Final Report

Backyard Biodiversity

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1. Abstract

As urbanization continues, critical wildlife may be lost. Residential landscapes, that are friendly to wildlife, can help protect biodiversity and advance sustainability. Urbanites who landscapes their yards to attract wildlife, can also gain greater knowledge and appreciation of nature. This project proposed an educational approach to encourage four households in the Victory Acres neighborhood in Tempe, Arizona to landscape their gardens with more than just aesthetics and food production as their goals. I developed a booklet on backyard biodiversity to provide the residents with information about the kinds of plants they could incorporate in their yards to attract pollinating species such as butterflies, bees, and birds.

It was found that the process of using the guideline to change the landscaping of their yards, changed how the residents thought about gardening and biodiversity. All residents acquired a basic understanding of how important biodiversity is and the mutual dependence between humans and their ecosystem. The booklet also included information that enabled residents to use companion planting to increase yields, attract beneficial insects, control pests, and provide access to healthy, affordable, fresh, and chemical-free produce. These efforts contributed to the project's goals of maximizing nature conservation efforts and reducing the disconnect between people and nature.

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3. Executive Summary

Introduction

Victory Acres is a neighborhood located in Tempe, Arizona where students from the Happy Hoods project are helping residents build a more sustainable community. The project, led by Dr. Scott Cloutier, focuses on promoting equal opportunities for all to pursue happiness through neighborhood design, practices, behaviors, and lifestyles that support a more sustainable future in the neighborhood. For instance, residents interest in gardening and food production led to edible landscaping and permaculture projects within Victory Acres. This provided the opportunity to tie together residents' interest in gardening with biodiversity in an urban area by using education.

Gardens designed with biodiversity in mind are vital for achieving sustainability as well as biodiversity protection through the shift in humans' perceptions and knowledge towards nature. This project proposed an educational approach to encourage residents of the Victory Acres neighborhood to landscape their gardens with more than just aesthetics and food production as their goals. The project's objective was to provide information on how to create residential landscapes that would increase ecological connectivity and habitat availability for wildlife in Tempe. To do so, an educational guideline on backyard biodiversity was developed to enhance plant and animal biodiversity in residential backyards. The booklet included information that enabled residents to use companion planting to increase yields, attract beneficial insects, control pests, and provide access to healthy, affordable, fresh, and chemical-free produce.

The sustainability challenge was to create residential urban landscapes that would support biodiversity while also meeting residents' desires to grow food and have an aesthetically pleasing landscape. An indicator of the problem was the lack of diverse plants and animals in the residential landscape, and a barrier to meeting the challenge was that residents knew little about the kinds of wildlife they could attract and how to do so. Moreover, the project's timeline did not allow for the identification of long term behavioral change. However, based on the interviews conducted, a shift in the residents' perceptions towards certain species of fauna and flora, was observed.

Methods and Interventions

I took a participatory action research approach to the project. I wanted the participants to define the problem so that I could identify a possible approach to solving it. To accomplish this, I made several visits to each of the four households the project served. These households are the same ones participating on the Happy Hoods research project. During the first visits I learned about the family's lives, their gardening practices, and what they wanted to do with their landscape. Based on what I found in the conversations, I created a survey to find out how much residents knew about biodiversity, gardening practices, ecosystem services, and social relationships in the community. Once the households had completed the survey, I used the survey results to guide me as to what I would include in the booklet. Next, I drafted the booklet for review by the residents to get their feedback. Based on the feedback, I simplified terms, added more pictures, and condensed information. Once the guideline was completed, I met with a graphic designer to help me illustrate the guide and make it appealing to the residents. The completed guideline is intended to be used by participants in the Happy Hoods project to encourage a more hands-on approach in gardening practices by providing education and raising awareness on the complexity of biodiversity within an urban area.

Outcomes/Results

The members of all four participating households reacted positively to the educational booklet despite their different backgrounds, ages, gender, and ethnicity. They were unanimously interested and excited about the project's goal. Every one of them said they planned to use the guideline to help change their landscapes to attract biodiversity.

At the beginning of the project, all four participants agreed that biodiversity was important for our ecosystem and our well-being, e.g., "Without biodiversity, Earth wouldn't exist." They also agreed that having a garden provides many benefits such as having access to food, reducing household costs, having a place in which you can relax, meditate, enjoy nature, and having access to fresh, clean produce. However, residents lacked knowledge on how to support biodiversity

through their own gardening choices, which can be addressed by the implementation of the educational guideline.

After participating in this project and learning about the relationship between biodiversity and gardening, the residents were more aware of the choices they could make when selecting vegetation. Additionally, the perception of birds, bees, and even insects shifted. It went from seeing these species as just bugs with no benefits to offer, to beings that would help make their gardening experience more pleasant by aiding in pest control and plant pollination.

The project's outcomes reflect some short-term progress in changing the perceptions and behaviors of the residents of Victory Acres. The project served as a first step towards more active backyard biodiversity conservation in the neighborhood. It provided knowledge in the form of the educational booklet and taught residents how to optimize the ecological, social, and economic values of gardening with biodiversity in mind.

Next Steps

This project on its own cannot address the challenge of increasing biodiversity in an urban area with just one neighborhood. However, it serves as a stepping stone toward greater empathy and understanding of the environment and creating a culture around human-nature interactions to stimulate conservation efforts. I do not believe there are any gaps to be filled other than to expand the project's scope in hopes of eventually creating a biological corridor between properties in Victory Acres. Due to the time limitations of the project, long term behavioral change will have to be a factor monitored by the Happy Hoods project in future research. Nonetheless, I am excited to see how my guideline is used by future residents from Victory Acres and how it can become a community educational tool on biodiversity conservation and gardening practices.

4. Introduction

A growing population is forcing humans to utilize more land for urbanization (World Health Organization, 2018). As urbanization expands, less land is available for wildlife. This has affected natural ecosystem cycles and biodiversity. In addition, modern society's fast-paced

technological consumerist lifestyle has furthered the disconnect between nature and humans (The Hartmann Report, 2012). Most individuals are aware that there is a need to reduce the negative impacts humans have on the environment. Mitigation efforts focus on eliminating the use of fossil fuels, finding new forms of sustainable energy, and/or embracing zero waste practices (G20 Germany - Business 20 Dialogue, 2017). These efforts are being undermined as there is a lack of both culture around human-nature interactions, and knowledge on how such interactions play a vital role in conservation efforts regarding biodiversity.

The Convention on Biological Diversity (CBD) has presented biodiversity as a significant asset that should be protected to guarantee human well-being. Biodiversity supports ecosystem functions which in turn provide the goods and services that humans require to sustain their lives (Navarro-Perez & Tidball, 2012). Biodiversity can be explained as the variety of life in all ecosystems on Earth; it refers to the amount of diversity between different plants, animals and other species in a given habitat at a particular time (Your Dictionary, 2017). This includes land-based, aquatic, and airborne organisms. Biodiversity is of significant importance because it enhances ecosystem productivity where each species, no matter how big or small, has an important role to play (Shah, 2014). For instance, a healthy ecosystem can be more resilient against a natural disaster; plants provide the oxygen we breathe; bees help pollinate the food we eat; insects help in controlling pests and act as the foundation for food chains that support ecosystems; and by having a more diverse pool of species, we can ensure ecological sustainability for all forms of life. Professor David Macdonald from Oxford University states that without biodiversity, there would be no future for humanity (Carrington, 2018). This statement encompasses how truly important and vital biodiversity is for the survival of Earth's inhabitants.

One of the greatest threats to biodiversity conservation according to the CBD is lack of education and awareness on biodiversity issues due to insufficient interest from the public, miscommunication from the media, and limited interaction between humans and nature. This creates the perception that these issues are not relevant to our lives (Convention on Biological Diversity, 2018). In order to address these issues, my Culminating Experience project was focused on educational efforts on backyard biodiversity conservation, for residents of Dr. Cloutier's local Sustainable Neighborhoods for Happiness (Happy Hoods) project in Victory Acres, Tempe,

Arizona. The Happy Hoods project promotes equal opportunities for all to pursue happiness through neighborhood design, and the integration of technology, practices, behaviors, and lifestyles that support a more sustainable future. Growing resident interests in gardening, food production, and traditional fruits and vegetables have led to edible landscaping and permaculture projects within Victory Acres. By designing yards that simultaneously promote happiness and sustainability, the Happy Hoods project has already begun to enhance the residents' interactions with nature, promote conservation efforts, reduce the disconnect between people and nature, and provide access to healthy foods at a relatively low cost (Cloutier, 2014). My project's goal was to build on these efforts by focusing on how yard design and education for biodiversity conservation could enhance the interactions between humans and nature. In addition, I wanted to promote the value of biodiversity for our own well-being while encouraging the residents of Victory Acres to see their gardens as a small contribution towards a greater conservation effort. I wanted to empower them to preserve and increase biodiversity via the creation of a wildlife friendly garden that would help provide food and habitats for different species in their backyards.

When considering biodiversity, most people usually think about exotic animals such as lions, rhinos, or elephants and the many places far away from home where these species exist. Conversely, we rarely think about birds, insects, butterflies, or bees and how these species are as important, if not more, to the balance of our neighborhood ecosystem. Attracting these species through gardening to increase biodiversity in the Victory Acres area was the end goal of my project. These species assist in the production of fruits and vegetables for the residents, alleviating household costs through food security while supporting healthy ecosystems. All species play a vital role in nature but, in hopes of rebuilding the lost connection between nature and humans, it is important to start by preserving the biodiversity that is right outside our door, in our yard, and in our neighborhood.

Most of our interactions with nature take place daily, especially in our neighborhoods and homes. It is through these interactions that we can learn to relate and create perceptions of the natural world. Since most of the human population resides in urban areas, urban nature was a leverage point to increase awareness of human-nature interactions for this project. I wanted to shift perceptions through conservation efforts that also promoted well-being and sustainability. Finally,

by the enhanced connection between humans and nature through this project, we could cultivate greater empathy for environmental issues and translate newly formed values into support for broader conservation policies.

