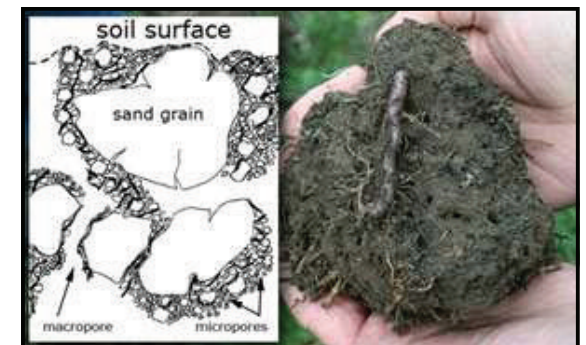
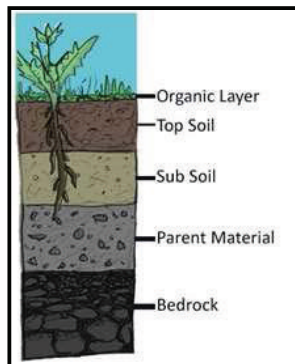
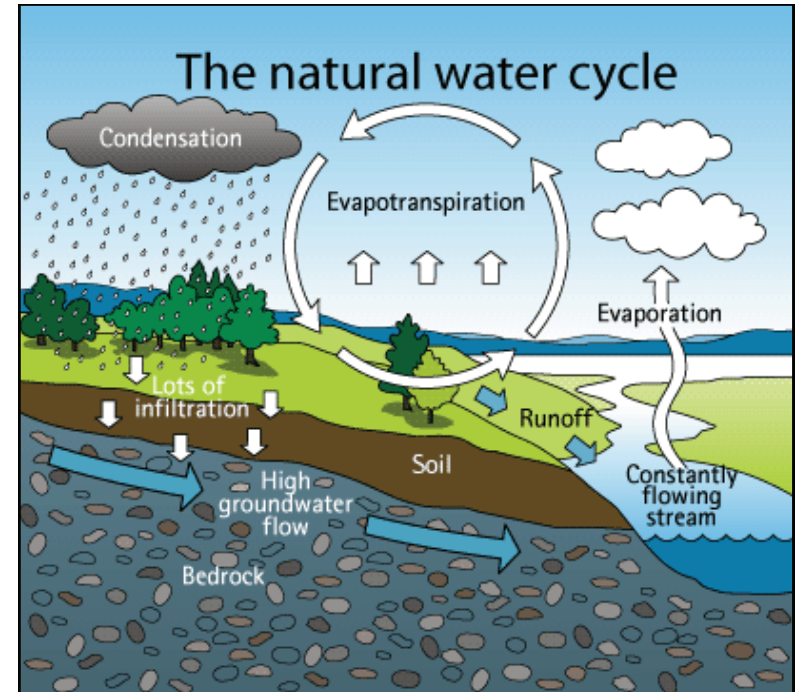
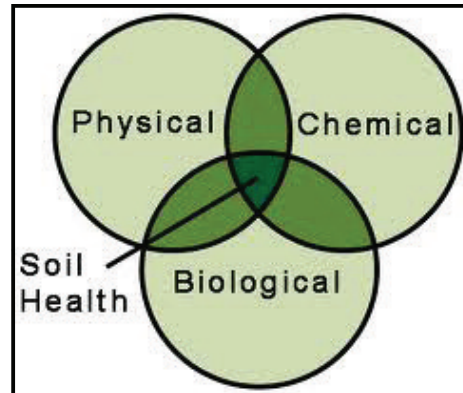


New Jersey Soil Health Assessment Guide

...A Locally Adapted Field Tool For NJ Communities



"The New Jersey Soil Health Guide is offered as a tool for homeowners and gardeners to assist in assessing the health of their soil. Managed carefully, healthy soils support local communities through encouraging plant and animal production and sustaining water resources for future generations. Basically, a healthy soil surface would consist of about half mineral and organic matter, and half pore spaces filled with water and air. Completing this self assessed Guide will enable you to provide background information about the condition of your soil. It will serve to assist you in determining what you can do to sustain these important soil functions, and how you can assist in helping sustain all life above and below the surface."

David Friedman, Ocean County Soil Conservation District Director



This guide has been created by the Ocean County Soil Conservation District and the USDA Natural Resources Conservation Service. Funding for this publication was provided through a Watershed Restoration Grant (#RP07-057) through the New Jersey Department of Environmental Protection.

