THE PRINCIPLES OF PERMACULTURE
from Bill Mollison & David Holmgren

PRIMARY DESIGN PRINCIPLE

Observe and Interact

The primary design tool is the designer.

Beauty is in the eye of the beholder.

Observation is a short way of saying, "Noticing the information coming from all your senses as they experience and interact with your environment, both inner and outer."

- The root of this principle is the willingness to begin designing a culture based on co-creation with Nature, while acknowledging the limitations of our present cultural norm of separation from Nature. It is the willingness to Dance with Nature, learning when to interfere, when not to; learning where limitations and abundances exist, and when; and how to intermesh our human-ness into an ecosystem to meet our needs and help it work better for All.

OBSERVATION PRACTICES: sit spot, meditation, breathing awareness, journaling, Nature Walks [learning about the flora and fauna that live around you], Herb Walks [learning about wild edibles and medicinals], learning tracking/hunting skills, learning about the movement of the constellations and the moon.

DESIGN PRINCIPLES IN GOAL-SETTING

Obtain a Yield

You can't work on an empty stomach. [and neither can anyone else]

- Definition of system yield**:** System yield is the sum total of surplus energy produced by, stored, conserved, reused or converted by the design.
- Energy is in surplus once the system itself has available all it needs for growth, reproduction and maintenance.
- As PC designers, we are creating "cultivated ecosystems" – cultivated to produce a yield of food, shelter, fiber, medicine, or other product/service useful to humans. Therefore, for each element we consider, we must design to obtain a yield.
- We remember that all other creatures in our shared ecosystems are needing to get a yield, and so we invoke the "Share the Surplus" ethic, and plant extra. >Design for surplus.
- A monocrop may yield an abundance of one product, but the combined yields of a polycrop on the same space will be more.

Redundancy

Have a backup plan. Be prepared!

- For every critical need, provide for multiple ways of meeting that need. Critical needs are water, food, money, heating, toilet, congeniality, social/political power.
- Have a backup plan. Provide for the unexpected – drought/flood, economic depression, etc.
- Have diverse ways of getting your needs met > Diversity

EXAMPLES IN NATURE

- Plants make thousands of seeds, and some have multiple methods of reproduction.
- Most animals are able to eat many different foods.

USE IN DESIGN:

- Food: Design to have fresh food all year long, *and* preserve as much as you can.
- Water: Cisterns, public utility, *and* pond.
- Electricity: Photovoltaics, and grid, or PV and wind/hydro power.
- Exercise: go to gym, *and* walk to work, *and* go outside and run with your kid/dog.
- Trade: create barter and local currency groups, grow more than you can eat, *and* stay in the money economy
- Money: have many income streams [network up & down, as well as laterally]
- Polycrop to provide plants with many avenues for pollination, pest protection, nutrients,

- Design or do other creative work with a team – have more than one mind, more than one person holding the skills and information.
- Have more than one friend!

Catch and Store Energy

Make hay while the sun shines.

- All Energy comes from the Sun. Since energy is lost with every transaction, we need to get as close to the origin as possible – that is, the sun itself, and plants – to meet our energy needs.
- Energy cycles thru our system and then it's gone, whereas minerals can recycle forever in a well-maintained soil.
- We want to catch "exotic" energy – that is, energy coming from offsite and moving past, convert it to energy we can use or store, and cycle it through our system as we need it.
- We want to grow our own renewable energy – that is, plants and animals for our consumption.
- Tantra: creating a container for holding Energy

EXAMPLES IN NATURE:

- Trees catch sunlight and store it as sugars in their roots, to get thru the winter.
- Rocks catch sunlight & store it as heat, creating microclimates.> more diversity
- Ponds catch the energy of moving water and store it as potential kinetic energy, and they catch sunlight and store it as heat, creating microclimates.

USE IN DESIGN:

- Creating microclimates
- PV, wind, and water power systems
- Waterwheels
- Winter storage of tubers & other food
- Masonry stoves
- Passive solar design of buildings
- Small livestock – energy available with no storage necessary
- Ecoforestry: creating renewable energy for the future, woodlots.

Multiple Functions

Stacking functions. Wearing more than one hat.

- Related to Get a Yield – Get *Lots* of Yields! [a function – pest control by chickens, for example – is a yield, also.]
- Every element in the design will have more than one function; ideally, it has at least three. [Beauty is not included because a good design is intrinsically beautiful.]
- The same structure, plant, animal, or action doesn't do just one job – it does 3 or more.
- Understanding niches – in space and time.

