



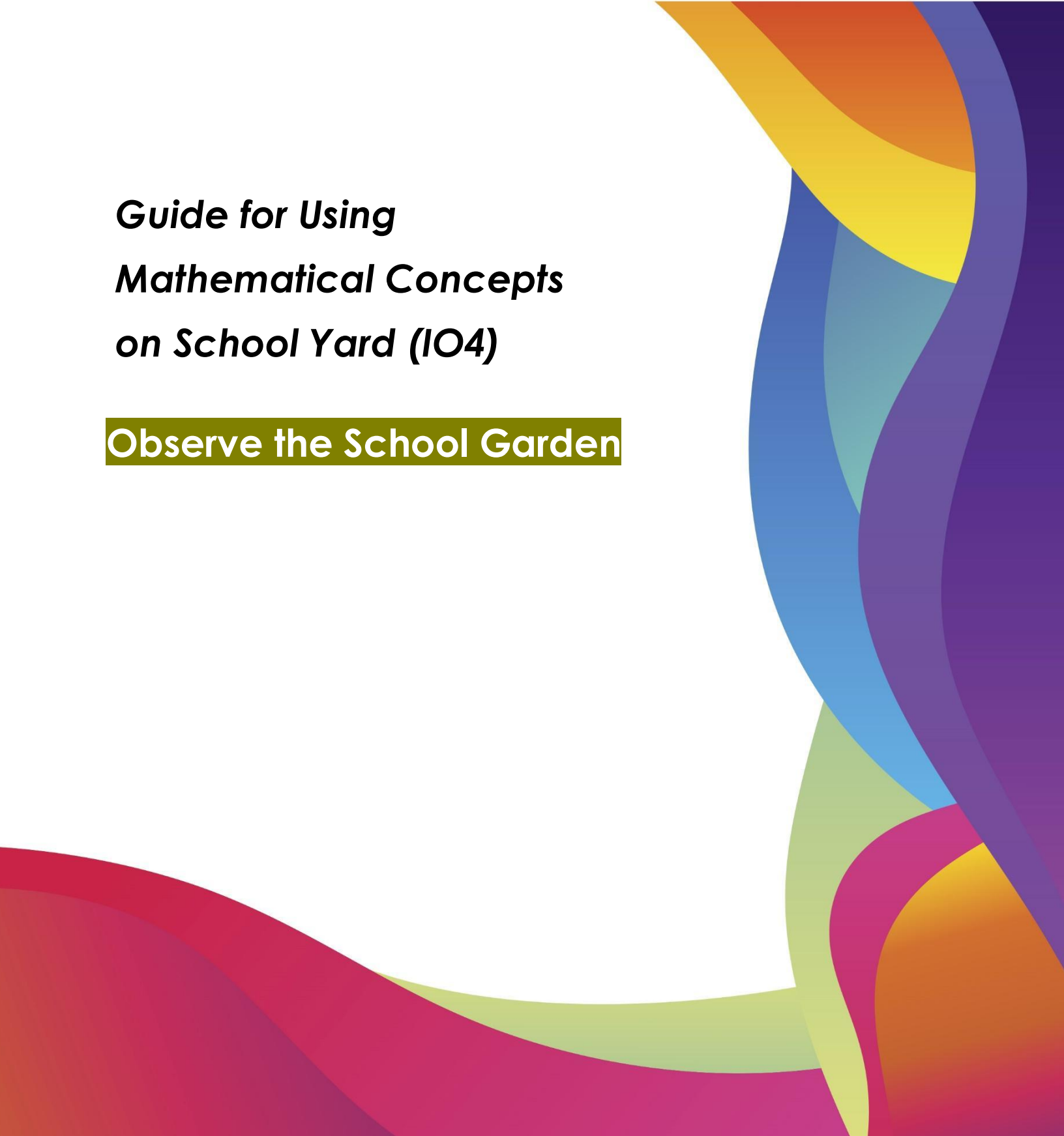
YARD4ALL

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***Guide for Using
Mathematical Concepts
on School Yard (IO4)***

Observe the School Garden



PROJECT

Yard4All – Using School's yard for ALL child's wellbeing and development

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1. INTRODUCTION

School gardens can be help for the emergence of new approaches to teaching, given the wealth of situations they present.

