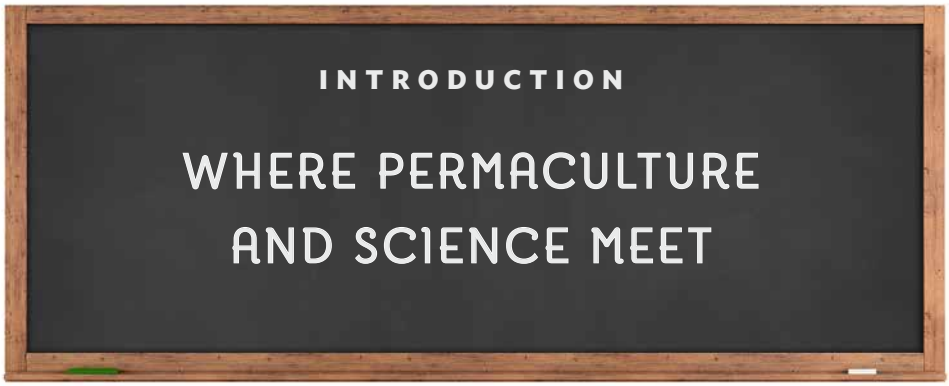

How can children produce food, learn science skills, and develop ecological values at the same time? This may seem to ask a lot from a single garden space. Over years of teaching garden education, I have compiled a model of what collaboration between permaculture-inspired practices, ecological mind-sets, and science-based activities can be in a school or youth learning garden. I developed the garden activities in this book when I worked as a School Garden Coordinator and Outdoor Educator for progressive schools in Oregon, as well as for educational farms, nonprofits, and small businesses. These lessons offer a framework for integrating a garden program into a school or community, cultivating place-based garden science studies for five- through fourteen-year-olds, and fostering a unique and valuable garden culture.

There is an endless collaboration between science and permaculture, in practice and philosophy. Both require a systems-based mind-set to guide individual and group work; both utilize observation, data gathering, and analysis to understand how diverse pieces create an interconnected whole. They encourage prioritizing objectivity over subjectivity and using a *beginner's mind* to experience wonder, generate questions, and explore ecology and natural systems. In the words of Bill Mollison:

> Permaculture is a philosophy of working with, rather than against nature; of protracted and thoughtful observation rather than protracted and thoughtless labor; and of looking at plants and animals in all their functions, rather than treating any area as a single product system.[1]

Youth learning gardens are a powerful place for children to cultivate the skills and mind-set of science and permaculture. It is where children learn to *Observe and Interact* and develop positive cooperation skills, inclusivity, and inquiry. When science and permaculture are focused together in one place for children—a youth garden—then the ecosystem studies and science skills that they develop and delve into are incredible. When "the landscape is the textbook," food, nutrition, and gardening skills extend naturally into a child's life experience.[2]

In an age where many children are growing disconnected from nature, where farmland is being saturated with chemicals, where the global climate is unpredictable and extreme, and where wild habitats are being replaced by urban development, our communities need

creative and innovative leaders to change our world. We need children to learn and engage in a new land ethic that inspires Care for Self, Care for Others, and Care for the Land and cultivates new generations of changemakers and environmentally conscious global citizens.

We accomplish this by encouraging children to engage in ecosystems and create spaces for cooperative stewardship and interaction. We provide opportunities to practice building community, creative problem-solving, healthy lifestyles, personal responsibility, craftsmanship, and engagement in nature through science. Gardens are a powerful place to learn these valuable skills and foster strong environmental and social literacy.

The lessons in *The School Garden Curriculum* are permaculture-inspired, place-based, and hands-on extensions that are supplemental to, or fulfill, Next Generation Science Standards (see Appendix A at the back of the book). In a school, these standards provide structure for even more immersive and engaging classroom units. The lessons in *The School Garden Curriculum* were also inspired by the Oregon Environmental Literacy Program which engages students in nutrition, literature, writing, art, and practical life skills.[3] *The School Garden Curriculum* helps children develop an ecological and naturalist perspective through science projects and permaculture gardening techniques.

I have taught all these lessons in onsite school and youth gardens, but the activities are easily adaptable to indoor projects, container planting, or window boxes. Many of the winter projects presented here illustrate gardening can be taught indoors and with limited materials or a budget. *The School Garden Curriculum* can be utilized by outdoor educators and teachers, especially those beginning to incorporate hands-on unit extensions into a school garden, as well as garden coordinators, after-school programmers, volunteers, and parents.

Cultivating a Gardener's Mind

One valuable and practical aspect of this garden program is the ritualization of certain garden chores. Each season, children of every age group participate in garden activities that help care for and develop the school, youth, or home garden by sowing seeds, mulching, planting starts, and composting. And even though some activities are repeated every year, they do not lose their meaning. Rather, they enhance the children's gardening knowledge by utilizing new themes for every grade and more complex engagement from different perspectives.

During visits to other school gardens, I have noticed teachers or coordinators who delegate certain tasks based on age. The job of one lower-grade class will be to plant garlic, but in the next grade the students move on to mulching and never return to nurture and observe their garlic as it grows. While I realize value in having students do age-appropriate activities—there are some things a five-year-old will struggle with—I've seen students lose appreciation for a garden activity when they no longer engage with it in following years. Some schools have their students garden for the first few years and then participate in only a couple of gardening projects when they get older. I would challenge these schools to do more.

Repetition instills more than a "practice makes perfect" model—though the children do improve planting, harvesting, and garden techniques each time they practice them. When children engage in seasonal garden

activities every year as they grow up, they develop valuable intrinsic knowledge of how seasons change and participate in the human agricultural tradition which tells them, "Now is the time to save seeds" or "Plant your seeds for summer food." I want children to watch leaves change colors and get an itchy sense nagging at them, from deep in their bodies and minds, that now is the time to prepare the garden for winter. This is the gift I can pass onto them so that years later, even if they forget many of the techniques of gardening, they are connected to the natural seasons and know intrinsically how to grow a garden.

The Garden as an Ecosystem

Practice letting go of any notion of what a garden should look like. What can a children's garden bloom into? With an open mind, evaluate the intentions of garden spaces and the community members participating in it. What will a children's garden become when science, observation, wonder, and thoughtfulness are practiced? It will be an ecosystem, a science lab, and a place of discovery. Adults can be helpful but also a damaging influence on school or youth gardens. Full of idealistic images and lacking a *beginner's mind*, willful adults can salt slugs, build sharp-edged raised beds, spray aphids, remove edible so-called weeds, and expose bare soil to the heat of the summer sun. Their priority is on a product, not a process.

In *The Sense of Wonder*, Rachel Carson observed, "A child's world is fresh and new and beautiful, full of wonder and excitement. It is our misfortune that for most of us that clear-eyed vision, that true instinct for what is beautiful and awe-inspiring, is dimmed and even lost before we reach adulthood."[4] Children are brimming with the capacity for wonder and awe. When student goals are to observe, study patterns and complex relationships, ask questions, conduct experiments, and learn from direct experience, they perceive the garden as an ecosystem and their wonder at the natural world is magnified. Youth gardens should be created from the minds and hands of children, who build up the space and their ownership of it, rather than act as occasional visitors who perform stand-alone activities. For all adults, allowing wonder to thrive requires practice in letting go.

> "The desire to solve problems, to experiment and to design is one of the defining characteristics of the permaculture gardener."[5]

Whether within one year of gardening regularly or nine years, children who work with permaculture, ecology, and science in mind will understand how soil organisms relate to decomposition and plant growth, consumer insects, predators, pollinators, seed sprouting, and so much more. Their knowledge of the garden as an ecosystem will be vast and punctuated by wonder, a willingness to experiment, and a deep appreciation for the value of a whole and complex system. The learning garden will look a little wild, but children will be committed to it, own it, and own their learning.

Children in Charge Everywhere

When children are allowed to be in charge of a garden, pick up slugs without prejudice, watch how they bite into leaves, and determine their own solutions from an ecological perspective, then they will naturally piece together an understanding of a holistic garden ecosystem.

They will also engage in valuable experiences of failure and apply trial and error, inquiry, and direct experience to their learning.

A method to enhance these opportunities is for an entire school or community to share the garden. This means that children work with the whole garden and overlap their plantings with other groups while interacting in the same spaces. Many schools are in favor of assigning a garden bed for each grade level as a way to delegate work in the garden. While this is successful for some schools, I have found that it pushes too many children into too small of a space, limits their engagement in activity for briefer amounts of time, and inhibits a sense of commitment to the work students perform. Students who plant tomatoes in one bed and then graduate to a new class and garden bed are not encouraged to see the relationships between those tomatoes and the plants or soils they are currently tending.

In many ways, this engagement is dependent on a school having access to a few garden beds, a plot of land, or part of a blacktop to grow plants on. Communities that plant in containers, window boxes, or inside classrooms have very different space requirements and opportunities for whole-school interaction. But if it is possible to have students return to their past container gardens and interact with them in the following seasons, I would encourage educators to make the time for those opportunities.

Letting children garden and interact with a whole space provides more opportunities for observing the garden's needs and its changes, while increasing a child's relationship and connections with the land. The space will change over time, and more opportunities will arise in an organic succession of student learning and natural spaces. When children are in charge, they can creatively challenge and innovate preconceptions of right and wrong and develop new, sustainable value systems in the garden.