EXAMPLES IN NATURE:

- A forest tree provides oxygen, shelter for wildlife, shade for understory, a space for vines to climb, and it retains water and holds soil in place. Then, when it dies, it becomes a nursery, and habitat for other wildlife.
- By harvesting nuts, squirrels feed themselves and their families, plant new nut trees, and spread genetic information [pollens, insects, other seeds, microorganisms]

USE IN DESIGN:

- A fence around a garden space serves as a trellis for climbing plants, a place to hang tools or decorations, a place to hang a nest box, bird perches, and a shady microclimate – as well as protecting the garden from invaders. Over time, it also becomes a hedge, if the birds and their droppings have their way.
- Chickens provide eggs, meat, manure, body heat, and manure; and bug, insect, and weed elimination in garden beds [prior to planting] and orchards.
- An apple tree provides apples, shade, bird perches, pollinator attraction, and – ultimately – firewood.
- A playground can be designed for use by young parents, toddlers, and elders in the mornings, older children's use in the afternoon, and night-time activities for adults.

- Live and work communally – design your life so that work, play, creativity, spiritual practice, and family life are all happening at the same time – no matter what you're doing.

Produce no Waste – Rethink, Reduce, Repair, Reuse, Recycle

Waste not, want not. A stitch in time saves nine.

For every by-product from one element, plan to have a productive use for it in another activity. >Needs & Yields

EXAMPLES IN NATURE: *Waste is a human artifact; it does not exist in Nature. In natural systems, everything is a Giveaway.*

USE IN DESIGN:

- Compost. Humanure – human nutrient residue.
- Learn to maintain and repair tools.
- Industrial "Cradle to Cradle" concepts – designing goods with full environmental accounting, and a plan for almost endless reuse & recycling.
- *The Story of Stuff* movie
- Cardboard mulch garden, cardboard for paths.
- Methane digester – methane is captured and burned instead of off-gassing.
- Greywater system – waste becomes biomass for garden.

PRINCIPLES OF DESIGN STRATEGY

Observe & Replicate Natural Patterns

- Natural patterns – nature's ways of structuring and organizing ecosystems – can be found at all scales in all ecosystems.
- As PC designers, we need to learn to NOTICE patterns, and how to USE them.
- These are Regenerative patterns – creating and maintaining the ongoing growth and health of the system.

EXAMPLES IN NATURE:

- Patterns of time, space, light, sounds, temperature.
- Branching, meanders, lobes, spirals, nets.
- Animals and plants preparing themselves for seasonal change.

EXAMPLES OF USE:

- Soil-building with mulch bed
- Herb spiral
- Seasonal deciduous shading
- Fermenting foods for storage and alcohol
- Creating wind funnels by lollypopping trees
- Contours as swales
- Forest gardening
- Learning what works in indigenous cultures re: relationship with the land

Use & Value Renewable Resources and Services *Let Nature take its course.*

- Measurements:
  - when replacement time is less than degeneration time
  - when the EROEI [Energy Returned on Energy Invested] ratio is above 1
- Embodied energy needs to be considered when determining renewability. [How long will it take to grow a new computer, i.e., how much materials and energy will it take to produce a new one?]
- Plants & animals are not only renewable, but regenerative – they will replace themselves.

EXAMPLES OF USE:

- Using wood for buildings - build them so that they won't rot before their replacement can be grown.
- Use biological resources: fruit & net trees, manures, compost, draft animals, worm bins.

- Solar, wind, PV systems *use* renewable resources, but are not themselves renewable. [wooden windmills?]

Design from Patterns to Details

Can't see the forest for the trees.

- Get the big picture clear before you start deciding on the details.
- Look at scales of time and space. Plan for the 7th generation.
- Assess available materials and energies before planning project.
- Know the limitations of your design. Examine the whole picture – especially the parts you'd prefer not to see.

USE IN DESIGN:

- Analysis of the whole landscape shows pockets of fertility/infertility to be exploited – concentrate the fertility, and build fertility on the infertile areas.
- Mind-mapping to envision land use area and basic pathways.
- Thoroughly analyze the landscape patterns on, and surrounding, a site before beginning to consider the human imprint upon it.
- Use the pattern of a tropical forest to design food forests, but use patterns of temperate forests to design "food woodlands" in those areas.
- Use patterns of existing vegetation to determine soil health and planting strategies.
- Don't get bogged down on ethical quibbling; look at the big picture of what good can come of using an earth-moving machine to help create long-term sustainability.
- Sector planning.

