Developing a Garden-Based Curriculum for Schools in the Sierra Region of Ecuador

An Interactive Qualifying Project Report Submitted to the Faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfillment of the requirements for the Degree of Bachelor of Science

BY:
Ethan Bae
Michael Laemmle
Alison Lambert
Andrew Ventura Molina

DATE:
May 11th, 2021

PROJECT CENTER:
Cuenca, Ecuador

SUBMITTED TO:

Desmion Dizney, Bill O'Brien
Cuenca Soup Kitchen

Professors Melissa Belz and Courtney Kurlanska
Worcester Polytechnic Institute

Abstract

As Ecuador's educational system has shifted to include more active learning, some schools and organizations are interested in harnessing the power of garden-based learning. The goal of this project was to develop a garden-based curriculum for schools in the Sierra region of Ecuador. Through interviews and analyses of the Ecuadorian national curriculum and a variety of garden lesson plans, we identified the resources and needs of potential pilot organizations, the most effective garden-based approaches and methods, and possible entry points for this curriculum to be integrated into Ecuadorian schools. The culmination of this project manifested in a collection of garden-based lesson plans and activities, and a set of recommendations for schools looking to implement garden-based learning.

El Resumen

A medida que el sistema educativo ecuatoriano ha cambiado para incluir un aprendizaje más activo, algunas escuelas y organizaciones están interesadas en aprovechar el poder del aprendizaje basado en el jardín. El objetivo de este proyecto era desarrollar un plan de estudios basado en el jardín para las escuelas de la región Sierra de Ecuador. A través de entrevistas y análisis del currículo nacional ecuatoriano y una variedad de planes de lecciones de jardín, identificamos los recursos y necesidades de posibles organizaciones piloto, los métodos y enfoques basados en jardín más efectivos, y los puntos de entrada posibles para que este currículo sea integrado en las escuelas ecuatorianas. La culminación de este proyecto se manifestó en una colección de planes y actividades de lecciones basadas en el jardín, y un conjunto de recomendaciones para las escuelas que buscan implementar el aprendizaje basado en el jardín.

Executive Summary

Garden-based learning is an effective option for schools and organizations looking to further integrate active learning into their everyday classwork. The benefits of garden-based learning are vast, and often leave lasting impacts on the students, teachers, and communities. Specifically in Ecuador, where education guidelines have shifted to incorporate more hands-on approaches, there is demonstrated interest in the use of garden-based learning. However, without structured lesson plans and activities, school gardens cannot be used as effectively as an educational tool. We worked with Desmion Dizney and Bill O'Brien, two directors at the Cuenca Soup Kitchen, to address this problem. Our project goal was to develop a robust, multipurpose, and sustainable garden-based curriculum for schools in Cuenca. To achieve our goal, we identified three objectives.

> **Objective 1:** Assess the geographical context, needs, and resources of two programs that could pilot test the project.
> **Objective 2:** Explore special topics associated with garden-based learning and how they could be taught in a garden-based curriculum.
> **Objective 3:** Determine entry points for garden-based learning in the Ecuadorian national curriculum and identify lesson plans that will support those topics.

Of the 439 schools in the Azuay province (where the city of Cuenca is located), the overwhelming majority are geographically located in the Sierra region (the mountainous longitudinal interior of Ecuador). This information helped to narrow our focus onto schools located in the Sierra region, of which 219 are classified as "rural" and 220 are classified as "urban". After mapping a small sample of schools in the province, we found that urban schools often did not have the green space for a traditional garden and would need to be given alternative gardening methods to match their needs. Because schools in Cuenca are split evenly between urban and rural designations, we recognized that it was imperative for this curriculum to be inclusive of all schools in the region.

After learning about the general area and demographics of Cuenca schools, we interviewed the directors of two educational support organizations (El Arenal and CETAP-Lucy) who expressed interest in piloting a garden-based curriculum. Located in urban Cuenca, El Arenal (shown in figure A) has virtually no green space for outdoor gardening. CETAP-Lucy, on the other hand, is in a more rural location and has large plots of land adjacent to their buildings, as demonstrated in figure B. El Arenal serves about 70 children and has limited educational resources, while CETAP-Lucy serves about 35 students and has access to many traditional school supplies. Both directors highlighted that, during the COVID-19 pandemic, their organizations have become a primary source of education for many of their students. Both directors were interested in implementing a garden-based curriculum and were passionate about the benefits that it could offer their communities, particularly those related to nutrition and resilience.

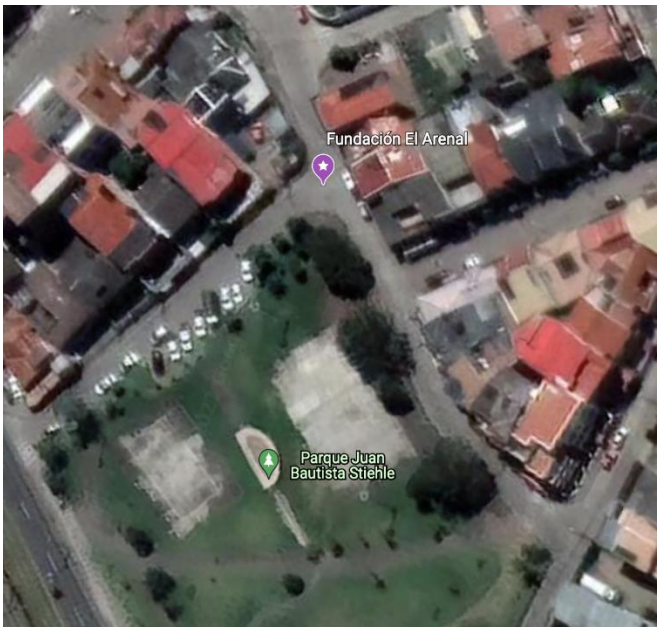

Figure A: A map of Fundación El Arenal.

Figure B: A map of CETAP-Lucy.

We analyzed how their differing locations and resources would impact the way our curriculum should be created and structured. An environmentalist we interviewed with experience building low-resource gardens suggested that we use hydroponics, raised bed gardens, or gardens created from recycled materials. We decided to include all three methods in the project because they can be used either inside or outside, and when compared to traditional gardens, save a significant amount of space and are easier and less expensive to build. These methods also give options to schools and organizations in urban areas that may not have access to much green space.

Across all our interviews, all of the educators and foundation directors agreed that children learn best from fun and engaging activities. It was clear that games, do-it-yourself (DIY) activities, and other hands-on exercises should be emphasized in a garden-based curriculum. Students need an outdoor, active component and an indoor theory component, and garden-based education should be one-part indoor lecture and discussion learning for every three parts hands-on learning. This split will help keep students engaged while also providing the necessary theory to understand the underlying processes.

We conducted a thorough content analysis of the Ministry of Education's national curriculum, in which we identified national objectives and standards in education. We found that possible entry-points of garden-based learning into the Ecuadorian curriculum are prevalent in Natural Sciences, Mathematics, Culture and Art, and Language and Literature. Within these areas, we identified certain objectives (the main learning goals in each subject) and performance criteria (the skills or learning in each subject that must be demonstrated by the students) that were relevant to potential topics and lessons. We focused on finding, adapting, and translating related lesson plans that could be matched to the specific objectives and performance criteria within

each subject area. An example of three performance criteria that could be entry points for garden-based learning is given in table A, along with activities and lesson plans that fulfill that criteria.

Table A: A table of specific elementary performance criteria that could be enhanced by a garden with corresponding activities, and their lesson plan location.

Subject Area	**Description of Performance Criteria**	**Lesson Plan**	**Example Activity**
Natural Sciences	Observe and describe the parts of the plant, explain its functions, and classify them by their stratum and use.	"Dissecting Flowers"	Flower Dissection.
Culture and Art	Observe creations using elements of the environment (land art productions, construction of musical instruments with vegetables, etc.) and comment on their characteristics.	"How to Measure Rain"	Interviewing an elder or family member about plants that they use in family recipes.
Mathematics	Measure, estimate, and compare lengths of objects in the environment, without disrupting them with unconventional measurement patterns.	"Interview an Elder"	Building a rain measurement apparatus.

To culminate our project, we created a complete set of garden-based lesson plans and activities, provided in both Spanish and English, suited to schools and organizations in the Sierra region of Ecuador. An example of one of these lesson plans is shown in figure C. We selected 42 lesson plans for inclusion in this deliverable because of their clear objectives, limited required resources, and flexibility. From this, we were able to match them to ten objectives from the national curriculum: three in Natural Sciences, three in Culture and Art, two in Language and Literature and two in Mathematics. We were also able to match these lesson plans to 39 performance criteria from the national curriculum: 13 in Natural Sciences, 11 in Culture and Art, five in Language and Literature, and ten in Mathematics. We adapted each lesson plan to match the available resources and regional and cultural significance of the pilot organizations, translated them into Spanish, and organized them by subject.

Germinación de Semillas

Una lección de Greater Richmond Fit4Kids

Duración De la lección: Tiempo de preparación (45 minutos), Lesson (1 hora), Lesson activity(30 minutos, Período de crecimiento de 7 días)

VISIÓN GENERAL Y PROPÓSITO

Los estudiantes examinarán el proceso de inicio de semillas (germinación) y su papel dentro del ciclo de vida de la planta.

NORMAS ECUATORIANAS

Ciencias Naturales: O.CN.2.1., CN.2.1.3., CN.2.1.7.

OBJECTIVOS

Los estudiantes podrán:

1. Entender la germinación de semillas.
2. ¿Qué condiciones son necesarias para que las semillas germinen correctamente? (agua/humedad, calor, medio de crecimiento, tiempo).
3. ¿Cuáles son las primeras partes vegetales que se desarrollan después de que la semilla haya comenzado a crecer? (raíces, tallo, 1er hojas o cotiledones).
4. Discutir los beneficios de un invernadero (clima controlado) para la germinación de semillas.
5. Analizar cuánto tiempo tardan las semillas en germinar y cómo diferentes plantas crecen a diferentes velocidades.

Seed Germination

Lesson Plan for Grades K-5, Social Science
Prepared by Greater Richmond Fit4Kids

Length of Lesson: Prep Time (45 mins), Lesson (1 hr), Lesson activity(30 mins, 7 day grow period)

OVERVIEW & PURPOSE

Students will examine the process of seed starting (germination) and its role within the plant life cycle.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.1, CN.2.1.3, CN.2.1.7

OBJECTIVES

Students will be able to:

1. Understand seed germination.
2. Learn what conditions are necessary for seeds to properly germinate? (water/moisture, heat, growing medium, time)
3. Learn what are the first plant parts that develop after the seed has begun to grow? (roots, stem, 1st leaves or cotyledons)
4. Discuss with students the benefits of a greenhouse (controlled climate) for seed germination
5. Discuss how long it takes seeds to germinate and how different plants grow at different rates

Figure C: An example lesson plan from the deliverable in both Spanish and English.

Along with this document, we have provided a brief set of suggestions for schools and foundations in Ecuador who are interested in implementing and sustaining a garden-based curriculum or approach. These recommendations are as follows:

1. Appoint a garden manager.
2. Collaborate with other garden organizations and experts for long-term support.
3. Adapt the content and structure of the curriculum when needed.
4. Focus on implementing active learning activities.

Garden managers provide structure to the garden and fill an administrative role, ensuring that the garden is maintained and running efficiently. Long-term support, access to garden resources, and sustainability are key to any garden's success. We encourage teachers and administrators implementing this project to adapt the lessons and structure as they see fit, while still emphasizing the importance of the active learning approach. Not everything will work in every classroom, so by embracing the adaptability of the curriculum, most educators can make full use of the content. Finally, students' curiosity and interest in the subject material grows exponentially when they can get hands on with what they are learning. By following these recommendations and taking full advantage of the lessons and activities contained in the deliverable, we hope that schools and organizations in Ecuador will reap the full benefits of garden-based learning.

El Informe Ejecutivo

El aprendizaje basado en los jardines es en una opción eficaz para las escuelas y organizaciones que buscan integrar aún más el aprendizaje activo en su clase diaria. Los beneficios del aprendizaje basado en el jardín son enormes y a menudo dejan impactos duraderos en los estudiantes, maestros y comunidades. Específicamente en Ecuador, donde las directrices de educación han cambiado para incorporar más enfoques prácticos, se ha demostrado interés en el uso del aprendizaje basado en los jardines. Sin embargo, sin planes y actividades estructurados de la lección, los jardines escolares no pueden ser utilizados tan eficazmente como una herramienta educativa. Trabajamos con Desmion Dizney y Bill O'Brien, dos directores del comedor popular de Cuenca, para abordar este problema. Nuestra meta del proyecto fue desarrollar un currículo robusto, polivalente y sostenible basado en jardines para las escuelas de Cuenca. Para lograr nuestra meta, identificamos tres objetivos.

> **Objetivo 1:** Evaluar el contexto geográfico, las necesidades y los recursos de dos programas que podrían probar el proyecto.
> **Objetivo 2:** Explorar temas especiales asociados con el aprendizaje basado en el jardín y cómo se podrían enseñar en un plan de estudios basado en el jardín.
> **Objetivo 3:** Determinar los puntos de entrada para el aprendizaje basado en el jardín en el currículo nacional ecuatoriano e identificar planes de lecciones que apoyen esos temas.

De las 439 escuelas de la provincia de Azuay (donde se encuentra la ciudad de Cuenca), la inmensa mayoría se encuentran geográficamente en la región de la Sierra (el interior longitudinal montañoso del Ecuador). Esta información ayudó a reducir nuestro enfoque en las escuelas ubicadas en la región de Sierra, de las cuales 219 están clasificadas como "rurales" y 220 están clasificadas como "urbanas". Después de trazar un mapa de una pequeña muestra de escuelas en la provincia, encontramos que las escuelas urbanas a menudo no tenían el espacio verde para un jardín tradicional y que tendrían que recibir métodos alternativos de jardinería para satisfacer sus necesidades. Debido a que las escuelas de Cuenca están divididas uniformemente entre las designaciones urbanas y rurales, reconocemos que era imperativo que este plan de estudios incluyese a todas las escuelas de la región.

Después de conocer el área general y la demografía de las escuelas de Cuenca, entrevistamos a los directores de dos organizaciones de apoyo educativo (El Arenal y CETAP-Lucy) que expresaron interés en pilotar un currículo basado en jardín. Ubicado en la ciudad de Cuenca, El Arenal (mostrado en la figura A) prácticamente no tiene espacio verde para la jardinería al aire libre. CETAP-Lucy, por otra parte, se encuentra en un lugar más rural y tiene grandes parcelas de tierra adyacentes a sus edificios, como se muestra en la figura B. El Arenal sirve a unos 70 niños y tiene recursos educativos limitados, mientras que CETAP-Lucy sirve a unos 35 estudiantes y tiene acceso a muchos materiales escolares tradicionales. Ambos directores destacaron que, durante la pandemia de COVID-19, sus organizaciones se han convertido en una fuente primaria de educación para muchos de sus estudiantes. Ambos directores demostraron

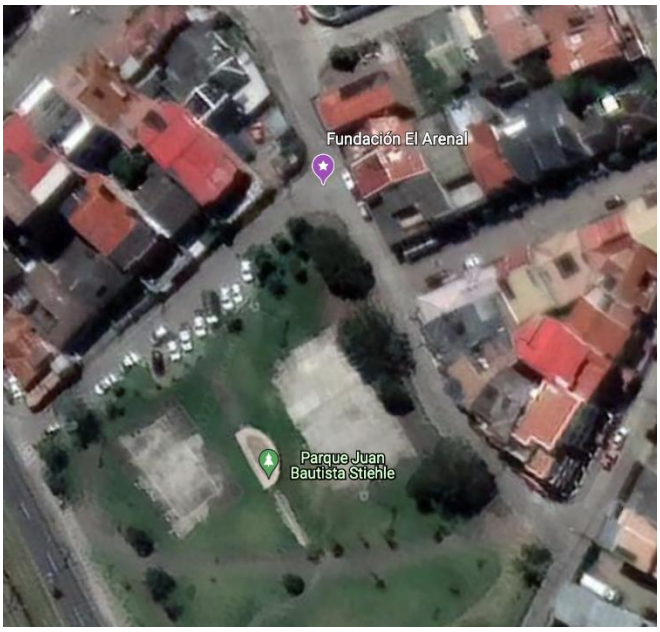

Figura A: Un mapa de Fundación El Arenal.

Figura B: Un mapa de CETAP-Lucy.

interés en implementar un plan de estudios basado en jardines y se mostraron apasionados por los beneficios que podría ofrecer a sus comunidades, particularmente aquellos relacionados con la nutrición y la resiliencia.

Analizamos cómo sus diferentes ubicaciones y recursos impactarían en la forma en que nuestro plan de estudios debe ser creado y estructurado. Así, entrevistó a un ambientalista con experiencia en la construcción de jardines de bajos recursos, y ella sugirió que usemos hidropónicos, jardines de cama elevada, o jardines creados a partir de materiales reciclados. Decidimos incluir los tres métodos en el proyecto porque pueden ser utilizados dentro o fuera, y cuando se comparan con jardines tradicionales, ahorrar una cantidad significativa de espacio y son más fáciles y menos costosos de construir. Estos métodos también dan opciones a escuelas y organizaciones en áreas urbanas que pueden no tener acceso a mucho espacio verde.

A través de todas nuestras entrevistas, todos los educadores y directores de fundaciones estuvieron de acuerdo en que los niños aprenden mejor de actividades divertidas y atractivas. Era claro que los juegos, las actividades de hacer-él-se, y otros ejercicios prácticos deben ser enfatizados en un plan de estudios basado en jardín. Los estudiantes necesitan un componente activo al aire libre y un componente de teoría interior, y la educación basada en jardín debe ser una parte de aprendizaje de conferencias y discusiones interiores para cada tres partes de aprendizaje basado en actividades al aire libre. Esta división ayudará a mantener a los estudiantes comprometidos mientras también provee la teoría necesaria para entender los procesos subyacentes.

Realizamos un análisis exhaustivo del contenido del plan de estudios nacional del Ministerio de Educación, disponible públicamente, en el que identificamos objetivos y normas nacionales en materia de educación. Encontramos que los posibles puntos de entrada del aprendizaje basado en jardín en el currículo ecuatoriano son prevalentes en Ciencias Naturales, Matemáticas, Cultura y Arte, y Lenguaje y Literatura. Dentro de estas áreas, identificamos ciertos objetivos (las principales metas de aprendizaje en cada tema) y criterios de desempeño (las habilidades o aprendizaje en cada tema que deben ser demostrados por los estudiantes) que eran relevantes para los temas y lecciones potenciales. Nos centramos en encontrar, adaptar y traducir los planes de lecciones relacionados que podrían adaptarse a los objetivos específicos y a los criterios de rendimiento dentro de cada área temática. En la tabla A se ofrece un ejemplo de tres criterios de desempeño que podrían ser puntos de entrada para el aprendizaje basado en jardines, junto con actividades y planes de lecciones que cumplen con esos criterios.

Tabla A: Una tabla de criterios específicos de rendimiento elemental que podrían mejorarse mediante un jardín con las actividades correspondientes y la ubicación de su plan de lección.

Área temática	**Descripción de criterios de rendimiento**	**Plan de lección**	**Actividad de ejemplo**
Las Ciencias Naturales	Observe y describa las partes de la planta, explique sus funciones y clasificarlas por su estrato y uso.	"Disección de Flores"	Disección de Flores
Cultura y Arte	Observar creaciones utilizando elementos del medio ambiente (producciones de arte terrestre, construcción de instrumentos musicales con verduras, etc.) y comentar sus características.	"Entrevistar a un Anciano"	Entrevistar a un anciano o familiar sobre las plantas que usan en recetas familiares.
Matemáticas	Medir, estimar y comparar longitudes de objetos en el entorno, sin interrumpirlos con patrones de medición no convencionales.	"Cómo Medir la Lluvia"	Construcción de un aparato de medición de lluvias

Para culminar nuestro proyecto, creamos un conjunto completo de planes de lecciones y actividades basados en jardines, proporcionados en español e inglés, adecuados para escuelas y organizaciones de la región de Sierra en Ecuador. En la figura C se muestra un ejemplo de uno de estos planes de lecciones. Seleccionamos 42 planes de lecciones para incluirlos en este producto debido a sus objetivos claros, los recursos requeridos limitados y la flexibilidad. A partir de esto, pudimos equipararlos a diez objetivos del plan de estudios nacional: Tres en Ciencias Naturales, tres en Cultura y Arte, dos en Lenguaje y Literatura y dos en Matemáticas.

También pudimos igualar estos planes de lecciones a 39 criterios de desempeño del currículo nacional: 13 en Ciencias Naturales, 11 en Cultura y Arte, cinco en Lenguaje y Literatura, y diez en Matemáticas. Adaptamos cada plan de lecciones para que coincida con los recursos disponibles y la importancia regional y cultural de las organizaciones piloto, los traducimos al español y los organizamos por tema.