Inspiring a Garden Culture

A *garden culture* is unique to the needs of every community and grows naturally from a commitment to common goals and visions. Educators and their school support staff or active community members often inspire initial gardening initiatives. Strengthen this initiative right away by taking a collaborative look at the garden program's long-term goals. What goal, or yield, will each teacher and class give to the school at the end of the year? How will they contribute to harvesting, work and labor, planting seeds, or offering scientific conclusions after a season of studying in the garden? Every community will have unique goals and site-specific solutions. Common positive goals can successfully create and respect the "local culture of place."[6] Communities who set realistic goals that fit their needs create a gardening structure that is collaborative, manageable, and sustainable. Remember to both start small and dream big.

A whole school or community commitment to a gardening initiative means that each class can commit to a yearly yield which will benefit the children and the whole community. The gardening activities I offer provide a structure for these yields in the form of developing science skills, application of organic gardening solutions, building structures, planting seeds, mulching, weeding, and more. But before integrating the gardening lessons, I recommend that communities discuss their group needs, site-specific projects, goals for the year, and how these can be integrated into the gardening program. With everyone working cooperatively to accomplish small pieces of a larger

vision, the work will become much lighter for everyone.

The sustainability of a gardening program is tied to a school-wide commitment to the garden space or gardening initiative. School garden programs struggle if there is only one teacher integrating garden activities in their class. In order to truly offer the students a science-based ecosystem experience that transforms their environmental literacy, let all of the school be involved. The garden then becomes a place where students build knowledge by applying their lessons in a physical way. But how can staff and school boards be motivated to buy in on the garden and commit to a yield? By experiencing the garden not as an additional chore but as the focal point of hands-on and science-based enhancement of the students' indoor studies, as well as an indispensable part of community culture, seasonal celebrations, and social events.

A school and community garden culture can also be enhanced through continuous use and engagement, such as talking about the garden publicly, reading about gardening themes in class, and studying other subjects in the space. Unstructured sensory exploration is also critical for fostering a culture that celebrates a positive land ethic and a child's relationship to land. As Rachel Carson suggested in *The Sense of Wonder*, visceral connection and engagement inspires a desire for knowledge.[7] Facts without emotional and experiential context hold little meaning. Leaving the garden open for student retreat and recovery, feeding families, making friends, magic and wonder powerfully foster positive garden culture.

In some communities, a youth learning garden is a place where different philosophies meet and clash, especially among adults. Addressing garden "pests" is one example of where different opinions come into contact. Every gardener has a different idea of what a pest is and what plants or insects fall into that category. Many school gardeners and educators share my experience in receiving a plethora of unasked-for advice on how to get rid of the garden's aphids, "too many" ladybugs, or ravenous slugs.

My own gardening philosophies are open to change, but rooted in permaculture and ecological ethics, organic solutions, and systems-based thinking. *Integrated pest management* is a key part of this mind-set and promotes student observation skills and ecosystem studies. It sees that "the problem is the solution" and perceives pests as opportunities or "surpluses of nature, which need to be used rather than destroyed."[8] When we value all the aspects of a system for their relationships to each other, then we begin to interact with "care, creativity, and efficiency."[9] Adhering to common goals and broad yet inclusive expectations can transform the garden itself and the culture into a space for sharing, exploration, open-minded conversations, and collaboration.

Care for Self, Care for Others, Care for the Land

Behavior expectations are important in setting a standard for community use and respect of the garden. The three expectations that inspired me at the first school garden I built are derived from the Ethical Principles of Permaculture. *Care for Self, Care for Others, and Care for the Land* (setting limits to consumption and redistributing the surplus) are my framework for ecological-based garden expectations and student behavior. I've heard it used in other school gardens using different language. The remaining permaculture tenets and ecological ethics fit into these three broad categories, and

are stated in words that children can easily aspire to understand and use.

These three ethics support the inclusive ecosystem-perspective of the garden, including the humans in it, and help foster socially and environmentally minded action. They guide children on how to treat each other in and outside of the garden. And they are flexible to children's growth by providing an empathetic framework for day-to-day activities. The language can be incorporated into wellness programs in schools and communities who focus on nutrition and physical activity.

Each beginning fall lesson in *The School Garden Curriculum* starts with a review of the behavior expectations for students and community members while in the garden space. The students discuss what *Care for Self, Care for Others, and Care for the Land* means when exploring the garden or engaging with an activity. This behavior could look like keeping low voices so as not to scare the living creatures in the garden, walking instead of running, and respecting each other's personal space. By creating a social contract within the class and making a list of behaviors that the class can refer to, students play their roles as a community members, gardeners, and scientists responsibly and respectfully.

School Gardens in the Summer

The summertime reality for every school is different. Some schools continue classes throughout the summer, and others take a few months for break. Schools with greenhouses experience scorching temperatures when left unattended, and it can be exhausting to garden after noon on some summer days. While winter and water-loving plants thrive during cooler seasons, they require extra love and nurturing in the early summer to become established. But who will water these plants over the summer, diligently, every week? Who will pick the beans, cucumbers, and tomatoes so that the harvest will continue into the school year? How will the garden survive for fall classes and food production?

The schools I've worked with all face summer concerns and issues, but I've developed some strategies that fit the model and focus of an ecologically minded garden. These solutions will change as a school garden becomes more established, more perennial, and more productive.

Water and Soil

Every community garden has different structures, needs, and resources. But all can benefit from a strong commitment to its garden soil. A thriving and rich soil structure that is filled with organic matter and decomposers at work will retain water longer throughout the summer. I prefer to build gardens where the paths and beds are inspired from children's explorations and wonder. And many watering systems don't quite fit into this creative model without careful planning. In order to cultivate a kid-planted, interactive, edible, biodynamic jungle, I have had to research and experiment with water-conserving methods that can be applied to a whole garden. Inspired by permaculture solutions and dry land farming techniques, I have encouraged students and schools to focus intensely on soil health throughout the school year.

In all the gardens I work with, I build experimental systems in different garden beds and compare the success of different methods over the seasons. For example, I have students build Hügelkultur beds in a section of a garden, and in other beds, we dig in raw compost or simply rotate cold compost systems until the beds are

ready to plant. And, rather than import soil, I have all the students actively explore varying methods of building a healthy soil ecosystem. Students learn how to grow and nourish soil as a living natural resource.

These experiments and techniques are more adapted to gardening in raised beds or direct soil, but can be extended to gardening in large containers. While it is not uncommon for container gardeners to purchase new soil every year, the methods of this curriculum encourage educators to strive to build their soil, feed and nourish a living system, and for student exploration and ecosystem study.

> "Within every terrestrial ecosystem the living soil—which may only be a few centimeters deep—is an edge or interface between nonliving mineral earth and the atmosphere. For all terrestrial life, including humanity, this is the most important edge of all. Deep, well-drained and aerated soil is like a sponge, a great interface that supports productive and healthy plant life."[10]

In fostering life-rich soils, students focus on the importance of various soil particle sizes, bacteria and mycelium, humus, oxygen, water, and lessening soil disturbance. With every class prioritizing soil health, the garden flourishes in all seasons, especially in the summer. It retains seasonal moisture for longer amounts of time, and the soil slows and holds water in a way that promotes optimal plant health, thus limiting a community's stress about summer watering. Having all student energies focused on fostering soil health gets the plants off to a great start in the spring, which will create even stronger and healthier plants by summertime. In repeating certain seasonal activities, mulching and composting, and engaging in new themes, children who study these lessons keep the garden soil health in mind.

> "The creation of soil…is greater than the sum of the parts. Soil must be understood and managed from this holistic perspective. Soil management is ecosystem management. Ecosystem management in turn is relationship management."[11]

Planting Perennially and All-season

Another perspective that helps garden programs thrive—and limits the stress of summer maintenance—is planting perennials and planting throughout every season. For schools that have summer breaks, garden education really begins in the fall, which is also the end of many annual plant life cycles. The first garden lesson begins in a time of transition. While many other gardens are "being put to bed" to wait for spring planting, fall can be an active season in the youth learning garden.

Permaculture and ecological gardens grow many of the same plants as a more conventional one, but prioritize perennials and all-season, cold-loving plants as well. Throughout the fall, winter, and early spring, a garden can provide taste tests of brassicas, edible "weeds," root vegetables, and plants grown under student-made cold frames or cloches. As a perennial garden becomes more established, natural succession and changes among plant systems will occur. Fruit trees with grow to provide shade, food, and leaf mulch. The seasonal foods and fruits will change, and new plant species may need to be introduced to thrive in changing environments or niches. Crop extension tools such as cold frames, cloches, frost-cloth, and mini-greenhouses can contribute to all-season food production even more. As more perennial or

multi-season plants become established, the amount of labor is often reduced because of the hardiness of these plants. A focus on perennial plants can slowly reduce the stresses of schools over summer garden maintenance.

Summer Maintenance

My summer message for communities is always the same: harvest, eat, and harvest some more! Gardeners can promote longer fruiting periods by harvesting regularly from many annual plants. And the opportunity to harvest free food is an activity some people love to do and will go out of their way to enjoy.

Because of the intense summer heat and wind that often sweeps across the region I live in, I don't usually ask volunteers to pull weeds. The only cool hours of the day are well before noon, so I say that if the work isn't done by the end of the school year, then "oh well!" Another reason that I don't ask volunteers to pull weeds is because the vast subjectivity about what is a weed. Some so-called weeds are foods that students love to eat, or they provide excellent medicine or increase soil vitality and habitat.

