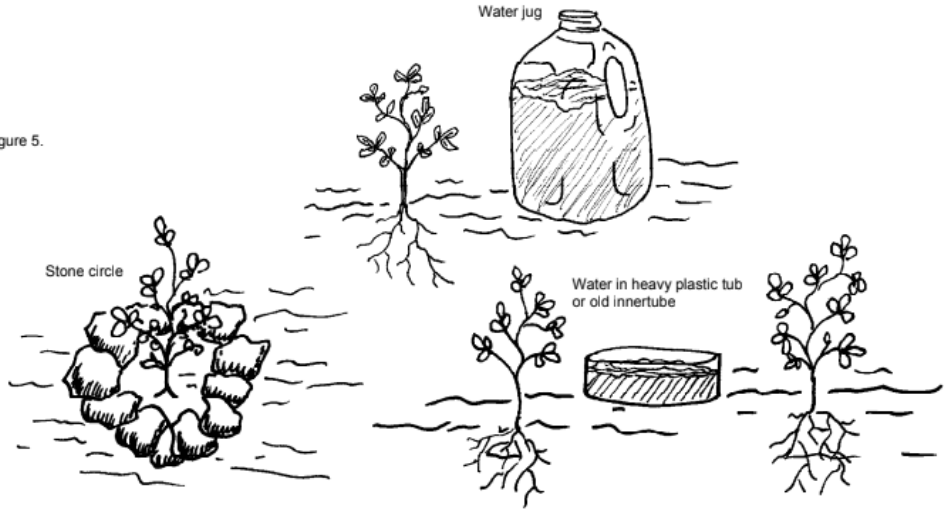
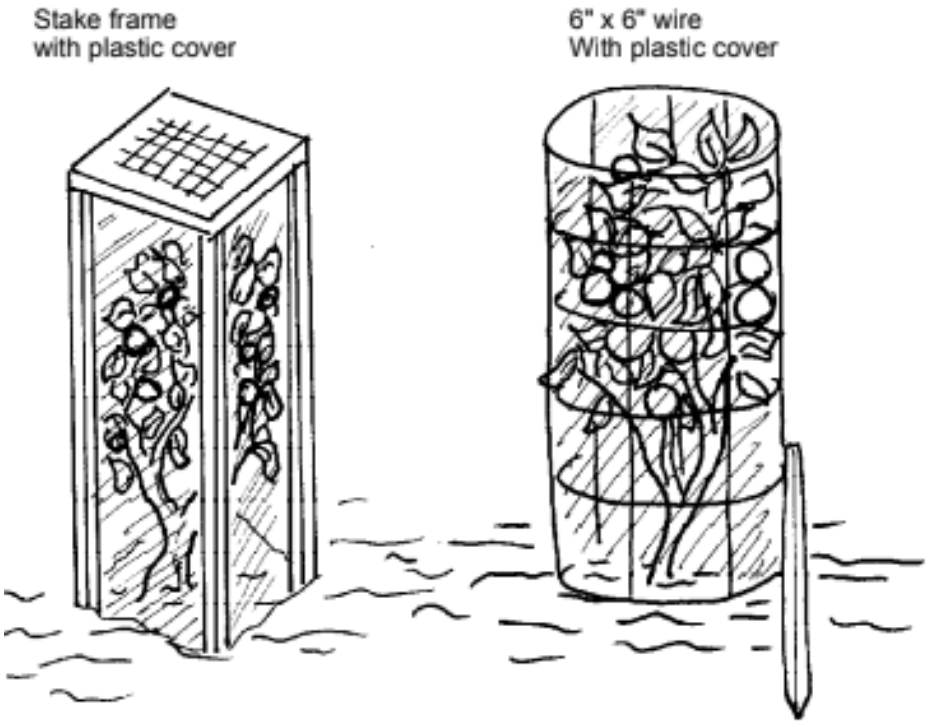


Figure 3.