Germinación de Semillas

Una lección de Greater Richmond Fit4Kids

Duración De la lección: Tiempo de preparación (45 minutos), Lesson (1 hora), Lesson activity(30 minutos, Período de crecimiento de 7 días)

VISIÓN GENERAL Y PROPÓSITO

Los estudiantes examinarán el proceso de inicio de semillas (germinación) y su papel dentro del ciclo de vida de la planta.

NORMAS ECUATORIANAS

Ciencias Naturales: O.CN.2.1., CN.2.1.3., CN.2.1.7.

OBJECTIVOS

Los estudiantes podrán:

1. Entender la germinación de semillas.
2. ¿Qué condiciones son necesarias para que las semillas germinen correctamente? (agua/humedad, calor, medio de crecimiento, tiempo).
3. ¿Cuáles son las primeras partes vegetales que se desarrollan después de que la semilla haya comenzado a crecer? (raíces, tallo, 1er hojas o cotiledones).
4. Discutir los beneficios de un invernadero (clima controlado) para la germinación de semillas.
5. Analizar cuánto tiempo tardan las semillas en germinar y cómo diferentes plantas crecen a diferentes velocidades.

Seed Germination

Lesson Plan for Grades K-5, Social Science
Prepared by Greater Richmond Fit4Kids

Length of Lesson: Prep Time (45 mins), Lesson (1 hr), Lesson activity(30 mins, 7 day grow period)

OVERVIEW & PURPOSE

Students will examine the process of seed starting (germination) and its role within the plant life cycle.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.1, CN.2.1.3, CN.2.1.7

OBJECTIVES

Students will be able to:

1. Understand seed germination.
2. Learn what conditions are necessary for seeds to properly germinate? (water/moisture, heat, growing medium, time)
3. Learn what are the first plant parts that develop after the seed has begun to grow? (roots, stem, 1st leaves or cotyledons)
4. Discuss with students the benefits of a greenhouse (controlled climate) for seed germination
5. Discuss how long it takes seeds to germinate and how different plants grow at different rates

Figura C: Un plan de lección de ejemplo de la entrega en español e inglés.

Junto con este documento, hemos proporcionado un breve conjunto de sugerencias para las escuelas y fundaciones en Ecuador que están interesadas en implementar y sostener un plan de estudios o enfoque basado en el jardín. Estas recomendaciones son las siguientes:

1. Nombrar un administrador del jardín.
2. Colabore con otras organizaciones de jardín y expertos para obtener apoyo a largo plazo.
3. Adaptar el contenido y la estructura del currículo cuando sea necesario.
4. Concéntrese en implementar actividades de aprendizaje activo.

Los administradores de jardines proporcionan estructura al jardín y llenan un papel administrativo, asegurando que el jardín se mantenga y funcione eficientemente. El apoyo a largo plazo, el acceso a los recursos del jardín y la sostenibilidad son claves para el éxito de cualquier jardín. Alentamos a los profesores y administradores que implementan este proyecto a adaptar las lecciones y la estructura según lo consideren oportuno, al tiempo que hacemos hincapié en la importancia del enfoque de aprendizaje activo. No todo funcionará en cada aula

con cada grupo de estudiantes, por lo que al adoptar la adaptabilidad del plan de estudios, la mayoría de los educadores pueden hacer pleno uso del contenido. Por último, la curiosidad y el interés de los estudiantes por el material de la asignatura crece exponencialmente cuando pueden ponerse manos a la mano con lo que están aprendiendo. Al seguir estas recomendaciones y aprovechar al máximo las lecciones y actividades contenidas en el resultado, esperamos que las escuelas y organizaciones en Ecuador puedan cosechar todos los beneficios del aprendizaje basado en el jardín.

Table of Contents

List of Tables

List of Figures

Authorship

Section	Primary Writer(s)	Primary Editor(s)
Title Page	Alison Lambert	Alison Lambert
Table of Contents	Alison Lambert	Alison Lambert
Abstract	Alison Lambert	Ethan Bae
Executive Summary	Alison Lambert	Michael Laemmle
Authorship	Michael Laemmle Alison Lambert	Andy Ventura Molina
References	All Contributors	Michael Laemmle Alison Lambert
Introduction & Background		
Introduction	All Contributors	All Contributors
The Power of Garden-Based Learning	Alison Lambert	Ethan Bae Alison Lambert
Hands-On Learning	Alison Lambert	Andrew Ventura Molina
Garden-Based Learning	Alison Lambert Andrew Ventura Molina	Michael Laemmle Andrew Ventura Molina
Curriculum Development	Ethan Bae	Alison Lambert
Ecuador's Current Educational System	Michael Laemmle	Ethan Bae Alison Lambert
Conclusion	Alison Lambert	Andrew Ventura Molina
Methodology		
Methods Introduction	Alison Lambert	Michael Laemmle Andrew Ventura Molina
Semi-Structured Interviewing	Michael Laemmle Alison Lambert	All Contributors

	Andrew Ventura Molina	
Qualitative Content Analysis	Michael Laemmle Alison Lambert Ethan Bae	All Contributors
Results, Discussion, and Recommendations		
Results Introduction	Alison Lambert	Ethan Bae
The Context of the Region	Ethan Bae Alison Lambert	Michael Laemmle Andrew Ventura Molina
El Arenal and CETAP-Lucy: A Case Study	Alison Lambert	Michael Laemmle
Development of the Curriculum	Michael Laemmle Alison Lambert Andrew Ventura Molina	Alison Lambert
Structuring a Garden Program	Michael Laemmle Alison Lambert	Alison Lambert Ethan Bae
Putting the Puzzle Together	All Contributors	Ethan Bae
Recommendations	Alison Lambert	Michael Laemmle Andrew Ventura Molina
Conclusion	Alison Lambert	Ethan Bae
Appendices		
Appendix A	Michael Laemmle	Ethan Bae
Appendix B	Michael Laemmle	Alison Lambert
Appendix C	Alison Lambert	Ethan Bae
Appendix D	All Contributors	All Contributors
Appendix E	Michael Laemmle Alison Lambert	Ethan Bae Andrew Ventura Molina
Appendix F	Michael Laemmle	Ethan Bae

	Alison Lambert	Andrew Ventura Molina
Appendix G	Michael Laemmle Alison Lambert Andrew Ventura Molina	Ethan Bae
Appendix H	Michael Laemmle Alison Lambert Andrew Ventura Molina	Ethan Bae
Appendix I	Ethan Bae Michael Laemmle	Alison Lambert
Appendix J	Michael Laemmle	

Introduction

Fresh air, outdoor play, healthy snacks, and getting your hands dirty - what kid wouldn't like that? School gardens provide all of this - and more. Through a school garden, children can learn about their environment, the importance of a healthy diet, and the value of gardening, all while feeling like they are playing outside (Williams & Dixon, 2013). The importance of a quality education and proper nutrition are extremely important in assessing the overall well-being of young students, and school gardens have the potential to address both (Utter et al, 2016). When paired with a garden-based curriculum, school gardens are a great place to utilize experiential learning methods that appeal to students of all learning styles and subject interests (Rogers et al, 2019). They can also serve as a source of fresh foods and a platform for teaching nutritional knowledge to students and school communities (Cotugna et al, 2012; Utter et al, 2016).

However, without solid lesson plans and engaging activities, gardens cannot meet their full potential as an educational tool. Our project goal was to create a multipurpose and sustainable garden-based curriculum for Sierran schools in Ecuador. We worked with Desmion Dizney, Bill O'Brien, two directors of the Cuenca Soup Kitchen, to create this curriculum. We also worked with CETAP-Lucy and Fundación El Arenal, two non-profit organizations focused on providing educational support for impoverished youth, as potential pilot locations where this project could be implemented. Our priorities in creating this curriculum were to make it easy to integrate into the current Ecuadorian school system, and into the schools' pre-existing curricula. Understanding the ways in which a garden-based curriculum could engage students and provide support to teachers working at these schools and foundations was key in ensuring the success of the project.

In this report, we begin by discussing the fundamentals of hands-on, garden-based learning, effective strategies for creating curriculums, the current Ecuadorian education system, and how they can all be connected through school gardens. After we provide the context for the use of gardens as an educational tool, we explain our project objectives, as well as the research methods that we used to obtain information about the educational resources available at potential pilot foundations, educational pedagogies associated with garden-based learning, and areas in which a garden-based curriculum could be integrated into Ecuador's current system. Then, we outline and discuss the main findings from our research, specifically our results on how this project could be implemented and how it would need to be developed to be most effective in both the organizations and in Ecuador as a whole. Finally, we share our recommendations on how schools and other organizations interested in garden-based learning can be successful in their endeavors.

The Power of Garden-Based Learning

Hands-on Learning

The majority of worldwide educational pedagogies focus on passive styles of learning that are often unable to effectively reach all students (Lujan & DiCarlo, 2006). Traditional passive methods of teaching, like lectures and worksheets, have been shown to be less effective than active-learning methods, such as projects, and real-world problem-solving (Wurdinger & Marlow, 2005). Studies even show that students involved in hands-on learning meet, and often exceed, the educational benchmarks of their peers (Scogin et al, 2017; Deslauriers et al, 2019). Because of this improved performance, some schools and countries have made the decision to start implementing more hands-on learning in the classroom. Schools that are adopting this change are truly starting to see the impacts that a hands-on approach can have on students in and outside the classroom (Scogin et al, 2017).

The benefits of experiential learning are numerous and can be seen in several areas of a child's education. Hands-on activities activate both sides of the brain, stimulating growth and increasing retention of the material (Goodwin University, 2019). Students are often more engaged in experiential lessons because they present them with real-world applications of their studies. In fact, students who focus their engagement on a hands-on topic have a higher chance of completing their high school education. For example, American high school students who concentrate in a Career and Technical Education (CTE) program (curricula characterized by their use of hands-on activities such as an auto mechanic program) have a 13% higher graduation rate than students who do not (Parlier, 2019). Furthermore, these types of hands-on learning activities, such as working together to fix the transmission of a car, can foster teamwork and critical thinking, which are key to developing strong communication skills and deepening students' capacity to understand the world around them (Wurdinger & Carlson, 2009). By utilizing a hands-on approach, schools can ensure that most students are receiving a quality education and are being impacted in positive ways.

Garden-Based Learning

A specific form of hands-on learning that incorporates different styles of learning and teaching while supporting a wide variety of subject areas is garden-based learning (Blair, 2009). By working in a school garden, students can see, hear, and feel physical manifestations of topics they are learning about, and the elements presented in a garden can engage many types of learners (Rye et al, 2012). In addition to these learning offerings, hands on-approaches like gardening incorporate teaching styles such as place-based learning, project-based learning, problem-based learning, and active learning (Blair, 2009). Project-based learning and problem-based learning both involve posing questions or project ideas and having students develop meaningful solutions, while active learning allows room for student participation, collaboration, and discussion, all of which could take place in a garden setting (Wurdinger & Carlson, 2009). Not only this, but garden-based learning can take place in a variety of geographical regions (Duncan et al, 2016). Although they may require different resources and approaches, students can experience garden-focused problems and projects in both rural and urban settings (Wolsey & Lapp, 2014).

Garden-based learning can also be used in a variety of different classes and subjects. In particular, science, technology, engineering, and mathematics (STEM) classes could see significant improvements from the introduction of gardens, especially as the need for these types of classes has skyrocketed (Williams & Dixon, 2013). For example, common competencies of the elementary science curriculum include life cycles, general earth science, and elements of ecology (Hasani et al., 2020). These competencies can be infused with gardening to create hands-on perspectives about their in-classroom activities (Hasani et al., 2020). Suzanne Kapelari notes that botanic gardens were originally used as scientific teaching and learning sites, and even though school gardens are much smaller in scale, the same principles apply (2015). A garden-based curriculum is also a versatile and flexible opportunity for students to learn from their environment and be outside, which can boost their environmental consciousness and let them explore the great outdoors (Williams & Dixon, 2013).

Certain aspects of nutrition, including cooking and health classes, can also be a fundamental area of study in a garden-based curriculum. Studies have shown that students who learn about nutrition through this type of approach can improve their knowledge about healthy eating and make healthier eating decisions (Morris & Zidenberg-Cherr, 2002; McAleese & Rankin, 2007). As shown in a 2018 study, this nutritional knowledge may also translate to an improved diet at home (Wells et al, 2018). Younger students who were participants in this study's garden-based curriculum had a higher availability of low-fat vegetables at home (Wells et al, 2018). This research shows that garden-based learning is an engaging way to enhance nutrition education for younger students, especially in low-income communities (Morris & Zidenberg-Cherr, 2002; McAleese & Rankin, 2007, Wells et al, 2018).

Another area of interest for garden-based learning is indigenous studies, where students can work with the plants native to their region that have been traditionally used by indigenous groups for food and medicine (Lever, 2020). These garden-based activities can be integrated with discussions of land ownership and colonialism, family stories about plant growth and use, and the ways in which plants impact a certain community to create a picture of indigenous communities and their history (Lever, 2020). The benefits of garden-based learning do not end here, because gardens themselves offer a plethora of other positive impacts for school communities.

Other Benefits of School Gardens

Not only do school gardens offer a solid foundation for a hands-on curriculum, but they have the potential to be a reliable source of food to be utilized in school lunch programs. Schools can be a primary site of intervention when it comes to malnutrition and obesity (Torres & Simovska, 2017). By having a school garden full of diverse plants and vegetables, schools can use their crops to create or supplement healthy meals and snacks that help meet the nutritional needs of their students (Vinueza et al, 2016). In fact, schools in El Salvador have successfully utilized the foods that are grown in their gardens as a main component of school snacks (Vinueza et al, 2016). Other studies also showcase the impact of school gardens on students' nutritional consumption and in mitigating childhood health conditions, such as obesity and malnutrition, that arise from improper nutrition (Vinueza et al, 2016).

Introducing school gardens that provide a diverse range of fruits and vegetables may offer a way to integrate healthier food into schools, help children make healthier choices, and boost the nutrition levels of the students so that they can grow properly and the have the energy to succeed in school (Cotugna et al, 2012). Studies have shown that school garden programs can boost student interest in consuming fruits and vegetables, so the students may be more apt to try new, nutritious foods if they are part of the gardening process (Ratcliffe et al, 2011). Additionally, having an accessible school garden could be a first step in addressing nutritional needs of entire communities, as children can share their knowledge and produce with their families (Wolsey & Lapp, 2014). A specific application of school gardens as a potential food source in Ecuador is detailed in Appendix A.

School gardens can also engage students in other ways. They can be a source of social growth, as the common garden goals can unite students, teachers, parents, and other community members by providing a site for collaboration and problem solving (Wolsey & Lapp, 2014). Partnered with at-home gardens, students can apply their knowledge beyond the school and increase its connections to their lived experience (Wolsey & Lapp, 2014). Studies have also shown that when children participate in a school garden, they become better communicators, develop initiative, self-confidence, and self-understanding skills, and show overall improvements in behavior (Miller, 2007; Robinson & Zajicek, 2005). Gardens also have physical aspects such as digging, planting, and weeding, that can provide a source of exercise and fresh air for students that they would not usually get in the classroom (Ozer, 2007). There are also specific positive impacts on attitudes towards school that appear through the implementation of school garden programs. A study performed in 1995-1996 provided evidence that female students had a more positive attitude towards school at the conclusion of a garden program, and that schools offering garden programs had more positive reception from students towards school (Waliczek et al, 2001). The benefits of a school garden mentioned here are extremely significant, especially when considering the health, happiness, and overall well-being of students.

Curriculum Development

To create a well-balanced and strong garden-based curriculum that incorporates experiential learning and maximizes the potentials of school gardening, a basic understanding of how school curriculums are developed is needed. Some commonly used, effective strategies that address the overall needs of students are identifying learning objectives, determining acceptable evidence of learning, and designing appropriate educational activities (Linnell et al., 2016).

Learning Objectives

A learning objective is a day-to-day instructional benchmark that a student must achieve in a certain subject's course (Marzano, 2014). When identifying such learning objectives, certain important factors include student age, abilities, and the course material. Learning objectives are often broken down into three distinct areas: what should be learned, the conditions under which it is learned, and the evaluation of the learning (Marzano, 2014). An example of a well-written learning objective that meets these three criteria is "Students will be able to solve equations with one variable and practice solving ten equations in cooperative groups" (Marzano, 2014, p.14). The subject of the lesson is to solve equations with one variable, the condition under which

learning occurs is in cooperative groups, and the method of evaluation is to solve ten equations. Specifying these learning objectives helps narrow down the lesson to the most important, relevant topics (Department of Education, 2016).

Evidence of Learning

Another effective strategy in developing curriculum is determining acceptable evidence of learning (McConnell, et a., 2014). In this strategy, the instructor will find or create evaluation tools that can show whether the students are learning the material sufficiently. The purpose of these types of evaluations is to measure student progress in the curriculum so that the instructor can identify students who need assistance. Some of the best forms of evidence of learning are short-answer based and context-rich multiple-choice questions because they show improvements in the retention and overall learning of the material, even over long periods of time (McConnell, et al., 2014). Without some form of evidence-of-learning, the instructor will have a difficult time in determining which students are struggling with the lesson material. One common difficulty in teaching occurs when instructors overestimate or underestimate the abilities of their students (Wexler, 2020). This issue leads to them teaching a subject that does not match the academic level of the students. Having evaluation tools allows teachers to best match their lesson difficulty with the current level of their students and to more easily identify children who are struggling with the material and provide the help they need (Dobson, 2008).

Lesson Plans and Activities

Designing activities that align with the learning objectives and evaluations of learning is crucial in developing an effective curriculum (Department of Education, 2016). The overall goal of lesson plans and activities is to help keep the curriculum organized and to help teach students important concepts (Panasuk & Todd, 2005). Examples of activities could include analyzing a related movie or working through an in-class assignment (Department of Education, 2016). The activities should be designed to help teach the material and further the students in their successful completion of the objectives and evaluation methods. The lesson plans and activities are also an opportunity for the teacher to accommodate for the various learning styles of their students (Panasuk & Todd, 2005). Some teachers approach students, who all have different backgrounds and learning styles, with inflexibility, which makes it difficult for the teacher to ensure that all students are progressing (Wexler, 2020).

Having a variation of lesson plans with different types of activities allows teachers to utilize different teaching approaches to ensure that every student understands the material (Panasuk & Todd, 2005). Following this flexible approach, curriculum development and lesson planning should be iterative and reflective processes where teachers can evaluate their objectives, evaluation methods, and activities to ensure that students are on pace with the curriculum (Linnell et al, 2016). Without teachers taking the time to analyze and adjust, the students can easily fall behind in the class which may lead to the children having a difficult time learning more complex topics in the future (Linnell et al, 2016). By understanding how to develop and create foundational lesson plans, teachers can adjust and reuse effective activities for future classes, ages, and subjects. These curricular development strategies are particularly important in Ecuador, where educational guidelines have shifted in the past 15 years (Schneider et al, 2019).

Ecuador's Current Education System

Ecuador's educational system is currently at a crossroads. Recent educational updates have increased funding for schools and created new, relevant learning objectives, but there is still a lack of training and support given for schools to follow through on these expectations. This shift in pedagogy began in 2008 under the newly elected President Rafael Corea in the new iteration of the Ecuadorian Constitution, known in English as the National Plan for Good Living (see Appendix B). The role of education was outlined in multiple sections; in Section V, article 27, it states that "education will focus on the human being… a sustainable environment . . . it shall encourage critical faculties… individual and community initiatives, and the development of competencies and capabilities to create and work" (National Assembly, 2008, Article 27).

Ecuador's federal government created a clear paradigm shift, focusing on promoting not only individual success, but also community success (National Assembly, 2008, Article 343). It also reaffirms the government's respect for indigenous rights and the rights of nature, as well as respect for the culture of Ecuadorians. To accomplish this, Ecuador's federal government increased funding for Ecuador's public-school systems (Schneider et al, 2019). Much of this funding resulted in the construction of new Millennium Schools (SOM), which were built to give children in rural areas a better education (Fajardo-Dack, 2016). Under Correa's administration, standardized test scores increased between 2006 and 2013 and teacher performance evaluations were put in place (Schneider, 2019).

However, some criticize the Ministry of Education and Ecuador's initiatives, arguing that Ecuador's public-school systems do not focus the funding on the most vital parts of Ecuador's school systems - namely, teacher training and pedagogy (Fajardo-Dack, 2016). Rosa-Maria Torres, the former minister of Education and Cultures, published her thoughts on a SOM she had just toured (Torres, 2012). In her expert opinion, there were training and pedagogy issues that were all overlooked during funding. The Ecuadorian pedagogy has been characterized as strict, disciplinarian, and autocratic. According to interviews with anonymous soon-to-be teachers, "… the students' analytical thought was very restricted. Everything was learned by heart. There was no opportunity to develop an idea from a concept" (Villafuerte et al., 2018, p. 219). In Ecuador, there is little observed innovation in the teaching-learning styles, processes, and interaction (López Pastor et al, 2015).