> "Weeds are perhaps landscape 'pests', but they are not landscape predators. In fact substantial research suggests just the opposite, that weeds are caretakers of the soil. From the ecological perspective, weeds are plants like all others."[12]

If I don't want certain "weeds" to go to seed, I will trim back potential seed heads and consider their removal in a less energy-draining season. But after months of intensive gardening and science experiments, the heat of the summer is a school gardener's version of "winter rest." Now is the time to rely on all the careful work the school has done in the garden and see how successful it was when the students return in the fall.

In my experience, when the students do return, it is to a lush, jungle garden. Most plants survive, a few do not—but what a great learning opportunity! And every year, the students can come back into the garden to a ready feast. They will spend months munching on tomatoes, beans, edible flowers, cucumbers, rhubarb, and so much more. And because of the vibrant soil health, these plants last far into the fall and provide months of produce for the community to eat.

Share the Surplus

A school garden reality that I don't address in these lessons is what to do with the surplus produce from the garden. I note opportunities for seasonal taste testing at the end of almost every lesson, and a few harvest celebrations and events that are possible. Taste testing is a great way to explore new foods and flavors. The ritual of sharing a small meal after class allows for regular conservations about flavor, preference, recipes, and changing taste buds. Foraging is my preferred method of student taste test experience, though the ability to forage-and-eat in a school garden may depend on regional and district regulations. However, when children forage for their food, then they take ownership of their choices and are more open to new experiences, seasonality, and experimentation.

> "If we expose very young children to the delight of foraging food in a garden, they are more likely to grow up with a deep and intuitive understanding of our dependence on nature and its abundance."[13]

School Garden Curriculum Outline

	Garden Theme	Fall: Patterns and Change	Winter: Discovery and Observation	Spring: Community and Interdependence
Kindergarten	An Introduction to Gardening	Getting to Know the Garden	Pollination and Seeds	Insects and Garden Species
1st Grade Grade One	Seeds	The Edible Parts of a Plant	Traveling Seeds	Sprouting Seeds Experiment
2nd Grade Grade Two	Pollinators and Cycles	Seasons and Garden Changes	Beneficial Insects and Bird Pollinators	Insect Pollinators
3rd Grade Grade Three	Becoming Soil Scientists	The Garden Ecosystem	Soil Vitality Experiment	Fostering Healthy Soils
4th Grade Grade Four	Vermicomposting	Becoming a Worm Expert	Mini-worm Bin Project	Worms Help Grow a Better Garden
5th Grade Grade Five	Composting	Composting Basics	Compost in a Jar Experiment	Healthy Soils and Garden Plants
6th Grade Grade Six	Rain Gardens	The Way Water Moves	Rain Garden Design	Building a Rain Garden
7th Grade Grade Seven	Renewable Resources	Catching and Storing Energy	Valuing Renewable and Nonrenewable Resources	Using Small and Slow Solution
8th Grade Grade Eight	Leadership and Stewardship	Energy Cycles and Conservation	Designing Systems	Supporting Biodiversity

Honoring the permaculture design principle of *Obtaining a Yield* should be a priority in every season. Each community has different goals and needs in their garden, so the methods of processing produce will vary. Where student hunger isn't a concern, I've seen some schools donate their harvests to local food banks. I've used a school garden as a "free grocery store" for rural families and students who live a distance from a store with fresh produce. Other schools work alongside their food services and nutritionists to incorporate the garden produce into student meals. Find the needs in your school, discuss the dreams and goals of the community around the garden, and acknowledge the reality of accomplishing or building this vision.

> "The experience of abundance encourages us to distribute surplus beyond our circle of responsibility (the earth and people) in faith that our needs are provided for."[14]

The First Lesson

For the first organized lesson at any level, I introduce the space to the students and allow them time to become familiar with the changes

that have taken place over the season. I may point out areas of key interest, but mostly I observe and enjoy the students' discoveries, like the unexpected vine that liberally grew up the side of the fence, beautiful pie pumpkins dotted along the path, or the rich smell of fennel on the wind when students brush by. Before students embark on their quiet exploration, we first sit together outside and come to an agreement about student behavior and communal land ethic.

I introduce each expectation, *Care for Self, Care for Others, and Care for the Land*, and ask the students to brainstorm examples of what each means. As I receive answers, I write them down on a list that will be posted on garden signboards outside of the main gates, in the classroom, or in another public space for all the students and community to see. Since the students envisioned these specific behaviors together, there is a higher expectation to follow those rules as a community.

As students sit in the garden, ladybugs crawl on their shoulders and spiders occasionally fall on their heads. Learning in the garden is a new or difficult experience for many children. Being outside and studying in the space can offer tough transitions and sensory distractions. I find these conditions to be optimal because they give me a chance to address students concerns and their behaviors toward insects, for example, or messy surprises that may await them in the garden. This is also a great time to judge the interests of the group for garden education during the year. What are they excited, curious, or even skeptical about?

A Final Note

The lessons in *The School Garden Curriculum* provide a valuable framework for whole school and community gardening integration, but also space for innovation and additional activities by educators. As an Outdoor and Garden Educator, I typically have only 45 minutes with each class, including transitions, and it is never enough to engage in all the complexities of any subject. I especially wish to explore the cultural diversity of garden foods with children more, but struggle to balance sit-down learning time with the value of hands-on work.

Some teachers are more open to extending garden integration into their own lessons by altering their reading lists and expanding garden themes into their units. When staff step up to integrate garden lessons into their curriculum, I observe remarkable differences in student engagement and knowledge. With children reading, writing, and doing math, and physical activity all around a gardening subject in their classroom, then my lessons provide the real-world experience and application of those subjects. Gardening is no longer a supplemental subject but part of a student's whole learning.

My advice for in-class teachers, educators, volunteers, and parents is to use the activities I provide as hands-on and place-based opportunities, but to extend from them even more. Explore incorporating multicultural nutrition education, agricultural history, advocacy, and food sovereignty into broader classroom curricula and children's learning. Practice community engagement and support local farmers through volunteerism, field trips, and interviews. Bring experts, leaders, and elders into your learning spaces to cultivate awareness, growth, and a community of voices.

A teacher, a parent, or a volunteer can teach these weekly lessons, though having a garden coordinator is a great force for change in any school. The lessons are most successful to student learning if the entire staff or community is dedicated to supporting garden-based edu-

cation in and out of the classroom. As with all teaching tools, this document is for inspiration and adjustment to each community's needs.

The lessons follow an organic and seasonal flow that respects the opportunities that arise each season in the garden, with an intention to develop science skills in young learners. Generally, the fall lessons will involve harvesting, seed saving, and introducing the students to their garden theme. In the winter, when the garden is mostly "asleep" and the weather often doesn't permit as much outdoor garden exploration, the lessons focus on inquiry and exploration into scientific methods. And the spring lessons utilize this developing knowledge and bring it back out to the garden for application and work.

I hope you can adapt and gather inspiration from these activities and extend the lessons I have learned into your own gardens and classrooms. May you and your students find fulfillment in your gardening adventures and may your gardens grow abundantly.

This year of discovery in the garden is a truly kinder garten experience for young students as they begin to interact with the basic values of a permaculture-inspired garden and healthy eating practices. When I am able to implement taste tests each week with this age group and work with them on how to discuss and experience new foods, then I see tremendous behavior differences in later school years. Students who taste spicy, sweet, bitter, and sour garden foods (raw turnips, beets, sprouted seeds, and strange flavor combinations) grow into remarkably adventurous and open-minded eaters.

Beyond taste testing, this year is the class's first introduction to an ecosystem, in the school garden and community. The students identify all the parts of the garden that they will work with in the future: compost bins, garden

FALL
Getting to Know the Garden

1. Garden Exploration
2. Seed Saving
3. Flower Bulbs
4. Planting Garlic Bulbs
5. Mulching
6. The Soil Ecosystem
7. Life in the Garden
8. Creating Compost
9. Compost to Soil
10. Soil Health and Roots

WINTER
Pollination and Seeds

1. Seed Discovery
2. Mini-greenhouses
3. Seed Survival
4. Sprouts
5. The Parts of a Plant
6. What is Pollination?

7|8. Butterflies, Birds, and Flower Shapes

9. Bees at Work
10. Planting Seeds for Spring

SPRING
Insects and Garden Species

1. Slugs and Pests
2. Decomposers
3. Consumers
4. Planting Insect Forage
5. Predators
6. Sowing Seeds
7. Planting Flower Starts
8. Mulching and Weeding
9. Spring Harvest
10. Celebration

beds, secret hiding spots, giant sunflowers, and garden tools. They come to understand how each person, place, and living thing work and relate to each other in the garden, and learn to cherish and honor every element through careful observation and interaction. By getting to know key players like worms, slugs, birds, snakes, the students practice the values of the garden: Care for Self, Care for Others, and Care for the Land.

Older students can be especially influential when it comes to leading by example and passing on these garden values. With older student partners, Kindergartners receive one-on-one guidance for how to interact with insects and living things, how to work like good, careful gardeners, and how to think like scientists with wonder and excitement. Behaviors that may take teachers months to instill in a class of Kindergartners will take a small amount of time when an older student directly engages with a younger one. I have found this collaborative teaching to be an incredible way to introduce the culture of a school garden to a new generation.

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And by having these young students observe pollinators at work, harvest and taste garden foods, plant seeds and watch them sprout, then they are inspired to participate in a positive culture, act with constructive behaviors, and grow a gardening mind-set.