Suggested Instructional Plan

Growing Success with School Gardens from School Garden Project of Lane County (2016)

school garden project

Curriculum Grid K-6th Grade

FALL				
Introduction	**Plant Parts**	**Adaptation/Diversity**	**Harvesting**	**Soil**
Rotation (Year) 1: *Session 1* Scavenger hunt	*Session 2* Plant Parts & Function	*Session 3* Seed Dispersal	*Session 4* Saving Seed	*Session 5* Soil Composition
Rotation (Year) 2: *Session 1* Garden Sketch	*Session 2* Leaves: Structure, Function & Photosynthesis	*Session 3* Annuals and Perennials	*Session 4* Food Preservation	*Session 5* Soil Building & Compost
Rotation (Year) 3: *Session 1* Exploration	*Session 2* Underground Plant Parts	*Session 3* Plant Families & Garden planning	*Session 4* Garden Art	*Session 5* Soil Nutrients & Erosion
SPRING				
Plant Needs	**Ecosystem**	**Invertebrates**	**Reproduction**	**Nutrition**
Rotation (Year) 1: *Session 1* Plant Needs & Photosynthesis	*Session 2* Garden Habitat	*Session 3* Worms	*Session 4* Flowers & Pollination	*Session 5* Colors & Diversity
Rotation (Year) 2: *Session 1* Seeds: Structure & Function	*Session 2* Organic Gardening	*Session 3* Insects	*Session 4* Weeds & Vegetative Propagation	*Session 5* Nutrients in our Bodies
Rotation (Year) 3: *Session 1* Transplant Needs & Plant Needs	*Session 2* Inquiry: Design & Implement	*Session 3* Inquiry: Food Web	*Session 4* Inquiry: Botanical Illustration	*Session 5* Inquiry: Presentations

Additional Tasks for Garden Maintenance

California School Garden Network's Gardens for Learning (Pounders, 2006)

Fall

— Plant and harvest fall vegetable crops
— Plant native and drought-tolerant plants
— Save seeds from summer-blooming annuals and perennials
— Gather leaves for composting
— Remove summer crops
— Plant spring-blooming bulbs
— Plant cover crops
— Mulch to provide protection against winter weather

Winter

— Plan the spring garden
— Force bulbs indoors
— Grow indoor plants from cuttings
— Obtain spring garden supplies
— Plant bare-root trees
— Start seeds indoors
— Prune fruit trees and perennial shrubs

Spring

— Clean out winter debris
— Prepare soil for planting
— Transplant seedlings
— Direct sow seeds
— Harvest spring vegetables

Summer

— Plant summer vegetables or prepare garden for summer break
— Schedule volunteers to help with summer care
— Keep weeds under control
— Deadhead flowers and harvest vegetables
— Collect supplies for fall garden

Appendix C - Figures

Figure 1: Instrument for measuring science knowledge from Wells et al. (2015)

Table 1. Instrument measuring knowledge of nutrition and plant science

1. People and plants need
   a. Water
   b. Food
   c. Air
   d. All of the above[a]
2. Which nutrient supplies our bodies with energy?
   a. Fiber
   b. Carbohydrates[a]
   c. Water
   d. Vitamins
3. Which part of the plant are we eating when we eat broccoli?
   a. Flower[a]
   b. Leaf
   c. Root
   d. Bulb
4. When looking at a food label, which nutrient do we want to see a lot of?
   a. Sodium
   b. Fat
   c. Calcium[a]
   d. Sugar
5. Which part of the plant uses the sun's energy to make food?
   a. Root
   b. Stem
   c. Leaf[a]
   d. Flower
6. Which item is not an ingredient used to make compost?
   a. Dried leaves
   b. Fruit and vegetable scraps
   c. Rocks[a]
   d. Water
7. Which part of the plant pulls water and other nutrients from the soil?
   a. Stem
   b. Leaf
   c. Root[a]
   d. Seed

[a]Indicates correct response.

