Photos by Patrick Mangan

Start Your 2020 Victory Garden!

Section 2: Garden Soils and Soil Testing

MONTANA STATE UNIVERSITY EXTENSION

A practical guide on the ins and outs of developing a backyard garden plot to grow your own fresh vegetables for a local, sustainable, secure food supply in the times we are having.

MASTER GARDENER · MONTANA ·

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MSU Ravalli County Extension Agent

WELCOME BACK!
Table of Contents: Where we have been and where are going…

Previously:

- Section 1: Bitterroot Valley Climate data for gardening. Site selection for a garden, and keeping the deer out.

Currently:

- Section 2: Garden soils, taking soil samples.

Coming Soon:

- Section 3: Garden beds, raised beds, and container gardening.
- Section 4: Soil amendments and preparing the garden. What a soil test analysis tells you. What to grow?
- Section 5: Seeding and transplanting plants when the time is right.
- Section 6: Watering and weed management in the garden.
- Section 7: What could possibly go wrong? Disease, insects, and other things to keep a watch out for. IPM management practices.
- Section 8: Harvest time! Canning and storage
- Section 9: Putting the garden beds to sleep for the winter
- Section 10: Next year…

Garden Soils:

Topics for this section:

- The 5 soil forming factors
- Components of soils
- Soil textures, their properties and how it can influence gardening
- Collecting soil samples for analysis

Soils are pretty darn important!

I say that because I am a soil scientist by trade! And because it is, as I said, important.

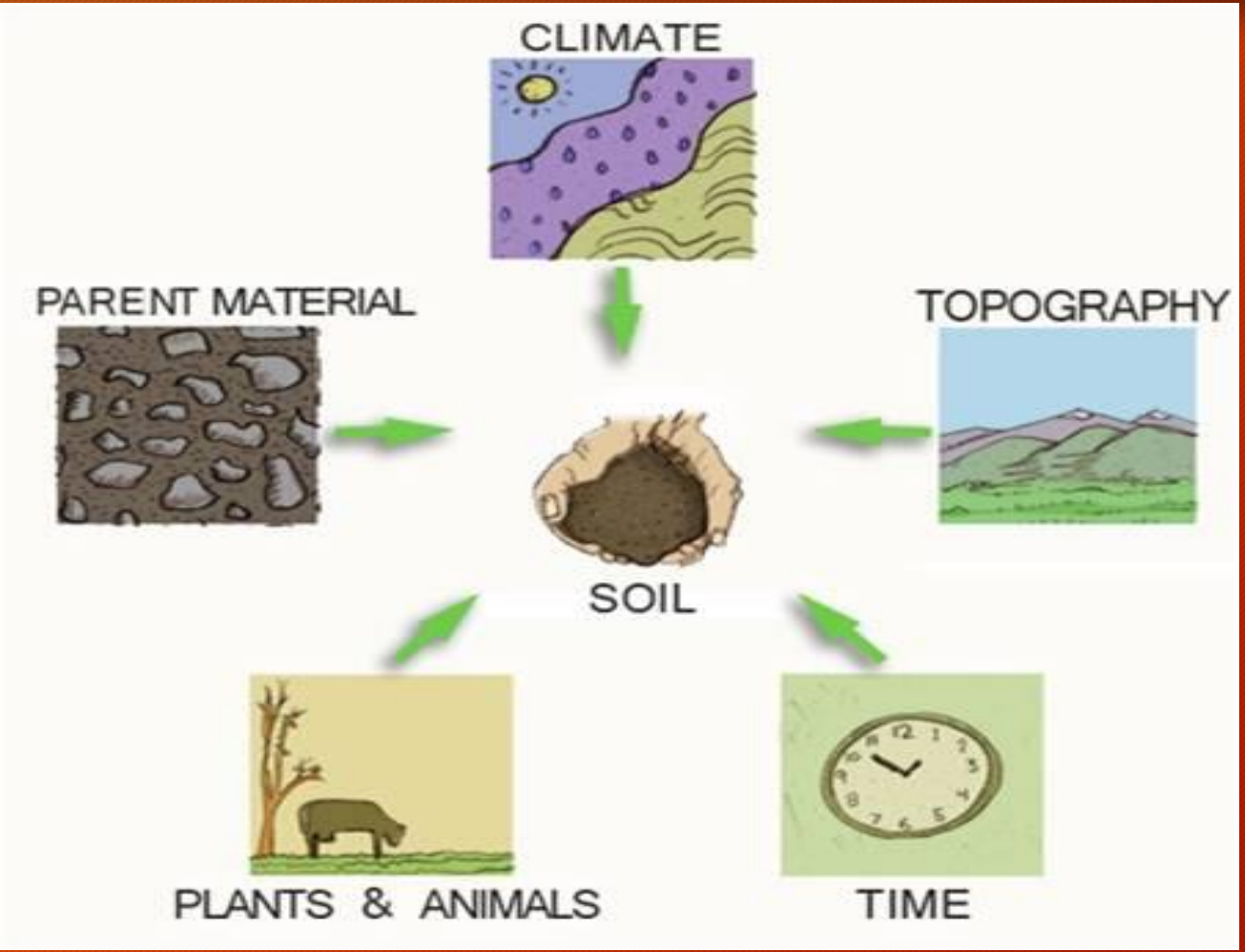
Soils are the skin of the Earth. All, and when I say this, I do mean ALL terrestrial ecosystem cycles involve soils as a part of the cycle.