Next Generation Science Standards

Over the year, the students will develop an understanding of what plants and animals need to survive as well as the complex relationships and balances in the garden ecosystem. The class will also engage in the beginnings of the scientific method through observations and wonderings, asking questions and investigating, creating working models and solutions to larger problems, and recording and interpreting data.

Classroom extensions for science, reading, writing, and storylines of this year's units include: mapping weather patterns, recording seasonal changes, and studying what seeds, pollinators, and garden ecosystems members need to survive.

Permaculture Principles

- Observe and Interact
- Catch and Store Energy
- Obtain a Yield
- Produce No Waste
- Use Small and Slow Solutions
- Use and Value Diversity
- Use Edges and Value the Marginal

Fall: Getting to Know the Garden

1 Garden Exploration

Time Frame: 30 minutes
Overview: The students will learn about behavior expectations in the garden and what are the key features.
Objective: To begin learning good garden behaviors and have the students practice taste testing and talking about food.

Introduction (5–10 minutes)

1. Begin introducing the students to what the garden class structure will be like, what activities they will do during class, what an outdoor classroom means, and the special environment that is the garden. Allow plenty of room for questions. Today is about practicing good behaviors and learning to act in garden class as they would in their other classrooms. The guideline for these discussions should revolve around three basic permaculture-inspired tenets that are the centerpiece for garden values: Care for Self, Care for Others, and Care the Land.

2. What kinds of creatures live in the garden? What should students do if they come across them? How should they treat the plants in the garden? When is it permissible to pick plants in the garden? What behaviors, words, and actions should students use in the garden toward each other, the plants, and the creatures that live there?

3. For today's exploration, the students will focus on how to walk carefully through the garden, stay on the paths, how to respond to insects and exciting things they may see, and when to pick or taste test things in the garden. Solicit their suggestions about how to accomplish these goals to the best of their abilities.

Activities (20 minutes)

1. Students will take a tour of the garden space with a teacher or adult volunteer as guides. Key features can be pointed out and discussed with the students (the greenhouse, garden shed, outdoor classroom spaces, compost bins). These spaces should be ones that the students will regularly interact with in the garden or have special rules around them.

2. If there is time for the students to have a free exploration, then they can return to places of interest with a classmate, or discover new features—like a vibrant pumpkin or large tomato. They can also share their favorite places and what features are most exciting for them. They will practice good garden behavior during their exploration. Students can try to identify plants they see and look for the items

In the garden, I discuss with the students how to avoid words like "Gross" or "Bleh!" Rather, I want them to think about flavors and textures by using phrases such as "This isn't a flavor I enjoy" or "Perhaps this would be better cooked." I want students to realize that gardeners put a lot of effort into growing these plants—and that taste buds change over time. Another phrase I learned from a teacher was "Don't yuck my yum!" If students didn't want to finish their taste test, I encourage them to calmly walk over to the compost bins and dispose of the food.

they will be taste testing (tomatoes, kale, cucumbers).

3. Before the students taste test, have them discuss how to try something new, use words to describe taste and texture, and what to do and say if they like or dislike the item.

4. Finish the tour at the compost bins and allow students to practice putting their food waste in the right spot.

Assessment (1–2 minutes)

1. Before students leave, conduct a verbal survey of the garden and behavior expectations, as well as the students' favorite discoveries.

2. What new foods did the students eat and enjoy? What was the most exciting or astounding thing they discovered?

Students carefully harvest sunflower seeds and experience the diverse textures of a seed head.

2 Seed Saving

Time Frame: 30 minutes
Overview: Students will save dry seeds, such as beans or sunflowers, from the school garden.
Objective: To practice a valuable fall skill and explore touching and describing different textures.

Vocabulary

1. Seedpod
2. Harvest
3. Dormant
4. Seed Saving

Introduction (5 minutes)

1. Introduce students to the idea of saving seeds, or collecting seeds and storing them away until springtime to plant. Discuss the value of doing this practice in the fall, as seeds become available, and mimicking winter conditions by storing them in a dark, cool place where they can stay dormant.

2. What is a seed? Why is it important to gather them and store them away? How will seasonal changes affect the seeds if they aren't harvested? What other animals collect seeds for winter? What textures do students expect to experience with the seeds and seedpods? What words can they use to describe different textures?

3. Demonstrate which seeds the students will be picking and how to identify them. With beans, use two examples: one seedpod that is ready to be harvested and another that is not ready or is still green. Have students determine what the differences are between the two examples and which one has traits that indicate the seeds are dry and ready to be gathered. Students should use these traits to identify similar seedpods in the garden (dry, brown, crispy, rather than green and moist). Also demonstrate how to open seedpods and gather the seeds. If

possible, this is a good activity to invite older students to join in and have them work with the younger students to identify dry seedpods and carefully harvest them.

Activities (20 minutes)

1. Using collection cups, the students will explore the garden in pairs or individually to find, identify, and gather dry bean seeds. They should practice careful picking—with two hands—and display focused work, rather than being rushed and competitive.

2. When the students' cups are full or it is the end of the activity, have them deposit the seeds in a labeled paper bag or envelope, and make sure to keep each seed variety separated. The class can gather the empty seedpods and put them in the compost pile.

3. After cleaning up from the activity, have the students reflect on what they discovered during their exploration and their experiences with the seedpods and seed textures.

Assessment (5 minutes)

1. What textures did the students experience that they did not expect? What discoveries did they make? What did the bean pod feel like compared to the bean seed?

2. Finally, take time to make a weather map with the students in their classroom, where they can record observations about the weather changes over the course of the school year (temperature, extreme weather). They can make these observations on the days that they have gardening class. The goal is for students to develop a sense of seasonality and how changing weather conditions relate to the seasonal garden activities, such as saving seeds. *How Groundhog's Garden Grew* by Lynne Cherry has great illustrations for changing seasons and the importance of saving seeds for spring.

Winter

is coming the squirrels say. Time for hibernation. Time for plants to leave and decay. Time for snow to fall. Time for gardens to go to bed. Time for thunder. Time for hail. Time for rain… Now time for Spring again.

— Anonymous Student Poem

Preparation

1. Collection cups
2. Seed/seedpod examples
3. Paper bags for storing seeds
4. A marker
5. Weather map

Resources

• *How Groundhog's Garden Grew* by Lynne Cherry.

NGSS and Activity Extensions

Further in-class studies can include making "observations of local weather conditions to describe patterns over time" (K-ESS2-1: Earth's Systems).

3 Flower Bulbs

Time Frame: 30 minutes

Overview: With the help of older students, the Kindergarteners will plant flower bulbs.

Objective: Younger students will learn how deeply to plant a bulb and build community with another class and for older students to share the culture and values of the school garden.

Vocabulary

1. Bulb
2. Depth

Introduction (5 minutes)

1. The goal of this activity is for older students to learn by teaching and for younger students to learn the garden's cultural values of Care for Self, Others, and the Land by interacting and observing older students at work. The older students will focus on teaching how deeply to plant a seed or a bulb.

> Planting depth varies on seed size, but I simplify this for my students by teaching them to plant seeds twice as deep as the size of the seed. A large tulip and daffodil bulb are great visuals for this message. Gardeners don't usually have measuring tape or rulers on hand, so when students use their feet, hands, and fingers, then gardening becomes an excellent application of mental and intuitive math.

2. Before the activity, have the students brainstorm as a class: What is a bulb? Is it alive? Why do students plant these seeds in the fall? How will they survive the winter? What does is mean when something is dormant? How deep should the bulbs be planted? Which end is the root and which is the stem?

Activities (20 minutes)

1. In pairs—an older student with a younger student—the class will plant flower bulbs in a garden bed or an otherwise color-lacking area of the garden and school grounds.

2. Older students should focus on two goals: teaching their partner how deeply to plant seeds and building community with their Kindergartener by getting to know their name and staying with their partner through the entire activity.

3. Younger students will also focus on staying with their partner and getting their hands dirty by planting the bulbs—the older student shouldn't do all the work!

4. Before cleaning up, students will make sure all the holes they dug are filled in (by hands, not feet) and any extra bulbs returned. Finally, the partners can wash their hands, return their tools, and explore the garden to taste test their favorite plants, with the older students demonstrating plant identification and proper harvesting techniques.

Assessment (5 minutes)

1. Have the older students test their partners. Can younger students thank their partners by name and recall how deeply to plant a seed?

2. Older students should also recall their partner's name and look over their planting site to make sure the bulbs are planted at the correct depth.

Preparation

1. Flower bulbs
2. Shovels

4 Planting Garlic

Time Frame: 30 minutes

Overview: Students will plant garlic bulbs in the garden and practice the lessons they learned from their older student partners during the previous activity.

Objectives: To learn that some plants can grow in cold weather, while others lie dormant under the soil until spring.

Introduction (5 minutes)

1. Introduce the students to a garlic plant by naming the parts of it. What part of a plant is a bulb? What kind of foods and recipes use garlic as an ingredient?

2. Explain how to plant the garlic in the soil and how deeply to plant it. What side of the bulb goes down into the soil? Where are the best places to plant garlic in the garden? Students should strive to plant the bulb twice as deep as the bulb is large and to cover each bulb with enough soil. Have the students recall the lessons they learned about planting bulbs during the previous activity.

Activities (20 minutes)

1. Have students count out five garlic bulbs to start out with, considering the best place to plant them and taking their time to space them apart and cover each one with soil. They can also work in a designated garden bed with pre-dug furrows and should work with their classmates to make sure the bulbs are spaced apart far enough (6 inches). This planting activity can be done in containers too.

