Permaculture Guide

From Appropedia

OSU Permaculture Garden: 2008-2009

Introduction

The OSU Permaculture Alliance was established in fall of 2008 for the advancement of education in permaculture and sustainable land management at Oregon State University. Beginning with a small grant of $4,000 from the Student Sustainability Initiative, our group has launched a garden project, landscaping the .2 acres surrounding the Student Sustainability Center. The Permaculture Alliance, in partnership with the Student Sustainability Initiative, has organized the construction of the garden through regular club meetings, petitioning for and attaining an accredited permaculture course at OSU, and by holding workshop with experts in various aspects of permaculture design and environmental science. Our garden is intended to be an educational tool for students to experience both the work and the rewards of creating sustainable and self-reliant food systems.

To ensure that the knowledge we have attained throughout the project is not lost as the garden changes hands to future generations, this document is intended to record the process by which the garden was established. The following is a step by step explanation of the design process and construction of main features in our landscape, including the logic we used to make decisions and the lessons learned from our mistakes.

Our design process was based on David Holmgren's Twelve Principles of Permaculture Design (see Principles of permaculture). Each feature in our garden was built to reflect several of these principles.

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 1. Observe and interact - By taking time to engage wit
 2. Catch and store energy - By developing systems that
 3. Obtain a yield - Ensure that you are getting truly 
 4. Apply self-regulation and accept feedback - We need
 5. Use and value renewable resources and services - Ma
 6. Produce no waste - By valuing and making use of all
 7. Design from patterns to details - By stepping back,
 8. Integrate rather than segregate - By putting the ri
 9. Use small and slow solutions - Small and slow syste
10. Use and value diversity - Diversity reduces vulnera
11. Use edges and value the marginal - The interface be
12. Creatively use and respond to change - We can have 
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You will see these principles referenced throughout this document to emphasize how our group has brought permaculture theory into practice.

Site Analysis and Observation:

Permaculture is a design technique that hinges upon careful and protracted observation. Awareness of solar orientation, prevailing wind direction, topography, water availability, climate and surrounding urban and landscape elements must be taken into consideration when choosing the placement of features in your garden. OSU Permaculture teacher, Andrew Millison, lead our club in a site analysis workshop that prepared us with a deep understanding of our landscape.

Our garden is located in an urban environment on the south side of OSU campus. The garden is bordered on the east side by a sidewalk and busy street and on the south side by the Student Sustainability Center and a large cedar tree. The busy street is the main channel of human access to the site and is therefore considered to be the front of the garden. Because the city block is undeveloped, the North and West borders of the garden are open lawn with several trees at a good distance away from our growing area.

Our .2 acre site receives different amounts of sunlight in different places. It is important to know the solar orientation of your site to understand the amount and timing of the sunlight different parts of your garden will be exposed to. The one story building that houses the Student Sustainability Center sits on the south side of the garden, blocks only a little winter sunlight from the front garden because the building is so short. The several story tall cedar tree behind the house has a much larger impact, blocking several hours of valuable winter sunlight from the back garden in the early afternoon to evening. On the east side of the site, there is a line of mature trees along the street that dapple the morning sunlight in the front of the garden. A line of tall shrubs and a mature apple tree line the north side of the garden, creating a natural 'sunbowl'. A sunbowl is a permaculture term for a line of vegetation that reflects sunlight into your garden because of its solar orientation. The western side of the garden is not blocked by any buildings and the tall shrubs that line the sidewalk are far enough away that they do not shade our property in the evening.

Winds are not often strong but local weather stations report that the prevailing winds in Corvallis blow

Northwest in the summer and South in the winter. It is important to know prevailing wind direction to orient barriers that will prevent wind erosion of soil and damage to young plants.

Our garden is relatively flat with a slight slope from the middle to the back garden. It is important to know the topography of your garden to design for water flow/catchment and erosion prevention. Water is a rich resource in Corvallis with regular rainfall in the winter and sporadic storms in the summer. The Pacific Northwest offers a temperate climate that rarely drops below freezing temperatures.

