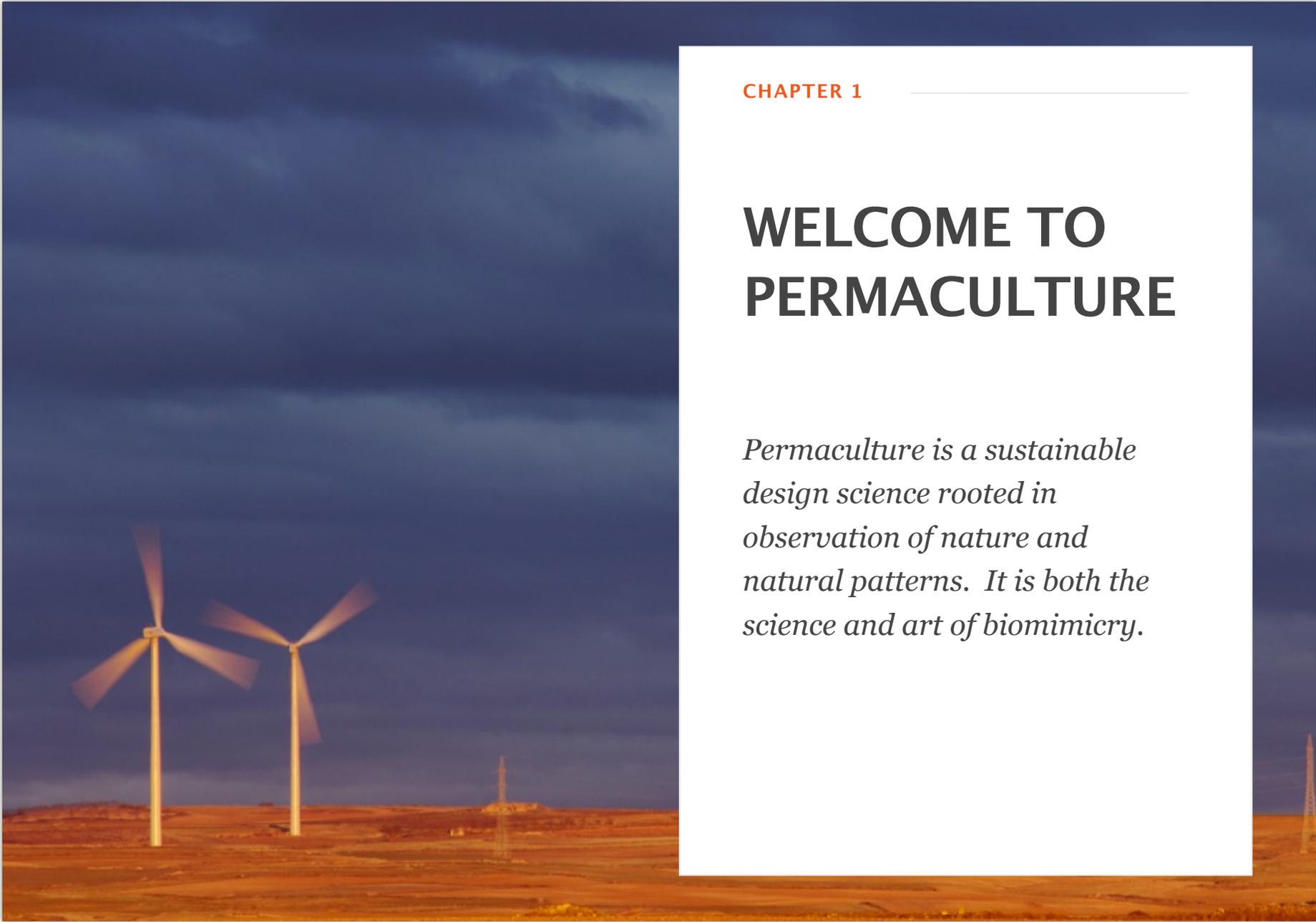


PERMACULTURE DESIGN FUNDAMENTALS

smart regenerative design will save the world



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CHAPTER 1

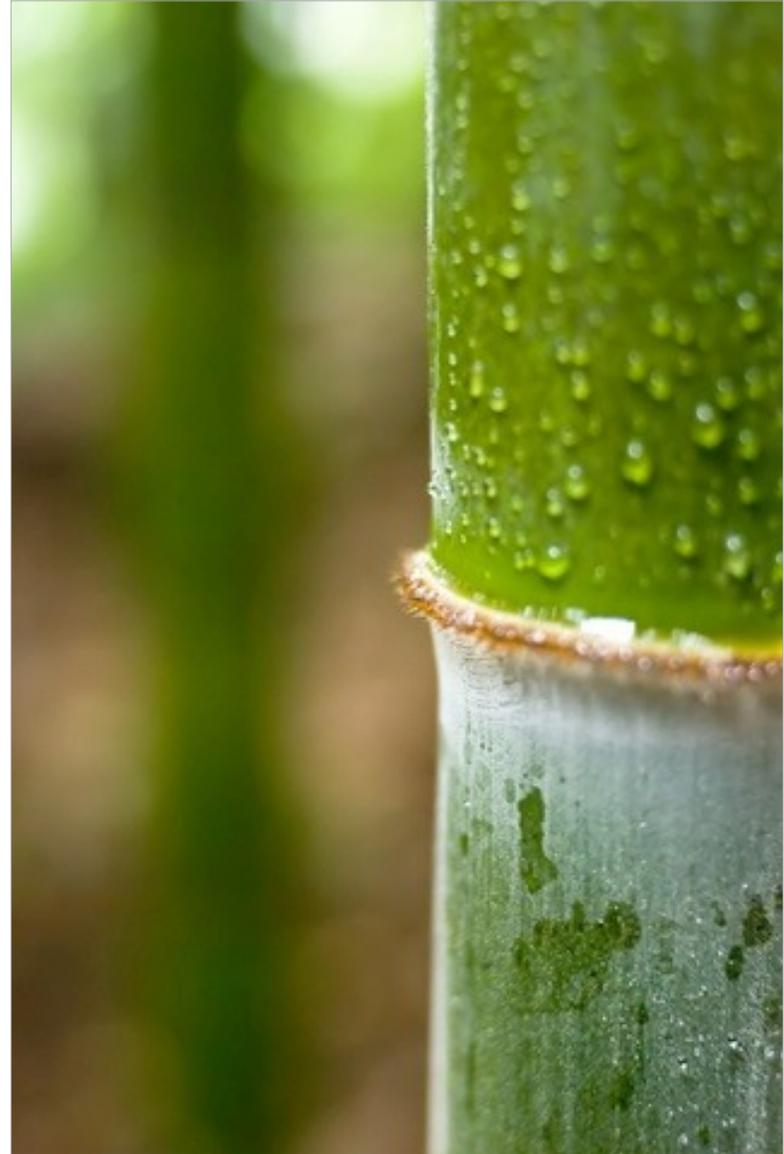
WELCOME TO PERMACULTURE

Permaculture is a sustainable design science rooted in observation of nature and natural patterns. It is both the science and art of biomimicry.

SECTION 1

INTRODUCTION

Many people think of permaculture as gardening, but that's a lot like thinking of math as building bridges. Permaculture is much greater than just gardening. Permaculture is a sustainable design science based in observation of nature (biomimicry), providing solutions to some of our most pressing problems. The same branching pattern that's found in a tree is also found in a river, in your heart, and numerous other places. Why is that? The pattern maximizes surface area for exchanging nutrients, increases diversity, and serves a whole bunch of other design functions.



Nature is the ultimate architect, evolving an intricately diverse universe supporting our solar system, and most importantly for us, our planetary home. Without the universe itself, we wouldn't be able to live on Earth today. In following nature's pattern of organic growth, where death gives birth to new life, our planet was born from the ashes of a dying star, also known as a supernova. By extension, we too are made of starstuff.

Nature's beauty is in its frightening efficiency when it comes to balancing form and function. One always informs and strengthens the other – there is no such thing as “useless” in nature. Everything has a function. The reason proteins work certain ways is all because of their structural form. Muscle cells are stacked in elongated form so they can contract and expand. A flower's beauty attracts animals to venture into its

pollen, allowing it to reach new territories and reproduce with other plants.

The most common example of biomimicry and permaculture is velcro, which was invented by a Swiss engineer who removed burrs from his dog, and noticed how the small hooks on the burr grabbed to his dog's fur.

Another great example is better packaging designs. Have you ever considered how nature packages pomegranate seeds inside a pomegranate? What we teach is fundamentally the art of biomimicry: observing and applying nature's most effective design principles.

Ultimately permaculture is a whole systems design methodology, a set of sustainable design principles derived from nature, applicable to anything and

everything that we design, and we design our entire surroundings. In the words of architect William McDonough, “Design is the first signal of human intent.”

When we look at nature’s ecosystems, we see that each animal gives and receives things from the environment – they breathe and eat food, they exhale and excrete waste, returning nutrients to their environment. Plants take up nutrients and release sugars and other compounds into the soil. Everything that’s present serves a specific function – when they all come together, they form a beautiful painting of a healthy, balanced ecosystem. We learn that what is taken from the environment is also returned in another form.

“Regenerative design” refers to an approach to design that seeks to return what is taken from nature.

Permaculture is in essence regenerative design based on biomimicry. As such, we can take permaculture beyond ecological landscape design, into the world of industry, manufacturing, finance, and even governance structures.

By designing our way of life to be inherently regenerative, we’ll be in a position to fully enjoy and appreciate our world. Right now, many of our buildings and vehicles are designed for very limited function rather than form, and their functions tend to create incredible damage to our world. Imagine instead, with regenerative design, that our buildings and vehicles could filter water and improve air quality. With the intent to replenish the environment, our world could be delightfully clean.

But how exactly is permaculture changing the world? For one, permaculture can transform deserts

into prolific food-producing oases. World renowned permaculturist Geoff Lawton literally turned a piece of the desert in the valley of Jordan into a food forest in a matter of a few years. He captured and stored water by digging large trenches (known as swales), implementing drip irrigation lines from the swales, and planting shrubs and important food trees along the mounds of the swales. The trees would soak up the stored water, requiring no need for outside water. Because a diversity of trees were planted, with complementary resource needs, there was no need to add outside nutrients. Within a few years, so much water had stored up in the soil, that they even began to see mushrooms pop up. The forest provided food for the local community, and transformed the desert from a harsh, scarce environment into a lush, life-supporting ecosystem.

Another great example of applied permaculture design is rainwater catchment and greywater

recycling. Drinking water is rapidly emerging as one of the biggest challenges of the 21st century, yet water is profoundly abundant virtually everywhere. We just haven't designed our systems efficiently.

In the desert surrounding San Diego, we once calculated that rainwater catchment – simply catching and storing the water off a roof – doing that in typical suburban home can mean around 10,000 gallons of water per year – and that's with just two inches of rain per year in the desert.

Now combine that with smart greywater design. Greywater, or sullage, is wastewater generated from domestic activities such as laundry, dishwashing, and bathing, which can be recycled on-site. This is water that has been used once but is not contaminated with poop. Here is the thing with greywater – it can easily be filtered, cleaned and re-used on-site, virtually

endlessly. In other words, we can easily reuse the water with which we wash our hands, once filtered, to do laundry. Once we do the laundry we can use the same water to water our plants, and so on. In other words we can easily cut the water use of an average home by 50% or more. Combined with rainwater catchment and storage, we can become almost completely self-sufficient on water use.

If we implement other permaculture designs such as a composting toilet and water-saving faucets, we can reduce our water usage even further. With smart water design, there is truly no need to be facing any water shortages ever again.

Einstein once said that problems cannot be solved with the same level of thinking that created them.

Permaculture is a very different level of thinking, because we're looking at solutions not only from a

perspective of how would nature do it, but from a whole systems perspective, addressing not just the symptom but the root cause of the problem. The examples of food forests, rain water catchment, and greywater re-use are just some very small examples of what's possible using permaculture design.

Our modern civilization has been operating under the paradigm of consumption and control over nature. We have sought to reduce and mechanize nature for our benefit, without regard to the ecological system as a whole. We have arrived at a moment in our history where it is necessary to learn from nature, to partner with her as our ally. Otherwise, under business as usual, we are moving towards our deathbed. From afar, our actions look like that of a yeast mold or a cancer cell, ceaselessly consuming all the resources available within the vicinity. Once the resources are fully consumed, nothing but death and decay remain in store for this organism.

SECTION 2

WHAT IS PERMACULTURE?

The overarching goal of permaculture is to restore the harmonious, ecological relationship between people and planet, creating a world where there is sufficient food, water, shelter, and opportunity for creative community for all. It sounds like an ambitious goal, but there is a very real potential we can create an incredible, thriving, abundant world.

We've talked about permaculture as biomimicry and regenerative design, which serve to expand permaculture as a broad concept applicable to our entire society and world. But the real practice of



permaculture is firmly grounded. Everything in permaculture is based on a set of core ethics and guiding design principles.

Like a tree growing tall into the sky, with roots penetrating deep into the earth, Permaculture pursues a high, ideal vision, and it also seeks to be deeply rooted in its core ethics and principles. Being grounded in ethics helps to ensure that the technologies we create from this ideal vision are supported by a strong foundation.

Permaculture ethics are incredibly simple yet effective. They are Care for People, Care for the Earth, and Sharing the Surplus.

Care for People

By caring for people, we ensure our human capacity to work towards a regenerative future. Permaculture recognizes the prodigious power that people hold for restoring ecological sustainability. Too often our human power has been used for destructive purposes, but this same power can be flipped around and used for regenerative, sustainable purposes.

People have been living on Earth for several millennia now. As our population has grown, so too has our destructive capacity. It's clear that we are now at a crossroads, a turning point brimming with opportunity for planetary healing. Beyond ecological design, permaculture also embraces a whole-systems life philosophy. It recognizes the critical role that all people have to play in making this vision of global health and sustainability come true.

Care for the Earth

Without a healthy planet, people have nowhere to live. We adapted to the biogeographical climate here through millions of years of evolution, and it is unlikely for us to colonize another planet anytime soon. If we can see ourselves as stewards of the earth, we can extend our time here a little longer.

It's important to be proactive about developing technologies and regenerative practices that not only heal the planet, but also provide maximum ecological benefits while meeting our current needs. This may sound like a lofty goal, but it pulls our perspectives in the right direction, and helps to align our design choices and actions to this intention.

Sharing the Surplus

This idea seems radical, and often people will compare it to communism or socialism. But in truth, it has nothing to do with that. Acknowledging the need to care for both people and planet, it follows naturally that we must share the fruits of our labor to ensure the health and well-being of all living things. Our current global consumption pattern is incredibly out of balance – wealthy nations consume the resources of several planets, leaving other nations impoverished. Permaculture rejects this imbalance in favor of equal care for all living things.

By setting ourselves up to share the surplus throughout the system, we are seeking to design genuinely resilient systems. Here's a good way of looking at this: growing sufficient food to keep one's own family and neighbors in good health is admirable; however, it must never be forgotten that one hard winter or late or early frost can easily undo much if

not all of one's hard work. For this reason, even as we design for extraordinary abundance, we seek to create resilient systems that are based in relationships that ensure that when we do experience a shortage, we will have access to surplus from our larger community. Permaculture is fundamentally a philosophy of bringing all the elements into right relationship, and social permaculture is absolutely critical to regenerative sustainability.