There are many reasons for having a vegetable garden at school. It can provide authentic learning about healthy eating, science, the environment and help students make meaningful connections between classroom concepts and life skills (Food and Agriculture Organization, 2009).

School gardens can reinforce classroom learning and involve important skills such as problem solving, planning and critical thinking, in addition to promoting social inclusion, cooperation, motivation to learn and promoting student achievement. We will thus introduce the themes that seem relevant to us for having a garden at school.

For many adults and children, the school garden can be a pressing reality, given the problems that society is going through, even facing some economic realities that some families with children in schools, momentarily or almost permanently, go through. In some cases, it can even help solve families' daily eating problems. In general, gardening, in this case the permaculture garden or school vegetable garden can mean the connection between everyday life and nature.

Given the problems we face worldwide, in relation to the environment and the quality or availability of food, society finds in gardening and school gardens, a form of defense against these problems.

A school garden can also be an innovative tool for education and learning that provides a very interesting experience for students, linking the activity of gardening, school gardens and the phenomena that take place there, to the learning of a school that seeks new approaches. The transformation of practices in school activities and, in this case, of the processes developed in a school garden, can represent significant learning activities.

The social interactions that always improve among students in school garden activities, where all the senses are involved, can also represent a stimulus for

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better learning and also represent a way to ward off practices of indiscipline and bullying.

The permaculture garden or school vegetable garden is the ideal tool for introducing a new approach to teaching, with new methods and content, representing an interactive space for carrying out quality learning.

The permaculture garden is a tool for sustainable development, through sustainable agriculture and healthy eating habits, using the guiding principles of organic gardening and permaculture.

The concepts of permaculture, the development of agricultural ecosystems, sustainable and self-sufficient, help us to conceive an intelligent school, oriented to the needs within the conditions existing in each school.

The cultivation of edible plants in school gardens allows the development of a deeper understanding of food production and the importance of sustainable ecosystem management. It also helps children, developing their senses related to food, especially taste and smell, and the ability to recognize the quality of the products they buy and eat. Children are also aware of the diversity of vegetables, fruits, herbs and foods in general and the importance of a wide variety of foods, particularly plants, for their health, well-being and pleasure.

In addition to these basic principles, school gardens can be used to support the learning process of all desired school content, from mathematics to languages, and not just from the natural sciences or biology.

School gardens also offer possibilities for building students' social skills, have the potential to improve relationships and communications between students and with teachers.

School gardens offer many opportunities for developing links and cooperation with the local community, through different school actions directed to the public (webinars), in cooperation with local partners.

Having a permaculture garden or school garden depends on the type of school and school conditions. Each school has its own specificities, from the available area, to the characteristics of the place, through the involvement of the school community.

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As for the available area, will it be necessary to define your objectives, what you want to achieve with the school garden, what are your main priorities?

As for the characteristics of the place, we will have to describe and evaluate the physical/spatial possibilities for creating the garden, the type and dimensions of the area/surface available for the school garden, check the availability of direct sunlight, among other characteristics.

The involvement of the school community involves evaluating the existing or anticipated support/opposition of the relevant parties, colleagues, teachers, management, other school personnel, for the realization of the school garden project.

Anyway, we must know that it is better to start with a small project and gradually grow, in line with the growing experiences and support.

Should we also seek professional help and support if available and/or needed, for example, is there any organization/school or school program in the country or region that has experience and supports the development of school gardens?

If possible, define actions and stakeholders. To help you with your task, we recommend that you implement a "SWOT analysis" for your school garden project or use the Canvas model.

SWOT Analysis

	Strengths (Strong points)	Weaknesses (Points to Improve)
Internal		
	Opportunities (Aspects that can help us achieve the objectives)	Threats (Aspects that make it difficult for us to reach our objectives)
External		

Canvas Model

What do we have? (problem/situation)	What should we do? (solution)
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What makes it special? (value proposition)	
Who is it for? (customers)	How do we tell to people about it? (channels)
How much will we sell it for? (cost structure)	

The creation of a school garden is not just a technical project, it is essentially a "social project".