2. The students can use their hands or shovels if the soil is too compacted. Adult volunteers can help the students in planting the bulbs upright and with enough soil to cover them. The students can repeat this process for the activity period. They should focus on careful gardening, rather than competitive work.

Assessment (5 minutes)

1. Have the students go back over the places they planted and make sure all the bulbs are covered with soil. Quality control is important. They should make sure the bulbs are planted deeply enough and in the right direction.

2. For the end of class, students can have a taste test opportunity of raw or green garlic (if available), as well as fresh nibbles from the garden foods.

Preparation

1. Garlic bulbs
2. Taste test for students
3. Adult volunteers
4. Shovels

Resources

• A song about planting: *Inch by Inch: The Garden Song* by David Mallett.

NGSS and Activity Extensions

Further in-class studies can include the effect of sunlight of the Earth's surface, identifying seasonal changes, and the Earth's yearly rotation (K-PS3-1 Energy).

5 Mulching

Time Frame: 30 minutes
Overview: Students will "put the garden to sleep" by tucking in the soil and plants with mulch.
Objective: To learn how to protect the garden soil from winter rains, provide habitat for decomposers, and create more nutritious soil.

Vocabulary

1. Mulch
2. Decomposers
3. Hibernate

Introduction (5–10 minutes)

1. Introduce the class to the practice of mulching. One of the last and important fall tasks to do in the garden is lay mulch over the soil. Straw and leaves capture and slow winter moisture, provide a home for important decomposers, and build soil organic matter. Mulch also protects the soil from winter wind, rain, and snow. Just like different mammals and amphibians hibernate during the winter, so do gardeners help the garden hibernate, or "go to sleep," until the springtime.

2. It is important to do careful gardening during this task and be careful of the plants that are still alive during the winter. Messy,

competitive, and sloppy work will not help the garden or the creatures living in it. Each student should focus on "Caring for the Land" by being careful of living plants and not wasting any mulching materials as best they can. Demonstrate the best method to cover the soil and tuck mulching materials in around plants.

Activities (20 minutes)

1. In pairs, students will gather small amounts of straw or leaves and tuck them around still-living plants and over mulched dead plants or bare soil. They will work slowly and do careful work to spread the mulch out on the beds. It is most effective for all students to work in one garden bed at a time. When students have finished mulching with straw, they can go on a taste test tour of the garden with their partners.

2. This is an activity that is excellent for older student and younger student partnerships. With older students helping, the Kindergarteners are productive and focused throughout the whole activity while receiving one-on-one gardening lessons. More experienced student gardeners can reinforce the importance of mulching for the soil and building habitat.

Assessment (5 minutes)

1. Have student groups share their experiences with another group. Did the students discover any worms or decomposers when they were mulching? What plants were still alive in the garden? What plants had already died?

2. Students can finish the activity with a taste test in the garden, either pre-picked or of a specific seasonal plant.

Preparation

1. Straw or gathered leaves
2. Older student partners
3. Volunteers

6 The Soil Ecosystem

Time Frame: 30 minutes
Overview: Students will explore soil samples with an older student partner, sketching and identifying what they see.
Objective: Younger students learn how to behave and interact with insects as well as identify new soil creatures.

Vocabulary

1. Ecosystem
2. Decomposer
3. Predator
4. Consumer

Introduction (5 minutes)

1. Brainstorm with the older and younger students, in turn, before introducing the activity: What kinds of creatures have students encountered in the soil before? What are the best ways to treat and interact with insects and bugs? What is a decomposer, a predator, and a consumer?

2. The goal of this activity is for older students to pass on the important skills of how to best treat insects and living things that make their home in the garden and play valuable roles as decomposers, consumers, and predators. The older students should understand that their role is to show the Kindergarteners through their actions and conversations how to respect living things according to permaculture-inspired principles. The older students can also exhibit how to think like a scientist by asking questions and generating "wonderings" throughout the activity and reinforce the concept of an ecosystem.

3. Before the activity, discuss what an ecosystem is with the Kindergarteners. They should understand that a soil ecosystem is vital to the health of a school garden. The greater the diversity of relationships within an ecosystem,

A *Polyphemus* caterpillar, in the giant silk moth family, travels safely across the shelter of mulch and layered garden plants.

the better balanced and more stable it often is. In the garden, students should celebrate all the insects and bugs they encounter. Sometimes unfamiliar creatures make children uncomfortable, but the students know that they shouldn't be fearful of them. Instead, the students can practice being calm and careful with the creatures they encounter. They are encouraged to think like scientists and ask questions about what they see.

Activities (20 minutes)

1. In partners, the students will work on The Soil Ecosystem worksheet to draw and identify different soil creatures. They can use pencils and magnifying glasses to find and sketch what they see.

2. If they can't identify the insect or bug, then they can use available resources to identify it and/or come up with their own name for it as a group. When the groups have filled up their worksheet with sketches, then they can color their sketches while older students lead a discussion with their partner and write down the questions they generated about the creatures they found.

Assessment (5 minutes)

1. Gathering back together as a group, the students can share one creature they found or participate in a quick survey of what they learned on how to treat insects and bugs. What parts of the soil ecosystem did they discover? What creatures were they unfamiliar with? How many different creatures did they find, and did they discover more of one type than another? What predators, consumers, and decomposers did they identify?

2. When the groups have cleaned up their learning stations, then they can enjoy a taste test in the garden with their partners.

Preparation

1. The Soil Ecosystem worksheets
2. Magnifying glasses
3. Pencils, colored pencils, crayons
4. Clipboards
5. Garden soil samples
6. Tray or plate for soil observation
7. Insect identification books

7 Life in the Garden

Time Frame: 30 minutes

Overview: To the best of their ability, students will search for and identify five key insects in the garden.

Objective: To practice how to behave around the insects in the garden and discover what roles they play in the garden ecosystem.

Vocabulary

1. Scientist
2. Observe
3. Insects
4. Habitat
5. Behavior

Introduction (10 minutes)

1. Begin with a brainstorm and quick share of what types of mammals and insects the students have seen in the garden. What creatures do they expect to see on a "safari" or exploration of the garden? What creatures live under the logs and rocks? What will students see flying in the garden?

2. The students can review what insects and creatures they discovered in the last activity with their older student partners, how they responded when they found something that made them uncomfortable or excited, and what behavior they used when interacting with the insects. How did they speak, move, or touch the insects? How did they Care for Self, Others, and the Land?

> The insects and creatures in the permaculture garden are valued as a part of the ecosystem. Students may encounter bugs and insects that concern them, such as slugs and snakes, but they should understand that all these creatures have a role in the garden ecosystem, even if they don't know or understand them yet. I encourage students to speak softly, not yell, and be very gentle with insects if they pick them up.

3. Students should put on their "scientist glasses" for this activity; let them observe their surroundings with wonder, questions, and without judgment (such as "Eww!" or "Gross"). If students feel uncomfortable about an insect, bug, or living thing, they should calmly walk away to a new spot without screaming, shouting, or making loud noises. Students should understand that it is OK to feel uncomfortable, but that they need to respond calmly during the activity. This is a great opportunity to introduce the students to how scientists observe the world: with constant curiosity, wonder, and questioning.

> Scientist glasses are plastic glasses without lens I give to the young students when they are doing observation activities. These glasses give them the power to look at the world like scientists, with wonder and questions, and give greater strength to their eyes and observation skills.

4. What are words that scientists would use to describe the creatures they come across? Where would a scientist look for insects and bugs in the garden?

Activities (15 minutes)

1. In pairs, the students will put on their glasses and explore the school garden with their Life in The Garden worksheets. They will search for slugs, worms, pill bugs, centipedes, and another creature of their choice or discovery, count how many they see, and observe their behavior and habitat.

2. The students will focus on working with their partner to complete their worksheet and should think like scientists by coming up with wonderings and questions about the creatures they encounter. Students who need help writing can seek an adult volunteer to assist them.

Assessment (5 minutes)

1. After the activity is finished and cleaned up, have the students reflect on what they discovered, through a class survey or quick story share.

2. What wonderings and questions did the students come up with during their activity? What new creatures did they discover? How did they treat and behave toward these creatures?

Preparation

1. Life in The Garden worksheets
2. Scientist glasses
3. Clipboards
4. Pencils or crayons
5. Adult volunteers

8 Creating Compost

Time Frame: 30 minutes
Overview: Students will explore the school compost systems and learn about all the ingredients in healthy compost.
Objective: To understand the importance and purpose of the school compost system and the role of decomposers.

Vocabulary

1. Compost
2. Decomposers
3. Brown/Green Materials

Introduction (5–10 minutes)

1. Brainstorm with the students what they know of composting: Do they have a bin at home, in their classroom, or in the cafeteria? What do they put into it? What is a decomposer? What decomposers have the students encountered in the garden before?

2. On a class poster, generate ideas about what materials can be added to a compost bin and work with the students to identify which ones can be considered green and brown composting materials.

Activities (15–20 minutes)

1. The class will read *Compost Stew: An A to Z Recipe for the Earth* by Mary McKenna Siddals and discuss key ingredients in the compost and the importance of creating nutritious soil by limiting food waste. Looking back at the class poster, are there materials that should be added or moved on the list?

2. After the book and discussion, students will each receive an ingredient to add to their own "compost stew" and create compost as a class, by adding living ingredients (soil and decomposers), green, and brown materials. This class-made compost can be added into outdoor or garden compost bins so the students will know which bins to put their compost in during the school day.

