Botanical Gardening at the Wat Pathumwanaram School:

Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Pitch Asawasathaporn, Greg DiLullo, Potchara Galaputh, Marinela Kirilova, Jennifer Moutinho, Akiko Aungsumalin Saga, Madison Shugrue, and Adam Thibault

Botanical Gardening at the Wat Pathumwanaram School:

Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

A Joint Interactive Qualifying Project/ Social Science Project Report
submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE and CHULALONGKORN UNIVERSITY
In partial fulfillment of the requirements for the
Degree of Bachelor of Science

BY:
Pitch Asawasathaporn
Greg DiLullo
Potchara Galaputh
Marinela Kirilova
Jennifer Moutinho
Akiko Aungsumalin Saga
Madison Shugrue
Adam Thibault

DATE:
1 March 2012

SUBMITTED TO:
Professor Bland Addison
Professor Luxsana Dubas
Professor Ingrid Shockey

ABSTRACT

Thailand, a nation deeply rooted in traditional customs and Buddhist ideals, seeks to retain these aspects of national identity amidst the pressures of modernization and industrialization. The Wat Pathumwanaram School, located in metropolitan Bangkok, aims to fulfill this national objective through practical education about self-sufficient and sustainable living, centered around a botanical garden of local medicinal Thai herbs. This project integrates the use of a traditional herb garden into the existing educational system through appropriate learning materials in order to enhance the natural literacy of the students and reconnect them to their cultural heritage.

EXECUTIVE SUMMARY

Thailand is home to a rich variety of medicinal plants; knowledge of these plants has been verbally passed down and, over centuries of Thai history, has grown to include information on cultivation and harvesting as well as target illnesses and remedies. The traditional medical care provides a philosophy and a way of life for Thai people by focusing not only on physical recovery, but also on mental and spiritual healing through the principles of Buddhism. Over the past 30 years, the King of Thailand has aimed to teach people to live in moderation and reasonableness under the "sufficiency economy" philosophy, which supports the growth and use of Thai medicinal herbs. Essential elements in this philosophy are the principles of self-sufficiency and sustainability. Self-sufficiency is the act of living on locally produced goods without relying on imported foreign products, and sustainability means to always seek to reuse things and find usefulness in all aspects of an object. In the spirit of the King's Principle, the Thai government supports education that maintains Thai culture and natural literacy in a nation that is experiencing rapid urbanization in some areas.

The Wat Pathumwanaram School is Located in Metropolitan Bangkok

As Thailand becomes increasingly westernized, education is necessary to prevent the loss of this cultural heritage. However, the Thai Ministry of Education focuses on making sure that students develop lifelong skills in fields related to modern professions. The challenge for schools is to teach students the modernized curriculum while maintaining their natural literacy and Thai cultural identity. The goal of this project was to convey a practical understanding of traditional medicine while promoting self-sufficient and sustainable life practices to enhance the cultural heritage and natural literacy of students at the Wat Pathumwanaram School. Knowledge of the variety, origins, and applications of traditional medicinal plants, along with the teaching of cultivation methods, would repair the loss of natural literacy that occurs in an urban environment.

Wat Pathumwanaram School is a highly modernized institution located on the grounds of a temple within a highly urbanized shopping district in Bangkok. The school is under the

patronage of H.R.H. Princess Maha Chakri Sirindhorn who sponsors a charity that emphasizes the importance of an equal opportunity for education in all communities. As part of ongoing support for traditional arts and skills, school officials have incorporated several gardens into the school grounds and curriculum to demonstrate the principles of sustainable and self-sufficient living. For this project we redesigned a botanical garden on the school grounds that, over time, had nearly disappeared. This rejuvenated garden would serve as both a supplement to the existing curricula as well as a community learning-center to increase knowledge of medicinal plants among students at all levels and the surrounding community. The school hopes to further the educational opportunities of students by introducing practical applications of Thai heritage into the curriculum, educating the students about the long-term benefits of living self-sufficiently and sustainably.

As urbanization in Bangkok continues to occur, creating green space in the city becomes increasingly important. A green space initiative sponsored by the National Economic and Social Development Plan (NESDP) helped promote the connection between cultural, social, and ecological factors by encouraging healthy, sustainable, and practical behaviors. A green space oasis in a city, such as a botanical garden, can contribute to the larger idea of human responsibility to sustainable consumption. Strongly supported by the Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), botanical gardens can also promote biodiversity while teaching natural literacy and conservation of local resources (Pinheiro, De Almeida Neto, Luiz C., & Monteiro, 2006). One of the advantages in using Thai medicinal plants is encouraging new generations to appreciate nature and its processes, leading to better care for the environment. By means of careful design, botanical gardens can act as a crucial tool in linking culture, ecology, and society together (Dodd & Jones, 2010). They provide for a hands-on and visual education aid in an urban location, helping teach natural literacy on a more engaging, inclusive level. An effective garden layout must consider the use of the garden as well as ways to ensure that the garden will be a sustainable green space (Carter, 2011).

Methodology

Our initial task was to assess the physical characteristics of the garden plot that would be relevant to the design of the garden. We studied the light patterns throughout the day using an interactive three-dimensional model of the garden, measured the dimensions of the designated space, and identified the present soil types. Weather in Thailand varies greatly throughout the year so we also researched the local weather patterns.

We then made a selection of plants that could be used in the garden design. Interviewing experts with a wide range of backgrounds regarding medicinal plants and their applications helped us establish a list of locally found, low maintenance plants. Further research and continued correspondence with experts helped us improve the list of plants and the garden layout design. We researched gardening techniques that would allow us to create a design that would be low maintenance and efficient for the available space. The team interviewed professors and experts to obtain more information regarding ways to utilize a garden area containing extensive root systems, and discussed other space saving techniques to help contribute to the easy upkeep of the garden.

To ensure that the garden could be used effectively, we researched the King's principle of self-sufficiency and sustainability and studied composting and recycling as applicable means for incorporating these principles into the garden design. Through semi-standardized interviews with teachers and random parents, we evaluated their perceptions of the principle, natural literacy, and

the use of medicinal plants. During the interviews with the teachers, we were also able to learn about their teaching methods. Using this information, we could establish a basis for our understanding of the educational context of the school. The team then conducted research on effective teaching and learning techniques that would help us to best incorporate education about the garden and medicinal plants into the curriculum.

Findings

Site Assessment and Plant Selection

The original plot included potted plants, a large Banyan tree, a few banana trees, and other small shrubs. The ground was found to have a range of sandy to clay-based soil and receive moderate amounts of direct sunlight. We compiled a set of relevant plants that would accommodate these plot characteristics. The experts' advice played a significant role in the refinement of our list of plants to include only those that are commonly used, easy to grow, and found locally. We were able to further narrow down the initial selection of medicinal plants by taking into account their medicinal uses as well as the local climate and soil type required for them to grow. We used our research findings, the experts' advice, and the physical characteristics of the garden to construct a set of ten plant groups, classified and compiled in accordance to the plants' medicinal properties. The medicinal properties of each plant group are anti-fever, nausea relief, anti-flatulence, anti-fungal, diuretic, blood thinner, indigestion relief, anti-toxin and a cure for throat symptoms and diabetes. Due to the frequent occurrence of these medical issues, plants that cure them are relevant to the students' everyday lives.

Educational Materials

The National Education Act of 1999 introduced the notion to Thailand that all students are capable of learning, and that knowledge is a tool acquired throughout one's lifetime. Interviews with teachers enforced this idea; students are encouraged to discover ideas and solutions with waning instruction from teachers. Most classrooms focus on teaching with handouts and lectures followed by supplemental activities to reinforce important concepts. Additionally, many teachers agreed that students retain information better when they are physically involved with the discovery of the knowledge. Two middle school teachers stated that the school "wants the students to be able to use and learn from the garden" through "allowing them to plant by themselves." In addition, an art teacher at the Chulalongkorn Demonstration School suggested ways to involve the students in the garden through arts and crafts as an integration of active learning principles into a supplementary curriculum.

Garden Design and the King's Principle

Ajarn Kanogwan Seraypheap, a professor in Chulalongkorn University's botany department, informed us that the King's Principle of self-sufficiency and sustainability has been governmentally promoted in the educational system and instruction in it begins as early as the fourth grade. The teachers we interviewed were acquainted in depth with this concept and stressed the importance of its incorporation. In the spirit of the King's Principle, we found many materials already in the site, such as pots and rubber tiles that the school officials said we were able to repurpose, decreasing the required budget. The experts that we interviewed interpreted organic gardening as gardening with what is readily available. An organic approach would not require the purchase or chemical additives specifically for the garden. They agreed that keeping

the garden organic would ensure that it is environmentally friendly, robust, and cost-effective, all of which would contribute significantly to the purposes of the botanical garden.

Implementation

Implementation of a low maintenance botanical garden was the conclusive practical outcome of our design. Ten areas were specifically cleared in order to accommodate the ten groups of plants selected for the garden. Raised beds were constructed so that the surface was level and the soil was at least twenty centimeters deep. We avoided planting in the root areas while controlling the proliferation of plants such as mint by planting in pots.

The Wat Pathumwanaram students participated actively in the garden construction by helping with an organized cleaning day. This day showed the kids that they were welcome to assist in the construction of the garden, and afterwards they would often help during their lunch breaks and after school. Although the large number of kids trying to help out would decrease our efficiency, we encouraged them to continue because we understood that it was important for them feel as though they were contributing, so that they would become invested in the garden's well-being.

Most materials in the garden were either already available at the school, or kindly provided by the school principal. To demonstrate waste conservation, we reused available rubber tiles and plastic bottles. Thus, the team and students obtained a first-hand experience applying self-sufficiency and sustainability at the site by planting local herbs, using recycled materials and following organic gardening guidelines.

Students Helping in the Garden

Conclusion

We developed and implemented a design for a botanical garden consisting of Thai herbs, as well as complementary educational materials in order to increase urban students' knowledge about traditional medicine. The garden design incorporated local, low maintenance plants and practices to allow for its undemanding upkeep and longevity in the school environment. The educational materials, developed in accordance to H.R.H. Princess Maha Chakri Sirindhorn's charitable ideals, serve as a template for the garden's application as an active, hands-on learning tool for both the classroom and the community. Integration of this botanical garden within an urbanized community will enhance the connection between cultural, social and ecological factors by encouraging healthy, sustainable and practical behaviors.

Recommendations

Sustainable Practices in the Garden

One of the main techniques for sustaining an organic garden is composting, a process through which waste materials are broken down to create a nutrient rich mixture. This mixture can be added to a garden to encourage the productivity of the plants. We advise that the school establish a composting program as an educational facility; using the instructive materials we have prepared to guarantee its success and upkeep.

Garden Maintenance and Student Participation

We recommend that the school involve the students the upkeep of the garden, ensuring a sustainable continuation in the future. Students of one particular subject, such as agriculture, could be responsible for the garden, or entire grades could rotate, taking turns to tend to the garden's needs. While we recommend that the school gardener also look after this area, it is advisable that the students take the largest responsibility, limiting the amount of work the teachers and staff need to put into sustaining the garden. This participation will provide the students with clear, real-life practice of the King's Principle.

The Garden as an Educational Tool within the Classroom

We suggest the use of curriculum supplements for various science disciplines. We would like to further recommend that the educational potential of this garden is not limited to the scientific subjects, but is rather taken to a higher teaching and learning level in subjects such as English, mathematics and art. The integration of this garden into many different grade levels and subjects will increase the students' exposure to the garden and help the program to receive support from all students.

Conveying Knowledge Outside of the Classroom

We recommend that the garden also be used to teach students and other members of the local community applicable knowledge independent from classroom subjects; topics might include responsibility and environmental awareness. As the garden becomes incorporated into the learning center, we advise that the community is made aware of the garden's existence on the school grounds through media similar to those suggested by the Social Science Project "Design Promotional Media for a School Community Learning Center" also conducted at the Wat Pathumwanaram School. We suggest that the school allow students to take home plant clippings or seeds, so that the children can start gardens at home as well, developing their education into a life style.

Incorporation of the Garden into the Entire Learning Center at the Wat Pathumwanaram School

We recommend that the botanical garden be applied to further educate students of methods to sustainably harvest plants with minimal harm to the environment. We advise that all of the gardens at Wat Pathumwanaram are integrated into the curriculum, and likewise knowledge is distributed throughout the surrounding community to raise awareness of Thai cultural heritage, healthier living alternatives, and more affordable healthcare options. Upon completion of the above recommendations regarding self-sufficiency, sustainability, plant cultivation and natural literacy, the students will develop a greater appreciation for the natural world, as well as life-long skills applicable in all facets of life such as responsibility. The Wat Pathumwanaram School area will benefit from the proposed garden and complementary

educational materials through gaining a better understanding of their own cultural heritage and by applying the core communicated principles to enrich their everyday life. Thus, with a garden design, its implementation and a few suggestions regarding its beneficial utilization, we have assisted the Wat Pathumwanaram School in teaching students how to live self-sufficiently and sustainably through the use of common, local Thai medicinal herbs.

ACKNOWLEDGEMENTS

We would like to thank the following individuals, institutions, and organizations for their support and contribution to the success of this IQP/SSP Project.

- Wat Pathumwanaram School for supporting our project, providing space for us to work, and supplying the necessary resources to complete the project.
- Mr. Sompob Intharachan, the Wat Pathumwanaram School Director, for his continuous support and great interest in the progress of the project.
- The Wat Pathumwanaram School Parent's Committee for their encouragement and generous financial support in the project.
- Chulalongkorn University Demonstration School for the tour of their botanical garden and valuable insight to relevant educational practices.
- Ajarn Arunee Nakhonchai for acting as our liaison and providing her guidance throughout the project.
- Dr. Dumrongsuk Chumsaengphan, an Herbal Medicine and Organic Gardening Expert, for his knowledge on composting, medicinal cultural heritage, and willingness to speak with us despite his busy schedule.
- Professor Ingrid Shockey and Professor Bland Addison, of Worcester Polytechnic Institute, for their guidance and support throughout the project.
- Ajarn Luxsana Dubas, of Chulalongkorn University, for her guidance and support throughout the project.
- Worcester Polytechnic Institute and Chulalongkorn University for making this project experience in Bangkok, Thailand possible.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

CHAPTER 1: INTRODUCTION

Medicinal plants have played an important role in many cultures and Thai culture is no exception. Thailand is home to many varieties of plants that have been shown to have medicinal properties. Historically within Thai culture these plants have been used to cure an assortment of ailments. Knowledge about the plants has been verbally passed on and has grown throughout Thai history; this collection of information includes how and when to harvest the plants, the medical conditions that they target, and their proper usage. Over the course of the late nineteenth century, with the modernization and urbanization of parts of Thailand like Bangkok, the once extensive knowledge of traditional medicinal plants began to fade away resulting in a decrease in natural literacy - an issue that has not been fully resolved by the school curriculum. Due to the increasing importance that technology has had in the growth of the country, the government of Thailand consistently strives to modernize the educational curriculum. The Thai Ministry of Education feels that this will help improve the students' skills pertaining to the advancing fields that they will likely experience in the work force. The challenge for schools is to teach students how essential both advancing technology and traditional skills are in their lives.

Fortunately, efforts have been made to preserve the knowledge of medicinal plants. A main figure in this effort is Her Royal Highness Princess Maha Chakri Sirindhorn. Due to her interest and continuous support, there have been extensive initiatives concerning the protection of Thai herbal plants, particularly at the HRH Princess Maha Chakri Sirindhorn's Herb Garden in Rayong. The princess is also driving interest in conservation and natural literacy in education. There is still progress to be made in education about medicinal plants as they could provide many Thai homes with "health support, financial income, cultural identity, and livelihood security" (Hamilton, 2004). This need for education applies directly to the students at Wat Pathumwanaram School located within the shopping district of Bangkok, no longer expressing the close connection to the land that Thai people held in this area before urbanization.

The Wat Pathumwanaram School is currently a highly modernized educational institution with students from kindergarten through the ninth grade. Located in one of Bangkok's wealthiest regions of malls and restaurants, the school itself is attended by students who are not from wealthy backgrounds. The school inhabits the grounds of the Wat Pathumwanaram Temple, which has historically affected the development of the school. Until 1932, the Temple itself was

the sole source of education for residents in this formerly rural area, before the urbanization and increased development around the temple area. After that date, the Wat Pathumwanaram School emerged as a governmental institution – one that, unfortunately, could not be completely sustained by their budget. The unaffordable school supplies and the severe poverty in the region resulted in malnutrition among students and absences due to illness (May, 2007). Through the eventual financial support of foreign beneficiaries, modernized school facilities and a new curriculum were introduced at Wat Pathumwanaram. However, the new school program, adapted from a Western developmental model, was hardly compatible with the social background of the students, whose parents are still struggling financially.

The clash of educational goals and social realities continued, but the Wat Pathumwanaram Temple kept the community strong, until Her Royal Highness Maha Chakri Sirindhorn was able to intervene and provide a solution. With Her assistance, the renewed Wat Pathumwanaram School opened its doors on June 18, 2007. With its excellent state-of-the-art technology, two libraries, English, Chinese and Japanese lessons, as well as free lunch meals and uniforms, today's Wat Pathumwanaram School provides superior educational opportunities to its more than 700 students (May, 2007).

As part of ongoing support for traditional arts and skills, school officials have incorporated several gardens into the school grounds and curriculum to demonstrate the principles of sustainable and self-sufficient living. The ideal of teaching students how to live more self-sufficiently was incorporated into the curriculum after the King's Principle initiative began throughout the country. The Wat Pathumwanaram School has recognized that their garden program can be further developed and improved through the implementation of a medicinal herb garden in the place of the existing, not well-maintained botanical garden. Therefore, the school would like to design and integrate a program that would provide knowledge of botanical gardens to the students, with a focus on Thai herbs and medicinal plants. This garden will serve as a community learning-center to raise knowledge of medicinal plants and herbs among students at all levels and the surrounding community. Thus, Thai students would be able to learn about their heritage and provide agricultural training. Similarly, educational programs in a new botanical garden can improve the students' natural literacy, while community-wide programs can help spread practical knowledge about traditional plants as an alternative solution to modern medication in Bangkok.

The goal of our project is to convey a more practical understanding of traditional medicine while promoting self-sufficient and sustainable life practices to enhance the cultural heritage and natural literacy of students at the Wat Pathumwanaram School. Knowledge of the variety, origins, and applications of traditional medicinal plants, along with instruction for cultivation, can repair the loss of natural literacy that occurs in an urban environment. Hands-on education through the use of a garden at the Wat Pathumwanaram School will not only enhance biodiversity of local plants, but also reinforce the importance of human interaction with the natural world. Through the design of an herbal botanical garden and the development of corresponding educational materials, the school will be able to convey a more practical understanding of organic botanical gardens to the students and community while demonstrating how traditional medicine and organic planting can be incorporated into sustainable and self-sufficient living.

CHAPTER 2: BACKGROUND

In this chapter we present the background research conducted on Thailand and the Wat Pathumwanaram School, as well as our gained knowledge of Thai education, medicinal plants, and health care that will provide the context for our project. First, we introduce the history of traditional medicine in Thailand, followed by the current health care system with regard to the role of traditional and Western medicine. Expanding on a principle developed by His Majesty King Bhumibol Adulyadej of Thailand, we explain self-sufficient and sustainable living. We talk about the educational system in Thailand, with special attention to the Wat Pathumwanaram School history and general learning strategies. Next, we present botanical gardens with their potential benefits for natural literacy, the well-being of Thai people, and the overall quality of urban life. Furthermore, we present information about designing a garden in a sustainable manner.

2.1 Traditional Medicine in Thailand – Past and Present

Medicinal plants are an important part of an emerging field in Thai traditional medicine that focuses not only on physical recovery but also mental and spiritual healing through the principles of Buddhism. In addition to treating illnesses, this medical care system embodies a philosophy and a way of life for the Thai people. As a cardinal part of traditional Buddhism, most Thai people believe in the existence of four elements (or *Dhatus*) that make up the body: Earth represents everything that is solid and tangible, Wind is what circulates through the body, Water represents the fluids, and Fire is what burns the food. Illness is thought to occur when there is an imbalance of these elements in the body or in the environment (Subcharoen, 2001). The diagnosis and treatment of an illness is closely linked to the believed cause, thus herbs of different qualities like sweet, bitter, delicate, and so forth, may be prescribed to cure imbalances in specific elements.

In its essence, the traditional medicine of Thailand is a combination of theoretical concepts from Indian Ayurvedic medicine and traditional Thai medical knowledge; these traditions first emerged during the Sukhothai Period (1238 AD – 1377 AD) of Thailand's history, although Thai people used herbal medicines to cure disease even before this time. Throughout the Ayutthaya Period (1350 AD – 1767 AD) pharmacies began to appear and a royal

dispensary was established. The Ayutthaya Period ended with a war in which the Burmese destroyed the city of Ayutthaya. In an effort to preserve knowledge of Thai traditional medicine at risk of being lost during the war, the collective expertise of the Thai people was called upon. The results were engraved on tablets on the walls of temples, and included over one thousand drug recipes as well as massage and stretching techniques. During the reign of King Rama V (1868 AD – 1910 AD), the first medical textbook based on Thai traditional medicine was compiled (Chokevivat & Chuthaputti, 2005). These events symbolize the commitment of the Thai people to pass down their knowledge of medicine to future generations.

2.2 Current Health Care in Thailand

Today, 42% of all medical centers in Thailand offer traditional Thai medical services and regularly prescribe 71 Thai indigenous herbs that have been added to the national drug list (The Government Public Relations Department, 2011). Vichai Chokevivat, the Director-General of the Department for Development of Thai Traditional and Alternative Medicine (DTAM), says that the Thai people have engaged in a variety of activities to incorporate traditional medicine into the regular health care system by combining traditional healing with Western medical practices, arranging educational meetings and sessions with experts to pass on the wisdom of curing through plants, and further encouraging the use of naturally extracted remedies (Suwankhong, Liamputtong, & Runbold, 2011). These initiatives are performed in the spirit of promoting localism that aims at a self-supported national health system, achieved by means of utilizing medicinal plants (Suwankhong et al., 2011).

Even in the absence of governmental support, traditional medicine would still be a significant factor in Thai health care. As of today, there are numerous traditional healers in all parts of Thailand and their practical knowledge of medicinal herbs and cures cannot be replaced by descriptions given in plant books. While foreign medications are expensive, natural, plant-based remedies prepared by experienced traditional healers are more accessible and affordable to the majority of the Thai population. In numerical data, statistics from 1999 indicate that 88% of people living in developing countries still utilize traditional medicine therapies as a main source of heath care (Mahidol, Prawat, Prachyawarakorn, & Ruchirawat, 2002). Plant-extracted remedies should still be regarded as an essential factor in the overall medical care accessible to children growing up in the slums.

2.3 Self-Sufficiency and Sustainability Principle - King's Principle

Since a young child, H.M.K. Bhumibol Adulyadej had been raised to live responsibly and conservatively. Throughout his reign, he has spoken much about "Sufficiency Economy", doing his best to teach people over the past 30 years to live in prudence. This philosophy is the focus of His principle to educate the general population about self-sufficient and sustainable living. Self-sufficiency is the act of living on locally produced goods without relying on imported foreign products. If people are satisfied with their situation, they will be less greedy, will cause less trouble to other people, and will in turn be happy. This does not mean that people are restricted to the items that they have, but instead implies that they must live within their own reasonable limits while not taking advantage of others who have less. Sustainability is to always seek to recycle and reuse things and find usefulness for all aspects of an object.

His Majesty the King described the application of the principle when he delivered his speech at the Royal Ploughing Ceremony on May 9th 1987.

> *In order to plough, the farmer goes to buy the pushcart, he has to buy the fuel and fill it to make it work, he has to spend money to fix it when it collapses, however what it gives him back is not only the work, but also the toxic gas from combustion. If the buffalo is used to plough instead, he can feed it grass to make it work, and its stool is not waste, but rather an excellent fertilizer.*

Thai farmers normally raise buffalo as the common pet for heavy labor because they are easy to tend to and resilient to the climate and geography. Their diet of grass, which is easily accessible, decreases food expenses – a real-world application of the self-sufficiency principle. Additionally, the buffalo stool can also be used as fertilizer, further incorporating the 'sustainability' concept in applications such as gardening.

2.4 Education in Thailand

Since Buddhism is still practiced by 95% of Thailand's population, "the national curriculum addresses students' human rights, morals and ethics. This is to ensure that national development will be in line with the Thai way of life and Thai culture" (Pagram & Pagram, 2006). The Thai government uses education as a means of maintaining Thai culture in a nation that is experiencing rapid urbanization in some areas. It teaches students to respect elders, others,

and themselves and to use their education to give back to their community, creating a more self-sufficient society.

2.4.1 Wat Pathumwanaram School History

Our sponsor is Wat Pathumwanaram School, under the Royal Patronage of H.R.H. Princess Maha Chakri Sirindhorn. This school is located in a quiet area amidst the bustling 'Siam District,' often called 'the heart of Bangkok.' The Wat Pathumwanaram School is a highly modernized institution located on the grounds of the Wat Pathumwanaram Temple. The switch from absolute monarchy to constitutional monarchy that occurred in Thailand in 1932 brought along the foundation of governmental schools. This is when the Wat Pathumwanaram School first emerged, however the governmental budget given to the school was unable to sustain the increasing price of education, while poverty levels in the local community did not improve. As a result, malnutrition was frequently observed in children, causing illnesses and decline in school attendance (May, 2007).

With the rapid influx of Western, large-scale urbanization and elimination of essentially all field crops, the pupils of the Wat Pathumwanaram School were introduced to a new 48-classroom school building with a modernized curriculum. While the children were taught with methods customary to a highly developed Western society, the financial condition of their families was still grim. This discrepancy of modernized education and low standards of living continued until the benevolent intervention of Her Royal Highness Maha Chakri Sirindhorn and her "H.R.H Princess Maha Chakri Sirindhorn Charity." The charity funds projects that help the disadvantaged, by means of improving living conditions, educating Thai youth in rural areas, and promoting higher education (Burapatana & Ross, 2007). Through this funding, the students obtained a school system more compatible with their home life. In all of Her Royal Highness's programs, she emphasizes education and the importance of an equal opportunity for instruction for all communities.

On June 18, 2007, the doors of the new Wat Pathumwanaram School, now under Royal Patronage of H.R.H. Princess Maha Chakri Sirindhorn, opened with excellent state-of-the-art technology and computer equipment. The more than 700 current students of the school are provided with two libraries, classes taught by 40 teachers, including lessons in English, Chinese and Japanese, free lunch and uniforms. Today, the school looks to refine the educational opportunities of its students by introducing practical applications of Thai heritage into the

curriculum and developing a self-sufficient and sustainable learning environment through the simultaneous integration of gardens with related educational materials.

2.4.2 The National Education Act of 1999

In an effort to construct a more contemporary and competitive educational system, Thailand proposed the National Education Act of 1999 as section 81 of the 1997 Constitution, the first National Education Act in place. The country recognized improvements that could be made to their current educational format, and intended to create a unified policy for achieving the highest level of academic excellence while also implementing a quality checkpoint to assure this objective is being met. This unified policy included many goals, and required the cooperation of not only the teachers and faculty, but the community as a whole.

One of the main results of this act was the implementation of free education accessible to all children for twelve years, and especially those with special educational needs. These twelve years were divided into two parts: basic education for grades one through nine which became mandatory and higher education for grades nine through twelve. Thailand also recognized that "learners are capable of learning and self-development, and are regarded as being the most important" (Thongthew, 1999) contributors to the curriculum. To ensure that this philosophy was being implemented correctly, governmental organizations were created at the Educational Institution Level, Educational Service Area Level, and National Level.

2.4.3 Learning Strategies

Through this switch in Thailand's educational philosophy, we researched learning styles to better understand effective ways to deliver material, focusing on the students' ability to learn. Active, semi-supervised, and transductive learning (See Appendix I for more details) are three modes of social learning that range from unaided problem solving to collaborating collectively to refine an existing protocol. These strategies incorporate the students' needs while also encouraging problem-solving and critical thinking skills within a group setting. Along with behavioral (obtaining goals in response to students' attitude), cognitive (recognizing the teacher as most knowledgeable on the topic) and constructivist (allowing students to discover knowledge collaboratively) orientations (See Appendix I for more details), these methods provide sufficient comparison to best understand the necessity of children and materials receptive to learning.

2.4.4 Models for Educational Gardens

The Wat Pathumwanaram School already provides top educational resources to its students. However, special efforts need to be made to improve the students' level of natural literacy and plant knowledge. A botanical garden with medicinal herbs and plants would be the most beneficial and natural source of this type of knowledge. Setting out to design an educationally applicable garden, examples were sought of similar projects that accomplished their goals by utilizing botanical gardens for various environmental, societal, and educational needs within the community and local schools. Special attention was paid to ways of integrating a botanical garden into a community to help ensure its future sustainability and incorporation into the school system. The following case study focuses on ways to successfully implement a garden into a school system. This initiative parallels the project goals and provides helpful tips for garden construction in Thailand.

In California, an initiative is in place to establish a garden in every school to help develop outdoor learning classrooms that will serve as an environmental educational program increasing the students' attention and enthusiasm for learning (H. Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005). In a study done by University of California, Davis, surveys were sent to all California schools with the hopes of getting a better idea of how successful the initiative has been since 1995 and how to further improve it. While some gardens had mostly vegetables and others were largely herbal, many of the schools with current garden programs reported similar feedback, that school gardens are widely applicable for incorporation into science, environmental studies, mathematics, and history classes while providing a hands-on setting to promote lifelong learning skills (H. Graham et al., 2005).

In order to ensure the annual use of the garden, all schools reported the importance of designating a person responsible for maintenance. Often the time commitment for a teacher is too much, and support from school officials, parents, community volunteers, students, and a garden coordinator is necessary to sustain the garden. For parents unable to become directly involved due to time constraints, encouragement can come from the students who bring home plants for tasting or family activities for discussion. Many schools also found the necessity of having contact with a knowledgeable expert for technical advice (Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011). Collaboration between the garden design and the teachers is also essential, so that the garden can be used in various subject lesson plans throughout the year

(Hazzard et al., 2011). Since financial support is crucial, a separate study at the University of CA, Davis found that the best way to reduce cost is reusing materials (Hazzard et al., 2011).

This case study depicts a project closely related to our objective and gives invaluable insight to problems we may encounter. The cultural diversity of the host community is a key factor in determining the design of teaching methods, as well as predicting how those methods will be received. Natural literacy is a trait disappearing from the modernizing world, and returning this notion to everyday life will be beneficial to the community. This study has made clear effective ways to relay information to the public, while also encouraging the dissemination of natural literacy throughout the community.

2.5 Botanical Gardens in Modern Society

As the density of the Bangkok population increases and its limits expand, and creating green space becomes increasingly important. A green space initiative began in the early 1990s sponsored by the National Economic and Social Development Plan (NESDP). The plan helps promote the connection between cultural, social, and ecological factors by encouraging healthy, sustainable, and practical behaviors (Ryan & Wayuparb, 2004). Due to rapid urbanization and natural resource reduction in and around Bangkok, specific attention was given to the vulnerable ecosystems in this evolving city (Ryan & Wayuparb, 2004). The plan set in the NESDP has few restrictions and supports a large range of conservation efforts, both rural and urban, including national parks, wildlife sanctuaries, and botanical gardens.

Small botanical gardens are one way for Bangkok to support conservation in its remaining limited undeveloped space. Strongly supported by the Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), botanical gardens can promote biodiversity while teaching natural literacy and conservation of local resources (Pinheiro et al., 2006). One of the advantages in using Thai medicinal plants is that they can encourage new generations to appreciate nature, leading to better environmental awareness.

Botanical gardens in urban cities support biodiversity. Due to its geographical location, Thailand is endowed with a vivid combination of plants, originally thriving in different climactic zones. Among its unique variety of evergreen forest and temperate climate plants, the country has an opulence of medicinal plants and herbs. Even though many of those plant species have not been scientifically tested, plant knowledge has been gathered and passed on generation after

generation in Thai culture (Mahidol et al., 2002). Thai medicinal folklore has been the major, and often only, source that people in the past relied on to supply remedies. This elaborate collection of medical knowledge has been recognized as a national treasure and is protected by the Act on Protection and Promotion of Traditional Thai Medicinal Intelligence, issued in 1999 (Robinson & Kuanpoth, 2009) indicating that Thailand values its heritage of indigenous plants and takes extra efforts to support it.

Natural literacy encompasses the teaching of science, society, economics, and ethics and how each pertains to the environment. Literacy is more than just being able to read and write. It refers to reading for knowledge, writing comprehensively, and thinking critically about already learnt facts. Natural literacy builds on this definition by developing environmental awareness through learning about the natural world critically. This learning can come by means of understanding how humans interact by maintaining, restoring, or improving ecosystems on a large, as well as on a small scale (Burapatana & Ross, 2007). Small scale ecosystem activities may aim at enhancing the interaction between a single community and neighborhood sharing of urban green space.

By means of careful design, botanical gardens can act as a crucial tool in linking culture, ecology, and society together (Dodd & Jones, 2010). They provide for a hands-on and visual education aid in an urban location, helping to teach natural literacy on a more engaging, inclusive level. With the ability to identify and name a plant, individuals form a connection with it (Louv, 2005). This association further promotes an interest in learning about the local ecosystem and native plants. Botanical gardens can also improve the quality of life for those living in cities by bringing individuals back to their natural surroundings and teaching the importance of plant diversity and conservation. The reconnection can help emphasize the potential devastation caused by climate change and species extinction to people detached from their changing local environments due to an urban lifestyle. Thus, the interdependence between plants and people can be accentuated, leading to a realization of how essential it is to stay connected mentally to the idea of nature, even while living in a densely populated city (Dodd & Jones, 2010). In many ways, a green space oasis in a city can contribute to the larger idea of human responsibility to sustainable consumption.

Knowledge of traditional medicinal plants can help repair the loss of natural literacy that occurs in an urban, developing environment. Not only can urban botanical gardens enhance

biodiversity of local plants, these gardens can also reinforce the importance of human interaction with the natural world. The design will consider the specific educational needs of the children in the Wat Pathumwanaram School, while enhancing self-sufficiency and sustainability in Bangkok.

2.6 Garden Design

A detailed garden layout must consider the use of the garden and ways to ensure that it will be a sustainable green space. The layout can include pathways, plant placement, and any other aesthetic characteristics. Round features, diagonal patterns, and curved pathways give narrow spaces more dimensions and create the illusion of a wider area (Carter, 2011). In creating a low maintenance garden, one consideration is in the use of potted plants or planting in the ground. For instance, perennials grow best in the ground because they do not require yearly replanting. On the other hand, high-risk annuals and aggressive spreaders, like mint or basil, should be grown in pots to prevent the disturbance of surrounding plants. Pots are also appropriate for protecting more delicate herbs (Wood, 2003). Both planting in pots and in the ground is necessary for a healthy and easily maintained garden.

A design that includes self-sufficient components also contributes to the low maintenance of a garden. One option is integrating composting; a process through which waste materials are broken down to create a nutrient rich soil-like mixture that can be added to a garden to encourage the productivity of the plants. Microorganisms such as bacteria and fungi digest and break down the waste so that it may be turned into finished compost, occasionally with the help of larger animals such as beetles and earthworms. Once broken down, nutrients in compost are better available for uptake through the plants' roots (See Appendix II for more details). Another necessary consideration is the natural conditions in Thailand to ensure that the garden is self-sufficient and maintainable throughout the year. A brief list of herbs were researched as prospective plants that are easy to grow, are compact in size, have multiple applications in cooking and treatment, and can cure multiple symptoms.

2.6.1 Natural Conditions in Thailand and the Bangkok Plain

Based on the yearly weather conditions in Thailand, the climate is characterized with three distinct seasons: a rainy season, a cool and dry season, and a hot and dry season. Bangkok is classified as having a tropical savannah climate (Yoothong, Moncharoen, Vijarnson, & Eswaran, 1997), conducive to growing a specific classification of plants. Figure 1 displays the

average monthly temperatures measured throughout 2009, presented in an official graph derived from the Bangkok Assessment Report on Climate Change for 2009. The collected data agrees with the common understanding that April is the hottest month while December and January are the months of lowest temperatures.