One of the most common mistakes made in relation to a school garden is the insufficient awareness of the importance of social support for such project. A school garden can become a long-term success if it is not built by a single person or a few individuals. We need the support of our colleagues (teachers), non-teaching staff, students and sometimes even the local community.

We may be able to organize the work in the garden during the weeks the children are at school, but what about during the holidays? Who will water the plants if there is going to be a dry period and we still haven't found a solution to provide enough water for the plants? Will our colleagues/teachers take the garden as something that is also theirs or the community? Or will they reject it for fear of additional work and "complications"? Will the cleaning staff always complain about the dirt when they find something from the garden on their way to school areas? Who will help us with the more specific or more demanding occasional jobs? Will there be collaboration from the school community to help organize events related to the school garden? Will students deemed undisciplined seek the location of the school garden to destroy the school garden or materials related to the school garden? Every garden needs attention and enough appreciation and for a school garden, sufficient attention can only be guaranteed if enough

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people share responsibilities. Therefore, we all need everyone's support and for that we must have an aggregating awareness plan.

It is clear that there's no chance of developing a school garden if the person(s) responsible for the management of the school are not supportive. On the other hand, the initiative for the school garden may also come from the management itself.

If we have to warm up the management of the school for the project, it is important that we clearly describe both the benefits and the challenges and the ways the school could deal with them. We need to be positive but realistic. A good way is to present some positive examples from other schools, even from schools in other countries if there aren't any good examples available in your country yet.

The idea of an innovative and forward-looking school which is doing something more than the usual in the education may especially appeal to the management.

Some teachers may immediately see the benefits of a school garden. They will have ideas about how they could use it to diversify, improve or deepen their teaching. Others will perhaps see it as a potential source for increased work. And many teachers may be rather neutral to the idea. We need to show potential benefits of school garden as an innovative teaching and educational tool.

It should be made clear from the beginning that involvement in school garden and its use is optional, intended for those teachers who would feel attracted to the idea. The level of involvement may of course gradually increase, as the school develops more experiences with its use. The more positive experiences the teachers will have, the more the others will be motivated to join.

Our experiences show that the teachers who initiate the school garden and oversee it are usually natural sciences teachers, especially biology. However, among the initiators there may also be teachers from several other areas of interest (mathematics, ...) that may not seem, at first, particularly related to gardening.

But a teacher's strong idea about the school garden is more important than his/her specific teaching area. Even better is if the initiator is a group of teachers!

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A good way to convince the teachers about the school garden is to present examples from other schools. Here you can show how the garden is used in connection to the different curricula and learning goals; what are the benefits for the pupils and teachers; etc. It is also important to present the challenges and possible solutions in concrete situations. Each school system or school has specific ways to deal with such projects.

The Permaculture design encompasses 3 basic ethics:

More than “a green way of living”, permaculture uses nature’s principles as a guiding light, promoting self-reliance, increasing the fertility of the land and integrating community into the efforts as much as possible.

The 3 Ethics of permaculture design:

Care for the Earth – how do we look after and tend to all living and non-living things? What kinds of materials will we allow into our DIY projects, even into our own wardrobes?

Care for people – how can we include community in producing food and in helping out one another near and far? What does it take for us to relearn how to share resources?

Fair shares or sharing the surplus – how can we limit our wants so that we all have enough to survive – not just in the here and now, but several generations into the future?

In the school gardens, it is important to keep in mind the twelve principles of Permaculture:

Observe and interact: (“Beauty is in the mind of the beholder”. By taking the time to engage with nature we can design solutions that suit our particular situation.);

Catch and store energy: (“Make hay while the sun shines”. By developing systems that collect resources when they are abundant, we can use them in times of need.);

Obtain a yield: (“You can’t work on an empty stomach”. Ensure that you are getting truly useful rewards as part of the working you are doing.);

Apply self-regulation and accept feedback: (“The sins of the fathers are visited on the children of the seventh generation”. We need to discourage inappropriate

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activity to ensure that systems can continue to function well. Negative feedback is often slow to emerge.);