They allow for pretty much all terrestrial plants to thrive (there are some weirdos out there who don't grow in "soil," like those air plants).

And for vegetable gardening, it is our stock and trade. It is what we should spend a lot of time feeding, and a lot of time obsessing over.

So, let's talk about them in more depth!

Soil Forming Factors



The Five Soil Forming Factors

- When scientists and geologists talk about soil genesis, they refer to five conditions that combine to make the soil at a place the way it is. These are called the 5 soil forming factors.
- The ways in which these factors combine, and the time involved create the soils we have in that place, and provide a basis for our gardening adventures.

Image source: Virginia State University Extension
https://www.ext.vsu.edu/events/2018/12/7/the-real-dirt-on-dirt-a-workshop-on-soil-amp-health

1= Parent Material:

Where did the material that weathered into soil come from? What was it before?

What was its previous form?

How was it moved to the site?

Residuum (decomposed bedrock), alluvial sediments (carried by water), Lacustrian (lake bed sediments), glacial till, loess or aeolian sediments (wind blown), volcanic origins

1= Parent Material (continued)

- What the soil formed from can impact its qualities greatly.
  - If it formed from residuum, it can carry the characteristics of the bedrock that decomposed to make it. It might be really sandy because it derived from sandstone, or high in calcium and have a high pH because it derived from limestone.
  - Soil deposited by rivers, called alluvium, are usually well-sorted into different sized particles, and have distinct layers.
  - Some soils can be deposited by wind, called Aeolian deposits. They would be without any rock fragments (because, imagine how hard the wind would have to blow to carry rocks!)
  - Glacial till is a jumbled mix-match of soil and particle sizes all mixed together because they were pushed and deposited by a glacial icesheet and dropped where they were.

Image Source: NRCS
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054253

2) Topography

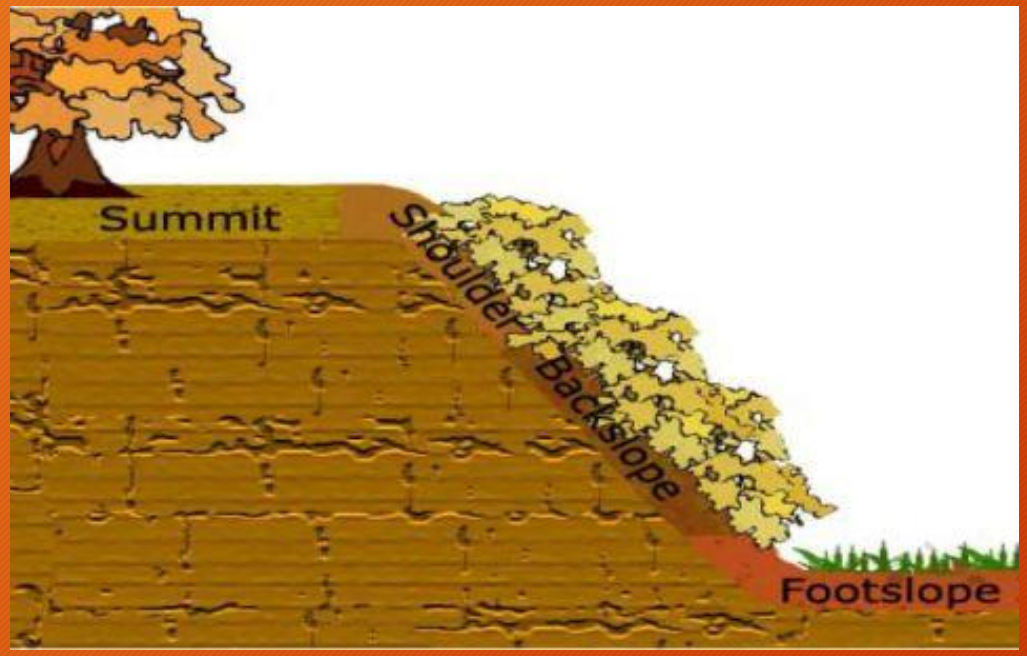


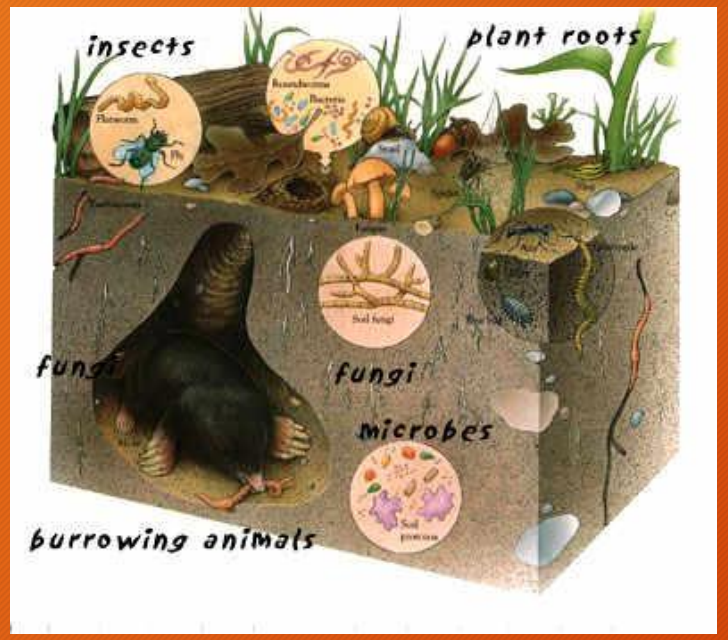
Image source: University of Minnestoa Extension
https://extension.umn.edu/soil-management-and-health/five-factors-soil-formation