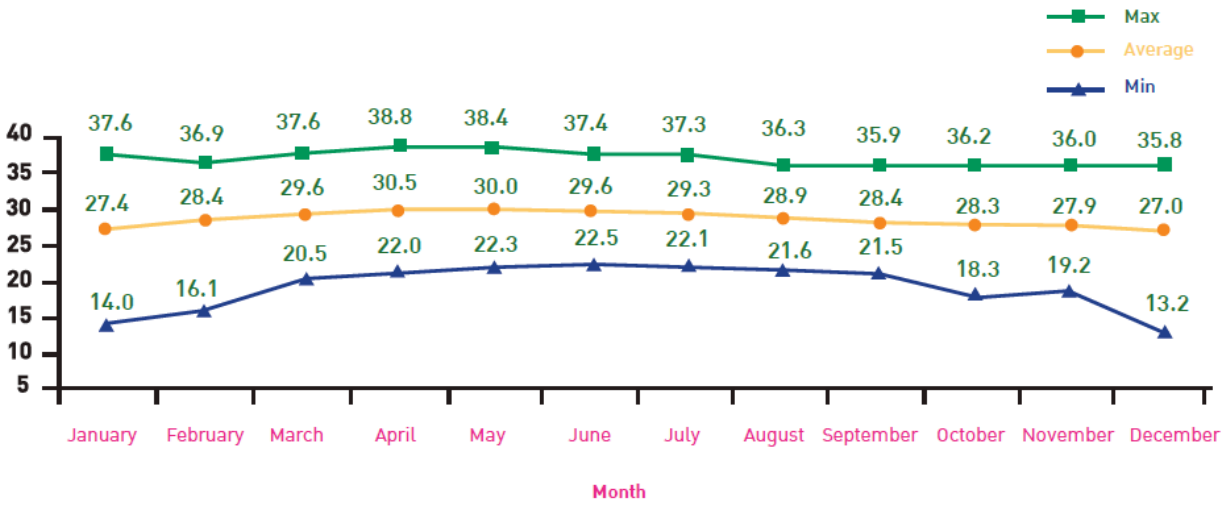


Figure 1: Official Plot of the Average Monthly Temperatures Measured in 2009

On average, the annual precipitation values throughout Thailand (excluding the rainier Southern regions) are 1000 to 4000 millimeters (Yoothong et al., 1997). An official graph issued by the Office of Agricultural Economics at the Ministry of Agricultural and Cooperatives, Thailand is presented in Figure 2. The bar graph exhibits the average monthly rainfall recorded in 2009, 2010, and 2011. The precipitation values are measured in millimeters and displayed in a comparative manner, since the average rainfall bars are grouped based on months for the three years. As obvious from the presented data, the heaviest rainfall occurs in the summer months (June, July, August, and September). On the other hand, December, January, and February are shown to have the lowest rain fall.

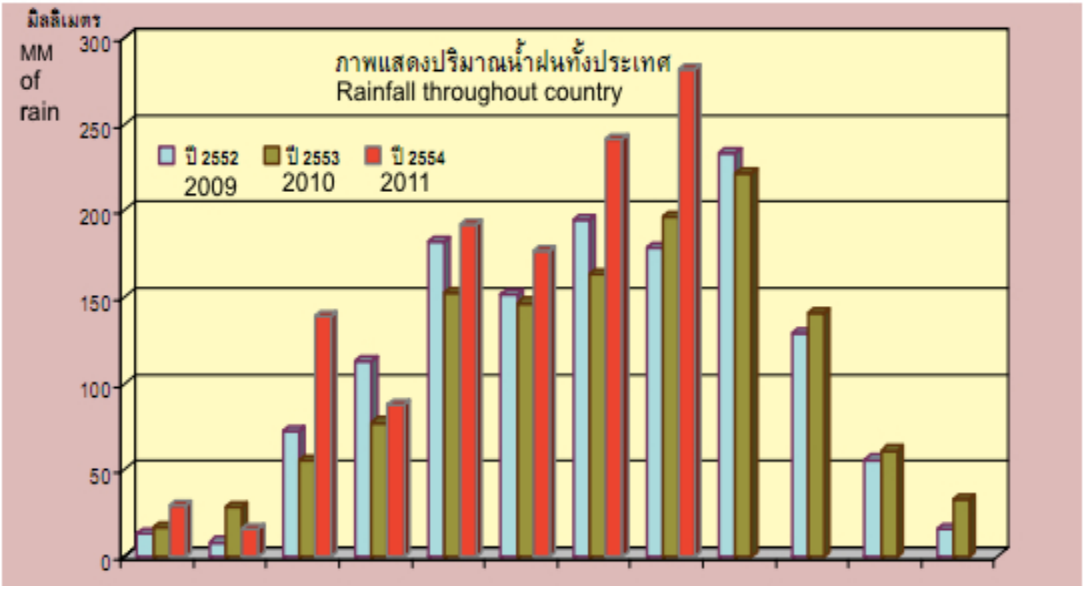


Figure 2: Official Graph of the Average Monthly Rainfall 2009-2011

The city of Bangkok is located within the Lower Central Plain, surrounded by Ayutthaya and the Gulf of Thailand, and experiences a hot and humid climate (Horpibulsuk, Yangsukkaseam, Chinkulkijniwat, & Du, 2011) (Kunchornrat, Namprakai, & du Pont, 2009). As a result, the annual amount of precipitation is relatively low, but the temperature of the soil during the rainy period enables good plant growth (Yoothong et al., 1997;Scott, 2000).

2.6.2 Prospective Plants

Throughout Thailand a variety of plants have been and still are commonly used to treat illnesses. In Appendix III, a list of common plants are present with further information about their size and growing needs, as well as their properties and applications. While it has not been confirmed that all of the plants thrive in the local climate of Bangkok, it is clear that all of the plants have medicinal applications used commonly in many local households. With an urban green space, a selection of these plants can be used to help reinforce the cultural heritage and natural literacy that may have been lost for the students studying in Bangkok.

Throughout this chapter, extensive research was done to recognize the importance of Thai traditional medicine throughout history and its current application to curing illnesses. The Wat Pathumwanaram School is interested in redeveloping these practices within the surrounding community while simultaneously reinforcing the principles of self-sufficient and sustainable living. One way to teach this knowledge to urban students is through the implementation of a

hands-on garden directly into the existing school system. A better understanding of botanical gardens and compatible educational materials led us to the following methodology striving for the completion of the project goals.

CHAPTER 3: METHODS

The goal of this project was to utilize an herbal botanical garden to convey a practical understanding of Thai traditional medicine while promoting self-sufficient and sustainable life practices, and strengthening the students' connection to nature. To achieve this project goal we designed a botanical garden containing medicinal plants and developed appropriate, interactive educational materials. We took steps towards the accomplishment of these project sub-goals through the completion of the following objectives:

1. Assessed and evaluated the school grounds
2. Evaluated the curricula
3. Surveyed parents and teachers
4. Interviewed experts in herbal medicine and organic gardening
5. Developed educational materials
6. Designed a botanical garden

3.1 Assessed and Evaluated the School Grounds

We assessed key qualities of the proposed garden site by observing the light patterns on the plot throughout the day and measuring the dimensions of the allotted space in order to create a layout for plants tailored specifically to the plot. Due to the two-month span of our project, the team did not have the opportunity to physically observe the effect of weather on the garden site throughout the year. However, we were able to research local weather patterns and experience firsthand the precipitation conditions in the region during the months of January and February. In addition, we assessed the soil for quality and depth in order to determine whether any special treatment would be necessary before planting. There was no soil testing laboratory available to us, so instead we relied on observation as well as the opinion of a professor at Chulalongkorn University. This evaluation of pre-existing factors at the garden site provided the base criteria for the compilation of our compatible plant list and for the corresponding garden layout.

By conducting an assessment of the teaching practices at the school, our group determined strategies to integrate the garden into the curriculum. Since the Wat Pathumwanaram School had initiated the construction of the botanical garden by labeling various plants around the school grounds, we observed the existing signage as a minimum requirement for information on additional signs. Textbooks and worksheets from various teachers were also used as models for our educational materials. A tour of the hydroponic garden on the roof of the school helped us to gain a better understanding of how the existing gardens are incorporated into the educational practices.

Figure 3: Hydroponic Tour at Wat Pathumwanaram School

3.2 Evaluated the Curricula

To guarantee appropriate development of educational materials, we assessed the pedagogical philosophies of the teachers at the Wat Pathumwanaram School through semi-standardized interviews. We determined that this style of interview was most appropriate because it allows the interviewer to determine a set of questions before the meeting without excluding the chance to add more questions during the interview (Berg, 2009). Throughout the

course of the interviews, the goal was to determine the interviewee's opinion and knowledge on various subjects using open-ended questions to encourage broad answers. Using a sample of convenience, we spoke to teachers that were available and willing to speak with us, initially focusing on the science teachers to better understand their expectations from the project. It was important to consider the existing cultural and language barriers while designing the interview questions to ensure that none of our interviewees were offended or made uncomfortable, and that all desired information was being translated accurately to English.

3.3 Surveyed Parents and Teachers

To establish appropriate methods for the dissemination of such holistic concepts as natural literacy and cultural heritage to the students and the entire community, we performed several semi-structured interviews with parents and teachers of the students at the Wat Pathumwanaram School. We gained a basic understanding of how to integrate these ideas into the curriculum through interviews with teachers of various grade levels. Similarly, the team approached random groups of parents in the schoolyard and conducted semi-standardized interviews with them. These interviews produced a kind of snowball effect in that as some of the parents were talking to us, other parents would become curious and were then eager to share their own answers and opinions. The goal of this activity was to determine the parents' perceptions about their children's pre-existing understanding of self-sufficiency and sustainability, as well as medicinal herbs and their uses.

In developing appropriate survey questions for the teachers and students, our bilingual team encountered difficulties with phrasing and cultural norms, which we had to rectify with appropriate question structure. We also formatted questions appropriately for the audience to avoid offending the interviewee. All of the people we interviewed were native Thai speakers, and did not understand English well. This challenge was overcome by the contribution of the Thai-speaking group members who conducted the interviews in Thai when necessary.

3.4 Interviewed Experts in Herbal Medicine and Organic Gardening

By speaking to experts with a wide range of backgrounds pertaining to medicinal plants and applications, we established a list of relevant plants. Based on the knowledge we gained about local climate, soil, and similar medicinal uses, we were able to narrow down our previous list of medicinal plants. We conducted semi-standardized interviews to allow for open-ended

answers. Since many traditional cures spring from religious practices, particularly Buddhism, it was important that the questions were formed in a way that would not offend the interviewee. We also took into account many of the same considerations that we did when interviewing the teachers and parents, particularly concerning the formatting of the questions and the language translation errors.

The team interviewed professors at Chulalongkorn University in the Botany Department and experts at local botanical gardens to gain insight regarding options for our project. The experts' advice played a significant role in the refinement of our list of plants that are commonly used, easy to grow, and found locally. The experts were also often able to comment on organic gardening tips and common practices like composting that would help to create a more sustainable garden. In many cases, we were able to use a snowball sample by asking the experts about people who might be knowledgeable in this area. For example, at an established herbal garden, the interviewed expert followed up by calling an herbal doctor for us to interview. We also conducted interviews with plant merchants at the Chatuchak Market in Bangkok to gather information about the accessibility and price of each plant for our garden budget. Those interviews proved to be an obstacle, since the merchants were busy with their work and could not participate in formal interviews. To overcome this difficulty, we acted as potential customers and addressed them with informal inquiries, gaining information about appropriate plants and other garden specifics.

3.5 Developed Educational Materials

As an important supplement to the garden itself, we created educational materials to spread the knowledge of medicinal herbs, their applications, and cultivation methods through a student and community learning center at the Wat Pathumwanaram School. To ensure the retention of this knowledge, students had to receive the information through understandable and appropriately designed means. Through interviews with teachers of various grade levels and research regarding the national statutes governing educational practices, the team gained insight on ways to integrate knowledge into the existing curriculum, determine effective learning strategies, and raise awareness of practical applications to students and the community.

Several obstacles were considered in the development of the educational materials. The school's budget was taken into account when proposing the volume and content of the educational materials. Since English is taught as a second language, we needed to determine

whether we should distribute only Thai or both English and Thai versions of the pamphlet and worksheets to the students. Inherent cultural barriers in teaching methods and learning styles were overcome through interviews with teachers and insight from related research, such as previous educational projects. Also, visual aids and the incorporation of youth culture were considered to attract the students' interest in learning the lessons being presented.

3.6 Designed a Botanical Garden

A major objective of the project was to design a botanical garden that would complement educational materials and effectively impart the concepts associated with our goal. We had previously researched a range of relevant plants, grouped in accordance to their health benefits. Research and expert opinions helped us to further refine the list of plants and gave insight on the garden layout. The plants that were included in the final design of the garden contributed to the various educational goals of the project and had multiple practical applications.

Throughout the design process, the team strove for the incorporation of self-sufficiency and sustainability into the garden. We researched His Majesty the King's principle in order to gain better insight into the concept and apply it to our project. More specifically, we sought information about garden organization that would allow us to build a garden with the materials available that would require minimal maintenance. In terms of optimizing the soil conditions, we researched the topic of composting. Although the type of composting that is commonly known in Western countries is more supported by research, the Thai government suggested a different method, so we investigated further to find information that would verify this strategy. It was important for us to try to honor the government's suggestion if possible because of the connection between the Thai government, Thai people, and the King's Principle.

We faced a few obstacles in the final design of the garden. The plot itself was a long narrow shape so we researched space saving techniques that would give the illusion of a larger garden and optimize the area. In addition, there was a large tree in the center of the plot. Since the herbs would not grow well if planted over the tree's roots, we researched ways to utilize this space in other ways. In terms of organization, we investigated ways to isolate the garden area from the fence and parking lot. Finally, in order to uphold the concept of sustainability and self-sufficiency, we wanted to be sure that the plants and materials would be affordable as well as effective.

In order to accomplish our objectives, we aimed to identify the current understanding of the students, which formed a general baseline of knowledge and expectations of the teachers. We took into account the characteristics associated with the garden site as well as the existing curriculum at the school. Numerous individuals ranging from school teachers to experts were available to provide their opinions and advice regarding the possible direction of the project. These steps allowed us to follow a systematic approach to completing our project goals.

CHAPTER 4: FINDINGS AND DISCUSSION

In the following chapter, we describe our major findings along with the observations, supporting data, and details regarding the physical construction of the garden. We created a comprehensive list of plants for cultivation in the garden, determined the most effective way to teach students, and created a realistic design for the allotted garden space, integrating the principles of self-sufficiency and sustainability.

4.1 Findings from Site Description

Figure 4: Ajarn Arunee

Our main liaison at the Wat Pathumwanaram School, Ajarn Arunee Nakhonchai who is pictured in Figure 4, provided the team with a tour of the school, allowing us to see the plot allotted for our garden as well as the rest of the school grounds. After speaking to the school directors, we discovered that plants were already growing in the garden space and around the school grounds. These plants were labeled with their Thai name, English common name, scientific name, and applications, as an initial effort to initiate a botanical garden. An example of the labels we found on plants when we first arrived on the school grounds is shown in Figure 5. Due to busy schedules and a demanding curriculum, the teachers were unable to finish the

garden successfully and it was not maintained as indicated by the litter and plant debris that covered the plot. We spoke to Ajarn Lalita Prasart, the agriculture teacher at the school, about the current state of the botanical garden. She said, “The herb garden in the school has existed since the time that the school was founded, but no one seems to care because knowledge of the herbs is not really important in the curriculum. So, it is incomplete as we see nowadays” (personal communication, February 15, 2012). Ajarn Arunee Nakhonchai, a biology teacher at Wat Pathumwanaram School, commented that, “While it is very good for the students to learn, the teachers are all busy with their work so they will not have enough time to construct the garden themselves” (personal communication, January 24, 2012).

Figure 5: Initial State of Garden Plot - Plant Sign

To gather a better understanding of the plot designated for the garden on the school grounds, we surveyed the area, recording dimensions and existing plants. Figure 6 and Figure 7 below display the initial layout of the allotted space, including the location of the existing plants. The plot itself has a length of 13.6 meters and width of 5.8 meters and 4.3 meters on the left and right hand side respectively, when facing the fence. A few of the plants were in pots, but others had extensive root systems in the site’s soil. Among these were a large Banyan tree, a few banana trees, and a few other small shrubs. The soil in the plot seemed to vary, as the soil on the left-most side of the plot was largely sandy, but the soil around the large Banyan tree was more clay-based. From our research we found that the sandy soil would provide less nutrients

compared to the clay-based soil.

Figure 6: Initial State of Garden Plot - Right Side

Figure 7: Initial State of Garden Plot - Left Side

The team followed the light patterns in the garden throughout the course of a day to determine the amount of sunlight available in various parts of the plot. Every hour we took pictures of the site observing the amount of light that was present and how it varied. In addition, we created a 3D model using a program that allowed us to imitate the sun patterns at different parts of the day. Figure 8 shows images created with the model for the morning, noontime, and afternoon. The majority of the garden receives little direct sunlight because of the trees and tall buildings to the East and West of the school, but there are sections on the left side of the area that receive direct sunlight in the morning. During the project, a considerable number of low branches were trimmed off the large Banyan tree leading to better lighting for the plot's central area in afternoon hours.

Figure 8: Garden Layout 10am, 12pm, 2pm

Additionally, we noticed the students spend time playing in the schoolyard in the proximity of the garden. They have been seen playing with balls and running through the garden plot. While there is the possibility of a ball hitting hanging pots, we also noticed that the students are careful to avoid stepping on any plants. This observation indicated a moderate damage hazard for the plants and structures in the future garden that would have to be considered in the design process.

4.2 Findings Pertaining to List of Appropriate Plants

To gain further information about the local, traditional medicinal plants, we interviewed experts from a range of backgrounds. In one of the interviews regarding suitable and culturally significant herbs, Ajarn Kanogwan Seraypheap, a professor in the Botany Department at Chulalongkorn University, shared her knowledge on low maintenance plants. For the purpose of a sustainable garden, she suggested that we use native plants that "grow very well in the wild and do not need a lot of attention or time to take care of" (personal communication, January 17, 2012). Also, Mr. Suthat Jaiya an expert gardener that we spoke with while touring the HRH Princess Maha Chakri Sirindhorn Herb Garden in Rayong, emphasized the importance of ensuring the plants' viability under the growing conditions at the school. He said that an ideal, low maintenance garden would be able to grow under the plot's sun pattern, local temperature, and precipitation conditions, without falling apart due to student mishandling (personal

communication, January 26, 2012). Merchants at Chatuchak Market commented that in general the plants with flowers require the most sunlight, suggesting that we plant non-flowering plants in the most shaded areas (personal communication, January 19, 2012). The experts that we interviewed each proposed a list of native, low maintenance plants to be considered for the garden design. These suggestions helped us form a table to compare the plants recommended in all expert interviews and create a list of the most suggested or relevant herbs. The complete table can be found in Table 2 of Appendix III. All the experts proposed similar sets of plants, indicating the more or less common understanding of traditional and local medicinal plants.

Another consideration for the team was the need to select plants that teachers at Wat Pathumwanaram School indicated as potentially useful when teaching about Thai traditional herbs in the classroom. With regard to the philosophies supporting self-sufficiency, sustainability, and organic gardening, we spoke with Dr. Dumrongsuk Chumsaengphan, an herbal medicine and organic gardening expert with 54-years of experience, at his home near Rayong. As the expert explained, people's close connection with nature is strongly encouraged by the "Dhamma, which is the doctrine of the Buddhism is derived from *'dhamma-chart'* (literally, *nature*), so it teaches us to determine the essence of the nature such as how to live with the nature and knowing nature" (personal communication, January 26, 2012). He explained self-sufficiency and sustainability as knowing "yourself and how many things you have. In knowing, you become immune to yourself to prevent greed and perform things locally. You also must know something precisely and you must share that knowledge with other people" (personal communication, January 26, 2012). With his passion for sustainable, organic gardening, he suggested that we genuinely design the garden depending on the King's Principle, since the essence of organic gardening, using everything around you to make the best outcomes, closely goes along with the King's Principle. As even pesticide can be made organically through insect-repelling plants, Dr. Chumsaengphan claimed that organic gardening turns out cheaper than the regular type, giving us a notably low budget suggestion (personal communication, January 26, 2012).

The team interviewed Dr. Phithak Teelek, an herbal doctor and expert at Chophaya Abhaibhubejhr Herbal Hospital to gain more insight about the plant types and species relevant for the botanical garden. The expert recommended that we incorporate plants "targeting diseases frequently found in Bangkok citizens," since if people find something useful, they would want to continue maintaining it (personal communication, February 8, 2012). Dr. Teelek explained that city residents tend to not grow edible herbs such as basil and pepper unlike people in the countryside who do not have such a vast access to pharmacies. He also mentioned that organic gardening is overall more affordable, as you make everything by yourself. The herbal doctor suggested that we create biodiversity in the garden by cultivating different plant types, predominantly medium trees and small plants considering our plot size. Due to its location in a busy city, insufficient access to pure carbon dioxide was described as more of an issue to plant growth than insufficient sunlight. Dr. Teelek additionally mentioned that the Banyan tree's hanging roots cure fever, turning it into an important element of the medicinal plant garden.

Figure 9: Interview with Dr. Phithak Teelek

Background research was helpful in terms of providing a wider and more extensive span of information about Thai traditional herbs and their applications. However, the actual selection of prospective plants for the garden relied on teachers we interviewed, as they were able to provide insight and directions specific to the project site and its purposes. When two middle school science teachers were asked what they wanted the students to learn, Miss Supitcha

Sangangamsakul and Miss Rungtawan Seecamme replied, “Basic information on Thai herbs and medicinal plant such as practical uses in terms of medicine and its benefits” (personal communication, January 25, 2012). As a result of this information, we were able to make a selection of plants that supported the teaching objectives of the garden.

Resulting from our research and the advice we received from experts and the teachers intending to use the garden for educational purposes, the team compiled a complete list of all selected plants describing their physical features, which is included in Table 3 of Appendix III. Examples of common diseases targeted by the herbs’ medicinal properties include digestive problems, nausea, hot fever, skin burns, and bacterial infections. (Hot fever is a condition of rising body temperature caused by prolonged sun exposure as opposed to cold fever which is caused by sickness.) Research findings provided typical examples of plants that treat those medical conditions, some of which are presented below.

Figure 10: Medicinal Herb Garden at Abhaibhubejhr Herbal Hospital

Holy Basil (*kra-praow*) is an annual crop that is no more than 30 to 60 centimeters tall with an average life span of one to two years. It grows well in all types of soil and its leaves can be harvested every 15 to 20 days. The leaves can cure any stomach symptom if eaten directly or squeezed and mixed with water. **Thai Sweet Basil** (*ho-ra-pa*) grows 50 to 100 centimeters tall, is harvested every one to two years, and relieves headaches and diarrhea. Even though good soil drainage is preferable, the herb is easily maintained almost everywhere and can be harvested 30 to 35 days after planting. **Kariyat** (*fah-talai-jone*) can be grown easily in all environments, but especially favors hot and humid climates. It grows 30 to 110 centimeters tall and the leaves can be harvested about 3 to 5 months after planting. The leaves alleviate hot fever caused by high temperatures, in addition to quenching thirst and curing aphthous ulcers. **Aloe** is a small plant that can be applied directly to the skin to treat skin burns and rashes. It grows well in sandy soils and no more than 50 centimeters tall. **Ginger** (*khing*) grows in hot climates, above ground as a clump of leaves about 90 centimeters tall. The roots can be harvested after 10 to 12 months or after the leaves and stem begin to shrivel. Ginger pieces with two to three buds can be planted individually in the soil to continue growing the following season. The root can either be boiled for drinking or directly applied on a wound to cure a wide range of ailments including nausea, vomiting, motion sickness, fever, and spider bite wounds.

4.3 Findings on Educational Materials

We created a manual introducing interactive games that incorporate the garden as a supplement to the curriculum as well as arts and crafts activities according to teaching methods at the school. Assessing the present educational system and researching innovative teaching techniques were instrumental in the work towards this objective.

4.3.1 Evaluation of Existing Educational Strategies

Our first step in this aspect of the project was to evaluate the existing educational curriculum at the Wat Pathumwanaram School. The National Education Act of 1999 introduced the notion to Thailand public school systems that all students are capable of learning, and that teachers should not present themselves as superiors in an educational setting, but rather as a mediator of free-flowing ideas and discussions. Interviews with the teachers reinforced this belief; they additionally informed our team that their teaching styles primarily utilize handouts to achieve this goal. Educational packets engage the listener and encourage students to arrive at their own solution, rather than the instructors repetitively displaying knowledge and expecting

the handouts to reinforce the opinion offered by the teacher. The teachers do lecture, however they use it as a means of explaining background details for laboratory exercises and activities rather than as the primary source of information. Miss Supitcha Sangangamsakul and Miss Rungtawan Seecamme, general science teachers at the Wat Pathumwanaram School, mentioned that in "elementary school, teachers would demonstrate the experiments," however middle school and high school students learn mainly through doing their own experiments and research (personal communication, January 25, 2012). Ajarn Lalita Prasart, who teaches agriculture for grades seventh through ninth, added that research is done commonly in her classes. "The reason for doing research is because students know only the theory of plants, so research will help them see the picture. The practical understanding is what is lacking and is necessary for the students" (personal communication, February 15, 2012).

After observing a seventh grade English class, our team learned that student participation and collaboration were essential to teaching. The entire class was asked to speak aloud as Mr. Saxner dictated to them in a call and response fashion. Each student tried their best to repeat what Mr. Saxner said, and they even worked with each other on the more difficult words.

4.3.2 Development of Educational Materials and Activities

Interviewing teachers with regard to their teaching styles and expectations helped in the development of possible educational materials relative to the mandatory education curriculum. We found that teaching often focuses on handouts and collaborative group work, following the active learning and constructivist philosophies. The information from our interviews with teachers helped us gain insight into ways to engage different levels of students actively while using the garden as a learning tool. Through an informal interview with David Saxner, an American English teacher for seventh through ninth grade, we learned possible complications in trying to teach Thai students. He warned us against teaching through student or group presentations. "I have tried this and most times the students will mumble or be too afraid to share their ideas, even if they know that they are right. Even in a group, students are likely to default to the most knowledgeable person, and that person is usually too timid to share their ideas in front of the class and the presentation does not happen" (personal communication, February 15, 2012). On the other hand, he did comment that competition is a highly motivational way to encourage engagement. In planning possible educational materials, he did not recommend including garden activities within the regular class period, since "it is difficult to get the students to focus after you

have allowed them to be outside and be active" (personal communication, February 15, 2012). Instead he recommended that we plan for our activities to be performed in a classroom of about 40 students.

When considering the uses of the botanical garden, the school teachers were interested in an emphasis on teaching self-sufficiency and sustainability through practice as well as the properties and practical application of medicinal herbs. Ajarns Supitcha and Rungtawan noted that "the school also has a program about teaching the students to collect money, since most of the children who get things easily will not look after them or take good care of them. So the teachers try to teach the students to manage money and become caring citizens. But the school cannot instill these practices alone, the parents should also help" (personal communication, January 25, 2012). According to the twenty parents that we interviewed, they all agreed that it is important for students to learn about self-sufficient and sustainable practices. One parent added that this would include "knowing to use everything around you to make the best benefits" (personal communication, February 16, 2012). About half of the parents agreed that reusing what you can and learning to save money is important. One way that parents try to reinforce sustainable living is through the use of medicinal plants at home. Fifteen of the parents explained that they rely on herbal medication more than 50% of the time. With a garden, the teachers feel that students will have the opportunity to learn to be responsible and make decisions that will allow them to become citizens who live self-sufficiently and sustainably.

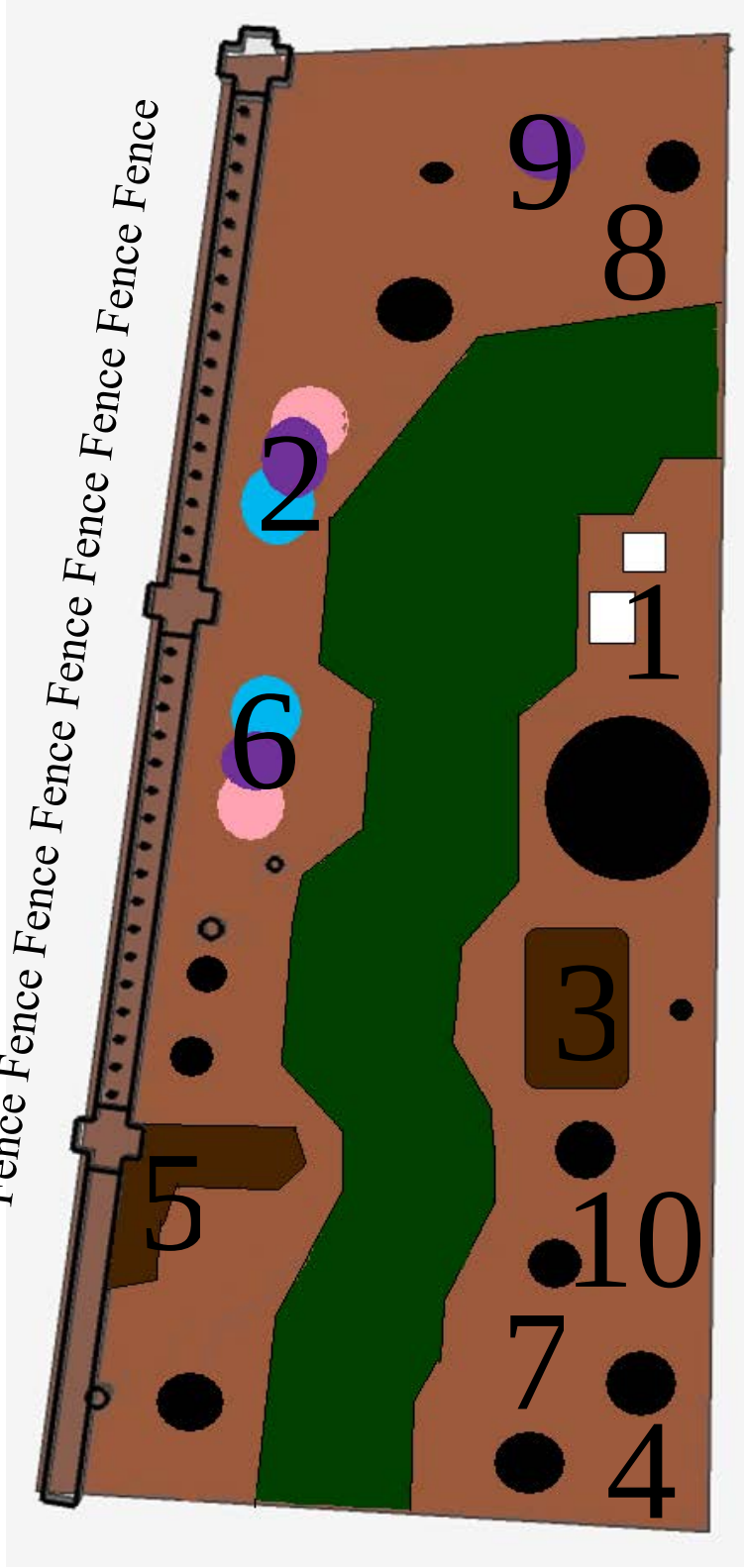
With the interest of incorporating the garden as a supplement to learning about medicinal herbs, we considered using active games and arts and crafts. As a result from a survey given to teachers in a wide range of subjects and grades, we determined that eleven of the thirteen teachers were in favor of using active games and arts and crafts to engage students in practical learning. In an interview with Ajarn Tinnakorn, the art teacher at the Chulalongkorn Demonstration School, we learned arts and crafts incorporating nature encourage exploration of the garden and appreciation of nature. He recommended that we create materials that teach the students about the medicinal properties of each plant used in the garden. He presented examples of projects completed by the students showing how the garden could be incorporated into supplemental curricula. One example was presented by Ajarn Saeng-tiwa Chaiyot, an English teacher at the Chulalongkorn Demonstration School. He said "Sometimes leaves are used when the students are studying the difference between two plants" (personal communication, February

7, 2012). Afterwards, Ajarn Aoracha and Ajarn Tinnakorn showed us the gardens on the Chulalongkorn Demonstration School campus. As we toured their facility, we noticed that the students had prepared informational signs for the garden as well as messages warning against picking the leaves of the plants and disposing of trash in the garden. Our observations in the Demonstration School grounds provided us with many ideas regarding the activities and structural details that could be incorporated into the Wat Pathumwanaram School botanical garden.

Figure 11: Interview at Chulalongkorn Demonstration School

4.4 Findings Pertaining to a Botanical Garden Design

The team completed the design of the botanical garden as a result of site evaluation and advice from teachers and botanical gardening experts, as well as research into and incorporation of the principles of self-sufficiency and sustainability. The small area allotted for the garden, displayed in Figure 12, required us to consider applying space saving practices and research design techniques that would give the illusion of a larger garden. For example, a path that curves through the site will make the area appear bigger by increasing the surface area for plants. The ground of the proposed area was also found to be uneven, requiring research to understand ways to compensate when planting and building the path with leveling techniques.



Key	
Purple, Blue, Pink	Painted Tires
Black	Existing Plants
Green	Rubber Path Tiles
Dark Brown	Raised Beds
White	Pots

Figure 12: Garden Design with Medicinal Groupings

Group 1: Anti-emetic (cures vomiting/nausea) Holy Basil Ginger Indian Mulberry	**Group 6: Cardiac tonic (Anti-heart attack / Arrhythmia) / Anti-hypertensive (anti-high blood pressure)** Asiatic pennywort
Group 2: Carminative / Anti-Flatulence Sweet Basil Kitchen Mint Cayenne Pepper Phlai Winged bean	**Group 7: Anti-pyretic (Anti-hot fever)** Kariyat Agasta
Group 3: Anti-eczema / Anti-fungal Galanga Star Gooseberry Aloe Turmeric White Crane Flower	**Group 8: Anti-toxin** Hop Headed Barleria
Group 4: Cough suppressant, Anti-expectorant, Mucolytic Common Lime Phlai	**Group 9: Diabetic drug** Wildbetal Leafbush
Group 5: Diuretics Lemon Grass Cat's Whisker	**Group 10: Anti-spasmodic, Anti-motility, Anti-secretory** Guava Kariyat

We approached experts about the Banyan tree growing in the middle of the plot – an important observation from our site assessment. Ajarn Kanogwan Seraypheap of the Botany Department at Chulalongkorn University stated that we would not be able to plant herbs in the immediate vicinity of the tree, since its large roots will continue to grow and drain the nutrients from the surrounding soil. She proposed the incorporation of an aqua garden near the tree in addition to potted plants and suggested a possible budget for the realization of an organic botanical garden. Herb merchants we interviewed at Chatuchak Market agreed with Ajarn Kanogwan Seraypheap's comment that plants with deep roots would have to compete with the tree for space and many will be left without sufficient nutrients due to the presence of the Banyan tree. They also suggested potted plants in this area as a solution to this problem.

The incorporation of the self-sufficiency and sustainability principles in the garden design was approached in a step-by-step fashion by gathering advice, feedback, and support from related experts, sponsoring school officials, and the parents of students attending the Wat Pathumwanaram School. The teachers were well acquainted with these widely promoted concepts and stressed the importance of incorporating them into teaching at the school. Ajarn Arunee felt that it is "very important because the students in this school are surrounded by civilized things such as technology and especially the exaggerated factors run by the big shopping malls, Paragon and Central World. So teaching the King's Principle will instruct the students to know how to be prudent" (personal communication, January 24, 2012). The parents also supported this ideal explaining that they felt students should learn to "walk in the middle of the path" meaning that the students should learn to understand and use only what they have, not wish for more (personal communication, February 16, 2012). According to Ajarn Kanogwan Seraypheap, a professor in Chulalongkorn University's botany department, the government has promoted the King's Principle in the educational system and instruction about the principle begins as early as the fourth grade (personal communication, January 17, 2012).