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WHAT IS A HEALTHY SOIL?

A healthy, fully functioning soil is balanced to provide an environment that sustains and nourishes plants, soil microbes and beneficial insects.

Soil is a living system, and healthy soil should look, smell and feel alive. Healthy soil is darker in color, crumbly and porous. It is home to worms and other organisms that squirm, creep, hop or crawl. Healthy Soil provides the right amount of air, water and organic matter for microorganisms to thrive and for plants to grow. Soil that is functioning at its' full potential is full of roots of the healthy and strong plants that it supports.

An unhealthy, poorly functioning soil, appears lighter in color, is compacted or has poor structure, and contains limited roots and living things.

Soil Health and Soil Quality are terms that are becoming increasingly familiar worldwide and are often used interchangeably.

Soil is made up of air, water, decayed plant residue, organic matter from living and dead organisms, and minerals, such as sand, silt, and clay. Increasing soil organic matter typically improves soil health since organic matter affects several critical soil functions.

“Soil Health or Quality can be defined as the capacity of a specific kind of soil to function, within natural (inherent) or managed (dynamic) ecosystem boundaries; to sustain plant and animal productivity; maintain or enhance water and air quality; support human health and habitation.”

WHY IS PROTECTING MY SOIL’S HEALTH IMPORTANT?

Healthy soil gives us clean air and water, bountiful crops, lush lawns, forests, productive grazing land, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:

Nutrient Cycling - Soil stores, moderates the release and cycling of nutrients and other elements. During these biogeochemical processes, analogous to the water cycle, nutrients can be transformed into plant available forms, held in the soil to be utilized by plants, or even lost to air or water.

Water Relations - Soil can regulate the drainage, flow and storage of water and solutes, which include nitrogen, phosphorus, pesticides, and other nutrients and compounds dissolved in the water. With proper functioning, soil partitions water for groundwater re-charge and for use by plants and soil animals.

Biodiversity and Habitat - Soil supports the growth of a variety of plants, animals, and soil microorganisms, by providing a diverse physical, chemical, and biological habitat.

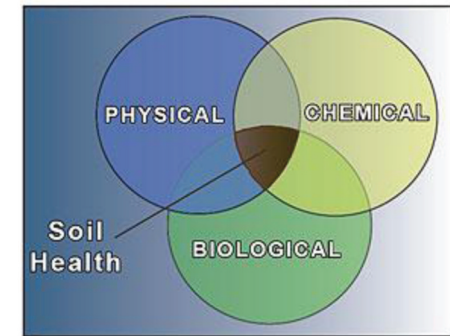
Filtering and Buffering - Soil acts as a filter to protect the quality of water, air, and other resources. Toxic compounds or excess nutrients can be degraded or otherwise made unavailable to plants and animals.

Physical Stability and Support - Soil has the ability to maintain its porous structure to allow passage of air and water, withstand erosive forces, and provide a medium for plant roots. Soils also provide anchoring support for human structures and protect archeological treasures.

USING THE SOIL HEALTH ASSESSMENT GUIDE:

This Soil Health Assessment Guide is based on the integration of the physical, chemical, and biological components of the soil. It is the synergy of these components that produce a healthy functioning soil ecosystem.

Eight Soil Health Parameters are the basis of this evaluation. Each component of Soil Health is broken out into various parameters.

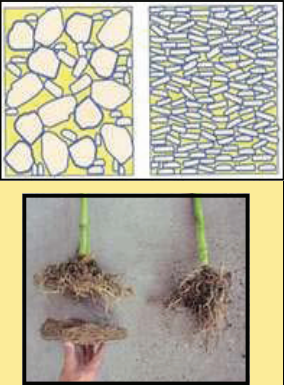
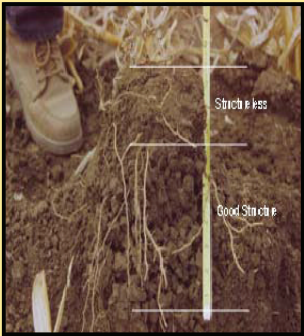


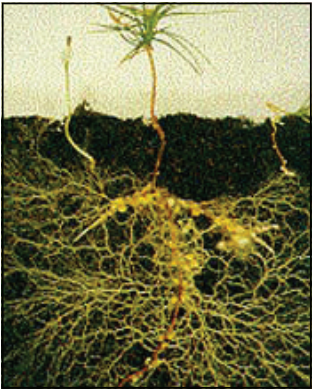
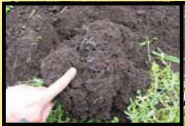
Physical Components: Surface Hardness/Soil Compaction, Structure, Friability, Consistence & Soil Tilth, Erosion and Drainage & Infiltration of Rain- water.