- How has the shape of the local landscape influenced the development of the soil?
  - Soils on the shoulders of hills or slopes is typically thinner, while soil on the flatland or base of a hill is thicker.
  - This can be as result of erosional movement of soil particles, carrying soil particles downhill to a new resting place.

3) Climate

- Temperature and precipitation change the ways soils develop
  - High precipitation can lead to the leaching of minerals out of the soil quickly.
  - Cold and dry soils develop very slowly
  - Arid soils, like in desserts, can have little change from the original parent material, while soils in tropical jungles will be very different than the original parent material.

4) Soil Biology



Animals, micro fauna, and fungi stir, breakdown soil components, and create macropores in the soil profile.

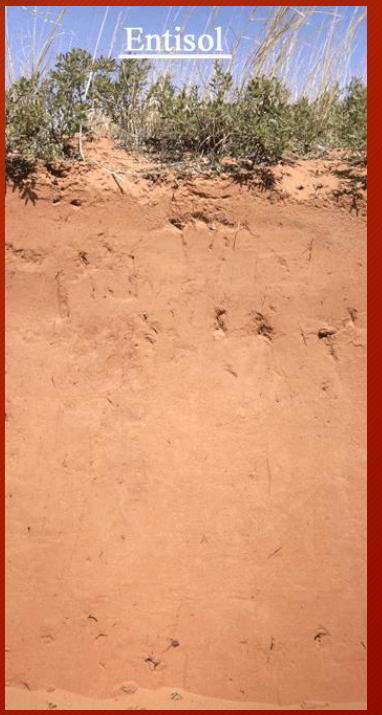
In this soil, pine tree needles are acidifying the upper layer of the soil, changing the chemistry, and allowing all iron oxides to leach deeper into the soil profile, leaving a blonde band of sand just under the dark organic soil near the surface

- Life forms directly and indirectly change soil. Organic matter decays, enriching top soil. Pine trees acidify soil. Worms and insects break down soil and create macropores.

5) Time

This soil shows how far down salts have leached into the soil profile as a result of precipitation. Not very far.

This desert soil has changed very little from the original parent material because the climate is so harsh.



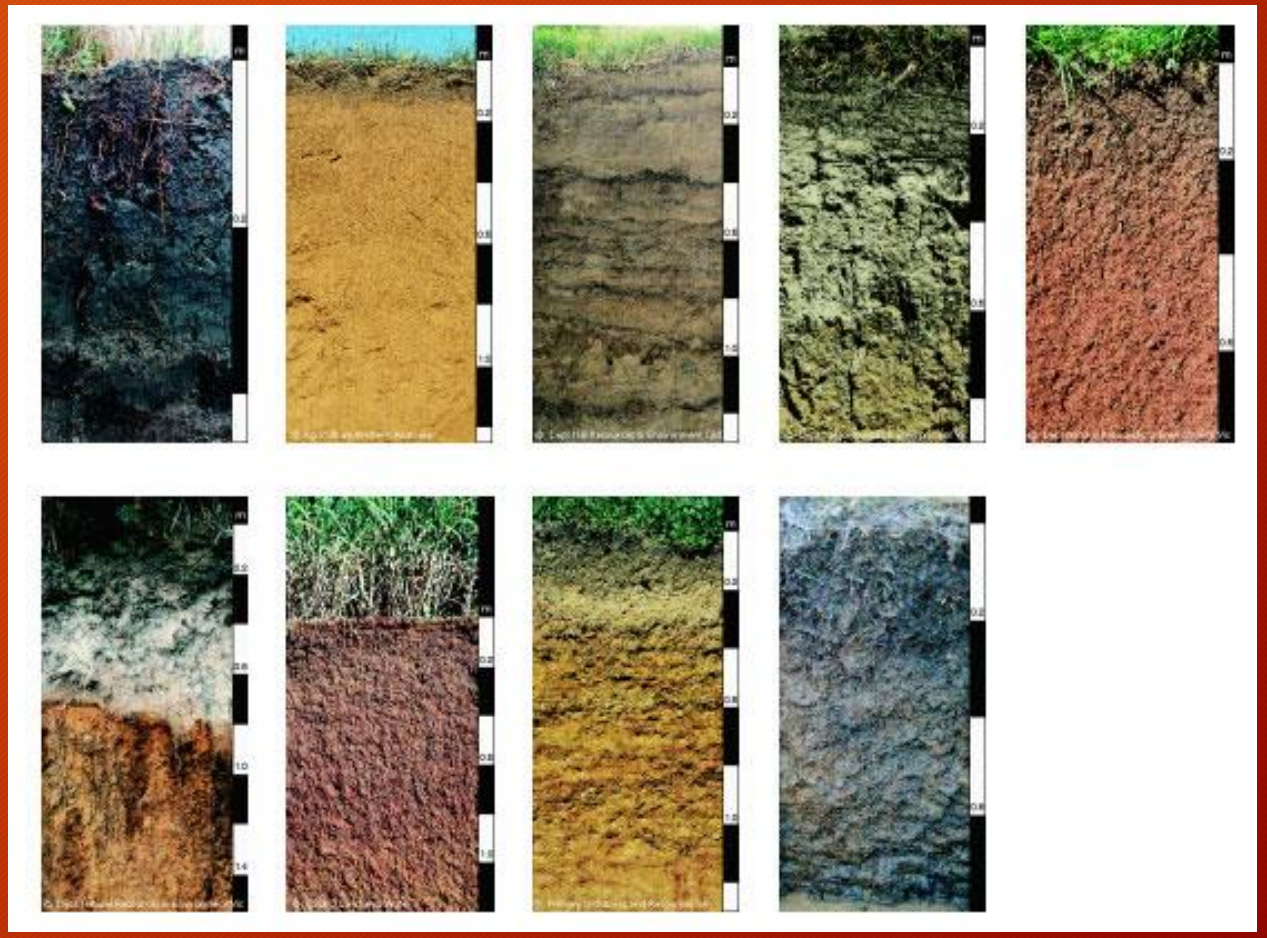
Measured in both absolute and relative time; the actual number of years the soil has been developing at that site, and its relative age, how developed and weathered is it as a result of the other factors?