Assessment (5 minutes)

1. What ingredients should not be added to the compost bin? Finish the activity with a conversation with the students about fruit stickers in the compost and the dangers of plastic and garbage in the ecosystem.

2. As always, a taste test is a great way to end the activity, especially since it will give the students another chance to practice putting any food waste in the compost bin.

Preparation

1. *Compost Stew: An A to Z Recipe for the Earth* by Mary McKenna Siddals
2. 20–25 compost ingredients, including food waste, decomposing compost, and living decomposers

Resources

• *Compost Stew: An A to Z Recipe for the Earth* by Mary McKenna Siddals.

9 Compost to Soil

Time Frame: 30 minutes
Overview: The students will sift finished compost to put on the garden beds and learn about how compost becomes healthy soil.
Objectives: For the class to continue engaging with the decomposition process, learn how some materials break down faster than others, and how food waste can turn into soil or humus.

Vocabulary

1. Living and Nonliving Materials
2. Nutrients
3. Sift
4. Humus

Introduction (10 minutes)

1. Brainstorm with the students what materials they added to the compost during the previous class. Review what the decomposition process is and why it is important to gardeners. What are living and nonliving elements that are a part of the compost system? How does composting create nutrient-rich humus?

2. Materials in the compost decompose at different rates, and some materials need more time to break down. A good example of this is a sample of nearly finished compost or a sample of the garden soil with many years of mulching materials. In order to remove some of the pieces that need more time to decompose, the students will be sifting the compost, harvesting nutritious soil from the decomposed food waste, and returning the larger pieces back into the compost pile.

3. Demonstrate to the student where the stations are (gathering compost, sifting, compost pile) and how to do each task collaboratively and carefully.

Activities (15 minutes)

1. In small groups or partners, the students will gather and sift completed compost. Every student will use containers (black plastic planting pots) and a small shovel to gather compost from one of the ready compost piles (hot or cold) into their container. Students may need an adult volunteer to help them with the tasks.

2. When students have their samples, they will carry them over to the sifting station. As a group, the students will pour their compost onto a screen or a planting tray with small holes, held over a large bucket or wheelbarrow. Students will gently shake their compost sample back and forth, sifting the finer and decomposed items from the larger and less decomposed pieces with the sifting screen. When their sample has been sifted, students will gather the less decomposed pieces that have fallen down and put them in a bucket to observe later. The students can repeat this process until the activity time is done. The sifted compost will be stored for next week's activity.

3. The students can clean up or return their supplies and tools and return to the gathering space to share their experiences.

Assessment (5 minutes)

1. Student volunteers can pick one item from the less decomposed bucket of materials—the ones that didn't fall through the screen. As a class, the students can try to identify the item and discuss why the material didn't break down. How long do they think it will take for the material to decompose? What insects, bugs, or mammals do they think would like to eat it? Is this material living or nonliving?

2. Pass around a sample of the finished compost. What words can students use to describe the texture and smell of the finished compost?

Preparation

1. Finished compost ready for sifting
2. Adult volunteers
3. 4-inch black planting containers
4. Wheelbarrow
5. Sifting tray
6. Gloves for students to handle compost
7. Trowels

Resources

• "Sifting Compost" in Patrick Lima, *The Natural Food Garden: Growing Vegetables and Fruits Chemical-free*.

10 Soil Health and Roots

Time Frame: 30 minutes

Overview: Students will apply their new knowledge of composting and plant root crop seeds in finished compost.

Objective: To discuss soil health and encourage nutritious soil and humus by applying finished compost in the garden and planting a spring food source.

Vocabulary

1. Root Crop
2. Organic Materials

Introduction (10 minutes)

1. During the last class time, the students harvested healthy soil for the garden by sifting finished compost into a fine soil. This soil is full of nutrients in the form of small pieces of decomposed plants and cafeteria waste that can best be accessed by microbes, decomposers, and plants.

2. By creating soil from organic materials, the students can grow healthy plants for their community to eat. Brainstorm with the students how plants take in these nutrients. What part of a plant helps it in taking up these nutrients? What roles do roots perform for a plant? What kinds of roots do students like to eat? Why do humans eat them?

Activities (15 minutes)

1. Individually, the students will gather cups of finished nutritious compost they gathered and spread it over a garden bed or fill up a deep black planting pot (three- to five-gallon). Students should pay attention to spreading the compost out evenly, not wasting this valuable resource, and doing the careful work of a gardener. They can repeat this process until the compost is gone or the bed/container is adequately filled or covered.

2. When the compost has been spread, the students will receive the seeds of a root crop (carrots, beets, radishes) and plant them in the soil. After they have scattered or sowed the seeds, they can gently put the seeds into contact with the soil by applying soft pressure with the palms of their hands. This will ensure seed-to-soil contact. Students should notice that the seeds are so small that it will be difficult to bury them twice as deep as the size of the seed.

3. Alternatively, the students can fill up a small planting container and accomplish the same activity.

Assessment (5 minutes)

1. When students have completed the activity, they can enjoy a taste test of the same types of root vegetables they planted (carrots, beets, radishes, turnips).

2. For an enhanced activity, have the students compare the taste test between a crop that has been grown in organic soil and another that hasn't, or has been grown with aquaponic liquid fertilizers. Can they experience differences in taste and texture? The student reflections can tie into the previous conversation on the benefits of healthy, nutritious compost.

Preparation

1. 4-inch black planting containers
2. Root crop seeds
3. Prepared taste tests
4. Sifted compost

Winter: Pollination and Seeds

1 Seed Discovery

Time Frame: 30 minutes
Overview: The students will explore different seed shapes and the unique features of each seed variety.
Objectives: To begin understanding the role of seeds and the diversity of their shapes, sizes, and colors.

Vocabulary

1. Diversity
2. Texture

Introduction (5–10 minutes)

1. Brainstorm with the students what they know about seeds. Write these responses on a poster for future reference. What is a seed? How can students tell something is a seed? What are the characteristics of a seed? Why are they so important to gardeners?

2. Students will be introduced to the great diversity of seeds, especially those from the garden. There are many shapes, colors, sizes, and characteristics of seeds that aid them in survival. Visual guides, such as *A Seed Is Sleepy* by Diana Aston, can be provided to help students understand this concept.

Activities & Assessment (20 minutes)

1. Individually, the students will receive cups with mixed seeds and sorting trays (egg cartons). Using any available tools (tweezers, spoons) or their hands, the students will be guided to sort the mixed seeds into cups based on color, texture, and shape.

2. Students who finish their sorting can go a step further by counting the seeds in each variety and recording the number on a board for the class to observe. Then, the students can sort their seeds again based on the next sorting method (color, texture, and shape).

3. Students will share their sorting methods with a partner. As a class, they can also explain their reasoning, observations, and discoveries as they explored the seeds. Were there any seeds that didn't fit into their sorting method? What seeds can students identify by name? How did students sort the seeds in their mixture? What wonderings and questions do students have about seeds?

4. When the students have finished sorting and reflecting, they can clean up their trays and remix their seeds before returning them.

Preparation

1. One egg carton for each student
2. Cups with mixed seeds
3. Tweezers and spoons

Resources

- *Seeds* by Ken Robbins.
- *A Seed Is Sleepy* by Dianna Aston.
- "Seed Sensation: Exploring and Sorting Seeds." (online—see Appendix B).

2 Mini-greenhouses

Time Frame: 30 minutes
Overview: Students will plant seeds for classroom observation and make predictions about plant growth.
Objective: To set up an ongoing experiment in order to observe seed sprouting, growth, and the parts of plants.

Vocabulary

1. Seed Coat
2. Stem
3. Sprout
4. Greenhouse

Introduction (5–10 minutes)

1. What do students know about what seeds need to thrive? What compels a seed to move from a stage of dormancy to sprouting? Brainstorm with the students what they know about seeds and how they grow.

2. Students will be assembling mini-greenhouses in class and watching seeds sprout and grow. As a class, they can prepare for this experiment by brainstorming their "wonderings" and what they think will happen. How does a seed sprout? Discuss with the students about the parts of a seed they will discover during the growth process (seed coat, stem, and root).

Activities (15–20 minutes)

1. Individually, each student will get a clear plastic cup, a napkin, and five seeds for their greenhouse. They will wet their napkins with a spray bottle until that they are damp and gently fold them in the bottom of the plastic cup.

2. Then, they will collect their five pre-soaked seeds and line them up at the bottom of their cup between the napkin and the plastic siding so that the seed is moist but the students can see them. The cups can be placed in a window, on student tables, or in another place where students can observe them growing every day.

3. When the seeds have been "planted," the students will receive a small piece of clear plastic, or another cup, to put over the top to trap moisture and heat. A volunteer can help write student names on the cups.

Plastic cups are not ideal, but I usually have to use whatever is on hand. Glass jars and other clear reusable containers are better alternatives.

Assessment (5 minutes)

1. When students have finished assembling their greenhouses, they can gather back together and discuss what they discovered about their seeds. Did they see the seed coat splitting or roots emerging on their presoaked seeds?

2. How long do they think it will take the seeds to sprout? Students should understand that not all seeds sprout and not to be disappointed or feel like they failed. Some seeds will grow quickly, others take longer, and some don't grow at all. This is an opportunity to think like scientists and develop wonderings about how and why seeds grow.

Over the next few weeks, students should be encouraged to observe their seeds sprouting every day and to take the lid off for a short amount of time to let their plants breathe. This is a great chance to encourage scientific thinking in students by creating a class chart documenting seed sprouting and growth.

