Improving Your Garden Soil

It starts with you!

February 14, 2021
San Mateo Arboretum Society

Presented by
Terry Lyngso

Photo by Terry Lyngso

Outline

What is soil?

Texture

Structure

Water Infiltration

Soil Community

Three Soil Tests

Working with Amendments, Compost and Mulch

Planting guideline

Q&A

Photo by Terry Lyngso

What is Soil

Lithosphere

Parent Rock: Sand, Silt, Clay

Atmosphere

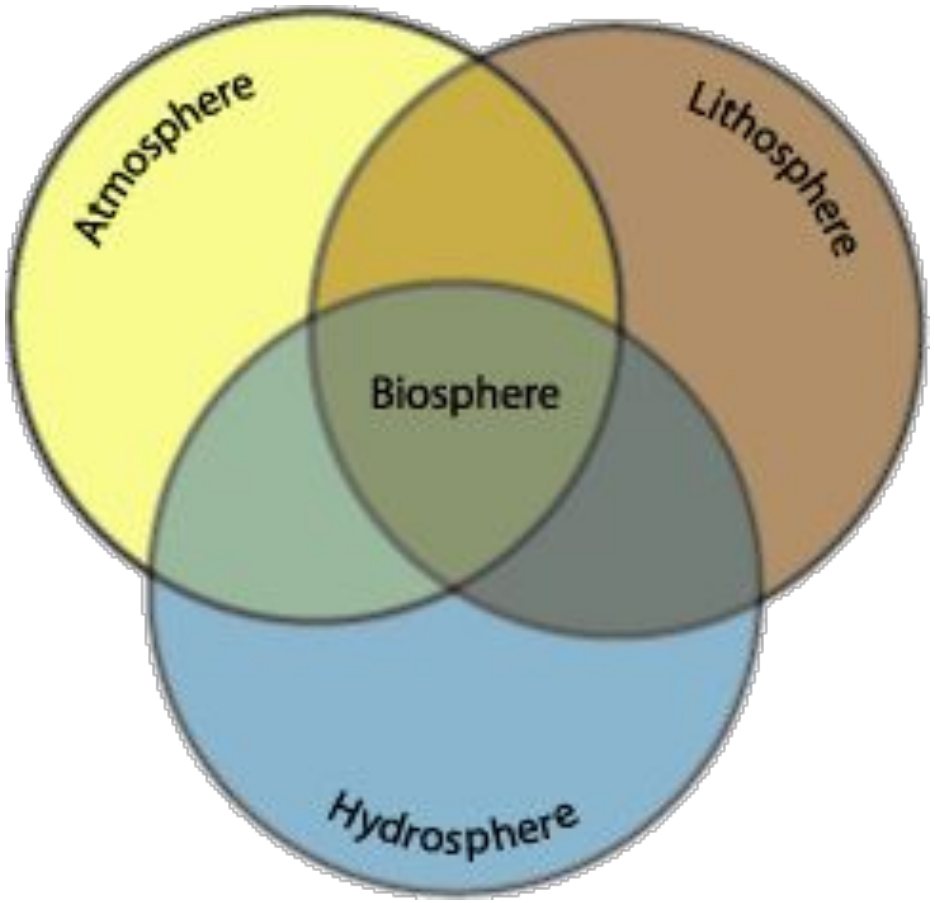
Gases: 78% Nitrogen, 21% Oxygen, 0.04% CO_2

