



Healthy Soils & Edible Landscapes Workbook



Take Notes Here

Concepts Covered



Building the Soil Sponge



- Watershed Wise Approach
- Test for Soil Type
- The Soil Party
- Creating Good Soil Structure (Sponge)
- Calculate How Much Compost Needed

Making Successful Compost



- Compost to Mulch Ratio
- Building Your Compost Pile
- Cold Composting
- Hot Composting

Sheet Composting



- Sheet Composting Steps

Managing Water



- Maintain A Balance of Oxygen & Water in Soil
- Water Moves Differently Through Soil Types
- Drip Irrigation
- Other Water Sources

Growing Flavorful, Nutritious Food



- Selecting Edible Plants
- G3's Eight Regenerative Principles

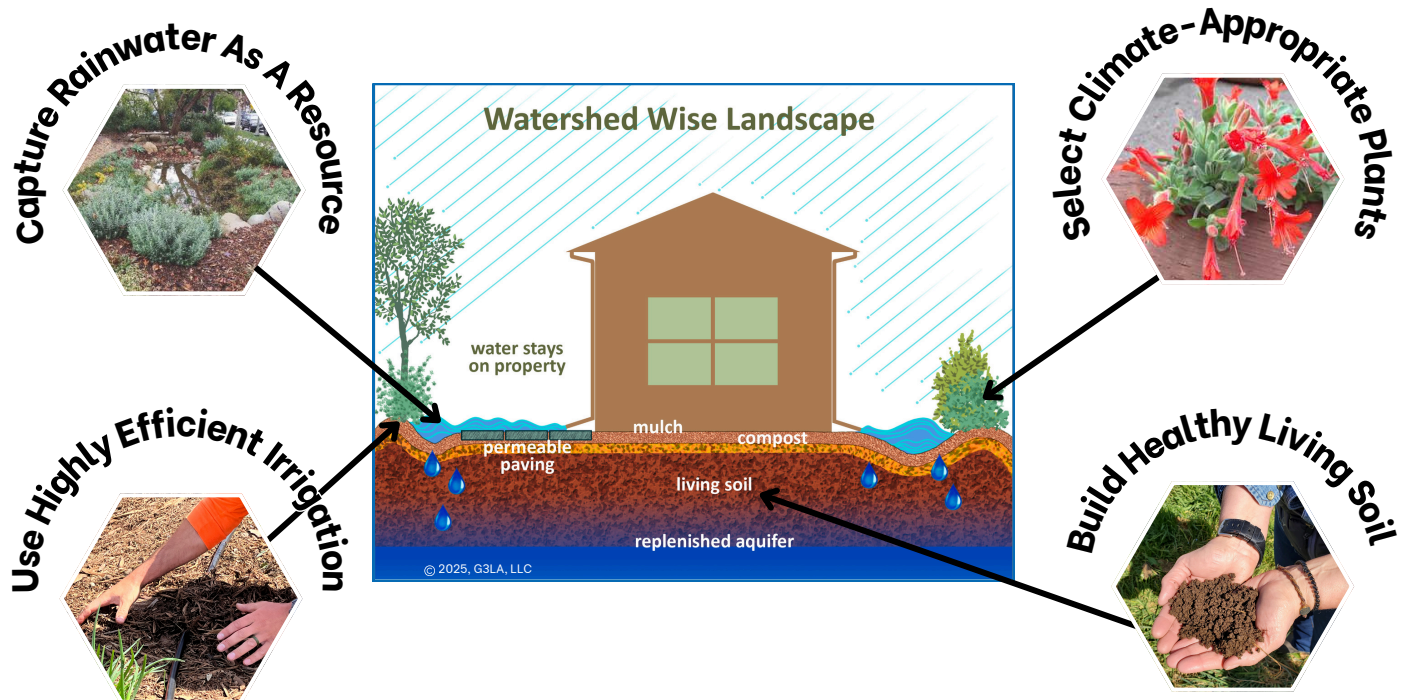
Designing an Edible Landscape



- In the Ground is Best
- Food Forests
- Edibles in the Landscape
- Planters
- Create Your Design

Building the Soil Sponge

Watershed Wise Approach Works for All Landscapes



Soil Type is Determined by Soil Particle Size

SAND



- Large particles
- Accepts water quickly
- Drains quickly
- Dries out quickly

SILT



- Medium size particles
- Accepts water more slowly
- Drains moderately well
- Dries out more slowly than sand