5. Context

The context of the project comes from the work that was already being conducted by the Happy Hoods research team in Victory Acres. The opportunity to build on those efforts was presented to me when I was a student in the Sustainable Neighborhoods for Happiness class with Dr. Scott Cloutier. When my project first started, most of the work on improving backyards was being done in one household, and the remaining houses were just starting to become familiarized with the work from Happy Hoods by implementing slight changes in their gardens. In addition, when I interviewed some of the residents, most of them had little knowledge regarding biodiversity and sustainability and how their gardens could help with these issues. This showed me that the business as usual scenario was missing a critical component: education. This component was vital to my project because it was a tool that would not only help with achieving sustainability, but biodiversity conservation as well. By educating residents, they were given the opportunity to become better informed, change their attitudes and perceptions towards nature, and act in favor of it.

To address this issue, I thought about how to incorporate education into what was being done already in the participant households. Since I am interested in biodiversity conservation, an approach to incorporate this into backyard improvement was discussed with Dr. Scott Cloutier. We wanted the residents to be more knowledgeable and aware of the current state of biodiversity in urban areas while involving them in hands-on activities that were good for the environment and their well-being. This is how the idea of a guideline was created. It was presented as an educational tool that could serve as a manual to help current and future residents understand what biodiversity was and how to attract it to their gardens by incorporating certain types of vegetation.

6. Literature Review

As the natural environment becomes more fragmented due to the increase of urbanization, residential gardens play a significant role for biodiversity conservation in urban areas. Urbanization reduces biodiversity which in turn affects the ecosystem services humans depend on. The expansion of urban areas is a contributor to habitat loss and degradation, reduced water and nutrient availability, an increase in abiotic stressors such as air pollution, and a decrease in richness and abundance of species (Hardman, 2011). Ecosystem services are significant to the health and well-being of humans. These services can be categorized as cultural (recreational experience, education, spirituality), regulating (waste decomposition, water and air purification), supporting (nutrient recycling, soil formation), and provisioning (food, raw materials, energy). Unfortunately, due to man-made pressures, the benefits to humanity provided by these services are being compromised, especially in the form of biodiversity loss. Biodiversity decline threatens the life support system we rely on to survive, from the air we breathe to the food we eat (European Commission, 2015).

Urban space, such as residential gardens, can help mitigate this issue by acting as wildlife habitats for varied species. They can carry the potential for enhancing sustainability, ecosystem services, and most importantly biodiversity. Gardens are the primary setting for interacting with wildlife in an urban environment where a disconnect between humans and nature is common. The management of these gardens can increase the presence of pollinators and provide us with environmental and economic benefits. Pollinators are animals such as insects, birds, butterflies, and bees whose function is to fertilize plants as they play an important role in the production of the crops we eat, act as natural pest control, and help spread seeds (Beumer & Martens, 2015). Additionally, pollinators are vital indicators of a healthy ecosystem that species rely on for shelter and food.

Gardens can serve as biological corridors. This means that birds, butterflies, and other species can travel from one resident's garden to the other, creating a natural system of interconnected species. By planting native or non-native vegetation, household gardeners can help maintain the ecological character and biodiversity of an area, strengthen the native plants, animals,

and insects that still exist in the city, and provide food and shelter for native birds and other wildlife (Forest and Bird, 2005).

No matter the size, gardens can contribute to natural functions and processes in the local area, such as collecting rain water runoff (e.g. coming from roof) , buffering the damaging effects of high winds, or providing food and shelter for native wildlife (Saunders, 2016). In areas where urbanization is prominent and space is limited, one method to encourage biodiversity in the backyard is to garden with pollinators in mind. A pollinator garden is one that produces flowers for most of the year and is built on diversity. Planting a monoculture (single flower type and color) is discouraged, as it will only attract a small number of species. In addition, native plants can also be a reliable source for attracting native pollinator insects and birds. Nonetheless, garden exotics, such as herbs, vegetable plants, or fruits can also attract a variety of species. It is recommended to plant a mixture of native and non-native plants to raise the biodiversity rate; these plants can support one another's growth and increase productivity (e.g. higher yields, warding off pests). The design, type of vegetation, and the structure of a backyard will determine the type of species that will make your garden either their home or a passing through area. Either way, your garden will play an important role in biodiversity conservation.

Many of the species that inhabit our backyards, which are sometimes viewed as pests, provide services that are beneficial to the environment and humans. As an example, we have pollinators, such as wasps. As adults, they act as pollinators, but during their larvae state, they control insect pests or can decompose organic waste. Other examples are dandelions and clovers, which are thought of as lawn weeds. However, their function is to act as a food source for bees and hoverflies.

The decline in biodiversity affects natural resource availability. Currently, about 25% more natural resources than Earth can sustain are being used (WWF, 2017). As a result, our life-support systems are deteriorating since the ecosystems we depend on are managed by biodiversity. Biodiversity is responsible for the functioning of natural cycles, clean water and oxygen, crop pollination, and it aids in controlling weather events. Moreover, it provides a food source for

pollinators, which are the vital component of wildlife gardens. Every home owner can increase biodiversity in their neighborhood by creating a wildlife refuge in their gardens or backyards.

7. Methodology

To achieve the objectives of my Backyard Biodiversity project, the subsequent methodology was followed. First, I visited the Victory Acres neighborhood as part of the Sustainable Neighborhoods for Happiness class. Before diving into conducting research for my project, I wanted to become familiarized with the neighborhood, its residents, and get a sense of the work that had been previously done in the area. During the first few visits, I spoke with some of the residents to build trustworthy working relationships with them. I visited their houses, spent time with them, and learned about the different activities the Happy Hoods team was engaged in. Some of these activities included planting new trees, adding vegetables or herbs to the garden beds, designing areas throughout the garden that could be used for meditation, and installing an irrigation system.

The first interactions with the residents were casual conversations in which I was able to learn about their life situation, the current state of their yard, their current gardening practices, their interest in specific plants or vegetables, their knowledge on biodiversity, and their feelings about animals in their yard. Once I had a better understanding of the current situation, what was missing, and in what aspects I wanted to help, I developed a set of questions targeting the areas that were relevant for my project such as biodiversity, gardening practices, ecosystem services, edible planting, and community relationships. The specific interview questions for each resident are cited in Appendix A. The interviews were carried out in an informal setting, which allowed for conversation and discussion to take place, permitting me to touch on topics that could help the residents appreciate biodiversity and the role that some species play in our health, happiness, and well-being. The interview was comprised of around twenty closed-ended questions and five open-ended questions, which took me about four days to complete. Some interviews took longer than others based on the personalities of the participants and the level of interest or curiosity they had regarding the project. The sample size was comprised of the four households that were part of the

Spring 2018 Sustainable Neighborhoods for Happiness class, which consisted of two females and two males from different ethnic backgrounds, all between the ages of 26 and 67.

After the interviews were completed, I proceeded to analyze the information I had gathered. I also took into consideration the initial casual conversations, so that I could address all the findings in the educational guideline. First, I developed a draft guide that presented the possible types of vegetation that could be used to attract biodiversity to the residents' gardens and what this might look like. Most of the vegetation offered here were suggestions from the residents, making it relevant to their needs. In addition, a draft of two possible yard planting designs were shown to the two residents, whose garden projects were further along (see Appendix E). These designs were based on their individual preferences they had conveyed to me in their interviews. These yard planting designs were created by Jason Tibbets, a permaculture expert, who is one of the researchers from the Happy Hoods Project.

Once the vegetation-biodiversity draft guide was completed, I showed it to the residents to receive their feedback on it. From their feedback, I was then able to make the necessary adjustments to the final deliverable. Based on the information obtained from the interviews, I developed the other sections of the educational guideline. This included simple but concise explanations on what biodiversity is, its threats, permaculture practices, what are pollinators and why they are important, most common types of pests, and what vegetation to plant to control it. After editing the complete guideline to its final design, I met with a graphic designer to help me illustrate the guide and make it attractive to the public's eye. Currently, the guide is being worked on by the graphic designer. When it is ready, I will present it to the residents one final time to see how they react and add their thoughts to my final conclusions. So far, I have observed interest and excitement from the residents involved. One of them approached me and told me that she had installed a bird feeder in her yard and that she had already seen three hummingbirds using it. This positive response has led me to believe that the steps taken to accomplish this project were successful.

8. Findings

As a personal goal, one of the most important findings from this project was developing relationships and learning from the residents. Each day that I went to the neighborhood, my bond was strengthened with each resident, especially with the one whose house I was assigned to for the Sustainable Neighborhoods for Happiness class. We developed a meaningful relationship since we both speak Spanish, which was our main connection. She would share stories about her life and what she would want to see in her garden in the future. Another one of the residents would also come up to me every time I went to her house and share stories about her garden and show me the new things she had accomplished with the help of the Happy Hoods team. Both residents' excitement made me feel very satisfied about the accomplishment of my project.

The results of the interviews with the four residents showed little in-depth knowledge about biodiversity, conservation, ecosystem services, and the relationship between vegetation, pest control and pollinators (refer to figure 1 and 2). I believe this was due to the use of "specific scientific terms" which they were most likely not familiar with. However, once I explained what each term meant, all four of them were able to relate with the concepts and were aware in some way that nature does help the environment and that it is good for well-being. Additionally, the four residents interviewed were aware that some vegetation attracts pollinators, such as bees and butterflies, and that some of the species can also act as pest control (refer to figure 3 and 4).