Use and value renewable resources and services: ("Let nature take its course". Make the best use of nature's abundance to reduce our consumptive behavior and dependence on non-renewable resources.);

Produce no waste: ("Waste not, want not". By valuing and making use of all the resources that are available to us, nothing goes to waste.);

Design from patterns to details: ("Can't see the forest for the trees.". By stepping back, we can observe patterns in nature and society. These can form the backbone of our designs, with the details filled in as we go.);

Integrate rather than segregate: ("Many hands make light work". By putting the right things in the right place, relationships develop between those things and they work together to support each other.);

Use small and slow solutions: ("Slow and steady wins the race". Small and slow systems are easier to maintain than big ones, making better use of local resources and produce more sustainable outcomes.);

Use and value diversity: ("Don't put all your eggs in one basket". Diversity reduces vulnerability to a variety of threats and takes advantage of the unique nature of the environment in which it resides.);

Use edges and value the marginal: ("Don't think you are on the right track just because it's a well-beaten path". The interface between things is where the most interesting events take place. These are often the most valuable, diverse and productive elements in the system.);

Creatively use and respond to change: ("Vision is not seeing things as they are but as they will be". We can have a positive impact on inevitable change by carefully observing and then intervening at the right time.).

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2. START A GARDEN OR OBSERVE THE GARDEN

Have you the desire to start a garden? Since this is a school project, it is important to gain support from the principal, staff, parents and students. Start by talking with your school principal and others about your idea to start a garden. You may learn that they have the same desire. Once you get commitment, it's time to have fun and start planning.

The Project could take 3 phases:

Phase 1: Create the Plan and the Design;

Phase 2: Build the Garden;

Phase 3: Maintain the Garden.

In the Phase 1: Create the Plan and the Design

To achieve the highest goals, a garden must meet the needs of the children it serves. It is a learning environment, and can be adjusted to achieve a wide variety of educational experiences. When the purpose is identified, it will be much easier to make other decisions such as location and plant selection, coordinated with the seasons.

In a given school, we will be concerned with making the following decisions:

- Form a planning team.
- Engage multiple partners in planning and engage more than the usual suspects. Be sure the entire planning is not dependent on one person. Make sure there is buy in from a core group at the school.
- Decide the purpose of the garden, the philosophy, integration into classroom and make sure there is buy in from a core group at the school.
- Do your homework: visit other school gardens.
- Hold multiple planning meetings such as meetings focused on the “vision” of the garden and the design.
- Develop strategies to engage teachers, families and youth in the planning process.

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Where will your garden be grown?

Select a specific location and microclimate. For example, tomatoes will like sun most of the day, but strong winds are not well tolerated. If possible, tomatoes would be placed in spots where the least amount of wind reached them.

Some aspects to consider:

Plants – What do you want to grow? What are the favorite foods of the students?

Space – How much do you need? How will the space be allocated or shared?

Time – How much time do you have to take care of the garden? If you determine you do not have much time then starting with a small plot may be advisable.

Sun – A vegetable garden needs 6-8 hours of direct sunlight a day. Examine your space at different times of the day. How does the sun move across the space? How does this change with the seasons?

Soil – What is the quality of the soil? What needs to be done to improve the quality so that plants will be successful? Is the soil compacted or loose? If it is compacted how will you loosen it? Is the soil safe?

Water – How will you water the garden? Who will water in summer? You want to build your garden close to a spigot or hose bib. If needed, who can help you install a water system?

Types of plots – Individual, classroom, communal? Rows, raised beds, double dug?

Planting – Will students direct seed into the soil or start the garden with transplants? When and what varieties do you start early? If you start early where will that be done?

Accessibility – A garden that is close to classrooms will be more accessible. Can garden work be done without stepping on the soil that plants are growing in? Is the garden accessible to all children (height, disability)?

Fencing – What is your plan to secure it from 2 and 4-legged creatures?

Permissions – Have you obtained permission(s) to use land and water from school leadership, district as appropriate? Having plans/ sketches in hand can be very helpful.

Sketch – Do you have a visual representation of the proposed space to share?

