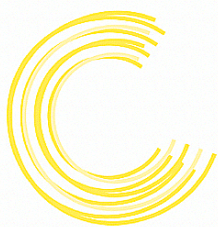


# GROWING A SCHOOL GARDEN

A guide to growing a successful Ecuadorian school garden which provides students with varied and complete nutrition



C A S T L E

# TABLE OF CONTENTS

|   |    |
|---|----|
| Preface.....                                  | 1  |
| Step 1: Determine Your Resources.....         | 2  |
| Soil Health.....                              | 2  |
| Water Supply.....                             | 3  |
| Space Constraints.....                        | 3  |
| Sloped Terrain.....                           | 3  |
| Step 2: Address Challenges in Your Space..... | 4  |
| Unhealthy Soil.....                           | 4  |
| Limited Water Supply.....                     | 5  |
| Space Constraints.....                        | 6  |
| Sloped Terrain.....                           | 6  |
| Step 3: Selecting Crops for Your School.....  | 7  |
| Vegetables.....                               | 7  |
| Fruits.....                                   | 8  |
| Grains.....                                   | 8  |
| Nutritional Information.....                  | 9  |
| Medicinal Herbs.....                          | 10 |
| Managing Pests.....                           | 11 |
| Pollinators in the Garden.....                | 12 |
| Step 4: Managing the Garden.....              | 13 |
| Management Structure.....                     | 13 |
| Engagement and Motivation.....                | 14 |
| Seed Saving.....                              | 14 |
| Summary.....                                  | 15 |
| Dedications.....                              | 15 |

# PREFACE

There are many factors to consider when making a school garden. This booklet outlines the steps necessary to create and manage a successful school garden in and around Cuenca, Ecuador.

This informational guide is sponsored by the Castle Foundation.

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**Note:** *This guide is intended as a resource to provide example solutions for the various challenges schools may face. While it is by no means exhaustive, it aims to help schools make decisions regarding garden planning.*

# STEP 1:

# DETERMINE YOUR RESOURCES

The success of a garden is only the sum of its resources. There are several factors to consider when creating a school garden. Soil, water, and space are the biggest challenges and limiting factors in creating a school garden.

## Soil Health

Soil is essential to having a successful and healthy garden. Soil provides valuable nutrients to the plants that helps them grow, without healthy soil, growing will be very challenging and frustrating. To assess your soil, there are several simple tests that serve as indicators of healthy soil.

### Test 1: Soil Organisms

Begin by digging a six inch deep hole in the soil. Observe the hole for a few minutes and take note of what kinds of organisms are present, and in what quantity. If you see ten or more, this is a strong indicator that your soil is healthy.



### Test 2: Soil Structure

Using the soil you dug out previously, break the soil apart. You should see a series of differently sized pieces of soil, healthier soil will have rounder chunks that help water and air move throughout the plant's root systems.



### Test 3: Existing Plants

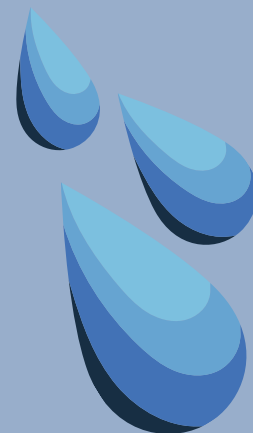
One of the greatest indicators of soil health is existing plants in the area. Find something else growing in the area like a weed and carefully dig the plant out roots and all. Healthy roots have thin white strings. Mushy brown roots indicate the soil is not draining correctly.





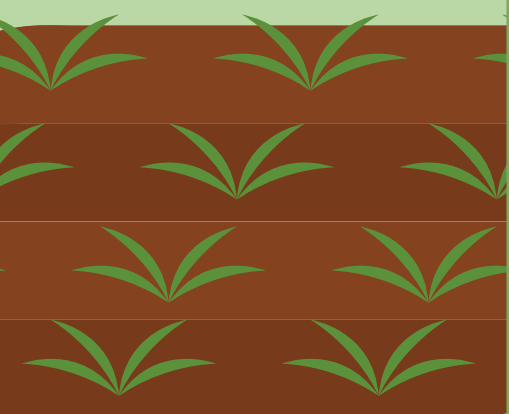
## Water Supply

Water availability is another important consideration. Plants need water to survive. Whether sourced from a pond or river, or collected from rainwater, there must be a consistent source of water to feed to the plants.