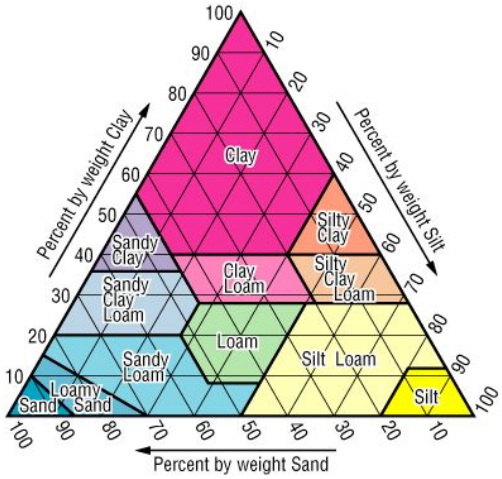
Hydrosphere

Water: Liquid, Vapor, Solid

Biosphere

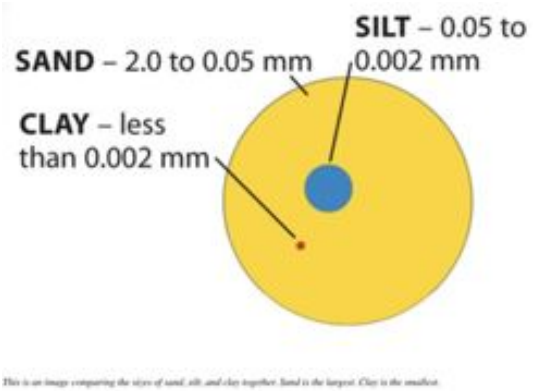
Soil Life: Plants, Roots, Microbes, Arthropods, Worms, Birds, Reptiles, Amphibians, Mammals





