

Getting Down and Dirty With Soil

Lesson Description

To begin to understand soils and how to work with them, we must take into consideration how they were formed and their physical, biological and chemical properties. Soil is a functional living system. Understanding soil formation will help in anticipating threats to soil stability and potential soil degradation.

Lesson Objectives

1. Understand soil texture and structure.
2. Understand the relationship between soil biology and soil fertility.
3. Understand the threat of soil erosion and how to avoid or minimize the threat.
4. Understand the elements of a good quality soil.
5. Learn practical ways to manage soils in order to maintain and/or improve them.
6. Understand the basics of soil testing and how and where to take a soil sample for testing.



Module 2, Lesson 1

Getting Down and Dirty With Soil

Activity Sheets and Homework

1. Determine Soil Texture by Feel Part 1: Soil Samples in Class
2. Determine Soil Texture by Feel Part 2: Several Locations on Your Property
3. Survey Your Property for Signs of Erosion or Compaction (Don't forget to take pictures for your records!)
4. Submit a soil sample to local laboratory

Supplemental Resources

Soils and Soil Testing, WSU Puyallup <http://puyallup.wsu.edu/soils/soils/>

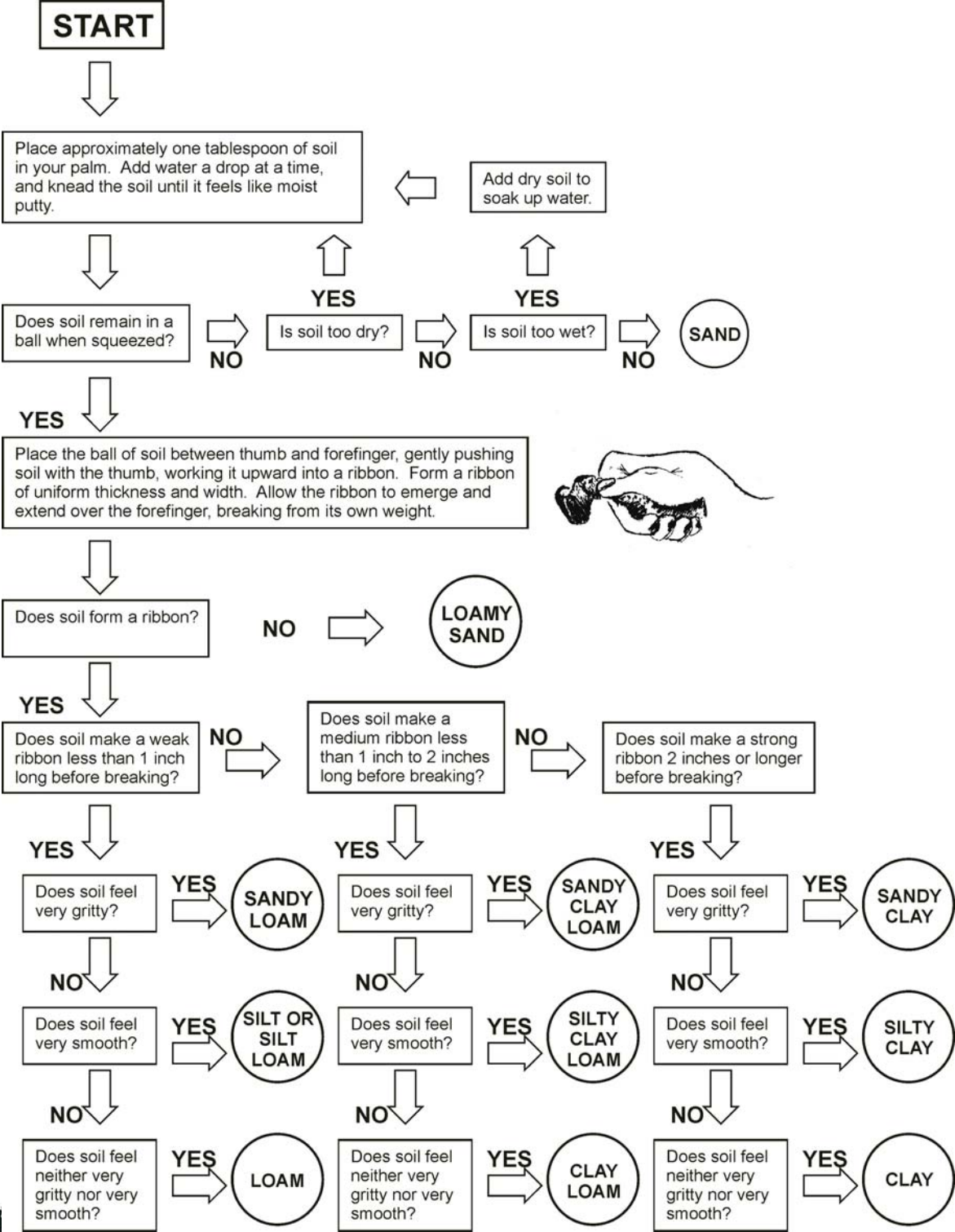
A Guide to Collecting Soil Samples for Farms and Gardens, Oregon State University Extension, http://ext100.wsu.edu/clark/wp-content/uploads/sites/7/2015/06/a-guide-to-collecting-soil-samples-for-farms-and-gardens_OSU.pdf