Everyone's been in a hard spot at some time or another and needed a hand to get out of it. This ethic acknowledges that although people in one area may be enjoying record-shattering yields from their food supplies, others not that far away may not be so fortunate. Therefore, it is desirable that where there is a surplus of food, that surplus should be shared with those who were not so fortunate in their own harvest, not because it's a nice thing to do but because we're all part of the same world and our own resiliency the

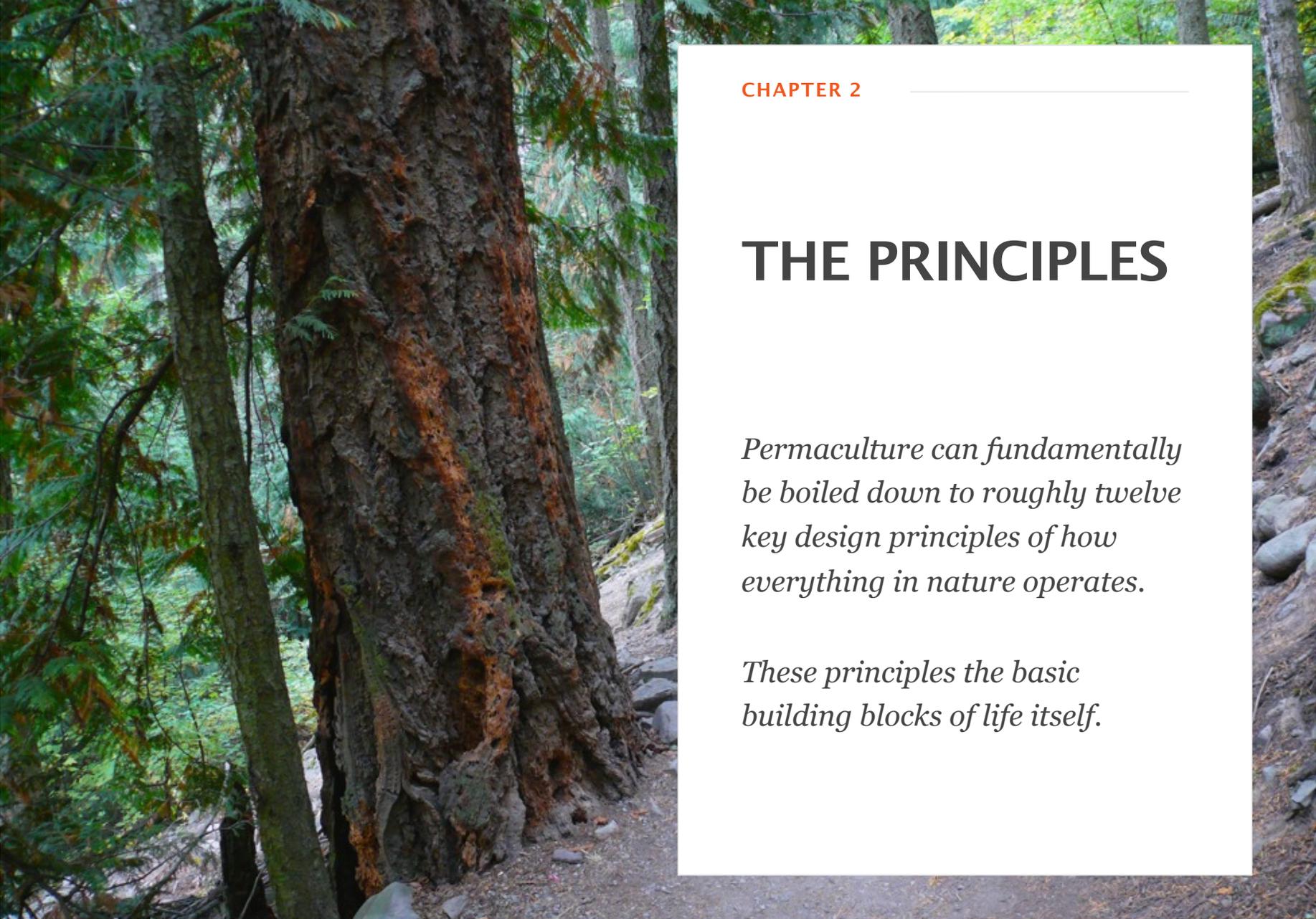
next year may well depend on today's less fortunate neighbors. This comes back to caring for people, as we mentioned previously, as well as our world by creating resiliency through right relationship with nature.

The entire permaculture ethic, when put together, is "Care for the Earth; Care for People; Share the Surplus." This forms a cyclic ethos which emphasizes the earth above all, human beings in a stewardship role, and that our activities upon the earth and with one another directly help the world thrive, rather than harm it. In this way, we can help assure a world that we can bequeath to our children and grandchildren with pride, rather than with embarrassment.

Permaculture may not be the cure for every social ill, but each day it becomes more apparent that something needs to change, and quickly. By observing

the principles of permaculture, which we'll discuss very shortly, we can break the cycle of destruction and violence against both people and planet. Most importantly, permaculture is very much something one person can commit to and expect to make a very tangible difference in the world, thus giving a clear pathway towards personal empowerment.

Let's take a look deeper into the principles of permaculture and see how they can shape the world we as human beings have always longed for



CHAPTER 2

THE PRINCIPLES

Permaculture can fundamentally be boiled down to roughly twelve key design principles of how everything in nature operates.

These principles the basic building blocks of life itself.

SECTION 1

OBSERVE AND INTERACT

By taking the time to engage with nature, we can design solutions that suit our particular situation.

Our world is abundant with varying landscapes, terrain, and climate. All of these offer unique opportunities and challenges. Nature prepares those who live in extreme climates with adaptations designed specifically for the area. Humans have proven ourselves to be supremely adaptable, but we are also destructive. We have irrevocably altered the landscape and the natural courses of potable water supplies to serve our needs. We have also become



accustomed to modern conveniences which cannot be utilized effectively at this point in time without expensive and environmentally dangerous sources of power.

However, if we were to look at the world around us and study how the native organisms interact with their environment, we would find many if not all of the solutions we require to survive and thrive. Igloos are often laughed at, but their domed construction makes them very efficient to heat and provide shelter from the worst storms the Arctic can dish out. This is an example of humans living in harmony with their home terrain, and the same design toolkit based on observation can be applied to every part of the world.

Every climate comes with different requirements and demands. However, every climate also offers the capacity to sustain life. In the desert, the challenges

and prerequisites for survival are drastically different than they are in the Olympic Mountains of Washington. Similarly, a rain forest provides different options than the tundra. The creatures and plants indigenous to an area have much to teach us about the best ways to effectively utilize an area's resources sustainably. If you take some time to observe the animals, you will see that they too are learning through observation. Communication, learning, and evolutionary growth are happening all the time, all around us, with all different species of life. When we tune into this, we empower ourselves to adapt and survive harmoniously in our given environment.

With the great strides we've made in nearly every discipline of the sciences, it is entirely possible to create sustainable living conditions nearly anywhere on the globe. The more we dedicate ourselves to a lifestyle that enhances rather than alters the natural environments we inhabit, the more healthy our world

and our society will be. But the first imperative has to be understanding the area, and to do that, we must make a thorough study of how the native life forms in a given climate interact with their environment.

Once we know how it's accomplished, we then have to duplicate it for ourselves. This is where our science and technology come into play. It is possible to condition tracts of soil to make them more suited to farming, even in the harsh climates of Death Valley and the Mojave Desert. Plenty of edible native plants could easily become staples of the diet in such places (as those plants have been for centuries, for the indigenous people who have inhabited there), creating a less intrusive and more balanced ecosystem in which humanity works side by side with nature to craft living conditions which benefit the whole.

The key to good observation is understanding that nature simply is – it is not good or evil, wise or foolish. There is no frame of reference in nature. Our personal judgments and biases separate us from nature, and hinder our designs. Non-judgmental observation is the key starting point to understanding our environment. When we walk over the same land several times, we begin to notice new things we didn't see before – a little sprout, a bird's nest, an ant colony, that was hidden from us the first time. Slowing down, we begin to notice changes from the micro-climate and geography. The more intimate we can become with our environment, the better we can work collaboratively with it. Developing a relationship with the land is essential to permaculture design.

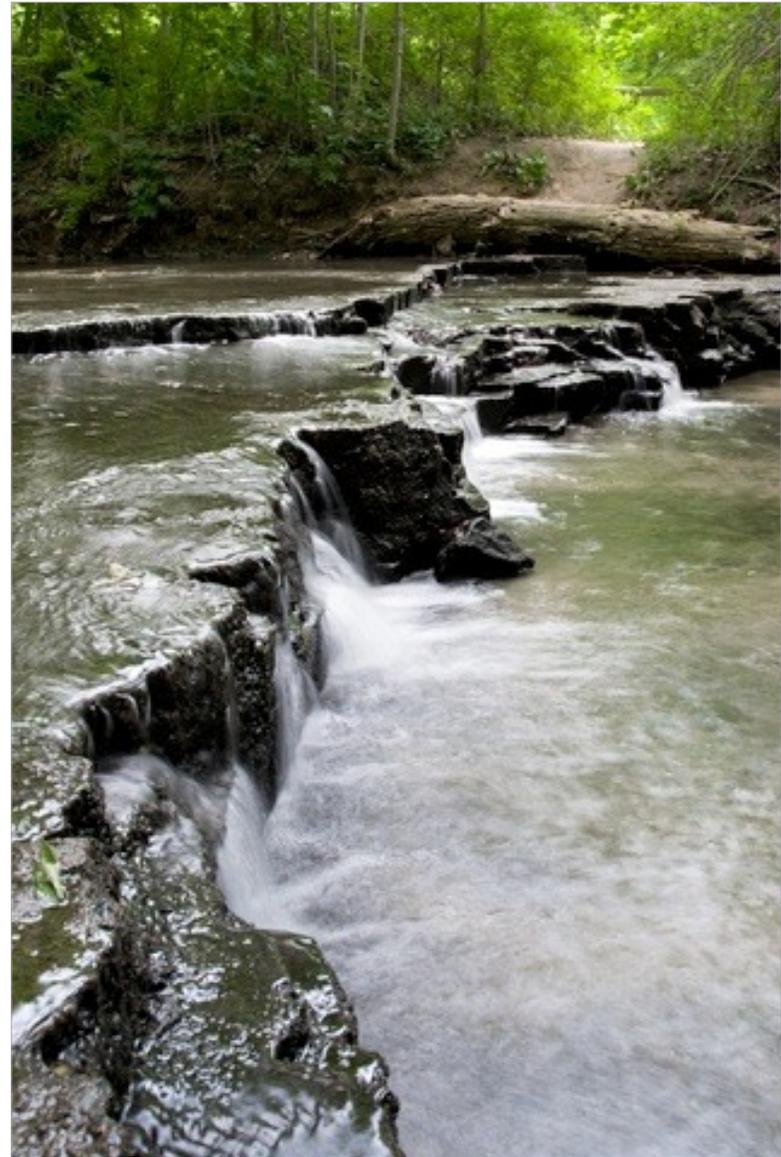
If we observe animals for a time, we will see that they too are observing their landscape. They learn from what they see in others, and so should we.

SECTION 2

CATCH AND STORE ENERGY

By developing systems that collect resources when they are abundant, we can use them in times of need.

Nature provides us with a plethora of energy from the sun, water, seeds, minerals, heat, wind, and organic matter. We can save ourselves a ton of sweat and labor by taking the path of least resistance – catch solar energy when the sun is high and strong, install a rainwater catchment system to store water, use rocks to store heat, and create compost to build organic matter. When we design with nature, our work becomes super simple.



We have the technology available to catch energy, what's more lacking is storage for these renewable energies. Plants can be our greatest inspiration in this area – every plant cell has a giant water storage unit known as a vacuole. Trees branch according to the fibonacci spiral, so that they can catch the greatest amount of sunlight per leaf. If we can build our energy capture and storage systems much like a tree, we can be incredibly efficient and regenerative. Research into artificial photosynthesis is already underway – the next step is mimicking how plants store energy.

Wind, rain, sun, and geothermal energy are all around us, in one form or another, most of the time. Harnessing this energy when it's at its most abundant and being able to store it for use when it isn't can help make sustainable forms of energy more realistic and practical than ever before.

SECTION 3

OBTAIN A YIELD

Ensure that you are getting truly useful rewards as part of the work that you are doing. In essence, take care of yourself, make a profit, and grow a good harvest.

A healthy harvest doesn't end with the vegetables you grow in your garden. There is also the consideration of providing power and water to your home and the ability to make use of modern conveniences while still being ecologically viable. Permaculture is not intended to eliminate technology or to espouse a "primitive" mode of living, but to



marry technology and ecology in a way that permits both to realize their maximum potential and benefits.

By establishing a yield adequate to maintain your own part of the ecosystem and creating a surplus, you become a producer. When you produce more food than you require, it offers opportunities not only to store food for the non-growing seasons, but allows you another medium of exchange with which to barter for goods and services you cannot readily obtain yourself. In this way, a sustainable economy fueled and driven entirely by the labor of the individual is not only possible, but a highly practical mode of living. In turn, the parts of crop plants not eaten can be used to compost and fertilize the ground for the next growing season. This cares for the earth. The food you create will go to sustain you and your family. This cares for people. And the surplus not required to take care of your own household can be stored or traded to others. This shares the surplus. In this way, every part of a

sustainable life upholds the basic ethic of permaculture and creates a more stable society where everyone works, but everyone gets a fair share and a reasonable return on their labor. By doing this, an ongoing, self-sustaining cycle is created which ensures the needs of all are met while still taking care of the earth properly.

SECTION 4

SELF-REGULATE AND RESPOND TO FEEDBACK

Nature is generally quick to restore imbalances in an ecosystem. An example of this is deer and wolves. Where there is ample food, deer will breed. Too many deer in an area will deplete the greenery and prevent new growth. Hence the wolves come along and find unimaginable numbers of deer in the area. They will feed and breed in their own turn until the deer are reduced in population. Then the wolves will press on to new territories, leaving the plants to begin the cycle all over again.



When we accept feedback from our environment, it quickly becomes apparent a great deal of what we do is not beneficial. Therefore, the feedback we receive from nature is a warning that we're on the wrong track and we need to change our behaviors accordingly. By doing this, we can reasonably expect to work in tandem with our world, rather than at cross purposes.

Anywhere two or more cultures collide, each will inevitably have an impact on the other or others. The natural world is the setting for these conflicts and negotiations, and humanity has been fairly cavalier in its regard for nature. The key is to understand that everything we do has an impact upon our world. By self-regulating our behaviors and activities so they mesh naturally and logically with our environment, we can work toward regenerating what we have damaged.

In human history negative feedback is often taken personally. When it comes to nature's warning signs, however, there is no judgment. There is simply an ecosystem imbalance, and it is in our interest to take heed – to change our systems to alleviate the stress signals, and restore balance to the ecosystem. Responding to feedback loops establishes right relationship with the earth.

SECTION 5

USE RENEWABLE RESOURCES

Choking fumes spewing from factories and power plants. Decimation of the rainforests and the myriad life forms which call them home. Wholesale slaughter and conquest as human beings struggle for limited reserves of oil, coal, and precious metals. All of these things stem from one source: Our modern reliance on non-renewable resources.

Nature has given us everything we need to survive. Our minds are likely the greatest tool for shaping and bending any environment we occur in to our own will. The difficulty is not in the fact that we use natural



resources, but in the fact that we do next to nothing to replenish them or replace non-renewable resources with renewable ones which offer the same outcomes.

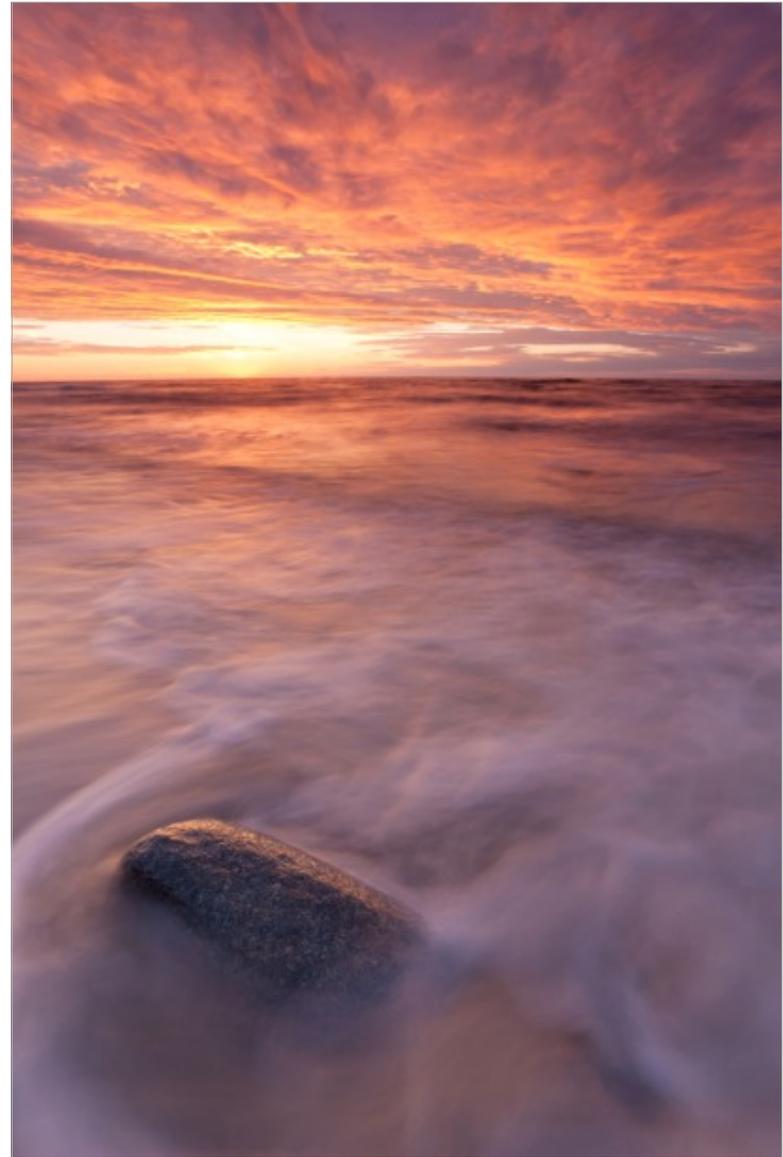
As human beings, we have the option and capacity to alter our environment in ways that simply don't exist for any other creature on Earth. Because of this, we have a far greater responsibility to our world to utilize renewable resources and services.