Figure 2: Subjects taught with SGPs from Burt et al. (2017a)

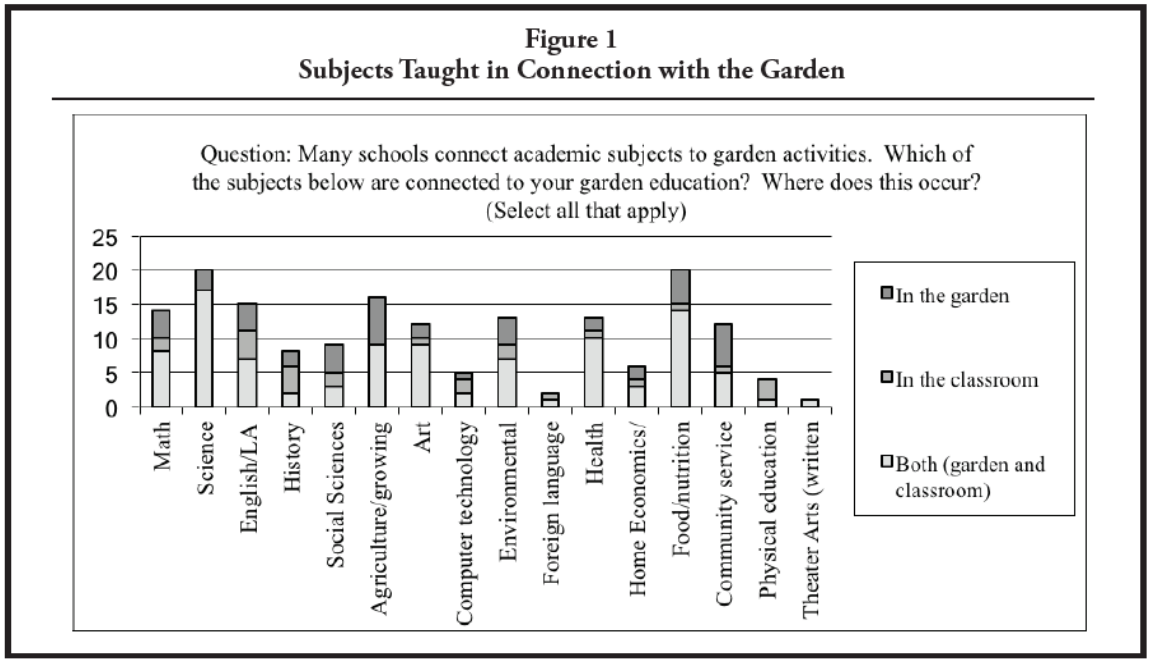


Figure 3: GREEN Tool from Burt et al. (2017b)