CLAY



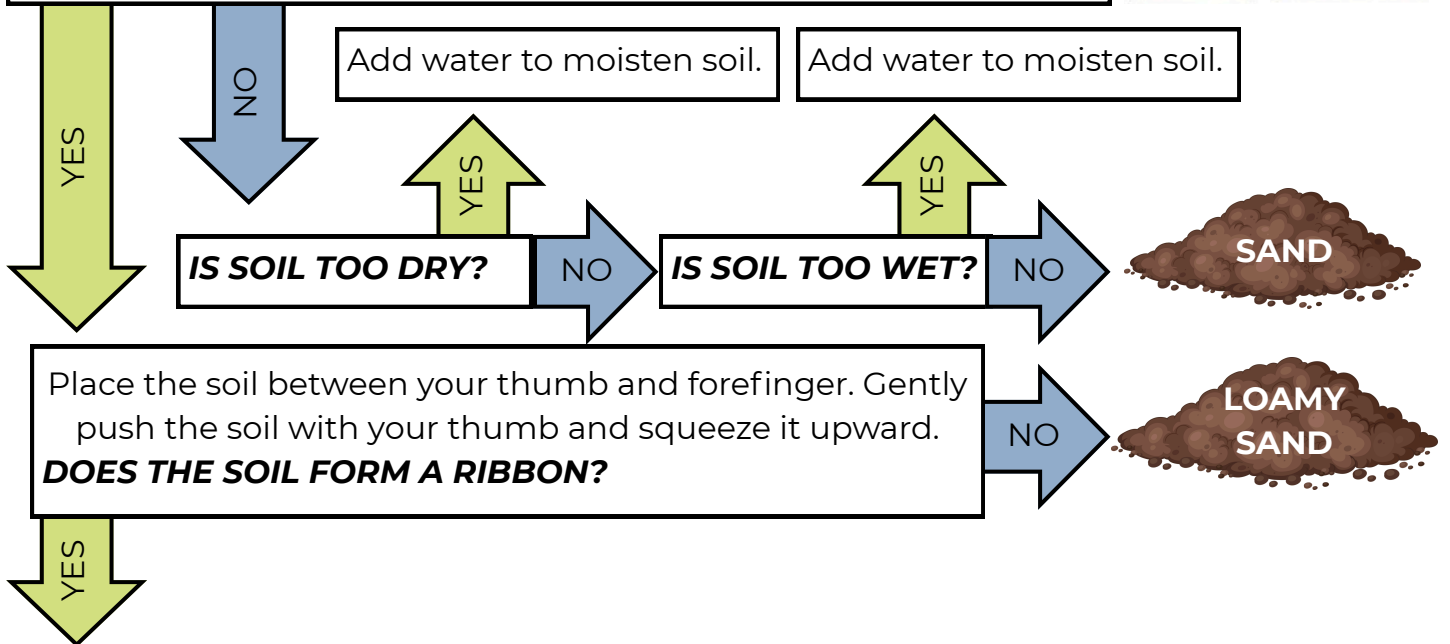
- Tiny particles
- Accepts water slowly
- Does not drain quickly
- Dries out slowly

You CANNOT Change Your Soil Type, Only the Structure

Hand Test for Soil Type

Put some soil in your palm. Spray with water to moisten it, knead until it feels moist like putty and then squeeze it into a ball.

DOES IT RETAIN ITS SHAPE?



WHAT KIND OF RIBBON DOES IT FORM?

AND form a weak ribbon less than 1" before breaking?
LOAM

OR form a ribbon 1-2" before breaking?
CLAY LOAM

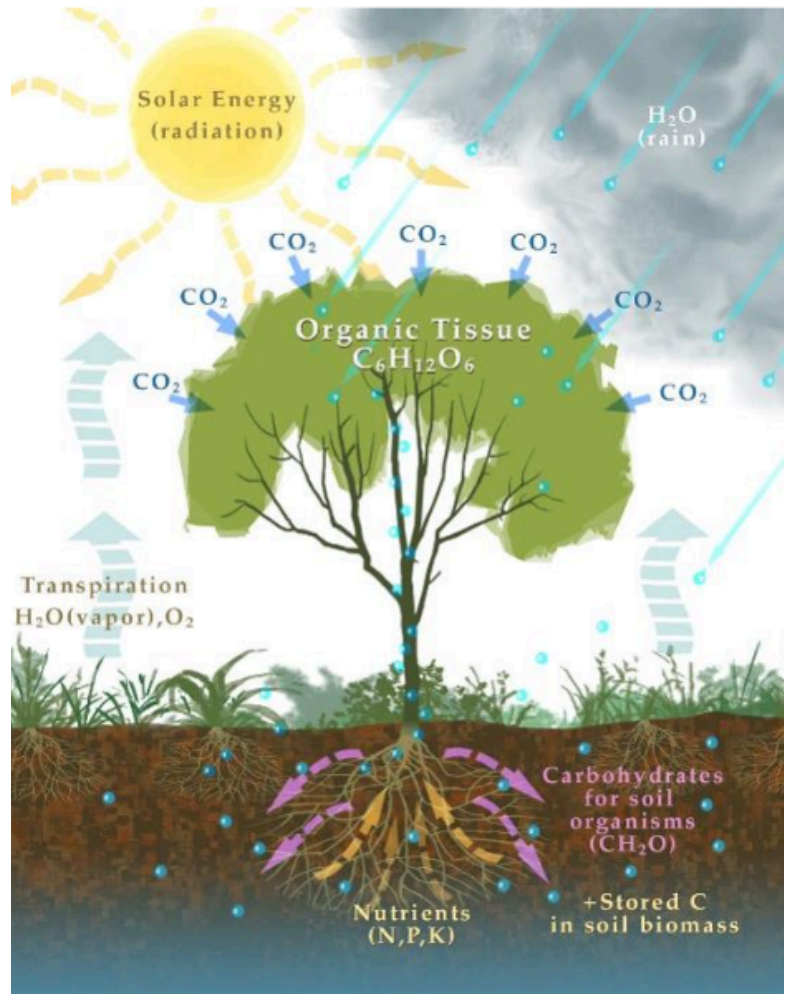
OR form a ribbon 2" or longer before breaking?
CLAY