## Space Constraints

Space is the largest factor in determining what and how much you can grow. Larger plantings like trees are often not viable for small garden spaces, but surface plants like beans or root plants like carrots will be perfect.



## Sloped Terrain

Sloped garden beds can cause the soil to runoff, exposing the roots of plants to the sun and causing dehydration. Taking account of any sloped land within the garden space before planting will be very important.



Garden programs can be presented with many challenges that can make the job harder. Fortunately, there are tools and techniques that can help overcome most challenges in gardening.

# STEP 2:

# ADDRESS CHALLENGES IN YOUR SPACE

The space available to build the garden is often not perfect. There may be some flaws in the space that need to be addressed. This section is designed to guide the user through steps that can help improve the garden space.

## Unhealthy Soil

### Composting

There are many different composting methods. You can use worms, bins, or just pile compost. All of these work in similar ways to decompose organic materials and effectively insert nutrients into the soil. These nutrients bolster plant growth and health as well as increase the water retention rate of the soil.



| Composting Method     | Cost   | Materials Needed | Space Required | Time     | Labor |
|-----------------------|--------|------------------|----------------|----------|-------|
| Vermiculture          | \$\$   | ✓✓               | 🏠 🏠            | ⚙️ ⚙️    | 🧑 🧑   |
| Open Bin (One Bin)    | \$\$\$ | ✓✓✓              | 🏠 🏠            | ⚙️ ⚙️ ⚙️ | 🧑 🧑 🧑 |
| Open Bin (Three Bins) | \$\$\$ | ✓✓✓              | 🏠 🏠 🏠          | ⚙️ ⚙️    | 🧑 🧑 🧑 |
| Pit                   | \$     | ✓                | 🏠              | ⚙️ ⚙️ ⚙️ | 🧑 🧑   |
| Piling                | \$     | ✓                | 🏠 🏠 🏠          | ⚙️ ⚙️ ⚙️ | 🧑 🧑 🧑 |

*An analysis of different composting methods, with respect to cost, materials needed, space required, time to make decompose, and labor involved.*

### Crop Rotation

Different crops should be grown during each growing season. This allows the soil to regenerate nutrients that it lost while still providing other nutrients to crops currently being grown.



# Limited Water Supply

## Rainwater Catchment

One method of storing rainwater is to use a gutter system from the roof of a building to direct rainwater into a large container. By using the roof as a catchment tool, a school can bypass the expense of constructing or buying a new catchment system. This technique requires a tank that can hold large amounts of water, which is often expensive if a recycled alternative cannot be found.



Rain water Catchment at Turn Back Time in Worcester

## Drip Irrigation

In drip irrigation systems, water is applied directly to a plant's roots, reducing the evaporation which occurs when spray watering systems such as sprinklers are used. Allowing the system to only run for a select amount of time during cooler parts of the day such as the morning further aids in reducing water loss. When properly installed, drip irrigation may help gardeners save up to 50% more water than conventional watering systems. However, there are many pipes, stakes, and other parts needed to establish and maintain a successful drip irrigation system which can be very costly.

## Xeriscaping

Xeriscaping is a water-saving technique that is focused on growing native plants that need minimal water. The logic behind this is that the climate will provide all that the native plants will need to survive. It also includes the idea of grouping plants with similar water needs near each other so as no plant is being under or over watered due to its proximity to a plant with different water requirements. Even when utilizing the xeriscaping tactic a garden might still have additional water requirements beyond the natural climate.

| Water Conservation Method                  | Cost   | Materials Needed | Labor Required |
|--|--------|------------------|----------------|
| Mulching with Organic Matter               | \$     | ✓                | Ψ Ψ            |
| Xeriscape                                  | \$     | ✓                | Ψ              |
| Rainwater Catchment System - New Tank      | \$\$\$ | ✓✓✓              | Ψ Ψ Ψ          |
| Rainwater Catchment System - Recycled Tank | \$\$   | ✓✓✓              | Ψ Ψ Ψ          |
| Drip Irrigation                            | \$\$\$ | ✓✓               | Ψ Ψ Ψ          |



# Space Constraints

## Hanging Pots

Hanging pots are a great way to use even indoor space to grow plants. To do this, plant seeds in small pots and use string to hang them from a window or somewhere with sun exposure.