	Jan	Feb	Mar	Apr	May	J

Avg. High 45° 50° 54° 58° 66° 74° 80° 81° 75° 64° 52° 45°

Avg. Low 34° 35° 37° 38° 44° 48° 51° 51° 47° 41° 38° 34°

Mean 38° 44° 46° 48° 55° 61° 66° 66° 62° 54° 45° 40°

Avg. Precip. 6.8′ 5.0′ 4.6′ 2.6′ 2.0′ 1.3′ 0.5′ 0.9′ 1.5′ 3.1′ 6.8′ 7.7′

The soil on the site is not the original native soil. It is clear that there has been a history of construction on the land though it is now covered by a dry, weedy lawn. The soil is heavy in clay with poor drainage. Large puddles form during the winter months, especially in the back garden. These appear to be the lowest point on the property. Soil tests were done to measure the pH and biological content. Samples were taken from four spots around the garden: the lawn of the front garden, the lawn of the back garden, under the apple tree on the north side and under the cedar tree on the south side. pH values were slightly acidic, ranging from 6.1 to 6.6.

In three of the four sites tested (all but the cedar tree site), extremely low counts of nematodes were observed by the lab. Nematodes are at the top of the microbial soil food web. The absence of this important organism indicates that the soil is not cycling nutrients as much as it could be. These predatory organisms are also responsible for regulating populations of other organisms in the soil such as bacteria, fungi and protozoa. It is thusly no surprise that populations of some of these organisms, especially protozoa, are unusually high. The front and back garden were both more populated by bacteria than by fungi and activity levels (test indicating if the organisms are dormant or actively metabolizing oxygen) of both organisms were low. This is typical of lawns that have been disturbed and deprived of the organic matter (mostly in the form of leaves) necessary to build healthy a healthy soil food web. An ideal soil would have a healthy balance of all of these organisms to decompose a diversity of organic matter into nutrients for plants. For more information on the soil food web and how it works, visit OregonFoodweb.com or SoilFoodweb.com.

Understanding these elements allow designers to be fully aware of how to create the best living conditions for our plants, animals and families. Going through this process exemplifies the first principle of permaculture design: observe and interact.

Broad scale Design:

Permaculture design zones areas for efficiency, placing the most intensively managed areas closest to the hub of human activity, and less managed areas farther away. The vegetable garden is the most labor intensive feature in our landscape because it requires the most compost amendments, weeding, watering and harvesting. Based on the zoning principle, the club decided to locate our intensive vegetable garden in the front (bordering the busy street) of the site, closest to the entrance of the Student Sustainability Center. This placement also prominently displays our project to the public because it is visually accessible to pedestrians on the busy street.

For the middle of our garden, we sited a large herb spiral (see explanation of ‘herb spiral’ below) that would be built up to create more dynamic topography and take advantage of the sunniest area of the garden to grow herbs and edible flowers. Because this is the sunniest area, in need of frequent watering, and because herbs can be harvested year round, this area requires moderate maintenance.

The back garden provided an opportunity to take advantage of the slight slope of natural topography on the property to harvest and direct water flow. We sited a bioswale to wind through our back garden to move water running off from the roof of a shed throughout an area that would be planted with trees.

Pathways were established to wind around all garden areas creating foot and wheelbarrow access to all planting beds. Areas of human gathering were established between each of the garden areas to invite education and human energy flow through the space.

Splitting the garden into three distinct sections gave us the ability to organize construction into smaller projects that we could focus on one at a time, using small and slow solutions rather than tackling the whole area at once. Breaking the garden into specialized sections also encouraged us to use and value diversity, creating different ecosystems in different areas of the garden.

Soil Building:

As with the start of any successful garden, our first step was to prepare the soil. Beginning from a weedy, dry, compacted lawn, we chose to focus on remediating the soil for the front garden. Our approach consisted of sheet mulching, composting and leaf mulching. Sheet mulching is a great technique for both weed control and soil building.

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We began by spreading an initial layer of compost direct
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All of the materials for building this soil were free, local and salvaged waste. The cardboard was recycled from boxes that were found at the Student Sustainability Center. The compost came from a composter outside a campus cafeteria. Manure came from the OSU stables and the leaves were collected by OSU landscaping maintenance. This strategy allowed us to turn waste into a renewable resource, combining two of the most important principles of permaculture.

Terraced Erosion Barrier and Front Garden Pathways

Building our soil for the front garden raised the ground level over a foot higher than the original lawn that was flush with the sidewalk along the border of the garden. This presented a great risk of erosion where our valuable soil could be easily washed away into the streets where its' nutrient content would be lost. To address this issue, we designed a terraced erosion barrier that gently sloped from the garden beds to the sidewalk, capturing any soil and water that would have otherwise run off our site.

To build the terraces we recycled wood that had been cut from laurel bushes a few feet from our site. We graded the soil constructing a two level terrace stepping down toward the sidewalk. We placed the long laurel logs along the edge of each terrace, ensuring that logs were raised slightly above the level of the soil to create a lip that would hold water and soil within the terraces. These terraces could then become decorative beds that welcome people into the garden.