Project Introduction

To provide more active learning methods that can be used in Ecuadorian schools, the Cuenca Soup Kitchen and their local partners hope to develop a hands-on curriculum focused on school gardens that can also improve the nutrition available to the students. Our project was to create a cohesive and sustainable garden-based curriculum that schools in the Sierra region of Ecuador can use for years to come. We worked with our sponsors, Desmion Dizney and Bill O'Brien, two of the directors at the Cuenca Soup Kitchen, to obtain information about the schools and achieve our goals. Although the implementation of the lessons did not occur during this phase of the process, our sponsors hope to implement it in the future.

Methodology

The goal of our project was to develop a robust, multipurpose, and sustainable garden-based curriculum for implementation in schools in Cuenca. We wanted to emphasize the unique cultural and social features of Ecuador's Sierra region, so we collaborated with two educational support programs - CETAP-Lucy and El Arenal - to develop a high-quality curriculum that could be implemented at similar schools. Our three objectives were to:

1. Assess the geographical context, needs, and resources of two programs that could pilot test the project.
2. Explore special topics associated with garden-based learning and how they could be taught in a garden-based curriculum.
3. Determine entry points for garden-based learning in the Ecuadorian national curriculum and identify lesson plans that will support those topics.

In this chapter, we discuss our two primary methods, semi-structured interviews and qualitative content analysis, and how they provided us with the adequate data to complete each objective and construct a hands-on, garden-based curriculum.

Semi-Structured Interviews

Interviewing is a highly effective method of data collection that tries to understand the perspective of certain groups by asking questions and building rapport, which inevitably results in in-depth answers and explanations (Lune & Berg, 2018). We used semi-structured interviews because they let interviewers ask specific questions, while also allowing for probing, deeper responses, and less rigid conversation (Lune & Berg, 2018). We conducted two, 30-minute interviews with the directors of El Arenal and CETAP-Lucy to assess the geographical context, needs, and resources of the two programs that could pilot test the project. These interviews were conducted in Spanish over Zoom, and they were recorded with permission.

The goal of these interviews was to learn about what these organizations do, who they serve, the constraints under which they operate, and their interest in garden-based learning. The directors are the most knowledgeable figures when trying to learn the details about an organization. Our interview preamble and guides can be found in Appendices C and D. We used our notes and the recordings from these interviews to perform a narrative analysis, which is a method of analysis that allows researchers to create an overarching narrative from the stories and responses they receive (Wiles et al, 2005). Even though some of the interview responses were not directly related to our project, they contextualized the two possible pilot locations and their daily operations.

We also used semi-structured interviews to learn about special garden related topics. Interviewing an expert in a certain subject field is one of the most effective methods to learn more about a given topic (Littig & Pöchhacker, 2014). Thus, we interviewed two experts who have experience with garden-based learning: Karin Ninburg, an educator and environmentalist who has previously implemented school garden programs, most recently in Cuenca, and Andrea Newton, an American middle-school teacher who runs her school's garden club. The goal of

these interviews was to learn about different approaches, lessons, and activities that were vital to the curriculum. We conducted these 30-minute interviews over Zoom, recording when consent was given. We then organized all interview comments by the subject that they pertain to and looked for any common patterns between responses to help determine the most important facets of education and implementation that we should focus on. Interview questions for this method can be found in Appendix E.

Qualitative Content Analysis

To determine entry points for garden-based learning in the Ecuadoran National Curriculum, we decided to use qualitative content analysis, which allowed us to better interpret the themes, phrases, and ideas presented in each document (Hsieh & Shannon, 2005). We began by studying the national curriculum extracted from the Ministry of Education database. The goal of this analysis was to gain a deeper understanding of the objectives and developmental criteria contained in the current national curricula, which will make the future integration of the garden-based curriculum smooth, and to ensure the relevancy of the content. We separated the national curriculum into smaller more digestible components - English, Language and Literature, Natural Sciences, Culture and Art, Social Studies, Mathematics, and Physical Education. English and Social Studies were not as relevant to our study, so we did not evaluate them as thoroughly. Then, we translated each document from Spanish to English using computer software assistance.

We then took notes on the curricula and looked for subject areas that could be enhanced using a garden and the objectives of the national curriculum. We began by looking at the objectives (the main learning goals) defined in each subject area to see if there were any topics that specifically connected to the garden, such as basic plant biology, the environment, life cycles, etc. We also looked at the performance criteria (the specific skills or knowledge that must be demonstrated by students) that were defined in each subject to see if we could find similar topics. We intentionally left our criteria to be loose, as we did not want our analysis to be so constrained, thereby limiting our search and selection of lesson plans. For example, objectives in Culture and Art may not be explicit in their application to a garden, but there may be lessons that we found that could address the objectives in a more abstract way.

We then looked online for existing lesson plans and activities. To find these lesson plans, we searched for terms such as “Garden Lesson Plans” and “Garden-Based Curriculum”, which directly related to the documents we hoped to find. These searches lead to websites that had many different lessons plans available for use in different subjects and grade levels, and some listed other resources and webpages with garden lesson plans that we could evaluate. We specifically looked on these websites for science, culture and art, and mathematics lesson plans that were created for elementary students. Through these searches, we were able to find 63 lesson plans that we wanted to analyze.

During our content analysis, we organized all our lesson plans and activities in a spreadsheet to record information about each plan. Once we finished collecting lesson plans, we determined which lesson plans were best suited for the project. To do this, we looked at four criteria: objectives, resource cost, subject/topic, and credibility of the source. First, we examined a lesson’s objective(s) and cross-checked it with the Ministry of Education’s objectives and

performance criteria. If a lesson had an objective that did not relate to any of the Ministry of Education's objectives, it was rejected. The second criteria we evaluated was the resource cost and how substitutable the materials were. If the lesson plans were too resource intensive, we rejected the lesson plan. However, when lesson plans were slightly more resource intensive than desired, we proceeded with our analysis and made note that certain required materials would need to be either replaced or disregarded.

Next, we took note of the subject of the lesson, and classified it by category. Because our focus was on Science, Culture and Art, and Mathematics, most lessons that were not in those subjects were rejected. This criteria was exceptionally important to the curriculum we were designing because it helped us maintain structure within the curriculum, evaluating the usefulness of a lesson plan with a clear purpose in mind - creating a cohesive and structurally progressive set of lesson plans. Last, we evaluated the credibility of the source - whether the source was established and reputable. If a source did not seem credible (i.e., published by a non-existent foundation, had typos, and had unsupported information), then the lesson plan was rejected. Once we had a set of lesson plans that we found to be suitable for our use, we adapted them based on notes that we made and findings that we discovered, translated them into Spanish, and compiled the selections into one cohesive curriculum.

Results and Discussion

Through our data collection, we were able to paint a more detailed picture of the potential for garden-based learning in Ecuador and the resources and structure that would be required to implement it in specific educational support programs in Cuenca. We learned how to construct a garden curriculum, what it needed to be successful, and how well the garden curriculum aligns with the Ministry of Education's national guidelines. In this chapter, we discuss the results from our research and how they allowed us to develop a collection of garden-based lesson plans and activities.

The Context of the Region

According to the registry of public schools from the Ministry of Education, there are 439 public schools located in Cuenca, of which 398 are categorized as "Sierra" schools, while the other 41 are considered "Coastal". This information helped to narrow our focus onto Sierra schools because they make up the vast majority of schools in Cuenca. The split between urban and rural schools in the city was almost equal, with 219 schools classified as "rural" and 220 classified as "urban". Beyond these basic categories, we also looked at the average number of students, teachers, administrators, and EGB (Basic, General Education only provided to 1st through 10th graders; the type of students we were targeting with the project) students, which helped us see the scale of how many students may use this curriculum. We looked at both the mean and median values, as the means were weighted heavily by schools of over 1000 students. The results are shown in Table 1.

Table 1: A summary of demographics per each school in the Azuay province.

Category	**Mean**	**Median**
Total Students	351	125
Total Teachers	18	10
Total Administrators	3	1
Total EGB Students	245	63
Total EGB Students (Urban Schools)	308	89
Total EGB Students (Rural Schools)	182	45
Total Teachers (Urban Schools)	23	13
Total Teachers (Rural Schools)	13	4

As shown in the table, the median number of students was 125, with about 63 of those being EGB students. The student-to-teacher ratio of 12.5:1 is not immediately telling, considering that, as of 2017, the average student-to-teacher ratio in the United States is 14.2:1 (UNESCO Institute for Statistics (UIS), 2017, Pupil/Teacher Ratio). But the Ecuadorian teachers are doing their job with significantly less administrative support and infrastructure. There is a median of only 1 administrator at each school, which tells us that teachers already have significant responsibility in planning lessons, taking care of students, and ensuring their success. Also, our sponsors told us that Ecuadorian schools often lack the access to technology, reliable internet and other resources that are practically guaranteed at many schools in the U.S. These factors showed us that a garden-based curriculum needs to be easy to understand, use and implement, so as not to overburden teachers who would like to have this type of program in their school.

We also wanted to properly visualize the broader region in which the curriculum may be used, so we created a Google Earth map (Figure 1) of a random sample of 15 schools in the Azuay province (the province where Cuenca is located) to learn more about the locations of other public schools in and around the city (read more in Appendix F). We learned that there were large differences in access to land and resources between the schools and foundations in urban areas versus those in more rural areas. Many urban schools have limited space for outdoor gardens, while schools in rural areas have more geographical advantages (green space, water sources, open fields) for outdoor gardening. These differences reinforced the importance of flexibility, as not all schools have comparable access to land and resources. Because Cuenca schools are split evenly between urban and rural designations, it was imperative for this curriculum to be inclusive of all schools in the region, regardless of their access to water, soil, land, and other geographical resources.

Figure 1: A map showing a random sample of schools in the Cuenca region. El Arenal is highlighted with a purple marker and CETAP-Lucy is highlighted with a red marker. Those marked in yellow were the other schools that we mapped.

El Arenal and CETAP-Lucy: A Case Study

After learning about the general area and demographics of Cuenca schools, we took a deeper dive into the two educational support organizations, El Arenal and CETAP-Lucy, that expressed interest in piloting a garden-based curriculum for the students that they serve. El Arenal is an after-school program that provides academic support to students whose families work in the local market, and CETAP-Lucy is an organization that provides educational support for rural, impoverished youth. These locations are representative of the geographical context and conditions under which other urban and rural schools and organizations may be operating.

Figure 2: A map of Fundación El Arenal

As demonstrated in figure 2 and confirmed through an interview with the director of El Arenal, the organization operates out of a house and has virtually no green space for outdoor gardening. They serve about 70 children, most of whom come from very impoverished families. She also said that El Arenal does not have access to many educational resources. Students are given pencils, paper, and paint; however, notebooks, pens, and folders need to be purchased by their parents and are not required. Technology is also a big element that El Arenal is trying to improve and provide for their students. Most of their students do not have access to a computer, so when their schools turned to virtual instruction, El Arenal tried to ensure that students had access to their virtual lessons.

Along with the limited access to technology, she explained that the COVID-19 pandemic has highlighted the fact that, although El Arenal is traditionally an after-school program that offers

educational support for students, her organization has become a primary source of education, where students receive the instruction and support that would normally be supplied in schools. When we asked about their interest in a garden-based curriculum, the director noted that they do not currently have any program focused on gardening, but that she was interested in the potential that the idea has in benefiting their community. She hopes that introducing a garden can bring a sense of responsibility and humanitarianism within her community, and that, if used in conjunction with a garden-based curriculum, could be an effective form of teaching.

Figure 3: A map of CETAP-Lucy

CETAP-Lucy, on the other hand, is in a more rural area and has large plots of land adjacent to their buildings, as demonstrated in figure 3. Rocio Illescas, the director of CETAP-Lucy, explained that they serve about 35 students who all come from different grade levels and ages. They have access to traditional school supplies, such as pencils, paper, and books, as well as a printer. Obtaining computers, quality internet, and headsets, while still somewhat difficult, is their main priority given the current pandemic. Although it is very expensive, she is trying to upgrade their internet service and get a headset for each student for their virtual schoolwork. Many of their students do not have access to this technology outside of their time at this organization, so Ms. Illescas highlighted how important their time at CETAP-Lucy was. Like the director of El Arenal, she is finding that students are relying on the organization more heavily than before for instruction and direction, so this impacts how much the organizations are asked to provide and the stress they are under.

One interesting note about this foundation is that they already have a garden at their facility. There is an educator at CETAP-Lucy who is well versed in agriculture and works with the children in the garden to take care of plants and do recreational activities. We also learned that school gardens used to be more heavily used in Cuenca, but because schools are currently virtual, no one is available to continue with their care. Ms. Illescas also expressed interest in the project, and highlighted some areas, such as nutrition and ecology, where she believed a garden-based curriculum could be effective for her students and for the community. She told us that the most important facet of the curriculum would be to use it to improve the nutrition and health of the general public. It should demonstrate the importance of healthy living, especially to young children and families. She also believes ecology to be an extremely important entry-point for the curriculum, as garden-based learning and ecology go hand in hand. Finally, she mentioned that the lessons and activities learned through a garden-based curriculum can be brought home by the students to create a positive impact on their families and on the greater community.

Overall, we think that these two organizations would be great pilot locations for this project. Both directors demonstrated interest in implementing garden-based learning at their facilities and were hopeful about the positive impacts that it may provide their communities. CETAP-Lucy already has the infrastructure for a garden-based curriculum to be implemented, and they have educators there who are already knowledgeable in teaching children through gardening. Also, the director of El Arenal told us that for a project like this to succeed for urban organizations, it could not be reliant on a certain season, climate, or outdoor locations. So, we took that as an opportunity to learn about (and include in the curriculum) gardening methods that are appropriate for schools with limited resources and garden space. If our deliverable is creative and includes some “non-traditional” gardening methods, then El Arenal would be a strong candidate to be a pilot location. With these two organizations in mind, we could then move on to the development of the garden-based curriculum.

Development of the Curriculum

After understanding the context of Cuenca and of the potential pilot organizations, we needed to analyze how their locations and resources would impact the way a garden-based curriculum should be created and structured. We recognized that for this curriculum to be inclusive of all schools in the region, it needed to include a variety of gardening methods, activities, and lessons. Seeing that schools operate in both urban and rural areas, including El Arenal and CETAP-Lucy, we needed to research and include different gardening methods that could be applicable in either of these scenarios. Also, although CETAP-Lucy has the infrastructure in place for a garden-based curriculum and both organizations have the materials to provide educational support for their students, it may be difficult for them to afford and collect uncommon and expensive supplies for this curriculum. So, we asked Karin Ninburg, an expert on low-resource gardening, which methods and approaches that she previously used in school garden programs in more urban areas. She suggested that we use hydroponics, raised bed, and indoor gardens created from recycled materials.

Hydroponics (shown in figure 4) is a method of growing plants solely in water, without any soil (which can be sparse and expensive in urban areas). This is a great way to create a garden inside the classroom because it is not very messy, takes up a small amount of space, and it relatively easy to build. However, some organizations may struggle when trying to grow a more diverse range of plants because the materials can become more expensive and complex to put together. Ms. Ninburg also explained how you can use recycled bottles as pots and build a garden virtually anywhere, including indoors. These are the most inexpensive option, and bottle tower gardens (as shown in figure 5) can take up a very small amount of space. Indoor bottle gardens are also great for kids because they are so easy to build and observe.

Figure 4: A simple hydroponics example. Provided by Karin Ninburg.

Finally, she shared how raised bed gardens (shown in figure 6) can be a great way to create a garden on concrete, and they are simple and inexpensive to build. You get a large container, fill it with cardboard, logs, plant waste, compost, and cheap soil. Then, you can add a small amount of quality soil on top for growing. Although the construction time and material cost can add up when building several of these garden beds, it might be a great option for schools without any green land to have an outdoor garden space. By sharing her experiences with this variety of gardening methods, Ms. Ninburg showed us how teachers and students from schools with limited resources can use these gardening methods and flourish.

Figure 5: A Bottle Tower Garden. Provided by Karin Ninburg.

These activities would be great for students to see the importance and educational value of gardening, while still not requiring many materials for the lesson. Ms. Ninburg also shared the instructions and photos of how she helped Hearts of Gold, another community organization in Ecuador, create raised bed gardens that were extremely inexpensive yet impactful. Andrea Newton, a middle school teacher who runs her school garden club, also explained a few ways to keep the costs and resources down when doing garden-based activities. Her club tries to reuse any materials that they can, and both she and Ms. Ninburg noted that recycled materials like plastic cups, liter bottles, and cardboard could be a great way to create a low-cost garden to be used in tandem with a curriculum.

Figure 6: A before and after of the construction of raised bed gardens. Provided by Karin Ninburg.

The directors of both organizations expressed a desire for the inclusion of active learning methods in this curriculum. Across all of our interviews, the educators and foundation directors all agreed on one thing: kids learn best when having fun. Because of this, we determined that games, do-it-yourself (DIY) activities, and other hands-on exercises have the potential to be extremely effective methods to teach children in a garden. Active learning is more effective than passive learning at grabbing and retaining the attention of all learners, but this is especially true for young students. When speaking with the director from El Arenal, she heavily emphasized how kids in her foundation love to play. She mentioned that seeing them smile when playing a game of soccer in the park across the street was a highlight of her work. She also believes that this love for play could be carried into classrooms and even integrated into a curriculum. When asked how she believes children learned best, she responded that "they learn through playing", and these sentiments were echoed by our other interviewees.

Ms. Illescas shared that her students at CETAP-Lucy often learn best through game-based activities. She also discussed how in the summer, her students love to go on field trips to different places, like museums. These excursions allow them to play and be more interactive than in the classroom, while also learning about relevant topics in a new place. Mrs. Newton also added that she tries to make her lessons "as fun as possible" for students who participate in her school's garden club and that they all love to play in the dirt and discover the outcomes of their work. Integrating games and play-based activities is a feasible task for this project and may be the best way to approach teaching students at foundations like El Arenal.

Do-It-Yourself (DIY) activities were also highlighted as a particularly important element of hands-on learning. Mrs. Illescas discussed how her students like to learn through DIY methods, like cooking, planting, and creating things by hand. Ms. Ninburg also presented DIY exercises as some of the most positive experiences for both students and the general population. In her past projects, communities have benefited significantly from participating in workshops that focus on the instruction and creation of different DIY topics. For example, she told us the story of how she taught one community how to grow their own vegetables in small in-home gardens, and that it helped to foster self-confidence and self-sufficiency within the community.

The director of El Arenal also noted that this feeling of independence could positively impact students, as the responsibility associated with gardening could become a sense of pride for students. Not only are these DIY activities important in creating positive reactions, but Ms. Ninburg also noted that they are often crucial in demonstrating practical ideas related to gardening. Many theoretical concepts that need to be taught in the classroom, like seed germination and hydroponics, lend themselves to activities that take a more practical approach. By planting a seed and watching it develop, or creating a small replica of a hydroponic system, these concepts can be reinforced in a meaningful way.

Structuring a Garden Program

A key finding that emerged from our research was that students need a structured outdoor "hands-on learning" time and a structured indoor "theory" time. In our interview with Ms. Ninburg, she explained that children need to be taught theoretical concepts about plants and gardening, such as the different parts of the plant, and how to construct gardens, but that they also need the hands-on experience. She suggests that garden-based education should be one-part indoor lecture-based learning for every three parts outdoor activity-based learning. This split will help keep students engaged while also providing the necessary theory to understand the underlying processes. This structure is also supported by Mrs. Newton, who noted that one of her most effective and engaging classroom strategies is to provide the background information for a topic, and then reinforce the concepts presented by showing it in the field.

Not only should this structure need to be applied to individual lesson plans, but each lesson module also needs to be structured in such a way that there was a clear, logical progression of topics and ideas that build on one another. When interviewing Ms. Ninburg, she suggested that we include lessons centered on soil studies, climate studies, plant structures, and photosynthesis when covering science. Mrs. Newton also mentioned that her groups have successfully done activities in areas such as pollination and hydroponics. For cultural studies, Mrs. Newton also told us about how her club had partnered with her town's historical society to start a garden at an historical site and learn about the history and culture of the area. Ms. Ninburg also suggested including cultural elements and gave an example of a past project she completed in Argentina, in which her team was able to learn about the country's pre-Hispanic roots through their research of native plants and trees.

With this variety of lesson ideas in mind, we created a guide to help us plan out which lessons should comprise a garden curriculum, and in what order we recommend they be taught. To do

this, we organized a list of topics relevant to a school garden as provided by our interview subjects, and then organized them based on their natural order and progression. For example, in the science curriculum, we determined the first topic of relevance to be soil, parts of a plant, seed germination, blossoming, and finally, what the crops yield. There is a clear progression here that follows the lifecycle of a crop, and the order of the lesson plans is intuitive. This guide helped us to focus our online research of lesson plans which will be discussed later in the chapter.