Preparation

1. Pre-soaked bean seeds
2. Clear containers
3. Napkins
4. Clear lids or plastic wrap
5. Spray bottle
6. Adult volunteer

Resources

• Deborah Stewart. "Creating a Mini-Greenhouse in Preschool." (online—see Appendix B).

3 Seed Survival

Time Frame: 30 minutes
Overview: The class will read *The Tiny Seed* by Eric Carle and learn about what seeds need to survive.
Objective: For students to understand how soil, air, water, and sunlight play a role in the growth and cultivation from a seed to a plant.

Vocabulary

1. Survival
2. Environment

Introduction (5–10 minutes)

1. During the last lesson, students planted seeds in their mini-greenhouses. How will they keep those seed growing and flourishing? What should students do to help the seeds survive? What do seeds grown indoors or outdoors in the garden need to thrive?

2. Before their activity, the students can create hypotheses about seeds and record their thoughts on a classroom chart. Why are soil, water, wind, and sun so important to seeds and plants? What do they each offer for the plant's survival? What environments do different seeds prefer?

Activities (15–20 minutes)

1. As a class, the students will read *The Tiny Seed* by Eric Carle. They should be aware of the differences between the reality of a seed's life and the fiction in the book. What events in the book could happen to a seed in the school garden? What was the right environment for the seed to grow in? Why did the other seeds not survive?

2. The students can observe different soil types in sample containers that are passed around. Each variety of seed needs a certain amount of sunlight, water, soil type, and wind. What differences can students spot in the various soil types? What soils would seeds prefer to grow in and why? Using their hypothesis from the beginning of class, what have students learned about seeds and how they grow? What ideas have changed since the beginning of class?

3. The students can finish the activity by carefully watering the plants in their mini-greenhouses and removing the covers to give them air.

Assessment (5 minutes)

1. Did students note any changes or growth to their seeds in the mini-greenhouses? Are the seeds getting enough water, soil, sun, and air? If not, what changes can the students do to provide these things for the seeds?

2. The students should be prepared to understand that not all seeds survive. Some seeds can have all the right balances of sun, wind, soil, and water but still not grow. That is OK. This happens when gardening, which is why gardeners plant multiple seeds together!

Preparation

1. Soil samples
2. Water for seedlings
3. Classroom poster

Resources

- *The Tiny Seed* by Eric Carle.

4 Sprouts

Time Frame: 30 minutes
Overview: Students will study the growth of their plants in the mini-greenhouses and learn about the nutritional value of sprouts.

Objective: For students to understand the process of seed growth and the different parts of a sprout.

Vocabulary

1. Photosynthesis
2. Cotyledon
3. Seed Coat
4. Roots
5. Germinate
6. Protein

Introduction (5–10 minutes)

1. Brainstorm with the students about what changes they have noticed with the seeds in their mini-greenhouses. Have them reflect on their observations and what parts of the seeds they see emerging.

2. Using a student's sprout as an example, have the class explain the growth of the seed and how the plant is developing. Which part of the plant emerged first? What stories can students tell about plant growth—when did it begin? How fast is it growing?

3. Introduce students to the term *cotyledon*. The cotyledon is the embryonic leaf or leaves, or simply the "baby" leaves of a sprout. As I explain to students, similar to "baby teeth," these leaves will fall off the plant when their adult leaves grow. In the bean seeds that the students planted in their mini-greenhouses, the cotyledon is inside the dormant seed, even when they are dehydrated. These little leaves help the sprouted seed begin harvesting sunlight through photosynthesis.

Activities (15–20 minutes)

1. Individually, the students will carefully handle their mini-greenhouses and observe the changes their seeds have encountered. They will try to identify the cotyledon, roots, stem, and seed coat of their seeds. If possible, they can record their findings on a classroom chart by counting how many seeds sprouted and which have roots or cotyledon (it's never too early to introduce scientific thinking and processes).

2. After students have observed their plant growth, they can reassemble the greenhouses and water their seedlings if needed.

3. The students can enjoy a taste test of pre-sprouted seeds and discuss how nutritious the sprouted seeds are for humans by making proteins more available—for further information, see Resources.

Assessment (5 minutes)

1. After the taste test, the students can gather back together to reflect on their findings and what they recorded on the class chart.

2. Were all the seeds in the mini-greenhouses at the same stage of growth? How many seeds have sprouted? Were there parts of the sprout that they didn't know or couldn't identify?

Preparation

1. Sprouts for students to taste test (alfalfa, mung bean, garbanzo beans)
2. Chart for recording findings

Resources

• J. K. Chavan, et al. "Nutritional Improvement of Cereals by Sprouting." (online—see Appendix B).

NGSS and Activity Extensions

Further in-class studies could include making observations on and describing patterns of what animals and plants need to survive (K-LS1-1: From Molecules to Organisms).

5 The Parts of a Plant

Time Frame: 30 minutes
Overview: Students will explore the basic parts of a bean plant and discuss the role of each part.
Objective: To identify key parts of a plant and make observations about them.

Vocabulary

1. Roots
2. Stem
3. Leaves
4. Flower
5. Cotyledon

Introduction (5–10 minutes)

1. Brainstorm with the class about what observations the students made about the growth of their seeds. What parts of the plant are emerging that they recognize or don't recognize?

2. As a class, the students will help identify at least four different parts of a bean plant: roots, stem, leaves, and flowers, and will define them on a poster for the class to reference later. As each part is listed/drawn, have the students discuss the role of each part to the plant as a whole.

All the parts of a nasturtium plant for the students to observe.

Activities (15–20 minutes)

1. In pairs, students will receive a sprouting seed from their indoor seed experiments and identify the different parts of a plant that they observe. Then, each student will work on The Parts of a Plant worksheet, focusing on correct labeling and spelling the parts of a plant. They can use the class chart as a reference for spelling.

2. When students have finished, they can color or decorate their worksheets.

Assessment (5–10 minutes)

1. Gathering the students back together, have them share the parts of the bean plant they identified with their observation examples. What parts of a plant were they unable to find but was on their worksheets? These observations will be preparation for the next lesson about the process a plant goes through in producing a flower and fruit.

2. Finally, students can disassemble their mini-greenhouses and either compost their seedlings or plant them in pots of soil for further study.

Preparation

1. Sprouting seed examples
2. The Parts of a Plant worksheet
3. Classroom poster

6 The Pollination Game

Time Frame: 30 minutes
Overview: Students will be introduced to the process of pollination and learn about the importance of pollinators in the school garden.
Objective: To value insects in the garden, especially pollinators, and become more comfortable with insects by understanding them as scientists and gardeners.

Vocabulary

1. Pollination
2. Pollinator
3. Nectar
4. Pollen

Introduction (10 minutes)

1. Brainstorm with the class and record their ideas and wonderings on a classroom chart. How and why do some plants produce flowers? What do the students know about pollen, pollination, or pollinators? Have they ever seen any pollinators before? What types of insects visit flowers?

2. Do all pollinators fly? How do they find their way from flower to flower? What would the garden be like if gardeners didn't have pollinators?

Pollinators play a very important role in gardens. Without pollinators—such as honeybees, mason bees, leafcutter bees, bumblebees, ants, wasps, hummingbirds, butterflies, and moths—we wouldn't enjoy many of the delicious fruits that grow in the garden. Each pollinator has a variety of flower colors and shapes that attract them. That is one reason why there are so many different varieties in flowers. For example, bumblebees prefer small flowers, especially purple and white ones. Hummingbirds tend to go for pink, red, purple, and even blue flowers with a long cone-like shape.

Activities (15 minutes)

1. This game can be performed in a variety of ways, but the students will need space for all of them. For the game, each student will become a pollinator. They will get a picture of a pollinator (hummingbird, honeybee, mason bee, butterfly) taped to the front of their shirt and another picture of a color (red, orange, yellow, white, purple) also taped to their front. The color of the flower should not be one their pollinator prefers. In this way, the student will be both a "flower" and a "pollinator," depending on the rules of the game.

2. The goal of the game is for the students to identify the colors that pollinators prefer and to engage with this knowledge throughout the activity. Again, the flower color on their shirt isn't necessarily the one their pollinator prefers. The games will be tag-like, but the teacher can direct the focus of each round. It can be a free tag game, where each pollinator tries to tag someone who has the flower color their pollinator prefers (hilarious chaos), or a game where only the pollinators that like them tag the red flowers and everyone else freezes for a small amount of time. It can also be as a "hawks and mice" game, where pollinators try to capture certain colors as they run past. Another variation is to have the "flowers" gather together according to color.

While many pollinators have mechanisms to help defend them, most are harmless for students in the garden. During the games, none of the students should feel the need to "sting" or "bite" as they imagine a certain pollinator might do!

Assessment (5 minutes)

1. At the end of the activity, gather the students back together and have them reflect on the colors their pollinators prefer. Can they remember which flowers the pollinator likes?

2. As a pollinator, is it easier or harder to spot these colors when they are grouped together or spaced apart? How do they imagine gardeners can help out the pollinators in their own pollination race? How can students best plant flowers in the garden while keeping this knowledge in mind?

Preparation

1. Pollinator and flower color identities/ stickers

Resources

• "12 Plants to Entice Pollinators to Your Garden." (online—see Appendix B).

NGSS and Activity Extensions

For greater conversations about plant and animal adaptations, the students can extend their studies into learning how plants and animals can change their environment to fulfil their needs (K-ESS2-2: Earth's Systems).