We then designed the pathways behind the terraces garden border, throughout the front garden. The pathways were patterned to maximize planting space while ensuring that all parts of the planting beds were accessible for seed sowing, weeding and harvesting. To establish this pattern, we dug out some of the soil beneath the pathways and piled it onto the beds. We then seeded the pathways with red clover, a nitrogen fixing legume that would provide more fertility for our vegetables and crowd out weeds that would otherwise encroach on an unplanted area.

These simple features illustrate the importance of using edges and valuing the marginal. Practicing this principle allowed us to increase our planting area, conserve our resources and improve fertility in our garden.

Swale Construction

Rainfall and water availability is a dynamic element of the Corvallis climate. Our goal was to capture the frequent but light rains of the winter and move this resource from inert aspects of our property directly to our plants. The swale was designed to wind and branch along the slight slope from the middle to back of the garden so that water would be moved slowly throughout the landscape, giving it time to be absorbed by as large of an area as possible. Beginning from the drip line running off a small shed bordering the garden, the swale captures and carries water to the fruit trees we planted throughout the back garden. It was our hope that the capillary force (the sponge-like effect that draws water horizontally in clay soils) of our heavy clay soils would draw the water out of the swale to the nearby tree roots.

Digging the swale caused us to expose bare soil to the elements of rain, wind and sunlight. When water falls on bare soil, each drop breaks up soil aggregates and weakens soil structure. When aggregates are broken and structure is lost, soil becomes much more dusty and vulnerable to wind erosion as well as water erosion. Sunlight shining directly onto bare soil causes water to evaporate out instead of trickle down to feed the roots of plants. To protect our soil and water from these elements, we lined the bottom of the swale with gravel, utilizing the stones it as inert mulch.

Ultimately, our goal is to create a microclimate using the trees and other plants along the border of the swale as the garden matures. Once the plants are well established, they will provide shade to prevent evaporation of the water that the swale holds. Our hope is that this will create an increasingly water retentive environment that will preserve moisture even in the dry summers.

We designed the swale to capture and store resources, utilizing a natural gradient to move water efficiently throughout our landscape. The branching pattern of the swale, mimics patterns in nature such as the veins of a leaf or the tributaries of a river. Beginning with this pattern, we are able to fill in the details by experimenting with the microclimates the swale will help to support.

Planting: front garden, trees, back garden

As a student run non-profit, we were able to have the majority of our plants donated. Our first priority was to plant the fruit trees donated by Erin Rainy from Bailey

Nurseries. In early spring we planted apple, pear and cherry throughout our back garden and on the north side of our front garden in a giant arched sun bowl that would reflect sunlight into the rest of the garden. It should be noted that trees generally like to be planted around February when they are still dormant. Our trees were planted in late March and many of them were already budding.

Students designed plant guilds to create complimentary growing systems in different parts of the garden. Classic planting combinations such as the Native American corn, beans and squash and the Mediterranean tomato and basil were planted in the front garden along with several other experimental guilds. We planted hardy herbs at the end of each bed in the front garden to be keystone plants for protection against foot traffic and erosion.

Guilds were planted around each of the trees with a focus on soil conditioning and symbiotic services. We planted mint, squash and strawberries to create ground cover that would reduce water evaporation and provide mulch to build the soil as leaves drop. We planted deep rooting herbs such as comfrey to break up the heavy compaction and accumulate nutrients from deeper deposits in the soil. One student experimented with planting a jasmine vine at the base of a young tree, allowing it to grow supported by the tree's trunk as a living trellis. We are interested to see if the jasmine will overtake the young cherry tree over time. Many other plants, including nitrogen fixers, herbs and some hardy vegetables, were installed beneath the trees to fill the understory with useful plants, preempting the establishment of undesirable weeds.

Wetland plants, herbs, nitrogen fixers and plants that thrive in flood/drought conditions were planted along the borders of the swale to prevent the collapse of the walls into the center of the swale.

The choices made in our planting highlight two essential permaculture principles: obtain a yield, and integrate rather than separate. Most of the plants we selected produce food for humans. Beyond this, all of the plants in our garden serve multiple ecological functions, delivering a yield to the soil, pollinator insects and to the people. It is the approach of integration that sets permaculture apart from conventional agriculture, even organics. Utilizing our understanding of how different plants serve different ecosystem functions to build self perpetuating growing systems makes healthier plants with less work for people in the long run. It is these principles that make permaculture the most sustainable form of food production for both people and the environment.