SECTION 6

PRODUCE NO WASTE

By valuing and making use of all the resources that are available to us, nothing goes to waste.

What our modern culture considers waste, nature often considers a valuable resource. Urine and feces are considered “waste,” but in actuality these byproducts of digestion are excellent fertilizers, second only to blood. Because these byproducts are rich in nitrogen, which plants rely heavily upon to grow, they are very useful for crops.



Our disposable lifestyle has led to an unnatural concept: that of waste. We vie desperately and often angrily to achieve more than we can practically use or really need. We throw away everything from paper cups to personal computers with no regard or thought for the damage these things can do to our environment. Some kinds of paper cups are produced using various toxins. Since these are intended to be disposable, our exposure is minimal. But what happens when they wind up in a landfill? These toxins are released and leach into the soil, where they intermingle with years of battery acid and other manmade contaminants. Over time, these commingled toxins can leach into the groundwater. Landfills are quite literally a slow and painful way of poisoning the very wellwater we depend on for our survival. Not to mention, they release carbon dioxide and methane into the atmosphere, adding potent greenhouse gases into the atmosphere. Methane is actually over 20 times more efficient at trapping radiation than carbon

dioxide, making it a much more lethal greenhouse gas.

In nature, there is no such thing as waste. It's common for people to say they are throwing things away, but in truth, there is no such thing as "away". Away is simply on another piece of the earth. In nature, "waste" is nourishment for new growth. In the cycle of life, death is a necessary part of replenishing the earth. In rethinking waste as a resource, we reconsider the landfill, and design materials that can be reused in some way, or composted, at the end of their life cycles.

We have a lot to learn about recycling. We've made incredible strides, but our methods are crude, crass, and hopelessly primitive compared to the nuanced, subtle, and efficient methods nature has developed. It helps to design materials for easy dis-assembly, and

thus more efficient recycling, but it's practically impossible to get away from the intricately pieced together components of many high-tech materials. Even if we shift towards a more low-tech culture in deference to sustainable living, circuit boards and electronics will likely remain a necessity, particularly for managing renewable energy systems and grids.

Many of the precious metals in a circuit board are interlaced with thin layers of resin. One of the most promising and exciting directions in new methods of recycling is molecular sorting, which can recycle complex materials into their individual molecular components without destructive techniques like burning. The Fraunhofer Institute's Beyond Tomorrow Project is behind the quest for "Molecular Sorting for Resource Efficiency".

One area of focus for this research is in glass recycling. Glass used in solar energy applications must be low in iron contamination. Scientists are researching ways to separate and remove iron molecules from glass.

Molecular sorting is still in research and development. Preparing methods for a wide range of materials, including automobile parts, treated wood products, and composite plastics, while overcoming challenges in automation and cost effectiveness, are all barriers to widespread adoption and implementation of this type of recycling.

Rocks and minerals oxidize and weather away in the atmosphere, and are only newly formed under high heat and pressure, in magmas beneath the earth's surface. Industrial engineering mimics the high heat and pressure necessary to form metals and

mineral rocks. Incorporating molecular recycling would help recover a vast store of seemingly trapped materials for new use.

Even with high-tech advances in recycling, reducing our waste takes more than simply being able to recycle goods. It also means creating new technologies that do not require toxins and large inputs of power or chemical reactions in order to be viable. By studying nature's reactions to various forms of "waste", from the carcasses of animals to the casings of computers, we can learn a great deal about how best to deal with them and then adapt this natural feedback to the way we live.

SECTION 7

DESIGN FROM PATTERNS TO DETAILS

Patterns are everywhere in nature, and each and every one serves a unique purpose. From the double-helix pattern inherent in the DNA of every living creature on the planet to the striated crimson and ochre patterns on the back of a coral snake to the arrangement of the seeds that comprise a pinecone, nature is virtually nothing but patterns.

One example of this is the strikingly complex architecture of the spiral shell of a nautilus snail. As the snail grows, it “builds” onto its shell. Because of this unique capability, the nautilus may well be the



poster child for sustainable living. It creates precisely what it needs to grow and thrive, and no more.

Recently, engineering students from Tehran, Iran, created a building modeled after the nautilus' shell. They discovered that the building would not only offer shelter, but self-regulating temperature to a degree previously thought highly improbable if not outright impossible. This achievement won them a prestigious sustainable design award and drew international attention. By observing the patterns inherent in the nautilus' shell and then adapting them to fulfill a very real human need, they created an engineering and social breakthrough.

This kind of adaptation need not be limited to its application. Imagine, for example, if we could determine precisely how an ant's muscles work to give them such incredible strength relative to their size. Or

perhaps we could adapt the patterns nature uses to break down "waste" material as discussed in the previous chapter. By using patterns to our own advantage, we can see that using crystalline matrixes for data storage may be much more efficient than the clumsy binary/magnetic systems we currently depend on.

Learning about and understanding the patterns nature has imposed is the first step to being able to work effectively within them. However, understanding the patterns is only the first step. We must then change the patterns sufficiently to make them useful to human interests. A human cannot fit into a nautilus shell, no matter how expert a contortionist they may be. Therefore, although the basic pattern is effective in a number of circumstances, though many of these patterns cannot be effectively used by humans without a certain amount of alteration. However, if we alter these patterns, we should not modify them more than

is absolutely necessary to make them suitable for human usage. Otherwise, we risk sacrificing the base functionality of these patterns, creating a zero-sum or worse, a losing equation.

The patterns inherent in nature exist to give structure and form to every facet of our universe, from the endless dance of atoms to the majestic sweeping rotations of galaxies. By applying these patterns to human endeavor in a natural form, we can engineer sustainable modes and means of doing just about everything. The key here is to ensure we use the patterns as intended and originally designed to the utmost possible degree, thereby getting the best of both worlds.

SECTION 8

INTEGRATE RATHER THAN SEGREGATE

By putting the right things in the right place, relationships develop between those things and they work together to support each other.

Segregation is not typically a natural phenomenon. Things which are alike tend to group together, but there is a complex relationship between seemingly dissimilar things. What, for example, does a small black beetle have to do with a horse?



On the surface, the answer would seem to be very little. However, dung beetles use horse droppings as food, shelter, and a birthing place for their hatchlings. The same could be said of the relationship between some of the smallest creatures on Earth, the virtually microscopic shrimp known as krill, and the largest creature, the majestic blue whale. The blue whale has adapted very fine bony filters which allow it to scoop up and feed on krill by the ton, making this pairing surely one of the oddest, at least on the surface, in the natural world.

A more common example is that between humans and horses. Domesticated horses rely on humans to feed, care for, and exercise them. Humans rely on horses for companionship, work, transportation, and food. You can probably think of a variety of other examples. The point to be gleaned is that when one puts seemingly disparate elements together in relation to each other, and the situation is one where both parties

stand to realize a factual benefit, these apparently non sequitur elements complement one another and work to mutual advantage.

Instead of separating plants into distinct blocks, as is typical for large-scale farming, permaculture favors an interplanting system. The diversity of plants provides mutually beneficial relationships in sharing nutrients, enhancing insect and microbial diversity, and therefore building ecosystem resilience against disease outbreaks.

By studying the native environment carefully and then judiciously introducing elements that enhance, rather than destroy, the area, humans can create relationships that strengthen and bolster the area's diversity. History is replete with examples of times and situations where humans, either through carelessness, thoughtlessness, or simple ignorance, introduced

non-native species into a biosphere only to have the interlopers spread like wildfire. A particular species of Japanese tree beetle is one of the more alarming examples. This pest came over aboard a ship and began to breed at an alarming rate once it reached American shores. Today, this beetle is directly responsible for millions of dollars' worth of damage to landscaping and naturally occurring trees annually. Without its natural predators to keep this beetle in check, humans have gone to increasingly desperate lengths to eradicate it.

The cycle of predator and prey, producer and consumer, is one of the most basic in nature. By fostering appropriate relationships and managing our own connections to our world, we in turn help create a thriving, healthy ecology which can support not only us, but the various plants and animals we depend upon in so many different capacities. Integration and working together for the common good is not merely

beneficial in the short term, but in the long view as well. However, for that to be a practical solution, we must first understand how things interrelate. We want to be sure that the diversely integrated system is well-designed. There is no benefit in putting things together willy-nilly and hoping the outcome is acceptable. Measured, reasoned, carefully controlled introduction and integration is far more sustainable than betting one's various food sources on a roll of dice.

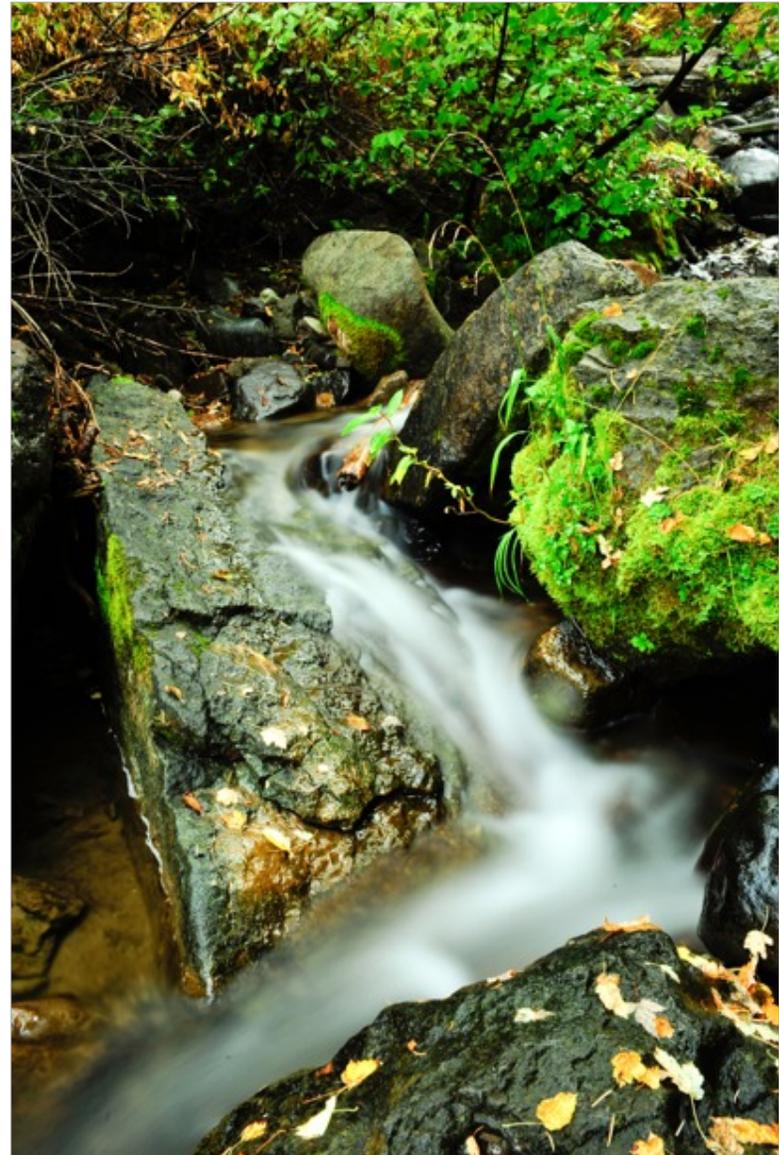
Similarly, when considering social and financial systems, we are more resilient when we have a diversity of perspectives and skills, as well as multiple streams of income. Greater resiliency follows greater diversity.

SECTION 9

USE SMALL AND SLOW SOLUTIONS

Small and slow solutions are easier to maintain than big ones, making better use of local resources and producing more sustainable outcomes.

Americans are an interesting breed. We are impatient on a cultural level rarely ever approached in history. Instant gratification, high-speed absolutely everything, and bigger, faster, stronger, more consumptive ways of doing everything from generating an Internet connection to creating a venti mocha frappuccino with a triple shot, soy creamer, and six different kinds of artificial sweeteners. We marvel



at the grandeur and sheer scale of Hoover Dam, but routinely ignore the architectural and engineering marvels which are the average anthill.

Because of these need for “more,” we have effectively barred ourselves from nature and the slower pace and greater rewards of a simpler lifestyle. Nature does not start out large when it puts a system into place. A hurricane begins with a simple eddy of warm air over cool water and grows. As was pointed out a few chapters back, nature does not permit waste. Therefore, nature is efficient in its solutions to problems, using the smallest, slowest, and simplest means of creating the desired effect.

Humans tend to think in terms of scale. Surely one snowflake or one seed can't have that great an effect, can it? But it only takes the weight of one snowflake too many to trigger an avalanche, and one seed can

easily feed a village if nurtured properly and permitted to grow into the plant it has the potential to be. To achieve a sustainable result that is truly in line with the ideals of permaculture, we need to stop looking for the home run and be satisfied when we manage a single. Sooner or later, we can load the bases, but more players have struck out trying for “the big one” than those who have chosen simply to bunt. Small systems don't possess the imagination-firing impressiveness of large, noisy systems, but they work better and more efficiently overall.

The drip systems many farmers are turning to as an alternative to traditional irrigation emphasize this point in a uniquely immediate way. Unlike traditional irrigation arrangements which require large swaths of land to operate and which waste as much or more water than they give the crops, drip systems deliver water in carefully measured amounts right where it will do the most good, as opposed to large irrigation

sprinklers. Because it works more slowly and targets the delivery of its payload, the drip system does not confer the immediate satisfaction of seeing one's crops being obviously watered. However, it does achieve a more satisfactory outcome in the long term when the plants grow healthier and the water table is not so heavily taxed, leaving more water for livestock and human consumption.

Sustainability and conservation have come to be equated with the idea of a decreased standard of living. However, by taking our cues from the way nature solves the kinds of problems we face, we can learn how to use smaller and less obtrusive means of accomplishing a greater net benefit for us all.

In our own lives and social structures, we tend to want change to happen overnight. Unfortunately, this simply isn't the way our world works. It's absolutely necessary to implement small and slow changes to achieve the whole-systems transformation we dream of.

SECTION 10

USE AND VALUE DIVERSITY

Diversity reduces vulnerability to a variety of threats and takes advantage of the unique nature of the environment in which it resides.

Biodiversity is a very hot topic right now. You can see, hear, and read about it being hotly contested on just about any news outlet if you listen long enough. When we think of diversity, we may think of such things as skin color, political affiliation, religious or philosophical persuasion, sexual orientation and gender, and a plethora of other real and perceived differences. However, in nature diversity has a



somewhat different and more encompassing definition. Consider for a moment if only one type of plant and one species of animal inhabited a given area. Within this area, there is still a natural balance to be kept. The plants must not grow too wild or they will crowd each other out, killing themselves in their quest for survival. The animals must keep the plants in check, but without natural predators, they run the risk of overbreeding and wiping out their own food source, leaving themselves with no sustenance. Thus these animals must either forage farther afield or risk grazing themselves right into extinction.

For this reason, nature has developed the elaborate food chains and ecosystems which drive even the most seemingly barren areas. Plants feed on nutrients and bacteria in the soil and are in their turn fed upon by various animals, which are fed upon by still larger and more capable predators, which in their turn are fed upon either by even larger predators. The biological

diversity of an area can be as simple as three or four steps, or as complex as many thousand potential divisions and diversions. In either case, the end results will prove to be the same regardless.

Diversity is also nature's way of strengthening species and creating new strains which can resist disease and mishaps which would fell a creature's less well adapted contemporaries. We see this in everything from bacteria which have developed a tolerance to penicillin to human beings who can eat, drink, and smoke seemingly anything without lasting ill effect. Predators in nature help cull herbivorous and minor carnivorous populations, ensuring that only the strongest and most genetically fit survive.