Here are sample questions to help you with your sketch/design:

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- What will you grow?
- What structures (fences and others) or conditions (shade, certain soil types) do these plants need? How will your design reflect these needs?
- How can you plan the structures and planting to create ideal microclimates?
- Where are existing plants or structure? Of these, which will stay, which will go? Where will the garden beds go?
- Where will walking paths go?
- Where will seating areas be?
- Where is water, how will you access it?
- What signs do you need to identify the garden or plants?
- Where are fences needed?

Identify garden participants, budget source, gardening supplies:

Growing a school garden is a great way to encourage parent participation in the educational process.

Participants – Who will tend your garden? What happens on breaks or during the summer?

Which classes will be involved? How will they be involved? Are there community groups or parents that can help?

Materials – Where will your needed materials come from? With a little creativity and a list of needs drawn from your garden plan, many supplies can be donated or accessed for free. Seeking recycled materials or other supplies from the businesses and others nearby provides a way for individuals to participate when they don't have time to contribute.

Budget – How much money do you need for your garden? How will you raise funds?

Supplies – What supplies do you need?

Typical materials include seed, plants, soil, tools, water related supplies such as hoses or drip irrigation, mulching materials, materials to build structures (raised beds, seating, shade structures), shade cloth, materials for staking larger or tall plants, curriculum/ books/posters and others.

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Tools needed for a garden – Shovels, rakes, hoes, hand tools (trowels, weeders, cultivators), watering cans, hoses/nozzles, wheel barrows/buckets for carrying soil, knee pads, gloves, hats.

Pitching a Garden

Pitching the garden is all about explaining your gardening project and bringing the community (school, neighborhood, youth, parents) on board. It can be very helpful when pitching your idea for a garden to be able to clearly explain:

- How the garden will be used to support classroom learning.
- The plans for building and maintaining the garden.
- Your budget and supply needs and how the community can help financially.
- The benefits of gardening.

It can also be helpful to engage students and parents to help develop and deliver the pitch.

The Phase 2: Build the Garden

There are many aspects to building a garden, but let's focus on the types of garden beds you can install.

Tip: For construction projects, many school gardens have a community work day to build their garden. Invite students, parents, employees, neighbors of the school, institutions as fire department, local businesses and elected officials or politics.

When building a school garden, it is recommended to vary as much as possible, using both leaves (lettuce, cabbage, parsley, chives, mustard, etc.), as well as flowers (artichoke, broccoli and cauliflower), and fruits (okra, pumpkin, tomato, etc.), vegetables (peas, green beans, or fava beans) and tubers/roots/bulbs (sweet potatoes, carrots, yams, cassava, turnips, radishes, garlic, onions, etc), because a more diversified diet has better nutritional quality and contributes to good health for all.

To define what to plant, it is necessary to plan production, based on criteria to achieve the goals to be achieved with the school garden. This planning can be carried out based on a weekly survey of the need for consumption of these foods in cafeterias or at students' homes, on the ease or performance of production in the school garden, or even taking into account the existing climate.

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The School Garden planning can be based on SMART criteria, **Specific** (What do I want to achieve with this objective, How will it be achieved, Where will it take place, Who will be responsible, What is the reason for this objective), **Measurable** (How long will it take to achieve, What result to get), **Attainable** (It is possible to reach the goal), **Relevant** (The goal to be achieved is relevant) and **Time based** (establishing the time it will take to reach the outlined objective).

The garden's location and purpose will determine what type of bed build. Below are four types of garden concerning the type of beds.

- 1) Raised Beds;
- 2) Waffle Beds;
- 3) Double-Dug Garden Bed;
- 4) Traditional In - Ground bed.

Raised Beds

Raised beds are commonly used in school gardens because they help to prevent compaction. They can be placed almost anywhere and serve both practical and decorative roles as a focal point in the garden. A typical height is anywhere from about 25cm-60 cm. Keep them narrow enough for small people to reach the center of the planting area.

Waffle Beds

Waffle gardens, or "deep beds", are a type of in-ground garden developed hundreds of years ago to combat difficult growing conditions. The waffle garden is created by low wells for collecting and keeping water surrounded by a mounded earth grid that provides a path for gardeners to access the square garden beds. When completed, the garden looks similar to a waffle and provides a flexible growing space for warm season varieties.