## Avoid Large Crops

Large crops will take up more space in the garden than other plants. If only small amounts of space are available, smaller plants should be prioritized. Information about individual plant size is available in the crop table in the pages.

# Sloped Terrain



## Flattening

Flattening the sloped terrain may be possible on a smaller scale piece of land. This would involve digging out the raised parts of the land until the entire plot of land is at the same elevation.

## Preventing Runoff

Preventing water runoff while farming on slopes is a big challenge. Mulching with organic matter is an easy and effective way to retain more water in sloped farming conditions.



# STEP 3:

# SELECTING CROPS FOR YOUR SCHOOL

Once your garden's challenges have been addressed, or you are aware of potential limitations, it is time to select crops. Crop selection is your opportunity to meet the specific needs and wants in your school's nutrition.



## Vegetables



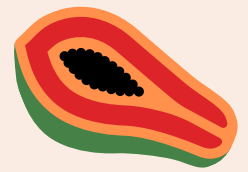
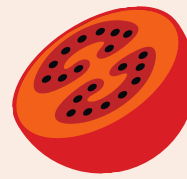
Vegetables are a big part of improving diet. They are loaded with nutrients and vitamins that work to keep your body working and healthy.

The chosen vegetables are being compared based on their nutritional value, space and water needs, as well as the time they take to grow and produce a harvest. Each category is ranked out of three, with three being the highest and one the lowest.

| Vegetable   | Nutrition Value | Space Required | Water Needed | Time     |
|-------------|-----------------|----------------|--------------|----------|
| Cabbage     | ✓✓              | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️ ☀️ ☀️ |
| Potatoes    | ✓               | 🏠 🏠            | 💧 💧          | ☀️ ☀️ ☀️ |
| Carrots     | ✓✓              | 🏠              | 💧 💧          | ☀️       |
| Broccoli    | ✓✓✓             | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️ ☀️ ☀️ |
| Kale        | ✓✓✓             | 🏠 🏠            | 💧 💧 💧        | ☀️ ☀️    |
| Peas        | ✓✓              | 🏠 🏠            | 💧 💧 💧        | ☀️ ☀️    |
| Lentils     | ✓✓              | 🏠              | 💧 💧          | ☀️ ☀️    |
| Black Beans | ✓✓✓             | 🏠 🏠            | 💧            | ☀️ ☀️ ☀️ |



# Fruits



Fruits present an opportunity to expand the traditional diet of students in Cuenca. Often fruits are not common for consumption even though they grow well in the climate. While fruits are not generally very effective based on time and space required, they produce healthy natural sugars and other vitamins as well as diversified the student diet.

| Fruit               | Nutrition Value | Space Required | Water Needed | Time     |
|---------------------|-----------------|----------------|--------------|----------|
| Uvilla              | ✓✓              | 🏠 🏠            | 💧 💧          | ☀️       |
| Naranjilla          | ✓✓              | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️ ☀️ |
| Strawberry          | ✓               | 🏠              | 💧 💧 💧        | ☀️ ☀️    |
| Tree Tomato         | ✓✓✓             | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️ ☀️ |
| Banana Passionfruit | ✓✓✓             | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️ ☀️ |
| Babaco              | ✓✓✓             | 🏠 🏠            | 💧            | ☀️ ☀️ ☀️ |

# Grains



Grains are vital for consuming nutrients that can't be obtained from fruits or vegetables. Below some native grains have been selected based on their tolerance of the climate in Cuenca. They are evaluated in the table based on the nutritional value, space needed to grow them, water requirement, and time to yield. The factors should help you make a decision on which grains are best suited to your school environment.

| Grain    | Nutrition Value | Space Required | Water Needed | Time     |
|----------|-----------------|----------------|--------------|----------|
| Quinoa   | ✓✓              | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️ ☀️    |
| Kaniwa   | ✓✓✓             | 🏠 🏠            | 💧 💧          | ☀️ ☀️ ☀️ |
| Amaranth | ✓✓✓             | 🏠              | 💧            | ☀️ ☀️    |