7|8 Butterflies, Birds, and Flower Shapes

Time Frame: 30 minutes for each activity (one hour total)

Overview 7: Students will learn about how butterflies and hummingbirds pollinate and which flower shapes they prefer.

Objective: To identify the unique physical characteristics of hummingbirds and butterflies as pollinators and begin identifying flowers that can support their work.

Vocabulary

1. Antennae
2. Proboscis
3. Nectar

Introduction and Activity 7 (30 minutes)

1. Begin class by brainstorming with the students about the experiences they have had with butterflies and hummingbirds in the garden. How can the students they tell the differences between the two flying pollinators? Record student ideas on a classroom chart.

2. Hummingbirds and butterflies are both pollinators that harvest nectar in similar ways, but with different tools and preferences. Both use a long tongue to drink nectar from flowers. For butterflies, this straw-like tongue is called a *proboscis*. What colors of butterflies and hummingbirds have students seen before? Do they know any specific names of these creatures?

3. Have any students seen the birds and butterflies visit flowers? What shape of flowers did the pollinators visit? Even though hummingbirds and butterflies visit flowers for nectar, how do they help pollinate in the garden?

4. Using books and images, have the students point out key and distinguishing features for hummingbirds and butterflies (feathers, wing shape, colors, antennae, beak, tongue). Discuss how the flexibility of the butterfly's long tongue allows it to drink nectar from a greater diversity of flower shapes, while the hummingbird's rigid beak helps it drink nectar from flowers with long cone shapes. These observations can be illustrated and listed on a classroom chart.

5. If possible, use a model of a cone- or trumpet-shaped flower to demonstrate how butterflies and hummingbirds use their tongues (and hummingbird beak shapes) to drink nec-

tar. Compare the flexibility and length of their tongues to how difficult it would be for a hummingbird to try and gather nectar from a flat or plate-shaped flower, like a sunflower.

Activity 8 Overview 8

Using their knowledge of hummingbirds, butterflies, and the flower shapes they prefer, the students will plant a variety of flowers indoors for future garden pollinators.

Activity 8 Objectives

To learn about garden flower varieties that encourage pollinator activity and provide forage, while also learning how to plant flower seeds in pots.

Activity 8 Introduction (5–10 minutes)

1. Brainstorm with the students about the flower shapes hummingbirds and butterflies prefer. Do students know what garden flowers have these shapes? What colors are the flowers? The class can refer to their previous classroom posters for brainstorm ideas.

2. What garden flowers do the students know about that have colors the two pollinators prefer, such as red, purple, pink, white, and yellow? Honeysuckle, salvia, and bean plants are all options for hummingbirds, while milkweed is a great option for monarch butterflies.

3. For the planting activity, students should be able to recall how deeply to plant their seeds and how high to fill the container with soil. What does good, careful gardening and positive behavior look like in this activity?

Activity 8 (15–20 minutes)

1. Individually or in pairs, the students will plant a variety of flowers for pollinator forage, specifically butterflies and hummingbirds. They can plant multiple types, but they should be in separate containers from each other and make sure they are labeled correctly. The students should focus on carefully planting the seeds and filling up the soil containers to the top with soil.

2. The students can choose from a variety of seed types, especially with the colors and shapes that the pollinators prefer.

3. When the students have planted the seeds and labeled them (with the help of volunteers), they can water them with a watering can.

Activity 8 Overview (5 minutes)

1. After the class has finished planting, they can clean up the workstations and move the seed starts to a greenhouse or indoor growing

A lovely garden pollinator lands on my hand for students to study its anatomy.

area. What flowers did the students plant? What pollinators do they expect will visit them?

2. When the students are done, they can enjoy a taste test of winter garden foods.

NGSS and Activity Extensions

There are so many excellent classroom extensions and resources on hummingbirds and butterflies. These activities merely scratch the surface of potential in-depth studies, reading, and math opportunities about life cycles and pollination. Further in-class studies and storylines could include following bird and butterfly migration routes or developing a model to illustrate the relationship between the needs of various plants and animals within the places they live (K-ESS3-1: Earth and Human Activity). The students could also develop and propose solutions to reduce human impact on natural systems and living things (K-ESS3-2: Earth and Human Activity).

Preparation 8

1. 4-inch pots
2. Soil
3. Flower seed varieties
4. Tape for labeling
5. Markers
6. Watering can
7. Classroom posters

Resources

- "The Bug Chicks: Butterflies & Moths." (online—see Appendix B).
- Everyday Mysteries. "How can you tell the difference between a butterfly and a moth?" (online—see Appendix B).
- *Gotta Go! Gotta Go!* by Sam Swope.
- *The Very Hungry Caterpillar* by Eric Carle.
- *My, Oh My—A Butterfly! All About Butterflies* by Tish Rabe.

9 Bees at Work

Time Frame: 30 minutes
Overview: The class will learn about the diversity of pollinating bees and play an identification game.
Objective: To demystify bee pollinators and for students to identify key pollinating players by their different characteristics.

Introduction (10 minutes)

1. Every student will have a story to share about a bee. During the following conversations, the students are encouraged to think like scientists and gardeners and wait to share their stories until the end of gardening class.

2. Brainstorm with the class about what kinds of bees the students know about. What pollinating bees have they seen in the garden before? Why are pollinating bees so important to the garden? Record student ideas on a classroom poster for future reference.

> Young students often want to talk about painful wasp experiences. I prefer to be direct in these conversations by emphasizing repeatedly that wasps and bees are not the same, that wasps and yellow jackets prey upon bees, and that their behaviors are very different.

3. For this activity and all of remaining the gardening lessons, it will be important for the students to become familiar with three active bee pollinators: the honeybee, mason bee, and bumblebee. There are many types of each bee, but most share certain traits that can help in

identifying them. If the students can recognize these traits and differences, then they can think and behave like scientists in identifying each species.

4. Using a picture of each bee species (honeybee, bumblebee, and mason bee), have the students identify each one or notice the differences between each type. How can they remember these bees if they were to see them in the garden? What makes each bee memorable and unique? Record these distinguishing differences on a classroom poster.

Activities (15 minutes)

1. For their activity, the students will be thinking and behaving like scientists by using what they know to identify different pictures of the three bees that are hidden across the room or garden space. In pairs, they will first have to find the pollinator picture and then use their Bee Guide worksheets to help them identify what bee species it is. They will make a tally for each species they identify and will report this number back to the class at the end of the activity. If it is possible to go outside and do this activity, I recommend it.

2. Students should focus on teamwork and creative problem-solving. They shouldn't worry about finding all the pollinators, but rather on correctly identifying each bee. This is will also provide practice in looking for live insects in the spring garden, so they can pretend it is real by keeping calm and using a low voice when they do this activity.

Assessment (5 minutes)

1. Bringing the class back together at the end of the activity, have the students share the quantity of pollinators they found and the type of bees they discovered.

2. Were there any pollinators that were difficult to identify? Which bees were easy to discover and name? Use the classroom posters from the beginning of the activity to clarify any misidentified bees.

Preparation

1. Bee Guides worksheets
2. Pictures of a bumblebee, honeybee, and mason bee
3. Classroom posters

10 Planting Seeds for Spring

Time Frame: 30 minutes

Overview: Students will plant vegetable seeds in pots that will later be transplanted into the garden.

Objectives: For students to continue practicing their seed planting and careful gardening, while beginning to imagine what the school garden will look like with their favorite foods growing.

Introduction (5–10 minutes)

1. Now is the time of year to begin planting the seeds that will flourish all summer and feed the students in the fall. Today, they will be planting warm season crops, such as sweet melons, cantaloupe, cucumbers, and tomatoes that will grow in a greenhouse, indoors under a growing light, or near a window until they are ready to be transplanted outside.

2. As a class, have the students brainstorm how deeply to plant seeds. At this point in the year, they have planted many seeds and bulbs of various sizes. All students have different descriptions of how deeply to plant seeds (a finger deep up to a knuckle). I recommend having the seeds twice as deep as the seed is large. This

is quite a concept for young students, but they should understand that many seeds need to be completely covered by the soil and not so deep that they are weakened before they reach the soil surface.

Activities (15–20 minutes)

1. Individually, students will pick out which variety of seeds they want to plant and will gather pots, soil, and seeds for their planting activity. Adult volunteers can help the students write their names on tape to put on the containers.

2. Students will need to focus on carefully planting their seeds and how deeply to plant them, as well as how much soil to put into the pots. I encourage students to keep the soil light and fluffy, rather than tamp it down with their hands.

3. The students will rotate through the available stations and work collaboratively and kindly with their classmates to do their best work.

Assessment (5 minutes)

1. When students have finished planting their seeds, they can clean up and enjoy a taste test of foods from the garden (chives, sorrel, kale, cabbage).

2. Students can also check on the growth of the flower seeds they planted weeks before.

Preparation

1. Summer seeds (watermelon, cantaloupe, cucumbers, tomatoes)
2. Soil
3. 4-inch pots
4. Tape and markers
5. Adult volunteers

Spring: Insects and Garden Species

Even slugs this large can provide opportunities for student learning, wonder, and garden math.

1 Slugs and Pests

Time Frame: 30 minutes
Overview: The students will learn how slugs play a role in an ecosystem and go on a slug hunt in the garden.
Objectives: To understand the important role that even perceived pests play in the garden and understand how these creatures are part of a permaculture and ecological garden.

Vocabulary

1. Ecosystem
2. Pest
3. Predator
4. Decomposer
5. Consumer