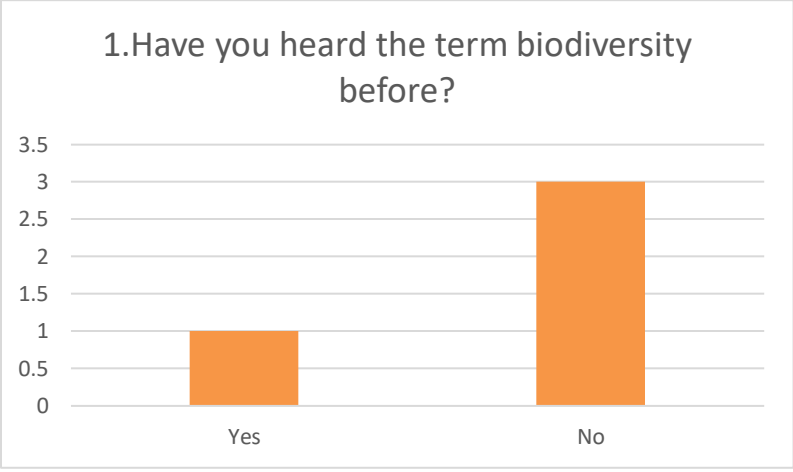


Figure 1. Results from interviews question 1 (n=4)

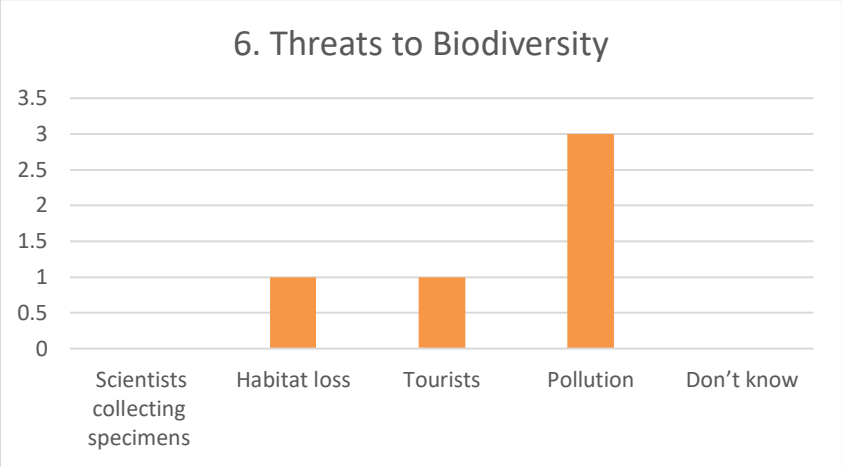


Figure 2. Results from interviews question 6 (n=4).

Residents could pick more than one threat.

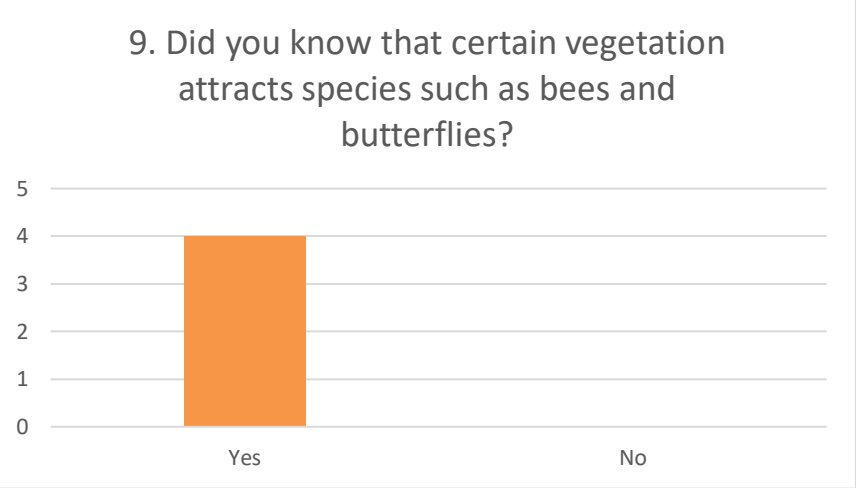


Figure 3. Results from interview question 9 (n=4)

Figure 4. Results from interviews question 10 (n=4)

Despite each resident coming from a different background, ethnicity, gender and age, they all showed interest, participation and excitement in the project's goals (refer to figure 5 and 6). For instance, one of the residents approached me and showed me that she had installed a bird feeder in her garden to attract hummingbirds. She was really excited about it and shared that every morning she would look out the window in hopes of seeing them. She mentioned that so far, she had seen three and that it was almost time to refill the feeder. In addition, she mentioned that she enjoyed spending time outside appreciating the nice weather, the peace and quiet, and looking at the birds fly by. This particular example shows a positive correlation between gardening, attracting biodiversity, and happiness and well-being.

Figure 5. Results from interviews question 27 (n=4)

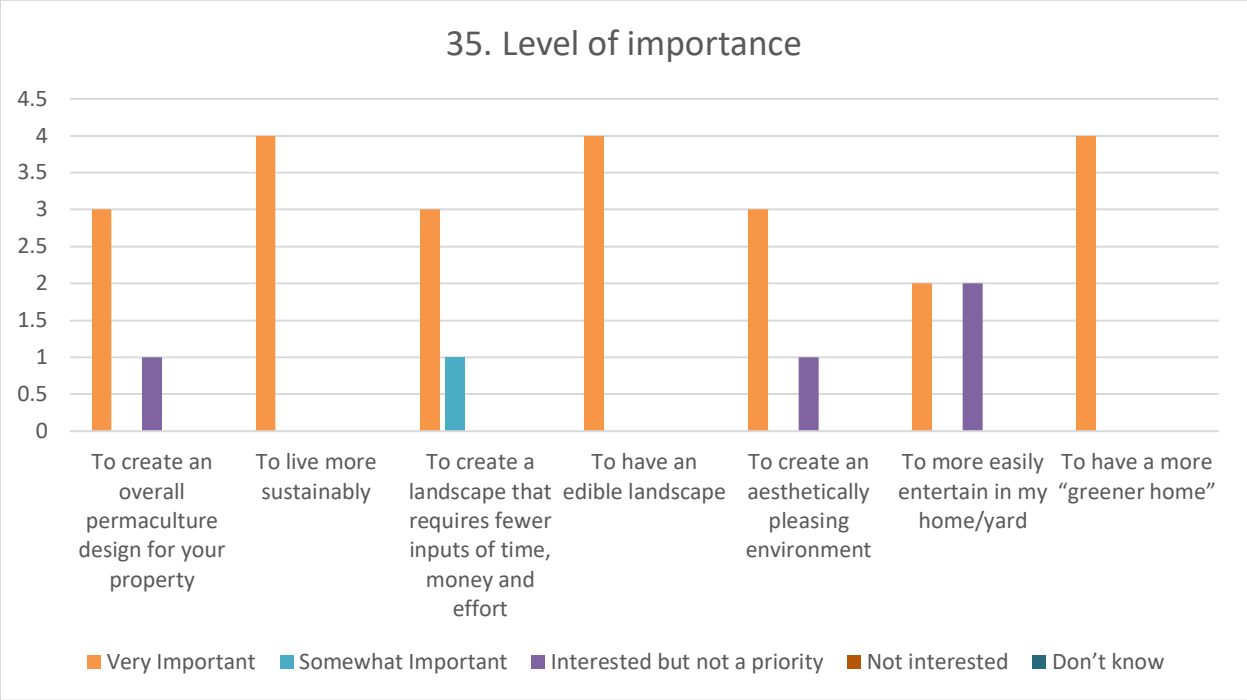


Figure 6. Results from interviews question 35 (n=4)

Furthermore, all of the residents that were interviewed agreed that biodiversity was important for our ecosystem and our well-being (refer to figure 7 and 8). For example, one resident said, "Without biodiversity, Earth wouldn't exist." Another resident stated, "No fruits, no life." These statements reflect the importance these residents attribute to how significant biodiversity and nature is for the survival of not just the Earth, but ourselves. Moreover, all four residents agreed that having a garden provides many benefits (refer to figure 9). All of them mentioned having access to food and reducing household costs as the main benefits, followed by having a place in which you can relax, meditate, and enjoy fresh and clean produce. One of the residents stated: "Having a garden gives you food, something to do, a place to meditate and a place to appreciate the animals that come to my garden." Again, these findings show the positive relationship between humans and nature and how working on a garden that is designed to attract pollinators and other species can help close the disconnect between these two.

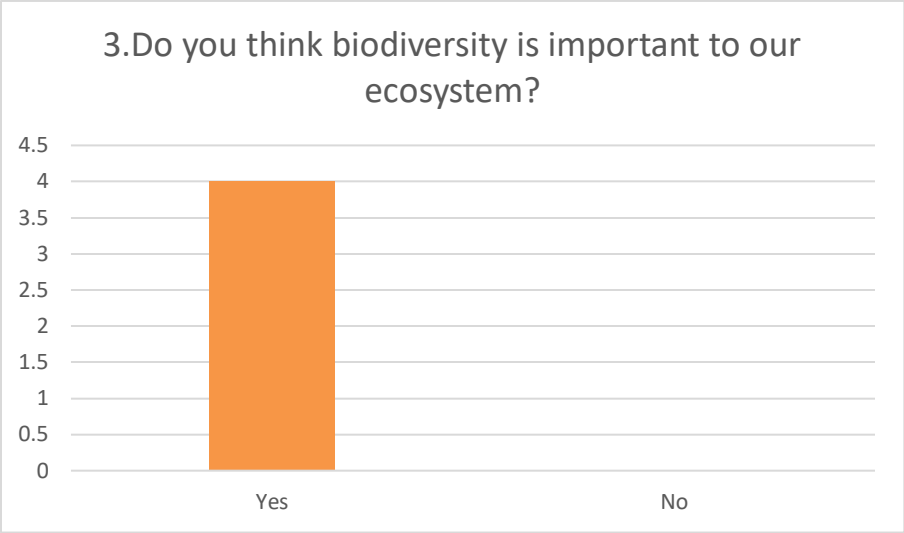


Figure 7. Results from interviews question 3 (n=4)

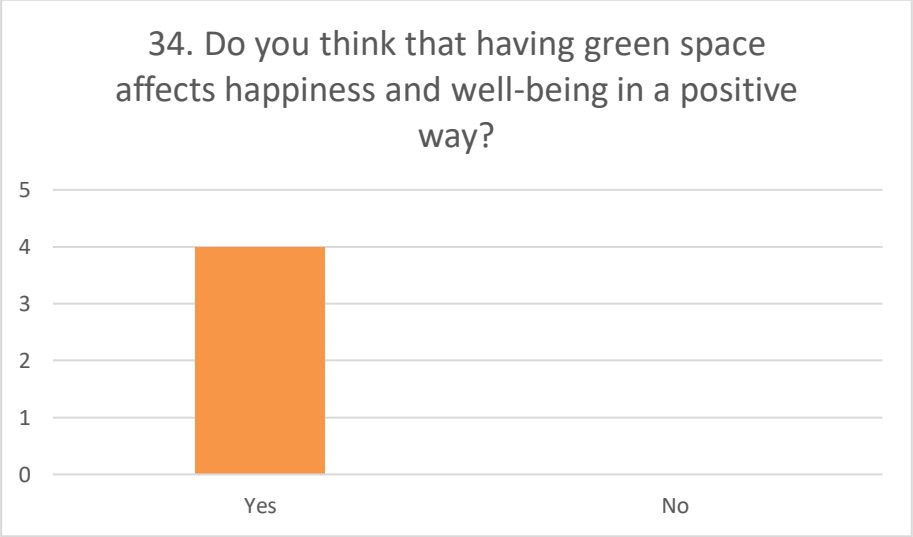


Figure 8. Results from interviews question 34 (n=4)