Another pertinent idea that was suggested in interviews was to ensure that the teachers were the central figures in the gardening program. This manifests itself in a few ways. Ms. Ninburg made it clear that teachers using garden-based curriculums need to have a strong grasp of the material they are teaching. Otherwise, they are not able to teach as effectively. She also suggested that we ensure that educators feel both knowledgeable, interested, and engaged with the garden, and perceive the garden as something from which students can benefit. If educators do not feel like the garden will benefit them or their students, they will not be interested in continuing to work with it. Furthermore, the gardens need to prove to be successful for an educator to want to engage with it, and if the educator is improperly trained or provided inadequate support, they will not see the full benefits of the garden.

It was also clear that to be used in the curriculum, the gardens themselves would require a fair bit of organization and upkeep. A previous WPI student team, whose project we referenced because it focused on developing school gardens in Ecuador, interviewed Dr. Elisabeth Stoddard, a human-environment geographer, about possible strategies in running a school garden successfully and efficiently. Dr. Stoddard and Mrs. Newton both noted that having a clearly defined hierarchy of responsibility is important when it comes to ensuring proper maintenance of a garden. Much like any other organization, there needs to be a leader who sees the whole picture and can delegate work and tasks. Without a garden manager, the direction of the garden is both variable and unclear. A garden manager determines which crops will be grown, how the space will be used, and which projects will occur. A manager is also in charge of ordering supplies, keeping inventory, and aiding garden users.

Putting the Puzzle Together

Once we had a clear direction for what we wanted to include in the curriculum, we needed to ensure that it could fit within the national educational guidelines set by Ecuador's Ministry of Education. After a thorough content analysis of the current national curriculum and using interview data, we found that possible entry-points of garden-based learning into the Ecuadorian curriculum are most prevalent in Natural Sciences, Culture and Art, Language and Literature, and Mathematics. Within these areas, we identified certain objectives (the main learning goals in each subject) and performance criteria (the skills or learning in each subject that must be demonstrated by the students) that were relevant to our potential topics and lessons. Appendix G depicts our evaluation table of all the objectives in these subjects as defined by the Ministry of Education, and Appendix H shows the evaluation table of performance criteria related to each subject.

In the Natural Sciences curriculum, the Ministry of Education places an emphasis on contextualizing life in the broader scope of the universe and the interconnectedness among all living things. From this section, we determined seven objectives and 23 performance criteria that

we decided go hand-in-hand with garden-based learning. Table 2 gives an overview of three Natural Sciences objectives and associated performance criteria that we felt could be successfully included in a garden-based curriculum. Natural Sciences was the clearest entry point for a garden-based curriculum because there are numerous topics that relate directly to plant life, the environment, and how it can be preserved and protected. Not only are these entry points well-suited for the introduction of garden-based learning, but some of them, like plant structures and nutrition, were directly related to the lessons suggested previously by Mrs. Newton, Ms. Ninburg, and Ms. Illescas for the creation of the curriculum guide.

The Culture and Art curriculum emphasized that students should learn how the natural world can be expressed through art. In total, there were seven objectives and 25 performance criteria that we found to be relevant to the development of the curriculum in this subject. Two of these objectives with associated criteria are shown in table 2. A garden can be a place of imagination and wonder for students, so having such a tactile and sensory-heavy location for them to draw inspiration from would be an extremely beneficial component of the garden programs. Some of the Culture and Art objectives also discussed that should learn through artistic creation related to the natural world and the environment around them. Mrs. Newton and Ms. Ninburg saw Culture and Art as an important topic for garden-based learning.

We also found that the Language and Literature curriculum, which emphasizes, unsurprisingly, students' ability to read and write, had a few entry points for a garden-based curriculum. It focuses on learning to distinguish and write in different prose and in a variety of genres, to talk about a variety of experiences, objects, and people, and to interpret textual data. However, we only found three objectives to be directly relevant to the garden. There were also five performance criteria that we found to be relevant to the curriculum. Two of these objectives with associated criteria are given in table 2. Although this may be a small portion of a garden-based curriculum, we still see this subject as a viable area to provide more versatility to the curriculum.

Finally, we found that the Mathematics curriculum, which focused primarily on the use of mathematical operations and methods to solve everyday problems in their environment, to be useful in the curriculum. We found all seven objectives in this subject to be relevant to garden-based learning, although there were only 16 performance criteria that we believe are applicable to garden-based learning. These two objectives with associated performance criteria are included in table 2. After determining entry points in this piece of the national curriculum, we were still a bit confused on how to address these areas in the garden, so we asked Ms. Ninburg and Mrs. Newton if they still believed it to be a feasible subject to include. Some examples that they thought might be interesting were the construction of raised-bed gardens, and the planning and mapping of the garden and the spaces where the different plants would go. Mathematics is also very closely related to Science, so perhaps interweaving those concepts would be a great way to make sure that the garden curriculum is multipurpose.

Table 2: A table of a small sample of elementary Ministry of Education objectives and relevant performance criteria that could be addressed in a garden-based curriculum. Full tables of objectives and performance criteria are in Appendices G and H.

Subject Area	Description of Objective	Description of Related Performance Criteria
Natural Sciences	Explore and understand the life cycles and essential characteristics of plants and animals, to establish similarities and differences; classify them into angiosperms or gymnosperms, vertebrates, or invertebrates, respectively, and relate them to their habitat.	Observe and describe the parts of the plant, explain its functions, and classify them by their stratum and use.
Natural Sciences	Explore and discuss habitat classes, the reactions of living beings when natural habitats change, the threats that cause their degradation and establish relevant decision-making.	Investigate, using ICT and other resources, the diversity and importance of vertebrates and plants with seeds of the natural regions of Ecuador; identify caring for actions of protection and care.
Natural Sciences	Describe, give examples, and apply healthy lifestyle habits to keep the body healthy and prevent disease.	Explain the importance of healthy feeding and physical activity according to its age and the daily activities it performs.
Culture and Art	Perform individual and collective artistic productions from the combination of techniques and materials given.	Use elements of the natural and artificial environment (wood, leaves, stones, etc.) in the collective creation of simple artistic productions.
Culture and Art	Identify and describe characteristic elements of products, heritage, and local and universal contemporary artistic productions.	Observe creations using elements of the environment (land art productions, construction of musical instruments with vegetables, etc.) and comment on their characteristics.
Language and Literature	Write stories and exhibition and descriptive texts, on various available media, and use them as means of communication and expression of thought.	To write, in communicative situations that require it, narratives of personal experiences, everyday events or other events or events of interest, ordering them chronologically and linking them by means of temporary connectors and additives.
Language and Literature	Communicate your ideas orally effectively by using the basic structures of the oral language and vocabulary relevant to the communicative situation.	Conduct oral presentations on topics of personal and group interest in the school context.

Table 2: (Continued).

Subject Area	Description of Objective	Description of Related Performance Criteria
Mathematics	Solving everyday situations involving measurement, estimation and calculation of lengths, capacities and masses, with conventional and non-conventional units of objects in your environment, for a better understanding of the space around you, the assessment of your time and that of others, and the promotion of honesty and integrity in their actions.	Measure, estimate, and compare lengths of objects in the environment, without disrupting them with unconventional measurement patterns.
Mathematics	To participate in projects of analysis of information of the immediate environment, through the collection and representation of data and statistics in pictograms and bar diagrams; thus, potentiating the logical-mathematical and creative thinking, when interpreting the information and expressing conclusions by assuming commitments.	Organize and represent statistical data relating to your environment in frequency tables, pictograms and bar diagrams, in order to explain and interpret conclusions and make commitments.

Lesson Plan Selection and Considerations

Our previous findings significantly affected our list of potential lesson plans. Therefore, after determining subject areas of entry, we focused on finding, adapting, and translating related lesson plans. The activities shown in Appendix I are a culmination of this analysis. We found that the best lessons to include were those that most aligned with government standards, required few resources, and were very flexible in their approach. If a lesson was not aligned with the Ministry of Education's objectives and standards, the lesson would be both ill-suited to the target population and unsustainable within the broader Ecuadorian curriculum.

Flexibility is essential in most teaching environments, in terms of both resource availability and cultural context. Our background research confirmed that flexibility in lessons and activities is also vital in reaching students from all backgrounds and academic levels (Wexler, 2020). The more customizable and adaptable a lesson plan is, the easier it is to integrate into any classroom and connect with any student. Lesson plans that adhere to a one-size-fits-all approach are likely to be inapplicable in our situation, especially because the target population of this project is of a different background and culture from where the lesson plans were developed. For example, a lesson that teaches about hydroponics using expensive filters and pumps is not feasible for many schools in Ecuador. By limiting the lesson in this way, without offering any alternative materials,

we may render the lesson plan useless. There are many more examples where social mismatches, differences in available resources, and cultural differences can make one-to-one translations of lesson plans extremely impractical.

We also selected lesson plans based on how they fit into the broader garden curriculum. For example, a lesson that discussed how fossilized organic matter can be consumed by plants under certain conditions would be entirely inappropriate if we did not include lesson plans on fossilization, how organic matter is consumed, and what those situations are. On the other end of the spectrum, we did not want to select lesson plans that would be redundant - having six lesson plans on germination that all teach the same thing in the same way would serve little purpose. All the lesson plans that we selected for our analysis were targeted towards elementary age students, so they did not necessarily have to be adjusted for age appropriateness.

After consideration and discussion, we decided that 42 out of 63 lesson plans were best suited for inclusion in the project because of their clear objectives, limited required resources and flexibility, as well as their relevance to the national curriculum. From this, we were able to match them to ten objectives from the national curriculum: three in Natural Sciences, three in Culture and Art, two in Language and Literature and two in Mathematics. We were also able to match them to 39 performance criteria: 13 in Natural Sciences, 11 in Culture and Art, five in Language and Literature and ten in Mathematics.

Recommendations

It is important to recognize that this project is only a single piece of a larger movement to implement more active learning in Ecuador. Although the lessons and activities were adapted to be representative of the resources and access to land afforded by organizations in both urban and rural areas, they may not work for all public schools and organizations in the region. Some schools may not have an interest in using garden-based learning at all, while others do not have the resources or support to introduce such a curriculum into their daily schoolwork. Finding the right balance of active and passive learning in each individual school and location will be crucial to the long-term success of garden-based learning in Ecuador.

To alleviate some of the struggles that may arise when schools and organizations begin their endeavors into garden-based learning, our team has created a set of guidelines that may lead to their success. These recommendations are as follows:

1. Appoint a garden manager.
2. Collaborate with other garden organizations and experts for long-term support.
3. Adapt the content and structure of the curriculum when needed.
4. Focus on implementing active learning activities.

Appointing a Garden Manager and Collaborating with Others

Our research made it clear that any garden-based curriculum needs a long-term support structure, and we found that there are two ways to ensure this. First, by appointing a garden manager, who provides structure to the garden itself, and second, by developing a relationship with a garden-focused organization, who could provide guidance, supplies, and suggestions for a successful garden and corresponding curriculum. The garden manager can be anyone willing to oversee the upkeep and general garden maintenance. A garden manager fills an administrative role; they facilitate care of the garden when school is not in session, schedule and allocate green space, request supplies from volunteer organizations, manage inventory, and/or create and enforce rules for conduct and behavior while in the garden. This role may be filled by a teacher or other school member but could also be outsourced to a community member with more time to dedicate to this role.

We understand that resources and time may be limited, so we recommend that schools using this curriculum reach out to organizations or individuals in Ecuador who may know someone who can assume the role of garden manager. These organizations may also be willing to provide long-term support of both the garden and the curriculum, as mentioned above. To aid in this step, we looked online and spoke with our sponsors and interview respondents to create a list of individuals and organizations who might be able to provide long-term support for the garden or the curriculum. This list is found in Appendix J. Not only do we hope that these individuals and organizations are interested in working with the schools as garden managers, but we also think that reaching out to them will allow schools to have local support and possible access to garden resources.

Adapting and Implementing the Lesson Plans

Our third suggestion is to adapt the curriculum to fit the specific needs and resources of one's organization. Although we tried to make the activities and lessons as accommodating as possible, there will be occasions where an activity will not work in absolutely every classroom with every student. If one feels that adjustments need to be made for a lesson or activity to fit under a different set of constraints, we think that that is the best course of action. The teachers should feel free to pick and choose lessons, activities, and topics that are most relevant and important to their educational needs. We do, however, believe that it is most important to focus on the active learning methods that are afforded by this curriculum. To only focus on the lecture portion of the lessons and not follow through with the practical exercises may not yield the best results. Our research has highlighted the importance and benefits of hands-on learning, so we think it is crucial to utilize this approach when trying to implement the curriculum.

We realize that implementing this garden-based curriculum invites a significant amount of trial and error, but we truly believe that the impact it may have on schools and communities could be extremely valuable. By considering these recommendations when beginning an application of this curriculum, we trust that organizations may have more positive outcomes.

Deliverable

The culmination of our project resulted in one deliverable: a collection of garden-based lesson plans and activities provided in both Spanish and English. This deliverable contains lesson plans and corresponding exercises that are suited to the schools in the Sierra region of Ecuador, with a focus on hands-on and Do-It-Yourself (DIY) activities. The QR Codes to the deliverable in English and Spanish are provided below. A table containing a sample of activities used in the curriculum is also provided in table 6. An example of a lesson plan in the curriculum in both English and Spanish is shown in figures 7 and 8.

Deliverable in English:

Deliverable in Spanish:

Table 3: A small sample of activities included in the deliverable, and the lesson plan in which they are located.

Subject	Activity	Lesson Plan Location
Natural Science	Soil investigation	"Gardeners Plant in Soil, Not Dirt"
Natural Science	Flower dissection	"Dissecting Flowers"
Natural Science	DIY drip irrigation system	"No Cost School Garden Drip Irrigation System"
Mathematics	Building a rain measurement apparatus	"How to Measure Rain"
Culture and Art	Interviewing an elder or family member	"Interview an Elder"

Seed Germination

Lesson Plan for Grades K-5, Social Science
Prepared by Greater Richmond Fit4Kids

Length of Lesson: Prep Time (45 mins), Lesson (1 hr), Lesson activity(30 mins, 7 day grow period)

OVERVIEW & PURPOSE

Students will examine the process of seed starting (germination) and its role within the plant life cycle.

ECUADORIAN STANDARDS

Natural Science: O.CN.2.1, CN.2.1.3, CN.2.1.7

OBJECTIVES

Students will be able to:

1. Understand seed germination.
2. Learn what conditions are necessary for seeds to properly germinate? (water/moisture, heat, growing medium, time)
3. Learn what are the first plant parts that develop after the seed has begun to grow? (roots, stem, 1st leaves or cotyledons)
4. Discuss with students the benefits of a greenhouse (controlled climate) for seed germination
5. Discuss how long it takes seeds to germinate and how different plants grow at different rates
6. Discuss with students types of plants that we eat in the seed stage (beans, rice, sunflower or pumpkin seeds) and those we eat as sprouts (alfalfa, mung bean sprouts)

MATERIALS NEEDED

1. Paper towels
2. Ziploc bags
3. Buckets of water
4. Pea seeds or beans
5. Example of edible sprouts to be a sample

ACTIVITY

Procedure

Give each student a paper towel and demonstrate dipping the paper towel into the water bucket, squeezing the paper towel between their hands to make sure the paper towels aren't soaking wet. It is important to be gentle so the paper towel doesn't rip. Don't wring it out.

Once students have moistened their paper towels, have them lay the paper towel flat in front of them.

Give each student one seed to place in the middle of the paper towel and then have them fold the paper towel in half so that the seed is in the middle.

Give each student a plastic Ziploc bag to place their paper towel in.

Have students write their names on the bags with a sharpie.

Students will take the bags back to their classroom to tape on a window and observe the seed's growth over the next 7 days.

Pass around the edible sprouts for students to try.

Discuss with students to help make connections between the sprouts that they're eating and the seed that they just planted.

Sprouts are high in energy, vitamins, minerals, and protein, ask students why they think sprouts might be so densely packed with nutrients? Hint: What is the plant doing when it is in the sprouting stage?

Figure 7: An example lesson plan from our deliverable in English.

Germinación de Semillas

Una lección de Greater Richmond Fit4Kids

Duración De la lección: Tiempo de preparación (45 minutos), Lesson (1 hora), Lesson activity(30 minutos, Período de crecimiento de 7 días)

VISIÓN GENERAL Y PROPÓSITO

Los estudiantes examinarán el proceso de inicio de semillas (germinación) y su papel dentro del ciclo de vida de la planta.

NORMAS ECUATORIANAS

Ciencias Naturales: O.CN.2.1., CN.2.1.3., CN.2.1.7.

OBJECTIVOS

Los estudiantes podrán:

1. Entender la germinación de semillas.
2. ¿Qué condiciones son necesarias para que las semillas germinen correctamente? (agua/humedad, calor, medio de crecimiento, tiempo).
3. ¿Cuáles son las primeras partes vegetales que se desarrollan después de que la semilla haya comenzado a crecer? (raíces, tallo, 1er hojas o cotiledones).
4. Discutir los beneficios de un invernadero (clima controlado) para la germinación de semillas.
5. Analizar cuánto tiempo tardan las semillas en germinar y cómo diferentes plantas crecen a diferentes velocidades.
6. Discuta tipos de plantas que comemos en la etapa de semillas (frijoles, arroz, semillas de girasol o calabaza) y las que comemos como brotes (alfalfa, brotes de frijol mung).

MATERIALES NECESARIOS

1. Toallas de papel.
2. Ziploc bolsas.
3. Buckets de agua.
4. Pea semillas o frijoles.
5. Example de brotes comestibles para ser una muestra.

ACTIVIDAD

El Procedimiento

1. Déle a cada estudiante una toalla de papel y demuestre sumergir la toalla de papel en el cubo de agua, apretando la toalla de papel entre sus manos para asegurarse de que las toallas de papel no estén mojadas. Es importante ser suave para que la toalla de papel no se rasgue. No lo hagas salir.
2. Una vez que los estudiantes hayan humedecido sus toallas de papel, pídales que dejen la toalla de papel plana delante de ellas.
3. Dé a cada estudiante una semilla para colocarla en el medio de la toalla de papel y luego haga que doblen la toalla de papel por la mitad para que la semilla esté en el medio.
4. Entregue a cada estudiante una bolsa de plástico para colocar su toalla de papel.
5. Pida a los estudiantes que escriban sus nombres en las bolsas con un sharpie.
6. Los estudiantes llevarán las bolsas de vuelta a su salón de clases para grabar en una ventana y observar el crecimiento de la semilla durante los próximos 7 días.
7. Pase alrededor de los brotes comestibles para que los estudiantes lo intenten.
8. Analice con los estudiantes para ayudar a establecer conexiones entre los brotes que están comiendo y la semilla que acaban de plantar.
9. Los brotes son altos en energía, vitaminas, minerales y proteínas, pregunte a los estudiantes por qué piensan que los brotes podrían estar tan densamente llenos de nutrientes? Sugerencia: ¿Qué está haciendo la planta cuando está en la etapa de brotado?

Figure 8: The lesson plan from figure 7, translated into Spanish.

Conclusion

This project is a great example of how the power of garden-based learning can be harnessed by schools and organizations to create an effective learning experience for their students. Although we were limited in our research because of the short timeline of the project, we believe that our results and deliverable can be implemented and even expanded in the future. If the desire for a garden-based curriculum is present, then anyone, regardless of their access to "traditional" garden materials and resources, can and should be able to take advantage of the opportunity. The positive impacts and applications of garden-based learning are vast and can even extend beyond the classroom - entire communities may benefit from its introduction and use. Our hope is that, through the development process, we have provided a multipurpose, and sustainable garden-based curriculum that schools and organizations in Ecuador can use to teach and inspire students about a variety of topics in the most fun, engaging, and effective way.

References

(2021, February 25). Map of Ecuador [Ecuador South America]. World Atlas. Retrieved March 8, 2021, from https://www.worldatlas.com/maps/ecuador

Blair, D. (2009). The Child in the Garden: An Evaluative Review of the Benefits of School Gardening. *The Journal of Environmental Education*, 40(2), 15–38. https://doi.org/10.3200/JOEE.40.2.15-38

Brief Information of Ecuador. Regions and provinces of Ecuador. Retrieved from: https://briefinformationofecuadorec.wordpress.com/natural-regions-of-ecuador/

Cotugna, N., Manning, C., & DiDomenico, J. (2012). Impact of the Use of Produce Grown in an Elementary School Garden on Consumption of Vegetables at School Lunch. *Journal of Hunger & Environmental Nutrition*, *7*(1), 11–19. https://doi.org/10.1080/19320248.2012.649668

Cuenca, Ecuador. (2020, May 11). *New World Encyclopedia*. https://www.newworldencyclopedia.org/p/index.php?title=Cuenca,_Ecuador&oldid=1037043.