Analytical Labs and Consultants Serving Ag in the PNW, WSU Puyallup <http://archive.puyallup.wsu.edu/analyticallabs/>

Home Gardeners Guide to Soils and Fertilizers, WSU Extension http://ext100.wsu.edu/clark/wp-content/uploads/sites/7/2015/06/Home-Gardeners-Guide-to-Soils-and-Fertilizers_WSU.pdf



Determining Soil Texture by Feel Activity Sheet, page 1 of 3



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Determining Soil Texture by Feel Activity Sheet, page 2 of 3

Determine soil texture of samples in class

Sample 1 Soil Texture _____

Sample 2 Soil Texture _____

Sample 3 Soil Texture _____

Your Sample Soil Texture _____



Determining Soil Texture by Feel Activity Sheet, page 3 of 3

Determine soil texture at several locations on your property

Location 1 Description _____

Soil texture _____

Location 2 Description _____

Soil texture _____

Location 3 Description _____

Soil texture _____

Location 4 Description _____

Soil texture _____

Location 5 Description _____

Soil texture _____

Location 6 Description _____

Soil texture _____

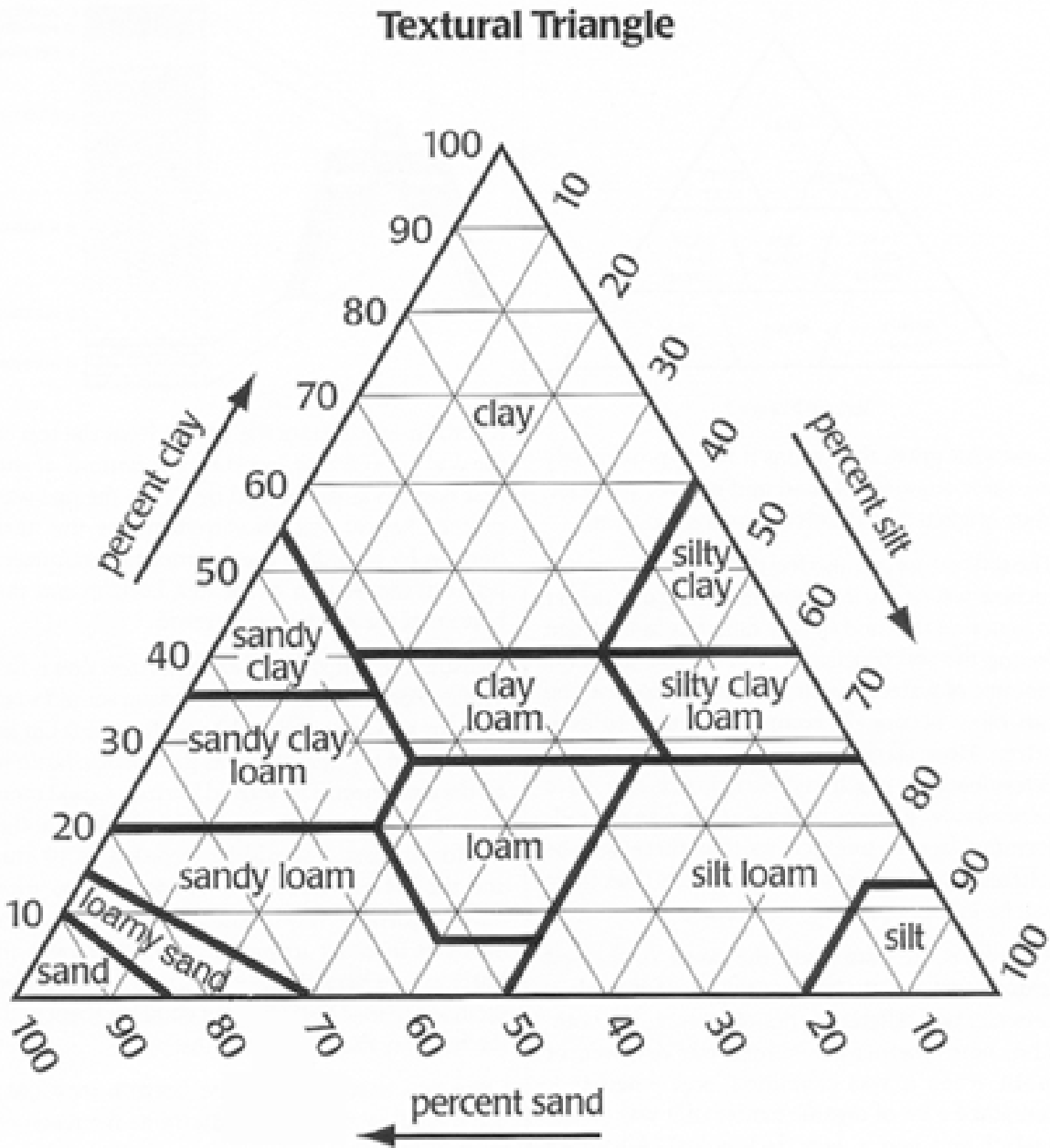
Location 7 Description _____

Soil texture _____



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U.S. Department of Agriculture National Resource Conservation Service Soil Texture Triangle



**Getting Down and Dirty With Soil
Unified Soil Classification System**