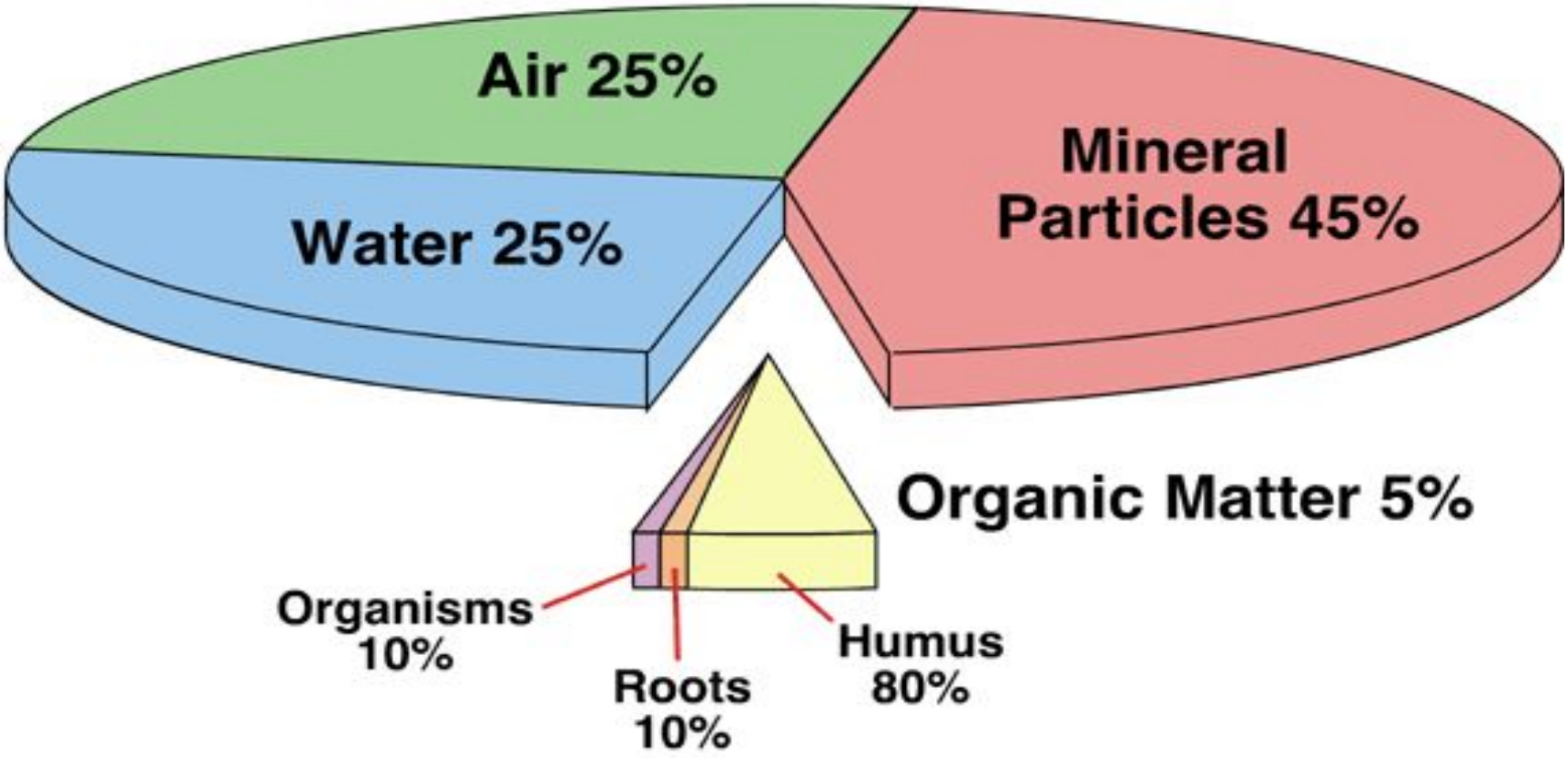
Soil Texture

- Soil texture is the parent rock component of soil
- Soil texture classification is defined by the percentage of sand, silt and clay
- Unlike sand and silt, clay is very small and flat and can hold onto positively charged ions like calcium, magnesium, potassium
- Soil's ability to infiltrate water and retain moisture is influenced by soil texture

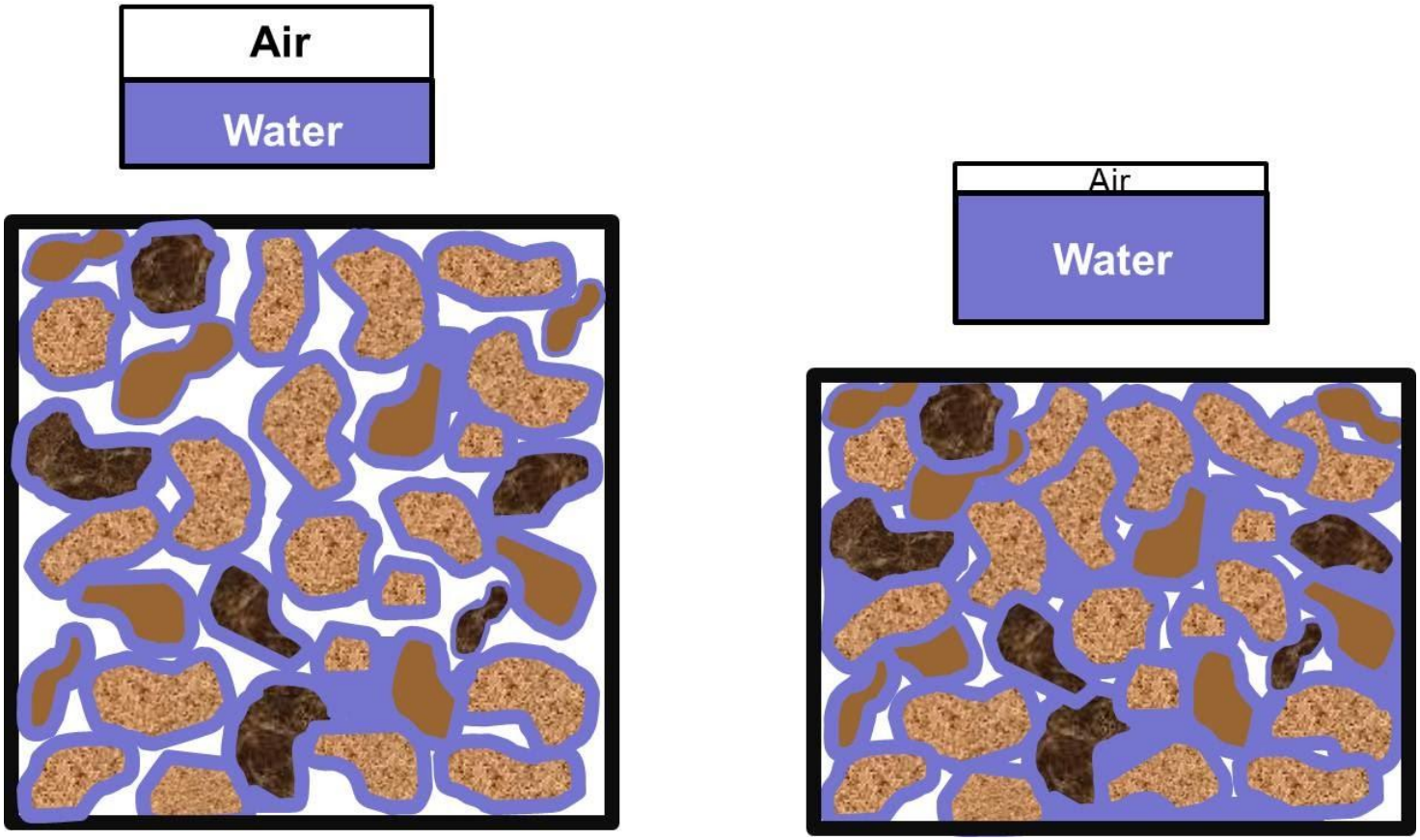


This is an image comparing the sizes of sand, silt, and clay together. Sand is the largest. Clay is the smallest.