Plant Soil Relationship

- Cultivate a microbial “Soil Party” that works for the plants.
- Sequester carbon gathered during photosynthesis.
- Some carbon goes for body and seed building, but much is fed to a “Soil Party” as root exudates in exchange for goods and services such as mining nutrients or providing water.
- The soil carbon sponge is the lifeforce of the entire planet and is powered by sunshine.

Through photosynthesis, the plant creates a giant carbon sponge in the root zone area. This sponge has 5-6x the biomass of the plants (including the roots) in the soil.



The Soil Party

A teaspoon of good garden soil contains billions of microbes that were only recently discovered.

These microbes re-engineer the soil into a sponge and also provide nutrients to the plants on demand, so the whole landscape can thrive.





Bacteria

- First to arrive or wake up with water.
- No feet, so needs a “taxi” like a bird’s foot.
- Decomposers eat everything but cannot release the nutrients to the plants.



Protozoa

- Love to eat bacteria.
- Have flagella and swim around.
- Eating bacteria releases their nutrients into the soil for other microbes.



Nematodes

- Love to eat bacteria & protozoa.
- Swim vigorously.
- Create nutrients that are available to the plant and aren’t water soluble.



Fungi

- Create a network to share resources.
- Awesome decomposers of wood.
- Cooperatively nurture all plants in the ecosystem.

Keep In Mind

Worms tell you there’s a soil party happening in your garden.



Paths to Building the Soil Sponge



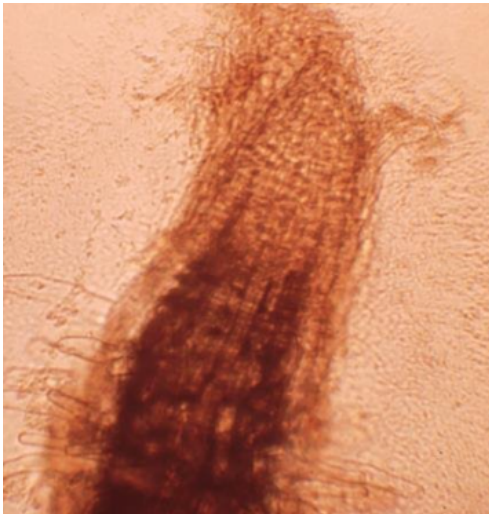
Decomposition

- Organic matter is decomposed by microbes and provides first food to the system.

Liquid Carbon

- Plants pump liquid carbon (exudates) into soil to incentivize microbes to mine nutrients from soil.
- Microbes construct spongy soil habitat to ensure enough oxygen and water so they are comfortable working with the plants and be fed themselves.

Where Does The Soil Party Biology Live?

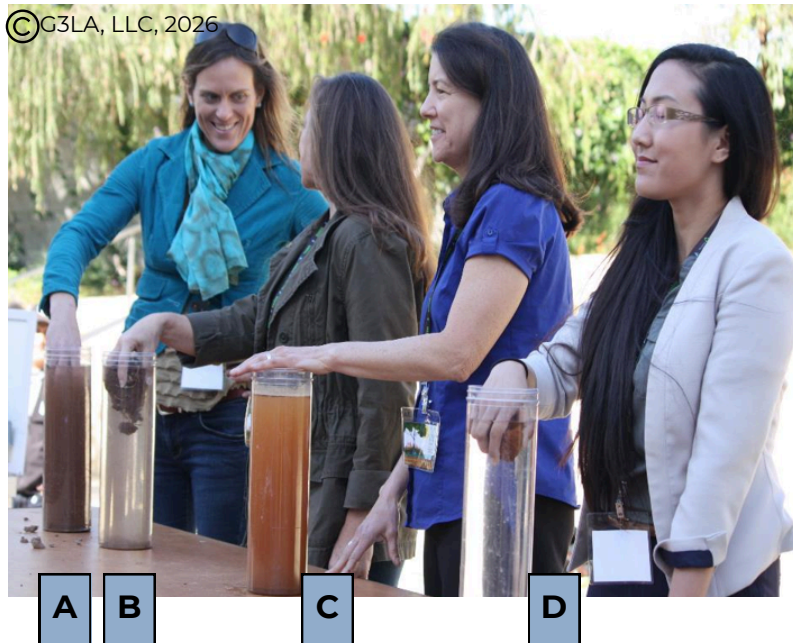


The RHIZOSPHERE area around the root of each plant is the most active area for biological activity.