COARSE-GRAINED SOILS More than half the material (by weight) is individual grains visible to the naked eye	GRAVELLY SOILS More than half of coarse fraction is larger than 4.75 mm		CLEAN GRAVELS Will not leave a stain on a wet palm		Substantial amounts of all grain particle sizes		GW
			Predominantly one size or range of sizes with some intermediate sizes missing		GP		
			DIRTY GRAVELS Will leave a stain on a wet palm		Non-plastic fines (to identify, see ML below)		GM
			Plastic fines (to identify, see CL below)		GC		
	SANDY SOILS More than half of coarse fraction is smaller than 4.75 mm		CLEAN SANDS Will not leave a stain on a wet palm		Wide range in grain size and substantial amounts of all grain particle sizes.		SW
			Predominantly one size or a range of sizes with some intermediate sizes missing		SP		
			DIRTY SANDS Will leave a stain on a wet palm		Non-plastic fines (to identify, see ML below)		SM
			Plastic fines (to identify, see CL below)		SC		
FINE-GRAINED SOILS More than half the material (by weight) is individual grains not visible to the naked eye (<0.074 mm)	Ribbon	Liquid Limit	Dry Crushing Strength	Dilatancy Reaction	Toughness	Stickiness	
	None	<50	None to Slight	Rapid	Low	None	ML
	Weak	<50	Medium to High	None to Very Slow	Medium to High	Medium	CL
	Strong	>50	Slight to Medium	Slow to None	Medium	Low	MH
	Very Strong	>50	High to Very High	None	High	Very High	CH
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture						OL OH Pt