Research into the design of organic gardens uncovered other options for this project as well. We discovered a variety of composting techniques spanning the typical western composting methods like home composting and vermicomposting as well as the methods more common in Asiatic countries involving microorganisms and fermentation. Although Western techniques are more widely supported in our research findings, the methods involving waste fermentation had been tested and praised throughout countries with similar waste production and

climate conditions as Thailand, two important factors for successful composting. After inquiring about composting recipes at both the HRH Princess Maha Chakri Sirindhorn Herb Garden and the home of Dr. Chumsaengphan, we were able to better understand the recipe suggested by the Thai government In addition, the process outlined by the government would be easy for the school to maintain due to its simplicity.

From interviews with vendors at Chatuchak Market and botanical garden curators, we learned that creating an organic garden could be more expensive, but the plants would be stronger. To complement the organic, environmentally friendly, and sustainable nature of the garden, we found many existing materials at the site that school officials encouraged us to repurpose or reuse, especially pots and rubber tiles. Additionally, the team observed and drew ideas from initiatives around Bangkok involving the use of waste like plastic bottles as pots for plants. During a meeting with the Parents Committee at the school, they also indicated their support by offering herbs from their own homes for planting into the garden as well as a monetary donation to be used for purchasing necessary materials for the garden.

4.5 Discussion

The site assessment revealed to us that the school has already begun a garden project. However we did not find the garden in the best of conditions due to the busy schedules of the teachers and lack of space in the curriculum for related education. A garden that needs minimal care would allow for active student participation in the maintenance, without requiring mundane and strenuous garden work. The teachers encouraged us to build upon the educational applications of the garden through various practical activities that would reinforce the students' connection to nature. The team needed to create a design that would be easily maintained so as to facilitate the long-term preservation and viability of the garden.

The site presented a few limitations that would have to be accounted for with clever design. For example, the large Banyan tree in the central plot section proved to be a major influence on the overall plan due to its roots. Both Ajarn Kanogwan Seraypheap at Chulalongkorn University and plant merchants at Chatuchak Market warned us against planting in the ground over and near the tree roots to avoid nutrient deficiency. The team had to work around this obstacle by incorporating decorations and pathways to utilize the spaces unable to sustain herb growth. The location of the garden in a frequently populated school area meant that students' recess games could present a risk to the plants. This affected the plant selection

pertaining to the type, growing requirements, and vulnerability of the prospective herbs, as well as orientation of pots within the garden. Additionally, the unevenness of the soil further restricted the proper usage of the allotted plot, so before planting it would be necessary to manually even out the soil to the best of our ability.

Using insight gained from background research and site assessment, the team created a list of Thai medicinal plants that would grow well in the garden based on their sustainability and possible educational applications. Observed sunlight, the soil conditions, and Bangkok's local climate were all taken into account, and in order to make our garden self-sufficient and sustainable, we sought plants that would be easy to maintain in these conditions and could be found locally. It was also important to choose plants that were easy to cultivate for their medicinal uses and had multiple traditional applications that could be taught in the classroom. Since the size of the site and the large plants already in the plot limited the number of plants that we could select, the team determined that certain plants, such as other large trees, had to be excluded from our list despite their common medicinal applications. In order to compensate for the size of the area we would have to apply efficient plant groupings and spatial organization techniques that would provide a viable environment for each plant without overcrowding the compact site. Our background research on space-saving garden practices proved particularly beneficial when taking on these difficulties.

In terms of the physical plot restrictions, the team determined that additional large medicinal trees would have to compete with the Banyan tree for nutrients. They would also create more shade once fully grown. We recognized that the site would not accommodate tall-growing plants and accordingly restricted the final plant list by picking mostly herbs of up to 150 centimeters in height. The availability of sunlight was recognized as a limitation at the starting point of the site assessment; few spots of the garden received direct light for most of the day. During a tour of the Chulalongkorn Demonstration School, we were informed about the existence of an herb garden on the grounds where many of the plants had died due the construction of a neighboring building, shading the previously sunlit area. This observation demonstrated to us the immense importance of proper lighting to the viability of the plants. Fortunately, shading caused by the tree branches and leaves was no longer a significant issue after the lower branches on the tree were removed by one of the school's workers. We would still have to specifically position the plants according to their light requirements to ensure the

longevity of the garden. Furthermore, because the garden would be located on school grounds, the team excluded plants such as poison berry from the selection, owing to their hazardous qualities.

Even though Thailand is endowed with an impressive variety of medicinal plants, we considered the plot limitations and used our research findings, expert advice, and planting guidelines to refine our comprehensive plant list and construct a set of ten plant groups, classified and compiled in accordance to the plants' medicinal properties. The plant specifics and groupings are presented in Table 3 of Appendix III. Knowledge and experience from the garden would have relevance to the community's everyday lives because the plant remedies would be able to cure common sicknesses. In addition, the plant grouping by properties would allow for focused teaching and learning, since the students will have the opportunity to make mental associations between the various herb species with similar medicinal features. Additionally, distinctly planting the herbs in a thematic fashion would contribute to a more clearly organized garden that can better serve as a learning center for educational activities.

It was essential to evaluate the educational background and regulations directly pertaining to the project. According to the National Education Act of 1999, Thai schools have already made steps to a more equal, collaborative level of interaction between teachers and students through compulsory elementary and middle school education. Additionally, studies done to analyze behavior of learners have indicated that active learning is a valuable technique for delivering knowledge to students. All of the Ajarns at Wat Pathumwanaram School have indicated that they use some level of lecturing coupled with visual displays and worksheets geared towards students discovering information upon their own means. Teachers also expressed a specific interest in teaching and learning through collaboration. As Mr. Saxner warned us, the applied active learning and constructivist philosophies encourage teamwork and critical thinking, but also tend to leave weaker students struggling and often times resorting to copying. Educational materials were prepared so that students would be engaged. We adapted the games and arts and crafts activities for indoor completion, as to not disrupt the work of the teachers by distracting the student's attention from the other daily material. Furthermore, the team considered the number of students per class, as well as the size of the classroom itself, since the developed games should not require too much free space. To inspire the students and not intimidate them, all games would have to include a level of competition and not require too

much formal speaking of individual students. Thus, the children would be able to relate to the activities and participate eagerly, quickly learning about medicinal plants and their properties. Keeping all of these considerations in mind, we designed an educational manual which included information about the plant and organic gardening as well as interactive games and arts and crafts activities, developed to teach students practical knowledge of medicinal herbs and their medical applications. Additionally, a pamphlet for each plant with details about their properties was prepared and included in the manual in both Thai and English. The complete manual in English containing all educational materials is attached in Appendix VIII. This appendix was originally formatted on A4 sized paper, and has been attached as a picture to depict accurate proportionality. The Thai version of the manual has also been supplied to the school; however it is not documented in this paper.

The faculty's support for this practical cause would contribute to the long-term project outcomes because they are interested in encouraging their students to learn and apply the self-sufficiency and sustainability practices through the garden. In an effort to increase practical understanding, Ajarn Supitcha Sangangamsakul and Ajarn Rungtawan Seecamme stated that the school "wants the students to be able to use and learn from the garden" through "allowing them to plant by themselves," as that activity would teach them "to bond with nature and also the rule of giving and sacrificing their time looking after the plants" (personal communication, January 25, 2012). They felt this might help make the students feel more involved and have a stronger sense of ownership of the garden if they helped in its construction and maintenance.

Organic gardening practices exemplify the self-sufficiency and sustainability ideals and were found to be worthwhile for the school and the garden. Education on these topics could enhance the lives of the students in the school system as well as the lives of the local residents. Living feasibly within your own limits ensures mindful spending and creates a more comfortable living situation. Even though merchants at Chatuchak Market mentioned that organic gardening might be expensive, both Dr. Chumsaengphan and Dr. Teelek at the HRH Princess Maha Chakri Sirindhorn Herb Garden in Rayong explained that the natural method is actually less costly because it utilizes available materials and hardly requires the need to buy commercial soil supplements. Refraining from purchasing and contaminating the site with fertilizing chemicals or pesticides and utilizing waste to enrich the soil instead would save the school's funds. Reusing old pots and tiles available at the school would also be financially beneficial. Apart from the

budget issues, the organic approach would be suitable for setting a practical example of environmentally-friendly, quality gardening for the students, which would be a significant success for the purposes of the botanical garden.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

This chapter discusses the details of our garden design implementation, the conclusions drawn from our findings, project achievements, and work experiences, as well as recommendations regarding the utilization of the garden for educational and social purposes.

5.1 Project Conclusion

Striving to increase the knowledge of low income, urban students about traditional medicine, we developed and implemented a design for a botanical garden consisting of Thai medicinal herbs, as well as complementary educational activities. Together, these deliverables reinforce traditional Thai customs by educating the students and community about natural literacy, self-sufficiency, sustainability, and the practical applications of Thai herbs. The garden design incorporates regional, low maintenance plants and cultivation techniques that allow for manageable upkeep and assure longevity in the school environment. We gave preference to multipurpose plants to accentuate the many potential uses of the medicinal herbs at home. We also stressed the availability and affordability of these plants in the local economy. The educational materials serve as a blueprint for the application of the garden as an active, hands-on learning tool, complementing the curricula of a wide range of subjects and examining the procedures required to utilize the plants' properties. Through the garden's design, use of indigenous medicinal Thai herbs, and incorporation into the Wat Pathumwanaram School community, along with suggestions for further improvements to its utilization, we believe we have enhanced the Wat Pathumwanaram School's teachings of self-sufficiency and sustainability.

5.1.1 Implementation of the Botanical Garden Design

Constructing the garden was the conclusive physical outcome of our design. The final layout is presented in Figure 12. First, we cleaned the garden plot of litter and dead leaves and removed the excessive small roots and spreading shrubs in the left corner of the site. The team also tilled and evened the soil throughout the plot to prepare for construction and planting. While tilling, we found a large concrete block to the left of the banana trees that had been covered in soil. This block prevented us from digging any deeper into the soil and leveling out the area. The pathway was made from rubber tiles, leftover from a previous landscaping project. The team

ensured that the path was wide enough to allow visitors to pass each other, with a few wider areas for larger gatherings. The tiles prevent weeds from growing in the pathway while defining an appropriate place to walk. Within the first week after the construction of the garden, we noticed that our design was working. The flow of traffic through the area was being managed;

Figure 13: Path Design: Before (Above) and After (Below)

the kids were staying on the path and were gathering in the wider sections.

Ten areas were specifically cleared to accommodate the ten groups of plants selected for the garden. These areas were chosen in conjunction with the pathway design and took into consideration the trees in the plot as well as sun availability. Figure 12 shows the locations of the planting areas and specifies on whether each one will use a raised bed or pots. The raised beds were constructed so that the surface was level and the soil was at least twenty centimeters deep. We used bamboo for the sides because of its availability and its adaptability to uneven surfaces. The team layered the bottoms of the beds with landscaping fabric to keep out weeds and prevent existing plant roots from competing for nutrition. Pots already available at the site were included throughout the garden. Thus, we avoided planting over root systems and uneven ground, while

preventing weed proliferation. We found eight car tires discarded around the school grounds. We cleaned, painted, and structured them into two pyramids to hold small plants. We were also able to recycle plastic bottles and hung them from the fence along the back of the garden to be used as pots and provide a distraction from the parking lot on the other side. We planted the donated Butterfly Pea seeds in these bottles because they are hanging plants, which are known to spread. New potting soil was used in the pots and raised beds to help add nutrients to the preexisting soil. We did not apply chemical and artificial fertilizers or pesticides because we wanted to keep the garden organic and safe for the students. Students helped to paint the bottles and pots as well as concrete slabs that were used as decoration throughout the garden.

Figure 14: Wat Pathumwanaram Science Club Students During Cleaning Day

We fostered further student participation by organizing physical activities involving the garden. Teachers were surveyed to gauge their interest and the availability of their students to help with the garden's construction. Of the teachers that returned the surveys, most thought it was a good idea to incorporate their students in the garden's development. However, most of the teachers suggested that the students participate outside of instructional hours, likely attributed to the lost school time caused by this year's flooding. The Science Club helped to start the cleaning of the garden plot during one of their weekly meetings. For two hours, around twenty students helped pick up trash, move bags of soil, relocate potted plants, and turn the soil. The students were excited to be given the chance to help and make a difference in the garden. Throughout the following days, during the garden's preparation for planting, students would come and watch the work with interest, occasionally helping and offering advice. Over time they became more confident with helping in the garden. Although the large number of kids trying to help out would decrease our efficiency, we encouraged them to continue digging or sweeping the path because we understood that it was important for them to feel as though they were contributing so that they would become invested in the garden's well-being.

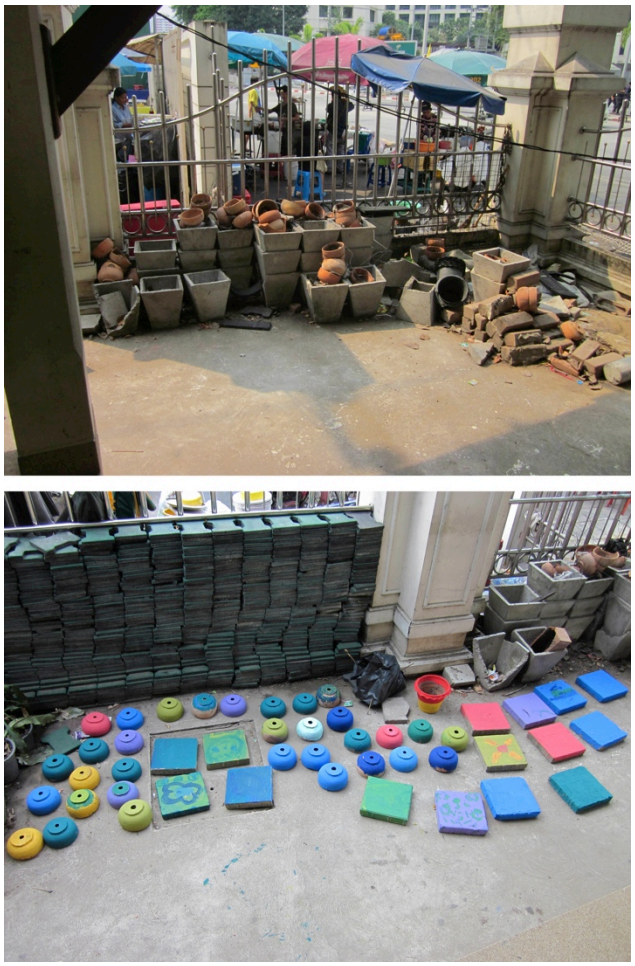


Figure 15: Pottery and Cement Tiles Painted by the Students: Before (Above) and After (Below)

The materials used in garden construction were mainly wood and pottery, much of which was either already available to us on the school grounds or was provided by the school directors. We purchased a few miscellaneous materials, like landscaping fabric and string, with some of the money donated by the Parents Committee of the Wat Pathumwanaram School. Even though the pathway tiles were rubber, they had been left unused and their utilization exemplified self-sufficient and sustainable gardening while decreasing the expenses. Lastly, the use of the plastic bottles for planting as an alternative to pots was an exception to our plastic-free policy because the reuse of the bottles demonstrated waste conservation to the students. Thus, the team incorporated the King's Principle in the botanical garden by using recycled and reused materials.

5.2 Recommendations

The following recommendations describe ways to maintain the garden sustainably in the future. We also offer advice as to how the Wat Pathumwanaram School may be able to use the garden as a valuable educational tool for the students and to teach constructive life lessons that can be applied to create a more sustainable and environmentally-friendly local community.

5.2.1 Completion of the Garden

Although much of the garden construction has been completed, there are still a few tasks that need to be finished. Most importantly, the plants need to be purchased and planted in the raised beds or pots according to the garden layout provided in Figure 12. As the planting continues, signs including the information specified in the provided pamphlets must be created and displayed in the garden to clearly label each species of plant. Spreading mulch over the exposed dirt in the garden might be desirable to control weeds and improve the overall appearance. Also, a sitting area would be a suitable addition to the spot with a large concrete block under the soil that prevents any planting or digging. This area could consist of a few overturned concrete pots for the children to sit on, or a bench could be added if funds allow it. Finally, as future art projects like painted pots and signs telling students to not leave trash in the area or pick the leaves are completed, they may be added to involve future generations of students in the garden.

5.2.2 Sustainable Practices in the Garden

We advise the school to use the instructive materials (See Appendix VIII) we have provided, which detail the process and materials required for the implementation of a successful composting program. This process demonstrates a clear, real-life practice of the King's Principle and offers another chance for students to become involved in sustaining the garden. Compost is a natural fertilizer, helping the plants create new and usable products to enrich the soil from the school's current food waste. Other processes that have been outlined in the manual produce organic pesticide and treat plant diseases. Another recommended example of organic practices is non-chemical weed control. Thus, the school can prevent the profuse spreading of weeds by tilling the soil, manually cutting and spreading mulch on the soil. This will help lower the cost of sustaining the garden by forgoing the need to purchase chemical fertilizers, keeping the garden healthy and organic.

5.2.3 Garden Maintenance

In order for the Wat Pathumwanaram School to maintain a new garden and compost program, upkeep and care will be necessary with the cooperation of a number of people. We recommend that the school involve the students, ensuring a sustainable continuation of the garden in the future with minimal additional work required from the teachers. Students of one particular subject, such as the botany classes, could be responsible for the upkeep of the garden. With multiple classes studying botany, we recommend that each class take one task or all classes rotate tasks periodically, for example cleaning the trash, weeding, or watering the garden. It is also important that there be a designated instructor and group of students in charge of running the composting program and using the finished compost, a full description of these duties can be found in the compost guide as part of the educational material manual in Appendix VIII. We further recommend that the school gardener tend to the garden area. The gardener's duties may include providing tools for the students when necessary and watering the garden when the children are not at school. Although low maintenance was a major aim in the garden implementation, gardens do require some care and we advise that the students take the largest responsibility, limiting the amount of work the teachers and staff need to put into sustaining the garden.

5.2.4 Use of the Garden as a Tool within the Classroom

Since botanical gardens naturally associate themselves closely with science curricula, we suggest detailed supplements for various science disciplines and grade levels (See Appendix VIII). These activities would be especially relevant for the Wat Pathumwanaram School Science Club because they contain similar material to what the club already covers and the games would be perfect for the club's goal of making science fun. The educational potential of this garden is not limited to the scientific subjects, and we strongly encourage the school to use it for broader teaching and learning. We would like to give a few broad suggestions pertaining to subjects other than science. A very promising educational opportunity would be for the English teachers to utilize the English common names of the plants as well as the names of the different parts of a plant, as a means of helping the children to familiarize themselves with the language through word searches, word scrambles, and worksheets. For the purposes of math instruction, the garden would be an effective tool for spatial thinking, allowing the students to measure various distances and better conceptualize how far away an object is. Math teachers could also teach the

students about potential profit from selling these plants to vendors. Finally, art classes would significantly benefit from various art projects and crafts using leaves, flowers, and impressions as detailed in our manual (See Appendix VIII). The integration of the garden into many different grade levels and subjects will encourage a wider range of students to enhance their natural literacy and learn the practical applications of local plants through both structured physical activities and worksheets.

5.2.5 Practical Knowledge Applicable Outside of the Classroom

While the botanical garden will be an excellent tool used to instruct students in a hands-on, visual-instruction manner, we recommend that it also be used to teach students broader knowledge regarding social responsibility, the preservation of Thai culture, and respect for the surrounding natural environment. These themes may be stressed in the classroom, but can further be reinforced when students participate in the upkeep of the plot. By taking part in the gardening, students are also exposed to the King's Principle, learning about the self-sufficiency and sustainability principles integrated into the design of the garden. We recommend that the garden be expanded to outreach to members of the community, educating them of these important living philosophies.

5.2.6 Incorporation of the Garden into the Entire Learning Center at the Wat Pathumwanaram School

Wat Pathumwanaram School has already established an educational cluster for vocational purposes at the school, encompassing a broad range of occupations, from hydroponics to woodworking. As the garden becomes incorporated into the learning center, we advise that the community be made aware of the garden's existence on the school grounds through media similar to that suggested by a team of Chulalongkorn University students that completed a Social Science Project titled "Design Promotional Media for a School Community Learning Center", which is also sponsored by the Wat Pathumwanaram School. Parents who observe the materials within the garden have the potential to personalize these practices for their own household and integrate them into their common life at home. We suggest that the school allow students to take home plant clippings or seeds and their own painted pots, after learning the appropriate cultivation techniques. Thus, the children can start gardens at home as well, developing their education into a positive life style. We recommend that the botanical garden be used to further

educate students about medicinal herb cultivation as a means to obtain remedies for common ailments. The students could later use their herb cultivation skills as the foundation for a career.

We advise that all of the gardens be integrated into the curriculum, and likewise knowledge is distributed throughout the surrounding community to raise awareness of Thai cultural heritage, healthier living alternatives, and more affordable healthcare options. Upon completion of the above recommendations regarding self-sufficiency, sustainability, plant cultivation and natural literacy, the students will develop greater appreciation for the natural world as well as life-long skills, like responsibility, applicable in all facets of life. The Wat Pathumwanaram School area will benefit from the botanical garden and complementary educational materials by gaining a better understanding of their own cultural heritage and by applying the core communicated principles to enrich their everyday life.

5.3 Team Experiences

Apart from the strictly project-oriented outcomes that we achieved as a team, we also collected a variety of impressions and experiences arising from cultural differences in our Thai-American group. All of us, regardless of our nationality, gained a positive experience collaborating as a team in a professional setting. Largely due to language difficulties, establishing successful communication on the project was at times challenging, but essential to the accomplishment of our objectives. The Chulalongkorn University students were irreplaceable in overcoming the language barrier between the English-speaking WPI students and Thai-speaking sponsors. However, the impact of subtle language differences was prevalent among the group. Occasionally, team communication was hindered due to differing cultural understandings of language idioms, grammar, rapid speech, and jargon. Regardless, the WPI students were more than willing to take into account the fact that English is not a native language for the Chulalongkorn University students and made efforts to speak in an easier to follow manner. In turn, the WPI students were valuable for their familiarity with the intricacies of the English language. They were available to correct the translations from Thai to English that were necessary when conducting interviews and examining Thai resources.

The team particularly appreciated the privilege to work daily at our project site – the Wat Pathumwanaram School. Working at this location considerably alleviated our potential struggles due to the proximity of the sponsors; almost every time a question arose, a teacher or a school official was available to respond and provide insight. Additionally, working at the school proved

to be truly inspirational for us. We obtained a clear vision of the site where the practical outcomes of our efforts will be applied. Meeting the numerous students of different ages at the Wat Pathumwanaram School daily was not only delightful, but also motivated us even more to have a positive impact on the school. For example, one of the younger students who spent a lot of time with our team helped put some of the first plants in the ground. The smile on the girl's face as she realized that she had just added a permanent living addition to the garden was unforgettable. These encounters gave a deeper meaning to our work and make the project come to life.

It is important to mention that we all entered the project with distinct, high expectations from the shared objectives and an agreed upon work schedule. The WPI students aimed at a completely planned out and fast-paced accomplishment of our weekly tasks. In comparison, the work process of the Chulalongkorn University students was more laid-back and less stressful, but also leading to successful results. Furthermore, they had additional responsibilities such as university classes running simultaneously with the project work. Due to the different perspective and background of each member, it was essential for all of us to understand and make compromises when necessary, in order to establish good group dynamics. Thus, the WPI students accepted that our Thai teammates could not dedicate an equal amount of time because of their other course responsibilities. The Chulalongkorn students, on the other hand, adopted many of the WPI members' work habits in terms of punctuality and pace. All of us were highly motivated to achieve the project goals, so the efforts we made to balance our team dynamics paid off well.

All team members recognized that we were working in a real-world professional environment to produce successful and applicable project outcomes. These conditions were distinct from the familiar atmosphere in university courses, where students obtain mainly theoretical knowledge. Thus, we focused our mindset around working as a team on a mission to reconnect Thai children with nature that is almost extinct in urban Bangkok. The team learned to communicate professionally with our sponsors at the Wat Pathumwanaram School, shaping the project objectives to meet their expectations. We took the opportunity to apply critical thinking, actively participate in group brainstorming sessions, as well as express and receive constructive criticism responsibly. We were also resourceful in scheduling numerous interviews and meetings with teachers, parents and experts at various institutions in and outside of Bangkok. The

sponsors' anticipation that the garden design would be followed up with actual clean-up and planting presented a significant project challenge owing to time constraints. However, the team managed to satisfy those expectations through organization and diligent work at the final stage of the project. In fact, most of the group members were from urban environments and had little past experience with gardening. By manually preparing and planting the garden, we personally reconnected with the natural world. Thus, not only did we work as a team to achieve the goals of the project, we also experienced firsthand the real-world impact from getting our hands dirty in the soil.

Our group collaboration introduced a unique type of cultural experience into everyone's lives. Owing to helpful and comprehensive meetings with Thai international students at WPI, the Western members of the team had already been acquainted with many aspects of Thai life. However, working, living and interacting with local individuals on site proved to the WPI students that Thai people are not as conservative as textbooks suggested. Admittedly, this experience resulted from working closely with teammates of similar ages, living in the highly modernized and westernized world of Bangkok. The project work in Thailand was particularly beneficial to the progressive development of the WPI students, providing them with the experience of adapting, working efficiently and behaving professionally in a foreign and relatively unfamiliar environment.

In the view of the Chulalongkorn University students, the project was an opportunity for all team members to gain a new perspective and unforgettable life experiences in terms of cooperation, despite language and cultural differences. Initially, the Thai students expected some obstacles while working together with WPI students due to the amount of classes and exams that they needed to also manage, while completing the project on time. We did not encounter such obstacles, since the group organized a convenient work schedule and group dynamics where teammates showed each other mutual respect and listened to each other's opinions. The Thai teammates found it valuable to observe and participate in the American work practices. Even though it sometimes seemed to them that the WPI teammates would move along too fast with work, we managed to find a good balance between tension and relaxation. The Chulalongkorn University members of the team did not experience any cultural stress from interacting with the WPI students, as most of the Thai students had attended international schools and had many foreign friends and teachers. In fact, the Thai teammates felt that we all shared with Westerners

many personality similarities in terms of open-mindedness and jocosity that made our work process even more enjoyable. Thus, the team did not suffer from cultural shock with each other, but rather turned our collaboration into an opportunity to make friends and exchange ideas, insight and experience in terms of work habits, career plans and lifestyle.

Figure 16: Group Picture at Kanchanaburi

REFERENCES

Bennet, A., & Bennet, D. (2008). E-learning as energetic learning. *VINE, 38*(2), 206-220.

Berg, B. L. (2009). *Qualitative research methods for the social sciences* (7th ed.)

Brooklyn Botanic Garden. (2012). *BBG's guide to composting organic waste.* Retrieved 01/20, 2012, from http://www.bbg.org/gardening/composting/

Burapatana, T., & Ross, W. (2007). Bangkok-suburbanizing and unsustainable. *Environment and Natural Resources Journal, 5*(1), 59.

Carter, P. (2011). *Channel 4: Gardens.* Retrieved January 12, 2012, from www.channel4.com

Chokevivat & Chuthaputti. (2005). The role of Thai traditional medicine in health promotion.

Cornwall, D. T. (2010). Theories of learning. *Bangkok Post.*

Dickerson, G. W. (2001). *Vermicomposting.* Retrieved 01/20, 2012, from http://aces.nmsu.edu/pubs/_h/h-164.pdf

Dodd, J., & Jones, C. (2010). Redefining the role of botanic gardens: Towards a new social purpose (11/2/2011)

Hazzard, Moreno, Beall, & Zidenberg-Cherr. (2011). Best practices models for implementing, sustaining, and using instructional school gardens in California. *Journal of Nutrition Education and Behavior, 43*(5), 409.

George Mason University. (2012). *Mason CTE: Active and collaborative learning* Retrieved 1/25/2012, 2012, from http://cte.gmu.edu/Teaching/active&collaborative.html#tools

Graham, S. (2010). Monkey see, monkey do. *Bangkok Post.*

Graham, H., Beall, D. L., Lussier, M., McLaughlin, P., & Zidenberg-Cherr, S. (2005). Use of school gardens in academic instruction. *Journal of Nutrition Education and Behavior, 37*(3), 147-151.

Hamilton, A. C. (2004). Medicinal plants, conservation and livelihoods. *Biodiversity and Conservation, 13*(8), 1477-1517.

Horpibulsuk, S., Yangsukkaseam, N., Chinkulkijniwat, A., & Du, Y. J. (2011). Compressibility and permeability of Bangkok clay compared with kaolinite and bentonite. *Applied Clay Science, 52*(1–2), 150-159.

Houghton Mifflin Company. (1997). *Teaching concepts: Cooperative learning* Retrieved 1/25/2012, 2012, from http://college.cengage.com/education/pbl/tc/coop.html#2

Karim, R. Y. (2008). *A toast to garbage.* Retrieved 02/10, 2012, from http://thestar.com.my/lifestyle/story.asp?file=/2008/7/26/lifefocus/1633121&sec=lifefocus

Kunchornrat, A., Namprakai, P., & du Pont, P. T. (2009). The impacts of climate zones on the energy performance of existing Thai buildings. *Resources, Conservation and Recycling, 53*(10), 545-551.

Louv, R. (2005). *Last child in the woods*. United States of America: Algonquin Books of Chapel Hill.

MacGregor, J. T., & Smith, B. L. (1992). *Collaborative learning* Retrieved 1/25/2012, 2012, from http://www.clinicalresearchlearning.org/index.php?option=com_content&view=article&id=13&Itemid=46

Mahidol, C., Prawat, H., Prachyawarakorn, V., & Ruchirawat, S. (2002). Investigation of some bioactive Thai medicinal plants. *Phytochemistry Reviews, 1*(3), 287-297.

May, K. (2007). *Transforming life.* Retrieved, 2011, from http://www.bangkokpost.com/education/site2007/cvnv0607.htm

Ong, J. (2010). *Wild Asia heroes - Dr. Joean Oon.* Retrieved 02/09, 2012, from http://www.wildasia.org/main.cfm/heroes/WA_Heroes_Dr_Oon

Pagram, P., & Pagram, J. (2006). Issues in e-learning: A Thai case study. *The Electronic Journal of Information Systems in Developing Countries, 26*(0)

Pinheiro, M. H. O., De Almeida Neto, Luiz C., & Monteiro, R. (2006). Urban areas and isolated remnants or natural habitats- an action proposal for botanical gardens. *Biodiversity and Conservation.*

Prakash, B. (2011a). *How to make and use garbage enzymes.* Retrieved 02/09, 2012, from http://www.ecowalkthetalk.com/blog/2011/02/27/how-to-make-and-use-garbage-enzymes/

Prakash, B. (2011b). *Responses: How effective are garbage enzymes?* Retrieved 02/09, 2012, from http://www.ecowalkthetalk.com/blog/2011/03/04/responses-how-effective-are-garbage-enzymes/

Robinson, D., & Kuanpoth, J. (2009). The traditional medicines predicament: A case study of Thailand. *The Journal of World Intellectual Property, 11*(5), 375-403.

Ryan, P., & Wayuparb, N. (2004). Green space sustainability in Thailand. *Sustainable Development, 12*(4), 223-237.

Scott, H. D. (2000). Soil water principles. In *Soil physics: Agricultural and environmental applications* (pp. 209) Wiley-Blackwell.

Sherman, R. (1997). *Worm away your cafeteria food scraps.* Retrieved 01/20, 2012, from http://www.bae.ncsu.edu/topic/vermicomposting/pubs/worms.html

Subcharoen, P. (2001). Thai traditional medicine as a holistic medicine. *Traditional Medicine in Asia*, 301.

Suwankhong, D., Liamputtong, P., & Runbold, B. (2011). Traditional healers (mor pheun baan) in southern Thailand: The barriers for cooperation with modern health care delivery. *Journal of Community Health, 36*(3), 431-437.

The Government Public Relations Department. (2011). *Inside Thailand -- major boost for traditional Thai medical services and herbal medicine* Retrieved 11/13, 2011, from http://thailand.prd.go.th/view_inside.php?id=5799

Thongthew, S. (1999). Education developments in Thailand. *School Effectiveness and School Improvement, 10*(1), 118-24.

Wood, P. (2003, How to organize a happy herb garden. *The Seattle Times*,

Yoothong, K., Moncharoen, L., Vijarnson, P., & Eswaran, H. (1997). Clay mineralogy of Thai soils. *Applied Clay Science*, *11*(5–6), 357-371.

Zhou, Z., & Li, M. (2010). Semi-supervised learning by disagreement. *Knowledge and Information Systems*, *24*(3), 415-439.

APPENDIX I: LEARNING STRATEGIES

Active Learning

The active learning strategy stresses the importance of engaging the students' body and mind to create an adequate absorption of knowledge. Research has been done to show how play-based learning in early childhood development and education of younger students plays a vital role in the construction of a thought process. This process achieves its goals by stressing the impact on the children's future success (Bennet & Bennet, 2008). The practice "promotes deep learning, not just the acquisition of facts" (George Mason University, 2012) and encourages better acquisition and retention of new knowledge by forming links to prior knowledge or life experiences in the brain (Bennet & Bennet, 2008). Joining memories with physical motions and building upon past experiences helps short-term memory transform into long-term memory (Bennet & Bennet, 2008). A proven method of implementing active learning in the classroom is through the students' collaboration with peers and teachers.

Collaborative Learning

Collaborative learning works by attaining mutual respect between students and teachers; this allows students to develop their own solutions to a problem from beginning to end as part of a group, and gain a larger sense of ownership of their ideas and strategies (MacGregor & Smith, 1992). Unfortunately, collaborative learning has also been known to leave the weaker students behind and discourage some students who feel as though they did not contribute a part of the solution. This method can also be flawed through inherent character trait discrepancies between participants (Houghton Mifflin Company, 1997). These difficulties are significant while implementing a collaborative learning environment, and should be taken into serious consideration.

Semi-Supervised Learning

Semi-supervised learning operates under the assumption that background knowledge is available on the topic, but presented to the learners in a restricted fashion alongside the problem so that a clear solution is not defined explicitly. The students have to assess the given information on the topic and the tasks required to solve the problem. From here they may

evaluate the necessity of all of the available information, and find ways to build upon it to reach a solid conclusion. This "open-world" assumption allows for creative liberties that can lead to unique solutions to a given problem (Zhou & Li, 2010). In a study done through the BBC, chimpanzees were shown varying amounts of a video describing how to make a tool to acquire food from outside of their cage. Animals shown less than the full video were able to construct an adaptable tool, and managed to easily accommodate changes in the surroundings (S. Graham, 2010). According to this study, semi-supervised learning is applicable in environments conducive to social learning methods, looking to foster intellectual curiosity and critical thinking.

Transductive Learning

Transductive learning is similar to semi-supervised learning with one major difference of taking a "closed-world" assumption. In this case, all of the data is known before the problem is introduced, and the students have to optimize the solution (Zhou & Li, 2010). In the same study done by the BBC on chimpanzees, some of the primates were shown the entirety of the video, then given the same task to retrieve food from beyond the cage's limits. Those shown the whole video created an identical mechanism, and struggled when applying it to the altered scenario. The study exemplifies that obtaining all information ahead of time and attempting to solve a problem most efficiently can sometimes be tainted by the temptation to follow a proven method. Educational materials will have to consider the difference between social learning and blatant copying to ensure that the subjects of the demonstrated material gain and retain the appropriate knowledge.

Behavioral, Cognitive and Constructivist Orientations

Dr. Timothy Cornwall, an English as a Foreign Language (EFL) teacher for 30 years, recognizes three main learning theories: behaviorist, cognitive, and constructivist orientations. Behaviorism, as explained by Cornwall, is the idea that subjects will learn the desired material, based on the attitude of the teacher in response to the subject's actions. This learning style is akin to a classroom format with structured, obtainable goals, which must be achieved by the students, as desired by the teacher. Cognitive orientation is defined as the transferal of knowledge from the teacher, who is the more knowledgeable on the subject, to the learner. In this case, it falls heavily on the teacher to create a relevant lesson plan and "adjust lessons to the uniqueness of each student" (Cornwall, 2010). Finally, constructivist orientation describes the method of learning

based on building upon past experiences and social interactions to foster further knowledge. This also means “reflection on what action should be taken” (Cornwall, 2010), and determining the most appropriate outcome. These three orientations provide insight into how students learn, and valuable information on ways to develop educational materials well received by their intended audience.