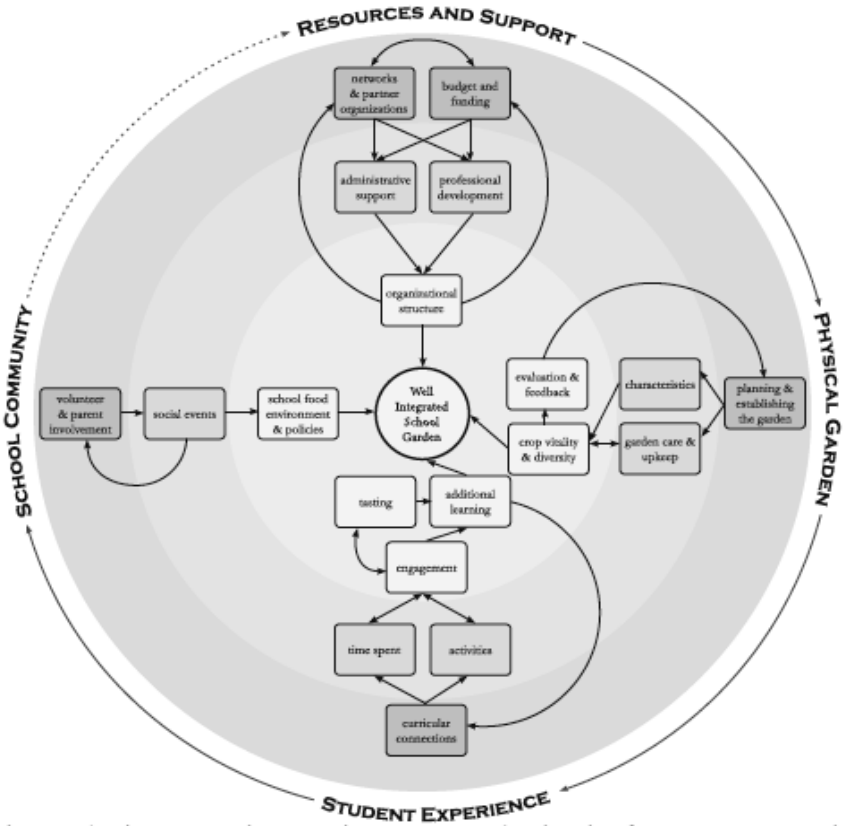


Figure 6. The GREEN (Garden Resource, Education, and Environment Nexus) Tool, resulting from surveys, interviews, observations, and concept mapping data collected from 21 participating New York City schools.

Figure 4: definitions of locale from CCD

City – Large (11): Territory inside an Urbanized Area and inside a Principal City with population of 250,000 or more.

City – Midsize (12): Territory inside an Urbanized Area and inside a Principal City with population less than 250,000 and greater than or equal to 100,000.

City – Small (13): Territory inside an Urbanized Area and inside a Principal City with population less than 100,000.

Suburban – Large (21): Territory outside a Principal City and inside an Urbanized Area with population of 250,000 or more.

Suburban – Midsize (22): Territory outside a Principal City and inside an Urbanized Area with population less than 250,000 and greater than or equal to 100,000.

Suburban – Small (23): Territory outside a Principal City and inside an Urbanized Area with population less than 100,000.

Town – Fringe (31): Territory inside an Urban Cluster that is less than or equal to 10 miles from an Urbanized Area.

Town – Distant (32): Territory inside an Urban Cluster that is more than 10 miles and less than or equal to 35 miles from an Urbanized Area.

Town – Remote (33): Territory inside an Urban Cluster that is more than 35 miles from an Urbanized Area.

Rural – Fringe (41): Census-defined rural territory that is less than or equal to 5 miles from an Urbanized Area, as well as rural territory that is less than or equal to 2.5 miles from an Urban Cluster.

Rural – Distant (42): Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an Urbanized Area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an Urban Cluster.

Rural – Remote (43): Census-defined rural territory that is more than 25 miles from an Urbanized Area and also more than 10 miles from an Urban Cluster.

Figure 5: 5 barriers that impede garden success according to review of literature by Diaz et al. (2018)

1. *Shortages of time, resources, and support* (i.e., too much additional work for teachers, lack of funding, insufficient green space, insufficient support from administrators and colleagues, lack of long-term volunteers).
2. *Inadequate skills and qualifications* (i.e., lack of confidence, expertise and experience in gardening and garden-based education).
3. *Challenges with the education sector* (i.e., challenges with large class size and dominance of performance-based pedagogy).
4. *The requirements of school curricula* (i.e., challenges identifying links to educational objectives and standards; lack of curricular support that links to academic standards).
5. *Concerns for health and safety* (i.e., issues of liability and risk management).