Double-Dug Garden Beds

This method creates prepared beds that can be used for several years. The method emphasizes creating defined beds with airy soil that is never walked on and planted densely to create a cool microclimate.

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Traditional In - Ground bed

Growing in-ground is the most commonly understood means of growing a garden and follows the tradition farming seen in almost every locals.

The Phase 3: Maintain the Garden:

Gardens are not self sufficient (even if they have drip irrigation systems on a timer) and they can go downhill fast or thrive depending on the amount of attention they receive. Ideally a garden should be checked on daily basis. Even 10-15 minutes can make a huge difference. Often, the condition of a garden reflects the time given to it.

A maintenance schedule must include these basic activities for positive results:

- Watering schedule based on the garden's unique design;
- Pest-watch and removal without the use of chemicals;
- Regular weeding without the use of chemicals - Planting in accordance with weather and seasonal conditions;
- Harvesting of vegetables and flowers in a timely manner to maximize flavor and appearance;
- Installation of cold frames, shade cloth or other structures to protect plants from weather conditions;
- Fertilize veggies at least once in a season, 1 month after planting;
- Work days 2-3 times a year that include big jobs like rakeing, loosening soil, planting, building new strictures, repairing old structures.

Things to observe in your garden for a successful harvest

The more time you spend in your garden, the more you will be able to observe your garden, and the better gardener you will become. While there are a lot of things that you could observe in your garden, here are three questions you should ask yourself to guide your observations:

- a. What critters and wildlife do you see in general, visiting your garden?
- b. How moist is your soil?
- c. How are your vegetables doing?

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When you observe your garden with these questions in mind you'll be able to address problems better, and you'll have a better idea what's working.

This way you can avoid surprises and make informed decisions.

One reason to make these observations is to be able to deal with pests better and know which predators you need to attract to keep the pests in balance.

If you don't observe your garden, you may not notice the pests or the predators that are helping you control them.

You might also make the common gardening mistake of over watering. Plus, when you observe your vegetables, you'll learn which varieties do the best in your garden, which can help guide your future decisions.

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3. ACTIVITIES

School gardens provide many benefits for the school community (students, teachers, parents, ...).

Good education is always linked to the work of educators who, in their pedagogical project and in their educational practice, have as reference:

- respect for your knowledge and that of others;
- loyalty;
- exemption from prejudice and judgment;
- the need to lead society to eliminate discrimination against sex, gender, race, class, age, social status;
- simplicity and humility;
- freedom (yours and others);
- tenderness and affection;
- solidarity.

We also find some of the characteristics of the good educators:

- Have a positive view of themselves and their work;
- Always have positive expectations about learners, whether they are children, teenagers, youth or adults;
- Do not blame learners for their failures, but believe that everyone is capable of learning;
- Never ridicularize students;
- Knowing that discipline, whether at school or in the classroom, depends on well-planned and participatory activities;
- Seeking the participation of everyone, through examples to illustrate their comments;
- knowing that tasks are given so that students can perform as a person facing a challenge;
- Dialoguing with their colleagues and ask for advice when they face difficulties in their task;

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- Develop and strengthen in daily life values that must be cultivated, promoted and respected;
- Enjoy teaching and learning from learners.

School gardens have learning benefits and can:

- increase the student's motivation to learn.
- allow for the development of leadership skills
- enable students to draw on different skill sets and interests that may not be highlighted in the classroom.
- Educators can use gardening as a way to support learning in math, Biology, science, history and other areas.

School gardens have culture benefits and can:

- allow for development of leadership skills.
- foster a sense of belonging amongst all involved.
- allow students to celebrate different cultural foods.
- help students of different backgrounds to connect over a common activity.
- allow students to organize themselves and work together toward a common goal.
- help to foster a sense of school pride.
- promote sharing (of harvest/tools/resources).
- allow parents that may not have formal academic skills to comfortably participate in a school activity.
- reduce discipline and classroom management problems.