Different plants have unique microbiomes of many billions of living species.

Plants share resources with the soil and each other. The more diverse the system, the more diverse the interaction among the various microbiomes and the more resilient the overall system becomes.

Slake Test for Soil Structure



Which one of these soils in the picture are spongy?

- 1.A
- 2.B
- 3.C
- 4.D

Which are NOT spongy?

- 1.A
- 2.B
- 3.C
- 4.D

Creating Good Soil Structure

Particles of soil are glued together in clumps (by glomalin) to form Soil Structure called *Micro-aggregates*. Spongy soil is essentially:

Oxygen + Water + Life

Life (bacteria) slime glues together the micro-aggregate particles, (fungi) weaves them into larger structures called *Macro-aggregates*. Now the microbes have houses and infrastructure to support the plants.

How to Hold onto More Water?



- When Soil Aggregation is high, soil takes on characteristics of a sponge.
- When it rains or we irrigate, infiltration is massive and rapid.
- Even though it infiltrates faster, the soil holds more water too.
- When there is too much water, the soil releases it slowly rather than becoming saturated.
- The key is having many diverse living roots in the ground all year long.

Building the Soil Feed Soil Microbes, Let Them Feed Plants



- Completely decomposed
- Looks like soil
- Does not smell like manure
- Dark chocolate color best
- Texture of moist cake
- Used mainly as soil amendment

- Not decomposed
- Looks like vegetation
- Sometimes smells like manure because of the decomposition process
- Finely chopped leaves and wood best; dyed mulch is not a good choice.
- Used mainly as soil cover

Can't "Overdo" Compost or Worm Castings



Build Diversity

- Make any garden more resilient by adding layers, diversity
- You can get layers and diversity with edible landscapes

When you create High Aggregation you can hold onto 26-34% more water.

Making Successful Compost

Compost to Mulch Ratio

Compost – 1,000 sq. ft. ¼” – 1” needs 1-3 yards

Mulch – 1,000 sq. ft. 3-4” needs 10-12 yards

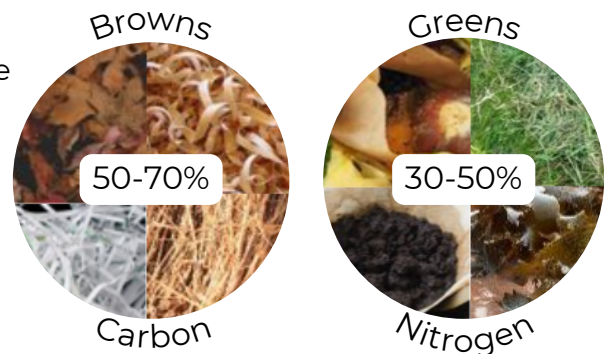
What’s the square footage of your landscape?

How much compost and mulch will you need?

Sq. Ft. x 0.003 = Yards of compost needed per Inch per Sq. Ft.

Key to Good Compost is the Balance

- Both Brown (Carbon) and Green (Nitrogen) are needed for a good compost pile
- Aeration is important
- Water is essential



Good compost requires
Oxygen, Water & Life



Building Your Compost Pile

1. Start your compost pile on bare earth – use a shovel of garden soil as “starter” for the pile.
2. Start Timing: Anytime is fine and be aware that fall into winter will be a slower decomposition process.
3. Lay brown twigs or straw (Carbon) first.
4. Next, add greens (Nitrogen).
5. Add compost materials in alternating layers like lasagna.
6. Cover to retain moisture and heat.
7. Make sure to turn occasionally to add oxygen.
8. Keep it moist but not saturated.
9. Protect it in winter: surround pile with straw bales for insulation.



Cold Composting



Passive Management

1. Let a pile build up and decompose.
2. Can take up to a year or more.
3. Requires minimal effort.
4. Don't put in weeds or pathogens as they won't be killed by heat.

Hot Composting

Active Management - Thermophilic

1. Fast break down of material if started in late spring and take advantage of summer heat (three – six months).
2. Hot enough to kill weeds and disease pathogens (141-155 F).
3. Two parts carbon (brown) / one part nitrogen (green).
4. Min. 3' x 3' x 3' area required.
5. Keep damp (wrung out sponge).
6. Manage temperature by turning or adding water as needed.
7. Protect it in the winter when decomposition slows down.
8. When it cools down, add worms for better quality compost.



Good compost should **NOT** smell bad

If it does...

- Add browns (paper or wood)
- Add oxygen (turn it)
- Don't use it! Spread it out or cycle through another compost bin.