Module 2, Lesson 1

Survey Your Property for Signs of Erosion Activity Sheet, page 1 of 2

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____



Survey Your Property for Signs of Erosion Activity Sheet, page 2 of 2

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____

Location _____

Signs of erosion _____

Signs of compaction _____

Possible solutions _____



Module 2, Lesson 1

Assessing Soil Quality Activity Sheet, page 1 of 3

Circle the appropriate description for each of the indicators listed. What is the overall assessment of your soil quality?

INDICATOR	LOW	MEDIUM	HIGH
Earthworms	Few worms per shovel, no casts or holes	More worms per shovel, some casts or holes	Many worms per shovel, many casts or holes
Soil organisms	Few insects, worms, fungi or soil life	Some insects, worms, fungi, soil life	Many insects, worms, fungi, soil full of variety of organisms
Smell	Swampy smell	Little or no smell	Fresh earthy smell
Surface organic material	No visible roots or residue	Some residue	Lots of roots/residue in many stages of decomposition
Organic matter color	Topsoil color similar to subsoil color	Topsoil color slightly darker than subsoil color	Topsoil clearly defined, topsoil darker than subsoil
Residue decomposition	Very slow decomposition, or rapid decomposition	Some visible, non-decomposed residue	Residue at various stages of decomposition
Compaction	Hard layers, tight soil, restricted root penetration, obvious hardpan, roots turned awkwardly	Firm soil, slightly restricted root penetration, moderate shovel resistance, and penetration of wire flag beyond tillage layer	Loose soil, unrestricted root penetration, no hardpan, mostly vertical plant growth
Workability	Many passes and horsepower needed for good seedbed, soil difficult to work	Soil works reasonably well	Tills easily and requires little power to pull implements
Soil tilth/structure	Soil clods difficult to break, crusting, tillage creates large clods, soil falls apart in hands, very powdery	Moderate porosity, some crusting, small clods, soil breaks apart with medium pressure	Soil crumbles well, friable, porous



Assessing Soil Quality Activity Sheet, page 2 of 3

Circle the appropriate description for each of the indicators listed. What is the overall assessment of your soil quality?

INDICATOR	LOW	MEDIUM	HIGH
Porosity	Few worms and root channels	Weak plow pan, some new and old root and worm channels	Many worm and root channels, many pores between aggregates
Soil aggregates	Soil surface is hard, clumps and does not break apart, very powdery	Soil crumbles in hand, few aggregates	Soil surface has many soft small aggregates which crumble easily
Crusting	Soil surface seals easily	Some surface sealing	Soil surface has open or porous surface all season
Water infiltration	Water on surface for long time period after rain or irrigation	Water drains slowly after rain or irrigation, some ponding	No ponding after heavy rain or irrigation, water moves steadily through soil
Drainage	Excessive wet spots in field, ponding, root disease	Some wet spots in field and profile, some root disease	Water is evenly drained through field and soil profile, no evidence of root disease
Water holding capacity	Plant stress immediately following rain or irrigation, soil has limited capacity to hold water, soil requires frequent irrigation	Crops are not first to suffer in area dry spell, soil requires average irrigation	Soil holds water well for a long time, deep topsoil for water storage, crops do well in dry spells, soil requires less than average irrigation
Wind and water erosion	Obvious soil deposition, large gullies joined, obvious soil drifting	Some soil deposition, few gullies, some colored runoff, some evidence of soil drifting	No visible soil movement, no gullies, clear or no runoff, no obvious soil drifting



Module 2, Lesson 1

Assessing Soil Quality Activity Sheet, page 3 of 3

Circle the appropriate description for each of the indicators listed. What is the overall assessment of your soil quality?