# NUTRITIONAL INFORMATION

| Vegetable   | Native | Protein | Fiber | Calcium | Iron | Potassium | Vitamins  | Other Nutrients                     | Food Uses                    |
|-------------|--------|---------|-------|---------|------|-----------|-----------|-------------------------------------|------------------------------|
| Broccoli    | N      | Y       | N     | Y       | Y    | Y         | A,C,D,E,K | phosphorus, zinc                    | raw, roast, steam, stir-fry  |
| Black Beans | Y      | Y       | Y     | Y       | Y    | Y         | A,C       | magnesium                           | soak                         |
| Cabbage     | N      | N       | Y     | Y       | Y    | Y         | C,K,B-6   | magnesium                           | boil, raw                    |
| Carrots     | N      | N       | Y     | Y       | Y    | Y         | A,C,K     |                                     | boil, roast, steam, stir-fry |
| Choclo      | Y      | Y       | Y     | N       | N    | N         | C         |                                     | boil, steam, roast           |
| Kale        | N      | Y       | Y     | Y       | N    | Y         | A,C,K,B-6 | copper, manganese, phosphorus, zinc | raw, roast, steam, stir-fry  |
| Lentils     | N      | Y       | Y     | Y       | Y    | Y         | N         |                                     | boil                         |
| Peas        | N      | Y       | N     | Y       | Y    | N         | A,B,C,E   | zinc                                | boil, saute                  |
| Potatoes    | Y      | N       | Y     | N       | N    | Y         | N         | magnesium                           | bake, fry, roast             |

\*Table mainly generated from: (Albert, 2009; Brennan, 2020; Zelman, 2019)

| Fruit        | Native | Protein | Fiber | Calcium | Iron | Potassium | Vitamins  | Other Nutrients                | Food Uses                      |
|--------------|--------|---------|-------|---------|------|-----------|-----------|--------------------------------|--------------------------------|
| Babaco       | Y      | Y       | Y     | Y       | Y    | Y         | A,C       | magnesium                      | cooked, juice, raw             |
| Banana       | Y      | Y       | Y     | Y       | Y    | Y         | A,C       |                                | juice, raw                     |
| Passionfruit | Y      | N       | Y     | Y       | N    | N         | C         |                                | jam, jelly, raw                |
| Uvilla       | Y      | N       | Y     | N       | N    | Y         | A,C,K,B-6 | niacin                         | cooked, jam, jelly, juice, raw |
| Naranja      | N      | N       | Y     | N       | N    | Y         | C         | manganese, healthy cholesterol | jam, jelly, raw                |
| Strawberry   | Y      | Y       | N     | Y       | Y    | Y         | A,B,C     | copper, zinc                   | jam, jelly, salsa              |

\*Table mainly generated from: (Bhargava, n.d.; Boeckmann, n.d.; England, 2020)

| Grain    | Native | Protein | Fiber | Calcium | Iron | Potassium | Vitamins | Other Nutrients   | Food Uses                 |
|----------|--------|---------|-------|---------|------|-----------|----------|---|---------------------------|
| Amaranth | Y      | Y       | Y     | Y       | Y    | N         | C        | amino acids, magnesium, manganese, phosphorus, selenium | baking, boil, dried, soup |
| Kaniwa   | Y      | Y       | Y     | Y       | Y    | N         | A,C      | amino acids, magnesium, zinc                            | baking, dried, soup       |
| Quinoa   | Y      | Y       | Y     | Y       | N    | N         | B-1      | magnesium, manganese, phosphorus                        | baking, soup              |

\*Table mainly generated from: (Carroll, n.d.; Repo-Carrasco-Valencia & Vidaurre-Ruiz, 2019; Smith, n.d.)

# Medicinal Herbs

Medicinal herbs can have many positive impacts on a garden. They can be used in teas and are used to treat many different minor ailments including infection, arthritis, and colds. Some herbs even contain trace minerals. Numerous herbs are ranked on the categories of space and water required and the time until they can be harvested.