Smelly compost is anaerobic and harbors pathogens

Animal waste should be well composted before adding to the garden



- Know source of animal waste and make sure it's healthy
- Specifically no de-wormers which kill soil biology long after the waste is put in the compost pile
- It will smell bad if not fully composted



Clay soil?



Add Compost



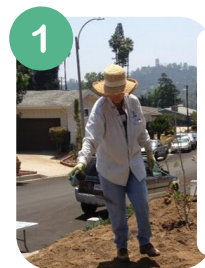
Sandy soil?



Add Compost and LOTS OF PLANTS

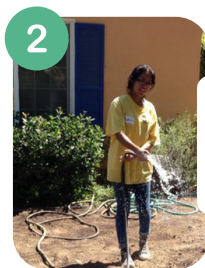
Sheet Composting

Builds soil and keeps down weeds without chemicals. Best done in fall to overwinter.



1

Add 1/4" - 1" compost or humates (a little goes a long way)



2

Water everything well



3

Roll out paper, overlap by 6"



4

More water. Add 1-2" of mulch



5

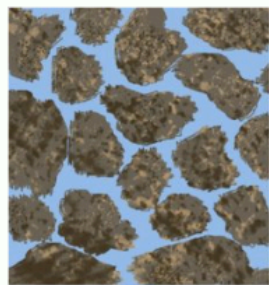
Add more water. Add another 2" of mulch.



SKIP the weed fabric. It keeps organics from breaking down and stops soil building.

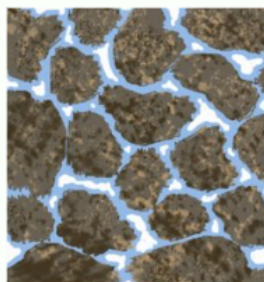
Managing the Water

Maintain a Balance of Oxygen & Water in Soil



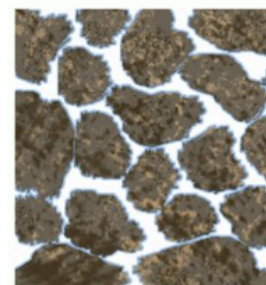
Saturated

No Oxygen.
Too Much Water.
Anaerobic Life.



Just Right

Balanced Oxygen.
Balanced Water.
Aerobic Life.

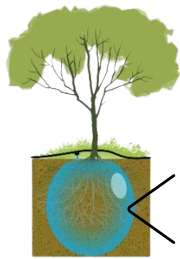


Too Dry

Lots of Oxygen.
No Water.
No Life.

Water Moves Differently Through Soil Types

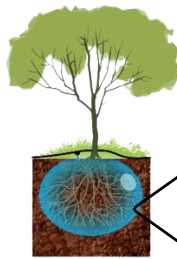
How does water move through soils that aren't yet sponges?