Soil Profiles as a result of the soil forming factors

As the 5 soil forming factors change for a given site, they combine to make soils with unique properties for that site.
Soils around the world, and even sometimes just around your valley can behave differently based on how they have developed.

These are all examples of soil profiles around the world.


Photo credit: Discovery



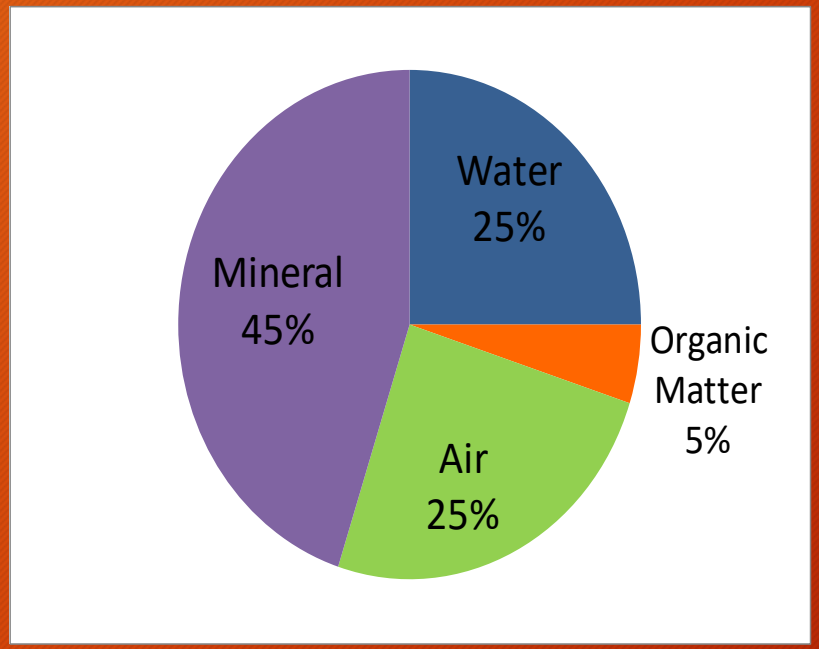
Components of Soil

Soils are a living ecosystem with many different parts.

Here are the proportions of an “Ideal soil”

Soil Components and their proportions

Approximately 45% of ideal soils are the "**mineral fraction**." This part is composed of the particles of sand, silt, clay and rock fragments that represent the weathered and decayed parent material.



Of the air pore space, half of it, or 25% should be filled with **soil water**. This is where nutrients are held in solution, and where soil bacteria live, in the "soil water skins."

About 5% of soil is comprised of **organic matter**; dead and decaying plant tissues, bacteria, and fungi. Soil organic matter retains water, holds onto soil nutrients, and feeds the soil microbial community.

50% of an ideal soil profile is **air pore space** (I know, it says 25%, check water...) This pore space allows for water to infiltrate down into the soil profile, where it is stored for use by plants. Plant roots also exchange gases into the air pore spaces.