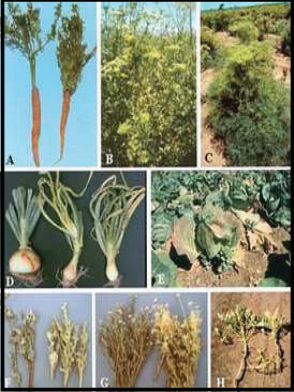
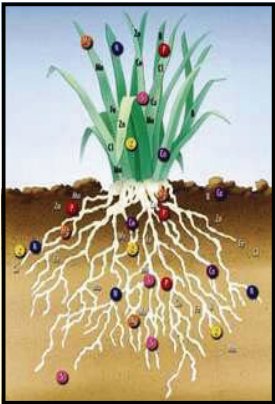
Chemical Components: Nutrient Holding Capacity and pH

Biological Components: Organic Matter, Soil Color & Roots, Soil Life, and Plant Growth.

Use this assessment to identify opportunities for improvement and to monitor and track changes in your soil over time. Land managers can use this information along with data from soil surveys, fertility tests, and other natural resource monitoring data to make sustainable management decisions.

	Soil Health Parameter & Symptoms	Rating Value GOOD =5	Rating Value FAIR =3	Rating Value POOR =1
	Surface Hardness, Soil Compaction (Physical Component of Soil Health) The perfect soil for the growth of most plants would be comprised of about 50% solids and 50% pore space. In compacted soils, the soil particles are so tightly packed together, it makes it difficult for roots, air and water to penetrate. Some soil compacts more readily than others but compaction also happens as a result of people. (walking, driving, cultivating, biking etc) It's a common problem around new construction where heavy machinery has been driven over the site during construction.	Wire Flag penetrates easily into moist soil with no resistance into the top 12" of the soil. 	Wire flag penetrates with some resistance into moist soil more than 4" into the soil. 	Wire flag cannot penetrate more than 4" into moist soil. 
	Structure, Friability, Consistence & Soil Tilth (Physical Component of Soil Health) Good tilth is a term referring to soil that has the proper structure and nutrient content to grow healthy plants. The ideal soil for most plants is made out of granules or small crumbs. Soil with loose granular structure is easy to dig and provides a good rooting environment for plants. Developing and maintaining good structure is one of the most important aspects of building healthy soil.	Soil is friable, crumbly or easily broken up. Soil is granular in structure and holds together in aggregates or clods. Feels like a soft cushion when you walk on it and roots grow easily. 	Soil very tightly compacted with restricted roots, single grained soil structure, individual soil particles aren't joined at all, water and nutrients flow too quickly. 	Looks like a concrete crust on surface, powdery, particles are packed so tightly together that they block developing roots. Hard to dig and feels very hard when you walk on it. 
	Erosion (Physical Component of Soil Health) Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity. Soil erosion is of particular interest because of its on-site and off-site impacts on the environment. Understanding and managing these processes has important long term implications for sustainability, natural resource condition and environmental quality.	No gullies or rills, runoff water clear in color, or no runoff on sloping ground, 90% of the ground surface covered by vegetation (10% bare ground). 	Few rills or gullies, gullies up to 2" deep, runoff cloudy in color, noticeable sediment deposition at the end of slopes, 60-90% of the ground surface covered by vegetation (10-40% bare ground). 	Large gullies over 2" deep, thin or no topsoil, muddy colored runoff, sediment deposition widespread, less than 60% of the ground surface is covered by vegetation (40% or more bare ground). 