More Frequent

Longer Cycles

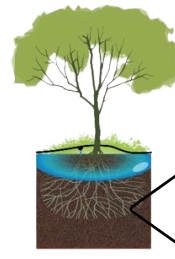
SAND



Less Frequent

Longer Cycles

LOAM

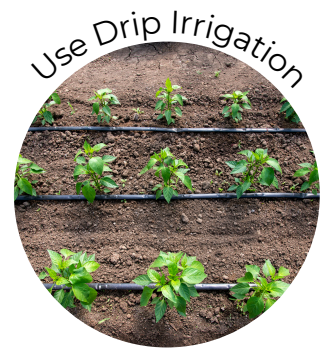


More Frequent

Shorter Cycles

CLAY

Watering Methods

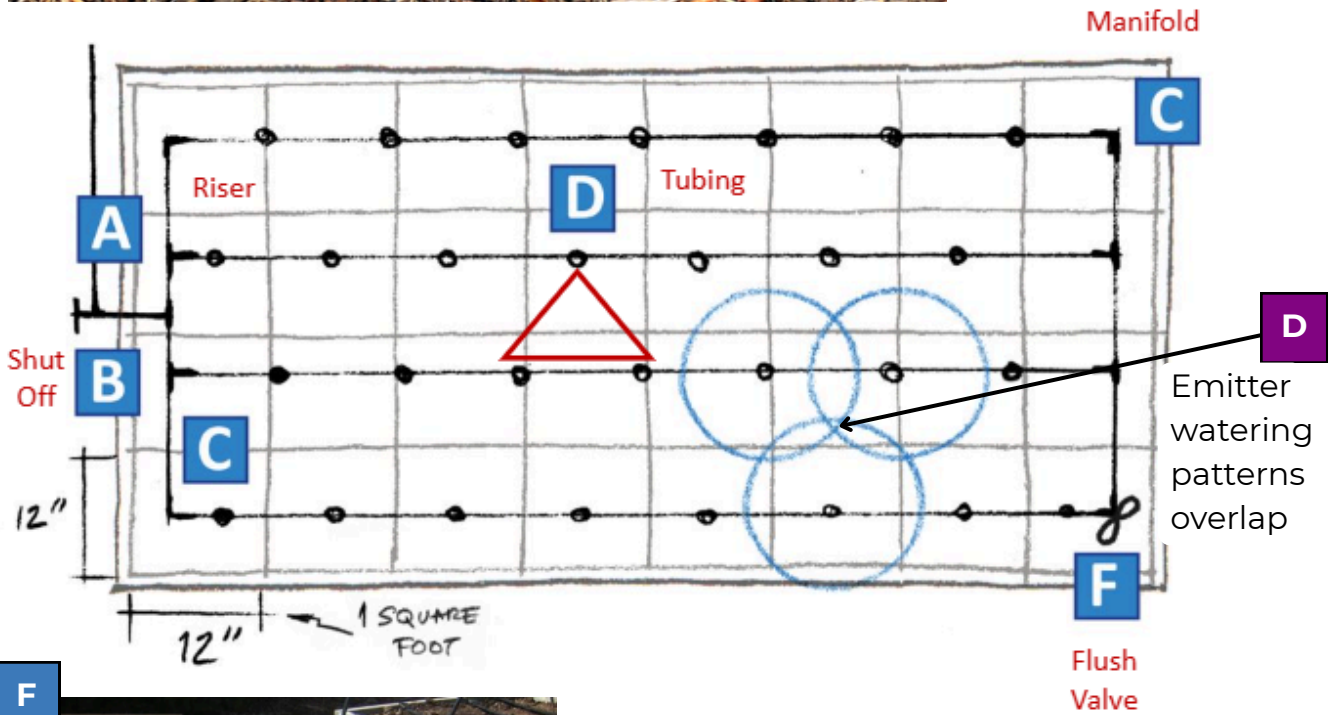


What kind of watering methods do you utilize in your landscape right now?

What watering method could you switch to in your landscape?

Drip Irrigation

In-line drip irrigation has embedded emitters at regular intervals, so use in a grid as below.

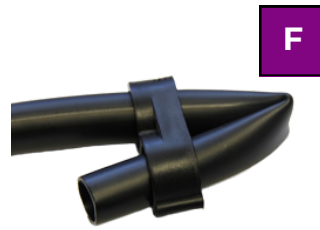


Zone shut off valve



Drip tubing shut off valve - allows for maximum control to isolate:

- Larger plants that don't need all the emitters
- An area that isn't planted



Drip flush valve "Figure Eight"

Other Sources of Water

Contoured to Capture Rainwater

Vegetable Garden at the end of the mulched path.

Raised Berms with native plants and trees.



Mulched path doubles as a swale capturing rainwater.

Hügelkultur: Carbon Culture, Mound Culture



- Turn green waste into assets by burying it in the ground.
- Buried wood does not “steal nitrogen,” especially if planted densely.
- Hügelkultur nurse logs in bioswale improve overall swale performance.
- The berms can be planted with ornamental plants or edibles.
- Buried wood becomes root zone insulator during winter months.

See Page 22 for landscape design using these plants.

Water Needs Based on Plant Type

Annual/Biennial = replace every one or two years

Perennial = come back year after year

Water Use

● High (1+-2"/week)

● Medium (1"/week)

● Low (less than 1" /week)

Warm Season Annuals/Biennials

 1	 1	 2	 2	 2	 3
Zucchini	Acorn Squash	Swiss Chard	Asparagus	Calendula	String Beans
 3	 4	 4	 5	 5	 6
Cucumber	Kohlrabi	Pepper	Cherry Tomato	Amaranth	Sweet Corn

Cool Season Annuals/Biennials

 1	 1	 2	 2	 2	 3
Cauliflower	Celeriac	Spinach	Chinese Mustard	Kale	Cilantro
 3	 4	 5	 6	 6	 6
Brussels Sprouts	Sugar Snap Peas	Garlic	Beet	Walking Onion	Carrot

See Page 22 for landscape design using these plants.

Water Use

- High
- Medium
- Low
- Very Low

Perennial Trees



Fruiting Seasons

- Serviceberry – July - August
- Plum – late August - October
- Sour Cherry – late July - early August
- Apricot - July - August
- Apples – late August - October
- Elderberry – mid August - September