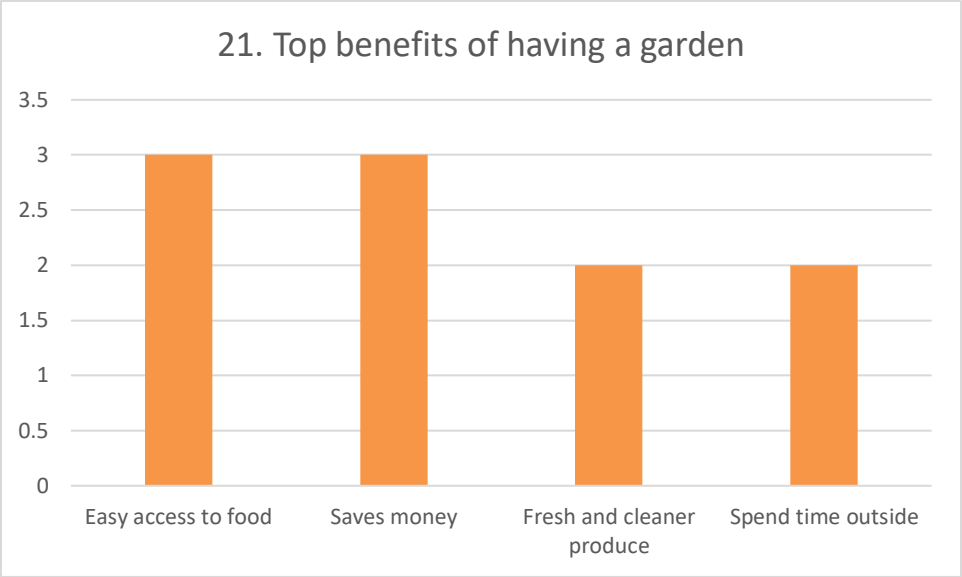


Figure 9. Results from interviews question 21 (n=4)

Even though the project does not propose a direct approach to closing the disconnect, by engaging the residents in gardening with pollinators in mind and teaching them about how their yards can be a habitat for varied species, they are already increasing human-nature connectivity and empathy. For instance, before the project, the residents thought about gardening as a way to reduce household costs and beautify their property. However, after participating on this project and learning about the relationship between biodiversity and gardening, they became more aware about the choices they would make when selecting vegetation. Additionally, the perception towards birds, bees, and even insects shifted. The perception of bugs went from species with no benefits to offer, to beings that enhance their gardening experience by providing pest control and plant pollination services.

To complete the main objective of this project, it was essential to assess whether the guideline was a successful approach in enhancing residents' knowledge on gardening with biodiversity in mind. To do so, the biodiversity guideline was presented as an educational tool to address the linkage between social and environmental issues, as well as aid in reducing the disconnect between people and nature. It was found that after exposing the residents to the information provided in the guideline, their perception on how to view these issues shifted, raising awareness on conservation issues, such as the importance of bees on the food production system

and the benefits pollinators provide to the planet and our well-being. These results can be seen below in some of the comments made by the residents after reading the final deliverable (see Appendix B for complete comments section and Appendix D for the guideline on Backyard Biodiversity). For instance, one of the residents said: "… I had never heard of companion planting, but after reading about it in the guideline, I now want to plant my vegetables, flowers and herbs in a way they can benefit and enhance each other's growth such as Marigold does for basil, eggplant, roses, kale and others… this will make gardening easier and less time consuming." Another resident stated: "… it is so exciting to know that some of the vegetation that I can plant in my garden will act as natural pest control and attract beneficial insects. I never gave much thought to insects but now I want to learn more on the subject and plant most of my vegetation following that method." These results show that the project was effective in providing a supporting environment in which behavioral change could be influenced by motivating and encouraging Victory Acres residents to be change making actors when it comes to gardening with pollinators in mind.

Additionally, the interviews also revealed as seen on question 33 and 34 (refer to figure 8 and 10) that residents believed that managing their own garden would give them access to healthy, affordable food, as well as affecting their happiness and well-being in a positive way. Having an edible garden can not only lead to economic benefits but can also lead to a resilient and healthy ecological system that generates high yields with fewer inputs and maintenance over time. It is also important to recognize that having an edible garden that produces high yields is related to the type of vegetation that is planted and the biodiversity that is around it, which helps increase this yield. Therefore, acknowledging the economic benefits from an edible garden, as the Victory Acres residents have, can incentivize them to garden with biodiversity in mind, helping reduce carbon emissions from not having to drive to the grocery store, consuming fresher and chemical free produce, and improving their well-being by soaking up their daily dose of vitamin D while reconnecting with nature.

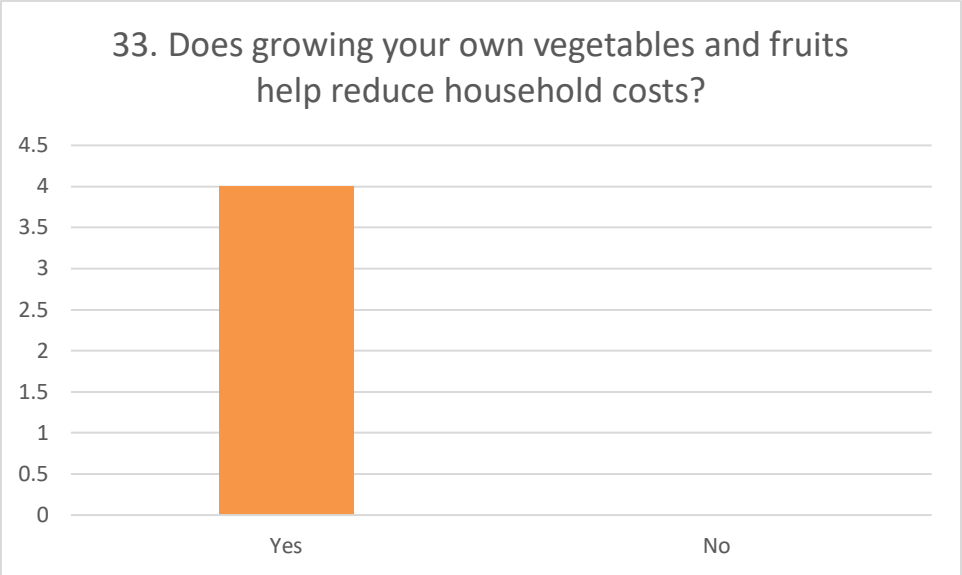


Figure 10. Results from interviews question 33 (n=4)

I also wanted to discuss the findings from the interview made to Jason Tibbets, the permaculture expert who designed the yard planting sketches and who is also a member of the Happy Hoods project team. The complete interview can be found in Appendix C. Jason addressed a critical issue -balancing the tension of increasing biodiversity while keeping species from eating what is being grown. He stated "… usually that balance falls into place after a while, in time nature will balance itself out." He followed by an example of how he had applied woodchip mulch to his parents' property. The first summer they had an enormous population of green fig beetles that took over and ate the roots of some trees. However, the following spring they had a tremendous bird population that helped with the beetle problem. This is a great example of how not intervening or not having an aggressive reaction towards something that we may consider a pest can bring benefits, in this case an increased bird population, if we wait and make educated decisions. This experience can be passed on to the residents who may come across similar issues and may not know how to handle them.

As the work of the Happy Hoods project is to increase happiness and well-being in a sustainable way by respecting the needs and desires of the residents involved in their work, it was important for my project to adhere to those same principles. So, when it was time to put together the guideline it was important to take into consideration the vegetables, herbs, fruits, and flowers

that the residents wanted in their gardens. How could we justify planting whatever the residents wanted versus what made sense regionally? To answer this, I refer to question 4 of the interview to Jason Tibbets (Appendix C). He stated: "… addressing that we are focusing on what residents want is where sustainability comes in. If we want a system to remain for a long period of time, we want to be able to have that system benefit the people that are going to be involved in it. If residents can't appreciate that system, in this case picking out their desired vegetation, then that system is going to be replaced by a less sustainable system. So, finding a middle ground is crucial for a long-term adaptation of an urban environment." This statement, in addition to interviewing and getting feedback from the residents, provided the right foundation for developing the guideline with the residents' needs in mind. It confirmed that for my project to be successful, I needed to be receptive to what the residents wanted and not try to control or redirect their suggestions. Jason also mentioned that planting non-native vegetation, in most cases, can also be used by native species. For instance, he mentioned that when we plant tomatoes, we are providing a food source for species like native carpenter bees. This shows, that sometimes we are already benefiting the existing fauna of an area while also taking into consideration the needs of humans.

Overall, the findings from this project reflect some short-term progress in changing the perceptions and behaviors of the residents of Victory Acres. It also shows how there is still room for improvement as this project serves as the first step towards future backyard biodiversity conservation in the neighborhood, focused on local expertise and knowledge, while optimizing the ecological, social, and economic value of permaculture. Additionally, it can also help encourage greater empathy and understanding of the environment at the same time as foster a culture around human-nature interactions to stimulate conservation efforts.

Finally, I was very pleased with how receptive residents were towards the educational guideline. Receiving their comments and feedback allowed me to inform my decisions moving forward and create a final deliverable that would be appealing and useful to my main audience. However, due to the time limitations of the project, long term behavioral change will have to be a factor monitored by the Happy Hoods project in future research. Nonetheless, I am excited to see

how my guideline is used by future residents from Victory Acres and how it can become a community educational tool on biodiversity conservation and gardening practices.