Sector & Zone Planning

- **Sectors** are areas on a site where energies are arriving from off-site. We design to mitigate or eliminate hostile sectors, and to enhance or concentrate beneficial sectors.
  - Winter & Summer Sun, Winter & Summer Wind, Water, Wildlife [migratory animals, or sensitive habitat], Fire potential, Noise, Pollution, Social interactions [both positive and negative].
- **Zones** are areas of decreasing need for human interaction, moving outward from a center.
  Zone 0 – The Heart or the Hearth – the person(s) inhabiting the space
  Zone 1 – The house/building and its immediate yard
  Zone 2 – The garden/yard [visit once a day], poultry
  Zone 3 – "The farm" – long-term storage and commercial crops, orchard, small animals
  Zone 4 – Grazing/woodlot/forest garden
  Zone 5 – Wild or Healing land - humans' only presence is for healing, and learning from Nature
  Zone 6 – The Commercial/Social Zone outside the site

Relative Location

It's the connections that matter.

Needs & Yields Analysis: locate elements so that their needs can be fulfilled by the surplus yields [wastes] of their near neighbors.

EXAMPLES IN NATURE:

- Most animals build nests near water and food.
- Pecan trees grow on the edge of a river, seeking moisture. The trees shade the river from the sun, benefiting aquatic life.

USE IN DESIGN:

- Plant a mulberry bush just outside the chicken yard, comfrey all around the chicken yard fence, and Siberian pea shrub all thru their range – to provide for food that you don't have to carry to the animals.
- Locate the chickens so they can range under the fruit trees; all your fertilizer, pesticide, and weed control are taken care of.
- Place rainwater catchment devices on all roofs, so water is where you need it.
- Locate the rain barrel on the side of the building where the most water is needed.

Use Edges and Value the Marginal

The edge is where the action is.

Don't think you are on the right track just because it's a well-beaten path.

- Edge Effect: The edges between 2 systems have more species, more productivity, than in either of the 2 systems alone. Humans, and many familiar species (deer, rabbits, birds, etc.) are edge species, preferring to live at the margin between forest and clearing.
- Edges define changes in time & space, where nutrients and information accumulate.

EXAMPLES IN NATURE:

- Edge of forest has the strongest trees, due to wind and accumulation of nutrients.
- Marshes & estuaries are among the most biologically diverse areas of Earth.
- Natural ponds have edges in all directions, including temperature gradients.
- Animals have preferred foods, but will eat many less desirable foods when necessary.

USE IN DESIGN:

- Blueberries on edge of pond; if pond is round, only 20 blueberries fit, but if you crenellate the edge, you get 30 or more.
- Extending the "edges" of the growing season - early and late season food production - with mulch, row covers, microclimate, etc.
- Swales create water and nutrient catchments, and concentrate growth.
- Design pond bottoms, as well as sides, to have edges - deep for coolness in summer, shallow for small fish.
- Wild foods are marginal foods: not our favorites, but life-saving when necessary - sochan, air potatoes, lambsquarters, wild blueberries & persimmons, acorns, squirrels, insects, etc.
- Grow non-preferred but prolific and nutritious vegetables – sunchokes, zucchini?
- A test for the health of a society: How big is the societal edge/the marginalized people and other animals? How many homeless, institutionalized, criminalized, factory farmed?

[Where NOT to increase edge: leave large forested tracts for wildlife; leave neighborhoods intact, without major streets bisecting them.]

Use & Value Diversity

Don't put all your eggs in one basket.

- The more diverse the elements in a system, the more diverse the yields and the more diverse the niches that are available to be filled, which creates even more diverse yields - up to a certain limit.
- More and more diverse elements will not contribute to the health of the system, unless they can make connections with each other. It's the diversity of connections that matter, not just the diversity of elements. >Relative Location
- Needs and yields analysis – use diverse connections to meet the needs of each element.

EXAMPLES IN NATURE:

- Natural ecosystems rarely resemble monocrops, but have many diverse plants & animals.
- A tree in the forest needs a complete guild to thrive.