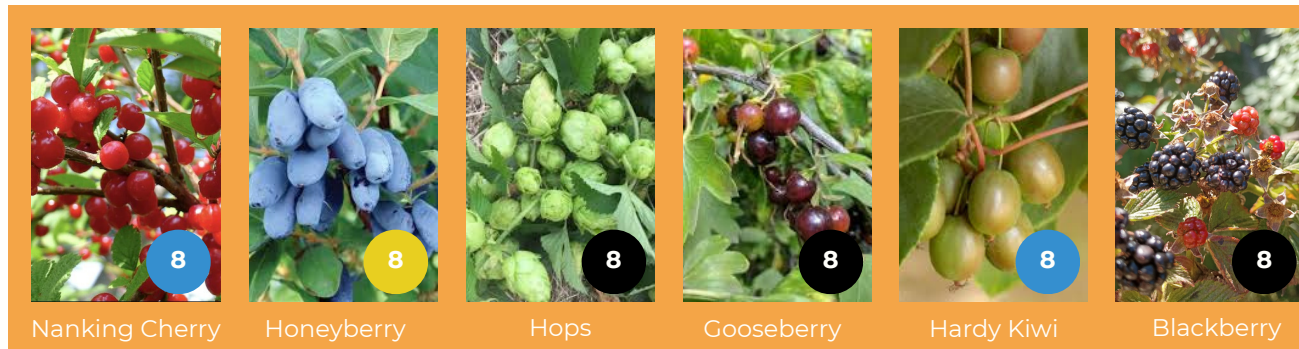
Perennials and Herbs



Fruiting Seasons

- Cardoon - before hard frost, late Fall
- Sorrel - early Spring
- Herbs - Summer into winter with heavy mulching

Perennial Vines/Fruiting Shrubs



Fruiting Seasons

- Nanking Cherry - July - August
- Gooseberry – mid July
- Honeyberry - late June - mid July
- Hardy Kiwi – late September mid October
- Blackberry – early August - mid October
- Hops - late Summer - early Fall

Growing Flavorful, Nutritious Food

Green Gardens Group's Eight Regenerative Principles

1. **Right Plant in Right Place** – every plant is in the context of the people, place, climate, geography, soils, animals, and traditions of the site. We plan to maximize diversity and abundance, and account for all the water required by the design.
2. **Minimal Disturbance** – mechanical and chemical disturbance slows or reverses soil aggregate building (don't incorporate amendments – keep them on top). Fungi may grow best in undisturbed soils, and they are able to access microfilms of water.
3. **Rainwater as Resource** – contouring the site encourages passively captured rainwater to stay on the land, rehydrating and recharging soil to offset irrigation requirements and to reduce the impacts of flooding in spring.
4. **Cover the Mother** – mulch and living groundcover (3-4" min. in summer, 4-6" in winter) build up surface armor of the earth, hold water, and protect from freezing temperatures and compaction. In Bozeman, refreshing mulch in the fall for winter cover is very important to reduce the effects of freezing temperatures and to continue encouraging decomposition.
5. **Keep Living Roots in Soil** – keep plants growing all year long as roots feed soil microorganisms, sequestering carbon, building fertility, and holding water. Cover cropping in the fall helps extend soil warmth into early winter. Selecting freeze-tolerant woody shrubs helps keep soil microbes working during the winter.
6. **Diversity Fosters Resilience** – vast diversity of plants, insects, microbes, and wildlife is essential to a resilient system, so plant as many varieties, families, shapes and sizes as possible; plant densely.
7. **Encourage Animal Impact** – in an urban context, this is encouraging interaction with insects, birds, native fauna, and most of all, humans and their domesticated animals.
8. **No Routines** – mixing up the management practices with planned disruptions cause compounding and cascading effects that benefit the landscape.

Minimal Disturbance



- Gentle aeration only if needed
- Treat Only ONE TIME & Add Compost
- No Double digging
- No Cultivating
- No Tilling
- Augering ok in limited amounts - think like a worm!

Cover the Mother



- Mulch – no bare soil, especially in fall through winter
- Use cover crops for living mulch and to add more roots that pump exudates into the system
- Nitrogen fixers pull nitrogen from atmosphere, send into soil and share with plants that need it (no fertilizers required).

What is your favorite Regenerative Principle? Why?

How can you integrate these 8 Regenerative Principles in your landscape?

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

7) _____

8) _____

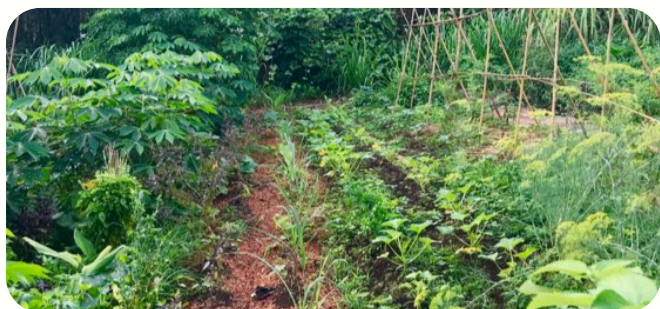
Designing an Edible Landscape

In the Ground is Best

- Vegetables grown in ground require LESS water than raised beds
- Soil holds onto water for longer
- Perennial plants in ground develop deeper root structures



Food Forest



- A combination of trees, shrubs and ground cover
- Overall uses less water
- Provides living crop cover (living mulch) and shades smaller plants
- The community of plants helps sequester carbon and fix nitrogen

Edibles in the Landscape

- Ornamentals and edibles
- An edible entry
- Groundcover between pavers
- Alternatives to lawn
- Plant fruit trees on South/West side of house for extra solar gain
- Espaliers – against a wall or make a fence; also helps with heat gain
- Get creative with trellises
- Vines – Shade / Fences
- Edible Hedges
 - Nanking Cherry
 - Rugosa Rose
 - Dwarf Korean Lilac
 - Alpine Currant



Planters

- Limited space
- Accessibility
- Poor soils
- Intensive vegetable growing



Where?