9. Conclusions

Based on the findings stated above, it can be said that my project provided the residents of Victory Acres with the appropriate knowledge on gardening with pollinators in mind. Overall, the residents who participated on this project seem to now have a better understanding of biodiversity, conservation efforts, how biodiversity can help with gardening practices, and how it relates to our happiness and well-being. More specifically, the educational guideline was a successful tool in teaching the residents how to design a backyard that promotes biodiversity, maximizes nature conservation efforts, reduces the disconnect between people and nature, and provides access to healthy foods at a relatively low cost.

The accomplishment of this project presented opportunities in the short and long term. In the short term, the most important opportunity was to create an educational guideline that would be presented as a tool to strengthen conservation efforts in the project area by empowering the residents to live sustainably and in harmony with nature. Education has been recognized as a vital tool to achieving biodiversity conservation and sustainability solutions through the change in humans' attitudes towards nature (Pringle & Ehrlich, 2008). It is likely that this project changed residents' thoughts about gardening through the use of the educational guideline, to the point where they now have a basic understanding of how important biodiversity is to all humans and the environment.

In the long term, the most valuable opportunity is to use this tool to aid in the continual preservation of the biodiversity that could be present in resident's backyards, as well as to continually provide education on gardening practices for the community by connecting them with their food source. Furthermore, it is hoped that, over time, this project can help build a sense of community by strengthening the relationships between the residents who can bond over food, beauty, biodiversity, and gardening at the community and individual levels.

Although the project's timeline was limited, and the sample size was small; efforts to make some sort of change don't have to be huge to make a difference. I consider making a change in just a few people, a success. With the ongoing work of the Happy Hoods project led by Dr. Scott Cloutier in the Victory Acres neighborhood, I expect for current and future residents to have an increased knowledge and awareness on biodiversity conservation and gardening practices with pollinators in mind, that would ultimately lead to long term behavioral changes.

Moreover, the project wanted to provide residents with the opportunity to respect, appreciate, coexist, and manage their properties to support native, non-native vegetation, and animals to directly boost their relations with them without trying to control them. After, talking to the residents I learned that some of them weren't fond of some species such as the woodpecker or weeds. However, learning about the benefits of gardening with pollinators in mind, as well as identifying the virtues of certain vegetation before reacting to those features that we don't like, helped direct that negative perception towards a more positive one. There is never going to be a perfect system in which everything that is around us is to our liking. Planting that seed on the mindset of the residents, allowed them to accept all species and understand that they all play an important role in our ecosystem. This portrayed a great opportunity for the project to use education to contribute to helping residents become better-informed to be able to act in favor of biodiversity. Moreover, by knowing the virtues of the plants and animals that we don't like, we can benefit from their functions and help in making more educated decisions (Tibbets, 2018).

Furthermore, based on the receptiveness of the residents, it can be concluded that some of the benefits the educational guideline can provide to the Victory Acres community are:

- Raising awareness on conservation issues.
- Raising awareness on the strong linkage between the well-being of the planet and our own well-being.
- Reducing the disconnect between humans and nature by helping them relate and change perceptions of the natural world.
- Increasing the interactions between humans and nature by having a hands-on approach to growing their own food.

- Influencing the attitudes and behaviors of the residents of Victory Acres towards gardening with pollinators in mind and creating a sense of appreciation for nature.
- Fomenting more responsible behavior towards gardening practices and biodiversity conservation. People that are better informed are more likely to value biodiversity, which makes it easier to implement conservation practices.

Likewise, the project delivered effective community education as a result of building a relationship with the residents. The creation of the educational guideline benefited from:

- Having an effective two-way street communication between the residents, other stakeholders, and the project manager.
- Involving all stakeholders, especially the residents, in all stages of the project, from the planning to the implementation.
- Providing a supportive environment in which behavioral change can be influenced.
- Supporting the already existing efforts of the Happy Hoods project and helping create new ones.
- Motivating and encouraging residents to be change maker actors.

Finally, I think it is very compelling that all four residents stated in their own way how important biodiversity was to have a healthy ecosystem and well-being. Moreover, they stated that the guideline allowed them to learn more about gardening with not just aesthetics in mind, but as an activity within their homes that can play a significant role in increasing ecological connectivity and habitat availability for wildlife within urban landscapes. This demonstrates that, in this case, the educational guideline was a successful tool in striving to reduce the disconnect between humans and nature by building on the efforts of the Happy Hoods project by providing residents access to open, natural, and green space where they can appreciate the nature that is in their own yards. Additionally, it helped increase happiness and well-being by promoting mental and physical health through nutrition, relaxation, and appreciation for the natural world found in their backyards.

10. Future Directions

It is hoped that the work done in this project will be carried on by the Happy Hoods project team. The educational guideline can be further improved to meet the needs of the growing neighborhood. In addition, to enhance its use, I would like The Happy Hoods team to host educational workshops in which the residents can be further informed on the information provided by the guide. As the work of The Happy Hoods project continues to expand and more houses join the project, the guideline can be made accessible to new residents so that their gardens can also attract biodiversity, transforming the neighborhood into a biological corridor where species can travel from one household to the other.

Moreover, I would like other students taking SOS 498- Sustainable Neighborhoods for Happiness- to continue with the goal of creating a culture of conservation in the neighborhood rooted in a newfound relationship between humans and nature. The work accomplished by this project reflects a shift in perceptions and behaviors in a short term. However, for the project to make an actual long term behavioral change, it needs to monitor the current involved residents as well as, expand its scope to future residents.

11. Appendices and Acknowledgements

Appendix A – Interview questions

Resident's name: Savanah

Interview Questions

1. Have you heard the term biodiversity before?

Yes No

2.If yes, what does biodiversity mean to you?

3.Do you think biodiversity is important for our ecosystem? Why?

Yes No

4.What are some ways that you could help to protect biodiversity?
I don't know

5.What would happen if we didn't have biodiversity?
I don't know

6.What is the most serious threat to biodiversity?
a. Scientists collecting specimens b. Habitat loss c. Tourists d. Pollution e. Don't know

7.Which of the following best describes the word "biodiversity"?
a. Endangered species b. Different kinds of planets in the solar system c. The variety of all life on earth d.Don't know

8.Do you currently see biodiversity in your garden? What do you see?
Yes No
9.Did you know that certain vegetation attracts species such as bees and butterflies?
Yes No
10.Did you know that certain species act as pests control?
Yes No
11.Have you had any negative experiences with any types of animals in your property?
Yes No --- besides ants
12.Have you heard the term ecosystem services before?
Yes No

13.Which of the following is an example of an ecosystem service?
a. A ladybug that protects your garden by eating aphid pests
b. A company that rakes people's yards
c. A wetland that filters dirty water
d. An ocean that controls the earth's climate
e. Don't know

14. Do you have a relationship with other residents? How many of your neighbors do you know?
Our neighbor, my husband has other relations with people on the street

15.What do you like about your community?
The location.

16.What do you think is the most important thing about community?
The support, circulation of ideas, next door is nice to go on there and post or see what's going on in the area

17.Do you ever help your neighbors? Do they ever help you? How?
Yes, our neighbor is an electrician, he has lots of tools that we can borrow or he will come and help – they are older people with more experience and can help us out, we aren't quite there yet.

18.Can you describe in a couple of sentences what your goals are for the property. Include "functional" goals and "benefits" you expect to gain from those functions/features (i.e. more food, more enjoyment, less work, peace and security, joy, etc.)
We want to expand off what you guys are doing, our main goal is to add more value to the property and make it more modern and more appealing.

19.Any specific challenges or problems that you really want to solve or minimize by? (Noise, privacy, drainage, maintenance, poor soil, erosion, biodiversity)
Only bad thing is that there is cement in the back patio that is sinking, besides that the house is pretty good just want to replace swamp cooling system. I would love for my kids to have a nice yard to play in and see birds and butterflies.

20.Do you have any experience with gardening?

Yes No – a little potatoes and corn,

21.What are the benefits of having a garden?

Accessibility knowing that your food is good and fresh helps save money, cut down on excessive farming and being able to spend time outside.

22.Does anyone living here have allergies (to plants, bee stings, etc.) that you're aware of

Yes No – seasonal

23.How much time do you currently spend maintaining your yard or landscape?

Right now, other people are coming and mowing the lawn because we are too busy with the baby

24.In the future, how much time would you like to spend maintaining your yard or landscape?

Maybe about ten hours a week

25.What are some of your favorite outdoor activities that you currently enjoy on your property?

When the weather is nice, I'll sit outside and enjoy coffee

26.What are some of the activities that you wish you could enjoy on your property in the future?

We plan on turning the back into an Arizona room at a low cost. Have a nice garden where I can teach my kids about nature.

27.How interested are you in growing some of your own food? Circle

Very interested – fruits/vegetables/herbs
Somewhat interested
At a "hobby garden" level only
Not at all interested

28.During which seasons of the year do you spend time in your yard?

Outdoors, fall and winter

29.Do you have favorite styles or types of gardens? Rate from 1-5. 1 being your top choice.

1 Edible Perennials (fruits, nuts, berries, etc.) 5
1 Vegetable gardens
3 Medicinal plants
3 Flower garden
2 Culinary herbs
2-3 Pollinator gardens
Other

30.If you said 'yes' to edible plantings, what varieties are you most interested in? (apple, peach, berries, nuts, etc.)

Starchy foods, potatoes yams, corn.

31.What "moods" or tones do you want your landscape to convey? Circle

Bright	Social
Meditative	Cheerful
Private	Relaxing
Playful	Ordered
Other	Welcoming

32.Do you have any particular types of plants that you really love?

Vegetation that is in for the season

33.Does growing your own vegetables and fruits help reduce household costs?

Yes No

34.Do you think that having green space affects your happiness and well-being in a positive way?

Yes No

35.Check according to your needs:

	Very Important	Somewhat Important	Interested, but not a priority	No interest	Don't Know
To create an overall permaculture design for your property.			X		
To live more sustainably	X				
To create a landscape that requires fewer inputs of time, money and effort	X				
To have an edible landscape	X				
To create an aesthetically pleasing environment			X		
To more easily entertain in my home/yard			X		
To have a more "greener home"	X				

Resident's name: Terry

Interview Questions

1.Have you heard the term biodiversity before?