USE IN DESIGN

- Leave the "weeds" in the garden to retain moisture, to provide nutrients and aid soil microorganisms.
- Polycropping – guild and companion planting - forest gardens, alley planting.
- Using animals as a part of other agricultural operations – chicken tractors, hogs for gleying.
- Animal associations – cattle and chickens, pigs and ducks, Muscovies & ducks.
- As a designer, engage and educate the owner/client.
- *The problem is the solution* – engage the "problem" in social programs [homeless, drug users, gangs, etc.], not just the experts, in creating true solutions for real situations.

Integrate Rather than Segregate

Many hands make light work.

Co-operative and symbiotic relationships will be more adaptive in a future of declining energy; however, we have a cultural disposition to see and believe in predatory and competitive relationships, and discount cooperative and symbiotic relationships – in nature and in culture.

EXAMPLES IN NATURE:

- Immature systems that are growing rapidly, in a situation of surplus energy, tend to be dominated by competitive relationships. Mature systems have more mutualistic and symbiotic relationships.
- Complementary relationship between photosynthesis and respiration.
- Predator/prey as interdependence.
- Fungi, bacteria, earthworm, and others have their niches in soil digestion.

EXAMPLES OF USE:

- Guild plantings: pollinators, pest confusers, dynamic accumulators, and N-fixers.
- Involving children in adult work – with child-sized tools.
- Designing over time to integrate short-term and long-term yields: thin timber forest to plant grass for sheep, get yields from sheep [and bees] while trees grow, eventually get yield from timber.
- Leave the weeds in the garden, to maintain beneficial microbes and insects.

Apply Self-Regulation and Accept Feedback

Make lots of small mistakes.

The sins of the fathers are visited on the children unto the seventh generation.

- Related to issues of scale: start small, get the feedback, redesign. By making small changes, we increase our confidence to tackle more difficult changes.
- Positive & negative feedback loops
  - Positive: suckling baby produces more milk with less effort, birds eating berries spread their berries, thus producing more berries.
  - Negative: weak animals get predated > they don't reproduce > healthier stock
- Self-regulation is a response to higher-order negative feedback: self-regulate before the system regulates you. Examples:
  - Kangaroos slow development of fetuses, which lowers population growth; before starvation, disease, and predators do it.
  - Traditional societies had constraints on population growth and resource use.
- Tripartite altruism [Howard Odum] – in balanced ecosystems, approximately 1/3 of captured energy is required for maintenance, 1/3 is fed back to maintain lower-order providers, and 1/3 is contributed upward to high-order system controllers. EXAMPLES:
  - Rabbits feed themselves, fertilize the grass, and provide food for predators. If they start fertilizing the brambles while escaping from predators, the system collapses; too many brambles outcompete the grass, and too many rabbits eat what grass there is.
  - As change agents: 1/3 of our time to taking care of physical needs, 1/3 to self-development, and 1/3 to wider societal benefit.

Use Small and Slow Solutions

The bigger they are, the harder they fall.

Slow and steady wins the race.

- Systems should be designed to perform functions at the smallest scale that is practical and energy-efficient for that function. This is a direct contradiction to the prevalent practice of using the biggest, fastest solutions that money can buy.
- PC design uses time as an element: allowing cultivated plants and animals to slowly integrate with each other and mature into their own place in natural cycles.

EXAMPLES IN NATURE:

- Cellular design replicates natural response to limits to growth – replicate, don't expand beyond limits.
- Snail's shell starts small, expands as needed.
- Soil is built up slowly over years, of many layers of detritus.

EXAMPLES OF USE:

- Garden walls grow over years from rocks removed from gardens.
- Design for bicycles and walking paths, not roads.
- Tweaking the system in small, almost imperceptible ways, causes great change: go out in the rain and dislodge debris from waterbars.
- Slow Food movement – celebrates the loving preparation & consumption of food.
- Small is Beautiful, E. F. Schumacher [Intermediate Technology Development Group]: promoting small, simple, local, human-powered technologies.
- Incremental design – start with a core or nucleus and build outward as needed.
- Rolling PC – start by planting 5% of your land with perennial plants, then follow with 5% more each year. As soon as production begins from the first year's planting, increase the percentage; within 10 years, the rollover will have happened.

PRINCIPLES OF TECHNIQUE

Stack & Pack

Put things closer together [pack], and use vertical space [stack] to get more benefit from less space.