APPENDIX II: COMPOSTING

Composting is a process through which waste materials are broken down to create a nutrient rich mixture that can be added to a garden, encouraging the productivity of the plants. Microorganisms such as bacteria and fungi use enzymes to digest and break down the waste so that it turns into usable compost, occasionally with the help of larger animals such as beetles and earthworms. Once broken down, compost nutrients are available for uptake through the plants' roots. In addition to providing nutrients, the compost helps soil retain water and creates gaps for better airflow (Brooklyn Botanic Garden, 2012). There are several different methods that can be used to break down organic waste materials.

Home or garden composting is accomplished by layering certain plant and food waste to foster the proliferation of composting organisms. A compost pile is full of living organisms, so certain guidelines must be followed in order to keep it alive and functioning properly. Some materials like bones, meat, and spicy food should not be added because they do not break down properly, cause foul odors, or adversely affect the organisms. In addition, there must be an even amount of wet, green materials containing a lot of nitrogen and dry, brown materials that provide carbon. The compost not only needs proper feeding, but also requires aeration and the right amount of hydration. Keeping the pile smaller than 1.5 meters cubed and frequent turning of the contents assists in the aeration of the pile. The compost must also be kept moist but not soggy; several sources relate the proper dampness to that of a wrung-out sponge. The process will typically take anywhere from six months to a year. However, if the compost pile is suitably layered, turned often, hydrated, and the waste is ground up, the process may take as little time as three months (Brooklyn Botanic Garden, 2012). Once done, the compost may be mixed with the garden's soil or spread over the surface as a fertilizer.

Another method for turning waste into compost is called vermicomposting and cultivates the development of a population of worms to help break down the waste materials in addition to the existing microorganisms. Discharge from the worm's intestinal track helps to make the nutrients in the compost more concentrated and available for plant uptake (Dickerson, 2001). A comparison between regular garden compost and vermicompost is presented in Table 1.

Table 1. Chemical characteristics of garden compost and vermicompost, 1994.

Parameter*	Garden compost[1]	Vermicompost[2]
pH	7.80	6.80
EC (mmhos/cm)**	3.60	11.70
Total Kjeldahl nitrogen(%)***	0.80	1.94
Nitrate nitrogen (ppm)****	156.50	902.20
Phosphorous (%)	0.35	0.47
Potassium (%)	0.48	0.70
Calcium (%)	2.27	4.40
Sodium (%)	< .01	0.02
Magnesium (%)	0.57	0.46
Iron (ppm)	11690.00	7563.00
Zinc (ppm)	128.00	278.00
Manganese (ppm)	414.00	475.00
Copper (ppm)	17.00	27.00
Boron (ppm)	25.00	34.00
Aluminum (ppm)	7380.00	7012.00

[1]Albuquerque sample [2]Tijeras sample

*Units- ppm=parts per million mmhos/cm=millimhos per centimeter

** EC = electrical conductivity is a measure (millimhos per centimeter) of the relative salinity of soil or the amount of soluble salts it contains.

*** Kjeldahl nitrogen = is a measure of the total percentage of nitrogen in the sample including that in the organic matter.

**** Nitrate nitrogen = that nitrogen in the sample that is immediately available for plant uptake by the roots.

Table 1 - Chemical Characteristics of Garden Compost and Vermicompost (Dickerson, 2001)

There are two types of worms often used for composting; *Eisenia foetida* commonly called Red Wrigglers and *Lumbricus rubellus* commonly called the Red Earthworm. These worms prefer to live in compost or manure unlike the garden earthworms, which thrive in soil (Dickerson, 2001).

A worm-based composting bin can be made from either wood or plastic recycled materials. The bin should be filled with no more than twelve inches of bedding material so that it stays properly aerated and hydrated. The bedding should be some sort of high cellulose matter like newspaper or dead plants, its purpose is to give the worms a base medium to move through and provide extra food (Dickerson, 2001). Worms must live in moist conditions to be able to breathe through their skin, but too much water will cause them to drown, so the bedding should be moist but not soggy (Sherman, 1997). Under optimum conditions, the worms are able to process their weight in food every day, but on average it takes two pounds of worms (2000 worms) to process a pound of food in a day. Waste may be added to the bin until the bedding materials disappear and the compost is ready to be harvested (Dickerson, 2001).

Vermicomposting has already been implemented into some school systems as a hands-on method of teaching recycling to the students. One example of successful implementation is at

Waterville Elementary School in Oregon, United States where students distributed thirty pounds of worms between five worm bins. They experimented with those bins, using different types of bedding material and including different types of food, some of which did not strictly follow vermicomposting guides. The students also used their knowledge of the worms and the composting process to design their own methods of feeding the worms and harvesting the compost (Sherman, 1997).

A method for breaking down food waste that has become common in Asian countries is called Garbage Enzyme. Dr. Rosukon Poompavong, a Thai organic farmer who was awarded "Outstanding Farmer" in 2003 by the United Nations Food and Agriculture Organization, first created and promoted this practice as a method for disposal of home waste. Dr. Poompavong's apprentice Joean Oon has further popularized the process by traveling throughout Asia giving public talks and demonstrations (Ong, 2010). The recipe is essentially 10 parts water, 1 part brown sugar, and 3 parts food scraps, this mix is sealed tightly and let to sit for up to three months as the fermentation takes place. Throughout the fermentation process, gas builds up and must occasionally be let out, for this reason it is also important not to use a glass container as it may break due to pressure. The waste is usually restricted to fruits and vegetables, it can include meat and dairy but they may cause foul odors (Karim, 2008). Once the garbage enzyme solution is finished it may be stored indefinitely and has been proclaimed to be a nearly universal cleaning aid as well as an effective garden additive. Specifically, after varying levels of dilution it is supposed to be able to disinfect, soften laundry and skin, deodorize, and unclog drains. If used on a garden, it is important to dilute at least a hundred fold otherwise it is too acidic, but it spreads nutrients to the garden as well as acting as a pesticide (Prakash, 2011a). Critics of this method cite the limited scientific research that has been done on the process, and for the most part contest that while it is hyped as a magic cure, it is just another method for the creation of vinegar and alcohol which have been used as cleaning agents for centuries (Prakash, 2011b).

The Garbage Enzyme technique is similar to what is suggested in a composting manual supplied by the Thai government. The main differences are that the Thai government's recipe calls for a higher ratio of molasses or sugar as well as the addition of "effective microorganisms", anaerobic microorganisms that are specifically known to break down organic wastes. Furthermore this method does not require that the mixture be sealed in an airtight container.

APPENDIX III: PLANT SUGGESTIONS AND GROUPINGS

Plant Name	Scientific Name	RES	A K	JJ	WPS	Mr. J	Mr. C	Dr. T
Aloe Vera	Aloe vera	X			X	X	X	
Asiatic pennywort	Centella asiatica	X					X	X
Banyan Tree	Ficus							X
Bean Sprout	Pisum sativum	X					X	
Cats' Whisker	Pisum sativum					X		X
Chili	Orthosiphon aristatus (Blume) Miq. Bolding.					X		
Devil tree	Alstonia scholaris							
Galangal	Alpinia galanga	X	X		X		X	
Garlic	Allium sativum	X	X			X	X	
Ginger	Zingiber officinale	X	X		X	X	X	
Kariyat	Andrographis paniculata	X					X	
Guava	Psidium guajava							
Guinea-Pepper	Capsicum	X		X			X	
Hanuman	Not Found		X	X				
Holy Basil	Ocimum tenuiflorum	X	X		X	X	X	
Horse Tail Grasses	Equisetum							X
Lemon Grass	Cymbopogon nardus		X	X		X	X	
Lime	Citrus aurantifolia	X	X	X	X	X	X	
Majurin	Mentha officinalis		X	X		X	X	
Melon	Allium cepa					X	X	
Mint	Mentha/ Melissa officinalis		X				X	
Pak wan baan		X	X				X	
Plai	Zingiber montanum (Koenig) Link ex Dietr.					X	X	
Poison Berry	Solanum Indicum					X		
Radish	Raphanus sativus						X	
Onion	Allium cepa		X					
Saled Pangporn	Not Found					X		
Sea Holly	Acanthus ebracteatus Vahl					X		
Star gooseberry tree	Sauropus androgynus	X					X	
Tamarind	Tamarindus indica	X	X			X	X	
Thai chili pepper	Capsicum frutescens		X				X	
Thai Sweet Basil	O. basilicum var. thyrsiflora	X	X			X	X	
Turmeric	Curcuma longa	X			X			X
Waan-ThoraneeSarn	Phyllanthus Pulcher Wall ex Muell Arg.					X		X
White Agasta	Sesbania grandiflora						X	
White Cane Flower	Rhinacanthus nasutus (L.) Kurz					X		
WildBetal Leafbush	Piper sarmentosum Roxb.					X		
Winged Bean	Psophocarpus tetragonolobus	X					X	
Yor (*Nori*)	Not Found			X				X
Not Found	Marinda Citrifolia							
Not Found	Ptychosperma macarthurii							

Source of Information Key	
RES	Background Research on Medicinal Plants
A K	Ajarn Kanogwan Serayphep, professor in the Botany Department at Chulalongkorn University, specialist in Agricultural Science or Post Harvest Physiology
JJ	Chatuchak Market Merchants
WPS	Wat Pathumwanaram School teachers: Ajarn Arunee, Ajarn Supitcha, and Ajarn Rungtawan
Mr. J	Mr. Suthat Jaiya: an expert gardener at the HRH Princess Maha Chakri Sirindhorn Herb Garden in Rayong
Mr. C	Mr. Dumrongsuk Chumsaengphan: Herbal Medicine and Organic Gardening Expert
Dr. T	Dr. Phithak Teelek: an herbal doctor and expert at Chophaya Abhaibhubejhr Herbal Hospital

Table 2: Possible Medicinal Plants

Plant Common Name	Plant Scientific Name	Sun or Shade	Height
Agasta	Sesbania grandiflora	N/A	3-6 m
Aloe	Aloe vera	Filtered Sun	30-60 cm
Asiatic pennywort	Centella asiatica	Both	3-4 cm
Cat's Whisker	Orthosiphon aristatus	Full Sun	50-100 cm
Cayenne Pepper	Capsicum frutescens L.	Full Sun	60-100 cm
Common Lime	Citrus aurantifolia	Full Sun	5 m
Galangal	Alpinia galanga	Sun to medium shade	1-2 m
Ginger	Zingiber officinale	Filtered sun	90 cm
Guava	Psidium guajava	Direct Sun	10 m
Holy Basil	Ocimum tenuiflorum	Sun	30-60 cm
Hop Headed Barleria	Barleria lupulina Lindl.	Full to Filtered Sun	60-100 cm
Indian Mulberry	Morinda citrifolia L.	Full Sun	2-6 m
Kariyat	Andrographis paniculata	Shade	30-110 cm
Kitchen Mint	Mentha/ Melissa officinalis	Filtered Sun	70-150 cm
Lemon Grass	Cymbopogon N/Ardus	Sun	100-120 cm
Phlai	Zingiber montanum (Koenig) Link ex Dietr.	Filtered Light	70-150 cm
Star Gooseberry	Sauropus androgynus	High to Low Sun	100-150 cm
Sweet Basil	O. basilicum var. thyrsiflora	Sun	50-100 cm
Turmeric	Curcuma longa	Sun but tolerates shade	1 m
White Crane Flower	Rhinacanthus Nsutus (L.) Kurz	Full Sun	50-100 cm
Wildbetal Leafbush	Piper sarmentosum Roxb.	Full Sun	30-80 cm

Table 3: List of Selected Plants

Plant Common Name	Grouping Title
Agasta	Anti-pyretic (anti-hot fever)
Aloe	Anti-eczema / Anti-fungal
Asiatic pennywort	Anti-hypertensive (anti-high blood pressure) / Cardiac tonic (anti-heart attack/ arrhythmia)
Cat's Whisker	Diuretics
Cayenne Pepper	Carminative / Anti-flatulence
Common Lime	Cough suppressant, Anti-expectorant, Mucolytic
Galanga	Anti-eczema / Anti-fungal
Ginger	Anti-emetic (cures vomiting/nausea)
Guava	Anti-spasmodic, Anti-motility, Anti-secretory
Holy Basil	Anti-emetic (cures vomiting/nausea)
Hop Headed Barleria	Anti-toxin
Indian Mulberry	Anti-emetic (cures vomiting/nausea)
Kariyat	Anti-pyretic (anti-hot fever)
Kariyat	Anti-spasmodic, Anti-motility, Anti-secretory
Kitchen Mint	Carminative / Anti-flatulence
Lemon Grass	Diuretics
Phlai	Carminative / Anti-flatulence
Phlai	Cough suppressant, Anti-expectorant, Mucolytic
Star Gooseberry	Anti-eczema / Anti-fungal
Sweet Basil	Carminative / Anti-flatulence
Turmeric	Anti-eczema / Anti-fungal
White Crane Flower	Anti-eczema / Anti-fungal
White Crane Flower	Anti-neoplastic drugs (cures tumors)
Wildbetal Leafbush	Diabetic drug
Winged bean	Carminative / Anti-flatulence

Table 4: Plant Groupings

APPENDIX IV: SEMI-STRUCTURED INTERVIEWS AND RESPONSES WITH TEACHERS

Interview with Ajarn Arunee Nakhonchai: Elementary School Science Teacher and Project Liaison at Wat Pathumwanaram School

Attendees - *Pitch Asawasathaporn, Greg DiLullo, Jennifer Moutinho and Adam Thibault*

Tuesday, January 24th, 2012 at 11:00 AM; Thursday, February 2nd, 2012 at 1:00 PM

First Interview

What's the current environmental education program at the Wat Pathumwanaram School?

Botany, every student brings the plant and individually grows it and studies about it together.

What kind of educational materials do you use to teach?

Worksheets

What educational materials would you like for the garden? (give examples: poster, pamphlets)

Big poster that explains everything

What would you like the students to learn as a result of the project?

The properties and the correct and practical application of the herbs

What would you be able to use the garden for in your subject?

As the learning center

How often would you want to use the garden as an educational tool?

4 -5 times a week

What are the uses of the existing gardens on the school grounds?

As the learning center to gain knowledge

Do you know of any medicinal herbs or plants? If yes, what do they treat and how do you use them?

Yes, such as basil. It is known by the older generation, for example, basil is grinded and applied at the wound to cure.

What kind of medicinal herbs and plants do you want to see in the garden?

The ones that can be used practically in daily life.

How do you want the garden to be designed (only for teacher or open all the time)?

For education, mainly

How familiar are you with the King's principle?

Very well

How would you explain sustainability and self-sufficiency?

To use the things that are easy to find around us to make the best profits for own self.

Do you think it is important for the students to learn the concepts of self-sufficiency and sustainability?

Very important because the students in this school are surrounded by an advanced civilization containing technology and especially the exaggerated factors run by the big shopping malls, Paragon and Central World. So teaching the principle will teach the students to learn how to be prudent.

From your experience, how much does it usually cost to produce educational materials?

Commonly, the ream contains 500 pieces of paper and costs 100 ฿ per one ream and PP Board (1x1 m^2) costs 15 ฿ for one

How do you feel about the project?

It is very good for students and it is very happy that the team comes to help design the project because the teachers are all busy with their stuffs so they will not have enough time. The team is really a great help.

Is there anything that we could do to improve our project in your opinion?

For suggestion, the project should mainly and really aim for educational purposes.

Second Interview

How long is a typical class?

1 hour

How much time of that do you typically lecture in a day?

40 minutes

How do you use the time when you are not lecturing?

Group activities, worksheets, large paper board, individual studying

How often do students work together in your classroom on a task?

Occasionally, normally just lecturing and individual studying

Do your classes have labs? If yes, how often?

Rarely use labs. Only when the topic is biological

How are textbooks used in your classes?

Students do not have their own textbooks, only borrow in school and cannot take them home. Write the problems and answers on a separate sheet of paper. Worksheets are photocopied from the textbook often.

What does typical homework look like?

Worksheets, too low grades for group work outside of classroom. Focuses on individual learning.

Are worksheets used primarily in the classroom, or given as homework?

Both

Can we have an example of some educational materials you typically use?

Yes

Interview with Ajarns Supitcha and Rungtawan: Middle School Science Teachers at Wat Pathumwanaram School

Attendees - *Greg DiLullo and Akiko Aungsumalin Saga*

Wednesday, January 25th, 2012 at 11:30 AM

What connections to religion should we keep in mind while planning the garden and developing the design?

Nothing. Except for the maintenance and looking after the plants such as teaching the students to bond with nature and also the rule of giving and sacrificing their time looking after the plants.

How has environmental education changed over time as you've seen it?

It depends on the environment. For example, the pollution and the effects of pollution.

What's the current environmental education program at the Wat Pathumwanaram School?

Reduce, reuse, recycle. For example collecting the recycled material and reuse it by developing it and further on selling the recycle materials. Another program was planting and taking care of trees.

What kind of educational materials do you use to teach?

PowerPoint, textbook/book, experiments (small lab)

What educational materials would you like for the garden?

Ebook about the plant and practical use, video, pamphlets

What would you like the students to learn as a result of the project?

Basic information on Thai herbs and medicinal plants such as practical use in terms of medicine and their benefits

How is active learning currently used in the curriculum?

Mostly through experiments and research for the middle school and high school. But for the elementary school, teacher would demonstrate the experiment.

How often are students encouraged to work with each other to complete school work?

It would be as a group if they’re doing an experiment and for the planting and taking care of the garden it would be in group of 2-6 people per group.

What would you be able to use the garden for in your subject?

Teaching in occupation and technology subject, Science, English, Math and almost everything

How often would you want to use the garden as an educational tool?

Integrate it as a part of the school curriculum and promote the traditional plants and Thai herbs, and cooperating between the school and students by allowing them to plant by themselves. They want the student to be able to use and learn from the garden.

What visual aids would be beneficial to include in the garden itself?

Picture with description with basic information and catergorize it.

How do you want the garden to be designed (only for teacher or open all the time)?

Varieties of plants and benefit. Look beautiful. Open up to students and parents

How familiar are you with the King's principle?

Don't use stuff out of one's capability. Use what you have around you and if their leftover from what you don't need, you can later share it.

How would you explain sustainability and self-sufficiency?

Self-sufficiency=use everything you have without over spending or over using it by using resources around and also saving up money

Sustainability=collecting and accumulating resources and money so you can use it throughout your life

"If people learn to be self-sufficient people would not be exploit at each other and learn to give and share to society"

Do you think it is important for the students to learn these concepts of self-sufficiency and sustainability?

Yes, the school also have a program about teaching the student to collect money, since most of the children who get stuff easily won't look after it or take good care of it. So the teachers try to teach the students to save and become caring citizens. But the school cannot instill the following concepts alone, the parent should also help them.

From your experience, how much does it usually cost to produce educational materials?

Phamphlet (A4)-around 5000 ฿

Interview with Ajarns Aoracha and Tinnakorn: Science and Art Teachers respectively at the Chulalongkorn Demonstration School

Attendees - *Pitch Asawasathaporn, Greg DiLullo, Potchara Galaputh, Marinela Kirilova, Jennifer Moutinho, Akiko Aungsumalin Saga, Madison Shugrue and Adam Thibault*

Tuesday, February 7th, 2012 at 9:00 AM

How has environmental education changed over time as you've seen it?

Education about the environment is not sufficient in Thailand. Instead of merging in science or some subjects, it should be separated to its own subject. Everyone learns that the world's environment is being demolished and is given the knowledge of how to protect it. But still without morals, all good knowledge becomes useless.

What's the current environmental education program at the Chulalongkorn Demonstration School?

The school has free elective courses and many of them concern environment such as Bird Watching and Young Botany. Free elective takes time in the afternoon but Bird Watching starts around 7.15 am and takes time before the usual class because it is the usual time for birds to come out of its nest for food. Apart from that, the normal required subjects are always integrated with nature just like measuring the height of the tree (in science).

What kind of educational materials do you use to teach?

Nature itself can be a good learning tool. But textbooks and bird guide are used sometimes Leaves are used in art working and even writing novel about that plants.

How often would you want to use the garden as an educational tool?

It depends on the need of the class.

What are the uses of the existing gardens on the school grounds?

Every place in the school can be used as the botanical garden and learning center where student can gain the knowledge according to Lord Buddha's personal physician Jivaka Komarabhacca speech "every single plant has the medical application more or less."

Do you know of any medicinal herbs or plants?

Basil, it can cure the flatulence and has a strong odor. (She finds the activity for the students to practice observation by investigating the smell of basil and sweet basil and classifying them.)

How would you explain sustainability and self-sufficiency?

King's Principle is to walk on the middle path; not to be extravagant or stingy. It teaches us to live without exploiting the others. Self-sufficiency is to use your self-consciousness to contemplate on yourself of how you would be sufficient with your stuffs; how much money you have and who are you in the society, etc.

Do you think it is important for the students to learn these concepts?

It is necessary for everyone not just students

How do you feel about the project?

It is good because herbs are cultural heritage of Thailand that is nowadays being forgotten because of the modern pharmacy.

Is there anything that we could do to improve our project in your opinion?

Many herbs are not expensive so the cost is likely not that high but still it depends on how luxurious you want the botanical garden to be, you can make it on the way of King's Principle by making use of everything around you. It will be much cheaper but still it depends on the perseverance of the doer. Grouping of plants with same properties is suggested. And in the area of 4 x 13 m^2 the potted plant is suggested. The light and shade must be considered.

Written Interview with Ajarn Saeng-tiwa Chaiyot: English Teacher at the Chulalongkorn Demonstration School

Attendees - *Pitch Asawasathaporn, Greg DiLullo, Potchara Galaputh, Marinela Kirilova, Jennifer Moutinho, Akiko Aungsumalin Saga, Madison Shugrue and Adam Thibault*

Tuesday, February 7th, 2012 at 9:00 AM

How has environmental education changed over time as you've seen it?

Nowadays people study the environment from nature insufficiently due to the social statement and changing way of life, especially in a metropolis area. People tend to stay with technology. We should turn around to learn the value of nature and developing it.

What's the current environmental education program at the Chulalongkorn Demonstration School?

Free elective courses: Young Botany, Bird Watching and English through the garden for example. And the study of nature is also integrated in various required courses and morning program. The teachers try to incorporate the botanical garden into learning because they want the school to be shady from the trees and want to make use of them by having the student learn.

What kind of educational materials do you use to teach?

It depends on the current content and lesson. Sometimes leaves are used when the students are studying the difference between two plants.

What would you be able to use the garden for in your subject?

It is very divergent; nonetheless it is very useful and necessary for the education since the students can learn from the real things rather than the book. Activities outside of the classroom in the botanical garden are also useful and enhance the good atmosphere for learning. Most of subjects make use of the garden.

Do you know of any medicinal herbs or plants?

Many things, but used for studying purpose mainly

How familiar are you with the King's principle?

Very familiar

How would you explain sustainability and self-sufficiency?

It is to live with everything knowing its value, using it for the basic need in accordance with Buddhism principle.

Do you think it is important for the students to learn these concepts?

Students are always taught about the King's Principle Students in CU Demonstration School are middle class and higher so they actually are not farmers. The King's Principle is then applied according to that fact. However, whether they would really comprehend successfully or not is dependent on the incorporation with their parents.

Is there anything that we could do to improve our project in your opinion?

This project is really useful because students can learn things from the learning center around themselves. It should be supported and promoted to every school since nature can make us happy and can give eternal learning.

Interview with Ajarn Lalita Prasart: Middle School Agriculture Teacher at Wat Pathumwanaram School

Attendees - *Pitch Asawasathaporn, Potchara Galaputh and Adam Thibault*

Wednesday, February 15th, 2012 at 11:30 AM

How long is a typical class?

Students study 6 hours per day, 6 subjects with 1 hour per subject

How much time of that do you typically lecture in a day?

4 hours

How do you use the time when you are not lecturing?

Schoolwork such as project's accountancy

How often do students work together in your classroom on a task?

The agriculture class was separated into 2 types: required and elective. The required one is the basic that every student in 7th-9th has to take, and in this class, group work is rarely done. The elective one is the 'required one in deeper detail' and uses group work all the time.

Do your classes have labs? If yes, how often?

The hydroponic garden is mainly used, sometimes the mushroom farm. The required course uses it during the final days of the semester but the elective one uses it most of the time.

How are textbooks used in your classes?

It is not used, instead the blackboard is used as the instruction media (teacher writes on blackboard) and the student has personal notebook to take note. Worksheet is often used.

What does typical homework look like?

The research such as how plants look like.

Are worksheets used primarily in the classroom, or given as homework?

In classroom, homework is the research. Homework is rarely given.

Can we have an example of some educational materials you typically use?

Yes

Do you have any further opinions and suggestions about the project?

The oral presentation is rarely done in the required course, seldom for the elective course

The reason for doing research is because students know only the theory of plants, so research will help them see the picture. The practical understanding is what is lacked and necessary for the students.

The herb garden in the school has existed since the time that the school was founded, but no one seems to care because the knowledge of the herbs is not really important in the curriculum. So, it is incomplete as we see nowadays.

This botanical garden will not be used often since the hydroponic garden is more direct in the agriculture.

The required agricultural class is 1 hour per week with more of theoretical study, but the elective one is 4-5 hours per week with the likely practical study.

Interview with Ajarn David Saxner: Middle School English Teacher at Wat Pathumwanaram School

Attendees - *Jennifer Moutinho and Adam Thibault*

Wednesday, February 15th, 2012 at 1:30 PM

How many students are in your classes on average?

40

How far do students travel to change rooms between classes?

Students do not leave the classroom between classes, teachers change rooms.

Is there ever an opportunity for students to get up in front of the room and present in your classes?

I have tried this, and most times the students will mumble or be too afraid to share their ideas, even if they know that they are right.

Is there ever an opportunity for groups of students to get up in front of the room and present?

In a group, students are likely to default to the most knowledgeable person, and that person is usually too timid to share their ideas in front of the class, and the presentation does not happen. Typically, since my main focus is pronunciation and exciting the kids about the language, when I want to get them to practice, I have them all read a passage together out loud. However, when I have to assess them, I have to take a group of two out into the hall, and listen to them individually and shoo away all of the other students.

General comments on project:

Having students go outside for an activity is not favorable for the teacher. Students in older grades are on the 6th floor of the building, so travel time alone takes 15-20 minutes to get outside to the garden. It would be better if you could incorporate these ideas for 40 students to be contained in the classroom.

Students enjoy competing against each other, so that is something that can be included in your games.

Homework is not typically assigned to students. When cooperatively teaching with a Thai teacher for the first month and a half, I believe she assigned three homework assignments over that period of time.

With my students, we have organized an activity where the students stand in multiple lines with the teacher at the front. The teacher says something, performs some action, and the students squeeze the hand of the person behind them until the end, where the last student in the line grabs a ball and raises it in the air. The winning line is awarded points. It is difficult to get the students to focus after you have allowed them to be outside and be active.

Class times are not regulated, and are highly dependent on the teacher and uncontrollable outside factors. For example, if the day does not start until 9:00am, a half hour late, the class may run until 9:45am, which is 15 minutes late also.

Interview with Ajarn Supicha Sangangamsakul: Elementary School Science Teacher at Wat Pathumwanaram School

Attendees -*Potchara Galaputh*

Wednesday, February 16th, 2012 at 1:30 PM

How long is a typical class?

1 hour for normal class

2 for the laboratory.

How much time of that do you typically lecture in a day?

5 hours per day.

How do you use the time when you are not lecturing?

Correct home works and preparing for the upcoming lectures.

How often do students work together in your classroom on a task?

Depends on the kind of educational material but they do it quite often.

Usually in group of 5

Do your classes have labs? If yes, how often are labs done?

Yes, the kids usually watch the lab. However it depends on the level of danger. If it is not too dangerous, the kid will perform the lab on their own.

How are textbooks used in your classes?

They are given to each of the students. The SSVT texts are used and the exercises are included in the textbook.

What does typical homework look like?

Usually in the form of work sheets

Are worksheets used primarily in the classroom or given as homework?

Both, for homework and classroom

Can we have an example of some educational materials you typically use?

Yes

How often do students present orally in the class?

We try to do it as much as possible. But it is usually not individual presentation, instead in groups (5 people)

APPENDIX V: SEMI-STRUCTURED INTERVIEWS AND RESPONSES WITH EXPERTS

Note: All of the following interviews were conducted in Thai and later translated.

Interview with Ajarn Kanogwan Seraypheap: Agricultural Science and Post-Harvest Physiology Professor at Chulalongkorn University

Attendees - *Akiko Aungsumalin Saga, Madison Shugrue, and Potchara Galaputh*

Tuesday, January 17th, 2012 at 10:00 AM

Are there any religious connections we should keep in mind while designing a garden?

The garden should be very low maintenance. The selection of the plants should go together and make it sustainable. You must keep in mind that some plants need a lot of water and some do not.

How familiar are you with the King's principle?

Very familiar. Even though I have been doing that for 40 years. The government has been promoting His theory and it has been taught in school, even 4th grade students (kids) have been studying it. I teach about using plants for a better life. I also introduce this theory to the students and how to apply it and how to recommend the farmers to apply it.

How would you explain sustainability and self-sufficiency?

Self-sufficiency and sustainability is the top of the development rather than technology. Development is about self-survival. And you can apply it to every area. Mainly this can be seen in farmers. They have to be able to survive on their own. With the very small area in Thailand, if they could grow rice, raise some animals, mainly how they survive and they do not have to depend on other people's money. Some people work in town and office but when they reach their highest status of work, they might go out and quit their job to go and blend into nature.

What do you suggest for a sustainable garden?

Choose plants that are native, grow very well in the wild, and do not need a lot of attention or time to take care of (ginger). The only maintenance you do is cut it out. Rain showers will do and do not need to water every day. Keep it low maintenance. Mint, Basil, Holy Basil, Ginger, Curcumas

What are some of the most broadly used medicinal plants?

Tamarind, Ginger, Basil, Garlic, Red onion, Galangal, Lime leaves, Lemon

What plants grow well in shady areas?

Try checking what they have at Chatuchak Market

Thursday and Wednesday- plant market at Chatuchak market

What plants grow well in regularly sunny areas?

Basil, Lemon grass

Should we pay attention to root size?

The size of the root matters if we grow a big tree

How much do think it will cost to develop an organic garden?

50000 ฿

Interview with Two Merchants at Chatuchak Market

Attendees - *Potchara Galaputh, Marinela Kirilova and Madison Shugrue*

Thursday, January 19th at 1:00 PM

Merchant 1

What plants are suitable for a space 12 to 13m long and 3 to 4m deep?

Pepper, lime, lemon grass.

Would those plants grow in the shade?

Yes, only some don't require shade. Those that have flowers tend to require sun light.

How should we consider the Banyan tree in the middle of the garden?

The roots of the tree would make it difficult to grow anything underneath it. Growing in pots would be a great idea as it doesn't interfere with the roots.

Is it necessary to buy extra soil?

The soil *Bai kam phu*.

Merchant 2

What herbs do you sell for a 12 to 13m long and 3 to 4m deep space?

We have Hanuman, Yor, Majurin and Lime

How should we consider the Banyan tree in the middle of the garden?

That would not be a problem, as the sun will not be directly above the tree all the time, meaning that the plants underneath the tree will still get some sunlight. The plants that you might want to grow under the tree should have strong support, as the leaves of the tree might fall and damage the plants.

Are there any special soils necessary?

It is ideal to mix the purchased soil with twigs, etc. This will provide drainage for the water and aeration. Fertilizer should be given once a month or in every 20 days. Organic fertilizer can also be useful.

Interview with Mr. Suthat Jaiya: Garden Expert at H.R.H Maha Chakri Sirindhorn's Herbal Garden

Attendees - *Pitch Asawasathaporn, Potchara Galaputh, Jennifer Moutinho and Adam Thibault*

Thursday, January 26th, 2012at 11:00 AM

What do you specialize in?

I graduated from the agricultural department, Herbal plants. I am currently in charge of the garden maintenance. I have been working here for over 20 years.

Possible to design the garden in the area provided?

Yes, but the big tree in the middle is a big deal. It has a lot of branches. There will be a lot of fallen leaves around the area; it can be a good and bad thing. The walls that surround the other side of the garden might affect the roots of the plants too. The root of the banyan tree will affect the planted herbs as the roots would spread everywhere. This might not allow us to plant species that have deep roots in the area. As well as the fact that it will steal nutrients from other plants. Planting in pots might be a more effective process.

What do you know about the self-sufficiency and sustainability? How would you define it?

Personally, I think it's about doing things that we have the ability (in terms of money) to do. Do not expect too much in return. For example, if you have an area, you may grow crops that you can cook with.

On the other hand, use affordable resources. To keep the cycle of the sustainability going, the rotation of things must be planned carefully.

We will design the garden based on the concept of self-sufficiency and sustainability. What do you think?

Small plants that can be grown periodically will help in this problem or herbs that can be used in cooking. This will allow us to achieve the sustainability within the garden.

The competition between plants balances the nutrients. The fallen leaves also provide nutrients. So the big tree also provides a positive effect. They can also be made into compost.

What are some common herbs?

Basils, ginger, lemon grass, common cooking herbs are good to grow in the garden. They are affordable and easy to grow. Many people are not aware that these are herbs. For example, holy basil can be boiled in water to drive gases out of the body. These herbs are simple and easy to find. The herbs contain different properties in different parts. It is common to mix the herbs together to provide a balance for medication purposes.

Do any plants grow well in shade?

Most plants require sun light up to 8 hours. Some herbs are fine under the shade. But most plants cannot be grown in complete isolation from sunlight. Plants that have flower will not be able to stand low amount of sunlight.

What about sun light at certain period of time in a day?

Yes, but they may not be fully grown. The plants under that tree stand no chance of being grown directly in the soil. The roots of the tree take over the soil, stealing nutrients and leaving no space for other plant to grow in. Pots should be used. Small plants are very suitable.

What plants grow well next to each other?

The only thing to keep in mind is that the plants that grow faster than its neighbors will steal all the nutrients, which will result in lack of nutrients for the other plants.

Does the size of the roots matter?

This is very important too. For small plants, it's not too much of a concern. The big trees will have a more complex root system. Plants in the palm tree family have complex root systems, no other plants can be planted around them as they will take all the nutrients as well as leave no space for other plant to fit into the soil.

Do you have any plants to suggest for our garden?

Saled Pangporn, *TongPanChang*, *ThoraneeSarn*, Aloe Vera, Ginger, *Plai*, *Chapoohl*, and *YaNuardMaeow*

Can Lemongrass be used to make a pathway?

Great idea! That can be done easily, as the lemon grass can be trimmed into shapes.

Should we use normal pots or hanging pots? Please explain.

Normal pots are better. The hanging pots might be too small. Drainage problems might occur. The pot can also be used for aquatic herbs. The hanging pots can be used to grow small plants as long as the water system is managed properly.

Are there any special soil considerations we should be aware of?

As long as it is fertile. Drainage and aeration is important. Some organic material can be added into the soil to make it rich in nutrients. The sandy soil the garden has right now will cause problem such as loss of water. The care of the plants is crucial: watering, pesticides, etc. Even in the heart of Bangkok, pests can be a major problem. Sometimes there is a right condition for the pest to accumulate and grow. Most of farmers today rely on chemical fertilizers.

Do you think an organic garden is feasible for us to create?

Yes, organic garden can defend pests in different ways. You should talk to this herbal doctor; he owns an organic herbal shop. He treats the local people with Thai traditional medicine. Organic fertilizers are better than chemical fertilizers, as it would not affect or mutate the property of the herbs.

How much do you think a garden would cost?

No more than 30,000 ฿. There might be a lot of money spent for the soil and plants. Organic garden will not be as costly, as most of the things in the garden are made by us.

Are there any improvements that we could be doing?

Be sure to know the kind of soil you have and if you need new soil. Watering is very important too. The garden must be watered every day. During the rainy season, there might be problems such as roots rotting, etc. You might also want to consult the University of Mahidol, agriculture department. They are famous for their organic gardening.

Other:

In addition, the leaves on the ground can provide nutrients to the soil. The herbs that are grown naturally tend to be stronger.