Delgado, R. C., Glas, J. Muñoz, P., Vaca, C., Long, G., Arellano, H., Rivera, P., Poveda, R., Espinosa, R., Ramírez, R., Sánchez, M., Martínez, J., Chilán, C., De la Torre, P., Maji, R., Quiñónez, Y., Rodríguez, K., Larrea, A. M. (2013). *National Development Plan / National Plan for Good Living*, 2013-2017. ISBN-97809942-07-493-5

Department of Education, I. (2016). *RISE Evaluation and Development System: Student Learning Objectives Handbook* (pp. 1-56, Rep.). Indianapolis, Indiana: Indiana Department of Education. doi:https://files.eric.ed.gov/fulltext/ED565865.pdf (ERIC Document Reproduction Service No. ED565865)

Deslauriers, L., McCarty, L. & Miller, K. ,Callaghan, K., Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*. 116. 201821936. 10.1073/pnas.1821936116.

Duncan, D., Collins, A., Fuhrman, N., Knauft, D., & Berle, D. (2016). The Impacts of a School Garden Program on Urban Middle School Youth. *Journal of Agricultural Education*, 57(4), 174–185. https://doi.org/10.5032/jae.2016.04174

EC Const.: Political Database of the Americas, English Translation

Ecuadorian Ministry of Education. (2012). *Proyecto Programa de Alimentación Escolar* (School Feeding Program). Subsecretaría de Administración Escolar, Quito.

Fajardo-Dack, T. M., (2016) Teacher Disempowerment in the Education System of Ecuador. *World Journal of Education*, 6(*3*). doi:10.5430/wje.v6n3p82

Freire, W. B., Silva-Jaramillo, K. M., Ramírez-Luzuriaga, M. J., Belmont, P., & Waters, W. F. (2014). The double burden of undernutrition and excess body weight in Ecuador. *The American journal of clinical nutrition*, *100*(6), 1636S–43S. https://doi.org/10.3945/ajcn.114.083766

Goodwin University. (2019). *Hands-on learning benefits for children*. Goodwin college.https://www.goodwin.edu/enews/benefits-of-hands-on-learning/

Hasani, A., Juansah, D. E., Sari, I. J., & El Islami, R. A. Z. (2020). Conceptual Frameworks on How to Teach STEM Concepts in Bahasa Indonesia Subject as Integrated Learning in Grades 1–3 at Elementary School in the Curriculum 2013 to Contribute to Sustainability Education. *Sustainability*, *13*(1), 173. MDPI AG. http://dx.doi.org/10.3390/su13010173

Hayes, M. (2020). The Coloniality of UNESCO's heritage Urban Landscapes: Heritage Process and Transnational Gentrification in Cuenca, Ecuador. *Urban Studies*, Vol 57(*15*) DOI: 10.1177/0042098019888441

Historic Centre of Santa Ana de los Ríos de Cuenca. (n.d.) UNESCO World Heritage Database. https://whc.unesco.org/en/list/863/

Hsieh, H., & Shannon, S. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15(9), 1277–1288. https://doi.org/10.1177/1049732305276687

Kapelari, S. (2015). *Garden learning: A study on European botanic gardens' collaborative learning processes*. Ubiquity Press. http://dx.doi.org/10.5334/bas.

Lever, J. (2020). *The Indigenous Garden Project: Reflecting on Land-Based Education, Decolonizing and Garden Spaces in British Columbia's K-12 Education System*. Master's Thesis, University of Victoria, Canada

Linnell, J., Zidenberg-Cherr, S., Briggs, M., Scherr, R., Brian, K., Hillhouse, C., & Smith, M. (2016). Using a Systematic Approach and Theoretical Framework to Design a Curriculum for the Shaping Healthy Choices Program. *Journal of Nutrition Education and Behavior*, *48*(1), 60–69.e1. https://doi.org/10.1016/j.jneb.2015.09.010

Littig, B., & Pöchhacker, F. (2014). Socio-Translational Collaboration in Qualitative Inquiry: The Case of Expert Interviews. *Qualitative Inquiry*, 20(9), 1085–1095. https://doi.org/10.1177/1077800414543696

Lujan, H. L., & DiCarlo, S. E. (2006). Too much teaching, not enough learning: what is the solution? *Advances in Physiology Education*, *30*(1), 17–22. https://doi.org/10.1152/advan.00061.2005

Lune, H., & Berg, B. L. (2018). A Dramaturgical Look at Interviewing. In *Qualitative research methods for the social sciences* (8th ed., pp. 106-127). Pearson India Education Services Pvt.

Macas, L. (2010). Sumak Kawsay: La vida en plenitud. *América Latina en movimiento*, 452, 14-16.

Marzano, R. J. (2014). *Designing and teaching learning goals and objectives: Tools and tips to enhance practices, design, and feedback*. Marzano Research Laboratory. ProQuest Ebook Central https://ebookcentral-proquest-com.ezpxy-web-p-u01.wpi.edu

McAleese, J., & Rankin, L. (2007). Garden-Based Nutrition Education Affects Fruit and Vegetable Consumption in Sixth-Grade Adolescents. *Journal of the American Dietetic Association*, 107(4), 662–665. https://doi.org/10.1016/j.jada.2007.01.015

McConnell, M. M., St-Onge, C., & Young, M. E. (2014). The benefits of testing for learning on later performance. *Advances in Health Sciences Education, 20*(2), 305-320. doi:10.1007/s10459-014-9529-1

Miller, D. L. 2007. The Seeds of Learning: Young Children Develop Important Skills Through Their Gardening Activities at a Midwestern Early Education Program. *Applied Environmental Education & Communication*, 6(1):49-66.

Morris, J., & Zidenberg-Cherr, S. (2002). Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *Journal of the American Dietetic Association*, 102(1), 91–93. https://doi.org/10.1016/S0002-8223(02)90027-1

MSP, FAO. (2021). Plan Nacional de Implementación de las Guías Alimentarias Basadas en Alimentos (GABA) del Ecuador. Quito. https://doi.org/10.4060/ca9955es

National Assembly, Legislative and Oversight Committee. (Published 2008, Oct. 20. Updated 2011, Jan. 31). Constitution of the Republic of Ecuador.

Ozer, E. J. The Effects of School Gardens on Students and Schools: Conceptualization and Considerations for Maximizing Healthy Development. *Health Education & Behavior*. 2007;34(6):846-863. doi:10.1177/1090198106289002

Panasuk, R. M., & Todd, J. (2005). Effectiveness of lesson planning: factor analysis. *Journal of Instructional Psychology*, *32*(3), 215+

Parlier, J. (2019). Reducing dropout rates through CTE and interactive technology. *The Journal*. https://thejournal.com/articles/2019/08/28/reducing-dropout-rates-through-cte-and-interactive-technology.aspx

López Pastor, V., Pérez Brunicardi, D., Manrique Arribas, J., & Monjas Aguado, R. (2015). Los retos de la Educación Física en el Siglo XXI (Challenges of Physical Education in XXI Century). *Retos*, *29*, 182-187. https://doi.org/10.47197/retos.v0i29.42552

Ra, Z. (2018). Gobierno difunde "GUÍAS Alimentarias del Ecuador". https://lodijeron.wordpress.com/2018/10/20/gobierno-difunde-guias-alimentarias-del-ecuador/

Ratcliffe M.M., Merrigan K.A., Rogers B.L., Goldberg J.P. (2011). The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption. *Health Promotion Practice*, 12(1):36-43. doi:10.1177/1524839909349182

Robinson, C.W., J. M. Zajicek. (2005). Growing minds: the effects of a one-year school garden program on six constructs of life skills of elementary school children. *HortTechnology* 15(3): 453-457.

Rodas-Espinoza, P., Pérez-Solís, G., Torres-Balarezo, G. (2020). El Ejido de Cuenca: Valoracion y Gestion en su Declaratoria Como Patrimonio Cultural del Ecuador. *Diseño Arte y Arquitectura*, (*8*), 257-272.

Rogers, M., Livstrom, I., Roiger, B., & Smith, A. (2019). Growing North Minneapolis: Connecting Youth and Community through Garden-based Experiential Learning, *HortTechnology hortte*, *30*(1), 25-30. https://doi.org/10.21273/HORTTECH04308-19

Schneider, B.R., Estarellas, P.C., Bruns, B. (2019). The Politics of Transforming Education in Ecuador: Confrontation and Continuity, 2006–17. *Comparative Education Review.* 63(2). https://doi.org/10.1086/702609.

Rye, J. A., Selmer, S. J., Pennington, S., Vanhorn, L., Fox, S., & Kane, S. (2012). Elementary School Garden Programs Enhance Science Education for All Learners. *Teaching Exceptional Children*, 44(6), 58–65. https://doi.org/10.1177/004005991204400606

Scogin, S., Kruger, C., Jekkals, R., & Steinfeldt, C. (2017). Learning by Experience in a Standardized Testing Culture: Investigation of a Middle School Experiential Learning Program. *The Journal of Experiential Education*, 40(1), 39–57. https://doi.org/10.1177/1053825916685737

Torres, R. M. (2012). Proyecto arquitectónico sin proyecto pedagógico. http://otra-educacion.blogspot.ca/2012/01/proyecto-arquitectonico-versus-proyecto.html

Torres, I., & Simovska, V. (2017). Community participation in rural Ecuador's school feeding programme: A health promoting school perspective. *Health Education*, 117(2), 176–192. https://doi.org/10.1108/HE-02-2016-0009

UNESCO Institute for Statistics (UIS) (2017). 2017 Pupil Teacher Ratio. Retrieved from http://uis.unesco.org/en/country/us.

Utter, J., Denny S., Dyson, B. (2016). School gardens and adolescent nutrition and BMI: Results from a national, multilevel study. *Preventive Medicine*. 83,1-4. https://doi.org/10.1016/j.ypmed.2015.11.022.

Villafuerte, J., Perez, L., Boyes, E., Mena, L., Pinoargote, J., Riera, A., & Delgado, D. (2018). Challenges of the basic education system in Ecuador; the voices of the future teachers. *Arts and Humanities Open Access Journal*, *2*(4), 217-224.

Vinueza, D. , Lera, L. , Salinas, J. , González, C. , Barrios, L. and Vio, F. (2016) Evaluation of a Nutrition Intervention through a School-Based Food Garden to Improve Dietary Consumption, Habits and Practices in Children from the Third to Fifth Grade in Chile. *Food and Nutrition Sciences*, **7**, 884-894. doi: 10.4236/fns.2016.710088.

Waliczek, T., Bradley, J., & Zajicek, J. (2001). The Effect of School Gardens on Children's Interpersonal Relationships and Attitudes Toward School. HortTechnology (Alexandria, Va.), 11(3), 466–468. https://doi.org/10.21273/HORTTECH.11.3.466

Wells, N. M., Meyers, B. M., Todd, L. E., Henderson, C. R., Jr, Barale, K., Gaolach, B., Ferenz, G., Aitken, M., Tse, C. C., Pattison, K. O., Hendrix, L., Carson, J. B., Taylor, C., & Franz, N. K. (2018). The carry-over effects of school gardens on fruit and vegetable availability at home: A randomized controlled trial with low-income elementary schools. *Preventive medicine*, *112*, 152–159. https://doi.org/10.1016/j.ypmed.2018.03.022

Wexler, N. (2020). Building Knowledge: What an Elementary School Curriculum Should Do. *American Educator*, 44(2), 18-22.

Wiles, J. L., Rosenberg, M. W., & Kearns, R. A. (2005). Narrative analysis as a strategy for understanding interview talk in geographic research. *Area*, *37*(1), 89–99. https://doi.org/10.1111/j.1475-4762.2005.00608.x

Williams, D.R., Dixon, P.S. (2013) Impact of Garden-Based Learning on Academic Outcomes in Schools: Synthesis of Research Between 1990 and 2010. *Review of Educational Research*, 83(2), 211-235. doi:10.3102/0034654313475824

Wolsey, T.D., & Lapp, D. (2014). School Gardens: Situating Students Within a Global Context. *Journal of Education*, 194(3), 53–60. https://doi.org/10.1177/002205741419400306

World Food Programme (2012), Estudio sobre la alimentación escolar en el Ecuador (Study of school nutrition in Ecuador), WFP, Quito http://documents.wfp.org/stellent/groups/public/documents/liaison_offices/wfp256486.pdf

Wurdinger, S. D., & Carlson, J. A. (2009). *Teaching for experiential learning: Five approaches that work.* Rowman & Littlefield Education.

Wurdinger, S. D., & Marlow, L. (2005). *Using Experiential Learning in the Classroom: Practical Ideas for All Educators*. R&L Education.

Appendices

Appendix A: Using School Gardens as a Food Source in Ecuador

Many Ecuadorian students suffer from some form of malnutrition (Freire et al, 2014). To help combat this, Ecuador created the *Guías Alimentarias Basadas en Alimentos del Ecuador* or the Food Based Dietary Guidelines. This dietary guide is represented by a large wooden spoon and displays all the dietary suggestions in a child-friendly format (MSP, pp. 4, 22). The inside portion of the spoon represents a plate with all the food groups in proportions and the handle symbolizes how the food should be produced and consumed.

Figure 9: Federal nutrition guide of Ecuador (Ra, Z; Gobierno Difunde).

Ecuadorian schools also have a School Feeding Program (SFP) system put in place by the Ministry of Education to help guide the meals that they provide for their students. School meals were traditionally reliant on community and parental contributions to cook and distribute meals, but in 2009, the Ecuadorian government assumed control of this system and removed the financial provisions for lunch. Once the government removed lunch as a meal that students would receive, many school lunches were replaced with granola bars and pre-packaged snacks that were cheaper to provide. Without the need for fully cooked, balanced meals, pre-existing school gardens started to disappear and community participation, that was an important factor in the cooking and distribution of school lunches, declined (Torres & Simovska, 2017; World Food Programme, 2012). As mentioned in our literature review, reintroducing school gardens may offer a way to integrate healthier lunches back into Ecuador's schools (Cotugna et al, 2012).

Appendix B: National Plan for Good Living

The National Plan for Good Living was a direct response to neoliberalism and the exploitation of Ecuador's natural resources (National Assembly, 2008, p.4). Following the election of President Rafael Correa, Ecuador codified *Sumak Kawsay*, or "Good Living" in English. *Sumak Kawsay* is an Andean/Amazonian way of living that suggests that we are all inexorably tied to each other and nature (Macas, 2010, p.14). By codifying *Sumak Kawsay*, the federal government legally recognized the Rights of Nature, and promised to uphold the Rights of Nature, the right for all citizens to live a happy life, and the rights of future generations (National Assembly, 2008, p23). These rights are more dynamic than rights guaranteed in the west, as they are not only political, but are also social. Under Title II: Rights, 74 Articles were published, each guaranteeing separate rights, with subclauses in many articles. To go over each right would be too exhaustive, so only a few clauses will be selected. In Title: II, Chapter two, the Right to Good Living is formalized, which includes rights to information and communication, culture, education, habitat and housing, and health. In Title II, Chapter seven, The Rights of Nature are codified, which treats land not as property, but as an entity which has rights (EC Const, art. II, XI).

Appendix C: Interview Preamble for Informed Consent in English and Spanish

Our names are Ethan, Michael, Alison, and Andy, and we are an undergraduate research team from WPI, a university in the United States, studying nutrition and education in Ecuador. We are developing a garden curriculum for Ecuador's national curriculum in conjunction with Cuenca educators and the Castle Foundation.

Before we begin the interview, we would like to let you know that this interview is voluntary, and you may stop the interview or refuse to answer any of the questions at any time. We will be taking notes and recording the interview if that is okay with you. Your identity will be confidential and if we use any portion of this interview in our report, your identity would be protected. We can send you our paper for review before it is finalized if you would like. For more information about this research or about the rights of research participants, or in case of research-related injury, please refer to the following contact information:

Project Team: Ethan Bae, Michael Laemmle, Alison Lambert, Andy Ventura Molina

Email: gr-huertod21@wpi.edu

Advisor: Courtney Kurlanska, Ph.D.

Email: cbkurlanska@wpi.edu

Nos llamamos Ethan, Michael, Alison, y Andy y somos un equipo de investigación de WPI, una universidad en los Estados Unidos, que estudia educación en Ecuador. Estamos desarrollando un currículo de jardinería en colaboración de educadores de Cuenca y la Fundación Castillo.

Antes de empezar, nos gustaría decirle que esta entrevista es voluntaria y puede parar la encuesta o negarse a responder a cualquiera de las preguntas en cualquier momento. Tomaremos apuntes y grabaremos la entrevista si eso está bien con usted. ¿Le importa si citamos alguna parte de esta entrevista en nuestro informe si usamos un seudónimo anónimo? Podemos enviarle nuestro documento para su revisión antes de que finalice. Para obtener más información sobre esta investigación o sobre los derechos de participantes en la investigación, o en caso de lesiones relacionadas con la investigación, consulte la siguiente información de contacto:

El Equipo de Proyecto: Ethan Bae, Michael Laemmle, Alison Lambert, Andy Ventura Molina

Correo Electrónico: gr-huertod21@wpi.edu

El Consejero: Courtney Kurlanska, Ph.D.

Correo Electrónico: cbkurlanska@wpi.edu

Appendix D: Guide for Interviews with Foundation Leaders in English and Spanish

Interview guides for the directors of El Arenal and CETAP-Lucy in both English and Spanish.

1. What do you do on a typical workday?
2. What are the general and classroom resources that your foundation has at their disposal?
3. How many students do you work with? What is the age range of your students?
4. What types of activities do you think students enjoy participating in?
5. In your experience, what makes lessons and activities most effective?
6. What do you think is the most effective way that your pupils learn?
7. Do you know of any schools or foundations that have used a school garden either for food or in the curriculum?
    a. What are your thoughts about it?
8. Where could a school garden be integrated with the current Ecuadorian public school curriculum?
9. What would you most like to see in a garden-based curriculum?

We appreciate you taking the time to answer our questions. They have been useful for our research.

Interview Guide in Spanish

1. ¿Qué hacer en un día de trabajo típico?
2. ¿Cuáles son los recursos que su fundación tiene a su disposición?
    a. Recursos escolares generales (internet, impresora, etc.)
    b. Recursos de aula (pizarras, lápices, etc.)
3. ¿Con cuántos estudiantes trabajas? ¿Cuál es el rango de edad de sus estudiantes?
4. ¿En qué tipo de actividades cree que disfrutan los estudiantes participando?
5. En su experiencia, ¿qué hace que las lecciones y actividades sean las más efectivas?
6. ¿Cuál cree que es la forma más efectiva en que aprenden sus estudiantes?
7. ¿Conoces alguna escuela o fundación que haya utilizado un jardín escolar, ya sea para comida o en el plan de estudios?
    a. ¿Qué lo piensa?
8. ¿Dónde podría integrarse un huerto escolar con el actual currículo escolar público ecuatoriano?
9. ¿Qué es lo que más le gustaría ver en un plan basado en el jardín?

Apreciamos que se tome el tiempo para responder a nuestras preguntas. Han sido útiles para nuestra investigación.

Appendix E: Guide for Expert Interviews

This first interview was conducted on 4/12/21 with Karin Ninburg.

1. Can you talk a little bit about your experiences with school gardens?
    a. Where did your interest develop?
2. What is the current project that you are working on?
    a. How did it begin?
    b. What is the status of the project?
3. Do you know any schools that have used a school garden either for food or in the curriculum?
    a. What are your thoughts about it? Was it successful?
    b. Were there areas that you think could have been improved?
4. Where do you think school gardens could be integrated with current school curriculums, specifically to Ecuador or in other parts of the world?
5. If you were a student or a teacher, what would you most like to see in a garden-based curriculum?
    a. Are there subject areas that you think we should focus on?
6. Do you have any other suggestions for our curriculum?

We appreciate you taking the time to answer our questions. They have been useful for our research.

This second interview was conducted on 4/16/21 with Andrea Newton.

1. Can you tell us a bit about your experiences with the garden club?
    a. What are typical activities that you do?
    b. How many students are involved?
    c. How was the club formed/the greenhouse created?
2. Are there certain activities, approaches, or lessons from a garden that you think could be used in the classroom?
3. As a teacher, what types of lessons or activities are most effective with your students?
4. What are certain activities or lessons that your students enjoy the most during school?
5. If you were a student, what would you most like to see in a garden-based curriculum?
    a. Are there subject areas that you think we should focus on?
6. Do you have any other suggestions for our curriculum?

Appendix F: Location Description

Ecuador is separated into three natural regions: La Costa, La Sierra, and El Oriente. La Sierra is the Andean interior of Ecuador, stretching from Ecuador's northern border with Colombia to its Southern border with Peru. Santa Ana de los cuatro ríos de Cuenca, or Cuenca in short, is located in the Azuay Province of Ecuador in the southern hemisphere of La Sierra and is one of the most culturally significant cities in Ecuador.

Figure 10: Regions and provinces of Ecuador.

Figure 11: World atlas of Ecuador.