	Soil Health Parameter & Symptoms	Rating Value GOOD =5	Rating Value FAIR =3	Rating Value POOR =1
	<i>Drainage & Infiltration of Rainwater</i> (Physical Component of Soil Health) Soils that are poorly drained deprive vegetation and microorganisms of the oxygen they need to grow.	No surface ponding of water or runoff observed after a soaking rain. 	Soil dries out within 1 day after a soaking rain, little or no ponding of water on flat surfaces. 	Water is ponded for at least 1 day after soaking rain on flat surfaces, evaporates more than it drains downward, ground remains wet or soggy. 
	<i>Organic Matter, Soil Color & Roots</i> (Biological Component of Soil Health) Living plants maintain an area of concentrated microbial activity around the roots of plants. When organic matter or carbon is not available from living roots then nutrient and water cycling happen at lesser rates. Sugars from living and dead organic matter feed the Soil Food Web.	Topsoil color within top 8" of surface is clearly defined and is darker than the subsoil below it. Soil is dark grey or brown in color with high organic matter. 	Topsoil and subsoil color within top 12" is not clearly defined. Topsoil is closer to subsoil color than a dark grey or brown color with lower organic matter. 	Topsoil and subsoil indiscernible from each other, not dark grey or brown in color, little to no organic matter. Roots, if any are stunted and shallow. 
	<i>Soil Life-The Soil Food Web</i> (Biological Component of Soil Health) The Soil Food Web is the community of soil organisms such as bacteria, fungi, insects, and earthworms that live and work in the soil all of or part of their lifecycle. As soil organisms decompose organic compounds, nutrients are converted to a form that is made available to plants.	Soil life abundant in top square foot hole of soil, visible worm excrement, and holes in soil clods (soil pores). Evidence of root channels or burrowing organisms, roots present and in good numbers with an earthy smell. 	Soil life less abundant, lack of visible soil pores, little or no roots with a mild earthy smell. 	No evidence of soil life or roots with no earthy smell or foul smelling. 

	Soil Health Parameter & Symptoms	Rating Value GOOD =5	Rating Value FAIR =3	Rating Value POOR =1
	Plant Growth (Biological Component of Soil Health) It is important to understand the interrelatedness of soil and plants as the soil provides many things plants need to grow. Plant growth can be limited by nutrient deficiencies, compaction, disease, drainage and land use.	Plants look a healthy color, excellent growth and uniform vegetative development, not drought stressed, dense fibrous root system within top 12" of soil.	Plants look off color, somewhat uneven vegetative development, evidence of drought stress, less dense or fibrous root system within the top 12" of soil.	Plants yellow and purple color and dying, uneven vegetative development, root development poor, shallow, restricted or nonexistent, plants are very drought stressed.
	Nutrient Holding Capacity/ pH (Chemical Component of Soil Health) Values based on laboratory soil test results from an accredited soil testing laboratory. Follow directions for taking sample. Samples should be taken every 3-5 years at the same time of year.	Adequate pH, organic matter levels, and nutrient levels for desired plant community.	Easily correctable pH, organic matter levels and nutrients for desired plant community.	Hard to correct pH, organic matter levels and nutrients for desired plant community. (contamination, acidic soils, inherent soil type etc)

Web Resources:

Ocean County Soil Conservation District (www.soildistrict.org)

NJ USDA Natural Resources Conservation Service (www.nj.nrcs.usda.gov)

NRCS East National Technical Support Center, Soil Health Division (www.soilquality.org)

Cornell Soil Health (<http://soilhealth.cals.cornell.edu>)

Rutgers Cooperative Extension (<http://www.njaes.rutgers.edu>)

Your Comments and Suggestions are Welcome and Encouraged!!

Please send comments on this Soil Health Guide to Eileen Miller, Soil Health Specialist, USDA NRCS NJ to eileen.miller@nj.usda.gov.

Please write **"Soil Health Guide"** in the subject line. Thank you!