Many of these herbs have additional uses and benefits, but these are the considerations that need to be accounted for when growing them.

| Herb                      | Space Required | Water Needed | Time     |
|---------------------------|----------------|--------------|----------|
| <b>Aloe Vera</b>          | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️ ☀️ ☀️ |
| <b>Broadleaf Plantain</b> | 🏠              | 💧 💧          | ☀️ ☀️    |
| <b>Borage</b>             | 🏠 🏠            | 💧 💧          | ☀️       |
| <b>Marigolds</b>          | 🏠 🏠            | 💧 💧 💧        | ☀️       |
| <b>Common Nettle</b>      | 🏠              | 💧 💧 💧        | ☀️ ☀️    |
| <b>Spearmint</b>          | 🏠              | 💧 💧 💧        | ☀️       |
| <b>Chamomile</b>          | 🏠 🏠            | 💧 💧 💧        | ☀️       |
| <b>Lemongrass</b>         | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️ ☀️    |
| <b>Fennel</b>             | 🏠 🏠            | 💧 💧 💧        | ☀️       |
| <b>Donkey Ear</b>         | 🏠 🏠 🏠          | 💧            | ☀️       |
| <b>Amaranth</b>           | 🏠 🏠            | 💧            | ☀️ ☀️ ☀️ |
| <b>Escancel</b>           | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️    |
| <b>Pata con Panga</b>     | 🏠 🏠            | 💧 💧          | ☀️ ☀️    |
| <b>Parsley</b>            | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️    |
| <b>Iresine</b>            | 🏠 🏠 🏠          | 💧            | ☀️ ☀️    |
| <b>Lemon Verbena</b>      | 🏠 🏠 🏠          | 💧 💧 💧        | ☀️       |
| <b>Pansies</b>            | 🏠              | 💧            | ☀️       |
| <b>Lemon Balm</b>         | 🏠              | 💧 💧          | ☀️ ☀️    |
| <b>Rue</b>                | 🏠 🏠 🏠          | 💧 💧          | ☀️       |
| <b>Mugwort</b>            | 🏠 🏠 🏠          | 💧 💧          | ☀️ ☀️    |

# Managing Pests

Pest management is an important factor in protecting the health of the garden. If provided unblocked access to a garden, birds and ground-dwelling animals like rodents may damage plants and consume the produce before it can be harvested. One prominent example is the white fly.

## Physical Deterrents

In order to prevent damage, it can be useful to put physical deterrents in place. These deterrents include fences or netting that can prevent rodents from getting into the garden, as well as scarecrows to keep birds away. One thing to note is that physical deterrents can often be costly, and therefore are not always practical for school garden applications.



## Herbal Deterrents

Use plants as deterrents by taking advantage of the odor properties of certain plants. Some potential plants of this nature include rue, mugwort, and marigolds, which grow in the Ecuadorian countryside and may be available to many schools. Using these plants as natural deterrents will also promote pollinator interaction, whereas using physical barriers might act as a pollinator deterrent.



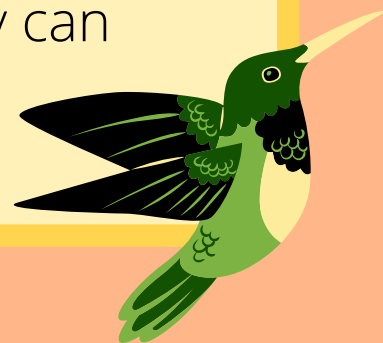
# Pollinators in the Garden

Pollinators are essential to garden life. Some plants are able to self-pollinate and create fruit without help, but this is not the case for many plants. Even for plants that can self-pollinate, with the help of pollinators their fruit is larger and healthier.



Bees, butterflies, and hummingbirds are the most common pollinators in the Cuenca region. One method of attracting these pollinators is to grow native plants as they have adapted to these plants over hundreds of years.

It can also be beneficial to leave a dish of water during hot or dry weather as they can get dehydrated as well.