INDICATOR	LOW	MEDIUM	HIGH
Crop vigor and appearance	Stunted growth, uneven stand, discoloration, low yields	Some uneven or stunted growth, slight discoloration, signs of stress	Healthy, vigorous, and uniform stand
Plant roots	Poor growth/structure, brown or mushy roots	Some fine roots, mostly healthy	Vigorous and healthy root system, good color
Root mass	Very few roots, mostly horizontal	More roots, some vertical, some horizontal	Many vertical and horizontal roots, deep roots
Salts	Visible salt/alkali, dead plants	Stunted growth, signs of leaf burn from salts	No visible salt, alkali or plant damage, especially after rains
Sodium	Soil surface seals after rain or irrigation, fluffy when dry, uneven crop stand	Only some spots with sealed surface	No sealing or fluff at surface, no plant damage

Directions:

- Take all measurements under adequate moisture conditions, when soil is neither too wet or too dry
- Assess all soil life, including earthworms, before major tillage occurs. Tillage can disrupt soil life.
- Repeated annual assessments should occur at the same time of year, to ensure comparison of assessments will be valid

Assessment table adapted from Guidelines for Soil Quality Assessment in Conservation Planning, NRCS Soil Quality Institute.



How to Test Soil Information Sheet

What do you learn from a soil test?

- The amount and type of nutrients needed so you don't waste money or pollute water supplies
- How much organic matter to apply to your soil
- Information that promotes successful plant growth
- The appropriateness of a given site for a given purpose

What are the disadvantages of soil testing?

- Cost
- Time spent taking samples
- Results are not immediate
- Sometimes trial and error works to give you the level of planting success you desire without a soil test

When should I test my soil?

- Soil should be tested prior to any large project, such as planting of a lawn or pasture.
- Have at least one soil test performed prior to adding fertilizer or amendments.
- Test the soil in the early spring before or at the beginning of the growing season.
- Don't sample immediately after fertilizer or manure applications, or when the soil is excessively wet.

What materials will I need?

- Shovel
- Plastic bucket
- Plastic bag or unbreakable container
- Marking pen

How do I collect a soil sample for testing? (Note: The soil test reflects the sample taken. Check with your local Cooperative Extension office for locations of soil test labs.)

1. Select 15 samples from random areas. Avoid sampling near gravel, manure or compost, leach fields, brush piles, or under eaves.
2. Remove samples, using a trowel or shovel, by digging a hole 6 inches to 12 inches deep. Slide the shovel or trowel down the side of the hole from top to bottom to remove a "slice" of soil from the edge of the hole. You're sampling from the soil surface to the deepest point in the hole.
3. Place all 15 samples together in a clean pail or other container, and mix thoroughly. Remove pebbles and other debris. Permit mixture to dry.
4. Place one cup of the mixed sample in a sealable plastic bag or other clean, unbreakable container.
5. Label the container clearly with your name, address, and phone number.
6. If you have several distinctly different soil types or growing conditions, you may want to take separate soil samples from each of the locations, e.g. the lawn, garden, pasture, etc.

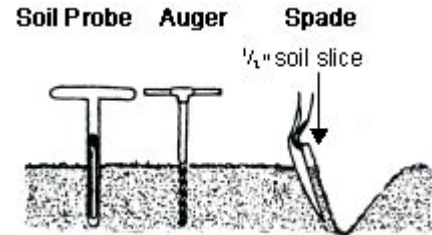


Module 2, Lesson 1

Module 2, Lesson 1—Getting Down and Dirty With Soil Sampling Soil: From A & L Agricultural Labs

Sampling Tools

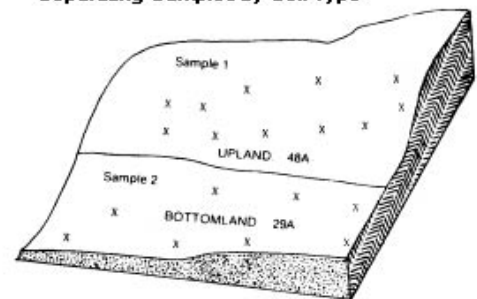
- Tools that may be used to take a soil sample include a soil-sampling probe, an auger, or a spade.
- Tools should be either stainless steel or chrome-plated to avoid contamination of the sample.
- Preferably, collect in a clean, dry plastic container as soil may pick up zinc for example, if the container is galvanized.