There is a story that some time ago, a group of scientists genetically engineered a strain of a type of grain which was supposed to offer yields vastly in

excess of anything its conventional cousin is capable of. A number of farmers agreed to grow this particular crop in place of their usual plantings as an experiment. However, it turned out that this engineered grain was excessively attractive and vulnerable to a certain type of insect. The fields were decimated in short order. However, the farmers who had not adopted the new grain but kept to their standard crops had no such difficulty. Variations of this tale have been told with corn, wheat, and various other grains, so it is likely you've heard at least some version of it. The moral of the story, no matter whether it's true or merely legend, is clear: diversity equals life, while uniformity can often mean death.

The more diverse an area and its indigenous species, the more likely it is able to continue to sustain life even under the most extreme conditions. Thus, maintaining diverse supplies of food not only encourages a healthy ecosystem, but ensures that if a

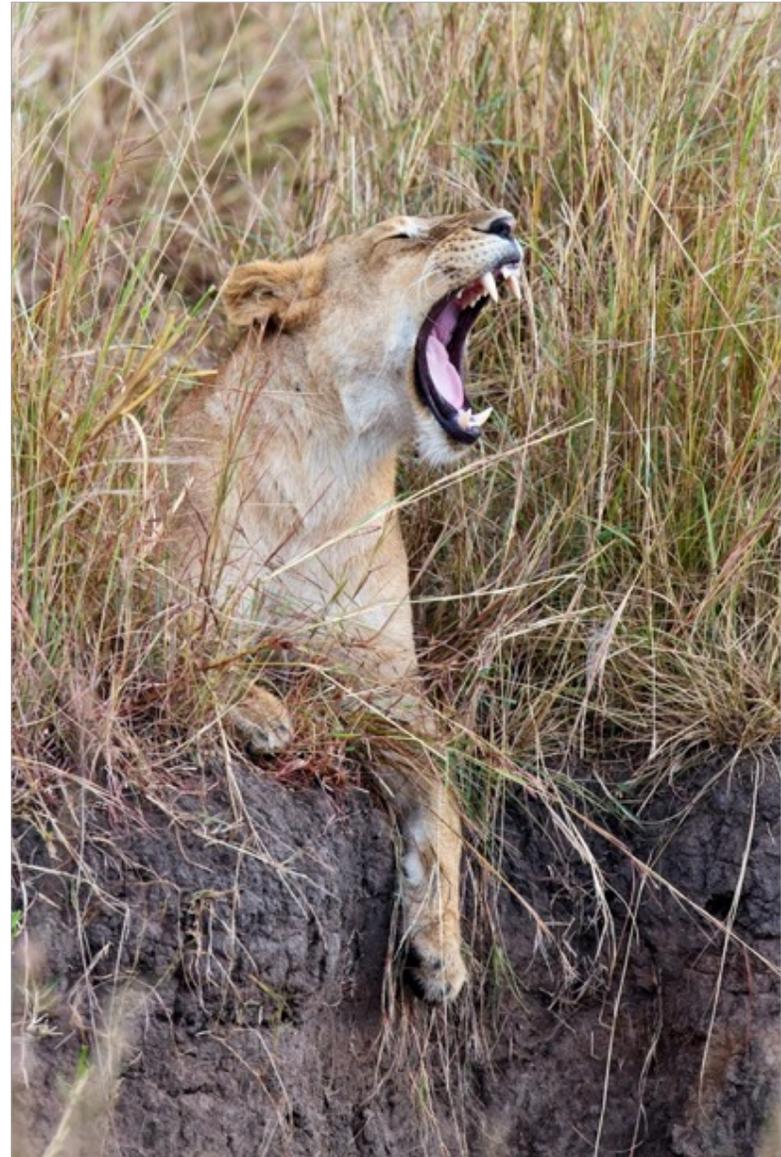
particular food source is wiped out by disease, pests, or predators, there will still be sufficient food available. Moreover, it is simply good husbandry and maintenance of our world and its inhabitants to ensure that healthy competition and evolution can occur, whether with or without our intervention.

SECTION 11

USE EDGES AND VALUE THE MARGINAL

The edges between ecosystems are the most diverse. They serve as a buffer zone between different climates and geographies, protecting the ecosystems within. Different things happen in different conditions, so we want to have many different conditions to support a diversity of activities. This increases the rewards we receive in turn.

Where two things meet and interact, be they inanimate or otherwise, a change is apt to occur. If you've ever met a person and instantly liked or disliked them, you were changed by the encounter.



The edge between one being's space and another's is where objects, creatures, and people have the ability to act upon and influence one another for better or worse. Understanding how these reactions occur and how to make them sustainable is a major part of permaculture, simply because these reactions are where the greatest potential for change and energy occur.

Wind meeting metal may not seem like much of an interaction at first glance.

After all, in the short term, wind can't do much to metal, right? But when the metal is shaped properly and catches the wind at the correct angle, it can generate power for any number of applications, from milling grain to the electrical current required for you to read this book. The same applies to other means of producing power and harvesting food.

Marginal land often holds the most potential for innovation and abundant growth. Like marginal lands, people and cultures pushed to the edges of society often hold great potential for innovation and transformation.

The edges and margins between things are where the dynamics shift. This is where farmers plant and harvest crops, where predator and prey determine which will live and die, and where various forms of energy are produced. By understanding the role the fringes and boundaries between things play in the complex relationships of nature, we are better equipped to produce our own changes. Used properly, our ability to be agents of change can help us shift the balance from our current destructive path to a sustainable, regenerative culture. But there is more to this understanding than simply its benefits to us.

By creating our own edges and interactions with the world around us, we can affect our world in profound and often unintended ways. It is important that whenever we begin to muck around with the edges of things, we are careful that we do not inadvertently rip away something that may ultimately prove to be key to our survival. Knowing how to manipulate the edges and understanding the value of the things which are only possible on the margins between conflicting points is not a license to turn things this way and that just to see what will happen. As with any other point of contact between humanity and nature, we must not rush in and change things simply because we can. Instead, we must take a studious approach, using this knowledge lightly, sparingly, and only when necessary. Too often over man's history, we have rushed into "new" territories and biospheres, only to wreak untold havoc in the process. Sustainable living means understanding an area and how everything in it relates to everything

else, and offers the chance to truly live on the edge in a way all but unthinkable in our current society.

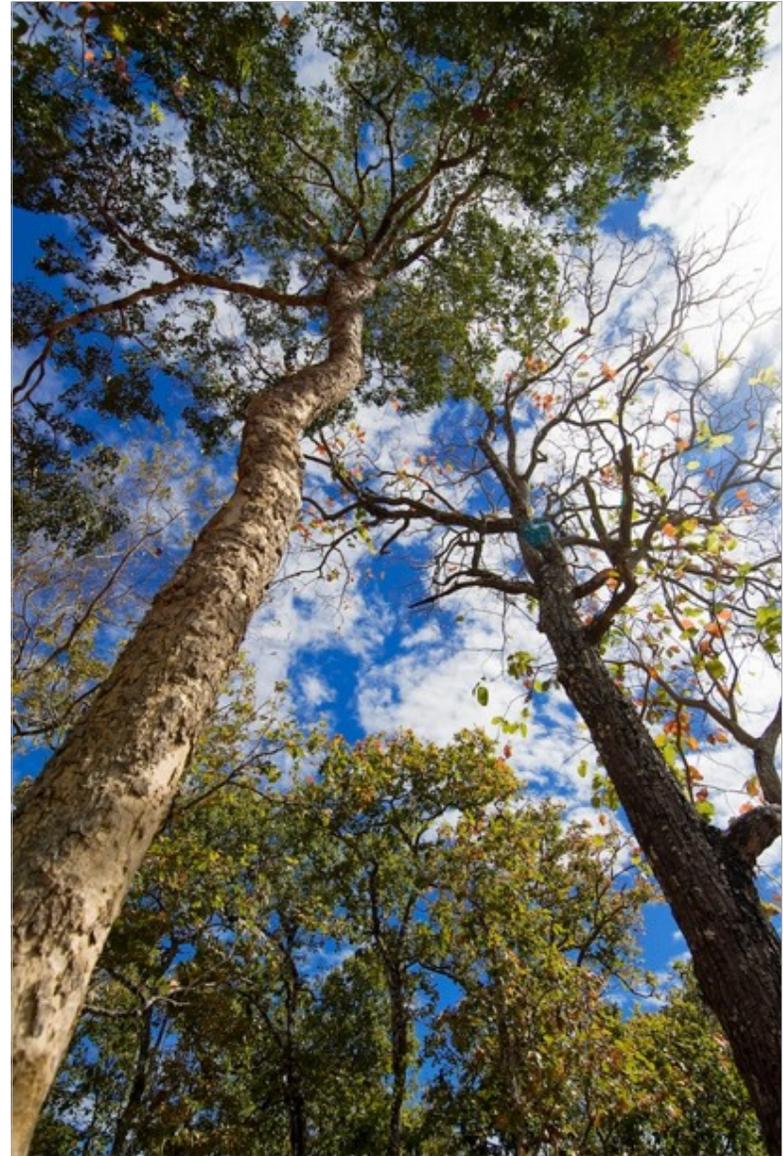
SECTION 12

CREATIVELY USE AND RESPOND TO CHANGE

In the words of Greek philosopher Heraclitus, “The only thing that is constant is change.”

We can have a positive impact on inevitable change by carefully observing, and then intervening, at the right time.

Just because we can do something does not necessarily grant us an unchecked license to do so. This particular tenet of permaculture is the logical result and inevitable conclusion of the other eleven,



and as a result may be the most important of them all. However, all these concepts and notions link together as inextricably as any food chain. Remove any one link from the chain and you risk the entire system collapsing.

Permaculture asks us to respond to change with creativity and positivity, bringing us back full circle to the basic ethics of permaculture. It serves no one to respond out of fear, we must respond out of care for the earth, care for the people, and sharing the surplus.

This principle easily applies to our personal lives and institutional structures. For many people, change is scary. Transitional periods in life are marked by shifts in identity and self-perception. If we can accept that change is inevitable, that it is an opportunity for learning, growth, and expanded perception, the harshness of change can be softened. When our

culture, climate, or our environment changes, we can easily respond out of fear and blame. But it's important to accept the present circumstances, and look forward with positive creativity.

ZONES AND SECTORS

Facing the task of transforming a wild or empty plot of land into a functional permaculture garden can be an intimidating feat. The good news is there are two techniques that help facilitate the design process; they are known as zones and sectors. Zones are based on the premise of reducing time and energy associated with travel. Plants are placed in zones based on how much attention they will need from you. Sectors are based on natural energy flows, and help to block or channel these natural energy flows.



While zones help to minimize time and energy from travel, there are no concrete borders around the zones. Zones flow from one to the other, without any specific boundary shape. There is no need for them to be placed in concentric circles or any other pattern. Although, oftentimes applying a natural pattern such as the Fibonacci spiral can enhance the energy and aesthetics of your garden.

Counting zones begins with you and your home as Zone 0, and moves outwards from there.

Zone 1 is the area closest to your home, which contains anything that needs a lot of attention. Herbs, salad vegetables, your favorite flowers, new seedlings, and plants that require daily watering make great options for Zone 1. The further away these plants are from your home, the less likely you are to take proper care of them. Raised beds, worm compost bins,

greenhouses, and animals that help you eat yard scraps (such as rabbits, chickens, guinea pigs, or ducks) are also great for Zone 1.

Imagine if it's pouring out, you're preparing dinner for visiting friends and family, but you're starting on dinner late because you've been held up by your other appointments. That fresh rosemary you need for your potatoes is sitting quietly at the end of a muddy path right in the back side of your garden. Would you really walk out, braving the relentless downpour just to make it to the far ends of your garden, for the simple task of picking some rosemary?

Zone 2 plants will also require lots of attention, though less than Zone 1. Fruit trees, perennial vegetables, ponds, hedges, windbreaks, beehives, and larger thermophilic compost systems are appropriate for Zone 2. These all require less frequent

maintenance. Vegetables with longer maturity and infrequent harvesting times, such as potatoes, tubers, cauliflower, and pumpkins are good for Zone 2.

The next few zones are more commonly found in larger spaces, especially rural areas. However, a large urban backyard can still play host to zone 3.

Zone 3 features plants that do not require much attention from you. Mulch may be the only thing they require. These include large fruit and nut trees. On a farm, it may be a large pasture area.

Zone 4 is a semi-wild area that is mainly for foraging wild edibles or wood production.

Zone 5 is completely left to the wild. Nothing is grown or cultivated. It is purely to allow wilderness to

be, and to observe natural cycles and patterns. Usually zone 5 is found in rural areas, and generally not included in an urban or suburban backyard garden.

While zones help you organize your garden in terms of what you need to access and how frequently, sectors harmonize your garden design with natural weather patterns and energy flows.

Every site is predisposed to nature's flow of energy, which includes wind, sun, fire, water, and even wild animals that can heavily influence your landscape. There are different types of wind you can have, such as hot summer winds, cold winter winds, or salty or damaging winds. Your area may also be vulnerable to fire or floods, and you may want to take into consideration the presence of unwanted views.

Once you account for the sectors affecting your area, you can implement design components that can deflect, encourage, minimize, or block the incoming sector energy. With some clever design, you can also channel the sector for special uses.

The most important part to understanding sector dynamics in your area is careful observation. Ideally, you'll want to observe your space for a year or two before you begin implementing your design. Otherwise, you may fall victim to relentless sunlight baking your delicate vegetables, or a clever predator claiming your chickens and rabbits for an easy nightly supper, despite your best efforts to protect them.

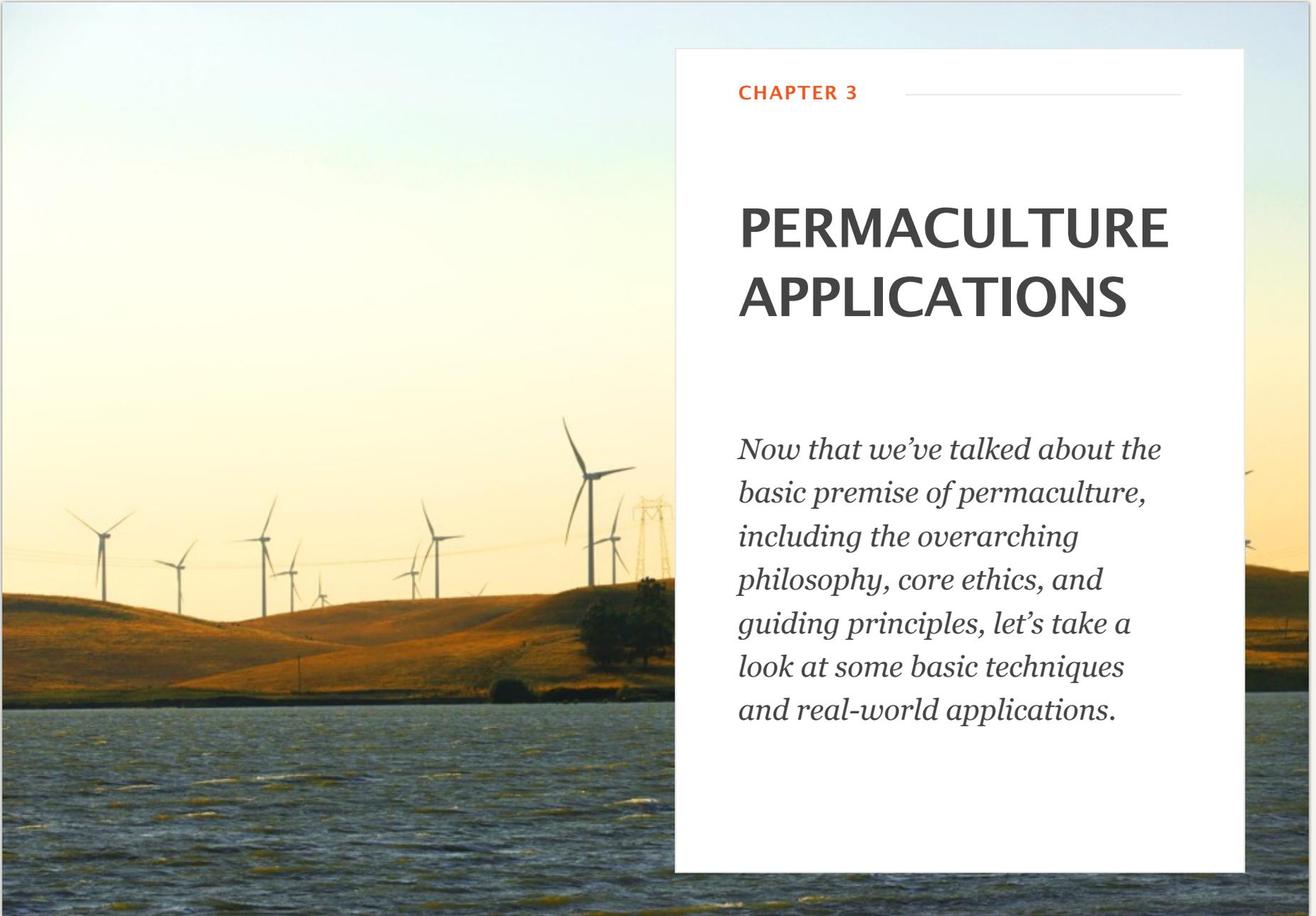
Fortunately, there are some modern tools to help you more quickly learn about nature's forces in your area. People have been tracking the movement of the sun, as well as annual wind speeds and directional

flows, for many years now. Sites like SunCalc will show you the annual sun trajectory for your area. There are also plugins for Google Earth and Google Sketchup that incorporate the sun position, and for Sketchup, show the shadows your buildings and structures would make on the ground. To block sunlight, deciduous trees provide shade in summertime. The leaves fall in winter, allowing sunlight to warm the area.