In 1557, modern Cuenca was founded by the conquistador Gil Ramírez . Built on Cañari and Inca ruins of Guapondeleg and Pumapungo, respectively, Cuenca is considered a possible candidate from which the myth of El Dorado originated. Cuenca's namesake comes from its geography - four rivers (Cuenca, Ecuador, New World Encyclopedia). These four rivers lead Cuenca to economic and agricultural success, and it remains one of the most economically successful cities, in terms of pure GDP. However, Cuenca's wealth disparities are significant; in the 1950s, Cuenca's municipal government hired famous architect and urbanist Gilberto Gatto Sobral to create an urban plan for Cuenca, looking to return urban order to the once culturally significant city that had grown exponentially large (and haphazardly) due to the industrial revolution (Rodas-Espinoza et al., 2020, p. 265). Gatto Sobral proposed a focus on modernist architecture, with a portion of the city dedicated to the rich and wealthy, preserving the architecture of the city center, and called for the structuring and organizing of the surrounding area.

In the 1970s, as the ruling elites moved into the surrounding suburbs, they looked to preserve the architecture inside the city center. They created an ordinance that prohibited the destruction of any buildings in the center, in addition to driving up rent prices. However, it was until the 1980s when an investment boom would solidify the class system in Cuenca. The investment boom exacerbated class imbalances between the rich and the poor, forcing the poor out of the center of Cuenca and into the outskirts. (Hayes, 2020, pp. 3062-3065). In 1999, UNESCO made the civic center of Cuenca into a world heritage site (Historic Centre, UNESCO). In an interview with Dizney, a notable philanthropist and Cuenca resident, Cuenca's wealth disparities manifests itself greatly in the education system. Printing curriculums and readings may be costly, internet access is limited, and the technology is subpar, in comparison to the inner-city school systems (D. Dizney, personal communication, February 16, 2021).

Appendix G: Table of Basic Elementary Objectives

We constructed our table of objectives with four elements: The Objective Code corresponding to those used in the Ministry of Education national curriculum, the subject area, the description taken verbatim from the national curriculum, and whether these objective areas could be naturally integrated into the curriculum design. The fourth column, "Suitable for use?", explains whether we deemed the objective suitable for use in a garden-based curriculum. If the row is green, the objective was referenced directly by one or more lesson plans in the deliverable. If row is red, the objective was not referenced directly in the deliverable.

Objective Code	Subject	Description	Suitable for use?
O.ECA.2.1.	Culture and Art	Perform individual and collective artistic productions from the combination of techniques and materials given.	✓
O.ECA.2.2.	Culture and Art	Identify and describe characteristic elements of products, heritage, and local and universal contemporary artistic productions.	✓
O.ECA.2.3.	Culture and Art	Describe the main characteristics of some professions of the world of art and culture.	✓
O.ECA.2.4.	Culture and Art	Take on different roles in the development of cultural and artistic projects.	✓
O.ECA.2.5.	Culture and Art	Express the ideas and feelings that arise from the observation of traditional and contemporary cultural and artistic productions.	✓
O.ECA.2.6.	Culture and Art	Use audiovisual media and digital technologies to search for information about works, authors or techniques and create simple sound, visual or audiovisual productions.	
O.ECA.2.7.	Culture and Art	Express and communicate emotions and ideas through language, sound, visual and body.	✓
O.ECA.2.8.	Culture and Art	Search, select and organize information about different cultural and artistic manifestations, and exhibit some acquired knowledge.	✓
O.CN.2.1.	Natural Sciences	Explore and understand the life cycles and essential characteristics of plants and animals,	✓

		to establish similarities and differences; classify them into angiosperms or gymnosperms, vertebrates, or invertebrates, respectively, and relate them to their habitat.	
O.CN.2.2.	Natural Sciences	Explore and discuss habitat classes, the reactions of living beings when natural habitats change, the threats that cause their degradation and establish relevant decision-making.	✓
O.CN.2.3.	Natural Sciences	Locate in your body the organs related to vital needs and explain their characteristics and functions, especially those that form the osteomuscular system.	
O.CN.2.4.	Natural Sciences	Describe, give examples, and apply healthy lifestyle habits to keep the body healthy and prevent disease.	✓
O.CN.2.5.	Natural Sciences	Experience and describe the changes and movement of objects by force action, in simple machines for everyday use.	
O.CN.2.6.	Natural Sciences	Experimentally research and describe the physical states of matter and its changes and verify them in the environment.	
O.CN.2.7.	Natural Sciences	Investigate and explain the forms of matter and energy sources, its classes, transformations, forms of propagation and uses in everyday life.	
O.CN.2.8.	Natural Sciences	Infer the simple cause-and-effect relationships of phenomena that occur in the universe and Earth, such as the phases of the Moon and the movements of the Earth and analyze the importance of natural resources for the lives of living beings.	✓

O.CN.2.9.	Natural Sciences	Understand that observation, exploration, and experimentation are scientific thinking skills that facilitate understanding of the historical development of science, technology, and society.	✓
O.CN.2.10.	Natural Sciences	Applying scientific research skills to relate the physical me to living beings and communicate the results honestly.	✓
O.CN.2.11.	Natural Sciences	To inform and communicate the knowledge applied to traditional agriculture by indigenous ancestral and cultural civilizations of Ecuador.	✓
O.M.2.1.	Mathematics	Explain and build patterns of figures and numericals will link them with addition, subtraction and multiplication, to develop logical-mathematical thinking.	✓
O.M.2.2.	Mathematics	Use objects from the environment to form sets, graphically establish the correspondence between their elements, and develop the understanding of mathematical models.	✓
O.M.2.3.	Mathematics	To integrate specifically the concept of number, and to recognize whether or not the environment presents problems that require the formulation of simple mathematical expressions, to solve them, individually or in a group, using the somewhat rhythms of addition, subtraction, multiplication and exact division.	✓
O.M.2.4.	Mathematics	Apply counting strategies, addition calculation procedures, subtraction, multiplication and divisions from 0 to 9 999, to collaboratively see everyday problems of your environment.	✓
O.M.2.5.	Mathematics	To understand the space around it, to value historical places, tourist and natural assets, identifying as thematic concepts the elements	✓

		and properties of bodies and geometric figures in objects of the environment.	
O.M.2.6.	Mathematics	Solving everyday situations involving measurement, estimation and calculation of lengths, capacities and masses, with conventional and non-conventional units of objects in your environment, for a better understanding of the space around you, the assessment of your time and that of others, and the promotion of honesty and integrity in their actions.	✓
O.M.2.7.	Mathematics	To participate in projects of analysis of information of the immediate environment, through the collection and representation of data and statistics in pictograms and bar diagrams; thus, potentiating the logical-mathematical and creative thinking, when interpreting the information and expressing conclusions by assuming commitments.	✓
O.LL.2.1.	Language and Literature	Understand that the written language is used with various intentions according to contexts and communicative situations, to develop a critical attitude in the face of written texts.	
O.LL.2.2.	Language and Literature	To value the linguistic and cultural diversity of the country through the knowledge and use of some words and phrases of the original languages to strengthen the sense of identity and belonging.	✓
O.LL.2.3.	Language and Literature	Participate in oral communication situations typical of family and school settings, with the ability to listen, maintain the topic of dialogue and develop ideas from exchange.	
O.LL.2.4.	Language and Literature	Communicate your ideas orally effectively by using the basic structures of the oral language and vocabulary relevant to the communicative	✓

		situation.	
O.LL.2.5.	Language and Literature	Self-read literary and non-literary texts, to recreate and meet information and learning needs.	
O.LL.2.6.	Language and Literature	Develop thinking skills to strengthen problem-solving and autonomous learning skills by using oral and written language.	
O.LL.2.7.	Language and Literature	Use classroom library resources and explore ICTs to enrich literary and non-literary reading and writing activities.	
O.LL.2.8.	Language and Literature	Write stories and exhibition and descriptive texts, on various available media, and use them as means of communication and expression of thought.	✓
O.LL.2.9.	Language and Literature	Reflect on the semantic, lexic, syntactic, or tographical patterns and textual properties to apply in their written productions.	
O.LL.2.10.	Language and Literature	Appropriate the alphabetic code of Spanish and use it automatically in writing.	
O.LL.2.11.	Language and Literature	To appreciate the statistic use of the word, from the listening and reading of literary texts, to enhance the imagination, curiosity, memory and develop preferences in literary taste.	
O.LL.2.12.	Language and Literature	Demonstrate a relationship lived with language in interacting with literary texts read or heard to explore creative writing.	

Appendix H: Table of Performance Criteria

Here, we evaluated the performance criteria, a term used to describe distinct skills that Ecuadorian students should be learning, that are defined by the MoE for each subject area. The objectives listed in Appendix G consist of performance criteria, and satisfying all performance criteria is key to fully satisfy objectives.

We constructed our table of objectives with five elements: The specific Objective Code corresponding to those used in the MoE national curriculum, the subject area, the description of the performance criteria taken verbatim from the MoE national curriculum, and whether or not these objectives could be naturally integrated into the curriculum design. The fourth column, "Suitable for use?" explains whether we deemed the objective suitable for use in a garden-based curriculum. The fifth column describes whether that piece of performance criteria is essential or non-essential, but desirable, to satisfy its corresponding objective. If the row is green, the objective was referenced directly by one or more lesson plans in the deliverable. If row is red, the objective was not referenced directly in the deliverable.

Performance Criteria Code	Subject	Description	Suitable for use?	Essential (E) or Desirable (D) Classification
ECA.2.1.1.	Culture and Art	Experiment with the possibilities of color and gesture by putting the silhouette of the body, and the footprints of the hands and feet on various supports (paper, cardboard, cardboard), of different sizes, and using different materials (painting, clay, plants, etc.)	✓	(E)
ECA.2.1.2.	Culture and Art	Define individuality by incorporating all the elements that are made necessary (a ring on the hands, a flower to the repressed chest, a faceless face, a green foot, and a blue foot, etc.) graphic body tations		(D)
ECA.2.1.3.	Culture and Art	Reflect on the results obtained by representing the body itself and expose them orally.		(E)
ECA.2.1.4.	Culture and Art	Experience the perception of smells, sounds, flavors, and textures through sensory games, in which you guess what is savored, smelled, heard, or touched.	✓	
ECA.2.1.5.	Culture and Art	Recreate sensory perceptions through movement and visual and sound representation, using syntheses such as:	✓	(D)

		paint the bitter, touch the sweet, make sound to the rough, give the movement to the red color, dance a painting, etc.		
ECA.2.1.6.	Culture and Art	Explore the possibilities of the moving body in response to various stimuli (tours, stories, images, musical pieces, sounds, etc.)		(E)
ECA.2.1.7.	Culture and Art	Naming the characteristics of natural and artificial textures as a result of a process of visual and tactile exploration and recreate its possibilities in the invention of new textures.	✓	(D)
ECA.2.1.8.	Culture and Art	Describe the characteristics and sensations produced by some elements present in the natural environment (plants, trees, minerals, animals, water, sounds), as a result of a sensory exploration process.	✓	(E)
ECA.2.1.9.	Culture and Art	Explore, through the senses, the qualities, and possibilities of organic and inorganic materials, and use them for the creation of plastic productions, puppets, sound objects, etc.	✓	(E)
ECA.2.1.10.	Culture and Art	Represent the house itself by drawings, models, constructions with materials, etc. and verbally describe its main characteristics		(D)
ECA.2.2.1.	Culture and Art	Interpret in small groups short stories, inspired by upcoming situations, stories heard, anecdotes lived or read, reaching agreements on the development of the action and on some visual and sound elements to characterize spaces and characters.		(E)
ECA.2.2.2.	Culture and Art	Practice rhythmic games (children's rounds, traditional games of the different nationalities of Ecuador, hand games, etc.) enable the development of different motor skills.		(E)

ECA.2.2.3.	Culture and Art	Create choreographies from the improvisation of the suggested movements by different musical pieces, exploring different possibilities of interaction (direct, follow, approach, move away, etc.) with the members of the group.		(E)
ECA.2.2.4.	Culture and Art	Observe and compare different representations of the natural and artificial environment (aerial photography, landscape painting, drawings, house plans, building models, maps, recordings and sound maps, videos, etc.)	✓	(D)
ECA.2.2.5.	Culture and Art	Create their own, individual or group representations of the natural and artificial environment, using different techniques	✓	(D)
ECA.2.2.6.	Culture and Art	Observe creations using elements of the environment (land art productions, construction of musical instruments with vegetables, etc.) and comment on their characteristics.	✓	(E)
ECA.2.2.7.	Culture and Art	Use elements of the natural and artificial environment (wood, leaves, stones, etc.) in the collective creation of simple artistic productions	✓	(E)
ECA.2.2.8.	Culture and Art	Observe sound sculptures and, in small groups, build some designed for different spaces (home, school, parks or other community spaces); install them and observe their use of them by the inhabitants or passers-by		(E)
ECA.2.2.9.	Culture and Art	Represent stories, myths, legends, stories and stories with puppets built in the classroom, coordinating one's own action with that of others and reaching agreements both in the construction process and in trials and representation.		(E)
ECA.2.2.10.	Culture and Art	Represent, through dramatizations, illustrations or sound sequences, the result of including, in traditional tales or stories, Ecuador's different nationalities, characters		(E)

		from other stories or stories, as a surprise or distorting element.		
ECA.2.2.11.	Culture and Art	Document with images, drawings, photographs and/or videos the process of making typical local meals, and creating illustrated recipes.	✓	(D)
ECA.2.2.12.	Culture and Art	Explain, after watching short videos, how some musical groups (such as Six On, Stomp, etc.) use cooking utensils as instruments		(E)
ECA.2.2.13.	Culture and Art	Create and interpret, in small groups, rhythmic pieces, using cooking utensils as musical instruments		(D)
ECA.2.3.1.	Culture and Art	Explain the similarities and differences in the traits (skin color, hair, physiognomy, tone of voice, etc.) of the companies family, community members and other cultures, based on direct observation or photographs		(E)
ECA.2.3.2.	Culture and Art	Explore the surrounding area to discover representations of people in craftsmanship, sculptures and images that make up visual culture; and observe, describe and compare the findings.	✓	(E)
ECA.2.3.3.	Culture and Art	Describe the plastic elements present in the artificial environment. (buildings, street furniture, museums, works on display in the streets, etc.) using a proper vocabulary.	✓	(E)
ECA.2.3.4.	Culture and Art	Comment on the impressions raised by the observation of production (music, dance, theatre, etc.), performed in the surrounding environment, on the streets, in the community, in auditoriums or in other settings		(D)
ECA.2.3.5.	Culture and Art	Select images of some places that are most representative of cultural heritage and the	✓	(E)

		natural environment to create albums, posters or murals		
ECA.2.3.6.	Culture and Art	Make sound or audiovisual recordings of some of the places more representative of the cultural and natural heritage of the surrounding environment		(D)
ECA.2.3.7.	Culture and Art	Write short texts describing the characteristics of some of the most representative places of the cultural and natural heritage of the surrounding environment	✓	(D)
ECA.2.3.8.	Culture and Art	Design and build traditional or popular toys (whistles, little houses with their furniture and crockery, dolls, carts, kaleidoscopes, stilts, trumpets, catapults, tops, yoyos, etc.) using waste or low cost materials (mud, clay, wood, tin, totora, wool, straw, tagua, fabrics, etc.)		(D)
ECA.2.3.9.	Culture and Art	Observe, photograph, and compare constructions and places representative of the cultural and natural heritage of the nearby environment (houses, monuments and archaeological sites, historical and modern buildings, forests, etc.) during the realization of walks	✓	(E)
ECA.2.3.10.	Culture and Art	Create simple posters or catalogs, with construction photographs of surrounding environment, describing the main characteristics of each of them	✓	(D)
ECA.2.3.11.	Culture and Art	Collect information about some relevant features of characters from traditional tales, myths and legends of the different nationalities of Ecuador.	✓	(D)
ECA.2.3.12.	Culture and Art	To devise possible modifications of characters from traditional myths and legends of the different nationalities of Ecuador; translate them into drawings or figures; and craft new stories	✓	(D)

ECA.2.3.13.	Culture and Art	Perform transformations on every day or discarded materials (pencils, fabrics, plastic bottles, cans, cartons, etc.), varying their usefulness to turn them into animals or dolls; add ornaments, modify their color and build structures		(D)
ECA.2.3.14.	Culture and Art	Responsible for the progressive transformation of some spaces of the educational center, incorporating the productions that they produce throughout the course.	✓	(E)
ECA.2.3.15.	Culture and Art	Record the transformation processes of some school spaces with periodic photographs showing changes or modifications	✓	(D)
ECA.2.3.16.	Culture and Art	To learn about the foods that form a traditional diet, their way of making in past times and their permanence in the present	✓	(E)
ECA.2.3.17.	Culture and Art	Create simple sheets that include names, location, and the specialties of local food establishments (street stalls, bars, cafes, restaurants)	✓	(D)
ECA.2.3.18.	Culture and Art	Identify the typical dishes of the country and prepare a calendar to prepare some recipes on the celebratory dates.	✓	(E)
ECA.2.3.19.	Culture and Art	Produce images, drawings, or collages to create menus for hypothetical restaurants with menus where a color predominates.	✓	(E)
CN.2.1.1.	Natural Sciences	Observe the stages of the life cycle of the human being and graphically record what changes according to age.		(D)
CN.2.1.2.	Natural Sciences	Observe and identify changes in the vital cycle of different animals (insects, fish, amphibians, reptiles, birds and mammals) and compare them with the changes in the life cycle of the human being.	✓	(E)

CN.2.1.3.	Natural Sciences	Experience and predict the stages of the vital cycle of the plants, their changes, and responses to stimuli, by observing the germination of the seed, and recognizing the importance of pollination and seed dispersion.	✓	(E)
CN.2.1.4.	Natural Sciences	Observe and describe the characteristics of the animals and classify them in vertebrates and invertebrates, by the presence or absence of column vertebral.		(E)
CN.2.1.5.	Natural Sciences	Investigate into the animals useful to humans and identify what they provide as food, clothing, companionship, and protection.		(D)
CN.2.1.6.	Natural Sciences	Observe in guided form and describe the characteristics of vertebrate animals, group them according to their characteristics and relate them to their habitat.		(D)
CN.2.1.7.	Natural Sciences	Observe and describe the parts of the plant, explain its functions, and classify them by their stratum and use.	✓	(E)
CN.2.1.8.	Natural Sciences	Observe and describe the plants with similes and classify them in angiosperms and gymnosperms, according to their similarities and differences.	✓	(E)
CN.2.1.9.	Natural Sciences	Investigate, using ICT and other resources, the diversity and importance of vertebrates and plants with seeds of the natural regions of Ecuador; identify caring for actions of protection and care.	✓	(D)
CN.2.1.10.	Natural Sciences	Investigate and describe the characteristics of local habitats, classify	✓	(E)

		them according to their characteristics and identify their plants and anni evils.		
CN.2.1.11.	Natural Sciences	Investigate in guided form the reactions of living beings to changes in natural habitats and exemplify measures focused on their care.	✓	(E)
CN.2.1.12.	Natural Sciences	To include and identify the different kinds of threats that manifest in local habitats, distinguish the measures of trolls that are applied in the locality and propose measures to stop their degradation.		(E)
CN.2.2.1.	Natural Sciences	Locate the brain, the heart, the lungs, and the stomach in your body, explain its functions and relate them to the maintenance of the vine a.		(E)
CN.2.2.2.	Natural Sciences	Explore and describe the organs that allow the movement of the body and exemplify the coordinated function of the skeleton and muscles in your body.		(E)
CN.2.2.3.	Natural Sciences	Observe and analyze the structure and function of the muscle osteo system and describe it from its functions of support, movement, and protection of the body.		(D)
CN.2.2.4.	Natural Sciences	Explain the importance of healthy feeding and physical activity according to its age and the daily activities it performs.	✓	(E)
CN.2.2.5.	Natural Sciences	Identify and apply body hygiene and food management standards; predict the consequences if you do not comply.	✓	(E)
CN.2.2.6.	Natural Sciences	Observe and analyze the food pyramid, select the food of a balanced daily diet, and classify them into energy-givers,	✓	(E)

		builders, and regulators.		
CN.2.3.1.	Natural Sciences	Observe and describe the physical states of the objects around them and differentiate them, by their physical features, in solids, liquids and gases.		(E)
CN.2.3.2.	Natural Sciences	Describe changes in the physical state of matter in nature; experiment with water and identify its changes in the face of temperature variation.	✓	(D)
CN.2.3.3.	Natural Sciences	Experiment and describe the general properties of the matter in the surrounding objects; measure mass, volume and weight with instruments and metric units.	✓	(E)
CN.2.3.4.	Natural Sciences	Observe and identify the classes of matter and differentiate them, by their features, in pure substances and natural and artificial mixtures.		(E)
CN.2.3.5.	Natural Sciences	Experience the separation of mixtures by applying simple methods and techniques and communicating the results.		(D)
CN.2.3.6.	Natural Sciences	Observe and experience the movement of the objects of the environment and explain the direction and speed of movement.		(E)
CN.2.3.7.	Natural Sciences	Observe, experiment, and describe the force action of simple machines used in daily jobs.		(E)
CN.2.3.8.	Natural Sciences	Observing and explaining the force of gravity and experiencing it tells me the fall of the bodies.		(D)
CN.2.3.9.	Natural Sciences	Explore and identify the energy, its		(E)

		forms, and sources in nature compare them and explain their importance for life, for the movement of bodies and the realization of all kinds of work.		
CN.2.3.10.	Natural Sciences	To inform and describe the transforms of the energy and explore, in the locality, its uses in daily life.		(D)
CN.2.3.11.	Natural Sciences	Observe and explain the features of light and differentiate luminous and non-luminous, transparent, and opaque objects.		(E)
CN.2.3.12.	Natural Sciences	Observe and describe the blocking of light and the features of the shadow and penumbra; experiment and explain their differences and relate to eclipses.		(D)
CN.2.3.13.	Natural Sciences	Investigate, by using ICTs and other resources, propagate light and experience it in different mediums.		(E)
CN.2.4.1.	Natural Sciences	Observe and recognize the daily cycle in living things and the friend and ask questions about the animals that perform their activities at night and during the day.		(E)
CN.2.4.2.	Natural Sciences	Differentiate the features of the day and night from the observation of the presence of the Sun, Moon and stars, the luminosity of the sky and the sensation of cold and heat and describe the responses of living beings.	✓	(E)
CN.2.4.3.	Natural Sciences	Describe the features of the Earth and its translation and rotational movements and relate them to the seasons, the day, the night, and their influence on the climate, both local and global.		(E)