Solutions

Soil Health Parameter/ Symptom	Potential Reasons for a Fair to Low Score	How do I make my soil healthy? 
Surface Hardness, Soil Compaction (Physical Component of Soil Health)	Compacted areas or hardpans, develop naturally in some clayey soils, however sometimes we create this situation by repeatedly tilling the soil to the same depth. Working wet clayey soil, excessive vehicle, animal, or foot traffic, heavy machinery, and low organic matter levels all contribute to soil compaction.	Dig and break apart the topsoil and as deep as you can into the subsoil, add composted organic matter, mix compost into the soil to create a good seed bed. Avoid working in wet soil, re-designate foot traffic patterns, avoid heavy machinery in wet soil conditions, consider planting deep rooted plants, reduce or minimize tilling the soil, keep the soil covered with vegetation or mulch at all times of the year, (carbon that feeds the soil microbes so they can naturally cycle nutrients) consider building raised garden beds if ground is still too hard and backfill beds with healthy topsoil and compost.
Structure, Friability, Consistence, & Tilth (Physical Component of Soil Health)	While texture tells us the particle size distribution of various mineral material, the structure of the soil tells us how they clump together. Developing and maintaining good soil structure is one of the most important parts of building healthy soil. A healthy soil will be made of soft granules or crumbs, less than 1/2" (1 cm) in diameter. Soil with this loose granular structure is said to have good tilth and is therefore easy to dig. Soil crumbs of this type, are small enough to make good seed-to-soil contact while still allowing water and nutrients to flow freely to the plants. Soils with less than ideal structure tend to be single grained, which means that the individual particles are not joined together, thus allowing water and nutrients to flow through the soil too quickly to be utilized by plants. Other soils may be massive, meaning that the soil particles pack together too tightly in irregular clods. These clods can be detrimental as they block developing roots and spaces between each clod may contain air pockets that can cause roots to dry out. Some soils have been damaged by poor gardening practices, such as working clayey soil when it's too wet, can lead to large clods that harden when dry. Walking over the soil too often causes compaction which leads to less room for air and water. Tilling the ground too often, as with a rotary tiller, can turn crumbly granular soil into a structure-less powder.	While a soils texture (sand, silt, & clay amounts) is not easily changeable, topsoil structure can be improved by adding adequate amounts of organic matter (carbon) in the form of compost, manure, grass clippings, chopped leaves etc. As the soil microorganisms break these materials down, they secrete a gummy substance called glomalin, that binds the soil granules together. The humus in this material is fluffy and light and can help loosen compacted soils. Many organisms enhance soil aggregation and porosity, thus increasing infiltration and reducing runoff. Beneficial soil organisms prey on plant pests and are food for above-ground animals. Once good structure is achieved, one must take great care to avoid damaging it again. Avoid working soil that is too wet or too dry. Dig in your garden when a fistful of moist soil holds together loosely when you open your hand, then crumbles when you touch it. Work the soil as minimally as you can, perhaps once a year, and incorporate organic matter when you do till it. Avoid walking through garden beds and stick to designated paths.

Solutions

Soil Health Parameter/ Symptom	Potential Reasons for a Fair to Low Score	How do I make my soil healthy? 
Erosion (Physical Component of Soil Health)	Erosion can be caused by improper land management, the inherent characteristics of a soil, a lack of vegetative cover or organic matter, excessive soil disturbance, as well as slope grade and length.	Use plants, mulch or stone to cover the soil and stop the impact of falling raindrops. Plant perennial vegetation to reduce the pace of flowing water or blowing wind. Plant on the contour of the land or across the predominant land slope. Install terraces or diversions to intercept and direct water. Avoid excessive soil disturbance-only disturb areas where plants will be planted. Use companion annual plants to provide quick vegetative cover during establishment period.
Drainage & Infiltration of Rainwater (Physical Component of Soil Health)	Some reasons for poor drainage and infiltration can be compaction and/or poor surface grading during construction activities or gardening. Inherent soil texture (amounts of sand, silt and clay) can affect drainage and infiltration as well. Heavy or clayey soils can be inherently poorly drained for several reasons.	Digging the top 8-12 inches or so of soil will provide good growing conditions for many plants, but in many cases it's useful to dig twice as deep. This "double digging" technique is useful in providing a healthy rooting environment for deeper rooted plants. If your soil is too soggy for the desired plant community, build raised garden beds to create drier soil conditions above original soil profile. Plant Rain Gardens to intercept stormwater flows. Rain Gardens reduce pollution in our waterways, recharge our groundwater, utilize rainwater on-site, and create a beautiful habitat for wildlife and butterflies.