If you want to block the amount of wind entering a spot, you can plant windbreaks, which are plants that are resilient to wind. Conifer trees are great as windbreaks, as are artichokes and giant sunflowers. Trees are also great for blocking out unwanted views. Some fire-resistant species can be planted if fire is a danger in your area. Most deciduous trees and shrubs are fire-resistant.

PERMACULTURE APPLICATIONS

Now that we've talked about the basic premise of permaculture, including the overarching philosophy, core ethics, and guiding principles, let's take a look at some basic techniques and real-world applications.



SECTION 1

NATURAL BUILDING

“The cob walls of Devonshire, which are formed of clay and straw trodden together by oxen, have been known to last above a century without requiring the slightest repair.” – Loudin’s Encyclopedia of Architecture, 1833

Contrary to popular sentiment, earthen structures have been known to stand sound for lifetimes. It’s truly incredible to see what the earth provides. Not only does it grow our food and nourish the diverse life forms on our planet, it is also a remarkable building material.



Today our buildings and homes are made of a mix of concrete, wood, plastic, and other materials. Synthetic materials cannot be composted back into the earth. Some parts can be recycled or reused, but for the most part, at the end of their lives, building remnants find themselves resting in the landfill.

We prize our modern civility in constructing large, glossy high-rise buildings, and yet they only serve to pollute our planet and create more waste. Ancient humans relied on the soil and other natural materials for building homes, leaving the structures to compost back into the earth once they left.

With rising costs in energy, housing, a global recession, and increasing concern for the environment, there has been resurgent interest in natural building. Natural building fits in perfectly with

permaculture principles. They value renewable resources and services, catch and store energy, and they produce no waste.

Earthen structures are cheap to build because they can use earth, clay, and water from on-site sources. You can simply dig earth in front of the space you choose to build! Natural buildings provide efficient insulation – keeping warm during cold winters, and cool in hot summers. They need wood or metal roofs to protect from water, but other than that, they will last for generations to come.

The act of building a home out of soil and clay requires that our hands work with the earth itself – shaping it with water and hay into the form we desire. It's not a one-person job – we absolutely need to invite the greater community to help us make our home. The work of natural building weaves community

together with the earth, demonstrating the core ethics of permaculture in the process.

Not only is natural building an ecologically sustainable way of building homes and structures, they also provide spiritual and psychological benefits as well. In nature where our ancestors evolved, right angles, flat surfaces, monochrome colors, and rigid uniformity don't exist. Most homes lack variety in shape, color, and structure, leaving our senses wanting further stimulation. With natural building, any form can take shape, so long as you can mold the damp earth. The organic curvature of natural buildings engages our creative senses and connects us with nature's forms and patterns.

If you don't like the organic curves of cob walls, you're in luck – you can also choose a modernistic rammed earth material with rectangular edges and

straight, flat walls. There isn't just one type of earth masonry – there are several flavors to choose from, such as cob, adobe, earthbags, straw-bale, and rammed earth. So you can take your pick, and design your natural building just for you.

Cob is one of the most popular natural building materials, using soil, clay, water, and straw. Modern-day cob structures take on a new creative form, boasting smooth and curvy wall design, decorated with upcycled glass, colored stones and rocks, and even paintings of earthen plaster. Cob walls adorned with glass mosaics are incredibly beautiful, as are the addition of stained-glass windows.

The great thing about cob is that it is one of the simplest forms of natural building, requiring no baking, no bricks, no formwork or structural molds. One of the most popular cob structures found on

permaculture sites is the cob pizza oven. It's a great way to showcase what cob can do, and it cooks pizza in literally just 2 minutes!

Adobe is like cob in that it is made from sand, clay, water, and straw, but differs in that it is shaped into bricks (using frames) and baked or dried in the sun. Adobe buildings are extremely durable and account for some of the oldest buildings in the world. Since bricks are used in adobe buildings, there is less use of curved edges. But decorative pieces can still be imbedded into individual bricks.

Earthbags contain a mix of soil and straw in a grain bag, and are stacked on top of each other like bricks. They are covered in adobe or plaster to shed water and prevent any damage from solar radiation.

Rammed earth is more complicated, as it requires formwork (a structural mold). A damp mixture of sand, gravel, and clay is compressed into wooden frame or mold, creating either a solid wall of earth or individual blocks. Lime can be added as a stabilizer.

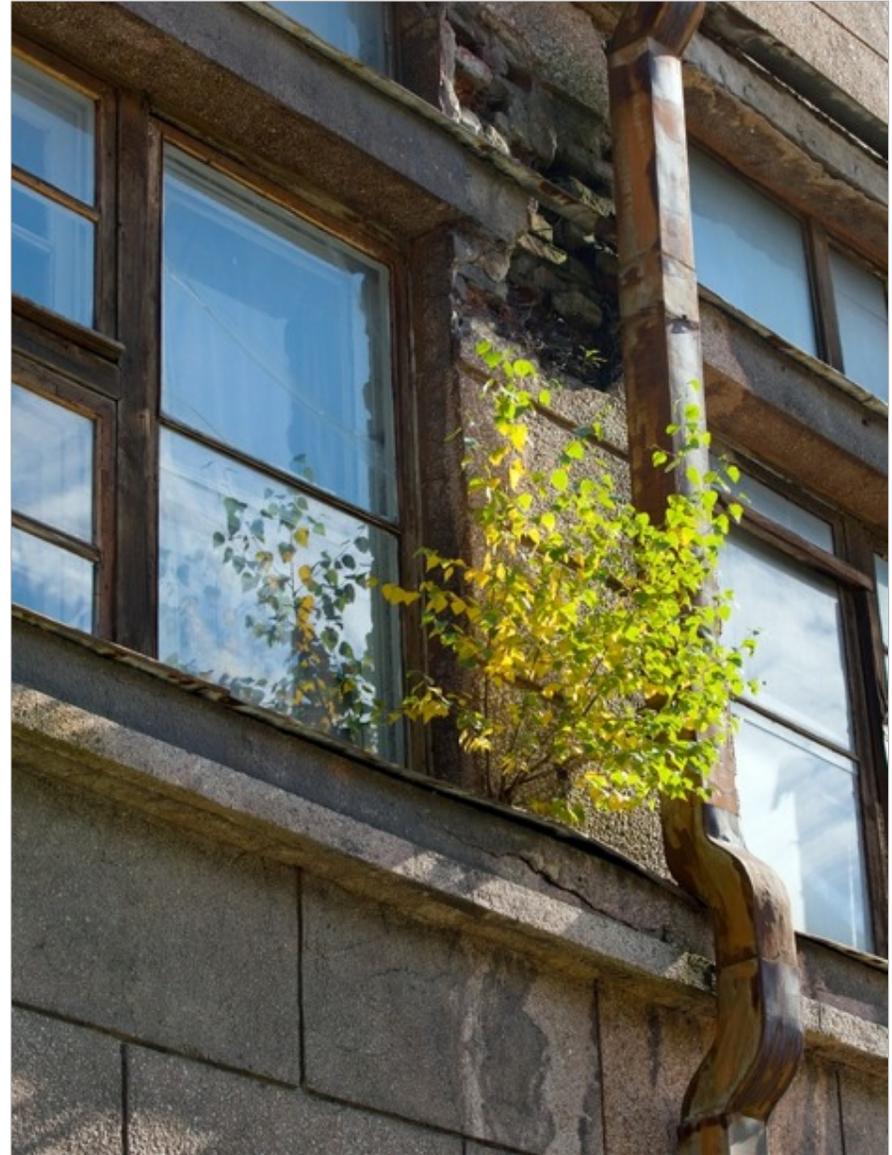
Architect Michael Reynolds is best known for starting the Earthship Biotecture community, which mixes natural earth-based materials with wastestream materials to build homes. Unwanted tires are used for structural support, old wine bottles, beer bottles, and other scavenged items are embedded into the earthen walls for decor and reinforcement. Based in New Mexico, what began as Reynolds' experiment in building with recycled materials, has now grown into a fledgling community that provides education, consultation, and construction of earthships around the world. What's even better is that earthships are built to fit in with existing building codes.

SECTION 2

RAINWATER CATCHMENT AND GREYWATER REUSE

Did you know that harvesting rainwater and reusing greywater can save over 50% of the average American family's household water usage? This is an astounding figure when we consider how vital water is to our planet's health and well-being. We can cut our water usage in half by designing smart water systems, and let the planet keep more clean water to maintain its ecosystems.

In permaculture, household wastewater is classified into two groups: (1) Greywater refers to the wastewater from your shower, laundry machines, and



bathroom sinks. It contains bacteria, fiber particles, and dead skin cells, which is very nourishing for your garden plants, and doesn't pose a huge health risk. (2) Blackwater refers to the wastewater from your toilet and kitchen sink, because it is loaded with feces and grease. It can contain animal parasites and excess nitrogen that will pollute the environment.

Greywater can be fed directly to your garden plants, whereas blackwater needs deeper filtration to be safe for returning to the ecosystem.

In permaculture, we use rainwater catchment systems to harvest rainwater. After all, rainwater falls freely from the sky, as part of the natural water cycle. Using rainwater helps significantly reduce the amount of water we take from ancient reservoirs both below and above the ground surface.

Rainwater is amazing because it's naturally soft, free of chlorine and other chemicals, which are present in the tap water supply, and you will save money on your water bill. It is super simple to harvest rainwater – all you need is a slanted roof, gutters and a downspout, a storage tank, a mosquito screen and lid, and a spigot or hosepipe. If you want to collect more rainwater off your roof, you can connect several storage tanks via pipe in a row. You can use your rainwater for drinking water, feeding your garden, or connect it to your household plumbing system.

When it comes to implementing a greywater system, it's best to use it for your garden plants. To keep things simple, you can pipe it directly onto your lawn, or you can store it in a settling tank, with a pipe at the top that connects to your irrigation or garden watering system. Keeping it in a tank allows the solids to settle at the bottom, so they don't clog up your pipes. But this also means you'll need to pump out the

solids once a year. You can add the settled material to your compost system.

A well-known permaculture farm in Australia has a really cool mulch pit greywater system, where they hooked up greywater from their laundry and outdoor sink and piped it into several different mulch piles. Next to each mulch pit they planted a beautiful shade tree that provides food for people and animals, as well as biomass for compost, fuel, and other uses. They plan to grow other companion plants near the tree in the future. Companion planting is the act of planting several plants that benefit each other in the same space.

There are other ways to filter greywater for reuse, such as through a wetland system, which uses a bed of reeds to filter the greywater. The reeds take up bacteria and pollutants, leaving the water clean. But

this method is a little more complicated, because you have to clean your bed of reeds every few years. The greywater helps compost the mulch, water the tree, and vitalizes the soil microbial community.

Harvesting rainwater and using greywater for your plants essentially harnesses the services gifted by the natural water cycle. Instead of the soil soaking up the rainwater, you are soaking up the rainwater. And in the end, you're giving that water back to your plants in the soil anyway, returning it to the natural water cycle.

Harvesting rainwater can fulfill one-third of your household water needs each year. Add that to a greywater system that reuses your household water to water your garden and lawn, and you've basically met close to two-thirds of your household water needs.

SECTION 3

COMPOSTING

Did you know that compost can not only be used to fertilize your garden soil, but can also be used to control soil erosion, suppress plant disease, filter stormwater, and generate heat and electricity?

Compost absorbs rainfall, thus preventing rainwater from washing your soil away. It's also full of beneficial micro-organisms, many of them known for their biocontrol properties. Biocontrol organisms outcompete disease pathogens, and also attack them through antibiotics, antifungals, and parasitism. Coarse compost can be used in rain gardens to filter



stormwater – toxic metals and inorganic acids are sequestered in humus (the end product of composting), allowing clean water to flow through.

If you haven't heard of Jean Pain, you should absolutely check out his work on Youtube. He was a French innovator who produced 100% of his energy needs from his compost system. He collected storm debris and fed it through a woodchipper to build a giant pile. He built an infrastructure of water hoses through the inside of the pile, and installed an anaerobic digester in the center of the pile, which produced methane to run an electricity generator, his cooking elements, and his truck. Jean Pain's innovative system is currently experiencing revived interest – more and more compost heat recovery systems are popping up all over the place.

If there's anything in nature that embodies regenerative potential, it's decomposition. In natural ecosystems, leaves, sticks, dead insects and microbes, find themselves falling onto the soil surface. A little water and a little oxygen spur to life an underground universe feasting vibrantly on the gifts of death. As bacteria and fungi feast, so too do larger micro-organisms like nematodes and protozoa feed upon them – the soil food web stretches from single-celled bacteria to multi-celled insects and even larger animals like earthworms and gophers. It's the activity of all of these soil organisms feasting and excreting that releases the nutrients once locked up in a single leaf cell into the soil, making it available once again for plant roots to take in and grow tall.

Often in permaculture, we allow the excess leaves, flowers, fruits, and sticks to simply fall in place, allowing it to decompose right where it was growing, creating a lush bed of mulch while also replacing

those nutrients previously locked into the growing plant. But there's also a great way to use that excess biomass and participate in one of the greatest gifts of nature – compost.

Composting toilets are also a savvy way to reduce water usage and plumbing issues, all while created nourishment for the soil. If you've ever used a composting toilet before, you know they don't smell whatsoever. After using a compost toilet, you cover your excrement with a layer of sawdust or woodchips, which soaks up the excess moisture and neutralizes any odors. This type of composting is often called "humanure", and if it's managed in a way that allows all parts of the compost pile to get hot for several days, then it's basically been pasteurized. Pathogens are killed and the compost is safe to use even on food crops.

Garden compost is super simple to create – you just need to follow a few rules to make sure that what comes out of your pile is odor-free, rich, vibrant, and nourishing for your soil. It doesn't even matter what C:N ratio you've got – decomposition is happening.

1. Know your Greens and Browns. Grab yourself a chart displaying materials that are Green (high nitrogen) and Brown (high carbon). Woody materials, leaves, nut shells, corn stalks, and fruit waste are all high in carbon (Browns). Grass clippings, pasture, coffee grounds, food waste, garden waste, manures, hay, weeds, and vegetable scraps are all high in nitrogen (Greens). Without getting into too much fancy science, simply aim for a 1:1 ratio of Greens:Browns.

2. Introduce soil microbes. This may sound complex, but really, all you have to do is add a little garden soil into your compost pile. This is enough to

introduce your native soil microbial community into the pile (known as “inoculating” your pile)

3. Add water and air. Because it’s the microbes that break down your plant matter, they need water and air to survive. So give them enough water to make it about 60% moist, and mix it all up with a shovel.

4. Place your pile in Zone 1 or 2. Ideally you’ll want to pick a site that’s easy for you to visit, or you risk ignoring and avoiding your lovely compost pile. Aim for zone 1 or 2 (closest to your home) and it’ll be easy to see how your pile is doing.

5. Choose a container for your pile. There are a variety of containers to choose from – wire mesh, open (no container), 3-bin mesh/wood system, tumblers, or solid plastic bins. If you have unwanted animal visitors, opt for a solid plastic bin with a lid as opposed to a wire mesh or open pile. If you’re handy with tools, you can also make your own. Be sure there

are a few air holes in your bin to allow fresh oxygen to flow through.

6. Visit your pile and give it a little care. Check on your pile at least once a week – add water if it’s dry, turn and mix it if it’s hot. This keeps your microbes happy and the compost going strong.