School gardens have health benefits too and can:

- provide stress relief and relaxation, which contributes to positive mental health.
- encourage participation in physical activity, which also contributes to positive mental health.
- assist with the development of endurance, flexibility and strength.
- encourage students to eat more vegetables and fruit.

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We can create very interesting activities to teach and develop the contents of the mathematics curriculum. We can reference multiple activities that the math teacher can do based on the school's garden:

Measurement - linear, weight, temperature, volume, metric Estimate - percentage of clouds in the sky, temperature, ratio - seeds germinated Data - how to collect, display and analyze

Patterns - in nature, in a plant, seasons/cycles, repeating, predictable Geometry - lines of symmetry identify and name shapes in nature Sums and differences, products and quotients

Time - how long does it take to sprout a seed? Make a sundial for the garden

Money - how much do the seeds/plants cost? What is the cost of food production?

Now, we are specifically referring to some of the activities that the math teacher can do in the school garden, with her students:

- Count the number of plants in a row.
- Pull weeds and keep track of the number of weeds they have pulled.
- Count and record the number of different plants.
- Use the data collected and create pictographs using the vegetables to illustrate the number of plants in the garden.
- Based on the counts made, create pictographs also using technological support such as Excel, Geogebra, scratch, ...
- Based on the counts made, create pictographs using structured scientific design.
- Estimate the length and width of the garden, rows and paths and heights of plants. Estimate and measure using standard or non-standard units (count steps, hands, fingers ...).
- Estimate the amount of soil for pots or other objects needed to fill plant plots of various sizes. Using measuring vessels, fill vessels or other objects and record capacity.
- If collecting weather/ temperature data for science activity, have students create a line graph to interpret data.

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- Create garden plans using scientific design. In these plans you can use seed catalogs to determine or choose which vegetables to plant. And for example, given the measurements of the garden or the rows, determine how many seeds are needed. Or, supposing that one wanted to sow an exaggerated number of seeds, calculate what the measurements of the garden or the lines should be.
- Create the garden plans also using technological support.
- Calculate the perimeter and area of beds, raising beds, garden, garden benches, ...
- Calculate the diameter, radius and area of the garden pond, other circular things or even circular constructions made by students in the garden...
- Measure and sketch 5 plants in the garden.

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4. ONLINE RESOURCES

- Metric Conversions, <https://www.metric-conversions.org/pt/tabela-de-conversao-metrica.htm>
- Growing with Nature, <https://www.growingwithnature.org/observe-your-garden/>
- Soil Calculator, <https://www.gardeners.com/how-to/soil-calculator/7558.html>
- National Gardening Association, Kids Gardening, <http://www.kidsgardening.com/>
- National Farm to School, <http://www.farmentoschool.org/>
- New Mexico Farm to School, <http://www.farmtotablenm.org>
- Edible School Yard, <http://www.edibleschoolyard.org/>
- Harvest of the Month, <http://www.harvestofthemonth.com/>
- Life Lab Science Program, <http://www.lifelab.org/>
- Peaceful Valley Farm Supply, <http://www.groworganic.com/default.html>
- Project Learning Tree, <http://www.plt.org>
- Junior Master Gardner, <http://www.jmgkids.us/>
- NM State University, http://aces.nmsu.edu/pubs/_h/
- School Garden Wizard, <http://www.schoolgardenwizard.org/>
- USDA Team Nutrition School Garden Resources, <http://www.fns.usda.gov/tn/>
- Pest control in a garden: <http://www.attra.org/pest.html>
- Integrated Pest Management (IPM) & Plants that deter pests: <http://www.nmda.nmsu.edu/pesticides/integrated-pest-management/>

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- Concurso “Horta na Escola,
<https://aminhacapitaleverde.abae.pt/regulamento/concurso-horta-na-escola-eu-ajudo-na-cozinha/>
- Projeto de Sensibilização e Formação sobre Agricultura Biológica,
<https://www.cm-moita.pt/viver/informacao-municipal/noticia/curso-maos-a-horta-em-formato-online>
- How to start a School Garden, <https://learn.eartheasy.com/guides/how-to-start-a-school-garden-your-complete-guide/>
- Double Digging, <https://www.easydigging.com/spades-forks/articles/double-digging.html>

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