Figure 6: How to plan for best soil warmth from Robbins & Colt

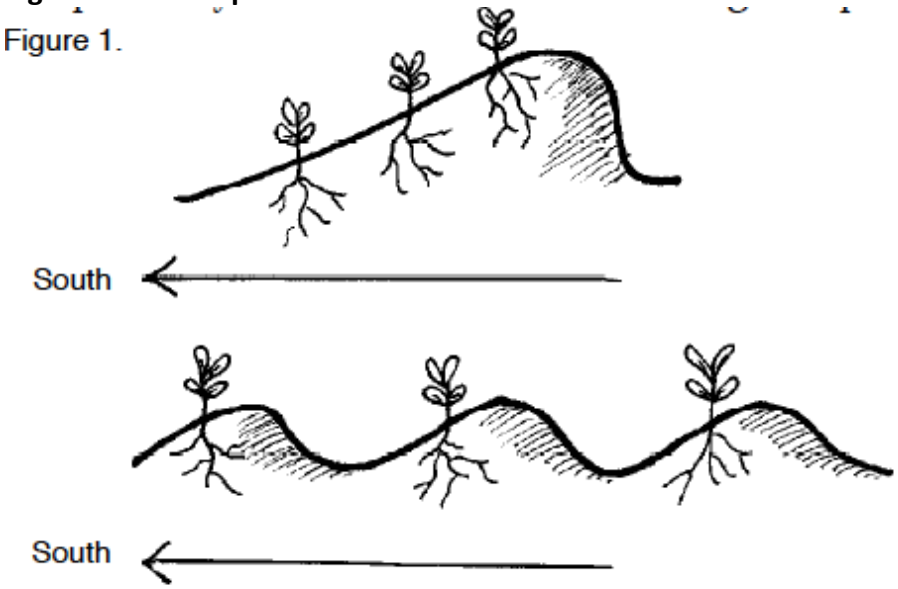


Figure 7: When to plant fall crops from OSU-ES

Number of days from seeding or transplanting outdoors to harvest
\+ Number of days from seed to transplant (if you grow your own transplants)
\+ Fall factor (about 2 weeks to account for the fact that plants grow more slowly in the cool, short days of autumn)
= Number of days to count back from first frost date

Figure 7: Images of Taft Elementary Garden - Before Implementation of SGP

Figure 8: Sample of Native Species Wishlist for Garden*

Common Name	Scientific Name	Edible?	Image
Salal	Gaultheria shallon	Yes (Berries)	
Common Juniper	Juniperus communis	No	
Red Huckleberry	Vaccinium parvifolium	Yes (Berries)	
Rhododendron	Rhododendron macrophyllum	No	
Salmonberry	Rubus spectabilis	Yes (Berries)	

*For the complete native species wish list with color images go to:
https://docs.google.com/document/d/e/2PACX-1vT3U70DT06CJZeg4FdU8Z34adTPWSnToJenthBzIRizKO77VEY1VBvtzldgr-RE1kQ_sHuPPYcdsxIp/pub

Figure 9: Monthly Garden Goals Determined by SGP Team

January		February		March	
Inventory and Waldport Garden Shed		**Garden Clean Up Day**		**Plant Salad Crops**	
To Do	**Supplies/Materials**	**To Do**	**Supplies/Materials**	**To Do**	**Supplies/Materials**
Inventory Garden	Inventory Sheets	Set a Date and Time	Shovels	Get Seeds/Starts	crop seeds/starters
Contact Waldport	Funds for Shed?	Recruit Volunteers	Rakes	Plan a day/lesson	shovels
		Ask about food	Gloves	Make a planting plan	gloves
			Yard Debris Bags		

April		May		June	
Plant Some Native Species		**STEAM Night - Possible Fundraiser**		**Create Microenvironments and/or Harvest/Eat Salad**	
To Do	**Supplies/Materials**	**To Do**	**Supplies/Materials**	**To Do**	**Supplies/Materials**
Get Seeds/Starts	crop seeds/starters	Decide craft/project?	TBD by Class	Create Microenvironment lab	2 litre bottles, plants, soils, mosses
Plan a day/lesson	shovels			Harves garden crops	bowls, sinks, forks
Make a planting plan	gloves				

Figure 10: Inventory Created by Taft Elementary Staff and Students

Taft Elementary Gardening Inventory

Item	Quantity
Plastic Trowel	34
Metal Trowel	11
Hand Garden Rake	4
Large Leaf Rake	1
Large Bow Rake	1
Large Shovel	1
Child Gardening Gloves	40 pairs
Large Green Watering Can	3
Worm Composters	2
Large Rain Catcher	1
Large Composter	1
Water Hose	1
Water Hose Nozzle	1
Garden Bed	8
Picnic Table	3
Soil	About 20 bags

Figure 11: Images of Taft Elementary at the End of SGP Project

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