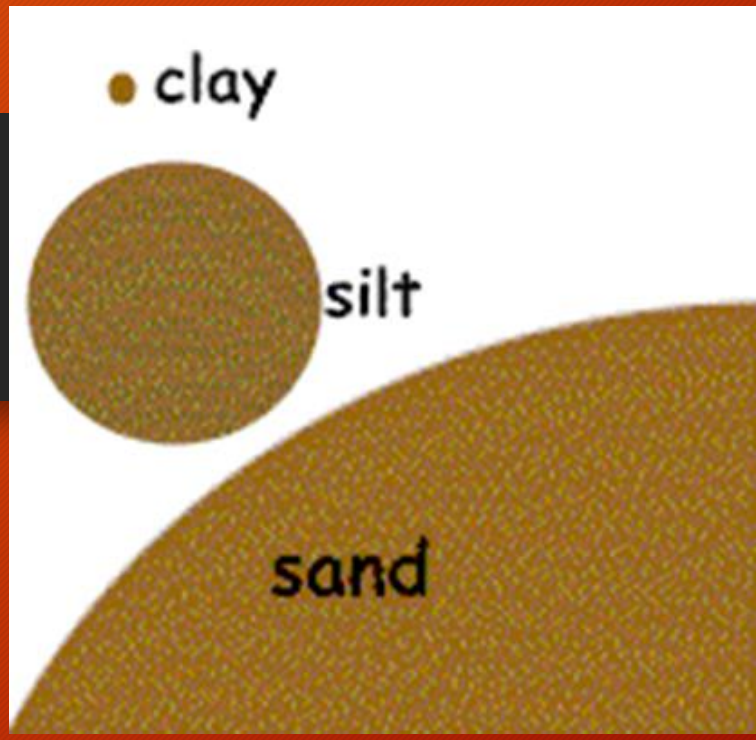
Textures of Soils

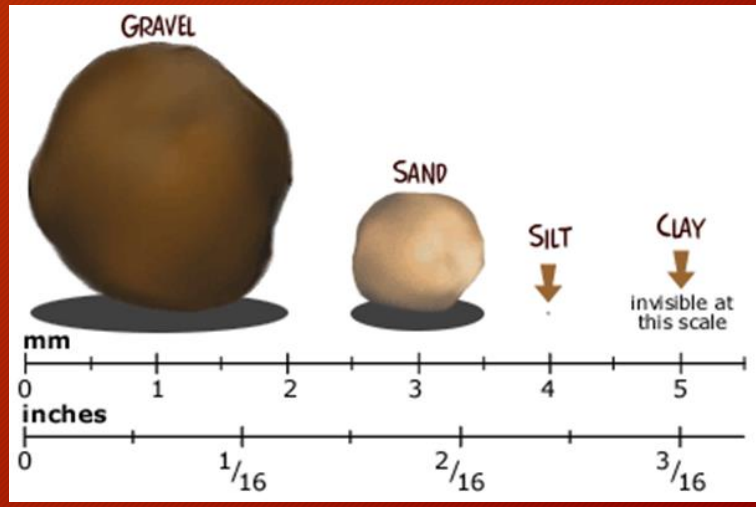
For this next section we are going to focus in on the mineral fraction of soils, and talk about the role particle size and makeup can play in soil health

Image source: Oregon State University Extension
https://extension.oregonstate.edu/news/sand-silt-or-clay-texture-says-lot-about-soil

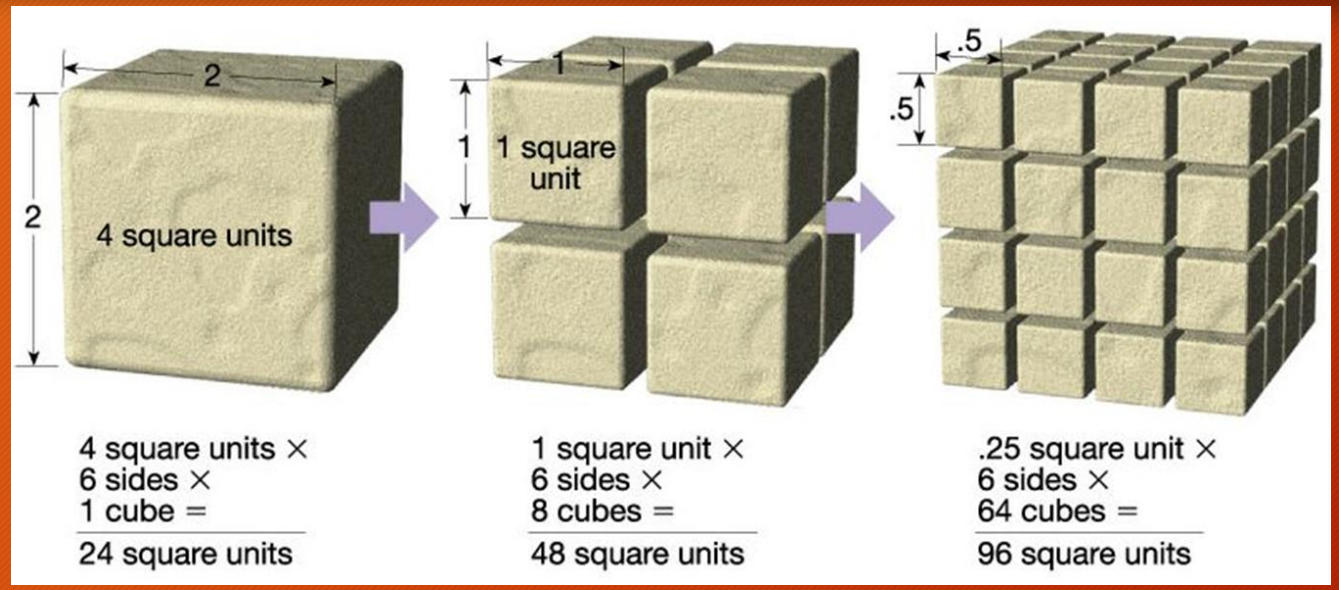
Particle Sizes

- Particles larger than 2mm in diameter are classified as gravel, or “course fragments”
- **Sand** particles are 2mm- 0.05mm in diameter
  - You can typically see sand particles with the naked eye, and feel rough or gritty to the touch
- **Silt** particles are 0.05- 0.002mm in diameter.
  - They feel smooth to the touch, can’t be seen
- **Clay** particles are less than 0.002mm in diameter
  - They are super small, and feel pasty, or tacky to the touch, super smooth.