As you visit your compost each week, you’ll see it goes through three phases: (1) mesophilic, which lasts for a few days – this is the point where the temperature begins to rise very quickly to peak temperature, due to heat given off by food web activity. Then it reaches phase (2) thermophilic, which can last for a few days to a few months – this is the point of highest microbial activity from thermophilic organisms. At some point most of the original organic matter has been consumed and as this quantity continues to decline, so too does food web activity, and we enter phase (3) cooling and maturation, which

can last for a few months. Once your compost has cooled to ambient temperature, you are free to use it in your garden.

Simple, right? There's no complex math or science when you simply want to replenish your soil with what your garden has taken.

Beyond garden composting, there's a real need for municipal composting to exist in every city and town around the world. Industrial composting, while it is large and energy-intensive compared to local, at-home composting, still provides a very valuable service in recovering resources that would otherwise be dumped in a landfill. There's also a big opportunity to design industrial composting facilities according to permaculture principles.

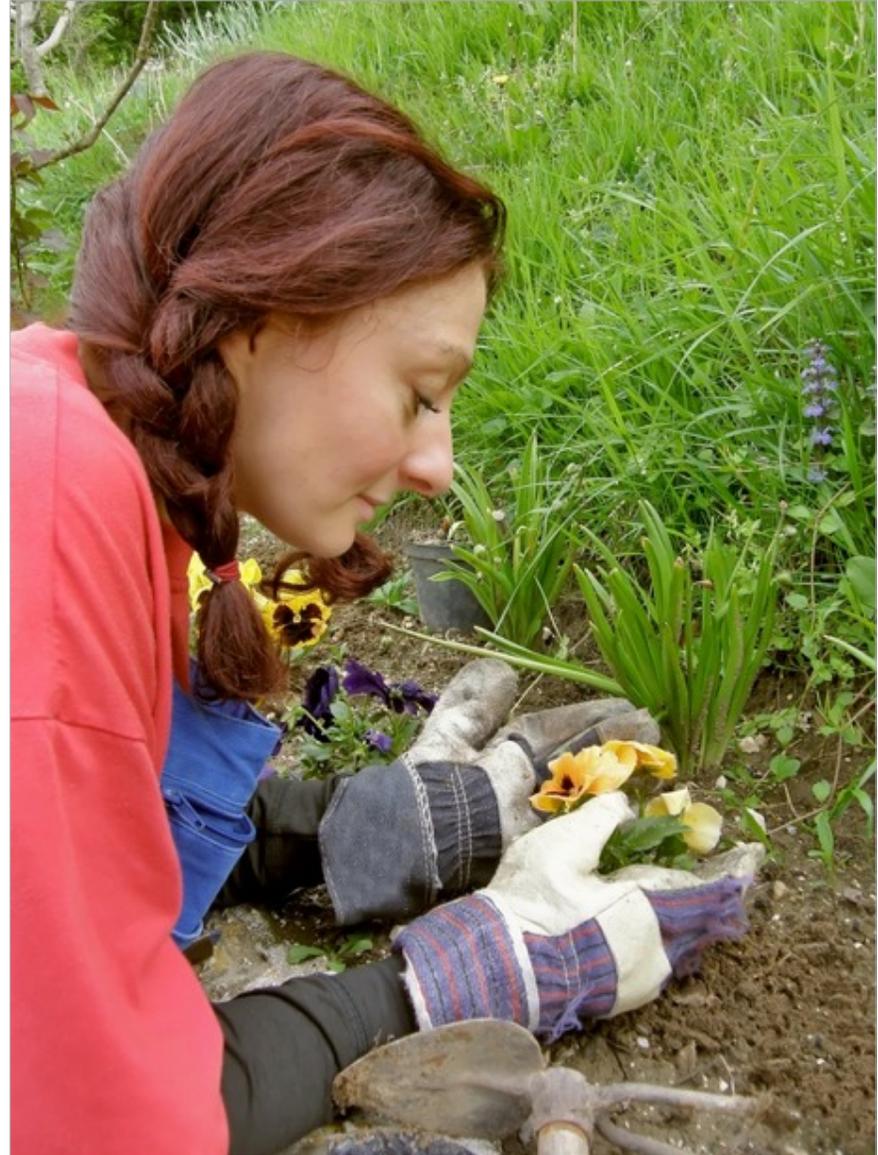
Large compost piles leach a liquid substance known as effluent, or leachate. Every industrial compost facility inherently needs to incorporate effective water drainage systems. From swales to rain gardens to filter berms, there's a lot of ways permaculture design can improve industrial compost facilities. Water collected from leachate can be stored in swales to grow trees, and even edibles. Industrial compost facilities can also offset some of their energy expenses by capturing the heat given off their large piles. Several facilities around the world have installed heat capture systems to reduce on-site energy usage.

Organic wastes can also be processed in anaerobic digesters, which produce a biogas consisting of methane, carbon dioxide, and traces of other gases, that can be used for cooking fuel, or in combined heat and power engines. Anaerobic digestion relies on the metabolism of anaerobic microbes. Anaerobic simply refers to a lack of oxygen. In regular composting, it is

SECTION 4

COMPANION PLANTING AND STACKING FUNCTIONS

Somehow conventional agriculture decided that planting rows and rows of the same crop stretched out for what seems like miles was the best solution for growing food. Unfortunately, they are dead wrong. Have you ever seen row after row of the same plant in nature? No forest will show you the same species of trees aligned in a pristine matrix. A grassland ecosystem has different species of grasses and shrubs interspersed everywhere. It seems as if there is no logical order. And yet, out of this chaos arises a stable



ecosystem at equilibrium. It needs no human intervention to continue thriving.

The permaculture idea of companion planting comes from this chaotic diversity of plants. In truth, it's not a chaotic system. There are very good reasons nature chooses to grow different species together. The main idea is based on the fact that different plants serve different purposes. Having different species next to each other can provide complementary benefits. Some plants have long taproots that bring up minerals locked deep in the soil subsurface, where most other plants can't reach them. Flowers attract pollinators, which helps other plants to reproduce and bear fruit. Some plants need more nitrogen than others, and are happiest next to a plant that releases nitrogen into the soil. Knowledge of these intricate relationships were lost in the transition to chemical agriculture, but they are not experiencing a revival as more and more people choose to garden and farm organically.

Choosing to grow food in a monoculture system (where there's only one crop species planted row after row) drastically reduces diversity in all realms, thereby reducing pest and disease resistance, and the crop's overall vitality.

Companion planting is a central component of permaculture. Plant diversity increases soil and insect diversity, which limits the number of pests that can cause disease and crop loss. Companion planting increases yields and reduces time spent weeding and managing pests and disease.

Dandelion has traditionally been seen as a scourge that should be annihilated. And yet, permaculturists often encourage dandelion because its long taproot has the ability to bring calcium locked in the deeper soil horizons up to the surface. In this way it makes calcium available to plants that need it. Not only does

it provide calcium, it also releases ethylene, which is a plant hormone that encourages fruit setting and ripening. As it is a flowering plant, it attracts pollinators that help your crops to bear fruit.

Every plant has a variety of functions and services, and there are now plenty of companion planting charts and books to help you decide which varieties would best serve your garden.

Companion planting is based on the idea of another permaculture concept – stacking functions. Nature loves multiple functions. All animals and plants perform multiple functions. Trees fix carbon dioxide and nitrogen, release oxygen, sequester carbon, provide shade and habitat for insects and animals, provide food and fiber for human consumption, and some trees offer healing properties in their leaves, stems, or bark.

We can utilize this basic concept in permaculture design. When we can bring complementary functions together, we can dramatically enhance yields and simultaneously reduce labor hours needed.

Consider the chicken. It scratches the dirt as it searches for bugs and worms to eat, it poops as it wanders around the yard, it lays eggs, and if you're an omnivore, it provides protein for your family. In terms of services for your garden, it helps to keep insect pest populations down, adds nitrogen in the form of manure, and provides food for your family. One chicken helps in so many ways – you won't need to add as much compost because your chicken is already fertilizing your garden.

You can try stacking functions not only for plants and animals, but also for structures in your garden.

For example, you'll likely want to have a tool shed for a fully functioning garden. You can add rainwater barrels to your shed, or channel the rainwater into an artificial pond. Keep the pond clean by planting wetland plants such as water lilies, reeds, hyacinths, and cattails.

Some permaculturists practice aquaponics, which has a fish tank at the bottom and hydroponically grown plants at the top. A stream of water is piped from the fish tank through the hydroponic tray, where plant roots have access to a continuous flow of water. The water is filtered by the roots, as plants take up the fish waste as nutrients, and then returns as clean water back into the fish tank. It is a closed loop system that cleans itself while providing fish and vegetables for food. Aquaponics demonstrates the potential of stacking functions to enhance yields and reduce labor hours.

Some will take this lesson back from the garden and into their own lives. You too have multiple skills and talents to offer. The most fruitful collaborative relationships come from partnering up with others in complementary ways. That way everyone benefits and your collective success can be drastically improved.

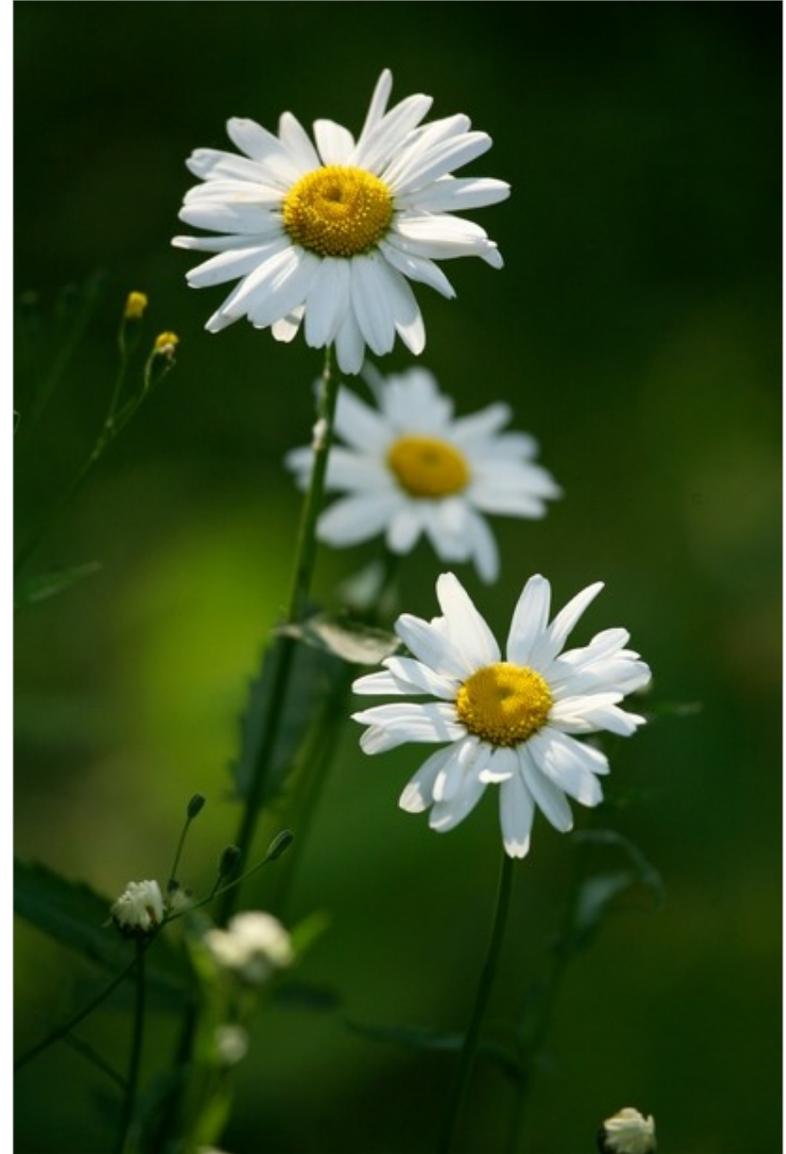
Beyond the garden, stacking functions is a great principle in engineering. Designing multi-functionality into materials and objects conserves resources and reduces waste. Two young fashion entrepreneurs created a multi-functional piece of clothing made from recycled fabric scraps known as the Versalette. The Versalette transforms into 15 different wearable styles, from a shirt, to a dress, and even to a purse. It also happened to be Kickstarter's most successful fashion campaign.

Designing for multi-functionality engages our minds in a new way. It may sound complex at first, but it's really more like solving a puzzle. The goal is a product that incorporates a number of different elements and functions, in order to extract the maximum benefit from the least amount of resources.

BENEFICIAL WEEDS

Have you ever considered that weeds can actually be a highly beneficial addition to your garden, if you just know how to use them?

Weeds are typically seen as a plague to every garden. But the thing is, nature has no name for weeds. They can be described as opportunistic species – hardy plants that consume and reproduce quickly, allowing them to survive in a variety of environments. And they serve a very useful and important purpose.



In nature, ecosystems don't mature overnight. They mature in stages, through a process known as ecological succession. An immature ecosystem is created through some sort of disturbance, such as human interference, fire, or extreme weather conditions. During this time of instability, nutrients and food webs are out of balance. The weedy, opportunistic species come in during this time, making use of whatever nutrients are available. Over time, they release nutrients into the soil through inherent metabolic activity as well as through their death and decomposition. As more nutrients and food web niches are made available, new species appear to play their role in evolving the ecosystem. As the soil food web diversifies, so too does the aboveground ecosystem continue to diversify in plant species. Eventually, a mature variety of grasses make up a grassland ecosystem, or in the case of a forest, a variety of canopy trees, woodland shrubs, and grasses make up a forest ecosystem. But this could never have

happened without the weeds coming in first to balance out a disturbed landscape.

Permaculture adopts nature's view of weeds – they are nature's way of remediating a disturbed ecosystem. Of course, gardeners won't want weeds in their space regardless of what it may mean in successional terms. But perhaps we can reclaim the value of weeds – they are edible, some are medicinal, and some can be good for your garden. Many weeds can be fed to livestock, which saves on buying feed. Weeds are great for a compost pile – if you can get your compost pile to a hot temperature, the heat will kill off the weed seeds so they won't grow again in your garden.

There might be some weeds growing in your garden right now that you didn't know were actually

really useful. Try giving them a second chance before you pull them out.

Lambsquarters is a vivacious salad green that sprouts early and best of all, it is a vigorous self-seeder. So you don't have to do anything to get these nutritious salad greens. What you can't use can be used as animal feed or compost feedstock.

Pea plants can be an annoying weed when they take over native plants or garden space. But they provide animal feed, attract pollinators, and fix nitrogen into your soil, which makes for a rich compost pile.

Dandelions are a ubiquitous weed that many find incredibly annoying. But as mentioned previously, dandelions can serve a variety of functions – they attract pollinators, bring up subsurface minerals, their

greens can be eaten in salads, provide food for animals, and you can even make dandelion wine from their flowers.

Mustard can be an annoyance in your garden, but the leaves and sprouts are edible. They attract aphids as well as ladybugs, increasing insect diversity in your garden. The aphids collect on mustard and thus avoid eating your actual garden plants. And, to prevent mustard from taking over your garden, you can harvest the seeds and make your own condiment mustard.

Nasturtiums make an edible addition to your garden salad – all parts of the plant can be eaten. The flowers make especially festive additions to any plate. They attract predatory wasps and help repel squash bugs, cucumber beetles, striped pumpkin beetles, and woolly aphids. Also, they serve as a trap crop for

URBAN AGRICULTURE

When we think about food and farming, it's easy to imagine a bucolic setting of rural pastures, far removed from the busy hum and thrum of city life. It's true that right now most of our food is produced on rural farmland, but does it really make sense to transport all that food to where most of the people are – in cities?

What if cities could feed the world? Growing most of our food locally, within the city, could practically eliminate the cost of transporting food. Fortunately, the success of urban agriculture has already been



shown by the nation of Cuba.

In 1989, Cuba was dependent on the Soviet Union for imports of fuel and food. Essentially overnight, they were forced to find a new way to feed themselves. Havana residents took matters into their own hands, planting fruits and vegetables on balconies, empty lots, backyards, and anywhere they could grow something. In just two years, there were gardens and farms in every neighborhood of the city. By 1998, Havana was producing about 50% of the country's vegetables, without using any pesticides.

In San Francisco, permaculturists once estimated how much food could be produced by utilizing all of the available backyard, side yard, and front yard space for growing food. It turns out that San Franciscans could produce an estimated 385 million pounds of food a year!