Soil Matrix

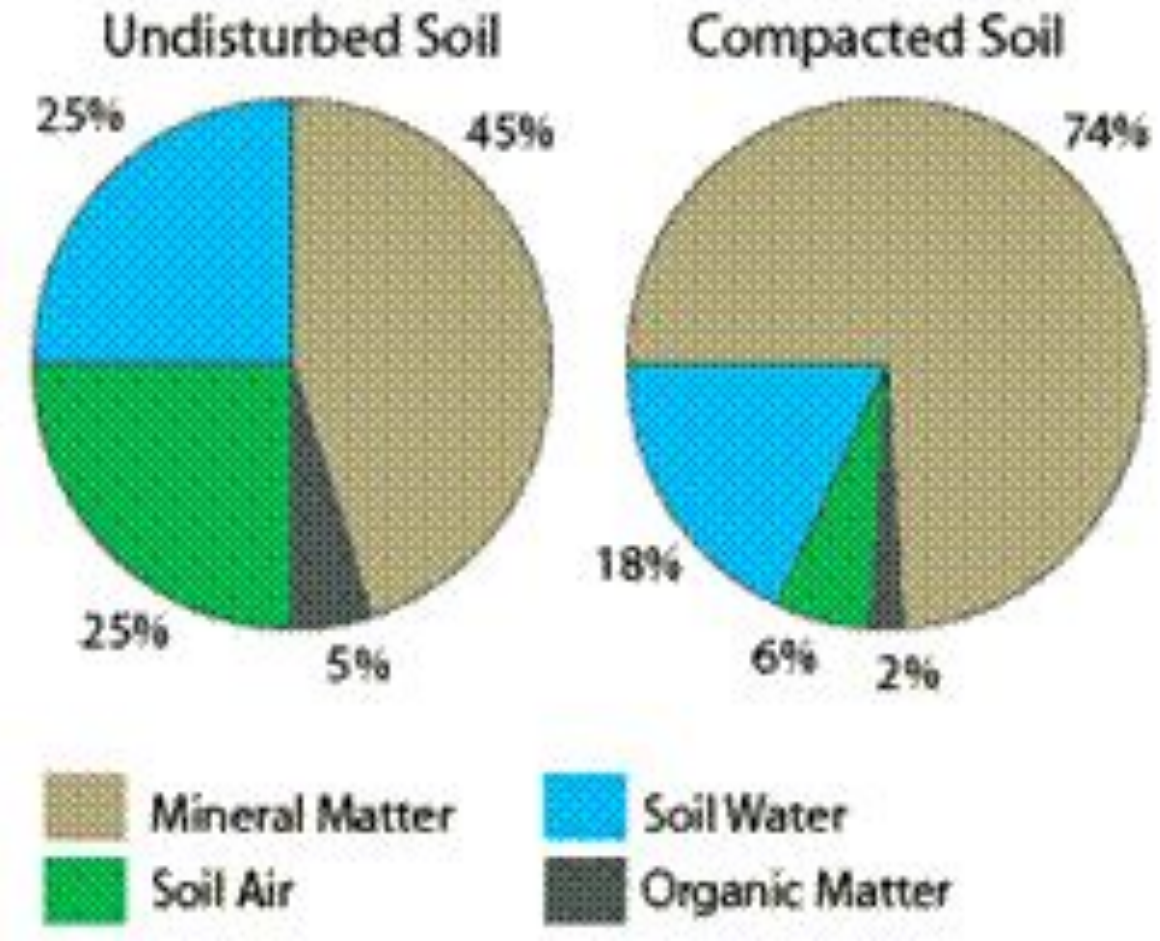

Air 25%
Water 25%
Mineral Particles 45%
Organic Matter 5%
Organisms 10%
Roots 10%
Humus 80%

Compaction: Impact on Air and Water



https://extension.umn.edu/soil-management-and-health/soil-compaction

Same Soil: Two Scenarios



Soil Compaction: Limits Water Infiltration

- **Creates Compaction**
  - Limits microbial community
    - Leaf blower, traffic
    - Repeated tilling, turning
    - Too much organic and inorganic fertilizers, and biocides
    - The elements: sun, wind, rain
    - No plant cover or mulch
- Rain and irrigation water runs off along with soil.