Why does particle size matter? Surface Area!



- Smaller particles have more surface area per volume than larger particles do. Think about it this way; if you have a jar full of golf balls and a jar full of small marbles, which jar has more surface area on the particles in the end? The marbles do.
- In soils, surface area is where water is stored and nutrients are bonded to, so more surface area means more places to store what plants need.

Touch some soil!

- Get some soil out of your prospective garden and prepare to manipulate it.
- We got some science to do!

Image source: University of Maine Extension
https://extension.umaine.edu/publications/4311e/13-14/

The jar soil test

What you'll need:

- A canning jar, approximately 1 quart size
- Some of your garden soil
- Water
- 2 drops of liquid dish soap

http://landresources.montana.edu/soilfertility/documents/PDF/SoilTextureJarTest.pdf

How to do the soil jar test

DO THIS:

- Fill a Mason jar 1/3 with soil.
- Add water until almost full.
- Add 2 drops detergent.
- Shake for 2 minutes and let sit for 24 hours

Jar test: what you'll see in 24 hours…

Clay layer

Silt layer

Sand layer

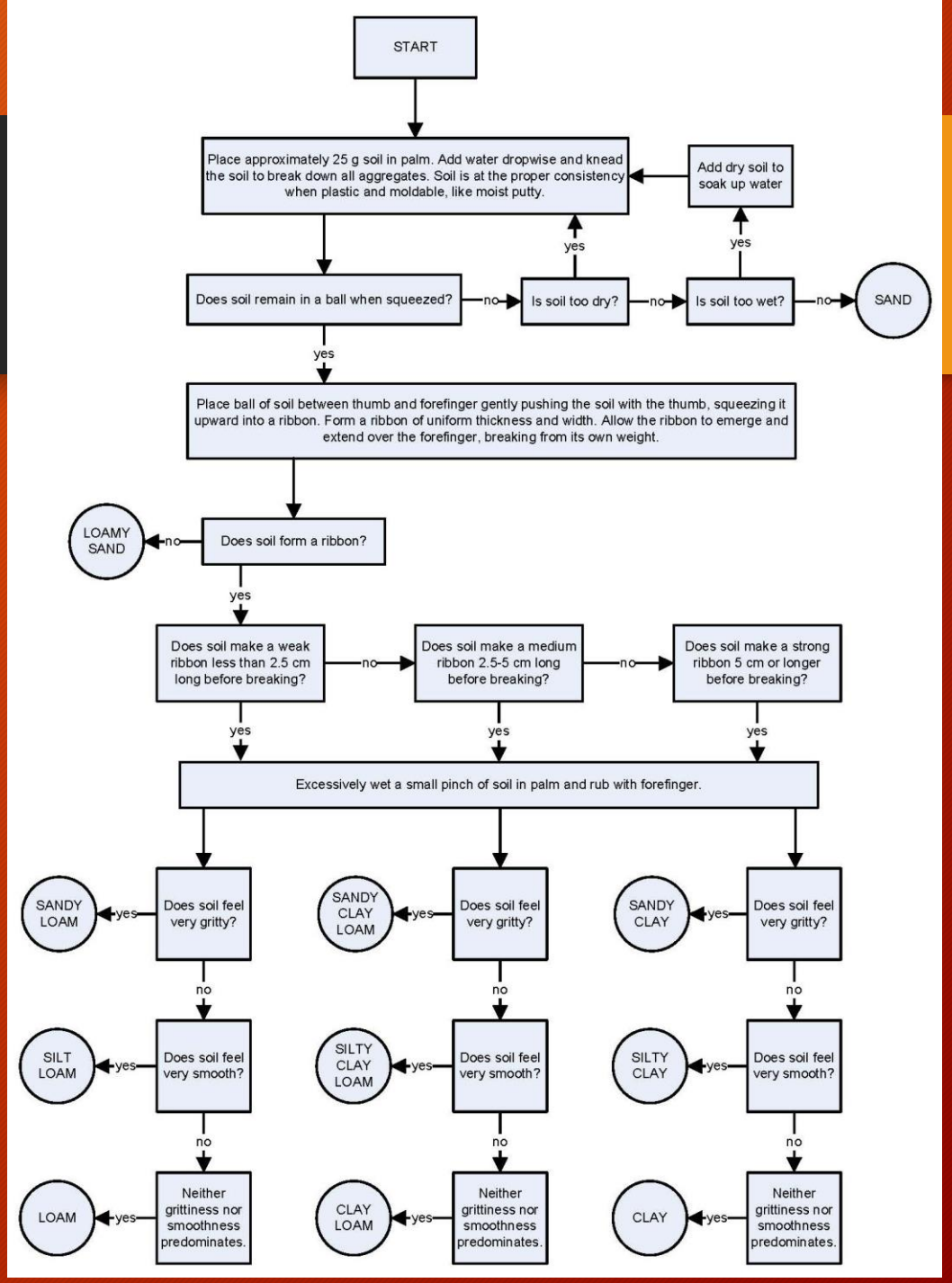
- The largest particles, sand, will fall out of suspension first (usually the first 30 seconds). They will be on the bottom of the jar. You can usually see the individual grains.
- Silt will settle in the first five minutes, on top of the sand. You should see a break in the layer.
- A clay layer will eventually settle on the top, the smallest particles that stay suspended in the water the longest.