Determining the Area to be Sampled

- Areas that differ in soil texture, color, plant growth, or treatment should be sampled separately, provided the areas can be treated separately.
- Site-specific farming may necessitate sampling by the acre.
- A soil map or plant response map can be of help in distinguishing areas.
- Unless of specific interest, avoid dead furrows, corners of fields, end rows, and areas that are poorly drained or have had fertilizers or amendments dumped on them.
- Stay at least 50 feet away from barns, roads, lanes, or fence rows when sampling fields.
- Perennial crops may be sampled by tagging specific trees or vines and returning to the same stations each time sampling is done.
- Home gardens or landscape may be sampled according to area of concern.
- Submitting at least two samples from different areas will help determine the degree of diversity, whereas one sample will provide only an average of all conditions present.

Separating Samples by Soil Type



Collecting the Soil Sample

- The soil sample collected should be a composite from 10 to 20 locations within a selected area; a sufficient number to "average out" variations.
- Sample from areas of main root development.
- Before collecting each subsample, scrape away surface residue then sample the top 6 inches or the depth of tillage.
- Deeper profiles may be sampled separately, if a concern. For example, nitrate nitrogen may be sampled at 1-foot increments down to 3 feet or more. Sodium, chloride, boron, and free lime may be more predominant deeper down.
- For permanent pastures and turf areas, it may be sufficient to sample only the top 3 to 4 inches.

- Even shallower sampling may be in order if determining water infiltration problems due to irrigation water low in salts.
- Mix cores or slices thoroughly in a clean plastic container, and send about a pintful (2 cups) of the composite sample to the laboratory.
- Submit a separate pint for nematode testing.
- Avoid submitting excessive quantities.
- Seek further advice for extensive testing that may require more than a pint of soil (1 gallon required for infiltration rate test).
- Annual sampling may be necessary to monitor residual nitrogen and problem soils.
- **Banded areas:** It takes only a trace of fertilizer to contaminate a sample. It may be wise to avoid these areas altogether when sampling.
- **Nematode Sampling:** Sample only from moist soil and always try to include feeder roots. This may be the top six inches for turf or down to three feet for many deep-rooted crops. Avoid sampling from completely dead plants.

Identifying and Submitting Samples

- Identify each sample with numbers and/or letters, by depth for example, or good versus bad (up to five alphanumeric characters).
- Avoid numbering samples simply as 1,2,3, ... as it may lead to confusion later.
- Indicate specific analyses to be run and provide complete information on plant type and age and whether preplant or maintenance fertility guidelines/recommendations are required.
- Select either the standard format (five samples per page) or the graphical format (one sample per page).

Shipping Samples

- If samples are very wet, they should be air-dried to a workable condition before packaging. (Nematode samples are an exception. They should be kept cool and moist).
- Include a completed soil sample information sheet or cover letter with instructions within the same package. Processing will be delayed if sent separately.
- Also, include payment if you do not have an established account.
- Samples should be shipped by a carrier such as UPS or FEDEX, or by first class mail.
- Ensure that samples are not packaged loosely, as they are likely to shift around and burst open during shipping.
- Caution: Do not submit organic amendments or soil-less nursery media as "soils". They require different testing.



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Getting Down and Dirty With Soil Glossary, page 1 of 3

Aeration: The movement of air from the atmosphere through the pores of a soil, water, or other medium.