Yes No

2.If yes, what does biodiversity mean to you?

3.Do you think biodiversity is important for our ecosystem? Why?

- *Yes* *No*

4.What are some ways that you could help to protect biodiversity?

I don't know. I shoo away the woodpecker because it pecks at my house.

5.What would happen if we didn't have biodiversity?

I don't know

6.What is the most serious threat to biodiversity?

a. Scientists collecting specimens b. Habitat loss c. Tourists d. Pollution

7.Which of the following best describes the word "biodiversity"?

a. Endangered species b. Different kinds of planets in the solar system c. The variety of all life on earth d. Don't know

8.Do you currently see biodiversity in your garden? What do you see?

Yes No

I hear noises from birds

9.Did you know that certain vegetation attracts species such as bees and butterflies?

Yes No

10.Did you know that certain species act as pests control?

Yes No

11.Have you had any negative experiences with any types of animals in your property?

Yes No

12.Have you heard the term ecosystem services before?

Yes No

13.Which of the following is an example of an ecosystem service?

a. A ladybug that protects your garden by eating aphid pests
b. A company that rakes people's yards
c. A wetland that filters dirty water
d. An ocean that controls the earth's climate
e. Don't know

14.Do you have a relationship with other residents? How many of your neighbors do you know?

Yes, I get along very well with many of them.

15.What do you like about your community?

They help me

16.What do you think is the most important thing about community?

Getting along

17.Do you ever help your neighbors? Do they ever help you? How?

Yes, sometimes we trade food. Once a neighbor gave me coffee grounds to use as fertilizer and I gave them radishes for their dinner.

18.Can you describe in a couple of sentences what your goals are for the property. Include "functional" goals and "benefits" you expect to gain from those functions/features (i.e. more food, more enjoyment, less work, peace and security, joy, etc.)

I want to have a beautiful garden to enjoy the nice weather and grow vegetables to cook.

19.Any specific challenges or problems that you really want to solve or minimize by? (Noise, privacy, drainage, maintenance, poor soil, erosion, biodiversity)

Birds pecking at my house

20.Do you have any experience with gardening?

Yes No

21.What are the benefits of having a garden?

It gives you food, something to do and a place to meditate.

22.Does anyone living here have allergies (to plants, bee stings, etc.) that you're aware of

Yes No

23.How much time do you currently spend maintaining your yard or landscape?

I go out to the garden every day to catch some sun and see how my plants are doing.

24.In the future, how much time would you like to spend maintaining your yard or landscape?

About the same time as I do now. Not too little not too much. I want to enjoy it**.**

25.What are some of your favorite outdoor activities that you currently enjoy on your property?

Making sure my plants are growing, enjoying the weather.

26.What are some of the activities that you wish you could enjoy on your property in the future?

Party, relax, meditate

27.How interested are you in growing some of your own food? Circle

Very interested – fruits/vegetables/herbs
Somewhat interested
At a "hobby garden" level only
Not at all interested

28. During which seasons of the year do you spend time in your yard?

Spring and Fall

29.Do you have favorite styles or types of gardens? Rate from 1-5. 1 being your top choice.

1 Edible plantings (fruits, nuts, berries, etc.)

2 Vegetable gardens

Medicinal plants

3 Flower gardens

Culinary herbs

Pollinator gardens

Other

30.If you said 'yes' to edible plantings, what varieties are you most interested in? (apple, peach, berries, nuts, etc.)

Vegetables like tomatoes, eggplant and spinach. Fruits like berries and guava

31.What "moods" or tones do you want your landscape to convey? Circle

Bright	Social
Meditative	Cheerful
Private	Relaxing
Playful	Ordered
Other	Welcoming

32.Do you have any particular types of plants that you really love?

I love all plants, especially colorful ones.

33.Does growing your own vegetables and fruits help reduce household costs?

Yes No

34.Do you think that having green space affects your happiness and well-being in a positive way?

Yes No

35.Check according to your needs:

	Very Important	Somewhat Important	Interested, but not a priority	No interest	Don't Know
To create an overall permaculture design for your property.	X				
To live more sustainably	X				
To create a landscape that requires fewer inputs of time, money and effort	X				
To have an edible landscape	X				
To create an aesthetically pleasing environment	X				

To more easily entertain in my home/yard	X				
To have a more "greener home"	X				

Resident's name: Terrance

Interview Questions

1. Have you heard the term biodiversity before?
Yes No

2. If yes, what does biodiversity mean to you?
From recycling, zero waste, to golf thing (waste management open?)

3.Do you think biodiversity is important for our ecosystem? Why?
- *Yes* *No*

50,000 species are being deleted. Cycles being affected

4.What are some ways that you could help to protect biodiversity?
Keep my up my garden so that they have a place to live.

5.What would happen if we didn't have biodiversity?
Earth wouldn't exist.

6.What is the most serious threat to biodiversity?
a. Scientists collecting specimens b. Habitat loss c. Tourists d. Pollution

7.Which of the following best describes the word "biodiversity"?
a. Endangered species b. Different kinds of planets in the solar system c. The variety of all life on earth d. Don't know

8.Do you currently see biodiversity in your garden? What do you see?
Yes No
I used to see more. I see sparrows, doves, black bird, pigeons

9.Did you know that certain vegetation attracts species such as bees and butterflies?
Yes No

10. Did you know that certain species act as pests control?
Yes No

11.Have you had any negative experiences with any types of animals in your property?
Yes No
Birds poop. Cats

12.Have you heard the term ecosystem services before?
Yes No

13. Which of the following is an example of an ecosystem service?
a. A ladybug that protects your garden by eating aphid pests
b. A company that rakes people's yards
c. A wetland that filters dirty water
d. An ocean that controls the earth's climate
e. Don't know

14.Do you have a relationship with other residents? How many of your neighbors do you know?
I try to. I have lived here over 20 years. I get along with some and not with others. There is some racism.

15.What do you like about your community?
Peace and quiet. Some neighbors landscape their yard. I don't like the lights on the front porch that are on all night.

16.What do you think is the most important thing about community?
Mind your own business and being friendly and respectful.

17.Do you ever help your neighbors? Do they ever help you? How?
Yes, Sometimes.

18. Can you describe in a couple of sentences what your goals are for the property. Include "functional" goals and "benefits" you expect to gain from those functions/features (i.e. more food, more enjoyment, less work, peace and security, joy, etc.)
I want to attract more birds like before. I am very proud of my front yard. It is my ecosystem. I would like to have more experience with gardening and install garden beds.

19. Any specific challenges or problems that you really want to solve or minimize by? (Noise, privacy, drainage, maintenance, poor soil, erosion, biodiversity)
Noise, lights, more biodiversity.

20.Do you have any experience with gardening?
Yes No
I love creating new things in my yard. I planted the first mesquite tree.

21.What are the benefits of having a garden?
Easy access to food. Learn more about gardening and animals.

22.Does anyone living here have allergies (to plants, bee stings, etc.) that you're aware of
Yes No
23.How much time do you currently spend maintaining your yard or landscape?
I try to do something every day. Go out and enjoy the sun and vitamin D.

24.In the future, how much time would you like to spend maintaining your yard or landscape?
About the same time as now. I enjoy it.

25.What are some of your favorite outdoor activities that you currently enjoy on your property?
Chilling outside, watering and trimming the plants.

26.What are some of the activities that you wish you could enjoy on your property in the future?
Relax and enjoy it with less noise.

27.How interested are you in growing some of your own food? Circle
Very interested – fruits/vegetables/herbs
Somewhat interested
At a "hobby garden" level only
Not at all interested

28.During which seasons of the year do you spend time in your yard?
When it is nice outside. Not too hot.

29.Do you have favorite styles or types of gardens? Rate from 1-5. 1 being your top choice.
1 Edible plantings (fruits, nuts, berries, etc.)
2 Vegetable gardens
Medicinal plants

Flower gardens

3 Culinary herbs

Pollinator gardens

Other

30.If you said 'yes' to edible plantings, what varieties are you most interested in? (apple, peach, berries, nuts, etc.)

Fruits and vegetables.

31.What "moods" or tones do you want your landscape to convey? Circle

Bright	Social
Meditative	Cheerful
Private	Relaxing
Playful	Ordered
Other	Welcoming

32.Do you have any particular types of plants that you really love?

Lantana, bouganville, mesquite and citrus trees, cactus.

33.Does growing your own vegetables and fruits help reduce household costs?

Yes No

34.Do you think that having green space affects your happiness and well-being in a positive way?

Yes No

35.Check according to your needs:

	Very Important	Somewhat Important	Interested, but not a priority	No interest	Don't Know
To create an overall permaculture design for your property.	X				
To live more sustainably	X				
To create a landscape that requires fewer inputs of time, money and effort		X			
To have an edible landscape	X				
To create an aesthetically pleasing environment	X				
To more easily entertain in my home/yard			X		
To have a more "greener home"			X		

Resident's name: Teresa

Interview Questions

1.Have you heard the term biodiversity before?
Yes No
2.If yes, what does biodiversity mean to you?

3.Do you think biodiversity is important for our ecosystem? Why?
- *Yes* *No*

4.What are some ways that you could help to protect biodiversity?
Taking care of plants to attract bees and birds. Not killing the animals.

5.What would happen if we didn't have biodiversity?
No fruits no life

6.What is the most serious threat to biodiversity?
a. Scientists collecting specimens b. Habitat loss c. Tourists d. Pollution

7.Which of the following best describes the word "biodiversity"?
a. Endangered species b. Different kinds of planets in the solar system c. The variety of all life on earth d. Don't know

8.Do you currently see biodiversity in your garden? What do you see?
Yes No
I see pigeons, doves, bees and sometimes butterflies.
9.Did you know that certain vegetation attracts species such as bees and butterflies?
Yes No
10.Did you know that certain species act as pests control?
Yes No
11.Have you had any negative experiences with any types of animals in your property?
Yes No
Some birds create nests
12.Have you heard the term ecosystem services before?
Yes No

13.Which of the following is an example of an ecosystem service?
a. A ladybug that protects your garden by eating aphid pests
b. A company that rakes people's yards
c. A wetland that filters dirty water
d. An ocean that controls the earth's climate
e. Don't know

14.Do you have a relationship with other residents? How many of your neighbors do you know?
Yes, a lot.