- Tucked in landscape
- Patios
- Balconies
- Decks
- Front of a residence
- On a roof
 - consider weight, drainage, and access

Potting Soil? Be Careful!

- No structure
- Sterilized soil is dead and repels water
- Very little organic matter to feed microbes
- Drains fast and needs frequent watering



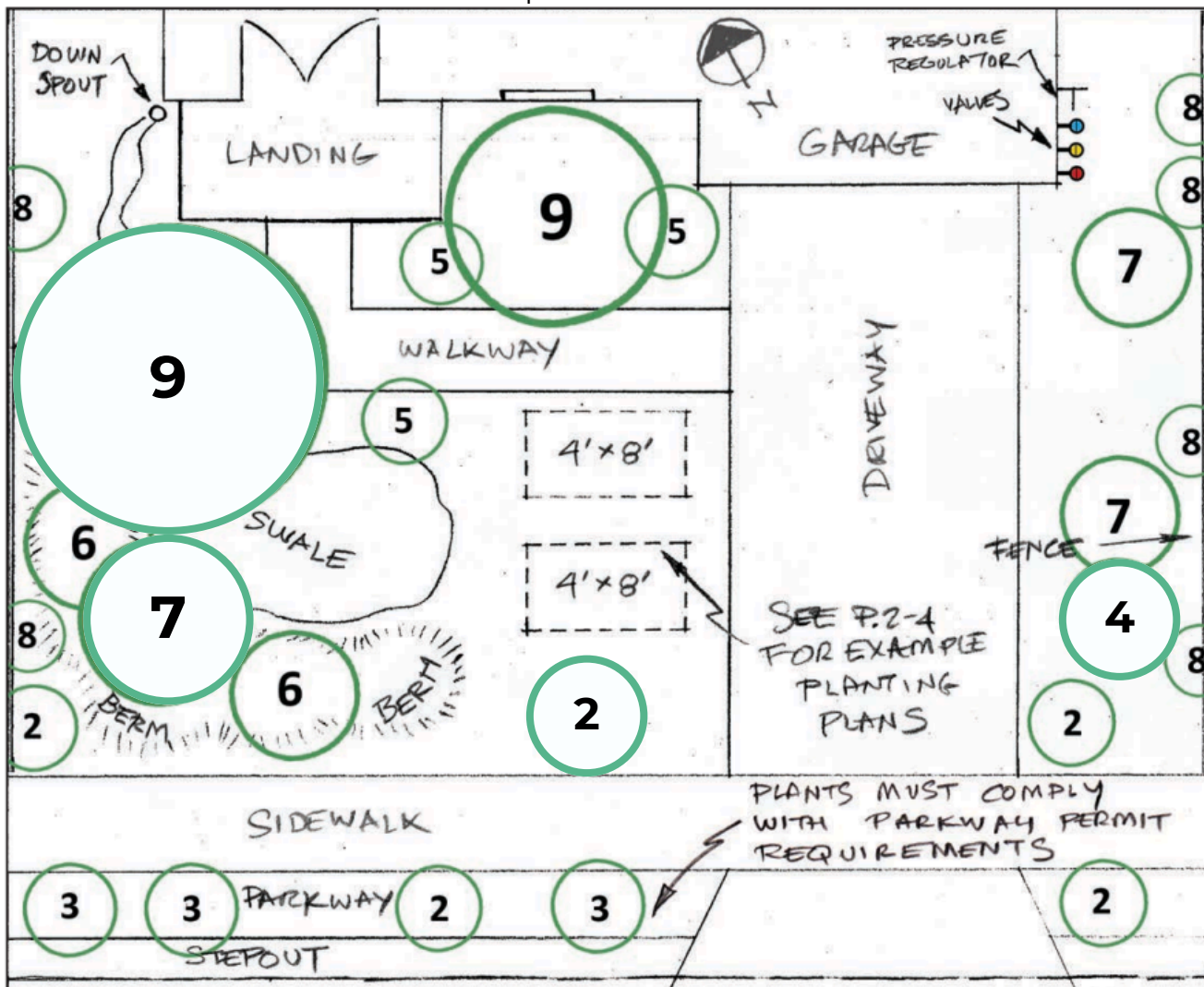
Materials?



- Keep it Simple
 - Concrete block
 - Wood
- Get creative
 - Seating/Benches
 - Trellises for vines
 - Colorful containers

Create Your Design Using the Plants on Pages

Example Front Yard



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Which plants would you add to the sketch above? Use the plants listed on pages 16 and 17 and match the numbers.

Create a sketch of your landscape and add in edibles.

Take Notes Here