Biological Soil Structure: Increases Water Infiltration

- **Builds Soil Structure**
  - Diverse microbial community
  - Keep the soil covered
    - Leave the leaves
    - Compost and Mulch
    - Sheet Mulch
    - Plants including cover crops
- Rain and irrigation water infiltrates deep into the soil. Held in micro and macro pores, available to plants over time. Recharges groundwater.

Sun
Plants
Microbes

The Soil Food Web

All members are needed for nutrient cycling

The plant gets exactly what it needs when it needs it

Plants
Shoots and roots

Nematodes
Root-feeders

Arthropods
Shredders

Fungi
Mycorrhizal fungi
Saprophytic fungi

Nematodes
Fungal- and bacterial-feeders

Arthropods
Predators

Birds

Nematodes
Predators

Soil with a diverse microbial community can detoxify pollutants

Biosphere protects plants from pests and disease

Organic Matter
Waste, residue and metabolites from plants, animals and microbes.

Bacteria

Protozoa
Amoebae, flagellates, and ciliates

Animals

First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

Important Members of Our Garden: Reptiles, Amphibians

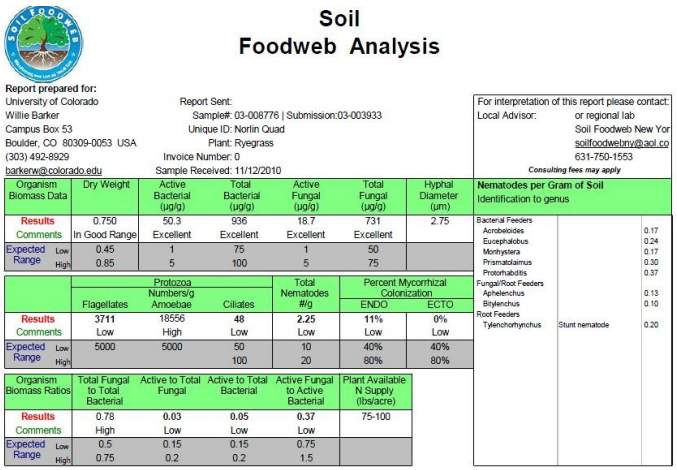
Observe, Observe, Observe






Lab Tests

Essential Elements for Plant Growth	
Macronutrients	**Micronutrients**
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O)	Boron (B)
Nitrogen (N)	Molybdenum (Mo)
Phosphorus (P)	Copper (Cu)
Potassium (K)	Zinc (Zn)
Calcium (Ca)	Chlorine (Cl)
Magnesium (Mg)	Nickel (Ni)
Sulfur (S)	Cobalt (Co)
	Sodium (S)
	Silicon (Si)



Soil Foodweb Analysis

Report prepared for:
University of Colorado
Willie Barker
Campus Box 53
Boulder, CO 80309-0053 USA
(303) 492-8929
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Report Sent:
Sample#: 03-008776 | Submission:03-003933
Unique ID: Norlin Quad
Plant: Ryegrass
Invoice Number: 0
Sample Received: 11/12/2010

For interpretation of this report please contact:
Local Advisor: or regional lab
Soil Foodweb New Yor
soilfoodwebny@aol.co
631-750-1553
Consulting fees may apply

Organism Biomass Data	Dry Weight	Active Bacterial (µg/g)	Total Bacterial (µg/g)	Active Fungal (µg/g)	Total Fungal (µg/g)	Hyphal Diameter (µm)
Results	0.750	50.3	936	18.7	731	2.75
Comments	In Good Range	Excellent	Excellent	Excellent	Excellent	
Expected Range Low	0.45	1	75	1	50	
Expected Range High	0.85	5	100	5	75	