15. What do you like about your community?
Everything is close by, it is quiet and safe. The orbit is close by too.

16. What do you think is the most important thing about community?
Respect

17. Do you ever help your neighbors? Do they ever help you? How?
Yes, Sometimes when I need to lift something heavy my next door neighbor helps me.

18. Can you describe in a couple of sentences what your goals are for the property. Include "functional" goals and "benefits" you expect to gain from those functions/features (i.e. more food, more enjoyment, less work, peace and security, joy, etc.)

I want to have a food, vegetables and enjoy my garden.

19. Any specific challenges or problems that you really want to solve or minimize by? (Noise, privacy, drainage, maintenance, poor soil, erosion, biodiversity)

No

20. Do you have any experience with gardening?

Yes No

21. What are the benefits of having a garden?

Easy access to food. The food is cleaner and organic. More affordable.

22. Does anyone living here have allergies (to plants, bee stings, etc.) that you're aware of

Yes No

23. How much time do you currently spend maintaining your yard or landscape?

4 times a week to check on it.

24. In the future, how much time would you like to spend maintaining your yard or landscape?

A regular amount of time. The irrigation system should help me out.

25. What are some of your favorite outdoor activities that you currently enjoy on your property?

Watering the plants, looking at how they are growing.

26. What are some of the activities that you wish you could enjoy on your property in the future?

Relax and enjoy it. Having my grandchildren come over and play and enjoy it too.

27. How interested are you in growing some of your own food? Circle

Very interested – fruits/vegetables/herbs
Somewhat interested
At a "hobby garden" level only
Not at all interested

28. During which seasons of the year do you spend time in your yard?

When its not so hot and not so cold. Good weather.

29. Do you have favorite styles or types of gardens? Rate from 1-5. 1 being your top choice.

1 Edible plantings (fruits, nuts, berries, etc.)

2 Vegetable gardens

Medicinal plants
Flower gardens

3 Culinary herbs

Pollinator gardens
Other

30. If you said 'yes' to edible plantings, what varieties are you most interested in? (apple, peach, berries, nuts, etc.)

Guava, apples, avocado, cilantro, mulberry.

31. What "moods" or tones do you want your landscape to convey? Circle

Bright	Social
Meditative	Cheerful
Private	Relaxing
Playful	Ordered
Other	Welcoming

32. Do you have any particular types of plants that you really love?

Plants that smell good

33. Does growing your own vegetables and fruits help reduce household costs?

Yes No

34. Do you think that having green space affects your happiness and well-being in a positive way?

Yes No

35. Check according to your needs:

	Very Important	Somewhat Important	Interested, but not a priority	No interest	Don't Know
To create an overall permaculture design for your property.	X				
To live more sustainably	X				
To create a landscape that requires fewer inputs of time, money and effort	X				
To have an edible landscape	X				
To create an aesthetically pleasing environment	X				
To more easily entertain in my home/yard	X				
To have a more "greener home"	X				

Appendix B - Comments section after being exposed to the educational guideline

Comments from residents after being exposed to the educational guideline on Backyard Biodiversity

Terry

I am very grateful for all the work and effort that has been put into making my garden better. Gardening has a special place in my heart because my late husband enjoyed it, so it is nice to be able to find joy in it again. I remember my husband would talk about how important bees were for us and for the environment, so touching on this subject of planting with pollinators in mind is

very interesting to me and makes me very happy because I think of him. I never liked the woodpecker because it would peck at my house. I tried to get rid of it, but nothing worked. Through learning the importance of birds, butterflies and even insects, I realized that I shouldn't attack the woodpecker but try to leave in peace with it because it is also an important component of life, just like me. Also, I installed a red bird feeder in my garden to attract hummingbirds. I have seen three so far and I am very happy. Each morning I look out the window trying to find them, even if sometimes I can't see them, I know they are coming because the birdfeeder needs to be refilled soon.

Teresa

I don't know much about gardening, but I liked learning about all the benefits that my plants can offer. I like to cook for my family, so it is a great advantage to have most of the things I need in such close reach. I don't drive, I take the Orbit, so not having to go to the grocery store so often is very time saving. I had never heard of companion planting, but after reading about it in the guideline, I now want to plant my vegetables, flowers and herbs in a way they can benefit and enhance each other's growth such as Marigold does for basil, eggplant, roses, kale and others. This will make gardening easier and less time consuming. With the information I learned from being around the Happy Hoods team and the guideline I feel like I gain some knowledge that I didn't have before. I can now share with my grandkids when they come to visit me and take them to the garden beds and teach them about the animals that depend on them and how plants help each other.

Savanah

I don't have any experience with gardening, so it is nice to have this information to go off from. Me and my husband want to increase the value of our property and make our yard a place where our kids can play. Once I start getting more involved with gardening, I can't right now because I have a newborn, I want my older daughter to do it with me. This will be a good opportunity for her to also learn about gardening and about the animals that benefit from these plants and that also help us. She will grow up with a more environmentally conscious mindset. It is so exciting to know that some of the vegetation that I can plant in my garden will act as natural pest control and attract beneficial insects. This will help me not have to direct so much attention to the garden, especially with two kids. I never gave much thought to insects but now I want to learn more on the subject and plant most of my vegetation following that method.

Appendix C – Interview questions to Jason Tibbets

Interview Questions for Jason Tibbets

1.How do you balance the tension of increasing biodiversity and keeping native species from eating what you grow?

Usually that balance falls into place after a while. So, initially any time you introduce a specie, you are going to have a wild swing of pests and such that cause problems. But if you sit back and do more observations than aggressive reaction, you are going to see nature kind of balance itself out. In some cases, it happens quickly and it others it happens slowly. Approximately in a 2-year period you will have this balance. For example, I applied woodchip mulch to my parents' property and that summer we had an enormous population of green fig beetles that took over and ate the roots of trees, but the following summer we had a tremendous bird population that helped with that. So, given time, nature will balance itself out.

2. How can humans respect, appreciate and coexist with native species rather than trying to control them?

It is important to take every plant and try to identify its virtues before we start reacting to those features that we don't like. Most of the time we have an issue because we don't understand and appreciate the virtues, we just see them as something that doesn't mash with our human constructive paradox. For example, we want a nice clean garden, we don't want weeds, but many times those weeds are serving functions and if we identify those functions properly we might even prefer having those weeds in our garden. Some of those weeds are even more nutritious than the vegetables we are planting, or we are creating healthier soil that we don't really observe. So, knowing the virtues of those plants can really benefit and help, and that really just takes education. Helping people know and understand all the virtues of the plants can really help them make educated decisions, whether they want to remove a plant or keep it.

3. How can increasing biodiversity and biodiversity education enable appreciation and understanding of nature within the limited confines of an urban environment?

In an urban environment sometimes, we see an even greater biodiversity than we would see in a natural environment and that is a lot because of the introduced species that come with an urban environment. Some people don't take that into consideration and all they see is that there are some native species that tend to have struggling populations because of how the urban environment is structured. When we increase biodiversity and its education, we can fully understand the virtues of the plants and our urban environments may need to shift a little as far as our residential paradigm in order to adapt to those biological virtues that some plants and animals may have that we may not have an understanding of. So, increasing our understanding will increase our ability to adapt to them as much as them adapting to our urban environment.

4. How can you explain or justify the fact that we are planting whatever the residents want or whatever we think they would use vs planting only native vegetation and attracting local species? It might not make sense regionally, but we are considering the preferences of residents

So ironically a lot of the species that we plant are usable by native species, not just pushing them out so we see for example, when we plant tomatoes we are providing a food source for species like native carpenter bees. So, a lot of times when we are planting we are benefiting the existing fauna, whether we realize it or not. However, that's not always the case, so addressing that we are focusing on what residents want is where sustainability comes in. If we want a system to remain for a long period of time, we want to be able to have that system benefit the people that are going to be involved in it. If residents can't appreciate that system of picking out their desired vegetation, then that system is going to be replaced by a less sustainable system. So, finding a middle ground is crucial for a long-term adaptation of an urban environment.

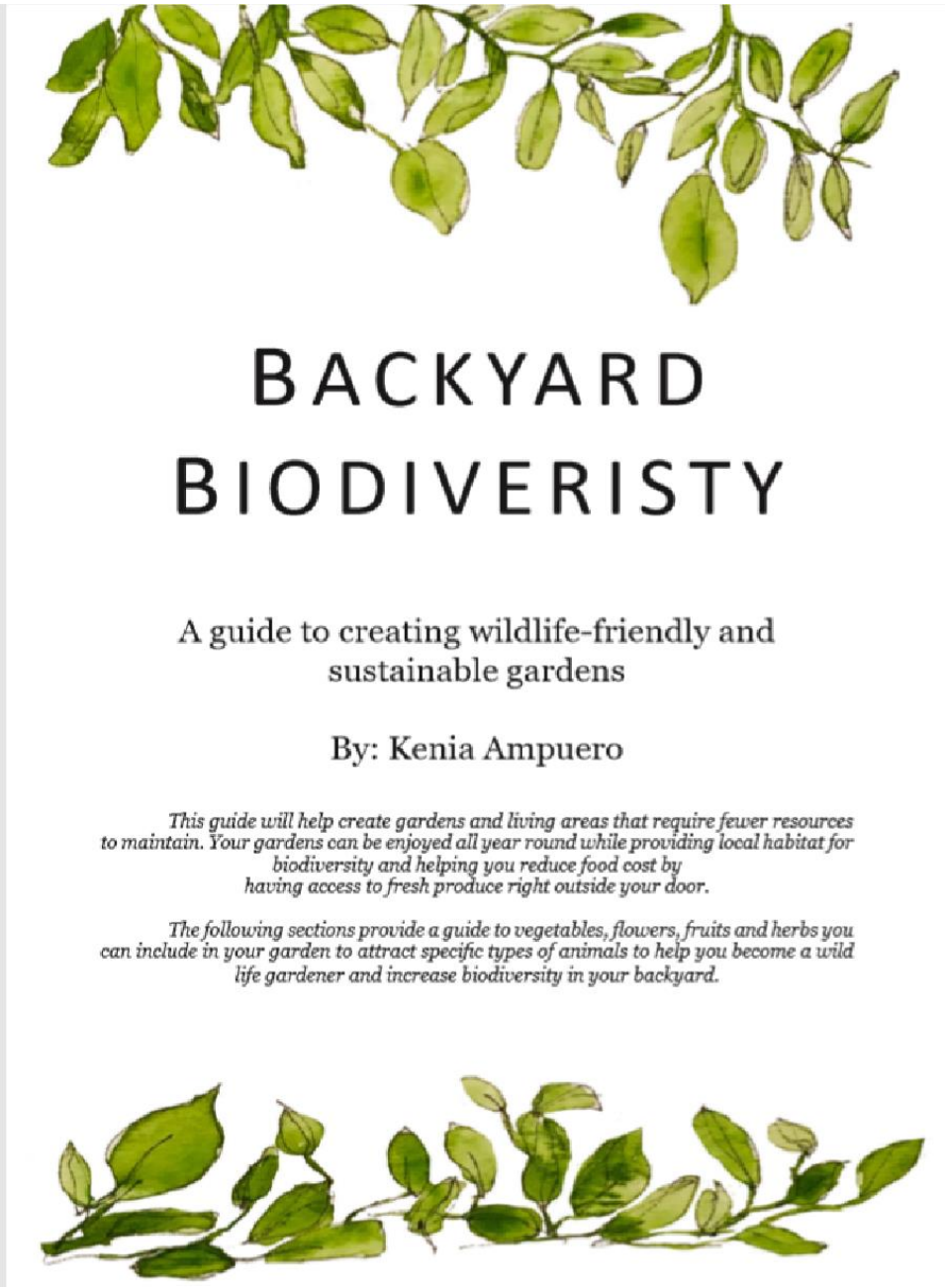
5. Do you think there is a conflict between biodiversity conservation and other goals such as desires to produce certain foods or aesthetic criteria?