Get your hands into it!

- Grab a handful of your garden soil and smear it about! You can tell a lot by just feeling and manipulating the soil. Wet it slightly, like adamp bal of dough
- Soils with a lot of sand will feel really gritty and abrasive, won’t stay in a ball or “worm” very well.
- Soils with a lot of clay will be very smooth, slippery, and tacky, with the clay coating your fingers. It’ll stay in a ball or worm easily.

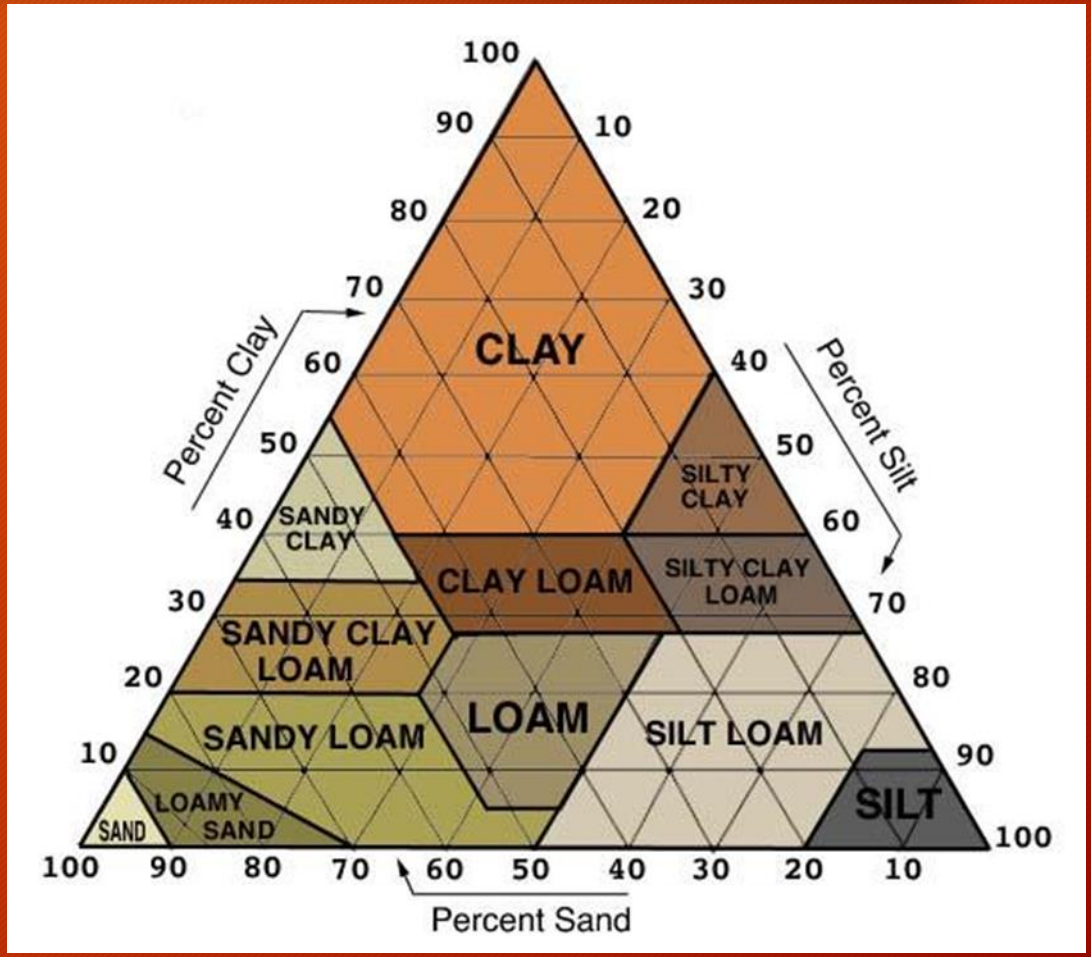
NRCS Hand Texture Guide

Try your hand at this soil texturing flowchart developed by the NRCS. It guides you through the flowchart to determine the soil texture your soil is.



The Soil Texture Triangle

- Once you narrow down an estimate on how much sand, silt, and clay comprise the mineral fraction of your soil, you can name you soil texture.



Why Soil Texture is Important

Different textures of soil will behave differently, especially when it comes to water holding capacity, and gas exchange in the rooting zone.