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Solutions

Soil Health Parameter/	Potential Reasons for a Fair to Low Score	How do I make my soil healthy?	
Organic Matter, Soil Color & Roots (Biological Component of Soil Health)	Lack of organic matter is caused by excessive tillage and a lack of vegetative cover. Water-logged soils with spots of different colors (mottles), usually rust colored, indicate a soil that has a period of inadequate aeration. Bluish gray or completely grey subsoil colors without mottles indicate longer periods of water logged conditions and inadequate aeration. Darker colors sometimes indicate higher	Add composted organic matter, reduce tillage and improve drainage. Eliminate compaction to provide a good rooting environment for plants. Keep the ground vegetated in a perennial planting, such as sod, shrubs, herbs, trees or a combination thereof. Plant a cover crop in vegetable gardens in the off season to protect the ground from erosion while protecting healthy soil microorganisms.	
Soil Life; Earth-worms, Ants, Beetles and other visible soil organisms (Biological Component of Soil Health)	Pesticide use, excessive tillage (or mixing the soil), lack of vegetative cover or food for the soil life, and soil compaction. Most soil organisms and plant roots need oxygen to survive. When oxygen is limited the soil microorganisms compete with the plants for the oxygen and can use it up before the plants can get to it. Oxygen is abundant in soils with good soil structure and soils that are well drained.	Eliminate or reduce pesticide and herbicide use, plant native plants that don't require as much or any chemical sprays. Promote diversity of soil microbiology by adding organic matter or compost to the soil. Use biological controls for plant pests. Provide food in the form of composted organic matter amendments for soil microbiology. Minimize garden tillage and use plant rotations to reduce plant pests. Plant in residues left behind from prior year's garden cover crops such as vetch or rye. Till small zones where plants need to be planted and leave other areas untilled. Add organic matter in the form of compost, plant residues, plant deep rooted plants.	
Plant Growth (Biological Component of Soil Health)	Compaction, saturated soil conditions, soil pathogens, nutrient deficiencies or imbalances, low organic matter content and lack of biological diversity in plant species.	Soil test to correct nutrient deficiencies and imbalances. Check for pathogens, reduce compaction, improve drainage, increase organic residues on the surface, add compost, use cover crops and proper cropping rotations in gardens.	
Nutrient Holding Capacity/pH (Chemical Component of Soil Health)	Nutrients & pH insufficient for desired plant community. Soil is contaminated by a toxic substance.	Soil test and adjust pH and nutrient levels based on soil sampling methods from an accredited lab. If soils are contaminated, (in gardening situations) consider using a raised bed system with fresh soil, rather than growing edible plants directly in the ground.	

Soil Health Data Sheet - Make copies as needed.

Tools Needed: Shovel or spade, and wire flag.

Directions: Select an area that is representative of the area that you are interested in. **Call 811 before you dig for a free utility line mark out.** Remove or brush away twigs, leaves or other surface debris and dig a hole at least 12" deep to make relevant visual observations. Assign values to each respective Soil Parameter and record on the data sheet. Make additional copies of this data sheet as necessary to track trends over time. Enter the value totals for each Soil Health Parameter/Symptom and add all totals to get the Value Total. This Value Total represents the relative value where the higher the number, the better the overall Soil Health. If score is "Poor to Fair", consult the "Solutions" section for possible alternatives.

Values are as follows: 5=GOOD; 3=FAIR; 1=POOR

Date	Location	Surface Hardness/ Compaction	Structure/ Friability/ Consistence	Erosion	Drainage/ Infiltration	Organic Matter/ Color & Roots	Soil Life	Plant Growth/ Visual Observation	Nutrient Holding Capacity/pH	VALUE TOTAL

SCORE	RESULTS
40	EXCELLENT
25-38	GOOD
10-24	POOR-FAIR: Critical need for improvement
8	POOR: Extreme need for improvement

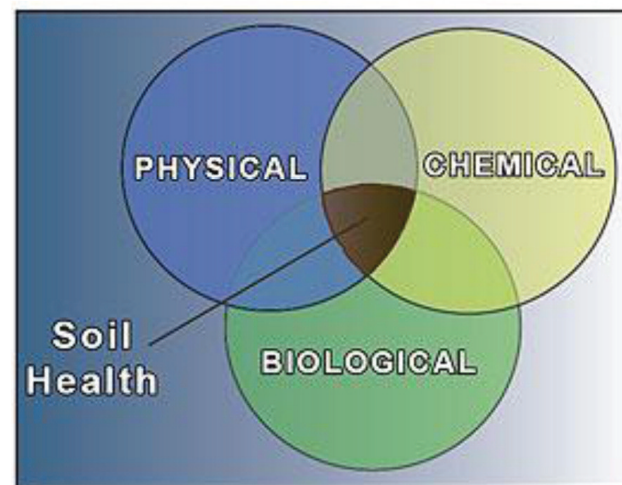


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Healthy Soil Is at the Root of Everything!

unlock the SECRETS IN THE SOIL



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