Interview with Dr. Dumrongsuk Chumsaengphan: Herbal Medicine and Organic Gardening Expert

Attendees - *Pitch Asawasathaporn, Potchara Galaputh, Jennifer Moutinho and Adam Thibault*

Thursday, January 26th, 2012 at 2:00 PM

Are there any religious connections we should keep in mind while designing a garden?

Dhamma, which is the doctrine of the Buddhism is derived from *'dhamma-chart'* (literally, *nature*), so it teaches us to determine the essence of the nature such as how to live with the nature and knowing nature.

Is it possible to create an organic botanical garden in a 13m by 4m area?

It is possible because everything involving organic agriculture is what you make yourself thus needs no expense and it is not a matter of the yard's size.

How familiar are you with the King's principle?

Know very well

How would you explain sustainability and self-sufficiency?

Knowing: know who you are, yourself, how many things you've got; know to make immune to yourself to prevent the greed; know how to perform things logically. Make sure that you know something; you must know them precisely and must share to other people.

What do you suggest for a sustainable garden?

Rely your agriculture on the King's Principle and must do it genuinely.

What are some of the most broadly used medicinal plants?

Ginger, Galanga, Chili, Radish, Melon

What plants grow well in shady areas?

Those whose leaves aren't colorful (green) because those with color will need direct light.

What plants grow well next to each other?

Any combination of perennial plants and creeper plants.

What kind of plants do you suggest for a small area?

Star gooseberry tree, Sesbania grandiflora

What kind of soil will these plants need?

Just the soil that is fertile, so one must know how to prepare the good soil such as loosening the soil.

What are some affordable organic gardening resources?

Everything about organic agriculture is actually without cost because you make it on your own although there might be some negligible cost such as pots and equipment.

What kind of organic soil and fertilizer should we use in our garden?

Just a combination of clay and compost and manure.

How much do you think we will need to spend on herbs and plants?

2000 ฿

Is there any other information that you think would be applicable that we may have overlooked?

One must know and comprehend nature through the observation of natural phenomena. The essence of organic gardening goes along with the King's Principle, since it is to use everything around you to make the best profits. Even pesticide can be made organically; first we know the nature of the insect such as what taste they hate which may be spicy or bitter by observing leaves of what plants insects will not eat. And then, we make some liquor from combining those plants and spray on the other plants and this is still edible by humans unlike chemical pesticide. The knowledge of comprehension on nature combines with the knowledge of taste and 4 elements are the Thai traditional medication that is passed down generation by generation as cultural heritage. Thai folk wisdom is to study the phenomena in the forest and comprehend them and use the taste of plants to balance the elements inside our body. In summer, the body is hot, so Thai people eat something that is sweet or bitter to balance that, so to cure the heat fever. So, what is to be suggested is that everyone should know the taste and know the pros and cons of each herb.

Interview with Dr. Phithak Teelek: Herbal Doctor at Chophaya Abhaibhubejhr Hospital in Prachinburi Province

Attendees - *Pitch Asawasathaporn, Greg DiLullo, Marinela Kirilova and Madison Shugrue*

Wednesday, February 8th, 2012 at 11:00 AM

Are there any religious connections we should keep in mind while designing a garden?

4 elements and tastes of herbs

Is it possible to create an organic botanical garden in a 13m by 4m area?

Possible, suspension pot is suggested

How familiar are you with the King's principle?

Very familiar

How would you explain sustainability and self-sufficiency?

Do something only what you really need to such as planting what herbs you really need, and use only what you have

What do you suggest for a sustainable garden?

Aim at the health care of local people such as seeking what diseases are frequently found in BKK citizens and plant the kind of herbs that can cure such symptoms. When people find it useful, they will want to continue.

What are some of the most broadly used medicinal plants?

People in big cities tend to use the exact medicinal plants such as Cat's Whisker or Warn-Thoraneesarn because people in big cities normally won't grow herbs that can be cooked such as basil and pepper. So when they cannot cure the disease by modern pharmacy, they will use such exact medicinal plants instead. It is vice versa for people in the country-side, they grow herbs that can be cooked and eat them normally, so they tend to have immunity somehow.

What plants grow well in shady areas?

Herbs in fern species

What plants grow well in regularly sunny areas?

Big trees

What plants grow well next to each other?

Just create good biodiversity; it would need big trees, medium trees and small trees together, we cannot do just single type.

Should we pay attention to root size?

It is really necessary to be careful when you plant something near the building, but in the garden, it is negligible.

What kind of plants do you suggest for a small area?

Medium trees and small plants

What kind of soil will these plants need?

Just fertile soil

What plants do you think will help us achieve our goal of a sustainable, self-sufficient garden?

Dendrolobiam lanceolatum Schindi, cat's whisker, Noni, Horse tail grasses, Asiatic bua-bok because they are all easy to grow-find, multitask and have multiple applications

What are some affordable organic gardening resources?

In organic gardening, you make everything by yourself so nothing is expensive

What kind of organic soil and fertilizer should we use in our garden?

Still fertile soil

How much do you think we will need to spend on herbs and plants?

Not more than 5000 ฿

Is there any other information that you think would be applicable that we may have overlooked?

Our banyan tree also has the medical application, the air roots and the bark can cure fever. One thing we really need to care about is "insufficient air", it is worse than insufficient sunlight. In case that sunlight is not enough, you can use spotlight or neon light (same way as plant's tissue growing). For the garden to be sustainable, just need a good care taker. Dendrolobiam lanceolatum Schindi is a very good choice as you can just leave the roots on the ground and concealed with little soil, it can grow well with just pouring water once per week.

APPENDIX VI: SEMI-STRUCTURED INTERVIEWS AND RESPONSES WITH PARENTS

Basic

- What grade(s) is your child(ren) in?

Sustainability and Self-sufficiency

- How familiar are you with the King's principle?
- How would you explain sustainability and self-sufficiency in your own words?
- How is this principle used in your everyday life?
- Do you think it is important for the students to learn these concepts?

Personal Opinions

- Have students lost an understanding of nature?
- Have students lost an understanding of Buddhist connections to nature?

Thai Medicinal Herbs and Plants

- How much do you rely on Thai Traditional Medicine?
- What herbs do you usually treat with?
- What knowledge of medicinal plants has been passed down to you from your parents?
- Have students lost an understanding of ancient medicinal practices?

Technology at Home

- Are students allowed to use electronics at home?
- If yes, how frequently are students using electronics at home?
- How much time do children spend outside at home?

APPENDIX VII: CRAFT SURVEYS

Dear Teachers,

The following survey is in regards to the botanical garden that we are currently designing for the Wat Pathumwanaram School. We are interested in engaging your students in the garden through educational craft projects and activities. Please fill out the following survey to help us coordinate appropriate activities for your students according to your subject.

Name:

1. Are you interested in having your class participate in a craft and/or activity associated with the development of the garden?
2. What subject(s) do you teach?
3. What grade(s) do you teach? 1 2 3 4 5 6 7 8 9 (please circle all that apply)
4. How many students are in each of your classes?
5. Is it appropriate for the students from first to third grade to be involved in cleaning the garden? Yes No
6. Is it appropriate for the students from seven to nine grades to be involved in planting the garden? Yes No
7. If the students' participation is allowed, what time of the school day would be preferred for the completion of the activity?
8. Can we use paint and liquid glue with your students? Yes No
9. Does the school have available art supplies? Would we be able to use them in our activities with the students?
10. Does the school have any garden cleaning tools available for the activities? (For example, gloves and trash bags)
11. What types of gardening and planting tools does the school have available and can the participants use these tools?

- Shovels
- Hoes
- Rakes
- Other?

Thank you for your participation. If you have any questions please email us at thaigardenc12@wpi.edu or visit us in the Smart Room from 9-11am or 2-5pm today.

Sincerely,
IQPSSP1

APPENDIX VIII: EDUCATIONAL MATERIALS MANUAL

2012

Educational Materials and Activities Manual for the Botanical Garden at the Wat Pathumwanaram School

Table of Contents

Plants

Medicinal plants play an important role in the preservation of Thai cultural heritage and the development of natural literacy in urban students. In this section, you will find a detailed description of each plant placed in the garden, including information about the characteristics of the plant, its medicinal properties, and the methods in which the plant should be used. Common plants were incorporated into the design of the botanical garden to help further teach students about the practical applications each plant has. As an addition to the complete manual, a pamphlet for each plant has been attached. These pamphlets include all of the information in the manual in a form that can be distributed to the students or the community.

Scientific name: *Ocimum sanctum L.*
Synonyms: *Ocimum tenuiflorum L.*
Common Name: Holy basil, Sacred Basil
Family: Lamiaceae (Labiatae)
Also known as: White Basil, Red Basil

Characteristics: Holy basil is a bush around 30-60 cm tall. The red basil stems are red and green colored. Red holy basil is commonly used as a medicinal plant, while the white basil has white with green shade stem are usually used in cooking. The leaf of the basil has an oval shape that is 1-3 cm wide, and 2.5-5 cm long.
The part that can be used: Both fresh and dried leaves and the top of the holy basil.

Properties:
Anti-nausea
Relieves flatulence, heartburn and abdominal pain
Cures coughing and increase perspiration
Acts as a vermicide
Decreases fever
Acts as an elixir
Mosquito and fly repellent

Method and amount used
For nausea and vomiting:
Crush fresh or dried basil, then add it to water and drink it.
Baby: 3-4 leaves of fresh basil
Adult: 1 handful of dry leaves of the basil (4grams or 1 tablespoon of dry basil leaves or 2 teaspoons of 25gramsof fresh basil)
Relieves flatulence, heartburn and abdominal pain:
Children: Use the fresh leaves of the holy basil and apply on the stomach of the child. This will help relieve the stomachache.
Mosquito and fly repellent:
Grind the fresh leaves of the holy basil and put it aside. The holy basil will act as a mosquito and fly repellent. You can also extract the oil from the holy basil by distilling fresh leaves which will act as a better mosquito and fly repellent.
Chemicals found:
Apigenin, Ocimol, Linalool, Essential Oil, Chavibetal

Scientific name: *O. basilicum var. thyrsiflora*
Common Name: Sweet Basil
Family: Labiatae
Also known as: White Im Kim

Characteristics: Sweet basil is an annual plant with a small stem. The herb is not seasonal, which means it can always be planted. Sweet basil has many branches with green and purple colored leaves. The flowers of sweet basil are small and either white or purple colored. The seeds of sweet basil are black.
The part that can be used: the whole plant, seeds and roots
The whole plant- Collect the herb during the winter when the sweet basil is in the mature state with the flower on the top. Chop it into pieces and dry it
Seed-Remove the seed from the plant and keep it dry. (Try not to let the seeds soak in water or else they would form a lump.)
Root-Use the fresh root or dry the root for later use.

Properties:
The whole plant
Increases appetite
Relieves headache, stomachache and cold
Cures diarrhea
Menstrual disorder
Bruises, snake bite
Rashes with lymph
Seed
Cures conjunctivitis
Used as a purgative
Root
Treats wound with chronic purulent (children)

Method and amount used

The plant

Boil with water or squeeze 6 to10 grams of dry sweet basil and drink it as a fresh juice. Grind the sweet basil and apply it on the skin

Seed

Boil 2.5 to 5 grams of dry sweet basil with water and drink. Grind the sweet basil into powder and apply it on the skin for external use. Place 4-12 grams of seeds in cold water and consume it to use as a purgative

Root

Burn the sweet basil into ash and apply it on the skin

Leaves

Use the fresh leaves of the sweet basil (2 to 4 grams) squeeze out the juice and drink it. This will stop you from coughing and cure bronchitis. The juice of the sweet basil can also cure toothache; use a small piece of cotton wool, soak it with the juice and place it on the tooth.

Chemicals found:

Ocimine, alpha-pinene, 1, 8- cineole, eucalyptol, linalool, geraniol, limonene, eugenol, methyl chavicol, eugenol methyl ether.methyl cinnaminate, 3- hexen -1- ol, estragol

Scientific name: *Tamarindus indica* L.
Common Name: Tamarind
Family: Leguminosae - Caesalpinioideae
Also known as: Karm, Taloob

Characteristics: Tamarind's tree is medium to large-sized with a lot of branches and a thick, rough and brown bark with yellow-greenish leaves. The fruit of the tamarind has a green color and turns brown after it matures. Inside the fruit is brown, with a sweet and sour taste.
The part that can be used:
Seeds inside the tamarind (must be roasted before removing the skin of the tamarind)
The tamarind meat

Properties:
Seed
Helps excreting the roundworm and *Enterobius vermicularis* from the body
Leaves
Helps with the pituitary gland.
Core
Helps with removing toxins from blood
Meat
Can be used as a laxative and cure coughing

Method and amount used
Excreting roundworms and *Enterobius vermicularis*:
Use the white seeds (20-25seeds) of the tamarind, boil it with water and add some salt. Either consume all the meat of the tamarind fruit or roast the tamarind until it turns yellow, take out the skin of the tamarind and eat it.
Suffer from constipation:
Use the meat of the tamarind mixed with salt to solve constipation
Act as laxative and cure coughing:
Use the meat, dip it with salt and consume it.

Chemicals found:
Meat of the tamarind: tartaric acid 8-18%, invert sugar 30-40%
Seed of the tamarind: albuminold 14-20%, carbohydrate 59-65%, semi-drying fixed oil 3.9-20%, mucilaginous materal 60%

Scientific name: *Zingiber officinale Roscoe*
Common Name: Ginger
Family: Zingiberaceae
Also known as: King-klaeng, King-pueak, Sa-ae

Characteristics: Ginger is an annual brown plant with yellow shades covering the outside part and an ivory colored inside. Ginger will grow underneath the soil, while its leaves will appear above the soil. The flower is yellow with green shades. Ginger is around 1.5 to 2 cm wide and 15 to 20 cm long.
The part that can be used: Rootstock, stem, leaves, flower, fruit

Properties:
Rhizome
Acts as antiemetic
Increases appetite
Cures flatulence
Cures coughing and phlegm
Prevents from peptic ulcer
Increases digestion
Cures constipation
Decreases blood pressure
Stem
Cures flatulence
Increases digestion
Kills parasites
Cures eye infection
Leaves
Kill parasites
Cure eye infection
Increase digestion
Flower
Kills parasites
Cures eye infection
Increases digestion
Fruit
Acts as anti-fever remedy

Method and amount used

Antiemetic

Use the dry or fresh mature ginger, if dry use 5-7pieces and if fresh use 5 grams and pound the ginger. Boil it with water for 10 to 15 minutes and drink the water.

Increase the appetite

Use ½ tablespoon of dry ginger or 0.6grams and mix it with water. Then drink it or cook it with food.

Cure flatulence

Use 2inches of mature ginger then pound it and boil it with water. After 5 minutes you can drink the water. This will help in sleeping.

Cure coughing and phlegm

Use ground fresh ginger and add lime and salt to it. Drink slowly.

Decrease blood pressure

Use fresh ginger, boil it with water and drink it.

Chemicals found:

Rhizome:

Gingerol Zingiberene, Zingiberone Zingiberonol, Shogoal, Fenchone, Camphene Cineol Citronellol

Extracted oil:

Bisabolene, Zingiberone Zingiberol, Zingiberene, Limonene, Citronellol Gingerol, Camphene, Borneol, Cineol

Stems:

5 - (1) - 6 - Gingerol Shikimic acid

Scientific name: *Alpinia galanga* (L.) Willd.
Common Name: Galanga
Family: Zingiberaceae
Characteristics: Galanga is an annual plant around 1.5 to 2 meters tall with green leaves 7 to 9 cm wide and 20 to 40 cm long. The white flower of the galangal grows on the top. The leaves of galangal have an oval shape while the fruit of the galangal is round.

The part that can be used: Rhizome

Properties:
Acts as carminative/anti-flatulence
Cures foodborne illness (food poisoning)
Cures urticarial
Acts as anti-eczema/anti-fungal

Method and amount used
Carminative/anti-flatulence
Use the fresh rhizome with the length of 1- 1 ½ cm and grind it. After grinding the rhizome of galangal, add limewater ($Ca(OH)_2$). Drink half a glass after each meal per day.
Cures urticarial
Grind one mature rhizome, and then add rice whisky to make it slushy. Apply them on the skin where there's urticarial until it has gone away.
Acts as anti-eczema/anti-fungal
Use a mature rhizome the size of your thumb and add rice whisky. Then apply it to the skin to cure eczema and fungus.

Chemicals found:
1 - acetoxychavicol acetate Extracted oil: monoterene 2 - terpineol, terpenen 4 - ol, cineole, camphor, linalool, eugenol

Scientific name: *Morinda citrifolia L.*
Common Name: Indian Mulberry
Family: Rubiaceae
Also known as: Yor barn

Characteristics: Indian Mulberry is a perennial plant of 2 – 6 m tall. Its barks are brown which, later, crack and scatter out. Its young bud is square shaped. Its leaf is single and granulates alternately. The leaves are shiny green and have an oval shape with width of 8 - 15 cm and length of 10 - 20 cm. The edge and the leaves themselves are smooth. Its flower granulates from the leaf's nook and resembles a circular bouquet and has a pleasant odor. The bases of the petals connect to each other becoming a tube. The tip of the petal splits into 5 v-shaped projections. Its fruit gather into a group and have a rough surface. The ripe fruit has an unpleasant smell. Its seed is brown.
The part that can be used: Leaves, root, fruits

Properties:
Leaves:
Its leaves provide more than 40000 vitamin A per gram and can help nourish the heart and eyes. The extracted water from the leaves can be used to cure arthritis. Indian Mulberry can also be used as an ingredient in cooking which can help cure diarrhea.
Roots:
The roots can be used as a laxative, and dye color (adjust the color by adding salt) such as pink, red brown, black, and yellow.
Mature Fruit (unripe):
Eaten with honey, which would act as a carminatives and anti-flatulence remedy.
Mature Fruit (Ripe):
Boil it with water and add the root of parsley. Drinking the water will act as an antiemetic.

Method and amount used
Antiemetic:
Use the mature fruit (unripe), cut it into pieces and fry it until the color changes to yellow. Then use the resulting 10-15 grams of the mature fruit, boil them with water and slowly drink it.

Chemicals found:
Fruit: Asperuloside, caproic acid, caprylic acid, glucose

Scientific name: *Centella asiatica* (L.) Urban.
Common Name: Asiatic Pennywort, Tiger Herbal
Family: Umbelliferae
Also known as: Pak-Ven, Pak-Nok

Characteristics: Asiatic Pennywort is an annual plant. Its stem and roots are one, crawling along the damp ground. It has rootlets come out of each section. It grows easily. The single kidney-like leaf of area 2-5 cm^2 holds high above the stem, granulating alternately. The leaf is green and has a circular tip, curved base and wavy edges. The small hairs also appear on the leaf. It has long leaf stalk. Its flower granulates from the leaf's nook and resembles a bouquet that looks like the teeth of an umbrella containing a couple of minor flowers. The flower has five reddish purple petals. Its fruit is black, dry and flat.
The part that can be used: leaves, the whole plant, seed

Properties:
Leaves:
Contain asiaticoside which can cure eczema
The whole plant:
Cardiac tonic
Heals scald
Cures migraine
Diuretic
Relieves sore throat
Lowers the blood pressure
Heals internal organ injury
Seed:
Cures fever and headache

Method and amount used

Migraine

Extract the juice from the plant and drink it for 2 -3 days.

Cures sore throat

Use the 20-30 grams of the plant and extract the juice. Add 2-3 tablespoon for vinegar. Then slowly drink it.

Lowers the blood pressure

Use the 30-40 gram of the plant and extract the juice from the plant. Add in sugar and drink it for 5-7 days.

Heals internal organ injury

Use a handful of the plant and grind it to extract juice and add in some sugar. Drink it for 5-6 days.

Heal scald

Use 2-3 plants and grind them. Then apply on the scald. Doing this will decrease the pain.

Chemicals found:

Extraction from leaves: madecassoside asiatic acid, asiaticoside, centelloside, centellic acid brahminoside, brahmic acid.

Scientific name: *Zingiber montanum* (Koenig) Link ex Dietr.
Common Name: Phlai, Z.purpureum Roscoe
Family: Zingiberaceae
Also known as: Warn-Fai, Poo-loi Poo-loey

Characteristics: Phlai is an annual plant of 0.7 – 1.5 m height. It has underground roots. Its bark is yellow-brown. The wood is yellow or yellow-lime. Its shoot, or pseudo stem, is composed of spathe or leaf's bases stacking on each other's granulates in coalescence. Its leaf is single and arranges alternately. The leaf resembles a spear and has width of 3.5 – 5.5 cm and length of 18 – 35 cm. The petal is bright yellow. The bract is purple. Its fruit is dry and has circular shape.
The part that can be used: mature rhizome

Properties:
Rhizome
Acts as a carminative/anti-flatulence remedy

Method and amount used
Use the dry mature rhizome of Phlai, and grind into powder. Then add ½ teaspoon of the powder into a glass of water. Add a little salt and drink it.

Chemicals found:
Alflabene: 3,4 - dimethoxy benzaldehyde, curcumin, beta-sitosterol, Volatile Oils

Scientific name: *Andrographis paniculata* (Burm.f.) Wall.ex Nees
Common Name: Kariyat, The Creat
Family: Acanthaceae
Also known as: Fah-ta-lai-jon, Yah-kun-nguu, Fah-sa-tarn

Characteristics: Kariyat is an annual plant of 30 – 70 cm height. Every part of this plant has a bitter taste. Its branch has a square shape. Its leaf is shiny green and single. Its flower granulates as bouquet at the tip of the branch and in the leaf's nook. The minor flower has white petal and a connected base. The tip of the flower splits into 2 mouths; the upper mouth has 3 petals and the lower mouth has 2 petals, separated by a red-purple line. The fruit is a pod with many seeds. When the pod becomes fully ripe, it can sprout.
The part that can be used: plant, fresh leaves, dry leaves (all the leaves would be collected during 3-5 months of the plant)

Properties:
Anti-pyretic
Cures infection
Suppresses inflammation
Increases appetite

Method and amount used
Tea extraction
5-7 leaves are placed in a glass and hot water is poured in. The glass is sealed for half an hour then drink 3-4 times per day before food and prior to sleep.
Herbal ball
Fresh leaves are dried in a ventilated and shaded area. The dried leaves are crushed. The materials are then made into a ball with honey. Each ball should be 250g. Once dried, consume 3-4 times per day before food and prior to sleep.
Capsulation
Fresh leaves are dried in a ventilated and shaded area. The dried leaves are crushed. Pack into 250mg capsules. The dose is 3-4 times per day before food and prior to sleep.
Alcohol extraction
The dried and crushed leaves are allowed to sit in 40% alcohol (the level of alcohol should submerge the materials). Shake the bottle once a day for seven days. The drink is consumed 3-4 times a day prior food, and each dose should be about 1-2 tablespoons
Powder extract for inhalation
The powder can be sniffed through the nasal and oral passages.

Chemicals found:
Andrographolide, neo-andrographolide, 14-deoxy-andrographolide

Scientific name: *Sesbania grandiflora* (L.) Desv.
Common Name: Agasta, Sesban, Vegetable humming bird
Family: Leguminosae - Papilionoideae
Also known as: Kae-Kao, Kae-dang

Characteristics: Agasta is a perennial plant of 3 – 6 m height. Its branches grow extensively. Its bark is grey brown, rough and splinters. Its leaf is multiple and looks like a bird's feather, granulating alternately. The minor leaf is oval and has the parallel edge. The leaf's width is 1 – 1.5 cm and the length is 3 – 4 cm. The tip and the base of the leaf are round and the surface is smooth. The leaf is green. Its flower granulates in bouquet in the leaf's nook (2 – 4 flowers at a time). The flower is red or white and has a pleasant odor. The white flower has 60 androecium filaments. The fruit is a pod that is 8 – 15 cm long. Each pod, when fully grown, will sprout into 2 pieces. The seed is brown and round and flat. One pod contains many seeds.
The part that can be used: bark, flower, and fresh leaves

Properties:
Leaves:
Cure diarrhea
Heal the bruise
Bark:
Cures diarrhea
Cleans wounds
Flower:
Cures fever

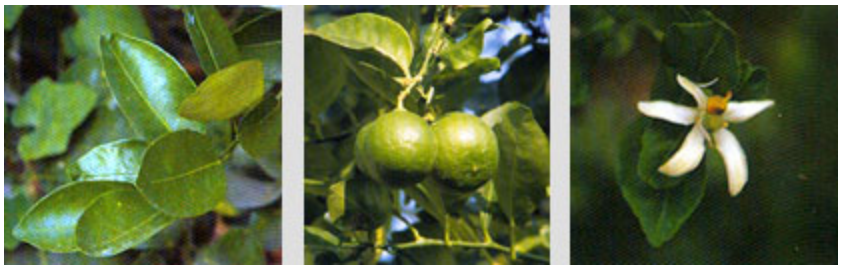
Method and amount used
Diarrhea
Use 1/10 of Agasta's bark and grill it. Add 10/10 of limewater/water for boiling. Drink 1-2 tablespoons.
Cure fever
Use the fresh leaves and boil them with water. Drink the result.

Scientific name: *Cymbopogon citratus* Stapf.
Common Name: Lemon Grass, Lapine
Family: Poaceae (Gramineae)
Also known as: Ta-Krai, Krai

Characteristics: Lemon grass is a clump annual plant of 1 m height. It has a long life time. Its stem is tube-shaped, strong and rigid. Each section on the stem is grease covered. Its leaf is single and splits into many seen as a clump. The leaf has parallel edges, pointed tip and a rough surface. There are hair covers at the edge. The leaf is green and has the rigid line in the middle. The width of the leaf is 2 cm and the length is 60 – 91.5 cm. Its flower granulates as a scattered bouquet. The minor bouquet has a pair of stalks and, in each pair, the bract is carried.
The part that can be used: the whole plant, roots, leaves

Properties:
Leaves:
Cure diarrhea
Heal the bruise
Bark:
Cures diarrhea
Cleans wounds
Flower:
Cures fever

Method and amount used
Diarrhea
Use 1/10 of the Agasta's bark and grill it. Add 10/10 of limewater/water for boiling. Drink 1-2 tablespoons.
Cures fever
Use the fresh leaves and boil it with water. Drink the result.



Scientific name: *Citrus aurantifolia* (Christm.) Swingle
Common Name: Common Lime
Family: Rutaceae
Also known as: Ma-now

Characteristics: Lime is a bush tree of 2 – 4 m height. Its young branch contains spikes. Its bark is grey-brown and smooth. Its leaf is multiple and granulates alternately. The leaf contains a minor leaf which is single and oval of 3 – 5 cm (width) and 4 – 8 cm (length). The tip of the leaf is sharply pointed. The leaf's base is round and has a narrow flank. The leaf has the oil glands scattered all over. Its flower granulates as either a short bouquet which contains 5 – 7 flowers or singly in the leaf's nook and at the tip of the branch. The flower is white, fragile and has 4 – 5 petals. Its fruit is round and smooth. Young fruit is strong green and changes to yellow when it becomes riper. Inside the fruit, it can be divided in a radius pattern. The fruit is sour. Its seed is white and polyembryonic. The fruit contains 10 – 15 seeds.
The part that can be used: Lime fruit, juice, roots, leaves, flowers and seeds

Properties:
Lime juice:
Scurvy
Phlegm
Cooking
Blood purification
Moistening skin
Common flu
Croup
Enhance voice
Enhance blood
Menstruation pain
Prevention of Whitlow
Stretch marks
Coughing
Parasite in stomach
Enhance health of hair
Drive out gases
Urticaria
Hemorrhoids
Leukorrhea
Cure poison from upas
Fever
Furuncle
Aches
Inflammatory

Root:
Common cold symptom
Food poisoning
Impaired memory
Fever
Common flu
Furuncle
Aches
Inflammatory
Leaves:
Blood purification
Enhance liver
Flower:
Flatulence
Coughing
Phlegm
Lime Fruit:
Flatulence
Coughing
Phlegm
Skin problem (Acne)
Cracked heel
Seed:
Croup
Improve respiratory health
Phlegm
Internal Furuncle

Method and amount used
Phlegm
Mix 2-3 tablespoons of lime juice, 10-20 lime seeds and add a little bit of salt. Drink the result.
Scurvy
Mix lime juice, salt, sugar and ice and drink it. The juice can also be mixed with food.
Prevent Bleeding from cuts
Squeeze lime on fresh wounds to stop excessive bleeding.

Chemicals found:
Leaves: Alcohols, Aldehydes, Elements, Terpenoids, Citral
Fruit: 1 - Alanine, γ - Amino butyric acid, 1 - Glutamic acid
Seed: Glyceride Oil
Essential oil: P - Dimethyl - Styrene, Terpinolene

Scientific name: *Phyllanthus acidus* (L.) Skeels
Common Name: Star Gooseberry
Family: Euphorbiaceae
Also known as: Mayom

Characteristics: Star Gooseberry is a perennial plant of 3 – 10 m height. Its stem stands straight and grows the branches on the top. The branch is fragile. Its bark is grey brown and rough. The leaf is pile containing minor leaves that granulate in 2 lines alternately. Each branch has 20 – 30 minor leaves. The leaf is round or rather rhombus-shaped and has parallel smooth edge and a pointed tip. Its flower granulates as a bouquet along the branch. The minor flower is yellow-brown. Its fruit is green when young and turns yellow or pale yellow when riper. The fruit is moist. Its seed is light brown, round and rigid. The fruit contains 1 seed.
The part that can be used: leaves, fruits and root

Properties:
Leaves:
Skin Itches
Small pox
Measles
Cooking
Fruits:
Cooking
Root:
Cures fever
Skin disease

Method and amount used
The leaves and roots are boiled for consumption.

Chemicals found:
Leaves: beta-amyrin, phyllanthol, tannin saponin, gallic acid
Fruit: tannin, dextrose, levulose, sucrose, vitamin C

Scientific name: *Aloe vera* (L.) Burm.f.
Common Name: *Aloe barbadensis* , Mill Star cactus, Aloe, Aloin, Jafferabad, Barbados
Family: Asphodelaceae
Also known as: Wan harng jora kae

Characteristics: Aloe is an annual plant of 0.5 – 1 m height. It has a long life time. Its stem is a stacking of various sections. Its leaf is single and granulates in a circular arrangement. The leaf is green, thick, long, and moist and has light green long spots. The leaf's base is large. The tip of the leaf is pointed. The edge of the leaf contains sparsely arranged spikes. Inside the leaf, a clear light green gel is contained. Its flower granulates as bouquet at the tip top of the plant. The flower stalk is long. The flower is yellow-red. The base of the flower connects each other, becoming a tube. The tip of the flower splits to 6 v-shaped projections in 2 layers and has a trumpet-like shape. Its fruit is dry and resembles a spaceship.
The part that can be used: Sap, gel, liquid from the gel and rhizomes

Properties:
Leaves:
Cooling effects
Cure furuncle
Whole plant:
Cooling effects
Root:
Bitter taste
Cures leukorrhea
Cures gonorrhea
Sap:
Laxative effect
Liquid from gel:
Treats scald
Heals scars (can be applied on face)
Gel:
Cures hemorrhoids
Rhizomes:
Gonorrhea
Leukorrhea

Method and amount used

Laxative:

The liquid from the gel can be made into a laxative, Ya dum.

Cut the leaves into triangle shapes. The plant should be at least 9 years old to be able to go through this process. The liquid obtained is then simmered until it becomes pasty. The pasted is left to dry in a mold.

The final product should be hard and brown/black in color.

Ingestion: Oral dose of 250 mg per person.

For stomach and intestine inflammation:

Remove the skin and consume the gel twice a day, 2 tablespoons per dose.

For joint pain

Simply drink the liquid and the gel inside the leaves to alleviate joint pains. It is recommended that the drink is served cold 2-3 times per day. Each dose should be about 1-2 tablespoons.

For external use:

Treatment of scald

The gel is used to apply to the scald for the first two days. The wound will heal quickly.

Treatment of sun burn

It can be used as a sun screen. The gel inside the leaf can be applied directly to the skin. The vegetable oil can be applied along with the aloe so this can prevent dryness of skin.

Treatment of fresh wounds, furuncles and bruises

The gel can be applied directly to wounds, furuncle and bruises. Cover the areas with a piece of cloth and keep them well moisturized with the liquid from the leaves.

Treatment of hemorrhoids

Clean the affected areas with water. Remove the outer layers of the leaf. Cut the tip of the gel to make it poky. The gel is then put in the freezer to make it hard. Once it is frozen, the gel is held at the wound. It should be done 1-2 times per day.

Treatment for headache

The aloe leaf is cut and red lime is put at the end of the tip. The tip is pressed to the forehead until the ache is gone.

Hair growth

The gel can be used to enhance hair growth. It can be directly applied to the affected area. It enriches the root of the hair and promotes the growth of the hair

Black spots

The gel can also be used to get rid of dark spots and wrinkles. It can be directly applied to the areas.

Acne treatment

The gel is applied to the areas affected by the acne. It will stop the bacterial infections.

Chemicals found:

Leaves: Aloe-emodin, Alolin, Chrysophanic acid Barbaboin, AloctinA, Aloctin B, Brady Kininase Alosin, Anthramol Histidine, Amino acid , Alanine Glutamic acid Cystine, Glutamine, Glycine.

Scientific name: *Rhinacanthus nasutus* (L.) Kurz
Common Name: White crane flower
Family: Acanthaceae
Also known as: Thong Kun Chang, Ya Mun Khai

Characteristics: White crane flower is a bush of 1 – 2 m height. Its young branch is square shaped. Its leaf is single. Its flower granulates as a bouquet in the leaf's nook. The petal is white and has the base connected, becoming a tube. The tip of the petal splits into 2 layers. The lower layer is red-purple. Its fruit is dry and cracked.
The part that can be used: leaves, whole plant, stem and root

Properties:
Leaves:
Cure fever
Skin disease
Joint related disease
Skin related disease
Root:
Helps excrete ringworms
Cancer treatment
Skin related disease
Symptoms of fever
Treat snake venom
Treatment for skin parasite
Whole plant:
Skin related disease
Treatment for lymphatic
Cure eczema
Helps excrete ringworms
Cancer treatment
Skin parasite
Cure yaws
Cure hernia
Bladder dysfunction
Stem:
Treatment for hair loss
Enhance overall health

Method and amount used

Treatment of cancer and tuberculosis

30 grams of fresh whole plant materials are boiled in water (slightly above the amount of the plant). The water is consumed for medicinal purposes.

Treatment of lung related diseases

30 grams of stems and leaves are boiled in water with sugar. The drink is consumed for medicinal purposes.

Treatment for skin related diseases

5-8 fresh leaves or 2-3 roots are crushed and mixed with alcohol (40% or 75%). The solution can be applied to the affected areas.

Chemicals found:

Rhinacathin, Oxymethylanthra quinone, Quinone, Rutin (quercetin - 3 - rutinoside)

Scientific name: *Mentha cordifolia* Opiz ex Frese
Common Name: Kitchen Mint
Family: Labiatae
Also known as: Sa la nae

Characteristics: Kitchen Mint is an annual plant that crawls along and covers the ground. It has a small stem that branches out extensively. The fiber can be observed on the leaf clearly. The tip of the leaf is pointed. The edge of the leaf is wavy and rather sharp like the saw's teeth. The leaf stalk is short. Every part of this plant has a pleasant odor.
The part that can be used: leaves

Properties:
Leaves:
Antiflatulents
Abdominal pain
Colic
Head ache

Method and amount used
Antiflatulents
The leaves are consumed as much as needed.
Headache
The leaves are crushed and applied around the forehead.

Scientific name: *Capsicum frutescens* L
Common Name: Cayenne Pepper
Family: Solanaceae
Also known as: Prik Kee Noo

Characteristics: Cayenne Pepper is the perennial plant of 30.5 – 76.25 cm height. It can be grown in different seasons. Its leaf is smooth and shiny. The tip of the leaf is pointed. The leaf granulates in an opposite pattern. Its flower is single and small. The flower stalk can be straight or curved. The petal is white or violet. The anther has 1 – 10 pollens. The pistil contains 1 – 2 oval(s). The fruit is small, 2.5 – 3.75 cm long and 0.635 – 1.693 cm in diameter. The young fruit is green and turns red or yellow as it becomes riper. Inside each fruit, there are many seeds arranged intensely. The roots are white.
The part that can be used: the seed pods

Properties:
Seed pods:
Used in cooking to enhance appetite
Help with phlegm
Cure for swelling
Antiflatulents

Method and amount used
Phelgm and increase of appetite
The pods are cooked in food.