	Protozoa Numbers/g			Total Nematodes #/g	Percent Mycorrhizal Colonization	
	Flagellates	Amoebae	Ciliates		ENDO	ECTO
Results	3711	18556	48	2.25	11%	0%
Comments	Low	High	Low	Low	Low	Low
Expected Range Low	5000	5000	50	10	40%	40%
Expected Range High			100	20	80%	80%

Organism Biomass Ratios	Total Fungal to Total Bacterial	Active to Total Fungal	Active to Total Bacterial	Active Fungal to Active Bacterial	Plant Available N Supply (lbs/acre)
Results	0.78	0.03	0.05	0.37	75-100
Comments	High	Low	Low	Low	
Expected Range Low	0.5	0.15	0.15	0.75	
Expected Range High	0.75	0.2	0.2	1.5	

Nematodes per Gram of Soil
Identification to genus

Bacterial Feeders		
Acrobeloides		0.17
Eucephalobus		0.24
Monhystera		0.17
Prismatolaimus		0.30
Protorhabditis		0.37
Fungal/Root Feeders		
Aphelenchus		0.13
Bitylenchus		0.10
Root Feeders		
Tylenchorhynchus	Stunt nematode	0.20

- **Chemical Soil Test**
  - Plant Available Macro, Micro Nutrients
  - Soil Texture
  - Organic Matter
  - pH
- **Biological Soil Test**
  - Bacteria, Fungi,
  - Protozoa, Nematodes
  - Mycorrhizal Fungi

DIY Soil Drainage Perk Test for Your Yard

Amy Dismukes, Tennessee State University Cooperative Extension (see References)

Almost every garden instruction guide refers to the importance of "well-draining soil."

If water drains (percolates) away from plant roots too quickly, the plants will parch even if they're getting regular water. And if water doesn't drain, many plants will drown and rot from the roots up.

A percolation test – or perk test – is a great way to measure drainage in your garden soil. Here's how to conduct an easy, DIY soil perk test in your yard.

Perk Analysis

The ideal soil drainage is around 2” per hour, with readings between 1”- 3”, which is generally ok for plants that have average drainage needs.

If drainage is more than 4” per hour, it’s too fast. Cover crops and grassy plants will provide carbon to sandy soil, soil structure will develop and water will be held in small pores and infiltrate.

If the rate is less than 1” per hour, your drainage is too slow. You may have compacted soil or a compaction layer. Plants and diverse microbial community can help break up compaction.

Slake Test

Jason Johnson Iowa NRCS

- Clump of soil
- Dry out for a week
- Gently submerge in water
- Watch
- Does it stay together?
- Does it fall apart?
- What does this tell you?

Soil Amendments

Structure

- Organic Matter
  - Compost
  - Wood fines
  - Mulch
- Soil Food Web
  - Compost Extract/Tea
- Minerals
  - Gypsum, No

Fertility

- Organic Matter
  - Compost
  - Organic Fertilizers
  - Mulch
- Soil Food Web
  - Compost Extract/Tea
- Minerals
  - Rock Dust

Compacted Soil? Broadfork

joe gardener®

Compost and Vermicompost

An important source of biology, labile organic matter, some soluble nutrients and stable organic matter. Supports biological soil structure, water infiltration, moisture retention, nutrient cycling, disease resistance, breakdown of toxins, healthy plants.

Compost and Vermicompost in the Garden

- Top Dress
  - Choose type of compost based on plants needs
  - Apply thin a layer, ⅜-½”, of compost over the top of the soil and cover with mulch unless you have good plant cover
  - Apply thin layer, ⅜” or less, of compost over the top of turf

- Open up compacted soil with a broadfork and apply 1” of compost over the top

- One time 2” application of compost incorporated into top 6-8” of soil as long as there are no tree roots in the area