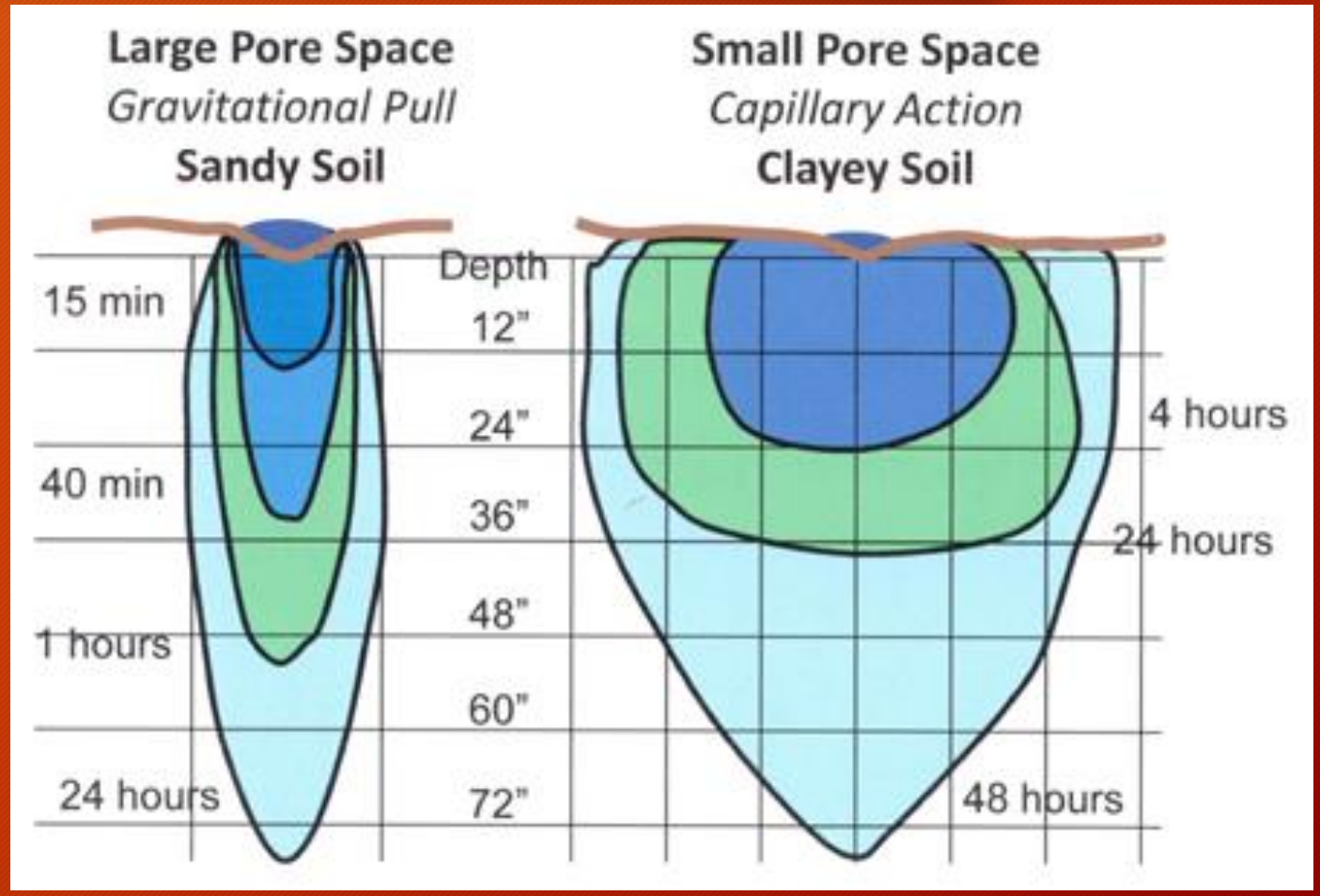
Texture Effects on air and water

	Particle size (mm)	Drainage	water holding capacity	Aeration
Sand	2.0	excellent	poor	excellent
Silt	0.05	good	good	good
Clay	0.002	poor	excellent	poor

Texture Effects Water Movement

As a general rule of thumb:

- Sandy soils allow water to infiltrate quickly. But, they also don't store as much soil water as clayey soils.
- Clayey soils let water infiltrate water slowly, and also hold onto more soil water as storage, making it available for plants.
- When you get to determining the watering duration and frequency in your garden, you may water sandy soils less volume, but at a greater frequency than a clayey soil.



Taking Soil Samples in your garden

- A soil test analysis can tell you some of the chemical properties of your soil, and guide you through some decisions about how to improve your soil. A chemical analysis can go hand in hand with a understanding your soil texture.

Image source: Purdue University Extension
https://extension.purdue.edu/marion/article/4487

MSU Soil Scoop!

- Our MSU Extension Soil Specialist, Clain Jones, wrote some great documents about how to collect soil samples.

Here is the link:

http://landresources.montana.edu/soilfertility/documents/PDF/pub/SoilSampStratMT200803AG.pdf

Your MSU County Extension Agent usually has sample bags and order forms for contract labs that do analysis, and can make lab suggestions. They can also help with interpreting the results.

Video for taking soil samples

- Check out this video about taking a soil sample from the University of Maryland Extension program.

https://extension.umd.edu/hgic/topics/soil-testing

Now go soil test!

- Go collect your soil sample, and play around with your soil texture.
- In Section 4, we will talk about the soil test results, and ideas for soil amendments.
- But next, in Section 3, we'll talk through garden beds, raised beds, and containers!

Questions?

- If you have thoughts or questions, feel free to reach out to your local extension agent.

Or, give me a call!

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