Scientific name: *Barleria lupulina* Lindl.
Common Name: Hop Headed Barleria
Family: Acanthaceae
Also known as: Saled Phang porn

Characteristics: Hop Headed Barleria is a crawling bush. Its stem and branches are green. Its leaf is single and granulates in an opposite pattern. The petal is orange-red. The petal's base connects to each other becoming a tube. The tip of the petal separates into 2 parts. It naturally grows in the wild, however, it can also be planted in the house. It can be bred by 'rooting the cutting'. There are 2 species of Hop Headed Barleria; Male Hop Headed Barleria and Female Hop Headed Barleria; the difference is that the stem of the male one contains spikes and has less medical properties than the female one. In order to not be confused, the female one is called Pha-ya-Yor. Thai traditional medication prefers this plant strongly.
The part that can be used: roots, the five part and leaves

Properties:
Roots:
Increase in appetite
Hyperbilirubinemia
Abdominal pain
Food poisoning
Snake venom
Insect bite
Tooth ache
Leaves:
Insects bite
Cure for hives
Skin related disease
Diabetes
Pain from fresh wound
Fresh wound
Cure furuncle
Cure mumps
Cure Erysipelas
Cure Herpes
Cure hemorrhoid
Treat mosquito bites
Treat scald

The five parts:
Treat venom from insects
Elevate inflammatory
Cure Herpes
Cure hives
Treatment for scald

Method and amount used
For Herpes, inflammatory
10-20 leaves are mixed with liquor or lime juice. The solution can be applied to the affected areas or consumed directly. 1000g of the leaves are left in 1000cc of 70% alcohol for 7 days. Strain the plant materials out and leave the solution to evaporate until about 500 cc is obtained. Add 500cc of pure glycerine in the solution. The solution is applied to the affected areas.
Insects bite
5-20 of the fresh leaves are crushed and applied directly on the wound
Scald
Crush the leaves and mix with alcohol. The solution can be applied to the wound.

Chemicals found:
Whole plant: Iridiod glycoside, Acetyl barlerin , Barlerin, Shanzhiside methyl ester

Scientific name: *Curcuma longa* L.
Common Name: Turmeric
Family: Zingiberaceae
Also known as: Kha min

Characteristics: It is an annual plant about 30 – 90 cm tall. It has a long life time. Its rhizome is a yellow-orange and has a specific odor and stays in the ground. The branch at the side of the rhizome has a cylindrical shape and points out in the opposite to the mass inside the rhizome. Its leaf is single, grows out from the rhizome and arranges circularly. The leaf is spear shaped of 12 – 15 cm (width) and 30 – 40 cm (length). Its flower granulates as a bouquet (3 – 4 flowers at the time) from the rhizome, penetrating through the leaf stalk. The flower is cylinder. The petal is pale yellow. The bract is light green. The fruit is round and has 3 sections.
The part that can be used: Rhizomes

Properties:
Rhizomes:
Internal:
Antiflatulent
Acute diahhrea
Stomach related disease
External:
Skin related disease
Scald head

Method and amount used
For **Internal use**
2 inches of the rhizomes are peeled, washed with clean water and crushed. Squeeze the liquid out. The liquid is consumed 3-4 times per day with 1 table spoon per dose.
For external use
The rhizomes (as much as needed) are dried are crushed into powders then applied to affected areas.

Chemicals found:
rhizomes: tumerone, zingerene bissboline, zingiberene,(+) - sabinene, alpha-phellandrene, curcumone, curcumin

Scientific name: *Orthosiphon aristatus* (Blume) Miq.
Common Name: Java tea, Kidney Tea Plant, Cat's Whiskers
Family: Lamiaceae (Labiatae)
Also known as: Ya nuad Meaw

Characteristics: Cat's whisker is an annual plant of 30 – 80 cm height. Its stem is square shaped. Its leaf is single and arranges in an opposite pattern. The leaf is deep green, trapezoid and has a wavy edge. Its flower granulates as a bouquet from the top of the plant. It has 2 species; white purple flower and cyan flower. The petals bloom from the lower to the higher section of bouquet. Its anther leans out long from the petal. Its fruit is dry.
The part that can be used: Roots, whole plant and leaves

Properties:
Roots:
Help with urinal problem
Whole plant:
Kidney-related disease
Helps with urinal problem
Back and lower back pain
Cures rhinitis
Leaves:
Kidney-related diseases
Joint and back pain
Low blood pressure
Cure diabetes
Decrease amount of uric acid from the kidney

Method and amount used
Urinal problem
The stems and leaves are washed with clean water then dried in the shades. 4 grams of the material is boiled in water (750cc). The drink can be consumed throughout the whole day. The treatment can last about 6 months.

Chemicals found:
Plants: Hederagenin, Beta-Sitosterol, Ursolic acid
Leaves: Glycolic acid, Potassium Salt Orthosiphonoside, Tannin, Flavone

Scientific name: *Piper sarmentosum* Roxb..
Common Name: Wildbetal Leafbush
Family: Piperaceae
Also known as: Cha plu

Characteristics: Wildbetal Leafbush is an annual plant 30 – 80 cm in height. Its stem is green and lays along the ground. The new bud grows from the stem. The roots grow from the section on the stem. Its leaf is single and granulates alternately. The leaf is shiny green, thin and smooth, is heart shaped, and 5 – 10 cm wide and 7 – 15 cm long. The tip of the leaf is pointed. The leaf's base is curved. Its flower granulates as a cylinder bouquet. The small white flowers stay on the bouquet stalk intensely. The anther and pistil are on the different flower. Its fruit is fresh, round and massive and granulates on the stalk.
The part that can be used: Fruits, whole plant, leaves and roots

Properties:
Roots:
Antiflatuent
Enchance internal elements
Shigellosis
Whole plant:
Antiflatuent
Phlegm
Diabetes
Fruits:
Used to make medicine for asthma
Roots, stem, flower and leaves:
Phlegm

Method and amount used
Diabetes
The fresh plant material from 7 different plants is boiled in water and consumed as tea
Antiflatuent
One handful of the roots are boiled in 2 glasses of water. Simmer until there are 75% of the water left. Consume 25% of the drink per dose.
Shigellosis
Half handful of the root, 2-3 handfuls of fruit are boiled in two glasses of water. Simmer until 50% of the water has evaporated. Consume 25% of the liquid per dose.

Chemicals found:
Plants: Hederagenin, Beta-Sitosterol, Ursolic acid
Leaves: Glycolic acid, Potassium Salt Orthosiphonoside, Tannin, Flavone

Common pests

Common pests can cause harm to the plants and are important to identify and remove if possible. In this section, you will find a detailed description of pests commonly seen in the garden, including information about the characteristics of the pest, the area of the plant the pest targets, and the result to the plant.

Cotton Aphid

Aphis gossypii

Morphology:

The wingless species would have the following characteristics:

- Body is egg-shaped and about two millimeters in length with a green color
- Antennae are yellow
- Legs are black and yellow

The winged species would have the following characteristics:

- Body is fusiform
- Head and thorax are black
- Abdomen is yellowish-green with black spots

The nymphs would have the following characteristics:

- Color ranging from tan to green to grey
- Head, thorax and wing pads are dark colored
- Abdomen is dark green
- Body is dull because of wax secretions

Target: fruits and flower plants, especially of the Solanaceae family.

Symptoms: They prefer to attack the stem, leaves and flower buds. They damage the crop by sucking the sap which will eventually lead to death of the plant.

Mealy bug

Pseudococcus

Morphology: The female will have the following characteristics;

- 3 millimeters in length
- Pale yellow with round and short body
- White powders covering the body

The male will look almost identical except they have smaller wings.

Target: fruits and flowering plants.

Symptoms: They suck water from the leaves, stems, flowers and fruits. The damaged parts of a plant will appear dead with black color.

Notes: They normally lay 600 to 800 eggs within 14 days and are transported by ants

Common cut worm

Spodoptera litura

Morphology: The eggs and larva would have the following characteristics;

- The eggs are colored dirty white
- The larva is yellow and green
- The head is bigger than its body

The mature larva would have the following characteristics;

- The body is larger than the head
- The body is darker brown in color with three thin yellow lines down the back

Targets: leafy plants and flowers

Symptoms: They feed on the lower part of the leaves cutting off water to the parts further up.

Grasshopper

Orthoptera

Morphology : Common characterization of the species;

- Thin and long antennae
- The front wings are leathery
- The back wings are brittle and transparent
- It has two small front legs used for walking
- It has two long back legs used for jumping
- Usually possess 3-5 body segments

Notes: The most common grasshoppers found in Thailand are the Short-horned grasshopper, Long-horned grasshopper, Pygmy grasshopper and Patanga succincta

Short-horned grass hoppers

Tegmina

Morphology: They can be differentiated from the others by;

- Short antennae
- The body has no more than 3 segments
- Body is grey or brown in color
- Wings are usually colorful

Long-horned grass hoppers

Tettigoniidae

Morphology: They can be differentiated from the others by;

- Longer length of body (4 segments)
- Long antennae
- Body is green in color

Pygmy grasshoppers

Tetrigidae

Morphology: They can be differentiated from the others by;

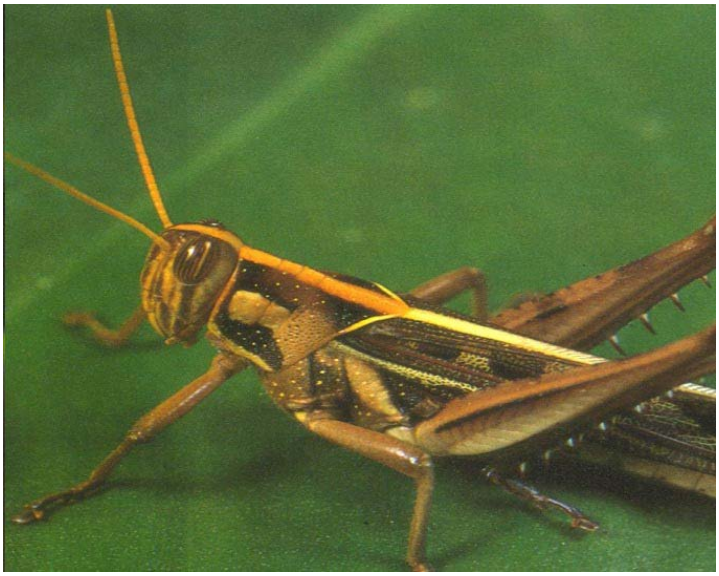
- Shorter body length (13-19 mm)
- Shorter wings

Patanga succinct

Linnaeus

Morphology: They can be differentiated from the others by;

- Length of male is about 6-6.5 cm
- Length of female is about 7.6-7.8 cm
- Body is brown in color
- There is a black mark on either side of the mouth



Common targets of grasshoppers: over 34 species of plants including, orange, corn, soybeans, etc.

Symptoms: They feed on the leaves, leaving bite marks. The plants cannot photosynthesize and eventually die.

Composting and Microorganisms

About Composting

Composting is a process that creates a natural fertilizer from organic waste that would otherwise increase the size of a pile of trash on its way to a landfill. Compost is created from everyday organic waste such as kitchen and yard waste, creating new and usable products. The organic waste is broken down by microorganisms such as bacteria and fungi, sometimes with the help of larger critters like worms and beetles. This process makes it so that the nutrients from the waste are available for plants to use. Different methods have been developed to facilitate this decomposition, many of which specifically concentrate on the cultivation of beneficial, or 'effective', microorganisms. The Thai government endorses the use of effective microorganisms in a process that creates liquid compost that can be diluted and applied when watering plants in a garden.

How to Make Liquid Compost

The following information has been adapted from the composting guidebook supplied by the Thai government. It creates effective liquid compost much like what is used at the HRH Princess Maha Chakri Sirindhorn Herb Garden and by herbal medicine and organic gardening expert Dumrongsak Chumseangpann.

Required Materials

- Compost barrel
- Molasses
- Effective microorganisms (EM)*
    - PD 2
    - PD 6
- Shovel/stirrer
- Designated organic waste barrels**
- Scale, clipboard, record sheets***
- Work gloves
- Ladle
- Watering can
- Rags

* These are microorganism solutions that found at Kasetsart University for free

** These bins should be placed in areas of food preparation and disposal

*** Examples of what should be on a record sheet: Types of food, Weight of food (to keep track of daily waste output), Length of composting, and Notes (if the ratios were different at all, what didn't compost, quality of final product, etc.)

Procedure

In order for a composting initiative to be successful, it is important to designate a supervisor that will be in charge of making sure that the following stages will be carried out properly.

- Filling Stage: This stage begins when a new batch is ready to be started. During the filling stage, the organic waste bins must be retrieved after every mealtime and dumped into the compost bin after being weighed. The weight of the food and the types of food that were added should then be noted in the record sheets. All tools should be cleaned as often as they are used. The Filling Stage ends when a sufficient amount of waste is gathered and the Mixing and Composting Stage can begin.
    - If using the pesticide or pathogen treatment recipes this stage will involve gathering the required herbs and placing them in the compost bin
- Mixing and Composting Stage: Depending on the organic material collected in the Filling stage, follow the 'How to make it' section from the appropriate recipe below. The mixture may be stirred a few times throughout the process. All tools should be cleaned as often as they are used.
- Application Stage: Using the ladle and watering can, dilute the liquid compost with water to the proper ratio as specified in the 'Usage' section of the appropriate recipe from below, then apply to the plants as needed or as specified in the recipe. All tools should be cleaned as often as they are used.

Compost Recipes

The following numbers are approximate and should act as guidelines. It is not necessary to use the correct amount of each ingredient so long as the ratios are roughly the same. Composting is not an exact science and experimenting with the ingredient ratios and compost time is encouraged.

Using Food scraps

Ingredients:

Food Scraps	40 kilograms
Molasses	10 kilograms
Water	10 liters
EM (PD 6)	1 package

How to make it:

1. Add molasses to the food scraps in the barrel and mix together. (Meat and dairy products are fine but will cause stronger odors)
2. In a separate container combine the effective microorganisms and water. Pour the mixture into the bin and stir until fully mixed.
3. Close the lid of the bin, but let small amount of air in. The process will take about 20 days.

Usage:

Use 1 part liquid compost to every 1000 parts water and spray it on the plant's leaves. Or the dilute solution can be used when watering the plant, every 5-7 days.

Using leftover plant materials and ripe fruits

Ingredients:

Plant materials and ripe fruit	30 kilograms
Molasses	10 kilograms
Water	10 liters
EM (PD 2)	1 package

How to make it:

1. Chop or grind the left over plant materials and ripe fruits into smaller pieces.
2. Add molasses to the organic material in the bin and mix together.

3. In a separate container combine the effective microorganisms and water. Pour the mixture into the bin and stir until fully mixed.
4. Close the lid of the bin but let small amount of air in. The process will take about 14-20 days.

Usage:

Use 1 part liquid compost to every 1000 parts water and spray it on the plant's leaves. Or the dilute solution can be used when watering the plant, every 5-7 days.

Other Recipes

These are slight variations of the composting recipes that have been designed so that their products have specific properties and are still organic.

Pesticide from bitter herbs

Ingredients:

Bitter herbs	30 kilograms
Examples: Yor, Bitter Gourd	
Molasses	5 kilograms
Water	10 liters

How to make it:

1. Grind and crush the herbs into smaller pieces.
2. In the compost bin, combine the molasses and herbs.
3. Pour the water in and close the lid of the bin tightly. The process will take about 14-20 days.

Usage:

Use 1 part liquid compost to every 200-400 parts water and spray it on the plant leaves. Or the dilute solution can be used when watering the plant, every 5-7 days.

Treatment for pathogens

Ingredients:

Astringent herbs	30 kilograms
Examples: Sesban, Guava, Asiatic Pennyworth	
Molasses	10 kilograms
Water	30 liters

How to make it:

1. Grind and crush the herbs into smaller pieces.
2. In the compost bin, combine the molasses and herbs.
3. Pour the water in and partially close the lid of the bin. The process will take about 14-20 days.

Usage for plants:

Use 1 part liquid compost to every 200-400 parts water and spray it on the whole plant every 5-7 days.

Pesticide from sour herbs

Ingredients:

Sour herbs 30 kilograms

Examples: Common Lime, Tamarind, Star Gooseberry

Molasses 10 kilograms

Water 30 liters

How to make it:

1. Grind and crush the herbs into smaller pieces.
2. In the compost bin, combine the molasses and herbs.
3. Pour the water in and close the lid of the bin tightly. The process will take about 14-20 days.

Usage for plants:

Use 1 part liquid compost to every 200-400 parts water and spray it on the whole plant every 5-7 days or when the pests are present.

Educational Materials

Active learning allows students to acquire knowledge collaboratively without the use of a textbook. In the following section, you will find activities with directions on how to execute them in a classroom as a supplemental learning tool. Each activity includes information about what should be learned by each student and the needed materials for the activity. These activities strive to help each student learn in a creative way and retain knowledge according to their own, unique learning style. Please note that most activities may be used in additional subjects with adjustments, and may be modified to better fit the classroom dynamics.

DIAGNOSIS MYSTERY

Skills to be gained:

- Practical understanding of medicinal plants and their properties
- Apply knowledge of the plants to a relevant problem
- Build off obtained information to intelligently contribute to a common solution

Required Materials:

- Provided prompts

Objective: Engage all of the students in a mind game and encourage them to all ask ‘yes’ or ‘no’ questions sequentially to understand what ails the patient and how to cure their illness. Students will learn about the plants in the botanical garden, and gain a better appreciation of the knowledge with which they are being presented in the classroom.

Procedure: Prompter will read only the scenario written on the card to the entire class. Students will systematically ask ‘yes’ or ‘no’ questions to the prompter to try to solve the mystery of what disease the person in the prompt is suffering from. Additionally, students will continue to ask questions to figure out which herb available in the garden outside they could use to help the person feel better. Hints provided on the card will be read after each round of guessing to help direct the guesses and improve the quality of questions. Hints may need to be adjusted based on grade level, and only an example is provided on the cards below. Students will use the knowledge gained from the past question to build upon this and determine the ailment.

Handout: On the following page, a list of scenarios are provided, each with one or two hints to ensure that the children stay engaged in the problem and do not get overwhelmed by the complexity.

Conclusion/Wrap-up: Immediately following this exercise, it would be a perfect teaching moment to remind the students that the cure is right outside in the garden, and that the plants can be used for many different applications, including medicinal ones.

DIAGNOSIS MYSTERY

Scenario: Pim went on a vacation to Kho Phi Phi last weekend, and had a great time snorkeling and enjoying the beautiful beach. He/She chose to eat very sparingly, and spend more time relaxing and enjoying the weather. Pim has not been to class in the last three days, and you are worried. You decide to call him/her to find out what is wrong. Ask your friend yes or no questions to try to figure out why they have missed school, and what you could give them to cure it.

Hint #1: Pim has no visible signs of illness on their body according to Pim's mother.

Hint #2: Pim's mother tried giving him/her Holy Basil, but the illness did not go away.

Solution: Pim is suffering from a throat illness, and requires either some Lime or Phlai from the garden outside. Quick! Run and get them to your friend!

Scenario: Bank and you have designated time tonight to spend with each other. You are both going to see the newest movie in theaters, and you are really excited. Bank calls you on the phone just as you are about to leave, and alerts you that he/she cannot come tonight. Ask yes or no questions to try to figure out why he/she is unable to come anymore, and what remedy could help them get better.

Hint #1: Bank seemed fine yesterday when you talked to him/her, and did not complain of anything being wrong.

Hint #2: Bank was extremely excited to see this movie all week, and must be feeling a good amount of discomfort to decide to cancel.

Solution: Bank must have eaten something that did not agree with him/her and is having digestive problems. Sweet Basil, Kitchen Mint, Cayenne Pepper, Phlai and Winged Bean from the garden will cure their illness, hopefully in time for the movie!

Scenario: Ajarn Somjai has been teaching for twenty years and has a perfect attendance record. Today, you come in and sit at your desk waiting for him/her to arrive, but they never show up. Instead, a substitute teacher enters the room, and the class is allowed to ask yes or no questions regarding Ajarn Somjai to figure out how they can help using the herbs from the botanical garden.

Hint #1: Ajarn Somjai had to see the doctor this morning to be diagnosed with this illness.

Hint #2: Ajarn Somjai has been showing visible signs of pain during the last few weeks.

Solution: Ajarn Somjai has hyper tension, and needs some Asatic pennywort from the garden!

GARDEN EXPLORATION

Skills to be gained:

- A better understanding of medicinal plants growing in the garden and their applications

Required Materials:

- Worksheet per student

Objective: This activity encourages students to consider the various plants that can be used to cure similar symptoms. Students will finish this activity by filling out the worksheet on the next page based on information learned from the botanical garden on the school grounds.

Procedure: This activity works well after the students have learned about the plants. One way for the students to gain this knowledge is through exploring the garden. Allow the students 20 minutes, adjusted as necessary, to walk around the garden observing the signs placed in front of each plant. Inform the students that they are to learn about the plants and the symptoms that the plants cure. At the conclusion of the free time, bring the students back together and ask the students what they learned.

Questions might include:

What plants are in the garden?
What different types of symptoms can the plants cure?

After the discussion, have the students fill out the worksheet based on the knowledge that they learned from the garden and the discussion.

Handout: The worksheet located on the next page contains instructions for the students. Allow the students 10 minutes, adjusted as necessary, to fill out the worksheet.

Conclusion/Wrap-up: After the students are finished with the worksheet, finish the class with a further discussion on the medicinal groups and the plants that fall under each grouping.

Possible Questions:

Do you have a better understanding of medicinal herbs grown in Bangkok?
What plants did you already know about?
What plants did you not know about?

GARDEN EXPLORATION

Name: _____ Class: _____

Place the letter of the symptom on the line next to the plant that cures that symptom.

_____ Agasta

_____ Aloe

_____ Asiatic Pennywort

_____ Cayenne Pepper

_____ Common Lime

_____ Galanga

_____ Ginger

_____ Guava

_____ Holy Basil

_____ Kitchen Mint

_____ Lemon Grass

_____ Star Gooseberry

_____ Sweet Basil

_____ Turmeric

a. Anti-eczema/anti-fungal

b. Anti-emetic

c. Antihypertensives

d. Anti-pyretic

e. Antispasmotic

f. Anti-flatulence

g. Cough suppressant

h. Diuretics

MATCHING

Skills to be gained:

- Practical knowledge of medicinal plants and their applications in everyday life
- Development of quick thinking skills
- Application of sensory skills to solve a problem

Required Materials:

- Paper
- 40 cards

Objective: Students will learn about the medicinal herbs, and what symptoms they cure. Additionally, students will enhance their sensory learning by solving problems with non-verbal modes of communication.

Procedure: Print out 40 cards (see attached) and hand them out to the students making sure to include an equal number of plant cards and their corresponding ailment. These cards have both the name of their plant with the symptom it cures or just the symptom written on one side, and a visual indicator on the opposite side. Students should look at the name on their card, and hold it close to them with the text facing them not visible to others. This is designed to be a silent activity, where the students use non-verbal modes of communication to approach students in the class with the opposite picture as theirs and match the plant and the symptom it cures. An example of a non-verbal communication would be to act out the illness so that plants can find the ones they are able to cure. Once the student feels they have found their match, they can compare the symbol on the side of their card that has the written words. If they match, the students should immediately sit down until all students have found their match.

Conclusion/Wrap-up: This activity is designed to help the students associate an illness with the cure. After the activity, students could stand up one at a time and present their cards and show that they match, while also educating all of the other children about that plant and its properties. Now would also be an appropriate time to tell the children about other applications of the plant that you are familiar with, such as common foods that they are included in and so forth.

MATCHING

[Name of symptom]	Coughing	Hot fever	Flatulence	Vomiting, nausea

[Name of plant] CURES: [symptom here]	Lime CURES: coughing	Kariyat CURES: hot fever	Sweet Basil CURES: flatulence	Holy Basil CURES: vomiting, nausea

SAVE ME!

Skills to be gained:

- Practical knowledge of medicinal plants and their applications in everyday life
- Ability to develop a constructive argument supported by facts
- Improved written and oral skills
- Ability to work collaboratively in a group setting

Required Materials:

- Scrap paper
- Reference materials

Objective: This activity introduces children to a typical problem with little information and asks them to provide a suitable solution and present it in front of a group. Students will use research skills to develop critical thinking and problem solving strategies within a group.

Procedure: Choose a plant from each grouping (such as holy basil, sweet basil, galangal, kariyat, and any others that have a pamphlet provided) and write the name of a plant on a piece of scrap paper, one piece of paper per student (some plants will be repeated, and all students with the same name will work together). Allow the students to select a piece of paper randomly. This will decide which plant they must defend. The scenario is that the school has only enough money to keep one plant alive, and the rest will die. Teams are challenged to come up with strong examples and reasons why their plant should be chosen, and give a presentation in front of "school executives" (another group, or the teachers/aids can be designated for this role). Students will be assessed based on the content of their oral presentation and their presentation skills, and a winner can be decided based on these criteria.

Conclusion/Wrap-up: Acknowledge the students' successes and comment on how the students that did not do well so that they could improve. This is a great time to bring the entire group together when announcing winners, and ask them to reflect upon what they learned, and how they can use it in their lives. Focus on the medicinal uses of the plants and their ability to grow in Thailand. Encourage the students to pursue an active role in preserving the environment and promoting the self-sufficiency and sustainability principle put forth by the King.

TELEPHONE

Skills to be gained:

- Practical knowledge about medicinal plants, composting, and the King's Principle in general
- Ability to make quick decisions under pressure
- Understanding of healthy competition practices

Required Materials:

- List of questions

Objective: Students will learn how to work individually to contribute to a group problem. Receiving a question from a fellow student will remove any fear or intimidation associated with the teacher asking a question. Additionally, this exercise aims to encourage the students to learn about aspects of the botanical garden. This activity can be adapted for inclusion in many subjects and an example of questions geared towards the botanical garden is included.

Procedure: Students will be grouped into either four or five groups of equal size and asked to sit in a line. The first student in each line will be asked to stand up and in the middle of the room with the teacher, equidistant from each of the lines. The teacher will give a question to the students on a piece of paper, who must then rush to their line and hand the question to the first person in line. The first person will pass the question to the next person, whispering the answer if they know it. If they do not know the answer, they will only pass the question. This process repeats until the last person in line is told an answer and given the question paper. The last person in line stands up immediately after receiving this information. The group who finishes first reads the question to the class with the answer. If the correct answer is supplied, the teacher gives that team a point. Once a team accrues a certain amount of points, or a certain amount of questions have been asked, the activity is complete with a winner.

Conclusion/Wrap-up: This would be a good time to provide a handout with the questions that were asked during the activity, and have the students hand in a written copy to see how much they learned or how much they were paying attention during the activity. If this is not supplied, another idea would be to give a brief overview as to the knowledge they should have learned.

TELEPHONE

Suggested questions are written here without their answers for use in the game. Answers are located at the bottom of this section. These questions are merely a suggestion, and there are many more questions that could be used to teach students about various topics.

1. What is the King's Principle?
2. What is vermicomposting?
3. What is Garbage Enzyme?
4. Name two things found in the botanical garden that are recycled.
5. Name 3 plants in the botanical garden.
6. What are three ingredients used in any form of composting?
7. What are four foods that would make good composting material?

Answers to the above questions:

1. Many possible answers
2. Using worms to break down organic matter
3. Using microorganisms, molasses and water to break down organic matter
4. Plastic bottles, rubber mats, tires, and many more
5. See plant section in this manual
6. Microorganisms, composting bin, organic matter, and many more
7. Most foods make good composting material, so choose the best answers

TRUE OR FALSE

Skills to be gained:

- A better recognition of self-sufficient and sustainable practices utilized in the garden
- Decision making

Required Materials:

- List of questions

Objective: 'True or false' is an activity that helps students actively choose if a statement is true or false by dividing into two groups.

Procedure: Create an open area in the classroom with one side understood to be the 'True' side and one side the 'False' side. Signage would help better describe this for the students in case they forget, get confused, or become disoriented. Read statements to the students and have them physically move to one side or the other based on their answer to the question. Answers will then be read to the students to let them know if they moved to the correct side. Repeat this process for any number of questions.

Conclusion/Wrap-up: This activity is to help the students learn together and from each other through being able to talk with each other and see each other move around the classroom. Additionally, practical knowledge of plants can further be enforced through either a debriefing at the end, or a reflective worksheet restating the questions and having the students select if the statement is true or false to gage learning and comprehension from the activity.

TRUE OR FALSE

Suggested options for this activity are written in the format Statement (Answer). This list is just a suggestion, and there are many more applicable statements relating to the botanical garden and many other subjects.

Compost is formed when microorganisms use enzymes break down organic matter (true)
Vermicomposting is a common practice in Thailand (false)
Buying a 1000 baht shirt is an example of self-sufficient and sustainable living (false)
Using foods grown in a botanical garden at home is an example of following the King's principle (true)
Garbage Enzyme compost uses water, sugar and food scraps in a sealed container to produce usable compost (true)
Garbage Enzyme compost expires one year after it is made (false)
With dilution, Garbage Enzyme compost can unclog drains (true)

WHAT PLANT AM I?

Skills to be gained:

- Specific characteristics about the various plants within the garden
- Ability to ask direct questions in order to find an answer

Required Materials:

- Slips of paper with the plant names on them or plant leaves
- Reference information such as the pamphlets on each possible plant

Objective: 'What plant am I?' is an activity designed to help teach students about the properties of the variety of plants existing in the botanical garden on the school grounds. Students will try to figure out what plant they are through the use of 'yes' or 'no' questions.

Procedure:

Attach a slip of paper with one of the plants name or a leaf from the plant on the back of each student, not allowing the student to see their own label or leaf. All of the students will walk around and ask each other 'yes' or 'no' questions to try to figure out what plant they are (for example: Do I cure skin burns?, Do I cure headaches?, Am I a tree?, Do I have shiny leaves?). Once each student has figured out which plant they are, have everyone report their plant to the class.

Conclusion/Wrap-up: This exercise focuses on teaching students about specific details pertaining to the plants. Judging by how often the pamphlets are used, it can be determined how well the students are able to identify their plant.

Art Projects and Crafts

Art projects and crafts are effective educational tools that keep students involved in the lesson plan while expressing their creative desires. This section contains art projects and crafts with step by step written instructions and picture guides. Each project sheet has a description explaining what grade levels it is appropriate for and what materials are needed. Furthermore, each project comes with a list of possible lesson plans to which it may be applicable, but you may also find other ways to incorporate it into your subject matter. Please note, most projects in this packet are intended to be used to decorate the botanical garden, but some may need extra materials to make the craft weather resistant.

SPONGE FLOWERS

For 1st through 3rd graders

Materials Needed: Sponges pre-cut into shapes, Heavy paper, Paint, Paintbrushes, Cups of water, Newspapers

Class Lesson Options:
In biology: Flowers, Reproductive system of plants, Parts of a plant

The Art Project:

Setup:

1. Gather materials needed.






2. Cover the students' work place with newspaper.

3. Perform a demonstration of how to do the project for the students according to the steps below.

When the students arrive:

4. Hand out a piece of heavy paper and have each child write their name on one side of the paper with a pen.
5. The students should pick up a circular sponge and paint one side any color with a paintbrush, then stamp the sponge onto the paper on the side opposite their name.
6. They can then pick up the petal shaped sponge, paint it any color, and place petals around the circle. If multiple colors are desired, make sure that the children rinse off their brush in a cup of water before applying a new color. Additionally, remind students that paint should only be applied to a dry brush, and a paper towel may be necessary for this.

SPONGE FLOWERS

7. Repeat this process for as many flowers as desired. Additional decoration is encouraged to contribute to the overall product.

.

HANDPRINT POTS

For 1st through 3rd graders

Materials Needed: Plant pots, Paint, Newspaper, Buckets of water, Paintbrushes

Class Lesson Options:
In botany: medicinal plants intended for the pots, physical characteristics of plants
In math: geometry of the pot

The Art Project:

Setup:

1. Gather materials needed

2. Paint the pots a base color, preferably white, the day before students perform the project

3. Cover students' workspace with newspaper

When the students arrive:

4. Allow each student to pick a color
5. Paint the student's hand their chosen color

HANDPRINT POTS

6. Help them place their painted hand on the pot, while the paint is still wet on their hands, this will leave a handprint

7. Continue their handprints in a circular patter until the circle is complete (a second color may be used). Then paint a circle in the center of their handprints, completing the flower.

8. Wait for it to dry and then have the children plant the herbs/plants into the finished pots.

LEAF IMPRESSIONS

For 1st through 6th graders

Materials Needed: Paintbrushes, Heavy paper, Paint, Cups of water, Fresh picked leaves, Newspapers

Class Lesson Options: In botany/biology: Before beginning the project explain each leaf to the students. Include what plant it came from and explain why it is in the garden. For older students you can have them label each used leaf with their scientific name and write a little bit about the plant on the back of their paper. With the younger students, you may show them how different plants have different vein patterns on their leaves.

The Art Project:

Setup:

1. Gather materials needed






2. Cover students' workspace with newspaper

3. Layout a handful of leaves, paintbrushes, paint, cups of water and a piece of heavy paper for each student
4. Perform a demonstration of how to do the project for the students according to the steps below

When the students arrive:

5. Instruct the students to write their names on one side of their paper with a pen
6. Instruct the students to start to paint the veiny side of their first leaf

LEAF IMPRESSIONS

7. Continue until the entire back side of the leaf is painted

8. Instruct the students to put the painted side of the leaf down on the side of the paper opposite their name and push down evenly on the unpainted side of the leaf

9. Now tell the students to slowly and carefully peel the leaf off the paper (start peeling the leaf off from one side and continue smoothly until the entire leaf has been removed)

10. You should be left with the impression of the shape and veins of the leaf

LEAF IMPRESSIONS

11. Lastly, instruct the students to repeat this process over and over again until they are satisfied with their picture, ensuring that they rinse their brushes before using a new color. The brush should also be dry when new paint is applied, and paper towels may be necessary. It is ok for them to overlap leaf impressions.


.

PINWHEELS

For 2nd and 3rd graders

Materials Needed: Wooden stick (example length), Crayons, Heavy paper, Push pin

Class Lesson Options:
In science: wind
In math: geometry of the shapes

The Art Project:

Setup:

1. Gather materials needed




2. Cut the paper into squares

When the students arrive:

3. Hand each student a square piece of paper
4. Instruct them to color and decorate both sides of the paper with crayons
5. Once they are finished drawing collect the squares from them and have them laminated
6. After lamination, take one corner and cut it down the middle towards the center of the paper stopping two centimeters short of the center of the paper
7. Repeat step 6 for all of the corners until 4 triangular sections of the paper with the center still attached results.

8. Take the top right corner of each triangle and bend it to the center (make sure not to fold or crease the paper, it needs the rounded shape to catch the wind)

PINWHEELS

9. Secure the corners to the center of the paper with a push pin

10. Continue to push the push pin into the top end of the wooden stick until it is secure (do not push it too far in, the wheel needs some space to spin)

We used a plastic straw for our pinwheel for demonstration purposes but a wooden stick is stronger and can better withstand an outdoor environment

11. Test the pin wheel by blowing in it to see if it works
12. Hand the completed pinwheels back to the students and have them place them in the garden.