Buffer zone, buffer strip: Neutral area that acts as a protective barrier separating two conflicting forces. An area that acts to minimize the impact of pollutants on the environment or public welfare. For example, a buffer zone is established between a composting facility and neighboring residents to minimize odor problems. A buffer strip is a grassed or planted zone that acts as a protective barrier between an area which experiences livestock grazing or other activities and a water body. Buffer strips can be streamside features to protect streams and streambanks or features built on slopes to slow water runoff velocities.

Clay: A flat or plate shaped mineral or soil grain, less than 0.002 mm across. Clay is also the name of a specific soil texture that contains 40 percent or more particles of clay size.

Compaction: Elimination of pore space in soil and destruction of soil structure, resulting in reduced soil volume and increased soil density. A decrease in soil pore spaces due to the physical compression of a soil. Compacted soils have poor tilth and limited production capabilities.

Compost: Organic material, rich in humus, formed by decomposed plant material and other organic matter, used as a soil amendment or improver and as a mulch.

Cover crop: A crop planted to protect the soil by reducing or stopping erosion.

Droughty soil: A soil that is unable to store enough water to meet plant requirements. Sandy and gravelly soils are droughty because they have low water-holding capacities.

Erosion: The wearing away, detachment and movement of soil and rock materials, generally by wind or water, through natural and/or unnatural causes. The group of natural processes that loosens or dissolves and removes soil or rock materials.

Green manure, green manure crop: Crop that is grown and then plowed into the soil or left to decompose for the purpose of soil improvement. A green manure crop helps put organic material into the soil and keep nutrients from leaching away.

Gully erosion: Form of water erosion that cuts through and removes soil; gullies are defined as rills large enough to restrict vehicular traffic.

Horizon: A layer of soil that is roughly parallel to the earth's surface and has distinct characteristics formed by the soil formation process.

Humus: A product of microbial decomposition of plant and animal residues that resists further decomposition and accumulates in the soil as organic matter. Humus has a dark color and darkens the A horizon (upper layer) in soils. It improves soil texture, moisture-holding capacity, and fertility.

Infiltration: The rate at which water enters the soil. Infiltration depends on the soil texture, soil structure and the depth of the soil.

Loam: A specific class of soil texture that contains a balanced mixture of sand, silt and clay. Clay must not exceed 27 percent. Loams have enough sand to feel some grit and enough clay to give the soil some body, but the properties and behavior of the soil are dominated by neither sand nor clay.

Microorganisms or microbes: Tiny, microscopic living organisms, including bacteria, fungi, algae, protozoa, and viruses. Microbes live in the soil and decompose dead plant and animal residues, converting them into humus. Some microbes help make soil nutrients more available for plant use.



Getting Down and Dirty With Soil Glossary, page 2 of 3

Organic matter: The sum of all plant and animal material, living or dead, that is mixed into the soil. Living microorganisms are part of soil organic matter, and so is the humus they produce. Living and dead plant roots are also part of the soil organic matter. Organic matter promotes good soil structure, reduces compaction, improves rates of movement of air and water through the soil, increases the storage of water for plant use and provides nitrogen and other elements needed by plants.

Parent material: The original geologic material from which the horizons of soil are formed. This can be bedrock, sediments, windblown material or volcanic ash.

pH: The symbol for the logarithm of the reciprocal of hydrogen ion concentration, used to indicate an acid or alkaline condition. On a scale from 1 to 14, a pH of 7 indicates neutral condition, less than 7 indicates acidic conditions, and greater than 7 indicates alkaline conditions.

Pores or pore spaces: Spaces between the mineral grains of a soil. The size, shape and arrangement of soil pores determines the rates of water and air movement into and through the soil. They also control the amount of available water that a soil can store for plant use.

Porosity: The total amount of pore space in a soil. Porous soils have plenty of pore space; compact, dense soils have low total porosity.

Rill: Form of water erosion that cuts through and removes soil. This early stage of erosion is characterized by a series of little channels (or rills) up to 30 cm deep.