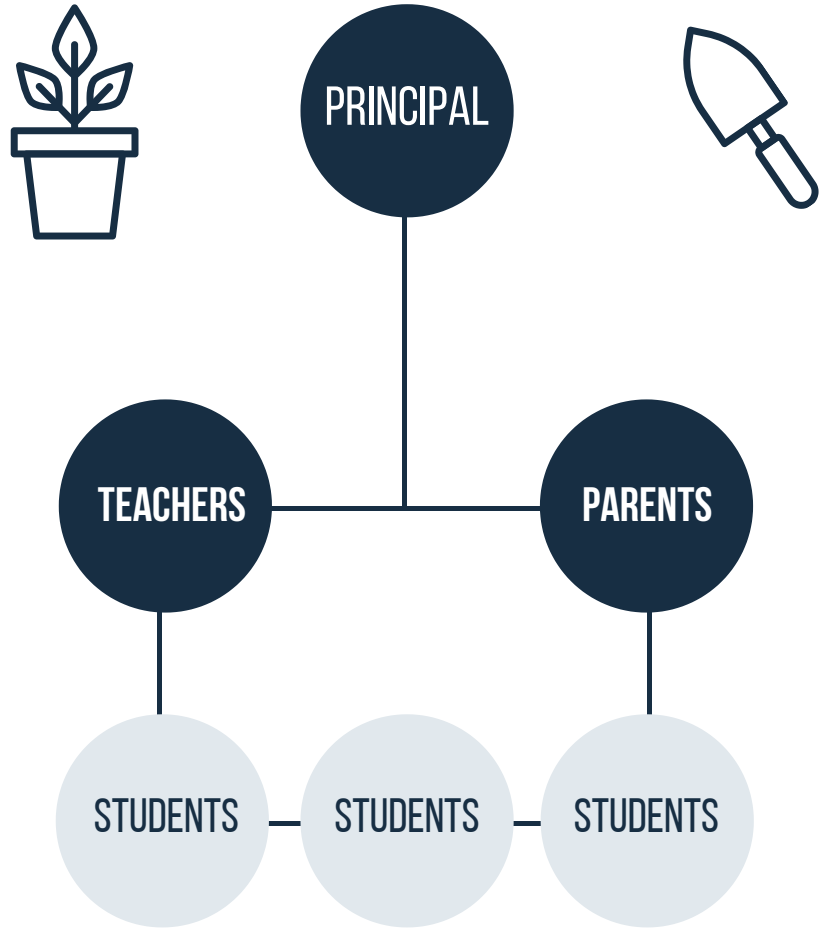
# STEP 4:

# MANAGING THE GARDEN

Garden management is the way by which a garden is organized and taken care of, it is essential to the success and sustainability of a garden. An undertaking as large as a school garden requires a team of individuals to take care of it. The major players in hosting a garden include teachers, students, community members, and parents. With all these members, there is an importance in keeping them engaged and motivated to take care of the garden.

## Management Structure

Growing a successful garden takes a lot of work! Setting up a management structure is one way to help. There are many different tasks that need to be performed either daily, weekly, or seasonally. It is important to have one or two people in charge to keep track of what has been done and what needs to be done. Delegating the work evenly will also prevent any workers from burning out. Including parents and students is also a great option.



### Different Roles:

- Team Lead - main garden coordinator, sets schedules, delegates tasks
- Team Members - assists in coordination, works more directly with students
- Students - small tasks or responsibilities based upon age group



# Engagement and Motivation



## Scheduling

Gardens are a series of cycles, grow, water, harvest, repeat. These cycles make it necessary to set schedules and stay on top of all the chores that a garden requires. Creating planting, watering, and harvesting schedules helps ensure that the garden is successful.

*The key to a successful garden is the people you surround it with, not the plants grown inside*

## Mingas

Mingas are a traditional Ecuadorian work party. These work parties gather to solve community issues and to better the community that they all live in. Schools often serve as a gathering place and a garden could enhance this social fabric.

## Seed Saving

Seed saving is more than just an aspect of culture, it is also a great way to start and continue a garden! The tradition of saving seeds can also lead to the biodiversity of plants and save money. Passing seeds down generationally provides for younger generations while also connecting them with their ancestors.

# SUMMARY



An improved and more widespread implementation of school gardens across rural Ecuador has the potential to produce a lasting impact on students. With this garden guide, teachers will be better informed in creating gardens at their schools from the ground up. This guide should help you as a basic and dependable resource and reference. Food insecurity is a burden that can last generations and lead to poverty and poor health, but by investing in students, the cycle can be broken, helping to improve our communities.

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## DEDICATIONS



Our team would like to give a special thanks to Desmion Disney and Bill O'Brien of the Castle Foundation for their guidance throughout the creation of this garden guide.