Many local nurseries donated to our garden including: Peoria gardens, Midway Farms, Fern Hill Nursery, Garland Nursery and One Green World Gardens.

Herb spiral

Herb spirals are classic permaculture design features that consist of a large mound of soil with a border of stone that rises into the center/top of the mound in a spiral pattern. Herbaceous plants are then placed around the spiral with the plants that need the least water on the top and the plants that need the most water on the bottom. Planting the most sun loving plants on the south side and shade loving plants on the north side of the mound is another technique that utilizes subtle microclimatic differences to meet the unique needs of each plant. The stone spiral pathway throughout the mound both guides water to spread throughout the growing area. This design prevents water from streaming straight down the mound in a single channel that would result in rapid erosion. Herb spirals exemplify the strategies of permaculture design because they meet the individual needs of a diversity of plants in the most resource efficient way.

Because the herb spiral is such an representative feature of permaculture design, our club wanted it to be a prominent aspect of our garden. We also wanted to create more dynamic topography on our site. Our herb spiral is ten feet in diameter and about 5 feet high. The stones that border the mound and create the spiral are urbanite (broken concrete) that was waste from an OSU construction site. Because of the amount of soil needed to build up the mound, the club decided to buy soil from local businesses. The herbs for the spiral came from Fern Hill Nursery, an organic nursery that focuses on functional and native plants for permaculture. We hosted a workshop with a local herbalist who helped us place the plants according to their water needs and affinity for sunlight.

It took seven truck loads of soil (about 14 yards) to create the mound. The first truckload came from a municipal composting operation called the Processing and Recovery Center, and was extremely poor quality. To remediate the bad soil, we mixed in unfinished compost from the Student Sustainability Center's kitchen and garden composter. We were concerned about anaerobic pathogens in both the soil, and our unfinished compost, so we also mixed in straw that we had on site so that the soil would have more air pockets that would prevent anaerobic pathogens from flourishing. Because this was a relatively small amount of soil, and because it was at the very bottom of the mound, the bad soil would not negatively affect our plants. We bought the rest of our soil from Bald Hill Farms. This soil was a high quality blend of fully composted horse, cow and pig manures. It smelled very good and did not blow in clouds of dust out of the back of the truck during transportation like the poor quality soil had. See an extended explanation of what made the municipal operation’s soil bad in the Extra Soil Information section below.

We primarily chose the soil from the municipal composting operation because it was half the price of any soil on the market. We had to apply the permaculture principle of self regulation when we received feedback that our initial decision was not the best way to go. Switching to the higher quality soil was a worthwhile investment, necessary to protect the health of our garden. We also had to respond to this change in a creative way. Instead of putting in extra work and wasting the bad soil, we chose to remediate it, saving ourselves time and money and improving the diversity of the soil without threatening our plants.

Our mound was so large that we planned to build the spiral to the middle as a pathway that students could walk up in order to get a good view of the whole garden. When we were building the concrete wall around the base of the mound, a student suggested that instead of constructing a single spiral, we could lay two spirals that would come together in the shape of a galaxy. This way, when we give group tours of the garden, students can walk up one spiral and walk down the other without having to turn around and bump into each other. Our teacher Andrew Millison, with several years of training in stone work, made this dream into a reality. The OSU Permaculture garden now boasts the first ever Herb Galaxy!

Harvesting results:

Accepting feedback does not end at remediating the soil for our herb spiral. After a full summer of growth, we were able to assess our design and planting choices so that next season we could adjust our practices according to what we had learned.

We witnessed many successes and a few problems over the summer in the garden. The biggest challenge was watering all the new plants. Because almost all of the plants in the garden were new to the soil and climate, the whole garden had to be babied. This was expected for the front garden, designated for annual plants, but the back garden needed just as much attention in order to get established. Luckily, a dedicated staff was able to provide the care needed to nurture these young plants and the back garden will be more mature and self sufficient in coming years. None the less, it is important to be realistic about your garden’s needs in the present, and plan ahead for changes in season. It was observed that mulch was the most important facet of preventing moisture loss. Areas with heavy mulch could last days longer without watering than areas that did not receive mulch.

One of the most impressive results was the vigor of the plants in the front garden which never received additional fertilization. Also, virtually NO weeds grew in this area, indicating that sheet mulching in conjunction with compost and intensive planting is an effective approach for impressive yield.