- Keep compost and mulch away from base of plants

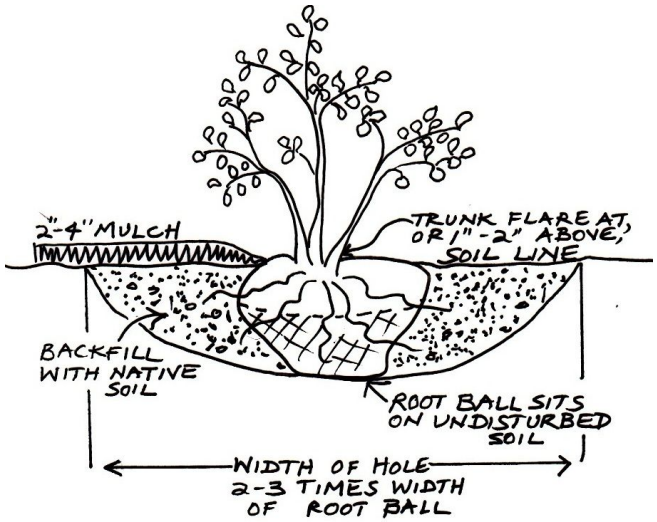
Compost Extract and Tea


Rodale Institute

- **Compost Extract**
  - Well made compost and vermicompost with a diversity of life.
  - Made quickly in a 5 gallon bucket and use immediately to supply life to the soil.
  - Easily made at home using a paint strainer bag, treated water or rain water and 2 cups of well made compost. Massage gently while holding bag in water for 60 seconds.
  - Water into root zone of plants, potted plants and even onto bare soil and cover with mulch.

- **Aerated Compost Tea**
  - Well made compost and vermicompost.
  - Brewed over 24-36 hours to grow the life in the compost/vermicompost.
  - Use immediately after dispensed, within hours.
  - Need a brewer that can aerate the liquid.
  - More complicated to make than extract.

(Chloramine treated water must be neutralized with humic acid)



Thoughts on Planting

- Do not amend the backfill soil, use only your native soil
  - Dig hole at least 3 times wider than diameter of the pot and no deeper than from base of root ball to root flare
    - Compacted soil - make hole wider by 5-10 times but not deeper than root ball
- Break up sides of planting hole of planting hole using pitch fork or shovel
- Water the root ball well before planting
- Place plant in hole making sure root flare is slightly above grade
- Backfill with native soil, compressing with hands as you go
- Put a thin ⅜" layer of compost over the top of the planting hole and beyond and then cover with 2-3" of mulch and water slowly
- Keep compost and mulch away from root flare of tree by 6"

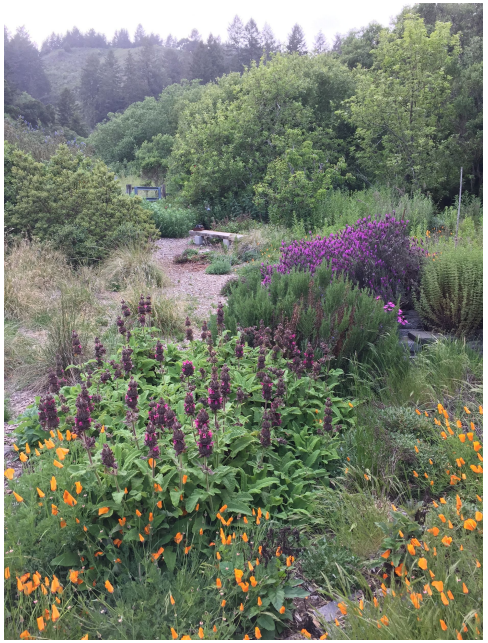
Your job:

Protect Soil Structure

Diverse Cover Crops

Compost, Mulch, Leaf Cover

Sheet Mulch



Plant Cover

Remember, It's Up to You

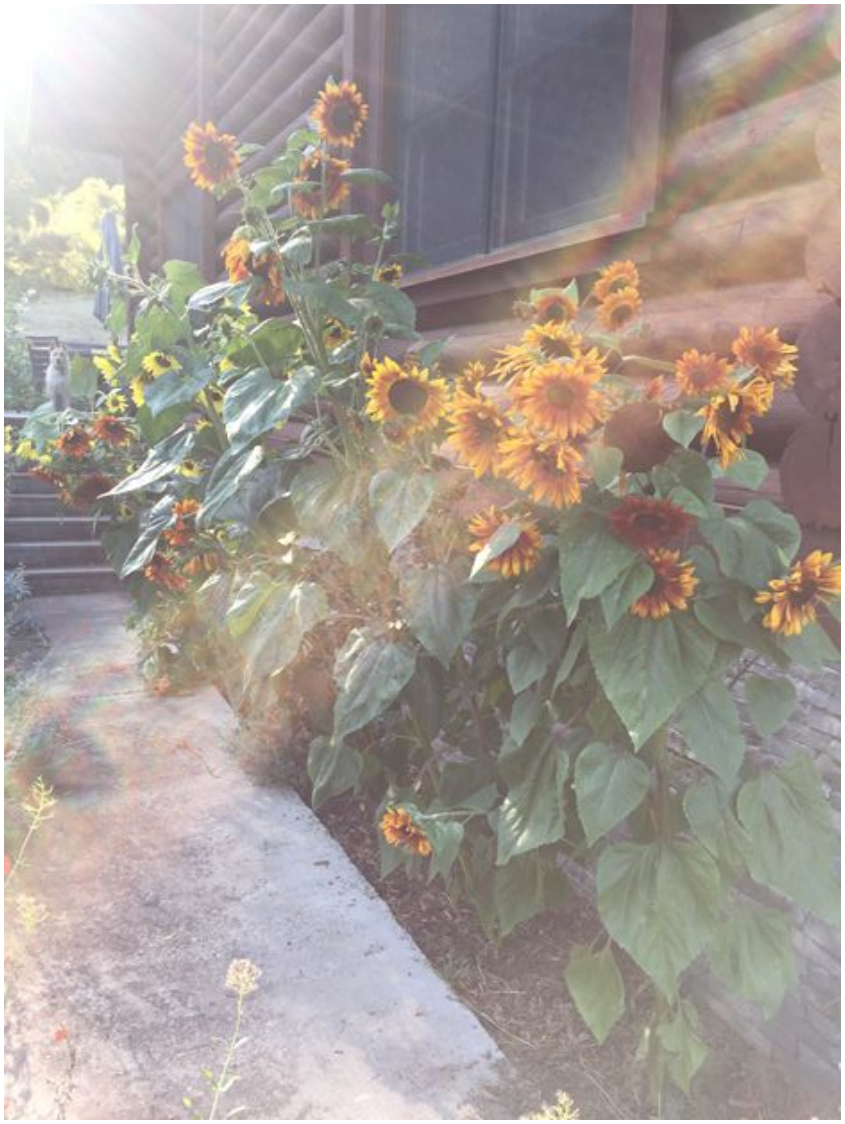


Photo by T. Lyngso

- Sunlight drives the system
- Know your plants' needs
- Protect the soil from the elements with plant cover and or mulch
- Good soil structure means good water infiltration
- Feed the microbes compost and mulch
- Let the microbial community and plants feed each other
- Support the community, it is an ecological system

Thank you from Grandmother Canyon Oak

Photo, T Lyngso

Happy Gardening Wishes From Pacific Tree Frog

Photo, T Lyngso

References, Inspiration

- Teaming With Microbes by Jeff Lowenfels and Wayne Lewis
- Growing a Revolution: Bringing Our Soil Back to Life by David Montgomery
- Dirt to Soil: One Family's Journey Into Regenerative Agriculture by Gabe Brown

Web Resources

- Soil Biology Primer: Soil Biology Primer
- Estimating Soil Texture: Colorado Master Gardener Training
- Soil Drainage Perk Test: DIY Soil Drainage Perk Test for Your Yard
- Slake Test: https://www.youtube.com/watch?v=YUXwCmpz1qo
- UC Davis Tree Planting How To: https://www.youtube.com/watch?v=8WCR9-IRE4w
- AL Western Lab: www.al-labs-west.com/services.php?section=Soil%20Analysis

How To Sheet Mulch

- Knock down weeds, mow lawn, water the area well so the soil is moist, good time is after a rain.
- Spread ⅜” of compost on soil, weeds, turf and moisten if dry.
- Wet cardboard on both sides, spread over the area overlapping by 4-6” so no sunlight gets in. Be sure and mositen well, make sure there is good contact with ground, few or no air pockets
- Spread 1-1 ½” of compost over the moistened cardboard
- Spread 3” of woody mulch over the top,mositening in layers.
- After 3-6 months, as long as there is sufficient moisture, the cardboard will decompose, the weeds/turf will decompose, the soil will open up and you may see earthworms.
- To be successful the microbial community needs moisture and good contact with the soil. They will open the soil up, creating an open structure.
- Do not sheet mulch against the base of plants, keep at least 6” away.
- Sheet mulching will not kill all weeds but it will build soil structure and make it easier for you to pull the weed out fully

Thank you for inviting me

San Mateo Arboretum Society Educational Seminar

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