CN.2.4.4.	Natural Sciences	Place and describe, using ICT and other resources, the features of the Sun, Earth and Moon and distinguish their similarities and differences according to their shape, size, and movement.		(E)
CN.2.4.5.	Natural Sciences	Directly observe the phases of the Moon and identify its influence on some of the Earth's surface phenomena.		(D)
CN.2.4.6.	Natural Sciences	To place, using ICTs and other resources, on the influence of the Sun on soil, water, air and living beings; explain it and interpret its effects.	✓	(E)
CN.2.4.7.	Natural Sciences	Define natural resources, classify them into renewables and non-renewables and highlight their importance as a source of food, energy, and raw materials.	✓	(D)
CN.2.4.8.	Natural Sciences	Explore and discuss the principle renewable natural resources of regions and identify their characteristics and uses.	✓	(E)
CN.2.4.9.	Natural Sciences	Explore and discuss the principle non-renewable natural resources of regions of the country and give reasons that have realized its controlled exploitation.		(D)
CN.2.4.10.	Natural Sciences	To include, through experimentation, and to describe the characteristics and the forming of the soil; recognize it as a natural resource.	✓	(E)
CN.2.4.11.	Natural Sciences	Include and classify soil types by their components and identify the causes of their deterioration and ways to conserve it in the locality.	✓	(D)

CN.2.4.12.	Natural Sciences	Observe and describe the water cycle in nature and recognize that water is an essential resource for life.	✓	(D)
CN.2.4.13.	Natural Sciences	To include and describe the characteristics of water, its uses and conservation and to highlight the importance of conserving freshwater sources.	✓	(E)
CN.2.4.14.	Natural Sciences	Analyze and develop models of the water potability process and explain the reason for treating water intended for human consumption		(D)
CN.2.5.1.	Natural Sciences	Include, in guided form, ancestral civilization's knowledge about the Sun and moon and its application in the traditional agriculture; information and communicate the results with relevant resources.		(E)
CN.2.5.2.	Natural Sciences	Notice the characteristics of the sky, measure some atmospheric phenomenon, by means of creation and / or use of technological instruments, record them graphically and predict atmospheric pressure.		(D)
CN.2.5.3.	Natural Sciences	Explore, in a guided way, the management of food and hygiene in local markets; predict the achievements of inadequate management for the health of people in the locality.	✓	(D)
CN.2.5.4.	Natural Sciences	Note, with appropriate technological instruments, the position of the Sun during the day, record it by means of photographs or graphs, ask questions, and give answers about its position in the morning, the median and the afternoon.		(D)

CN.2.5.5.	Natural Sciences	To place, in a guided way using ICT and other resources, on the technological development of instruments for astronomical observation; communicate and recognize the contributions of science and technology to the knowledge of the Universe.		(E)
CN.2.5.6.	Natural Sciences	Experiment, in a guided form, the types of mixtures that are used in the preparation of different foods; identify the physical state of the components and communicate their conclusions.	✓	(D)
CN.2.5.7.	Natural Sciences	Investigate, using ICT and other resources, on the traditional agricultural technologies of indigenous cultures, and Afro-Ecuadorian and Montubio peoples; communicate the conclusions and recognize the contributions of the informational knowledge in soil management.	✓	(D)
CN.2.5.8.	Natural Sciences	To place and explain, by means of models, the application of clean technologies in water management for human consumption; communicate prevention measures to prevent their contamination.		(E)
CN.2.5.9.	Natural Sciences	Investigate, using ICTs and other resources, the contribution of the Ecuadorian scientist Misael Acosta Solfs to the foundation of Ecuadorian flora; recognize its contribution in national herbariums as a source of information.		(D)
M.2.1.1.	Mathematics	Graphically represent sets and subsets, discriminating against the properties or attributes of objects.		(E)
M.2.1.2.	Mathematics	Describe and reproduce patterns of objects and figures based on their attributes.	✓	(E)

M.2.1.3.	Mathematics	Describe and reproduce numerical patterns based on sums and highlights, counting back and forth.	✓	(E)
M.2.1.4.	Mathematics	Describe and reproduce increasing numerical patterns with addition and multiplication.		(E)
M.2.1.5.	Mathematics	Build patterns of figures based on their attributes and numerical patterns from addition, subtraction, and multiplication.	✓	(D)
M.2.1.6.	Mathematics	Relate the elements of the output set to the elements of the arrival set, based on the correspondence between elements.		(E)
M.2.1.7.	Mathematics	Represent, in diagrams, tables, and a grid, the ordered pairs of a specific relationship between the elements in the output set and the items in the arrival set.	✓	(E)
M.2.1.8.	Mathematics	Identify related items in an output set and arrival set as ordered pairs of the Cartesian AXB product.		(E)
M.2.1.9.	Mathematics	Represent by extension and graphically the ordered pairs of the Cartesian product AxB.		(E)
M.2.1.10.	Mathematics	Identify the elements of the output and arrival sets, based on the ordered pairs represented in a grid.	✓	(D)
M.2.1.11.	Mathematics	Identify the subset of ordered pairs of the Cartesian AxB product that meet a one-to-one correspondence relationship.		(D)
M.2.1.12.	Mathematics	To represent, write and read the natural numbers 0 to 9 999 in concrete, graphic (in the numerical semirrecta) and symbolic form.		(E)
M.2.1.13.	Mathematics	Count quantities from 0 to 9 999 to verify estimates (in groups of two, three, five, and ten).		(E)
M.2.1.14.	Mathematics	Recognize the positional value of natural numbers of up to four figures, based on the		(E)

		composition and decomposition of units, tens, hundreds and units of a thousand, using concrete material and with symbolic representation.		
M.2.1.15.	Mathematics	Establish sequence and order relationships in a set of natural numbers up to four digits, using material with creto and mathematical symbology (=,<, >,).		(E)
M.2.1.16.	Mathematics	Recognize ordinal numbers from first to twentieth to organize objects or elements.		(D)
M.2.1.17.	Mathematics	Recognize and differentiate even and odd numbers by grouping and numerically.		(D)
M.2.1.18.	Mathematics	Recognise Halves and Doubles in Object Units.		(D)
M.2.1.19.	Mathematics	Replace the notion of addition with that of adding objects to a con together.		(E)
M.2.1.20.	Mathematics	Link the notion of subtraction to the notion of removing objects from a set and establishing the difference between two quantities.		(E)
M.2.1.21.	Mathematics	Make additions and subtractions with numbers up to 9 999, with concrete material, mentally, graphically and numerically rich.		(E)
M.2.1.22.	Mathematics	Apply decomposition strategies in tens, hundreds and thousands in addition and subtraction calculations		(D)
M.2.1.23.	Mathematics	Apply commutative and associative properties of addition in mental calculation strategies.		(D)
M.2.1.24.	Mathematics	Solve and pose, individually or in a group, problems that require the use of sums and subtractions with numbers up to four digits, and interpret the solution within the context of the problem.		(E)

M.2.1.25.	Mathematics	Relate the notion of multiplication with equal summand patterns or with "so many times so" situations.		(E)
M.2.1.26.	Mathematics	Make multiplications based on the group, geometric, and linear model.		(E)
M.2.1.27.	Mathematics	Memorize the multiplicative combinations (tablas de multiplicar) gradually with the manipulation and visualization of concrete material.		(D)
M.2.1.28.	Mathematics	Apply multiplication rules by 10, 100 and 1000 in numbers up to two digits.		(D)
M.2.1.29.	Mathematics	Apply the commutative and associative properties of multiplication in both written and mental calculation and problem solving.		(D)
M.2.1.30.	Mathematics	Relate the notion of division with equal subtraction patterns or give up quantities in equal numbers.		(E)
M.2.1.31.	Mathematics	Recognize the relationship between division and multiplication as inverse operations.		(E)
M.2.1.32.	Mathematics	Mentally calculate exact products and ratios using various strategies.		(D)
M.2.1.33.	Mathematics	Solve multiplication and division-related problems using various strategies, and interpret the solution within the context of the problem.	✓	(D)
M.2.2.1.	Mathematics	Recognize and differentiate the elements and properties of cylinders, spheres, cones, cubes, square-based pyramids, and prisms recede gulares in objects in the environment and/or geometric models.	✓	(D)
M.2.2.2.	Mathematics	Sort objects, geometric bodies, and geometric figures according to their properties.	✓	(D)

M.2.2.3.	Mathematics	Identify square, triangular, rectangular, and circular shapes in geometric bodies of the environment and/or geometric models.		(E)
M.2.2.4.	Mathematics	Build geometric figures such as squares, triangles, rectangulares, and circles.		(D)
M.2.2.5.	Mathematics	Distinguish sides, inner and outer boundary, vertices, and angles in geometric figure: Squares, triangles, rectangles, and circles.		(E)
M.2.2.6.	Mathematics	Recognize and differentiate squares and rectangles from the analysis of their characteristics, and determine the perimeter of squares and rectangles by estimation and/or measurement.		(E)
M.2.2.7.	Mathematics	Recognize lines, lines, and curves in flat figures and bodies.		(E)
M.2.2.8.	Mathematics	Graph the half-straight, segment, and angle.		(E)
M.2.2.9.	Mathematics	Recognize and classify angles according to their amplitude (straight, sharp, and obtuse) in objects, bodies, and geometric figures.		(D)
M.2.2.10.	Mathematics	Measure, estimate, and compare lengths of objects in the environment, with disrupting them with unconventional measurement patterns.	✓	(E)
M.2.2.11.	Mathematics	Use the length units of measurement: The meter and its sub-murmurs (dm, cm, mm) in the estimation and measurement of environmental object lengths.	✓	(E)
M.2.2.12.	Mathematics	Perform simple conversions of meter length measurements to submultiples.	✓	(D)
M.2.2.13.	Mathematics	Represent monetary amounts using coins and notes of 1, 5, 10, 20, 50 and 100 (didactic).		(E)

M.2.2.14.	Mathematics	Perform simple currency conversions in significant situations.		(E)
M.2.2.15.	Mathematics	Use the monetary unit in playful activities and in simple daily transactions, highlighting the importance of integrity and honesty.		(D)
M.2.2.16.	Mathematics	Recognize day, night, tomorrow, afternoon, today, yesterday, days of the week and the months of the year to assess own time and that of others, and to order sequential temporal situations associating them with even significant events.	✓	(E)
M.2.2.17.	Mathematics	Perform usual conversions between years, months, weeks, days, times, minutes and seconds in significant situations.		(E)
M.2.2.18.	Mathematics	Read hours and minutes on an analogue clock. Two and judge the validity of the results.		(D)
M.2.2.19.	Mathematics	Measure, estimate, and compare masses against non-conventional measurement patterns.	✓	(E)
M.2.2.20.	Mathematics	Use the units of mass measurement: Gram and thematic with those of other scientific disciplines and knowledge kilogram, in the estimation and measurement of environmental objects.		(E)
M.2.2.21.	Mathematics	Make simple conversions of mass measures.		(D)
M.2.2.22.	Mathematics	Identify the pound as the unit of mass measurement.		(D)
M.2.2.23.	Mathematics	Measure, estimate, and compare capabilities by comparing with non-conventional measurement patterns.	✓	(E)
M.2.2.24.	Mathematics	Use the units of measure of capacity: The liter and its submultiples (dl, cl, ml) in the estimation and measurement of environmental objects.	✓	(E)

M.2.2.25.	Mathematics	Perform simple conversions of liter capacity measures to their submultiples.		(D)
M.2.3.1.	Mathematics	Organize and represent statistical data relating to your environment in frequency tables, pictograms and bar diagrams, in order to explain and interpret conclusions and make commitments.	✓	(E)
M.2.3.2.	Mathematics	Perform simple combinations and solve everyday situations.		(E)
M.2.3.3.	Mathematics	Recognize random experiences in everyday situations.		(D)
LL.2.1.1.	Language and Literature	Distinguish the communicative intention (persuade, express emotions, inform, require, etc.) that have various texts of daily use from the analysis of the purpose of its content.		(E)
LL.2.1.2.	Language and Literature	To issue, honestly, opinion is valid on the usefulness of the information contained in texts for everyday use in different communicative situations.		(D)
LL.2.1.3.	Language and Literature	To recognize words and expressions typical of the origin languages and/or variety is linguistic of Ecuador, in different types of texts of daily use, and to investigate their meanings in the context of interculturality and pluriculturality.		(E)
LL.2.1.4.	Language and Literature	Investigate on the dialects of Spanish in the country.		(D)
LL.2.2.1.	Language and Literature	Spontaneously share your ideas, experiences, and needs in informal situations in everyday life.	✓	(E)
LL.2.2.2.	Language and Literature	Dialogue with the ability to listen, maintain the topic and exchange ideas in informal situations of daily life.		(E)
LL.2.2.3.	Language and Literature	Use the basic guidelines of oral communication (shifts in conversation, give in the word, eye contact, active		(D)

		listening) and use vocabulary according to the communicative situation.		
LL.2.2.4.	Language and Literature	Reflect on oral expression with the use of linguistic consciousness (semantic, syntactic, and lexical) in everyday contexts.		(E)
LL.2.2.5.	Language and Literature	Conduct oral presentations on topics of personal and group interest in the school context.	✓	(E)
LL.2.2.6.	Language and Literature	Enrich your oral presentations with the selection and adaptation of audiovisual and other resources.		(D)
LL.2.4.1.	Language and Literature	To develop progressively autonomy and quality in the process of writing accounts of personal experiences, everyday events or other events, events of interest and descriptions of objects, animals, places and people; applying the planning in the writing process (with graphic organizers do to the text structure), taking into account the linguistic consciousness (weekly, syntactic, lexical and phonological) in each of its steps.		(E)
LL.2.4.2.	Language and Literature	Apply thought strategies (expanding ideas, logical sequence, selection, sorting and ranking of ideas, use of graphic organizers, among others) in writing accounts of personal experiences, everyday events or other events and events of interest, and in descriptions of objects, animals, places and people, during the self-evaluation of his writings.		(E)
LL.2.4.3.	Language and Literature	To write, in communicative situations that require it, narrations of personal experiences, everyday events or other events of interest, ordering them chronologically and linking them by means of temporary connectors and additives.	✓	(E)

LL.2.4.4.	Language and Literature	Write descriptions of objects, animals, places and people; sorting the ideas according to a logical sequence, by themes and subthemes, by means of consecutive connectors, attributes, descriptive and possessive adjectives, in communicative situations that require it.	✓	(E)
LL.2.4.5.	Language and Literature	Use various formats, resources and materials , among others strategies that support the writing of stories of personal experiences, everyday events or other events of interest, and descriptions of objects, animals and places.		(D)
LL.2.4.6.	Language and Literature	To support and enrich the process of writing their personal experiences stories and everyday facts and descriptions of objects, animals and places, through paratexts, ICT resources and the citation of sources.	✓	(D)
LL.2.4.7.	Language and Literature	Progressively apply the rules of writing by means of the phonological reflex in the orthographic writing of phonemes that have one, two and three graphic representations, the letter that represent the sounds "x", the letter that has no sound: "H" and the letter "w" that has little use in Spanish.		(E)

Appendix I: Lesson Plan Evaluation

When we were analyzing our lesson plans, we needed a structure. Thus, we broke lesson plans up into seven separate categories: the name of the lesson plan, the objectives laid out in the lesson plan, how resource intensive the lesson plan is and whether or not we believe it can be viably implemented, the projected amount of time it would take to teach the lesson, the subject area, the material source, and our notes on the material. We highlighted lesson plans highlighted in green if they were selected for the curriculum, and in red if they were discarded.

Name of Lesson Plan (National Learning Objectives)	Objective of LP	Resource Intensive?	Time Length of LP (Hrs & Mins)	Subject	Source	Notes
No Cost School Garden Drip Irrigation System	- Create no-cost irrigation system for school gardens - Experimentation of Milk jugs and the optimum placement of watering jugs	No, only requires old milk jugs and materials to hang jugs	Prep Time : 30 mins Lesson : 1 hr	Irrigation, Irrigation systems, Engineering, Science	New Jersey Agricultural Society (NJAS)	*Super useful to our project, the garden would definitely need to have an irrigation system in order to implement a successful one. Definitely need this in our curriculum*
How to Measure Rain	- Explain that plants need water and in nature water comes from rain - Be able to measure how much rain falls on their garden	No, only requires old bottles and measurement tools	Prep Time : 15 mins Lesson : 1 hr	Weather, Measurement, Engineering, Earth Science	New Jersey Agricultural Society (NJAS)	*Andrea did make a point about having a decent background knowledge of plants and seeds. So I think this lesson plan will definitely have some use*
Bugs in the Garden	- Teach students about different, common bugs in the garden	No, does not really require anything except for cups	Prep Time : 5 min Lesson : 1 hr	Earth Science	Greater Richmond Fit4Kids	*Important but not super important. Could be included*
Seed Germination	- Teach students how to examine seed germination process - Teach about seed and seed germination in plant life cycle	No, but ziploc bags or subs may be difficult to obtain	Prep Time : 45 min Lesson : 1 hr	Earth Science, Plant Biology	Greater Richmond Fit4Kids	*Definitely important to know the germination process*

Do Plants Really Need Light? (	- Teach what a plant needs to grow (Water, Soil), specifically sunlight - Teach how plants use sunlight to produce sugar, their food - Explain the photosynthesis process and its hand in the life of a plant	No, paper and plants	Prep Time : 10 min Lesson : 1 hr	Plant Biology, Earth Science	New Jersey Argiculture Society (NJAS)	*Important for sure*
Learning About Plants	- Teach what a plant needs to grow	No, just paper	Prep Time : 5 mins Lesson : 45 mins	Plant Biology, Earth Science	Teacher.org and distinguished universities	*Important but one lesson plan could probably cover this entire subject*
Garden Planning	- Teach how to prepare a plan for a gardening season - Teach how long it takes for a plant to produce fruit, vegetables - Teach how some plants grow better in different seasons	No, Garden calendar and Magnetic board	Prep Time : 5 mins Lesson : 45 mins	Plant Biology, Earth Science, Garden Preparation	Greater Richmond Fit4Kids	*Important lesson*
Gardeners Plant in Soil Not Dirt	- Describe the contents of a small scoop of dirt - Describe soil as an ecosystem and explain what that means for the plants growing in it - Dirt is dead but within the soil is an ecosystem	Magnifying glass	(For one magnifying glass) Prep time: 5 mins Interactive time: 45 mins (For multiple magnifying glasses) Prep time: 15 mins Interactive time: 15 mins Theory time: 15 mins	Earth Science, Garden Preparation	NJAS	*Important to talk about decomposing and its role in the growing process*

Making Mud Shakes to Learn About Soil	- Distinguish between silt, sand, and clay soils - Why are some better than others?	No, just a couple bottles and homemade funnels	Funnel prep: 10 mins (for entire class) 35 mins (for teacher preparing funnels alone) Soil game: 5-10 mins Making mud shakes: 10 mins	Earth Science	NJAS	*Could be important but I don' t know how important, could be a substitute*
Charting Seasonal Changes	- Observing temp changes, day length changes, and sun angle changes to determine seasonal changes	Not much, just some yardsticks, time pieces, and paper	Prep time: 15 minutes Daily notes: 5 minutes each Discussion /synthesis: 35 minutes	Astronomy, Earth Science(?)	Grow Pittsburgh	*This seems difficult. It might be something one might find in a university course.*
What Grows Here	- Make educated guesses as to why certain crops grow in certain environments - Learn about global "Food zones" - Tropical plants, temperate plants, etc.	Map of the World, some paper	Prep time: 5 minutes Lesson time: 45 mins	Weather, Earth Science	Grow Pittsburgh	*Seems to be oriented towards North America. Seems cool in theory, but difficult to implement*
Tiny Gardens Giant Farmer	- Introduce students to garden layouts - Show how placement of plants affects others - Learn how to optimize light received by plants	Paper, flashlights. Optional: digital camera	Prep time: 5 minutes Lesson time: 45 mins	Astronomy, Earth Science, Garden Management	Grow Pittsburgh	*I really like this one. Good structue and flow.*