EXAMPLES IN NATURE

- Plants cover every inch of soil, leaving no bare spots.
- Vines grow up trees, rocks, even almost vertical cliffs.

USE IN DESIGN

- Plant thickly, and grow upward with trellises
- Use vines up walls for insulation.
- Plant thickly so that plants self-mulch, knowing that you will thin.
- Plant "scaffolding" for vining plants – corn or sunflowers with pole beans.
- Use floor-to-ceiling shelves instead of 6-foot shelves.
- Teach PC for all educational/social levels, and network laterally with other PC teachers.

Use Appropriate Technologies

Appropriate technology is technology that we can appropriate!
Because tools extend our personal and community power, control of tools is essential to effective self-governance.

- Permaculture is generally biology-centered, not techno-centered**:** we want tools and technologies that help liberate us from dependency and grant autonomy and self-reliance - things that we can build and maintain with little external assistance.
- Appropriate technologies may include solar, wind, wood, biomass and water-driven equipment for generating power, pumping water, and heating hot water.
- Consider medium-tech: maintaining and riding a bicycle, using a refillable pen, using a razor with replaceable blades, and substituting other nondisposable items where disposables were used.
- Other Appropriate Technologies may include equipment to design permaculture sites (such as computers and software), large earth-moving equipment, cartage services, and other "largescale" items which would tend to be used once, in the implementation of the design, but not on a regular or daily basis.
- Be aware of the challenges in providing technology to undeveloped countries. Who will fix it when it breaks? How much access to consumer culture do we want to be responsible for providing?
- AT's should be reliable, high quality, well designed, low cost (when possible), durable, reparable, capable of economic yield, adaptable to many functions. They should have high EROEI (Energy Return on Energy Invested) and low EMERGY (embodied energy).

Consider Succession

One thing leads to another.

To see into the future, stand on the shoulders of those who have come before you.

- Ecological succession: creating conditions such that a new life form can take root.
- Human land use patterns usually hold back succession at the herbaceous weed phase – grains & annual vegetables, and the grassland phase – pasture.
- By understanding the stage in succession, we can predict which forces will be attempting to change a landscape – what is the force of succession trying to do?
- PC designers use time as an element in the design. Natural ecosystems are not static, but change over time.
- Much succession is pulsed, not continuous.

EXAMPLE IN NATURE:

- Creation of niches after a forest fire – lichens [which eat rock to make soil] > little ferns & mosses > small herbaceous plants > grasslands > woody herbaceous > shrubby > conifer [it can germinate in sunshine] > oak [it needs shade to germinate].
- Each climate & soil regime has a particular climax ecology, but most will proceed to forest.
- Some of these stages may be viable ecosystems in themselves, in other regions.

USE IN DESIGN:

- We can "push succession" by planting all stages of a succession together, including the climax species.
- We hold back succession by suppressing growth in gardens and pathways with mulch, cardboard, wood chips, etc.
- Plant dwarf fruit trees in the eventual shade of standard fruit trees; by the time the standard tree has grown that large, the dwarf will have finished its lifetime.

Creatively Use and Respond to Change

Attitude matters.

Vision is not seeing things as they are, but as they will be.

- Design to make use of expected change [entropy & succession, for example], and prepare to respond to changes that cannot be planned for.
- Responses to entropy: Maintenance of built environment, or building w renewable materials that will decay & can be rebuilt easily.
- Durability & stability come from flexibility & change.

USE IN DESIGN;

- Plant bendable trees where intense winds or flooding may occur.
- Design buildings to change easily for future uses.
- In fire-adapted forests, anticipate fire and reduce fuel levels > smaller fires.
- Build animal shelters with straw bales and put them in different locations each year, instead of trying to control problems related to hygiene in permanent buildings.
- Opportunistic responses to change or anticipated change: In arid land, plant on a floodplain in hopes of just the right amount of water at just the right time.
- Use pulses of change – fire, grazing, cultivation - after long periods of catching & storing energy. [Swidden agriculture resulted from noticing the changes in fertility after a fire, and reproducing them].
- Breeding animals & plants to thrive in low-energy conditions. [Many have been bred specifically for high energy availability, so must be bred back]
- Ecosynthesis – ecosystems aren't static; they change with environmental change. Question the "exotic invasives" hysteria. [Ex: Sailing ships from Europe probably changed the waters of the world by seeding with new life forms.

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