One plant that did have trouble in the front garden was the squash. Although the plant did produce fruit, the leaves were colonized by a fungus. The front garden only receives dappled sunlight in the morning, so dew collected on the plants does not evaporate until later in the day. We believe that the large, hairy leaves of the squash plants contracted the fungus because they were holding excess moisture until exposed to full sunlight. Next season, we should plant the squash in more open areas of the garden where they will receive full sunlight early in the morning, reducing moisture and preventing fungal predation.

We were surprised to discover that our garden attracted gophers onto the property. During the first few months of summer, an increasing number of gopher holes appeared throughout our back garden, especially around the end of the bio swale. We were concerned that the gophers would eat the roots of our plants, so we put out traps for them. We were mostly unsuccessful at catching them. Surprisingly, we did not see any harm done to our plants. One thing we can be sure of is that these animals are doing an incredible job moving around soil, loosening compaction and creating macro pores that will improve drainage for this part of the garden. Though we haven't seen the affect yet, if we do begin to notice a decline in the health of our trees, we should remember that this may be a cause.

Like most farmers, we did have a love/hate relationship with the insects that our garden attracted. Some of our brassicas, especially the broccoli and kale, fell victim to an aphid infestation. Perhaps next year, the club can focus on experimenting with some integrated pest management. We were very successful, on the other hand, with attracting pollinator insects. An abundance of furry bumble bees flourished in the garden and were especially attracted to the lavender planted in the back garden.

The list of detailed anecdotes could go on forever and should be recorded. It is important to pass on the lessons as we learn them so that we can learn and move forward with the wisdom gained from what we've already accomplished. Thanks to the hard work of our founding members, the next generation of students to inherit the garden will begin from a strong starting point to create healthier ecosystems that nurture the diversity intrinsic to respecting all life in nature.

Extra Soil Information:

Soil Biology in our Garden:

In three of the four sites tested, extremely low counts of nematodes were observed by the lab. Nematodes are at the top of the microbial soil food web. The absence of this important organism indicates that the soil is not cycling nutrients as much as it could be. These predatory organisms are also responsible for regulating populations of other organisms in the soil such as bacteria, fungi and protozoa. It is thusly no surprise that populations of some of these organisms, especially protozoa, are unusually high. The front and back garden were both more populated by bacteria than by fungi. This is typical of lawns that have been disturbed and deprived of the organic matter (mostly in the form of leaves) necessary to build a healthy soil food web. An ideal soil would have a balanced diversity of organisms to decompose a diversity of organic matter into nutrients for plants. Rebuilding this soil food web will have to be our first step to creating a healthy garden. For more information on the soil food web and how it works, visit OregonFoodweb.com or

SoilFoodweb.com.

Leaf pile compost:

In November of 2008, we collected an enormous pile of leaves that sat in the middle of our garden for about 6 months. In mid-May, while moving the leaf pile, we noticed an exceptional number of earthworms and a good amount of white mycelium covering many of the leaves. A few weeks later, one student dug an irrigation trench across the lawn where the leaf pile had been. The student reported that he experienced significantly less resistance as he pushed the trencher through the soil that had been under the pile than he was experiencing throughout the rest of the lawn. This incident indicates that the leaf pile significantly reduced compaction in the soil. This lesson is exciting because it presents an alternative to labor intensive tilling that destroys the environment of soil organisms necessary for the functioning of a healthy ecosystem. Leaf liter is an important resource for building soil, yet it seems to be a cultural enemy of many who desire healthy lawns. This story exemplifies the service our leaf piles could provide if only we were not to waste the resource.

Further Explanation of Bad Soil from the Municipal Composting Operation:

The first load of soil we purchased from a municipal operation, called the Processing and Recovery Center, was far cheaper than any other provider. We quickly learned that you get what you pay for when we saw the quality of the ‘soil’. The soil was black and ashy and did not have a good smell. Transporting the soil a short distance from the Center to our garden caused huge clouds of black dust to trail behind the pickup truck even though we were driving very slowly. This, in addition to hand testing, indicated that the soil had NO structure. When soil has no structure, it is an indication that the biology in the soil is highly imbalanced and very inactive. Consulting local experts in thermal composting and soil biology at Oregon Foodweb, we learned that most large scale municipal composting operations focus more on waste reduction than on producing good quality soil. The fastest way to make soil out of raw landscaping debris is to over compost it by turning it too often. This practice disturbs the compost so often that the diversity of organisms necessary to build healthy soil with good structure cannot establish themselves. This condition of constant disturbance only allows for a small range of organisms to survive. Most of these organisms will be bacteria as they are the fastest growing and most adapted to conditions of disturbance. This lack of biological diversity robs the soil of the structure and fertility that only a healthy soil food web can provide.