Food Begins With a Plant...	- Understand how food is created from nature, and how it can be combined to make meals - Identify what common items are made from plants - Understand how everything grows from plants	Food begins with a Plant game pieces	Prep time: 5 minutes Lesson time: 45 mins	Earth Sciences, nutrition	Grow Pittsburgh	*I really like the concepts from this one. We might wanna repurpose it tho*
Scavenger Hunt Spring (now *Installing Plant Markers*)	- Students recognize plants prior to being fully grown - Students recognize the realities of disease and pests and can recognize the symptoms of both - Disease mitigation through species diversity - Categorization of crops	Journals and paper, magnifying glass, popsicle sticks	Prep time: 5 minutes Lesson time: 45 mins	Garden Management	Grow Pittsburgh	*I also really like this one*
Weeding Our Garden	- Identify weeds and tools - Importance of removing weeds at the root - Resource competition - Weeds aren't the enemy - they are just growing in the wrong place at the wrong time - Weeds spread differently than plants	Garden gloves	Prep time: 5 mins Lesson time: 30 minutes	Garden Management, Weed biology	Grow Pittsburgh	*I really like how it discusses weeds, and learning about weeds is important in general*
Dissecting Tulips (Now *Dissecting Flowers*)	- Learn the different parts of flowers - Students learn what parts of flowers help with pollination, and how pollination works	Couple of flowers	Prep time: 10 mins Lesson time: 45 mins	Pollination, Plant biology	Grow Pittsburgh	*Could be very useful and hands on, idk about access to flowers tho*

Garden Habitat	- Define and understand the word "Habitat" - Identify ecosystem boosters that the animals and plants rely on - Make connection and identify ecosystem in garden - Brainstorm a plan to improve an ecosystem	No, Paper and pen/pencil/etc. is suffciient	Prep Time : 5 Mins Lesson : 45 mins - 1 hr Lesson Activity : 45 mins	Earth Science (Ecology)	Lane County School Garden Program	*Good to know about ecosystems but I think if we were to include it, we would be more specific to an ecosystem within a garden*
Parts of a Plant	- Identify parts of a plant - Conceptualize progression of a plant's growth - Understand purpose of parts of plant	Slightly, printable material, salad making ingredients, and paper/crayons	Prep Time : 10 mins per lesson Lesson : 1 hr per lesson Lesson Activity : 1 hr per actvity	Plant Biology	Grow Pittsburgh	*Very broad topic that can definitely be utilized and materials are substitutable*
Weather and Climate Data Collection Part 1	- Will learn to identify, observe, and document weather conditions	Very material heavy lesson: Various weather measuring instruments	Prep Time : 10 mins Lesson : 1 hr Lesson Activity : 1 hr 30 mins	Earth science, Mathematics, Weather	Greater Richmond Fit4Kids	*Some form of this could be implemented but it is very lesson material heavy and is very dependent on the weather.*
Seeds and How They Grow	- Learn different parts of a seed - Learn about the process of germination - Understand overall concept of how a seed becomes a plant	No, required materials are very minimal and reasonable to obtain	Prep Time : 30 min Lesson : 3 days Lesson Activity : In conjunction with the growth progression of seeds	Plant Biology, Earth Science	Tower Garden Plant Lesson	*Seems very feasible as long as beans are not an expensive commodity. This could potentially help us transition into garden topics*

Measurement and Geometry In the Garden K, 1st, 2nd	- Will utilize garden to apply concepts of measurement and geometry - Real world example of mathematics being used - Learn how to apply concepts in planning of a garden	No, materials required are very minimal and substitutable	Prep Time : 10 min Lesson : 1 hr 30 min	Mathematics, Garden Planning	Greater Richmond Fit4Kids	*Very useful lesson plan to have in our curriculum, very easy and useful lesson.*
Measurement and Geometry In the Garden 3rd, 4th, 5th	- Will utilize garden to apply concepts of measurement and geometry - Real world example of mathematics being used - Learn how to apply concepts in planning of a garden	No, materials required are very minimal and substitutable	Prep Time : 10 min Lesson : 1 hr 30 min	Mathematics, Garden Planning	Greater Richmond Fit4Kids	*Exactly the same content as the previously mentioned lesson plan. A bit more mathematically complicated than previous.*
Healthy Eating Habits	- Learn about healthy eating options - Students make a meal using ingredients from the garden	Slightly, could become difficult when actual food needs to be prepared	Prep Time : 15 min Lesson : 45 min Lesson Activity : 45 min	Health and Nutrition, Cooking	Greater Richmond Fit4Kids	*Besides the cooking portion of this lesson plan, it is easily implementable*
Plant Structures	- Will explore different parts of the plant - Research and explore function/role of each part	No, magnifying glass is the only item that may be challenging to get but that is all	Prep Time : 5 min Lesson : 1 hr	Plant Biology	Greater Richmond Fit4Kids	*Very interesting lesson plan that can very easily fit into the garden-based curriculum. The information would also be a first for some math integration*
Seed Saving	- Will use plants from garden to learn how to save seeds for next planting season - Learn about the life cycle of plants - Seed Germination	No, besides seeds that can either be bought or harvested from the school garden	Prep Time : 30 min Lesson : 1 hr Lesson Activity : 45 min	Plant Biology	Greater Richmond Fit4Kids	*Really cool lesson that teaches sustainability and being resourceful*

Classroom Garden from Trash	- Create and grow several plants from parts of plants that are normally thrown away - Learn what makes a food sustainable and how it can be regrown from its scraps - Use grown food to create a healthy meal	No, requires scraps of foods and some bowls. All materials are substituable	Prep Time : 1 hr Lesson : Couple of weeks(2?), in accordance with plant growth Lesson Activity : Couple of weeks(2?), in accordance with plant growth	Plant Biology, Gardening, Health and Nutrition, Earth Sciences	Teacher.org and other distinguished universties	*Really useful and easy lesson plan to include in curriculum. Helps teach how to make food when there is nothing. Materials are also very changeable*
Growing a Knowing Nose	- Learn plants give off distinct scents - Understand the connection between sense of smell and taste - Learn and understand that the plants use the scent for survival	No, items don't have to be the listed examples. Plants, cotton balls, small containers	Prep Time : 30 min Lesson : 1 hr Lesson Activity : 1 hr	Plant Biology	KidsGardening	*Interesting lesson plan about using your senses as well as other tools to help you. Really cool approach/angle we could include in the curriculum. Using your senses when you don't have the correct tools*
Plants Parts and Functions	- Learn the 6 major parts of a plant - Identify the 6 parts and each part's job	No, but having a school garden is preferable. Many optional materials	Prep Time : 25 min Lesson : 40 min to 1 hr Lesson Activity : 1 hr	Plant Biology	Lane County School Garden Program	*Very similar to all the other plant structure LP's . Note: We could probably make this a more advanced version of the Plant structures*
Soil Composition	- Understand what soil is made up of and the importance - Identify the 4 different types of soil, which soils are best for growing	No, although there are quite a few materials they are all substitutable	Prep Time : 5 min Lesson : 1 hr Lesson Activity : 45 min	Earth science (Geology)	Lane County School Garden Program	*Very good lesson plan to use. I like the games and rainy day activity they included*

Flowers and Pollination	- Identify parts of a flower and function of each - Explain 2 or more common garden pollinators - Describe the relationship of pollinators and flowers	No, unless the mentioned games want to be played. Other than that all materials are substitutable	Prep Time : 10 min Lesson : 45 min - 1 hr Lesson Activity : 30 min	Plant Biology, Earth Science (Ecosystems)	Lane County School Garden Program	*Same as the plant dissection in "Plant Parts and Functions"* ***It has been updated to focus more on pollination, uses the Seed and Seed Dispersal Lesson Plan.***
Planting the Summer Garden	- Understand the warm and cool season and how it affects crops - Identify which plants cannot survive in certain climates	No, materials are simple and are substitutable.	Prep Time : 10 min Lesson : 45 min - 1 hr Lesson Activity : 1 hr	Plant Biology, Gardening, Earth Science, Weather	Lane County School Garden Program	*I think this is an important lesson that is very relevamt to the project. Many great activites within the lessons*
There are Days and Seasons	- Understand why there are days and nights - Understand that the tilting of the Earth and orbiting around sun causes seasons - Understand that different parts of the Earth have different climates due to factors such as the equator	No, resources are simple and substitutable	Prep Time : 10 mins Lesson : 40 mins Lesson Activity : 15 mins	Earth science, Space science, Space	Community Resources for Science	Useful in teaching students about what makes the sun come up and go down. Integrating this with the importance of the sun
Grow an Art Garden: Plant a Rainbow	- Conceptualize color and visual aesthetics - Make connection between the color of the plant and its health benefits, biological properties	No, Unless the schools does not already have a garden. But materials can definitely be substituted	Prep Time : 30 mins Lesson : 1 hr Lesson Activity : 1 hr	Gardening, Plant biology, Art, Food science	Cornell Garden Based Learning	Interesting topic but would be difficult to implement a small garden for every child. If used we could just have kids contribute one idea to add to the garden and the multiple gardens become one class garden

Introduction to the Garden	- Understand the gardening basics (planting seeds, safely using tools, etc.) - Explore the life cycle of a plant and understand what they need to grow - Differentiate between what a plant needs and what a human needs	No, all materials can be easily substituted	Prep Time : 30 mins Lesson : 1 hr 30 mins Lesson Activity : 10 mins	Plant biology, Gardening	Growing Gardens	*This is a great lesson for introducing students to what a garden is and what the rules are*
Parts of the Plant	- Learn about the 6 parts of a plant - Understand the life cycle of a plant - Understand the parts of a plant that people eat	No, all materials can be easily substituted	Prep Time : 30 mins Lesson : 1 hr 30 mins Lesson Activity : 15 mins	Plant biology, Earth Sciences, Cooking	Growing Gardens	*Not as big of a fan of this. Seems a bit too involved.*
Seed and Seed Dispersal	- Understand that there are many different types of seeds - Understand the germination process and parts of a seed - Understand the basics of seed production and dispersal	No, all materials can be easily substituted	Prep Time : 30 mins Lesson : 1 hr 30 mins Lesson Activity : 6 week period	Plant Biology, Earth Sciences	Growing Gardens	**See Flowers and Pollination**
Bugs and Insects	- Describe basic anatomy of a bug - Identify beneficial and non-beneficial bugs in the garden	No, all materials can be easily substituted and obtained	Prep Time : 30 mins Lesson : 1 hr 30 mins Lesson Activity : 6 week period	Insect Biology, Earth Sciences,	Growing Gardens	

Soil and Compost	- Understand the role that soil plays in a healthy ecosystem - Explain how compost is formed and how it helps plants - Identify producers, consumers, and decomposers. Their roles in the soil food web	No, main materials are bottles/cups and those can be easily replaced	Prep Time : 30 mins Lesson : 1 hr Lesson Activity : 1 hr	Insect Biology, Earth Sciences, Plant Biology	Growing Gardens	
Wondrous Worms	- Understand how worm bin composting works - Conceptualize why worms are so important for soil and plant health - Understand the anatomical parts of a worm	No, only material that could be challenging would be a ton of worms	Prep Time : 30 mins Lesson : 1 hr 30 mins Lesson Activity : 25 mins	Insect Biology, Earth Sciences	Growing Gardens	
Celebration	- Understand that once the plants are fully grown, they can harvested and eaten!	No, only resources from the garden are really needed	Prep Time : 10 min Lesson : 1 hr Lesson Activity : 45 mins	Plant biology, Cooking	Growing Gardens	I think this could be very useful - you could talk about cleaning plants, cooking them if needed, what is safe to eat, and what isn't
Visual Art : Using a Viewfinder Drawing in the Garden Pt 1	- Draw plants utilizing the viewfinder as a tool to help them and to better observe details	No, all resources are handmade and simple to obtain	Prep Time : 30 mins Lesson : 40 mins Lesson Activity : 1 hr	Observation , Plant biology	Cornell Garden Based Learning	Credible
Writing in the Garden	- Learn to write about experiments and observations - Learn to write stories and poetry - Learn to describe through the garden	No, low resource cost. pencils and paper	Prep time: 5 mins Lesson activity: 45 mins	Observation , Language skills	New Jersey Agricultural Society	This was something Melissa really thought we should do

Weather vs Climate	- Learn how to observe and compare monthly temperatures and precipitation data in a region to better understand climate - Uses resources to gather data about regional forecasts - Identify weather data that can assist in predictions - Understand climate is different varying region	No, but issue could arise if there is limited access to weather forecasts	Prep Time : 30 mins Lesson : 2 hrs 15 mins (over a few days) Lesson Activity : a couple of days	Observation , Engineering, Weather, Climate	Generation Genius	Really useful lesson plan to get some inspiration from
Sprouting Seeds - A Seed Has a Coat	- Learn about not only seed growth but the oddities of seed growing - Learn how plants are like us in some ways	No, all resources are simple to obtain	Prep Time : 30 mins Lesson will take a couple of weeks, depending on seed growth	Plant Biology	Whole Kids Foundation and American Hearts Foundation	Indoor use of seeds and planting
Seed Germination	- Understand importance of germination and plat growth - Learn about the organic materials needed for plant growth - Process of photosynthesis - Learn more about the needs of germination	No, all materials are substitutable	Prep Time : 45 min Lesson and activity would occur over 52 days	Plant Biology	The New York Botanical Garden	*The other seed germination lesson teaches this in a more hands-on way, imo.*
Observing Earth's Seasonal Changes	- Learn to back up evidence with explanation - Describe and predict expected weather conditions in a season	No, but could be an issue if attatched files aren't able to be distributed	Prep Time : 10 mins Lesson : 1 hr Lesson Activity : 45 mins	Weather, Seasons	NASA	NASA suggests to use their attached handouts

	- Utilize observation skills to explain phenomenons					
Observing Water Movement Within Celery	- Understand how plants get their water	No, food coloring may be the only difficult item to obtain	Prep Time 25 mins Lesson : 45 mins Lesson Activity 30 mins	Plant Biology		
Classroom Hydroponics	- Learn that water, nutrients, light, air, and solid support for the roots is essential for a plant to not only grow but thrive - Learn about hydroponic systems and their role in equally distributing water so that all plants get enough	Maybe, some of the materials seem a bit challenging to find substitutes	Prep Time : 20 mins Lesson : 1 hr Lesson Activity : 1 hr 15 mins	Plant Biology, Engineering, Gardening, Hydroponics	KidsGardening, non-profit educational organization	The most adaptable and implementable
Soil Versus Water : Exploring Hydroponics	- Learn what plants need to grow - Understand how traditional soil-based gardening provide the necessary environment for plant growth - Interact with hydroponic systems and growing techniques to better understand the needs of plants	No, all materials are obtainable and reasonable	Prep Time : 20 mins Lesson : 1 hr Lesson Activity : 45 mins	Plant Biology, Engineering, Gardening, Hydroponics		Targeted for grades 6-12 but definitely could be simplified to be taught to a younger age group
Hydroponics in the Classroom	- Teaches about hydroponics and the history, usage	No	Prep Time : 15 mins Lesson : 1 hr 15 mins	Hydroponics, Gardening, Engineering	KidsGardening, non-profit educational oranization	Nice, 30 page lesson in powerpoint about elementary level hyrdroponics

Measurement and Graphing in the Garden	- Learn how to collect data from the garden and use the data to create various graphs to represent it - Solve real-world problems using the graphs	No, rulers and thermometers	Prep Time : 30 mins Lesson : 1 hr Lesson Activity : 45 mins	Mathematics, Gardening	NC State University	Explains several ways to teach diffrent grade levels of elementary students
Square Foot Seeds (Integrated into *Seed Germination*)	- Explore a variety of seeds and understand that not all seeds and plants grow in the same manner - Understand the unique care an individual plant may need	No, simple classroom resources (glue, markers) only problem could be with the variety of seeds but that can be easily addressed	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins	Gardening, Plant biology, Mathematics	NC State University	Best seed germination lesson plan so far in my opinion
Harvest Math	- Explore math concepts using harvested crops - Teach students how to measure plants, etc. - Integration of math concepts to better help understand math in the real world	No. Minimal resource requirement	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins	Mathematics, food	NC State Uni	
Interview an Elder	Interview an elder about common or personal foods/meals	No, pencil and paper only	30 minutes, can do 45 minute class discussion	Cooking, culture	Edible Schoolyard	Great for indigenous studies and the connection to native plants

Your Ingredients	Make a list of ingredients that are important or personal to you	No, pencil and paper only	30 minutes, can do 45-minute class discussion	Cooking, Culture	Edible Schoolyard	Goes along well with interview an elder – connect to native plants/food
Chlorophyll Prints	Extract chlorophyll Make an art print	No too many, paper, tape, spoons	1-1.5 hours	Art	Cornell Garden-Based Learning	Really cool activity that connects art and science
Blind Contour Drawings	Learn about contour drawings	No, just paper and pencils	30-45 minutes	Art	Cornell Garden-Based Learning	Just drawing, not as helpful but could be used as an art activity
Drawing Upside Down	Observation Focusing on different types of drawing and art	No, just paper and pencils	30 minutes	Art	Cornell Garden-Based Learning	Similar to other drawing in the garden activities
Painted Leaf Prints	Creating prints for leaves, flowers, etc.	Some, paint and brushes so it will depend on the location	1.5-2 hours, lots of prep and cleanup	Art	Cornell Garden-Based Learning	CETAP-Lucy could do this, idk about El Arenal
Garden Songs	Making songs about garden topics	No, pencil and paper	1.5 hours max for groups to create and discuss	Music	Cornell Garden-Based Learning	Great activity to end a unit that is fun and wraps everything up

Negative Space	Practice botanical art only by drawing negative space	No, paper and pencil	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins30 minutes	Art	Cornell Garden-Based Learning	Again, just another drawing one that is similar to the others
Investigating the food pyramid (Now Investigating the Nutritional Guideline)	- Understand positive, healthy behaviors that enhance wellness - Classify healthy foods and identify food combinations according to the Ecuadorian Nutritional Guide - Use simple graphs, pictures, written statements, and numbers to observe, describe, record, and compare data	No, simple classroom materials only	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins	Science, Nutrition	Beacon Lesson Plan Library	I really like this, but it might need updating for Ecuador
Cooking a few of my favorite things	- Solve problems by generating, collecting, organizing, displaying, and analyzing data using histograms, bar graphs, circle graphs, line graphs, pictographs, and charts. - Understand the nutritional values of different foods	It's honestly really easy	Prep Time : 15 mins Lesson : 15 mins Lesson Activity : 1 hr	Nutrition, cooking	Joyce Sewell, Beacon Lesson Plan Library	I love cooking ,and this is a great way to engage students with whatever

Pyramid matching game (Now Nutritional Guideline Matching Game)	- Memorization skills - Food nutrition knowledge	- No, not resource intensive	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins	Food, Health, Nutrition	Teachnology	
Cross contamination of food	- Observe and recognize cross contamination.	- No, not resource intensive	Prep Time : 15 mins Lesson : 30 mins Lesson Activity : 30 mins	Nutrition, Health, Cooking	Teachnology	- Very useful lesson to teach and could be useful knowledge for students later on
Compost Chaos	- Students learn about the usefulness of composting and the benefits of it - Students learn about recycling natural resources - Students learn about how compost can help give the garden fuel that it needs to thrive while growing	- No, requires trash and food waste	Prep Time : 15 mins Lesson : 1 hr Lesson Activity : 30 mins	Gardening, Recycling, Earth sciences	Growing Gardens	Think this is a very useful

Appendix J: Groups/Individuals that might provide long-term support

Potential Resource	Contact information	Description
University of Cuenca community outreach	Vinculación | Universidad de Cuenca (ucuenca.edu.ec)	The University of Cuenca requires students to complete 160 hours of community service. It may be a good idea to reach out to UC to see if they would be interested in working with school gardens to complete their requirements.
Banco de Alimentos Diakonia	Banco de Alimentos Diakonía | Facebook	Banco de Alimentos Diakonia is a Food bank and charitable organization that does a large variety of community projects. They have worked on distributing clothes, food, etc. in the past.
Rocio Warmi	+593 99 125 8873	Rocio Warmi works with a gardening Minga in Cuenca. However, this Minga is not very mobile, and is unlikely to be able to provide support to cities outside the city limits of Cuenca.
Des Dizney	info@cuencasoupkitchen.org	Des Dizney works with various charitable organizations in Cuenca and runs the Cuenca Soup Kitchen. Although she is unable to provide direct garden support, she is well connected to others in Cuenca, and may be able to provide indirect support.