There can be and there often is a conflict or a perceived conflict and I think it all goes back to recreating a system that works on a middle ground. I think that quite often simple changes in our food system or in our aesthetic system for example: substitution of plants. Instead of planting almonds we can plant native jojobas for nuts or instead of planting non-native flowers we can plant a native or at least a drought adaptive plant that could substitute and fulfill the same aesthetic function. So, there is definitely a conscious that needs to be involved there, because if there isn't we are just going to end up doing what we have always done in search of the results we try to attain. So, there must be that middle ground. There doesn't have to be a conflict with biodiversity conservation, but it requires a consciousness and so when we design we need to design w those things in mind and educate w those things in mind as well.

6. How does the work of the happy lab increase human nature connectivity and empathy?

Happiness is subjective to an individual and so the work of the happy lab is largely adapted to the individual, so the specific work of the happy lab is going to fluctuate depending on the needs of the individual: its emotional needs and its well-being needs. Happiness for each of us can fluctuate but coming to an understanding as to what we need as a person and what another person needs is important. And our connectivity with other people is going to come as we work together to identify what residents need to fulfill to their own happiness. Meet their common ground between their needs and sustainability.

Appendix D – Final Deliverable (Educational guideline on Backyard Biodiversity- sections of the guide)



BACKYARD BIODIVERISTY

A guide to creating wildlife-friendly and sustainable gardens

By: Kenia Ampuero

This guide will help create gardens and living areas that require fewer resources to maintain. Your gardens can be enjoyed all year round while providing local habitat for biodiversity and helping you reduce food cost by having access to fresh produce right outside your door.

The following sections provide a guide to vegetables, flowers, fruits and herbs you can include in your garden to attract specific types of animals to help you become a wild life gardener and increase biodiversity in your backyard.

Creating a Wildlife-Friendly Garden Supports Biodiversity

Growing vegetation in your backyard increases the beauty of your property. It also creates spaces for animals like birds, bees, butterflies and insects to live in, helping bring back biodiversity to your neighborhood.

Gardening can help you connect to nature and increases your happiness and well-being.

What is Biodiversity?

Biodiversity is all the living things around us: the different species of plants, animals and microorganisms on Earth.

Attracting Biodiversity

Why are pollinators important?

Pollinators such as bees, hummingbirds, and butterflies are vital to maintaining the health of an ecosystem and are essential for plant reproduction.
One third of the food we eat, including fruits, vegetables, nuts, grains, and beans need to be pollinated before we can eat it. Without pollinators we wouldn't have food to eat.

85% plants exists because of bees

Bees

1/3 of all food we eat depends on pollinators

Butterfly

More than 100 types of crops are pollinated by bees in U.S.-including the clover and alfalfa that feed our cows

Hummingbird

You Can Become a Wildlife Gardener Too

It is more important than ever that we do our part to protect and create habitats for insects, lizards, birds, butterflies and bees. With the right plant choices and some planning, you can start your wildlife friendly garden and support biodiversity.

Benefits of growing your own garden

- You will save money, time and fuel not driving to the grocery store.
- It's cheaper than buying food.
- Organically grown vegetable plants are much healthier and generally taste better.
- You will become more self-sufficient and less dependent on your local grocery store.
- Physical activity is good for you.

Adopt sustainable gardening practices

- Design to suit local conditions. Keep in mind the Arizona weather!
- Set aside part of your backyard for an edible garden and enjoy fresh vegetables, fruits, and herbs.
- Use water-wise plants where possible, mulching garden beds, and using tank water for watering plants when necessary.
- Avoid pesticides or chemicals.
- Recycle food and garden waste by using a compost bin.
- Use sustainable, locally sourced, or recycled materials when designing your garden. Avoid rocks, timber and pebbles collected from the wild.
- Use companion planting for pest control
- Attract beneficial insects.

Beneficial Insects That Should be Welcome In Your Garden

Lacewing Larvae
feed on aphids. Plant dill, coriander, fennel, tansy and dandelion.

Hover Flies
Feed on many insects, including leafhoppers and caterpillars. Plant daisy and chamomile and mints (spearmint, peppermint, or catnip)

Parasitoid Wasps
Feed on aphids, caterpillars and grubs. Plant fennel, angelica, coriander, dill, clovers, and rue

Ground beetles
Feed on ground-dwelling pests. Plant thyme, rosemary, mint

Ladybugs
Feed on aphids. Plant garlic, dill, cilantro, parsley, mint, chives, and marigold.

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Rosemary

This herb is a good companion plant to cabbage, beans, carrots, broccoli, and hot peppers. It serves as insect control because it repels harmful insects such as bean beetles, cabbage flies, cabbage moths and carrot flies. Rosemary needs exposure to full sun for the best growth. It develops more flavorful oils in strong sunlight than weak sunlight.

Attracts: beneficial insects, bees, hummingbirds, moths

Basil

The strong scent of basil repels many garden pests including mites, aphids, and flies.

Use it as a companion plant for tomatoes and lettuce, as it will repel pests and improve their flavor and growth.

Attracts: bees, helping tomato plants to be pollinated.

Cilantro/ Coriander

This herb can be grown so that you harvest in spring, fall, or winter.
It attracts beneficial insects, such as lacewings, ladybugs, hoverflies, and parasitic wasps that help control pests.
It is a good companion plant for tomato, spinach, basil, mint, and tansy.

Attracts: beetles, centipedes, spiders, bees, butterflies.

Spinach

This herb grows better in cool weather, so for the summer plant it where it will receive a half day of shade.
To avoid pests, some good companion plants are celery, corn, eggplant, cauliflower, and strawberries.

Attracts: beneficial insects

Pomegrante

Grown as a tree, shrub or espaliered against a wall. It requires bees for pollination so plant near herbs or flowers that attract bees, such as dill, cilantro, parsley, mint, basil, thyme, zinnias, and sunflowers.

To repel pests such as aphids, plant near flowers like nasturtium, which attract beneficial insects, such as ladybugs and lacewings.

Attracts: Songbirds, Hummingbirds, cardinals,bees

Guava

A tree that can provide shade, attractive foliage, flowers, and delicious tropical fruits. A good companion planting for this is cirtus.

Attracts: Hummingbirds, Pigeons, & Bees

Parsley

This herb does well in both full-sun and part-sun environments. Planting it nearby roses enhances their health and aroma. It attracts hoverflies and wasps, which eat pests, such as aphids, thrips, beetles, and tomato worm-horn. Good companion plant to tomato, chives, peas, onion and chili.

Attracts: Black Swallowtail caterpillar.

Thyme

A drought-tolerant herb that is pollinator-friendly. It makes a good companion plant because its flowers attract honeybees and beneficial insects. It also helps repel garden pests such as cabbage and tomato worms.

Attracts: butterflies (Black Swallow tail), insects, and bees.

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Mulberry

The tree is fast growing, animal friendly, shade producing, climatically tolerant, abundant and diverse from an edible perspective.

Attracts: Catbirds, Cardinals, Purple Grackles, Crested Flycatchers, Woodpeckers, Pigeons, Silkworks, and Insects.

Wild Sundflower

Wild sunflowers have medicinal benefits and can be used for cooking. It provides shade for less heat tolerant plants like lettuce and cucumber. Planting it near roses or tomatoes will get rid of aphids. Hummingbirds also protect the flower by eating soft-bodied insects like mosquitos and the white fly.

Attracts: insects, bees, beetles, hover fly, birds (Northern Cardinal, Lesser Goldfinch, House Finch) and hummingbirds.

Bougainvillea

Bougainvillea can be grown as a shrub or as a vine against walls or fences for decoration. It is best grown in full sun with minimal shade. Its bright colors help attract pollinating insects and hummingbirds. It also has medicinal value by helping with inflammations, sore throat, and coughing.

Attracts: Butterflies, moths and hummingbirds, which often distribute pollen to nearby plants.

Desert Hackberry

A shrubby tree with thick, leathery leaves and juicy orange berries in summer and fall that are sweet to humans and birds.

Attracts:
Birds: Northern Cardinal, Abert's Towhee, Black-tailed Gnatcacher.
Butterflies: Leilia Hackberry Butterfly, Snout butterfly.

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Appendix E – Residents landscape map

Resident: Teresa

Resident: Terry

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