Urban spaces are a prime opportunity for implementing permaculture design. We can utilize both community and personal spaces for growing food. In 2011, Seattle received funding to grow a 7-acre food forest just 2.5 miles from downtown. A food forest interplants trees, shrubs, and other useful plants together in an ecologically supportive way. The idea is to design it for maximum harvest and minimal labor. There's no need for large tractors or plowing, reducing overall energy consumption. Imagine if there were food forests in every major city – they could increase food security while reducing resource consumption.

Front lawns are another prime location for growing food. If we can get past our need for mowed grass, we'll have freed up an enormous amount of space for growing food and other useful plants. However, this topic is highly charged. Several citizens who cultivated

their front lawn for food and medicinal herbs were threatened by their local city governments. A Michigan woman almost faced jail time, while in Quebec, local authorities came to remove the plants without receiving permission from the homeowners. In Georgia, a man received a \$5,200 fine for growing and selling vegetables to his friends.

Typically, the greatest barrier to a flourishing urban agriculture is local policies on zoning and commercialism. Recently in San Francisco, legislation was passed to incentivize and streamline urban agriculture projects. There was previously no program to survey and coordinate urban agriculture throughout the city. Oftentimes, urban farmers grow an abundance of food, to the point where they could sell or give away a large portion of their harvest. The questions policymakers are interested in include, at what point does an urban farmer become a commercial entity, and how much traffic is the urban

farmer generating? When considering the urban farm as a commercial entity, does it fall into the appropriate zone?

Other cities are not always so open to streamlining urban agriculture projects. In New York City, Mayor Giuliani pulled the land from community gardeners for development projects. Fortunately in the end, guerilla gardeners were able to rally the support of their fellow citydwellers and reverse his policies to allow their community gardens to stay for good.

Beyond backyard and community gardens, there are other hidden places where food can grow. From vertical gardens to green roofs, there is immense potential in all of the nooks and crannies of city spaces to provide food for its residents. Cities have long been held as bustling forums of new ideas in art,

science, and culture. They hold the same promise of creative innovation in sustainability as well.

Have you ever considered the functional potential of a wall? It can actually serve as a great spot for growing food. Vertical gardens can be as simple as a tall, narrow shelf of planters, sitting by a sunny window indoors, or decorating an outdoor garden. The planters can be affixed directly to the wall, and can be made of wood, metal, or even burlap bags. You can have plants growing directly from a wall made of soil, as in the popular French museum near the Eiffel Tower, le Musee du quai Branly. This living wall, as its known, is about 200 meters long and 12 meters tall. In recent years, concepts for skyscraper farms (or sky farms) have emerged from all over the world. One proposed \$200 million sky farm in Las Vegas would boast 30 floors of indoor farmland, producing enough food to feed 72,000 people per year. An awesome feature of sky farms is that they can produce as much

as a 420 hectare farm, but will take up 3% of the true land space.

Rooftops are another oft-overlooked space in cities, ripe with possibility not only for growing food but also to reduce energy use and enhance stormwater management. They are especially noteworthy because they can help reduce what's known as the urban heat island effect. This heat island effect means that in a metropolitan area, the temperature is significantly warmer than in surrounding rural areas. It's caused by human activities, particularly construction materials that effectively retain heat. Green roofs help offset the urban heat island effect by removing heat from the air through evapotranspiration. Evapotranspiration is the process by which plants absorb water through their roots and release it through their leaves, where the water converts to air. On a hot summer day, the surface of a conventional rooftop can be up to 90°F warmer.

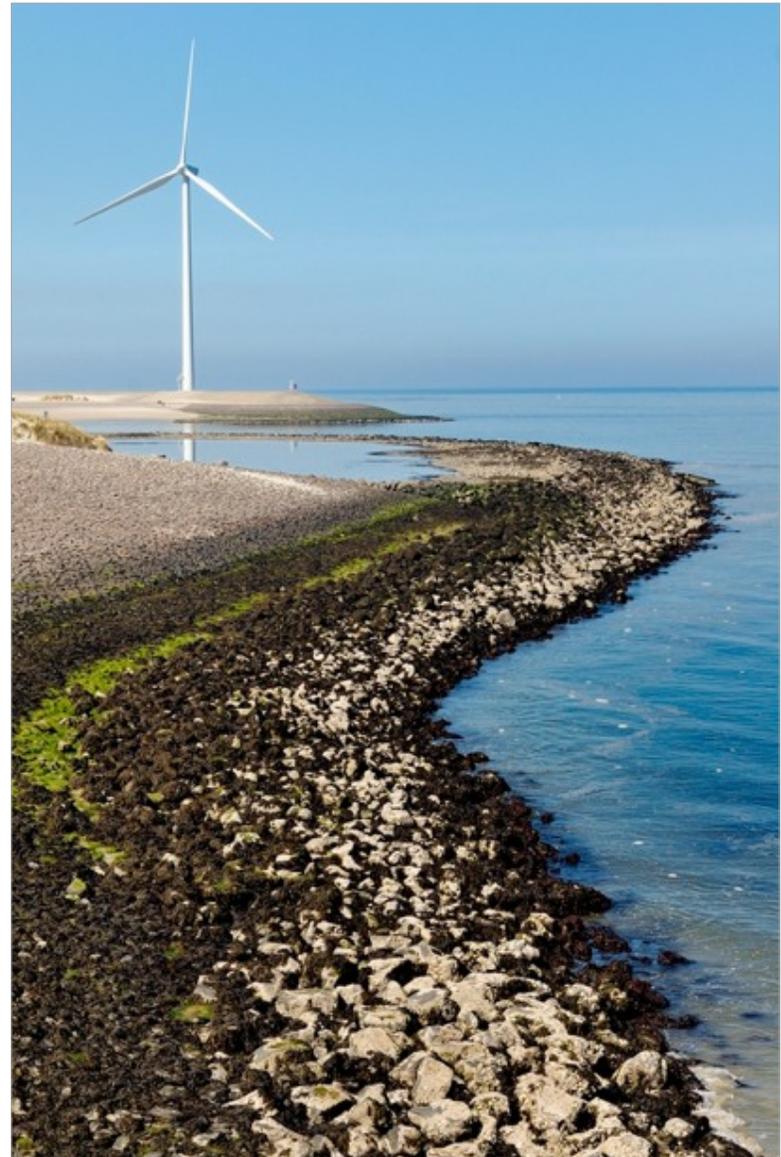
Green roofs can be installed just about anywhere, so long as the roof's weight-bearing ability is considered in the design. Green roofs absorb heat and act as insulators for buildings, reducing the energy needed for cooling and heating. They reduce air pollution and greenhouse gas emissions, improve indoor comfort and air quality, enhance stormwater management and water quality, and also provide wildlife habitat. Plants and soil naturally filter water and pollutants from rainfall.

Window planters are another source of growing space. This begs the question, How many people could we feed if we were growing food in all of these spaces? The next time you walk down your street, think about how those blank walls and roofs and empty windowsills could be utilized to grow food. Perhaps when we fully take advantage of these spaces, we will truly be able to feed ourselves with local food.

SECTION 7

APPROPRIATE TECHNOLOGY AND RENEWABLE ENERGY

What if technology could be built for the very purpose of serving people and planet, as opposed to profit and the image of modernity? These days we've become accustomed to non-stop technological innovation and what seems to be progress. Yet, our technology hasn't been created with people and planet in mind. In permaculture, all technology must be grounded in ethics of care for the earth, care for people, and sharing the surplus. This is also known as "appropriate technology".



Gandhi is often cited as the “father” of the appropriate technology, as he disagreed with the idea of technology that benefited a minority of people at the expense of the majority. Technological progress in industry often means big machines that put people out of work. Cell phones, computers, and laptops often use rare minerals and minimum wage labor from poor countries. When they are discarded, they often end up in these poor countries, where peasants scavenge them for valuable parts to sell, sacrificing their personal health and creating an environmental catastrophe in the process.

On the other hand, appropriate technologies are designed to be sustainable and give power back to the people. They can be characterized as follows:

1. Sustainable

2. Small – Small is important because it often means local, affordable, and adaptable, putting more control into the hands of the user, thereby supporting resilience. Small is typically defined by:

- Few moving parts (meaning less can go wrong)
- Can be built locally (increasing public access)
- Easily repaired by local people with locally available equipment
- Affordable
- Made with locally available materials

3. Appropriate to the context, including the environmental ethical, cultural, social, political, and economical context. Due to varying needs from each location to the next, what is appropriate in one situation may not be so in another.

Appropriate technologies include portable, wood-burning stoves, animal-drawn carts, bicycle trailers and ambulances, solar ovens, as well as low-cost, low-tech renewable energy projects. They are usually found in poor regions, but these technologies also assimilate well within an off-grid community.

The conceptual framework of appropriate technology completely transforms our relationship with technology. It requires us to take in a holistic view, which is more lengthy and detailed in thought and planning, but actually may be more simple and easy to execute than the alternative method of mining for rare minerals. By using local materials, resource levels can be better managed. Excess materials will be used more quickly, allowing scarce materials time to restock. In this process, materials use is more similar to that of a food web in nature.

If we used more human-powered machines, like bicycle-powered machines, we could get in shape at the same time that we accomplish creating something new. The Dynapod is a stationary bicycle that can be used to generate power for a number of activities. Any tool or device can be attached to the Dynapod, including corn grinders and a winnowing machine. Even pedal powered laptops have been developed, which are powered entirely from the kinetic energy of pedal motion.

Stacking functions with appropriate technologies, some gyms around the world are plugging their machines into the grid. The kinetic energy from people running and cycling on machines is converted into electricity and used for domestic energy needs. Extra electricity is fed back into the local grid.

Let's take a closer look at some popular types of renewable energy. Sometimes it seems like clean, renewable, people-friendly energy is a distant dream for a surreal world. But it doesn't have to be that way. We've made significant progress in overcoming financial and technological barriers to implementing more renewable energy projects, even though there are still many challenges to overcome. We can take strides to make even more progress, especially through greater education and implementation, because we already have the technology we need.

Permaculture sites often use some type of renewable energy source for their energy needs. The most popular types are solar and wind, but there are also projects that now use compost for energy. For those who can't afford to install solar panels or wind turbines, they have an option in financial permaculture.

The Permaculture Credit Union is a unique, visionary banking institution that is founded on permaculture ethics. It hosts a Sustainability Discount Program, which provides discounted loans for customers who use their loans for sustainable installations, including energy efficiency, renewable energy generation, permaculture landscaping, water catchment and delivery, farm machinery, etc. In exploring creative ways to finance renewable energy projects, the PCU offers just one more incentive.

Renewable energy comes from sources that are continually replenished by nature, such as sunlight, wind, rain, tides, waves, and geothermal heat. Our sun was born about 4.6 billion years ago, with another 5 billion years left to burn brightly, so we can reliably depend on sunlight for energy for the next 5 billion years.

Wind power converts kinetic energy from wind into electricity. Many permaculture sites also install wind turbines to reduce energy dependence. They typically all have the same design, with a horizontal axis having an upwind rotor with three blades, attached to the top of a tall tubular tower.

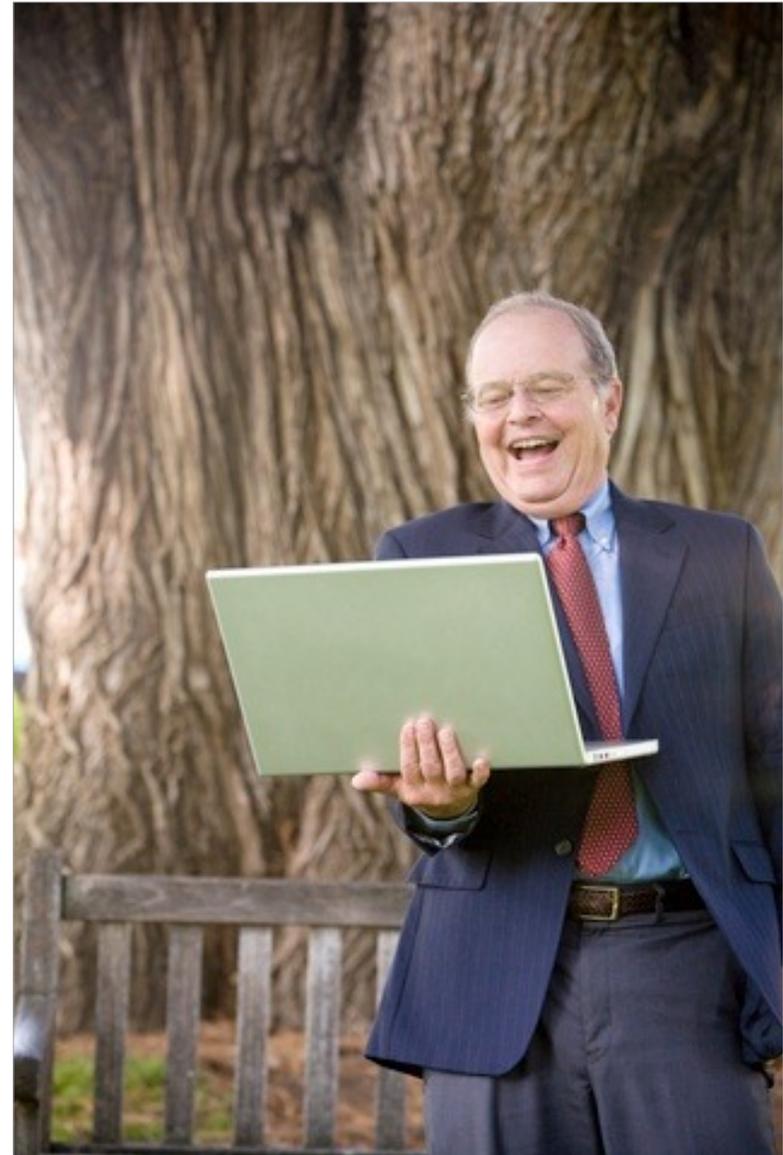
If you've enjoyed a relaxing soak in a hot spring, you'll have experienced firsthand the power and potential of geothermal energy. Geothermal energy converts thermal energy trapped within the Earth into electricity. This thermal energy originates from the original formation of the planet and from radioactive decay of minerals.

In truth, these technologies are fairly straightforward. The more we can spread the word through education and implementation, the more quickly we can overcome the existing challenges. As

this continues to happen, we can truly realize our hopes of living in a world powered by clean, renewable energy.

GREEN BUSINESS

Change makers often see business as a plundering, predatory force with nothing but profit on their minds, leaving to the wayside all sense of humanity and well-being. But in permaculture, we often see the problem as part of the solution. If we take a closer look at businesses, what are they really? They are conscious entities of their own, each with its own purpose and values system. Suspending our thoughts about corporate personhood for a moment, in a way they truly are like people – they hold different beliefs and values about different situations, they have personalities, appearances, they influence the



surrounding eco-social community, and their actions ultimately stem from their beliefs and values.

International corporate businesses may boast values of service and well-being on the surface, but do their actions truly align with their supposed values? When the actions of a business are truly aligned with the permaculture ethics of care for the earth, care for the people, and sharing the surplus, the business can truly only be a force for good. Green businesses embrace the triple bottom line – people, planet, and profit. They aim to use the profit to do more good.

Green businesses embrace authenticity branding and approach marketing in a way that doesn't exploit their customers, but instead educates and inspires them to support eco-social sustainability. Can branding really be authentic? This may sound like a revolutionary, impossible idea, but it really can be. If

you can be authentic in the way you express yourself, then you can be authentic in the way you brand your business. In a sense, your physical expression and your personality combine to form something like a brand for your personal self. By extension, an authentic business brand expresses its core purpose, beliefs, and values.

Permaculturists are truly businesspeople. Running a design consultation firm, a farm, or an educational company all require business expertise. When business skills are lacking, permaculturists cannot reach as many people, nor transform as many sites into edible ecological havens. Without conscious business skills, the movement suffers and slows down.

Permaculture businesses commonly revolve around consultation, design, landscape architecture, natural building, farming, and education. But the opportunity

also exists to infuse other areas of business and culture with permaculture ethics and principles, such as alternative medicine, personal development, and engineering.

There is incredible power in working together with people from different fields of expertise, united by common values. Expanding the permaculture community to ally with other fields, effectively growing business ecosystems that are mutually supportive, can exponentially magnify the metamorphic impact of the permaculture philosophy.

Integrating ecological sustainability with social harmony is a core goal of permaculture ethics. The green business sector is growing quickly, with inspirational stories to be found just about everywhere. There are people like Ray Anderson, founder and former CEO of Interface, Inc., one of the

world's largest manufacturers of modular carpet, who re-oriented his entire company's mission statement towards zero waste sustainability after reading Paul Hawken's book, *The Ecology of Commerce*. Now Interface has its own sustainability consulting branch, supporting other industrial corporations to also move towards zero waste sustainability.