GLUE FLOWERS

For 4th through 6th graders

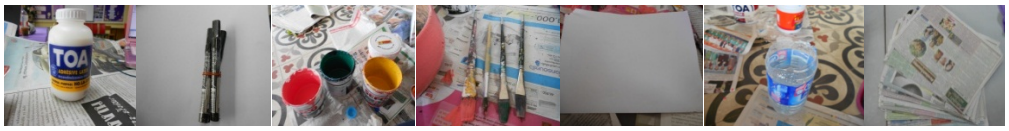
Materials Needed: Latex glue, Black marker, Water color paint, Paintbrushes, Heavy paper, Cups of water, Newspaper

Class Lesson Options:
In Botany: biology of plants

The Art Project:

Setup:

1. Gather materials needed



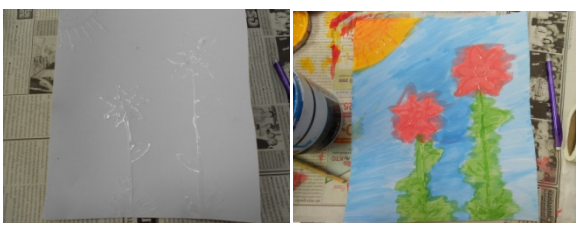
2. Cover workspace with newspaper

3. Provide each students' work station with a piece of paper, a paint brush, paint, cups of water, a black marker and a tube of latex glue

When the students arrive:

4. Instruct each student to draw flowers with the latex glue, using the end of a paint brush without bristles

5. After the glue dries, set up water colors for the students and cups of water
6. Instruct the students to paint any color and as many colors as they want over their glue, ensuring that they properly wash and dry their paintbrush between colors



GLUE FLOWERS

7. Instruct the students to outline the glue flowers with a black marker, after the paint has dried

PAINTED POTS

For 4th through 6th Graders

Materials Needed: Plant pots, Paint, Paintbrushes, Newspaper, Cups of water

Class Lesson Options: Give the students an environmental theme and ask them to express that theme in a painting on their pots

The Art Project:

Setup:

1. Gather materials needed

2. Paint all the pots a base color the day before the students are to perform the project (White is a preferred base color)

3. Cover students' workspace with newspaper

When the students arrive:

4. Prepare paint, cups of water, and paintbrushes at stations with prepared pots for the students to use. If the pots are large, split the students into groups of three or four. If they are small, the students may work individually

After students arrive:

5. Instruct the students to paint the pots according to the given theme, making sure to properly wash and dry their paintbrushes when switching colors. (Example: Flowers)

PAINTED POTS

6. After the pots have dried, have the students plant their herbs/plants into them

Appendix

Below are pamphlets in both Thai and English. The plants included are the ones that can be found in the botanical garden on the school grounds. Additional information about these plants is provided in the plants section of this document.

แคขาว แคดอกแดง
ชื่อวิทยาศาสตร์: Sesbania grandiflora (L.) Desv.
ชื่ออื่นๆ: Agasta, Sesban, Vegetable hummming bird
วงศ์: Leguminosae - Papilionoideae
ชื่อพื้นบ้าน: แค แคบ้าน แคดอกแดง แคขาว (ภาคกลาง) แคแดง (เชียงใหม่)
ส่วนที่ใช้: เปลือกต้น ดอก ใบสด ยอดอ่อน
ลักษณะทางพฤกษศาสตร์:
ไม้ต้นขนาดเล็ก สูง 3-6 เมตร
แตกกิ่งก้านสาขามาก เปลือกต้นสีน้ำตาลปนเทา ขรุขระ แตกเป็นสะเก็ด ใบ
เป็นใบประกอบแบบขนนก ออกเรียงสลับ ใบย่อยรูปรีขอบขนาน กว้าง 1-1.5 ซม. ยาว 3-4 ซม. ปลายใบและโคนใบมน ขอบใบเรียบ
แต่ละใบมี 20 คู่ สีเขียว ดอก ออกเป็นช่อตามซอกใบ 2-4 ดอก ดอกสีขาวหรือแดง มีกลิ่นหอม
ก้านดอกยาวประมาณ 60 ซม. กลีบดอกรูปดอกถั่ว ยาว 8-15 ซม. ที่กลีบดอกเป็น 2 สี กลีบดอกแรกเป็น สีน้ำตาล
แคดอกแดง
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
แคขาว แคดอกแดง
Institute

แคคอกขาว
แคคอกแดง
วิธีและปริมาณที่ใช้

ว่านหางจระเข้
ชื่อวิทยาศาสตร์: Aloe vera (L.) Burm.f.
ชื่อสามัญ: Star cactus, Aloe, Aloin,
Jafferabad, Barbados
วงศ์: Asphodelaceae
ชื่ออื่น: หางตะเข้ (ภาคกลาง) ว่านไฟไหม้
(ภาคเหนือ)
ส่วนที่ใช้: ยางในใบ น้ำวุ้น เนื้อวุ้น
และหน้า
ว่านหางจระเข้
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุกอายุหลายปี สูง 0.5-1 เมตร
ลำต้นมีหน่อต่อเนื่องสั้น ใบ เป็นใบเดี่ยว
ออกเรียงเวียนรอบต้น ใบหนาและอวบ
โคนใบใหญ่ ส่วนปลายใบแหลม
ขอบใบมีหนามแหลมสีน้ำตาลอ่อน
แผ่นใบหนาสีเขียว มีจุดสีขาวสีเขียวอ่อน อวบน้ำ
ข้างในเป็นวุ้นใสสีเขียวอ่อน ตัด
ออกเป็นช่อกระจะขึ้นตามซอก ก้านช่อดอกยาว
ดอกสีเหลืองหรือแดง โคนเชื่อมติดเป็นหลอด
ปลายแยกเป็น 6 แฉก มี 6 เป็น 2 วง รูปแตร กลับ
เป็นหนามรูปกระสวย
IQP-SSP1: Botanical Gardening at the Wat
Pathumwanaram School
ว่านหางจระเข้
Institute

บัวบก
ชื่อวิทยาศาสตร์: Centella asiatica (L.) Urban.
ชื่อสามัญ: Asiatic pennywort, Indian pennywort
วงศ์: Apiaceae (Umbelliferae)
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก
ลำต้นเป็นไหลคลุดิน ไปตามดินที่ชื้นแฉะ
ชื้นง่าย มีรากที่ออกตามข้อ ใบรูปไต
ปลายใบกลม โคนใบเว้า ขอบใบหยัก
ดอกเป็นช่อแบบซี่ร่มตอกใบ มีดอกย่อย 2-3
บัวบก
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
Worcester Polytechnic Institute
บัวบก
Worcester Polytechnic Institute

ใบบัวบก
สรรพคุณ:
ใบ
ราก
เหง้า
ทั้งต้น
-ขับพิษไข้
-ขับปัสสาวะ
-ขับน้ำนม
-ขับพิษในเลือด
-ขับพิษตานซาง
-ขับพิษฝีภายใน
-ขับพิษฝีภายนอก
-ขับพิษฝีฝักบัว
-ขับพิษฝีดาษ
-ขับพิษฝีหัด
-ขับพิษฝีเม็ดผื่นคัน
-ขับพิษฝีเม็ดผื่นคันเรื้อรัง
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนอง
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อย
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็น
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหล
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออก
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนอง
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็น
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหล
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออก
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนอง
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็น
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหล
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนอง
-ขับพิษฝีเม็ดผื่นคันเรื้อรังเป็นหนองเน่าเปื่อยมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนองและมีกลิ่นเหม็นและมีน้ำเหลืองไหลและมีเลือดออกและมีหนอง
วิธีและปริมาณที่ใช้
ใช้ทั้งต้นสดตำพอกหรือคั้นน้ำทาบริเวณที่เป็นฝีหนอง
ใช้ทั้งต้นสด 1 กำมือ ล้างให้สะอาด ตำคั้นน้ำเติมน้ำตาลเล็กน้อย ดื่ม 1 ครั้ง วันประมาณ 3 ครั้งก่อนอาหาร ติดต่อกัน 5-6 วัน
ใช้ทั้งต้นสด 2-3 กำมือ ล้างให้สะอาด ตำให้ละเอียดคั้นเอาน้ำผสมน้ำดื่ม
ใช้ทั้งต้นสด 10-20 กรัม หรือ 1 กำมือ ล้างให้สะอาด ตำให้ละเอียดคั้นเอาน้ำผสมน้ำดื่มวันละ 1-3 ครั้งหลังอาหารติดต่อกัน
ใช้ทั้งต้นสด 30-40 กรัม คั้นน้ำผสมน้ำดื่มวันละ 5-7 วัน
สารสกัด:
สารสกัดจากใบบัวบกประกอบด้วย madecassoside asiatic acid, asiaticoside, centelloside, centellic acid brahminoside, brahmic acid,methyl chavicol, eugenol,methyl ether,methyl cinnamate, 3-hexen -1- ol, estragol

หญ้าหนวดแมว
ชื่อวิทยาศาสตร์: Orthosiphon aristatus (Blume) Miq
ชื่อสามัญ: Java tea, Kidney Tea Plant, Cat's Whiskers
วงศ์: Lamiaceae (Labiatae)
ชื่ออื่น: บางถิ่น(ประจวบคีรีขันธ์) พยับเมฆ (ภาคกลาง) อีตู่ดง (เขมรป่าดง) ส่วนที่ใช้: ราก ใบ ทั้งต้น
ใบและดอกสดนำมาต้มน้ำดื่มต่างชา
หญ้าหนวดแมว
ลักษณะทางพฤกษศาสตร์:
ทั้งต้นสูงประมาณเกือบ
ใบเดี่ยวเรียงตรงข้าม
แผ่นใบรูปไข่หรือรูปขอบขนานแกมรูปไข่
ดอกช่อ มี 2 ทิศ
ดอกสีขาวอมม่วงอ่อน
ผลแห้งแตกตามยาวด้านละ
เมล็ดมีจำนวนมาก
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
Institute

สรรพคุณ:
ราก - ขับปัสสาวะ
ทั้งต้น - แก้ไอ ขับปัสสาวะ รักษาโรคกระเพาะ
รักษาโรคปวดกล้ามเนื้อ และบำรุงผิว รักษาโรคผิว
รักษาโรคมือเท้าปากเปื่อย
ใบ - รักษาโรคไต รักษาโรคผิวหนัง ผื่นคัน ลมพิษ
ลดความดันโลหิต รักษาโรคมะเร็งเม็ดเลือดขาว
วิธีและปริมาณที่ใช้
ชนิดชง
ขับปัสสาวะ
1. ใช้ต้นใบหญ้าหนวดแมว ขนาดกลาง
ใบแห้งหรือสดจนท่วมหม้อ ต้มกับน้ำ 4 ถ้วยตวง
นานประมาณ 10 นาที ดื่มน้ำต้มครั้งละ 4 ถ้วย
ชงกับน้ำเดือด 1 ถ้วยน้ำชา (250 ซีซี)
เหมือนกินชา ดื่มต่อเนื่องทุกวัน รับประทานนาน
1-6 เดือน
2. ใช้ต้นกับใบวันละ 1 กลุ่มมือ (ตก 90- 120 กรัม
แห้ง 40- 50 กรัม) ต้มกับน้ำรับประทาน ครั้งละ 1 ข้วยเล็ก (75
ซีซี.) วันละ 3 ครั้ง ก่อนอาหาร
ข้อควรระวัง - คนที่เป็นโรคกระเพาะ ไม่ควรรับประทาน
เพราะอาจไปกัดกร่อนกระเพาะ ถ้าใช้ยาก
จะใช้ยาควรอยู่ในดุลยพินิจของแพทย์
ชื่อทางพฤกษศาสตร์ Hedyotis corymbosa (L.) Lam.
ชื่อวงศ์ Rubiaceae
ชื่อสามัญ Hedyotis, Bara-Sitostarol, Ursolic acid
ใบมี Glycolic acid, Potassium Salt Orthosiphonoside, Tannin,
Flavone Organic acid และน้ำมันหอมระเหย

พริกขี้หนู
ชื่อวิทยาศาสตร์: Capsicum
frutescens L.
ชื่อสามัญ: Cayenne Pepper
วงศ์: Solanaceae
ชื่ออื่น: ดีปลี ดีปลีขี้นก ปะแกว
พริก พริกแม้ พริกแม้ พริกนก
พริกแห้ง
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก สูง 30-90 ซม. ใบ เดี่ยว เรียงสลับ
รูปไข่หรือรูปรี กว้าง 2-4 ซม. ยาว 3-8 ซม.
โคนใบเบี้ยว ดอก ช่อ ออกที่ซอกใบช่อละ 2-3
ดอก กลีบดอกสีขาวหรือเขียวอ่อน ผล
เป็นผลสด สีเขียว
เมื่อสุกเปลี่ยนเป็นสีแดง
พริกขี้หนู
IQP-SSP1: Design and Integration of a
Botanical Garden into the Wat
Pathumwanaram School System
พริกขี้หนู

พริกขี้หนู
สรรพคุณ:
ผล : ใช้ปรุงอาหาร ช่วยย่อยอาหาร และช่วยขับลม
ต้น : ทั้งต้นใช้ทำยาขับลม
ใบ : ใช้ขับลม
ราก : ใช้ขับลม
ประโยชน์และวิธีใช้
1. รักษาอาการปวดท้อง ท้องเสีย ให้ใช้พริกขี้หนูสดตำพอแหลก
2. รักษาอาการปวดตามข้อและกล้ามเนื้อ ให้ใช้พริกขี้หนูและขิงสด
รักษาอาการอักเสบ ฟกช้ำดำเขียว
และอาการปวดตามข้อ ให้ทาขมิ้นผสมกับพริกขี้หนูและขิงสด
ส่วนประกอบทางเคมี
สารสำคัญ: capsaicin

มะนาว
ชื่อวิทยาศาสตร์: Citrus aurantifolia (Christm.) Swingle
ชื่อสามัญ: Common lime
วงศ์: Rutaceae
ชื่ออื่นๆ: มะนาวแป้น (ภาคกลาง)
ส่วนที่ใช้: น้ำมันจากผิวของผลสด น้ำคั้นจากผลและน้ำ

มะนาว
ลักษณะทางพฤกษศาสตร์:
ไม้พุ่ม สูง 2-4 เมตร กิ่งอ่อนมีหนามแหลม เปลือกต้นเรียบ สีน้ำตาลปนเทา ใบ เป็นใบประกอบ ออกเรียงสลับ มีขอบจักเป็นคลื่น รูปไข่หรือรูปรี กว้าง 3-5 ซม. ยาว 6-8 ซม. ปลายใบแหลม โคนใบมน ขอบใบหยักเป็นคลื่นตื้นๆ ห่างๆ ผิวใบด้านบนมีต่อมน้ำมันกระจายอยู่ทั่วไป ดอก ออกเป็นช่อสั้น 5-7 ดอก หรือออกดอกเดี่ยวตามซอกใบ ที่ปลายกิ่ง ดอกสีขาว กลีบดอกมี 4-5 กลีบ หลุดร่วงง่าย ผล รูปทรงกลม หัวท้ายมนเล็ก ผลอ่อนสีเขียวเข้ม ทนต่อโรคพืชและแมลงได้ดี ให้ผลผลิตดี สีเขียว ที่ระยะปลูก ระยะ 5x5 เมตร

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
Worcester Polytechnic Institute

มะนาว
Worcester Polytechnic Institute

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

อุพาสะคาสถาบันเทคโนโลยีแห่งวูสเตอร์ และ Worcester Polytechnic Institute

ข่า

ขิง
ชื่อวิทยาศาสตร์: Zingiber officinale Roscoe
ชื่อสามัญ: Ginger
วงศ์: Zingiberaceae
ชื่ออื่น: ขิงแกลง ขิงแดง (อีสาน)
ขิงผือก (เชียงใหม่) ตะขิง (กะเหรี่ยง-แม่ฮ่องสอน)
ส่วนที่ใช้: เหง้าแก่สด หั่น ใบ ดอก
ผล

ลักษณะทางพฤกษศาสตร์: ไม้ล้มลุก มีหลายใหล้ม
สีน้ำตาลแกมเหลือง เนื้อในสีนวล มีกลิ่นฉุนเฉพาะ
ใบ เป็นใบเดี่ยว ออกเรียงสลับ รูปขอบขนาน
ขอบใบเรียบ แทงออกจากเหง้าใต้ดิน ใบประดับรี
ดอกเป็นช่อ แทงออกจากเหง้าใต้ดิน ใบประดับรี
ผล เป็นผลแห้ง แตกตามยาวเป็น 3 พู เมล็ดสีดำ
เป็น 3 พู เมล็ดสีดำ
ขิง
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
Institute

ขิง
Institute

กระเพรา
ชื่อวิทยาศาสตร์: Ocimum sanctum L.
ชื่อพ้อง: Ocimum tenuiflorum L.
ชื่อสามัญ: Holy basil, Sacred Basil
วงศ์: Lamiaceae (Labiatae)
ชื่ออื่น: กะเพราขาว กะเพราขาว กะเพรา (ภาคกลาง) กอมก้อ กอมก้อดง (เชียงใหม่) อีตู่ (ไทย (ภาคอีสาน)
ส่วนที่ใช้: ใบ และยอดกะเพราแห้ง ทั้งสดและแห้ง ทั้งต้น

ลักษณะทางพฤกษศาสตร์: ไม้ล้มลุก สูง 30-60 ซม.
ใบ เป็นใบเดี่ยว ออกตรงข้ามกันรูปไข่ กว้าง 1-3 ซม. ยาว 2.5-5 ซม. ปลายใบแหลม ขอบใบหยักมน โคนใบแหลม
ดอกสีขาวแกมม่วงแดงหรือขาวแกมชมพู
กลีบเลี้ยงโคนติดกันเป็นรูปกรวย
ก้านชูดอกยาว ก้านดอกย่อยยาว 2 มม. ปากล่างมี 4 แฉก ปากล่างมี 1 แฉก ปากล่างยาวกว่าปากบน ผิวหน้าใบมีขนประปราย
เกสรเพศผู้ 4 อัน ยาว มีเพศผู้ 4 เมล็ดเกสรเพศผู้สีดำ รูปไข่

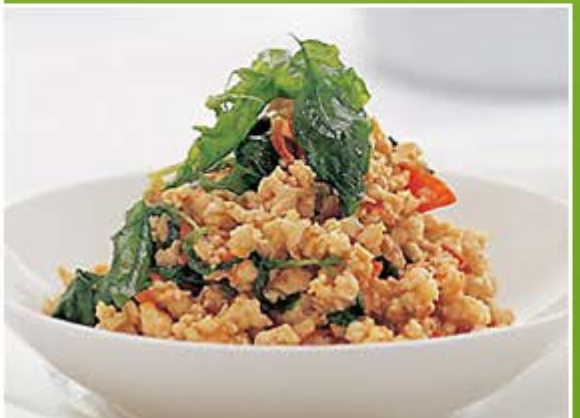
กระเพรา
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
อุพาสกสัมมาวิทยาลัย และ Worcester Polytechnic Institute

กระเพรา
อุพาสกสัมมาวิทยาลัย และ Worcester Polytechnic Institute

กระเพรา

สรรพคุณ:

1. แก้อาการคลื่นไส้อาเจียน (เกิดจากธาตุไม่ปกติ)
2. ใช้แก้อาการท้องอืดเฟ้อ แน่นจุกเสียดและปวดท้อง
3. แก้ไอและขับเหงื่อ
4. ขับขยาธิ
5. ขับน้ำนมในสตรีหลังคลอด
6. ลดไข้
7. เป็นยาอายุวัฒนะ
8. เป็นยารักษาหูด กลากเกลื้อน ต้านเชื้อรา
9. เป็นยาสมุนไพรใช้ไล่หรือฆ่ายุง
10. เป็นสมุนไพรไล่แมลงวันทอง



วิธีและปริมาณที่ใช้

- แก้คลื่นไส้อาเจียน (เกิดจากธาตุไม่ปกติ)

อาการท้องอืดเฟ้อ แน่นจุกเสียดปวดท้อง

ใช้กะเพราทั้ง 5-ทั้งสด หรือ แห้ง ชงน้ำดื่ม รับประทาน

เด็กอ่อน ใช้ใบสด 3-4 ใบ

ผู้ใหญ่ ใบแห้ง 1 กำมือ, 4 กรัม ผงแห้ง 1 ช้อนโต๊ะ หรือ 2 ช้อนแกง ใบสด 25 กรัม

ภายนอก เด็กอ่อน ใบสด 10 ใบ

- วิธีใช้:

ยาภายใน

เด็กอ่อน - ใช้ใบสด ใส่เกลือเล็กน้อย บดให้ละเอียดผสมน้ำผึ้ง หยอดให้เด็กอ่อนแทงคลอด 2-3 หยด เป็นเวลา 2-3 วัน จะช่วยขับลม และถ่ายขี้เทา

ผู้ใหญ่ - ใช้ใบกะเพราแห้ง ชงกับน้ำดื่ม เป็นยาขับลม ถ้าป่นเป็นผง ให้ชงกับน้ำรับประทาน

คนโบราณใช้ใบกะเพราสดแกงเลียงให้สตรีหลังคลอดรับประทาน ช่วยขับลม บำรุงธาตุ

ยาภายนอก

ใช้ใบสดทาบริเวณท้องเด็กอ่อน จะลดอาการท้องขึ้น ท้องเฟ้อได้ ในทางยานิยมใช้กะเพราแดง แต่ถ้าประกอบอาหารมักใช้กะเพราขาว

ยาเพิ่มน้ำนมในสตรีหลังคลอด

ใช้ใบกะเพราสด 1 กำมือ แกงเลียงรับประทานบ่อยๆ หลังคลอดใหม่ๆ

- เป็นยารักษากลากเกลื้อน

ใช้ใบสด 15-20 ใบ ตำหรือขยี้ให้น้ำออกมา ใช้ทาถูตรงบริเวณที่เป็นกลาก ทาวันละ 2-3 ครั้ง จนกว่าจะหาย

- เป็นยารักษาหูด

ใช้ใบกะเพราแดงสด ขยี้ทาตรงหัวหูดเช้า-เย็น จนกว่าหัวหูดจะหลุด

ข้อควรระวัง:

น้ำยางที่ใช้สำหรับกัดหูดนี้เป็นพิษมาก ดังนั้นควรใช้ด้วยความระวัง

- อย่าให้เข้าตา
- ให้กัดเฉพาะตรงที่เป็นหูด อย่าให้ยางถูกเนื้อดี ถ้าถูกเนื้อดี เนื้อดีจะเน่าเปื่อยจึงรักษาให้หายได้ยาก

- เป็นยาสมุนไพรใช้ไล่หรือฆ่ายุง

ใช้ทั้งใบสดและกิ่งสด 1 กิ่งใหญ่ๆ เอาใบมารขยี้แล้ววางไว้ใกล้ๆ ตัว จะช่วยไล่ยุงได้ และยังสามารถใส่แมลงได้ด้วย น้ำมันกะเพรา เอาใบสดมากลั่นจะได้น้ำมันกะเพรา ซึ่งมีคุณสมบัติไล่ยุงได้ดีกว่าต้นสดๆ

- เป็นสมุนไพรไล่แมลงวันทอง

ใช้น้ำมันที่กลั่นจากใบสด ตามความเหมาะสม น้ำมันหอมระเหยนี้ไปล่อแมลง จะทำให้แมลงวันทองบินมาตอมน้ำมันนี้

สารเคมี :

ในใบพบ Apigenin, Ocimol, Linalool , Essential Oil, Chavibetal

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

เถาคันแดง (ต่อ)
สรรพคุณ :
ใช้ดื่มและใช้ภายนอก
ส่วนที่ใช้ : ราก ลำต้น
อายุเก็บ : 1 - 2 ปี
ขนาดและวิธีใช้ :
ใช้ดื่ม : ใช้รากสดหนัก 30 กรัม ล้างน้ำให้สะอาด ทุบให้แตก ต้มกับน้ำ 3 แก้ว เคี่ยวจนเหลือ 1 แก้ว ดื่มวันละ 3 ครั้ง ก่อนอาหาร
ใช้ภายนอก : ใช้ลำต้นสดหนัก 30 กรัม ล้างน้ำให้สะอาด ทุบให้แตก ต้มกับน้ำ 3 แก้ว เคี่ยวจนเหลือ 1 แก้ว ใช้ชุบผ้าขนหนูสะอาดประคบบริเวณที่ปวด
ข้อควรระวัง :
ไม่ควรใช้ในหญิงมีครรภ์
ชื่อสามัญ :
ชื่อวิทยาศาสตร์ :
ที่มา : ทบ Indirod glycoside Acanyl baterin , Barterin, Sharchisidemadyl ester

ยอบ้าน
ชื่อวิทยาศาสตร์: Morinda citrifolia L.
ชื่อวงศ์: Indian Mulberry
วงศ์: Rubiaceae
ชื่ออื่น: ยอบ้าน (ภาคกลาง) มะตาเสือ (ภาคเหนือ) ยอ แย่ไหญ่ (กะเหรี่ยง-แม่ฮ่องสอน)
ส่วนที่ใช้: ใบ ราก ผลดิบ ผลสุก
NONI

ยอบ้าน
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
ลักษณะวิสัยพฤกษศาสตร์: ไม้พุ่ม สูง 2-6 เมตร เปลือกต้นสีน้ำตาล แตกกิ่งและกิ่งมีขนสั้นนุ่ม ใบเดี่ยว ออกตรงข้าม ก้านใบสั้น รูปรี กว้าง 8-15 ซม. ยาว 10-20 ซม. ขอบใบเรียบ แผ่นใบเรียบ สีเขียวเข้มเป็นมัน ดอกสีขาว ออกเป็นช่อกลมตามซอกใบ ดอกสีขาว กลีบดอกโคนเชื่อมติดกันเป็นหลอด ปลายแยกเป็น 5 แฉก มีกลิ่นหอม ผล เป็นผลรวม ก้านชูระเป็นปุ่ม ผลสุกสีเหลืองมีกลิ่นเหม็นอ่อน เมล็ดสีน้ำตาลมีหลายเมล็ด

ยอบ้าน

ยอป่า

สรรพคุณ:

- ใบ - ผื่นคันเนื่องจากแมลงกัดต่อย
- ราก - ใช้ทำให้อาเจียน เพื่อระบายพิษ
- ผลดิบ - เป็นยาสมานลำไส้ ช่วยย่อย

วิธีและปริมาณที่ใช้

ใบ: ผื่นคันเนื่องจากแมลงกัดต่อย

ราก: ใช้ทำให้อาเจียน เพื่อระบายพิษ

ผลดิบ: เป็นยาสมานลำไส้ ช่วยย่อย

สารเคมี:

- Asperuloside, caprylic acid และ glucose

ฟ้าทะลายโจร
ชื่อวิทยาศาสตร์: Andrographis paniculata (Burm.f) Wall.ex Nees
ชื่อสามัญ: Kariyat, The Creat
วงศ์: ACANTHACEAE
ชื่ออื่นๆ: หญ้ากันงู (สงขลา) น้ำลายพังพอน
ฟ้าทะลายโจร (กรุงเทพฯ) ฟ้าสาง (หนังสือเก่า) เขยตายยกลุม สามสิบดี (ร้อยเอ็ด) แผงหะลาย (ยะลา) ฟ้าทะย้ม (ตรัง)
ส่วนที่ใช้: ทั้งต้น ใบสด ใบแห้ง
ใบจะเก็บมาใช้ตั้งแต่ต้นฝนที่มีอายุได้ 3-5 เดือน
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก สูง 30-70 ซม. ทุกส่วนมีรสขม กิ่งเป็นเหลี่ยมค่อน ใบเดี่ยว แทงใบสีเขียวเข้มเป็นมัน ดอก ช่อ ออกที่ปลายกิ่งและซอกใบ ดอกย่อย กลีบดอกสีขาว โคนกลีบติดกัน ปลายแยก 2 ปาก ปากบน 3 กลีบ มีเส้นสีม่วงแดงทอดยาว ปากล่าง 2 กลีบ กลม เป็นตุ่ม เมื่อแก่เป็นสีน้ำตาล เมล็ด กลมเป็นสี่เหลี่ยมขนมเปียกปูน
ฟ้าทะลายโจร
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute
ฟ้าทะลายโจร
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute

ฟ้าทะลายโจร

ตะไคร้
ชื่อวิทยาศาสตร์: Cymbopogon citratus Stapf.
ชื่อสามัญ: Lemon Grass, Lapine
วงศ์: Poaceae (Gramineae)
ชื่ออื่น: จะไคร้ (ภาคเหนือ) ไคร (ภาคใต้) ตะไคร้หอม (ใบยาว-แม่ฮ่องสอน) ห่อวอตะไป (กะเหรี่ยง-แม่ฮ่องสอน) หัวสิงไค (เขมร-ปราจีนบุรี) ตะไคร้แกง (ทั่วไป) ส่วนที่ใช้: ทั้งต้น เก็บได้ตลอดปี ล้างให้สะอาด ใช้สดหรือตากให้แห้งในที่ร่ม เก็บไว้ใช้ได้นาน เก็บได้ตลอดปี ล้างให้สะอาด ใช้สด
ตะไคร้
ลักษณะทางพฤกษศาสตร์: ที่ลำต้นหยุ่ม ใบสีเขียวอ่อนหลายชั้น ทุกส่วนมีกลิ่นหอมคล้ายกลิ่นมะนาว แตกกอแน่น ใบเดี่ยว เรียงสลับชั้นๆ 2 แถว สีเขียวปนน้ำเงิน ใบรูปหอกแกมรูปแถบ ปลายและโคนสอบเรียว เส้นกลางใบแข็ง ขอบใบสาก การใบมีขนหยาบ ช่อดอกแบบช่อแยกแขนง แขนงย่อยเรียงหลวมๆ แกนช่อดอกมีข้อ การมีช่อดอกยาว คลแบบคลุมมีขั้ว
ตะไคร้
IQP-SSP1: Design and Integration of a Botanical Garden into the Wat Pathumwanaram School System
สถาบันเทคโนโลยีพระจอมเกล้าพระนครเหนือ และ Worcester Polytechnic Institute
ตะไคร้
สถาบันเทคโนโลยีพระจอมเกล้าพระนครเหนือ และ Worcester Polytechnic Institute

ขิงผา
ชื่อวิทยาศาสตร์: Zingiber montanum (Koenig) Link ex Dietr.
ชื่อพ้อง: Z.purpureum Roscoe
วงศ์: Zingiberaceae
ชื่ออื่น: ปูลอย ปูเลย (ภาคเหนือ) ว่านไฟ (ภาคกลาง) มันสะค่าน(ฉาน-แม่ฮ่องสอน)
ส่วนที่ใช้: เหง้าแก่จัด
เก็บเหง้าจากพื้นไพลงทั่วแล้ว

ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุกสูง 0.7-1.5 เมตร มีหน่วใต้ดิน
เปลือกลำต้นเทียมสีเขียวแกมเหลือง
เนื้อในลำต้นสีเขียวอ่อนแกมเหลือง
ขึ้นประกอบด้วยกาบหุ้มใบที่หุ้มซ้อนกัน
ใบเดี่ยว เรียงสลับ รูปขอบขนานแกมใบหอก
กว้าง 3.5-5.5 เซนติเมตร ยาว 18-35 เซนติเมตร
ดอกช่อ แทงจากหน่วใต้ดิน กลีบดอกสีขาว
ใบประดับสีม่วง คล้ายกลีบดอกแห้งรูปกลม
ขิงผา

ขิงผา
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute

มะขาม
ชื่อวิทยาศาสตร์: Phyllanthus acidus (L.)
Skeels
ชื่อสามัญ: Star Gooseberry
วงศ์: Euphorbiaceae
ส่วนที่ใช้: ใบ ผล ดอก ราก ต้น
มะขาม
ลักษณะทางพฤกษศาสตร์:
มะขาม
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
มะขาม
Institute

มะขามป้อม
วัตถุและโรงเภสัชใช้
สรรพคุณ :
ใบอ่อน - แก้ปวดตา ขับเสมหะ ช่วยให้ตาสว่าง ใช้ทำยาหยอดตา ใช้ทำยาแก้ไข้
ผลดิบ - ใช้เป็นยาระบายระบาย
ราก ต้น - แก้ไข้ ขับเสมหะ แก้ปวดตา แก้ปวดฟัน ดับพิษเมาสุรา ขับน้ำดี
ผลดิบ : ใช้ขับน้ำดี ขับเสมหะ ขับน้ำดี
สารเคมี
ผล มี tannin, dextrose, levulose, sucrose, vitamin C
ราก มี beta-amyrin, phyllanthol, tanninsaponin, gallic acid - ใช้ลดการเคลื่อนไหวของลำไส้ ขับน้ำดี ขับเสมหะ
1 ช้อน รับประทาน 1 มื้อ รับประทานติดต่อกัน 3-7 วัน จะได้ผล

โหระพา
ชื่อวิทยาศาสตร์: Ocimum basilicum L.
ชื่อสามัญ: Sweet Basil
วงศ์: Labiatae
ชื่อพ้อง: ห่อกายหวาย ห่อวอซู
(กะเหรี่ยง-แม่ฮ่องสอน) อีหมิงงาว
(ลาว-แม่ฮ่องสอน)
ส่วนที่ใช้: ทั้งต้น ยอดอ่อน และราก
โหระพา
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
โหระพา
โหระพา

ขมิ้นชัน
ชื่อวิทยาศาสตร์: Curcuma longa L.
ชื่อวงศ์: Turmaric
วงศ์: Zingiberaceae
ชื่ออื่น: ขมิ้น (ทั่วไป) ขมิ้นแกง ขมิ้นหยอก ขมิ้นหัว (เชียงใหม่) ขมิ้นอ้อย ขมิ้น (ภาคใต้)
ส่วนที่ใช้: เหง้าแก่สด และแห้ง
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก อายุหลายปี สูง 30-90 ซม.
เหง้าใต้ดินรูปไข่เป็นแง่งรูปกระสวยแตกออกด้านข้าง 2 ด้าน
ดอกช่อ ออกที่ยอดเทียน ใบ เดี่ยว
แทงออกมาเหนือพื้นดินประมาณ 10 ซม. ดอก ช่อ ยาว 12-15 ซม. สีขาว 30-40 ซม. ดอก ช่อ
แทงออกมาเหนือพื้นดินประมาณ 10 ซม. ดอก ช่อ
รูปกรวยกระบอก กลีบดอกสีเหลืองอ่อน
ใบประดับสีเขียวอ่อนหรือสีขาว มากกว่า 3-4
ดอก ต่อ รูปกลม 3 พู
ขมิ้นชัน
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute

ขมิ้นชัน
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute

ทองพันชั่ง
ชื่อวิทยาศาสตร์: Rhinacanthus nasutus (L.) Kurz
ชื่อภาษาอังกฤษ: White crane flower
วงศ์: ACANTHACEAE
ชื่ออื่น: ทองคันชั่ง หญ้างูขาวใหญ่
ส่วนที่ใช้: ใบสด ราก สด หรือ ตากแห้งต้มดื่มเป็นยาชาชั้นดี
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก ไม้พุ่ม สูง 1-2 เมตร
กิ่งอ่อนเป็นสี่เหลี่ยม ใบ เดี่ยว ตรงข้าม
ออกที่ซอกใบ กลีบดอกสีขาว
โคนติดกันเป็นหลอด ปลายแยกเป็น 2 ปาก
ปากล่างมีประสีม่วงแดง ผล แห้ง แตกได้
ทองพันชั่ง
IQP-SSP1: Design and Integration of a Botanical Garden into the Wat Pathumwanaram School System
ทองพันชั่ง
Canon A40 Photo by Anch

วิธีและปริมาณที่ใช้
Natural Toner
Natural Toner
Natural Toner

พลู(ช้าพลู)
ชื่อวิทยาศาสตร์: Piper sarmentosum Roxb.
ชื่อสามัญ: Z.purpureum Roscoe
วงศ์: PIPERACEAE
ชื่ออื่น: นมวา(ภาคใต้) คัดปูนา คัดพลูนก ทุดิง (ภาคเหนือ) เผ่ยซู่ (กะเหรี่ยง-แม่ฮ่องสอน)
ส่วนที่ใช้: ผล ใบ ทั้งต้น ราก
พลู(ช้าพลู)
ลักษณะทางพฤกษศาสตร์:
ไม้ล้มลุก ลำต้นทอดคลาน ไปตามพื้นดิน สูง 30-80 เซนติเมตร ลำต้นสีเขียว
มีไหลงอกเป็นต้นใหม่ มีรากออกตามข้อ ใบเดี่ยวรูปไข่ ออกเรียงสลับ แผ่นใบบาง ก้านใบมีกาบสีเขียวหุ้มเป็นปีก ใบกว้าง 5-10 ซม. ยาว 7-15 ซม. ปลายใบแหลม โคนใบมน ขอบใบเรียบ
ออกเป็นช่อที่ออกใบรูปทรงกระบอก ดอกสีขาวอัดแน่นอยู่บนแกนช่อดอก
ดอกแยกเพศ ผล เป็นผลสด กลม
อัดแน่นอยู่บนแกน
พลู(ช้าพลู)
IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute
พลู(ช้าพลู)
อุทยานการศึกษาวัดปทุมวนาราม และ Worcester Polytechnic Institute

ชะพลู (ผักพลู)
สรรพคุณ:
ใบ - ขับน้ำนมสตรีหลังคลอดบุตร ช่วยให้เจริญอาหาร แก้ปวด
ราก ต้น ดอก ใบ - ขับลมในลำไส้
ราก - แก้ไข้ทุกชนิด บำรุงธาตุ แก้ปวดฟัน ปวดหู ปวดตา ปวดศีรษะ แก้ปวด
ทั้งต้น
แก้ลมพิษ ขับเสมหะ ขับเสลด ขับลม
รักษาโรคมะเร็งในช่องปาก
วิธีและปริมาณที่ใช้
รักษามะเร็งในช่องปาก
ใช้ระดมสดๆ 5 ใบ ประมาณ 7 ต้น ล้างน้ำให้สะอาด
ใช้ระดมสดๆ ล้างให้สะอาด ตำให้ละเอียด ผสมกับ น้ำมะนาว
ใช้น้ำมะนาว ตำให้ละเอียด ผสมกับ น้ำผึ้ง
เหมือนกันทั้ง 3 ข้อ
ข้อควรระวัง -
ระดมสดๆ ล้างน้ำสะอาด ใช้เฉพาะส่วนที่ไม่มีรอยด่างเหลือง หรือรอยแมลงกัดกิน
ผู้ที่ มีประวัติแพ้ยาชา ผู้ที่มีอาการแพ้ง่าย ไม่ควรรับประทาน
ห้ามรับประทานร่วมกับยาแก้ไอ ยาแก้ปวด ยาแก้ท้องเสีย ยาแก้ท้องผูก
วัน ตามวัตถุประสงค์
แก้หลอดลมพิการ ขับเสมหะ
ใช้ราก 1 กำมือ ต้มกับน้ำ 2 ถ้วยแก้ว เคี่ยวให้เหลือ 1 1/2 ถ้วยแก้ว
รับประทานครั้งละ 1/2 ถ้วยแก้ว
แก้ปวด
ใช้ระดมสดๆ ตำให้ ละเอียด ต้มกับน้ำ 2 ถ้วยแก้ว
เคี่ยวให้เหลือ 1 ถ้วยแก้ว รับประทานครั้งละ 1/4 ถ้วยแก้ว

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Agasta

Scientific name: *Sesbania grandiflora* (L.) Desv.
Common Name: Agasta, Sesban, Vegetable humming bird
Family: Leguminosae - Papilionoideae
Also known as: Kae-Kao, Kae-dang

The part that can be used: bark, flower, and fresh leaves

Characteristics:
Agasta is a perennial plant of 3 – 6 m height. Its branches grow extensively. Its bark is grey brown, rough and splinters. Its leaf is multiple and looks like a bird's feather, granulating alternately. The minor leaf is oval and has the parallel edge. The leaf's width is 1 – 1.5 cm and the length is 3 – 4 cm. The tip and the base of the leaf are round and the surface is smooth. The leaf is green. Its flower granulates in bouquet in the leaf's nook (2 – 4 flowers at a time). The flower is red or white and has a pleasant odor. The white flower has 60 androecium filaments. The fruit is a pod that is 8 – 15 cm long. Each pod, when fully grown, will sprout into 2 pieces. The seed is brown and round and flat. One pod contains many seeds.