Sand: A specific grain size in the soil. Sand grains range in size from 0.05 to 2.0 mm in diameter. Sand grains are big enough to see with the naked eye and they feel gritty. Sand is also the name of a specific soil texture that has 90 percent or more sand and almost no clay.

Sheet wash: Type of water erosion characterized by the uniform removal of a thin layer of soil by raindrop splash or water runoff. This is a difficult type of erosion to monitor and detect until it is too late, and the subsoil is exposed.

Silt: A specific grain size in the soil. Silt grains range in size from 0.002 to 0.05 mm in diameter. The grains of silt are too small to see with the naked eye and they feel smooth, like flour, cornstarch or talcum powder.

Soil aggregation: Formation of soil structure when soil particles loosely or strongly stick together into peds. Organic matter (humus) and soil clays are important agents of soil aggregation.

Soil ped: A single unit of soil structure. Ped shapes include granular, platy, blocky and prismatic. Ped sizes can range from 1-mm granules to 10-cm prisms.

Soil structure: The arrangement of individual grains of sand, silt and clay into larger units, called peds or aggregates. Plant roots, humus and clay minerals all help to hold the grains together. Soil structure is characterized by the type, or shape, of the peds and their degree of development.

Soil texture: The amounts of sand, silt and clay that make up a soil sample. Names are given to specific combinations of sand, silt and clay to form textural classes, such as loam, silty loam, sandy loam, etc.

Streambank erosion: This type of water erosion is the natural removal of the rock and soil material along a river or stream by the action of moving water. This erosion type can be accelerated by human activity, such as removal of streambank vegetation.



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Getting Down and Dirty With Soil Glossary, page 3 of 3

Tilth: The physical condition of the surface soil. Good tilth requires plenty of organic matter, good soil structure, and good porosity for air and water movement into and through the soil. Soils in good tilth are easy to work. Seedlings easily emerge from and plant roots grow well into soils that have good tilth.

Topography: The physical features, relief and contour of the land.



Web sites for further information

WSU Extension Puyallup Soil Testing and Soil Biology: <http://puyallup.wsu.edu/soils/soils/>

Washington State University Small Farms Team, <http://smallfarms.wsu.edu/soils-compost/>

OSU Small Farms: Soils: <http://smallfarms.oregonstate.edu/soils>

USDA-NRCS Washington Soils Program, <http://www.nrcs.usda.gov/wps/portal/nrcs/main/wa/soils/>

Clark County Maps Online, <http://gis.clark.wa.gov/maponline/index.cfm>

SARE Building Soils for Better Crops, <http://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition>

Soil and Water Conservation Society: <http://www.swcs.org/>

Soil Science Society of America: <http://www.soils.org/>

Soil Terms Glossary: <https://www.soils.org/publications/soils-glossary>

USDA-NRCS Soil Quality: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>

Washington State NRCS <http://www.nrcs.usda.gov/wps/portal/nrcs/site/wa/home/>

Penn State University Backyard Composting Program,
<http://extension.psu.edu/plants/gardening/composting>

Soil Biological Communities, Bureau of Land Management National Science and Technology Center,
www.blm.gov/nstc/soil

Soil Biology and Soil Management, Part of the Soil Management Series, University of Minnesota Extension,
<http://www.extension.umn.edu/agriculture/tillage/soil-management/soil-management-series/soil-biology-and-soil-management/>

Soil Publications, ATTRA, <https://attra.ncat.org/publication.html#soils>

University of Nebraska Lincoln Cooperative Extension Acreage and Small Farm Insights,
<http://acreage.unl.edu/>

University of Nevada Cooperative Extension Small Ranch Projects Guide,
<http://www.unce.unr.edu/publications/files/ag/2000/eb0002.pdf>

USDA-NRCS Soil Quality Resources and Publications,
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/forestry/pub/>

USDA-NRCS Soil Survey, <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>