Eve Blossom is an architect whose life was changed when she witnessed the sale of a little girl in Thailand to a man for sex. She vowed to do something for these little girls, and eventually created Lulan Artisans, a sustainable textile company empowering village women to spin beautiful fabrics using renewable, local materials, sold to premium markets around the world. Their housing is made of local bamboo, they upcycle bicycle wheels for spinning looms, incorporate fibers from local agricultural wastes, and use natural dyes in all of their products. By employing women who would otherwise be prostituted for money to eat and live, her

company has saved the lives of countless young women.

While neither of these people would necessarily identify as permaculturists, their values speak for themselves, aligning them with the ethics of care for the earth, care for people, and sharing the surplus. So it is for many other professionals – doctors growing food and herbs using ecological principles, life coaches guiding clients newly awakened to global injustice to a path of positive, solution-oriented change, artists using upcycled and renewable materials to spread awareness and inspire participation, and engineers producing sustainable materials while cultivating a positive and creative working community.

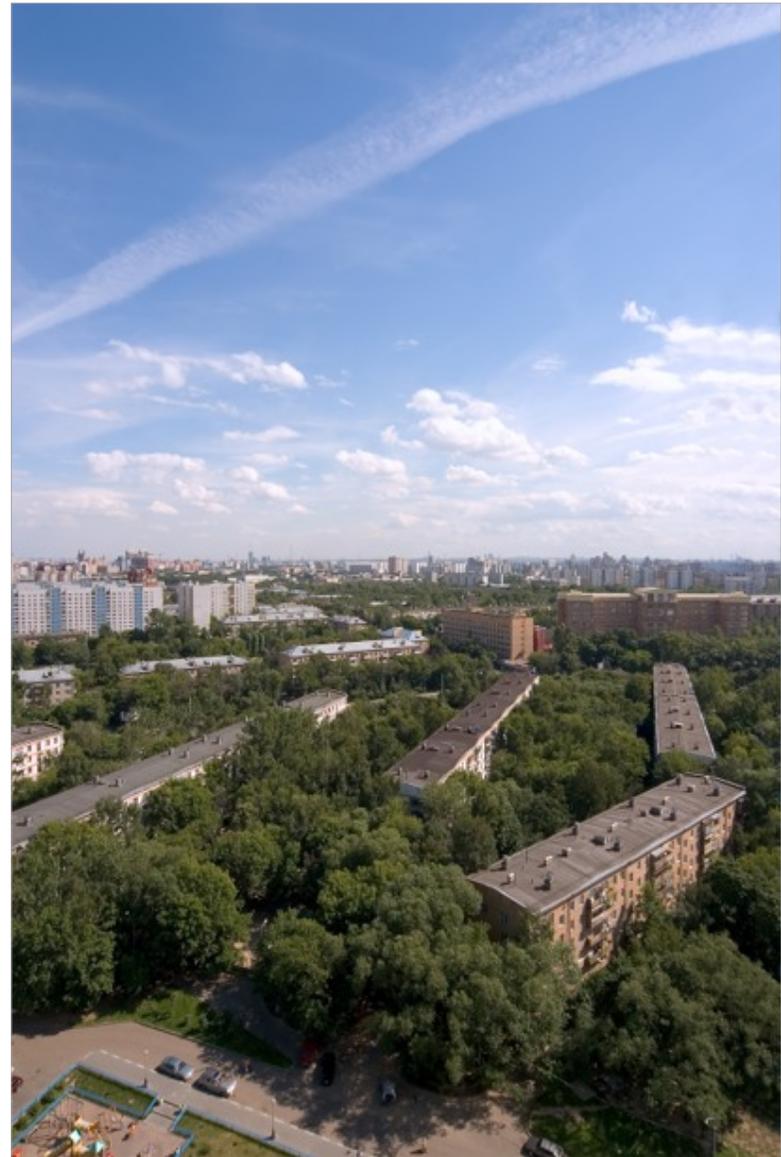
By including the dynamic, diverse community of people from all walks of life, we increase our pool of

skills and resources, we grow business ecosystems, and we empower communities all over the world to carry out real, lasting change.

GREEN CITIES

Urban culture is open, diverse, full of color, and facilitates the flow of new ideas. The world's population is increasingly concentrated in cities, with many cities around the world continuing to grow. As the primary consumers of energy and resources, greening cities are crucial to greening the world.

In the late 20th century, movements for a sustainable future focused on dropping out of urban culture, and living off grid in nature. But in truth, urban systems can actually be more ecologically sustainable than rural or suburban living. Because the



population is more dense, less energy and resources are necessary for transportation of both people and goods.

Most efforts in sustainability are interested in low-impact design. Through a regenerative perspective, however, permaculturists are interested in design that is not only low-impact, but maximally beneficial to both people and planet.

A well known permaculturist called Starhawk wrote a story about a future world where a peaceful ecocity must defend itself from an invading army. In this story, San Francisco is an ecotopia, designed and constructed to be ecologically sustainable in every way. The streets are lined with flowers and food, roofs are covered in greenery, solar panels and wind turbines adorn the urban landscape, and the architecture is conscious and beautiful. Everywhere

there is food available, there is life. Instead of a gray mass on the planet, it is green.

Concepts for green cities all feature similar themes of integrating plant life, renewable energy, and eco-conscious design pretty much everywhere. The streets are friendly for walking and biking, the energy infrastructure supports renewable energy and clean transportation, and food is plentiful because it's grown just about everywhere. Arts and music are the central piece of the urban community, fostering a fun and peaceful culture.

Because fresh food is everywhere, there is no lack of access to healthy, nutritious food. Because there is little to no pollution, and plenty of space for walking, hiking, biking, and physical activity, people are healthy.

It's exciting to think about a lush green metropolis catered to urban citizens, but it's also important to take a good approach, particularly one based on permaculture ethics, decentralization, and appropriate technology. For a city to be truly sustainable, its citizens must be empowered to make decisions about their local community.

Current ecocity concepts tend to rely more on centralized systems for energy distribution and waste management. A new eco-city planned in Portugal plans to use a centralized computer "brain" to control functions like water use, waste processing, and energy consumption. It's an attempt at urban metabolism, structuring the city as a living organism. However, there's something eery about a computer-managed city. While it sounds convenient, it ultimately takes power away from the people and doesn't fit in with the principles of appropriate technology. The burning

question emerges: What happens when the brain becomes self-aware and rebels against us?

All dystopia aside, metabolic pathways exist whether or not they are intentionally designed. Energy and water flow into and out of cities in certain patterns, culminating in urban metabolism. But there must be a way to manage urban metabolism through regenerative, decentralized design.

Ecovillages provide exemplary starting points for considering the design of a larger metropolis. Most ecovillages are situated in rural areas, but some are located in urban environments. Local, decentralized design requires collaboration among community members. Learning to work together across differences is important to this process, and is a core aspect of ecovillage life.

Key features of ecovillages include:

- home and garden composting (including toilets)
- organic permaculture gardens (food forests if the situation allows)
- garden animals such as chickens, ducks, goats, or rabbits
- bicycle as the primary transportation system
- communal decision-making
- non-violent communication
- collective art and music
- community service projects and social enterprises
- greywater use
- participation in ecovillage community including barter networks

Burning Man is another community that is often referenced when considering organizing large communities. Burning Man is an annual gathering in the Nevada desert, where millions of people from all over the world come to enjoy a temporary city. Burning Man supports sustainability through its community education and policy of leave no trace and sustainable living. Talented scientists and artists bring their projects in renewable energy and sustainable art to contribute to this diverse and thriving culture. With just a few principles to abide by, the community self-organizes. Interestingly, the community often follows the key features of ecovillage life.

We can learn a lot from studying both small-scale city concepts such as community groups, as well as large-scale designs for a green metropolis. If we can combine the best of both worlds, we may be onto something that truly satisfies all of our desires for peace, equality, and sustainability.

SOCIAL PERMACULTURE

When we talk about caring for people and designing green cities, there's a crucial component to really making that work in a sustainable way – social permaculture. Biomimicry and regenerative design provide us with a breathtaking array of inspirational ideas for designing a more sustainable place to live. But what about the way we live and work together?

Living in community is a dream for so many people, and yet they so often fail because communicating with people who are different from ourselves is one of the greatest challenges we can



face. The art and practice of non-violent communication is a critical aspect of social permaculture.

Because most of us were brought up in a cultural environment that taught us to compete and judge others, we lack an understanding of empathy. We were taught to think and communicate in terms of “right” and “wrong”, often positioning ourselves as the victim to someone else’s careless etiquette. The use of violence is learned through our cultural upbringing. Violence is sexualized and glamorized in the media, and in most cultures, the rigid parenting practice of hitting children is seen as the best way to “discipline” a wild child. Domestic affairs are private, not something to be commented on by those outside the family. The persistence of domestic violence is also rooted in this silence surrounding familial privacy.

On the other hand, non-violent communication focuses on self-empathy, empathy, and honest self-expression. In order to communicate authentically, it is necessary to practice empathy with yourself. In other words, you must practice nonjudgmental awareness and compassion towards yourself. By extending compassionate empathy towards yourself, you can then more easily extend it to others. Honest self-expression is meant to inspire compassion in others. Rather than making the other person feel bad about themselves, let them know how you have been hurt.

Tense miscommunication often arises from our own inability to understand our needs in the moment, and therefore we lack the capacity to effectively ask for what we want. We blame other people for the way we feel. In the words of Marshall B. Rosenberg, founder of Non-Violent Communication (NVC), “What

others do may be a stimulus of our feelings, but not the cause.”

The process of NVC generally works in the following way:

- Person A talks about his/her concerns while Person B remains silent and listening.
- When Person A is finished, Person B repeats what Person A stated, making sure he/she has understood it properly.
- Person A affirms the understanding or corrects it.
- Person B then talks about his/her concerns while Person A remains silent and listening.
- When Person B is finished, Person A repeats what Person B stated, making sure he/she has understood it properly.

- Person B affirms the understanding or corrects it.
- The dialog continues in this way, with one person remaining silent and listening while the other talks, until the conflict is resolved to mutual satisfaction.
- Hugs and laughter ensue.

While we credit Rosenberg for the modern development of NVC, the principles behind the practice have been used in ancient societies. Native Americans used something called the “talking stick”, which basically repeats the NVC process. Whoever holds the talking stick is the one with permission to speak. Everyone else must remain silent and listening. This is incredibly powerful, because it creates a safe container for the one speaking to express him or herself fully and authentically. It also allows the listener space to process his/her emotions, so he/she

does not react immediately from a space of fear, anger, or anxiety, and instead responds from a space of full understanding and compassion.

It's interesting that this process of silently listening, with full compassionate intent, is common to ancient cultures, and yet incredibly foreign in our modern-day society. It can even seem weird, unnecessary, or simply silly to listen with full compassionate intent. This process of NVC brings us to more compassionate, empathetic connection with all other human beings, and by extension, living things.

There is a spiritual quality to this process. In most successful communal living groups, not only are ecological and social values important, but spiritual values are also an important thread keeping the peace and maintaining a thriving community culture.

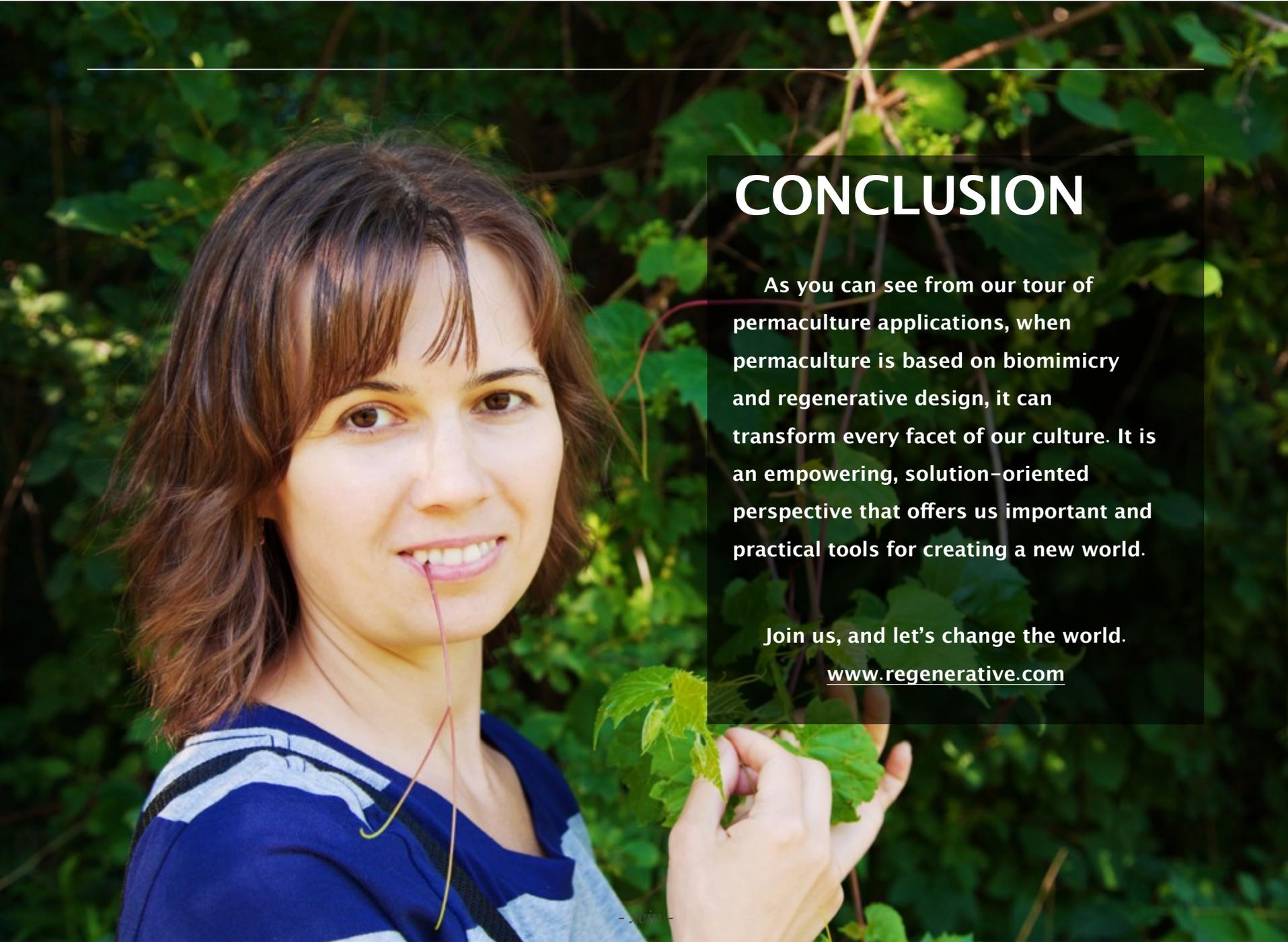
While not everyone is necessarily interested in living in a communal setting, lessons learned from successful eco-communities can be applied to other group situations, such as a workplace, or group project. These are settings in which every member has dedicated themselves to the success of the whole, and therefore depend on other members to work well independently as well as together. When communication breaks down in a group work situation, the end product suffers greatly.

Can you think of a job you had where your co-workers or managers were especially terrible at empathetic communication? Your needs aren't met, your concerns aren't heard or validated, and it ultimately feels useless to bring up your own ideas. These kinds of situations can truly break your sense of worth and independence, resulting in lower productivity and quality of work.

When it comes to actualizing our vision of a more sustainable, just world based on permaculture ethics, it's absolutely important to ensure that we can trust each other, communicate honestly, and collaborate authentically.

It's easy to talk about the concepts of non-violent communication, but it's a million times harder to practice. To start, if you have never practiced compassion with yourself, then you likely have not been able to express yourself authentically, even to yourself. Meditation and positive self-talk are tools that can help you engage in self-compassion. But when the going gets tough, and negativity won't leave you alone, it's best to invest in a therapist or life coach that you trust.

There are now a handful of life coaches who also have training in permaculture. They hold a unique position in which they can introduce people newly awakened to eco-social injustice to the promising, solution-oriented power of permaculture. They also serve to mediate conflict within the permaculture community, supporting to growth of ever more effective leaders in the movement.



CONCLUSION

As you can see from our tour of permaculture applications, when permaculture is based on biomimicry and regenerative design, it can transform every facet of our culture. It is an empowering, solution-oriented perspective that offers us important and practical tools for creating a new world.

Join us, and let's change the world.

www.regenerative.com