Agasta

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Agasta

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

2012 Sasawadee Thanthanawong, Pitchaya Chaiphan, Thanida Nuntawa, Monthon Jaga, Bhagus Thitabut

Agasta

Properties:

Leaves:
Cure diarrhea
Heal the bruise

Bark:
Cure diarrhea
Clean the wound

Flower:
Cure fever

Method and Amount Used

- Diarrhea
  Use 1/10 of Agasta bark and grill it. And 10/10 of limewater/water for boiling. Drink 1-2 tablespoons.

- Cure fever
  Use the fresh leaves and boil it with water. Drink the result.

Aswasaduphon, Dilluno, Gadaphun, Kunnova, Mouunno, Saga, Singhue, Thuaun

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Aloe

Scientific name: *Aloe vera* (L.) Burm.f.
Common Name: *Aloe barbadensis* , Mill Star cactus, Aloe, Aloin, Jafferabad, Barbados
Family: Asphodelaceae
Also known as: Wan harng jora kae

The part that can be used: Sap, gel, liquid from the gel and rhizomes

Characteristics:
Aloe is an annual plat of 0.5 – 1 m tall. It Aloe is an annual plant of 0.5 – 1 m height It has a long life time. Its stem is a stacking of various sections. Its leaf is single and granulates in a circular arrangement. The leaf is green, thick, long, and moist and has light green long spots. The leaf's base is large. The tip of the leaf is pointed. The edge of the leaf contains sparsely arranged spikes. Inside the leaf, a clear light green gel is contained. Its flower granulates as bouquet at the tip top of the plant. The flower stalk is long. The flower is yellow-red. The base of the flower connects each other, becoming a tube. The tip of the flower splits to 6 v-shaped projections in 2 layers and has a trumpet-like shape. Its fruit is dry and resembles a spaceship.

Aloe

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Aloe

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasaunphon, Dilhuno, Gadapuun, Kunnova, Moulumo, Saga, Shugtue, Thibaun

2014

Aloe

- Leaves: Cooling effects, Cure furuncle
- Whole plant: Cooling effects
- Root: Bitter taste, Cure leucorrhea, Cure gonorrhea
- Sap: Laxative effect
- Liquid from gel: Treat scald, Heal scar (can be applied on face)
- Gel: Cure hemorrhoids
- Rhizomes: Gonorrhea, Leukorrhea

Method and Amount Used

Laxative:
The liquid from the gel can be made into a laxative, Ya dum. Cut the leaves into triangle shapes. The plant should be at least 9 years old to be able to go through this process. The liquid obtained is then simmered until it becomes pasty. The pasted is left to dry in a mold. The final product should be hard and brown/black in color.
Ingestion: Oral dose of 250 mg per person.
For stomach and intestine inflammation:
Remove the skin and consume the gel twice a day, 2 tablespoons per dose.
For joint pain
Simply drink the liquid and the gel inside the leaves to alleviate joint pains. It is recommended that the drink is served cold 2-3 times per day. Each dose should be about 1-2 tablespoons.
For external use:
Treatment of scald
The gel is used to apply to the scald for the first two days. The wound will heal quickly.
Treatment of sun burned
It can be used as a sun screen. The gel inside the leaf can be applied directly to the skin. The vegetable oil can be applied along with the aloe so this can prevent dryness of skin.
Treatment of fresh wound, furuncles and bruises
The gel can be applied directly to the wound, furuncle and bruises. Cover the areas with a piece of cloth and keep it well moist with the liquid from the leaves.
Treatment of hemorrhoids
Clean the affected areas with water. Remove to outer layers of the leaf. Cut the tip of the gel to make it poky. The gel is then put in the freezer to make it hard. Once it is frozen, the gel is held at the wound. It should be done 1-2 times per day.
Treatment for headache
The aloe leaf is cut and red lime is put at the end of the tip. The tip is pressed to the forehead until the ache is gone.
Hair growth
The gel can be used to enhance hair growth. It can be directly apply to the affected area. It enriches the root of the hair as well as promotes the growth of the hair
Black spots
The gel can also be used to get rid of dark spots and wrinkles. It can be directly apply to the areas.
Acne treatment
The gel is applied to the areas affected by the acne. It will stop the infections of the bacteria.
Chemical found:
Leaves: Aloe-emodin, Alolin, Chrysophanic acid Barbaboin, AloctinA, Aloctin B, Brady Kininase Alosin, Anthramol Histidine, Amino acid, Alanine Glutamic acid Cystine, Glutamine, Glycine.

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Asiatic Pennywort

Scientific name: *Centella asiatica* (L.) Urban.
Common Name: Asiatic Pennywort, Tiger Herbal
Family: Umbelliferae
Also known as: Pak-Ven, Pak-Nok

The part that can be used: leaves, the whole plant, seed

Characteristics:
Asiatic Pennywort is an annual plant. Its stem and roots are one, crawling along the damp ground. It has rootlets come out of each section. It grows easily. The single kidney-like leaf of area 2-5 cm^2 holds high above the stem, granulating alternately. The leaf is green and has a circular tip, curved base and wavy edges. The small hairs also appear on the leaf. It has long leaf stalk. Its flower granulates from the leaf's nook and resembles a bouquet that looks like the teeth of an umbrella containing a couple of minor flowers. The flower has five reddish purple petals. Its fruit is black, dry and flat.

Asiatic Pennywort

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asiatic Pennywort

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Aswawadhanabhuti, Dilumo, Galapunt, Kunnova, Mounmo, Sage, Sungsang, Thanam, 200

Asiatic Pennywort

Properties:

Leaves:
Contained asiaticoside which can cure eczema

Seed:
Cure fever and headache

The whole plant:
Cardiac tonic
Heal scald
Cure migraine
Diuretic
Relieve sore throat
Lower the blood pressure
Heal internal organ injury

Method and Amount Used

- Migraine
  Extract the juice from the plant and drink it for 2 -3 days.
- Cure sore throat
  Use the 20-30gram of the plant and extract the juice. And add 2-3 tablespoon for vinegar. Then slowly drink it.
- Lower the blood pressure
  Use the 30-40 gram of the plant and extract the juice from the plant. Add in sugar and drink it for 5-7 days.
- Heal internal organ injury
  Use a handful of the plant and grind it to extract juice and add in a few sugars. Drink it for 5-6 days.
- Heal scald
  Use 2-3 plants and grind it. Then apply it on the scald. Doing this will decrease the pain.
- **Chemical found:**
  Extraction from leaves: madecassoside asiatic acid, asiaticoside, centelloside, centellic acid brahminoside, brahmic acid.

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Cat's Whisker

Scientific name: *Orthosiphon aristatus* (Blume) Miq.
Common Name: Java tea, Kidney Tea Plant, Cat's Whiskers
Family: Lamiaceae (Labiatae)
Also known as: Ya nuad Meaw

The part that can be used: Roots, whole plant and leaves

Characteristics:
Cat's whisker is an annual plant of 30 – 80 cm height. Its stem is square shaped. Its leaf is single and arranges in an opposite pattern. The leaf is deep green, trapezoid and has a wavy edge. Its flower granulates as a bouquet from the top of the plant. It has 2 species; white purple flower and cyan flower. The petals bloom from the lower to the higher section of bouquet. Its anther leans out long from the petal. Its fruit is dry.

Cat's Whisker

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Cat's Whisker

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasadhuni, Thanno, Gadpaiboon, Nunnova, Moonmin, Sagar, Bhagat, Thibault

2008

Cat's Whisker

Properties:

- Roots: Help with urinal problem
- Whole plant: Kidney related disease, Help with urinal problem, Back and lower back pain, Curerhinitis
- Leaves: Kidney related diseases, Joint and back pain, Low blood pressure, Cure diabetes, Decrease amount of uric acid from the kidney

Method and Amount Used

Urinal problem

The stems and leaves are washed with clean water then dried in the shades. $ grams of the materials is boiled in water (750cc). The drink can be consumed throughout the whole day. The treatment can last about 6 months.

Chemical found:

Plants: Hederagenin, Beta-Sitosterol, Ursolic acid\
Leaves: Glycolic acid, Potassium Salt Orthosiphonoside, Tannin, Flavone

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Common Lime

Scientific name: *Citrus aurantifolia* (Christm.) Swingle
Common Name: Common Lime
Family: Rutaceae
Also known as: Ma-now

The part that can be used: Lime fruit, juice, roots, leaves, flowers and seeds

Characteristics:
Lime is a bush tree of 2 – 4 m height. Its young branch contains spikes. Its bark is grey-brown and smooth. Its leaf is multiple and granulates alternately. The leaf contains a minor leaf which is single and oval of 3 – 5 cm (width) and 4 – 8 cm (length). The tip of the leaf is sharply pointed. The leaf's base is round and has a narrow flank. The leaf has the oil glands scattered all over. Its flower granulates as either a short bouquet which contains 5 – 7 flowers or singly in the leaf's nook and at the tip of the branch. The flower is white, fragile and has 4 – 5 petals. Its fruit is round and smooth. Young fruit is strong green and changes to yellow when it becomes riper. Inside the fruit, it can be divided in a radius pattern. The fruit is sour. Its seed is white and ovary. The fruit contains 10 – 15 seeds.

Common Lime

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Common Lime

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasaphan, Dilumo, Gadpuan, Kunnova, Moumino, Saga, Sungtae, Thanom, 2010

Common Lime

Properties:

Lime juice: Scurvy, Phlegm, Cooking, Blood purification, Moistening skin, Common flu, Croup, Enhance voice, Enhance blood, Menstruation pain, Prevention of Whitlow, Stretched marks Coughing, Parasite in stomach, Enhance health of hair, Drive out gases, Urticaria Hemorrhoids, Leukorrhea, Cure poison from upas, Fever, Furuncle, Aches ,Inflammatory

Root: Common cold symptom, Food poisoning, Impaired memory, Fever Common flu, Furuncle, Aches, Inflammatory
Leaves: Blood purification, Enhance liver
Flower: Flatulence, Coughing, Phlegm
Lime Fruit: Flatulence, Coughing, Phlegm, Skin problem (Acne), Cracked heel
Seed: Croup, Improve respiratory, Phlegm Internal Furuncle

Method and Amount Used:

Phlegm
Mix 2-3 tablespoons of lime juice, 10-20 lime seeds and add a little bit of salt. Drink the result.

Scurvy
Mix lime juice, salt, sugar and ice and drink it. The juice can also be mixed with food.

Prevent Bleeding from cuts
Squeeze lime on fresh wounds to stop excess bleeding.

Chemical found:
Leaves: Alcohols, Aldehydes, Elements, Terpenoids, Citral
Fruit: l - Alanine, γ - Amino butyric acid, l - Glutamic acid
Seed: Glyceride Oil
Essential oil: P - Dimethyl - Styrene, Terpinolene

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Galanga

Scientific name: *Alpinia galanga* (L.) Willd.
Common Name: Galanga
Family: Zingiberaceae

The part that can be used:
Rhizome

Characteristics:
Galanga is an annual plant around 1.5 to 2 meters tall with green leaves 7 to 9 cm wide and 20 to 40 cm long. The white flower of the galanga grows on the top. The leaves of galanga have an oval shape while the fruit of the galanga is round.

Galanga

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Galanga

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasadaphan, Dilloun, Gadapuun, Kunnova, Moounun, Saga, Singkus, Thanan

Galanga

Properties:

- Act as carminative/anti-flatulence
- Cure foodborne illness (food poisoning)
- Cure urticarial
- Act as anti-eczema/anti-fungal

Method and Amount Used

Carminative/anti-flatulence
Use fresh rhizome with the length of 1- 1 ½ cm and grind it. After grinding the rhizome of galangal, add limewater ($Ca(OH)_2$). And drink half a glass after each meal per day.

Cure urticarial
Grind one mature rhizome, then add rice whisky to make it slushy. Apply them on the skin where there's urticarial until it has gone away.

Act as anti-eczema/anti-fungal
Use a mature rhizome the size of your thumb and add rice whisky. Then apply it to the skin to cure eczema and fungus.

Chemical found:
1 - acetoxychavicol acetate Extracted oil: monoterene 2 - terpineol, terpenen 4 - ol, cineole, camphor, linalool, eugenol

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Ginger

Scientific name: *Zingiber officinale Roscoe*
Common Name: Ginger
Family: Zingiberaceae
Also known as: King-klaeng, King-pueak, Sa-ae

The part that can be used:
Rootstock, stem, leaves, flower, fruit

Characteristics:
Ginger is an annual brown plant with yellow shades covering the outside part and an ivory colored inside. Ginger will grow underneath the soil, while its leaves will appear above the soil. The flower is yellow with green shades. Ginger is around 1.5 to 2 cm wide and 15 to 20 cm long.

Ginger

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Ginger

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Botanical Gardening at the Wat Pathumwanaram School: Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Ginger

Properties:

Rhizome
- Act as antiemetic
- Increase appetite
- Cure flatulence
- Cure coughing and phlegm
- Prevent for peptic ulcer
- Increase digestion
- Cure constipation
- Decrease blood pressure

Fruit
- Act as anti-fever

Stem
- Cure flatulence
- Increase digestion
- Kill the parasite
- Cure eyes infection

Leaves
- Kill the parasite
- Cure eyes infection
- Increase digestion

Flower
- Kill the parasite
- Cure eyes infection
- Increase digestion

Method and Amount Used

- Antiemetic

Use the dry or fresh mature ginger, if dry use 5-7pieces and if fresh use 5 grams and pound the ginger. Boil it with water for 10 to 15 minutes and drink the water.

- Increase the appetites

Use ½ tablespoon of dry ginger or 0.6gram and mix it with water. Then drink it or cook it with food.

- Cure flatulence

Use 2inches of mature ginger then pound it and boil it with water. After 5 minutes you're able to drink the water. This will help in sleeping.

- Cure coughing and phlegm

Use ground fresh ginger and add it with lime and salt. Drink slowly.

- Decrease blood pressure

Use the fresh ginger, boil it with water and drink it.

Chemical found:

Rhizome:

Gingerol Zingiberene, Zingiberone Zingiberonol, Shogoal, Fenchone, Camphene Cineol Citronellol

Extracted oil:

Bisabolene, Zingiberone Zingiberol, Zingiberene, Limonene, Citronellol Gingerol, Camphene, Borneol, Cineol

Stems:

5 - (1) - 6 - Gingerol Shikimic acid

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Holy Basil

Scientific name: Ocimum sanctum L.

Synonyms: Ocimum tenuiflorum L.

Common Name: Holy basil, Sacred Basil

Family: Lamiaceae (Labiatae)

Also known as: White Basil, Red Basil

The part that can be used: Both fresh and dried of the leaves and the top of the holy basil.

Characteristics:
Holy basil is a bush around 30-60 cm tall. The red basil stems are red and green colored. Red holy basil is commonly used as a medicinal plant, while the white basil has white with green shade stem are usually used in cooking. The leaf of the basil has an oval shape that is 1-3 cm wide, and 2.5-5 cm long.

Holy Basil

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

Chulalongkorn University & WPI

Holy Basil

CU & WPI

Asawaree Thanthanawasi, Chanya Chaipipat, Nuttanan Kunnava, Phimphan Sangkhong, Thitima Thitaram

2010

Holy Basil

Properties:

1) Anti-nausea
2) Relieve flatulence, heartburn and abdominal pain
3) Cure from coughing and increase perspiration
4) Act as a vermicide
5) Decrease fever
6) Act as an elixir
7) Mosquito and fly repellent

Methods and Amount Used

<u>For nausea and vomiting:</u>
Crush fresh or dried basil, then add it to water and drink it.
Baby: 3-4 leaves of fresh basil
Adult: 1 handful of dry leaves of the basil (4gram or 1 tablespoon of dry leaves of the basil or 2 teaspoon of 25gramsof fresh basil)

<u>Relieve flatulence, heartburn and abdominal pain:</u>
Children: Use the fresh leaves of the holy basil and apply on the stomach of the child. This will help relieve the stomachache.

<u>Mosquito and fly repellent:</u>
Grind the fresh leaves of the holy basil and put it aside. The holy basil will act as a mosquito and fly repellent. You can also extract the oil from the holy basil by distilling the fresh leaves of the holy basil, which will act as a better mosquito and fly repellent.

Chemical found:
Apigenin, Ocimol, Linalool, Essential Oil, Chavibetal

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Hop Headed Barleria

Scientific name: *Barleria lupulina* Lindl.
Common Name: Hop Headed Barleria
Family: ACANTHACEAE
Also known as: Saled Phang porn

The part that can be used: roots, the five part and leaves

Characteristics:
Hop Headed Barleria is a crawling bush. Its stem and branches are green. Its leaf is single and granulates in an opposite pattern. The leaf is flat ovary with parallel edge. The petal is orange-red. The petal's base connects to each other becoming a tube. The tip of the petal separates into 2 parts. It naturally grows in the wild, however, it can also be planted in the house. It can be bred by 'rooting the cutting'. There are 2 species of Hop Headed Barleria; Male Hop Headed Barleria and Female Hop Headed Barleria; the difference is that the stem of the male one contains spikes and has less medical properties than the female one. In order to not be confused, the female one is called Pha-ya-Yor. Thai traditional medication prefers this plant strongly.

Hop Headed Barleria

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Hop Headed Barleria

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasadaphun, Pitiluno, Sadaphun, Ruttanova, Moolumla, Sagda, Singhue, Thanan

Hop Headed Barleria

Properties

Roots: Increase in appetite, Hyperbilirubinemia, Abdominal pain, Food poisoning, Snake venom, Insect bite, Toothache
Leaves: Insects bite, Cure for hives, Skin related disease, Diabetes, Pain from fresh wound, Fresh wound, Cure furuncle, Cure mumps, Cure Erysipelas, Cure Herpes, Cure hemorrhoid, Treat mosquito bites, Treat scald
The five parts: Treat venom from insects, Elevate inflammatory, Cure Herpes, Cure hives, Treatment for scald

Method and Amount Used

For Herpes inflammatory
10-20 leaves are mixed with liquor or lime juice. The solution can apply to the affected areas or drink directly. 1000g of the leaves are left in 1000cc of 70% alcohol for 7 days. Strain the plant materials out and leave the solution to evaporate until about 500 cc is obtained. Add 500cc of pure glycerine in the solution. The solution is applied to the affected areas.

Insects bite
5-20 of the fresh leaves are crushed and applied directly on the wound

Scald
Crush the leaves and mix with alcohol. The solution can be applied to the wound.

Chemical found:
Whole plant: Iridiod glycoside, Acetyl barlerin , Barlerin, Shanzhiside methyl ester

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Indian Mulberry

Scientific name: *Morinda citrifolia L.*
Common Name: Indian Mulberry
Family: Rubiaceae
Also known as: Yor barn

The part that can be used: Leaves, root, fruits

Characteristics:
Indian Mulberry is a perennial plant of 2 – 6 m tall. Its barks are brown which, later, crack and scatter out. Its young bud is square shaped. Its leaf is single and granulates alternately. The leaves are shiny green and have an oval shape with width of 8 - 15 cm and length of 10 - 20 cm. The edge and the leaves themselves are smooth. Its flower granulates from the leaf's nook and resembles a circular bouquet and has a pleasant odor. The bases of the petals connect to each other becoming a tube. The tip of the petal splits into 5 v-shaped projections. Its fruit gather into a group and have a rough surface. The ripe fruit has an unpleasant smell. Its seed is brown.

Indian Mulberry

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Indian Mulberry

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasauapoth, Dilluno, Gadapuni, Kunnova, Moulunno, Saga, Shugrue, Thibault

2270

Indian Mulberry

Properties:

Leaves:
Its leaves provide more than 40000 vitamins per gram and can help nourish the heart and eyes. The extracted water from the leaves can be used to cure arthritis. Indian Mulberry can also be used as an ingredient in cooking which can help cure diarrhea.

Roots:
The roots can be used as a laxative, and dye color (adjust the color by adding salt) such as pink, red brown, black, and yellow.

Mature Fruit (unripe):
Eaten with honey, which would act as carminatives and anti-flatulence.

Mature Fruit (Ripe):
Boil it with water and add the root of parsley. Drinking the water will act as an antiemetic.

Method and Amount Used

- Antiemetic:

Use the mature fruit (unripe) and cut it into pieces and fry it until the color changes to yellow. Then use the following 10-15gram of the mature fruit and boil it with the water and slowly drink it.

- **Chemical found:**

Fruit: Asperuloside, caproic acid, caprylic acid, glucose

Asawasadaphun, Dr.Rung, Sadaphun, Morinda, Morinda, Saga, Singha, Thabali

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Kariyat

Scientific name: *Andrographis paniculata* (Burm.f.) Wall.ex Nees
Common Name: Kariyat , The Creat
Family: ACANTHACEAE
Also known as: Fah-ta-lai-jon, Yah-kun-nguu, Fah-sa-tarn

The part that can be used: plant, fresh leaves, dry leaves (all the leaves would be collected during 3-5 months of the plant)

Characteristics:
Kariyat is an annual plant of 30 – 70 cm height. Every part of this plant has a bitter taste. Its branch has a square shape. Its leaf is shiny green and single. Its flower granulates as bouquet at the tip of the branch and in the leaf's nook. The minor flower has white petal and a connected base. The tip of the flower splits into 2 mouths; the upper mouth has 3 petals and the lower mouth has 2 petals, separated by a red-purple line. The fruit is a pod with many seeds. When the pod becomes fully ripe, it can sprout.

Kariyat

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Kariyat

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasaengkul, Dilumo, Gadpaiboon, Kimnova, Moumou, Page, Sungsue, Thanom

Kariyat

- **Properties:**

Anti-pyretics
Cure infection
Suppress inflammation
Increase appetite

Method and Amount Used

Tea extraction
5-7 leaves are placed in a glass and hot water is poured in. The glass is sealed for half an hour then drank 3-4 times per day before food and prior to sleep.

Herbal ball
Fresh leaves are dried in a ventilated and shaded area. The dried leaves are crushed. The materials are then made into a ball with honey. Each ball should be 250g. Once dried, consume 3-4 times per day before food and prior to sleep.

Capsulation
Fresh leaves are dried in a ventilated and shaded area. The dried leaves are crushed. Pack into 250mg capsules. The dose is 3-4 times per day before food and prior to sleep.

Alcohol extraction
The dried and crushed leaves are allowed to sit in 40% alcohol (the level of alcohol should submerge the materials). Shake the bottle once a day for seven days. The drink is consumed 3-4 times a day prior food, and each dose should be about 1-2 tablespoons

Powder extract for inhalation
The powder can be sniffed through the nasal and oral passages.

Chemical found:

- andrographolide
- neo-andrographolide
- 14-deoxy-andrographolide

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Lemon Grass

Scientific name: *Cymbopogon citratus* Stapf.
Common Name: Lemon Grass, Lapine
Family: Poaceae (Gramineae)
Also known as: Ta-Krai, Krai

The part that can be used: the whole plant, roots, leaves

Characteristics:
Lemon grass is a clump annual plant of 1 m height. It has a long life time. Its stem is tube-shaped, strong and rigid. Each section on the stem is grease covered. Its leaf is single and splits into many seen as a clump. The leaf has parallel edges, pointed tip and a rough surface. There are hair covers at the edge. The leaf is green and has the rigid line in the middle. The width of the leaf is 2 cm and the length is 60 – 91.5 cm. Its flower granulates as a scattered bouquet. The minor bouquet has a pair of stalks and, in each pair, the bract is carried.

Lemon Grass

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Lemon Grass

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Lemon Grass

Properties:

The whole plant:

1) Cure headache, cough suppressant, anti-expectorant
2) Act as carminative/anti-flatulence
3) Cure diarrhea, increase appetite
4) Heal internal organ injury

Root:

1) Act as diuretic

Leaves:

1) Cure fever
2) Decrease blood pressure

Method and Amount Used

Carminative/anti-flatulence

1) Use mature lemon grass (40-60 gram) and pound it. Then boil the following mature lemon grass with water or cook it.

2) Use 5 mature lemon grass and cut it into pieces. Then boil the pieces with water and salt. And wait until the water volatile until 1/3 of the water is left. And drink a glass of the following water for 3 days.

Diuretic

1) Use mature lemon grass (40-60grams) and boil it with water and drink it.

Chemical found:

Citral 75-85 % Citronellal, Geraniol Methylheptenone, Eugenol, Methylheptenol

•

Asawasadaphun, Dilluno, Sadaphun, Rinnova, Mounmin, Saga, Singtus, Thinnaun

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Phlai

Scientific name: *Zingiber montanum* (Koenig) Link ex Dietr.
Common Name: Phlai, Z.purpureum Roscoe
Family: Zingiberaceae
Also known as: Warn-Fai, Poo-loi Poo-loey

The part that can be used: mature rhizome

Characteristics:
Phlai is an annual plant of 0.7 – 1.5 m height. It has underground roots. Its bark is yellow-brown. The wood is yellow or yellow-lime. Its shoot, or pseudo stem, is composed of spathe or leaf's bases stacking on each other's granulates in coalescence. Its leaf is single and arranges alternately. The leaf resembles a spear and has width of 3.5 – 5.5 cm and length of 18 – 35 cm. The petal is bright yellow. The bract is purple. Its fruit is dry and has circular shape.

Phlai

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Phlai

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Phlai

Properties:

Rhizome
Act as a carminative/anti-flatulence

Method and Amount Used

Use dry mature rhizome of Phlai, and grind into powder. Then add ½ teaspoon of the powder into a glass of water. Add a little salt and drink it.

Chemical found:

- Alflabene: 3,4 - dimethoxy benzaldehyde, curcumin, beta-sitosterol, Volatile Oils

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Star Gooseberry

Scientific name: *Phyllanthus acidus* (L.) Skeels
Common Name: Star Gooseberry
Family: Euphorbiaceae
Also known as: Mayom

The part that can be used: leaves, fruits and root

Characteristics:
Star Gooseberry is a perennial plant of 3 – 10 m height. Its stem stands straight and grows the branches on the top. The branch is fragile. Its bark is grey brown and rough. The leaf is pile containing minor leaves that granulate in 2 lines alternately. Each branch has 20 – 30 minor leaves. The leaf is round or rather rhombus-shaped and has parallel smooth edge and a pointed tip. Its flower granulates as a bouquet along the branch. The minor flower is yellow-brown. Its fruit is green when young and turns yellow or pale yellow when riper. The fruit is moist. Its seed is light brown, round and rigid. The fruit contains 1 seed.

Star Gooseberry

IQP-SSP1: Design and Integration of a Botanical Garden into the Wat Pathumwanaram School System

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Star Gooseberry

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasamapoom, Dilumo, Gadapuni, Kimnova, Modumio, Saga, Shugrue, Thibault

Star Gooseberry

Properties:

Leaves:
Skin Itches
Small pox
Measles

Fruits:
Cooking

Root:
Cure fever
Skin disease

Method and Amount Used

The leaves and roots are boiled for consumption.

Chemical found:

Leaves: beta-amyrin, phyllanthol, tannin saponin, gallic acid
Fruit: tannin, dextrose, levulose, sucrose, vitamin C

Asawadaphun, Tiranu, Sadaphun, Thanthai, Ruttanova, Mounmun, Saga, Singtue, Thuwan

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Turmaric

Scientific name: *Curcuma longa* L.
Common Name: Turmaric
Family: Zingiberaceae
Also known as: Kha min

The part that can be used:
Rhizomes

Characteristics:
It is an annual plant about 30 – 90 cm tall. It has a long life time. Its rhizome is a yellow-orange, ovary, has specific odor and stays in the ground. The branch at the side of the rhizome has a cylindrical shape and points out in the opposite to the mass inside the rhizome. Its leaf is single, grows out from the rhizome and arranges circularly. The leaf is spear shaped of 12 – 15 cm (width) and 30 – 40 cm (length). Its flower granulates as a bouquet (3 – 4 flowers at the time) from the rhizome, penetrating through the leaf stalk. The flower is cylinder. The petal is pale yellow. The bract is light green. The fruit is round and has 3 sections.

Turmaric

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Turmaric

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Turmaric

Properties:

Rhizomes:

Internal: Antiflatulent, Acute diahhrea, Stomach related disease

External: Skin related disease, Scald head

Method and Amount Used

For **Internal use**

2 inches of the rhizomes are peeled, washed with clean water and crush. Squeeze the liquid out. The liquid is consumed 3-4 times per day with 1 table spoon per dose.

For external use

The rhizomes (as much as needed) are dried are crushed into powders then applied to affected areas.

Chemical found:

rhizomes: tumerone, zingerene bissboline, zingiberene,(+) - sabinene, alpha-phellandrene, curcumone, curcumin

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

White Crane Flower

Scientific name: *Rhinacanthus nasutus* (L.) Kurz
Common Name: White crane flower
Family: ACANTHACEAE
Also known as: Thong Kun Chang, Ya Mun Khai

The part that can be used: leaves, whole plant, stem and root

Characteristics:
White crane flower is a bush of 1 – 2 m height. Its young branch is square shaped. Its leaf is single. Its flower granulates as a bouquet in the leaf's nook. The petal is white and has the base connected, becoming a tube. The tip of the petal splits into 2 layers. The lower layer is red-purple. Its fruit is dry and cracked.

White Crane Flower

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

White Crane Flower

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasaunapoom, Dilumo, Gadapuun, Kunnova, Moolumlo, Saga, Singtue, Thibaut

252

White Crane Flower

Properties:

Leaves: Cure fever, Skin disease, Joint related disease, Skin related disease

Root: Cure ringworm, Cancer treatment, Skin related disease, Symptoms of fever, Treat snake venom, Treatment for skin parasite

Whole plant: Skin related disease, Treatment for lymphatic, Cure eczema, Cure ringworm, Cancer treatment, Skin parasite, Cure yaws, Cure hernia, Bladder dysfunction

Stem: Treatment for hair loss, Enhance overall health

Method and Amount Used

1. Treatment of cancer and tuberculosis
30g of fresh whole plant materials are boiled in water (slightly above the amount of plant). The water is consumed for medicinal purposes.

2. Treatment of lung related diseases
30g of stems and leaves are boiled in water with sugar. The drink is consumed for medicinal purposes.

3. Treatment for skin related diseases
5-8 fresh leaves or 2-3 roots are crushed and mixed with alcohol (40% or 75%). The solution can be applied to the affected areas.

Chemical found:
Rhinacathin, Oxymethylanthra quinone, Quinone, Rutin (quercetin - 3 - rutinoside)

Asawasadaphon, Dilloun, Sadaphun, Rittova, Moounun, Saga, Singtue, Thuaun

Botanical Gardening at the Wat Pathumwanaram School:
Realization of a Medicinal Herb Garden and Instructional Materials Promoting Self-Sufficient and Sustainable Living

Wildbetal Leafbush

Scientific name: *Piper sarmentosum* Roxb..
Common Name: Wildbetal Leafbush
Family: PIPERACEAE
Also known as: Cha plu

The part that can be used: Fruits, whole plant, leaves and roots

Characteristics:
Wildbetal Leafbush is an annual plant of 30 – 80 cm height. Its stem is green and lays along the ground. The new bud grows from the stem. The roots grow from the section on the stem. Its leaf is single and granulates alternately. The leaf is shiny green, thin and smooth, is heart shaped, and 5 – 10 cm wide and 7 – 15 cm long. The tip of the leaf is pointed. The leaf's base is curved. Its flower granulates as cylinder bouquet. The small white flowers stay on the bouquet stalk intensely. The anther and pistil are on the different flower. Its fruit is fresh, round and massive and granulate on the stalk.

Wildbetal Leafbush

IQP-SSP1: Botanical Gardening at the Wat Pathumwanaram School

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Wildbetal Leafbush

จุฬาลงกรณ์มหาวิทยาลัย และ Worcester Polytechnic Institute

Asawasaduphun, Dilumo, Gadpuun, Kinnova, Moumino, Saga, Singhue, Tinnamit 2554

Wildbetal Leafbush

Properties:
Roots:
Antiflatuent, Enchance internal elements, **Shigellosis**
Whole plant: Antiflatuent, Phlegm, Diabetes
Fruits:Used to make medicine for asthma
Roots, stem, flower and leaves: Phlegm

Method and Amount Used

Diabetes
The fresh plant materials from 7 different plants are boiled in water and drink as tea

Antiflatuent
One handful of the roots are boiled in 2 glasses of water. Simmer until there are 75% of the water left. Consume 25% of the drink per dose.

Shigellosis
Half handful of the root, 2-3 handful of fruits are boiled in two glasses of water. Simmer until 50% of the water has evaporated. Consume 25% of the liquid per dose.

Chemical found:
Plants: Hederagenin, Beta-Sitosterol, Ursolic acid\
Leaves: Glycolic acid, Potassium Salt Orthosiphonoside, Tannin, Flavone