
"AND
JUSTICE
FOR ALL"
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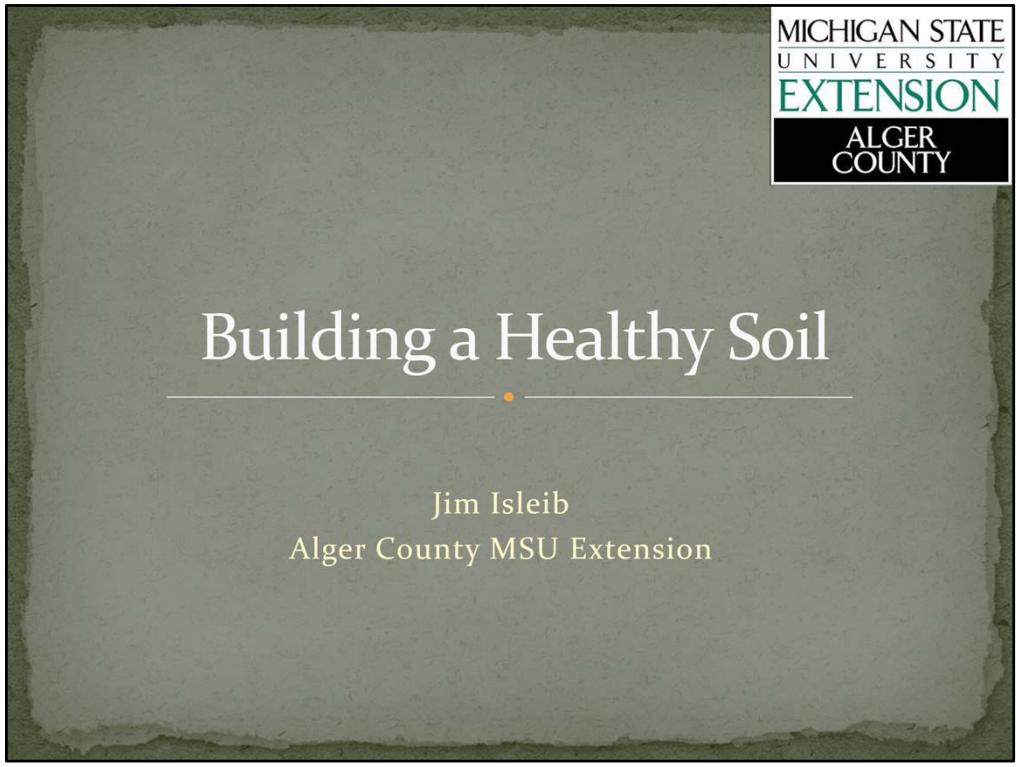
United States Department of Agriculture - March 1998
Form AD-475A (Revised 3-98)


MICHIGAN STATE
UNIVERSITY
EXTENSION
ALGER
COUNTY
Building a Healthy Soil
Jim Isleib
Alger County MSU Extension

Soil building materials.....

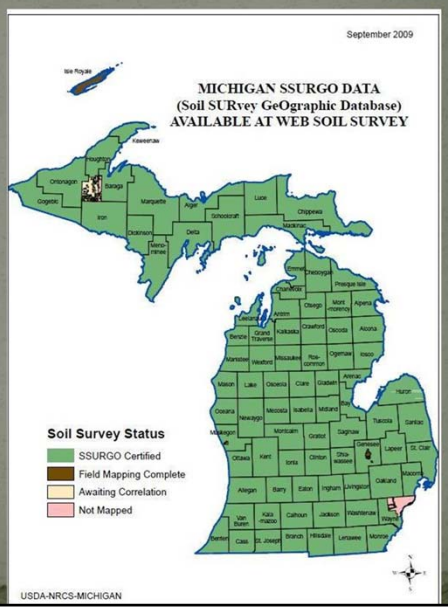
- Native Soil
- Amendments
- Gardening practices
- Time

What functions does soil perform related to plant growth? Soil provides
• Anchorage - it holds plants in place
• Water - to carry nutrients throughout the plant, to provide turgor and to cool the plant as it evaporates from the leaves.
• Air - Roots need oxygen to “breathe” or respire. They need to get rid of the carbon dioxide that they produce.
•Nutrients - nutrients from the soil allow plants to build tissue and carry out the biological processes that they need to grow.
• A chemical environment that produces growth - Soils buffer, in other words hold as a sponge, excess acids, alkali, salts and contaminants that might interfere with plant growth.

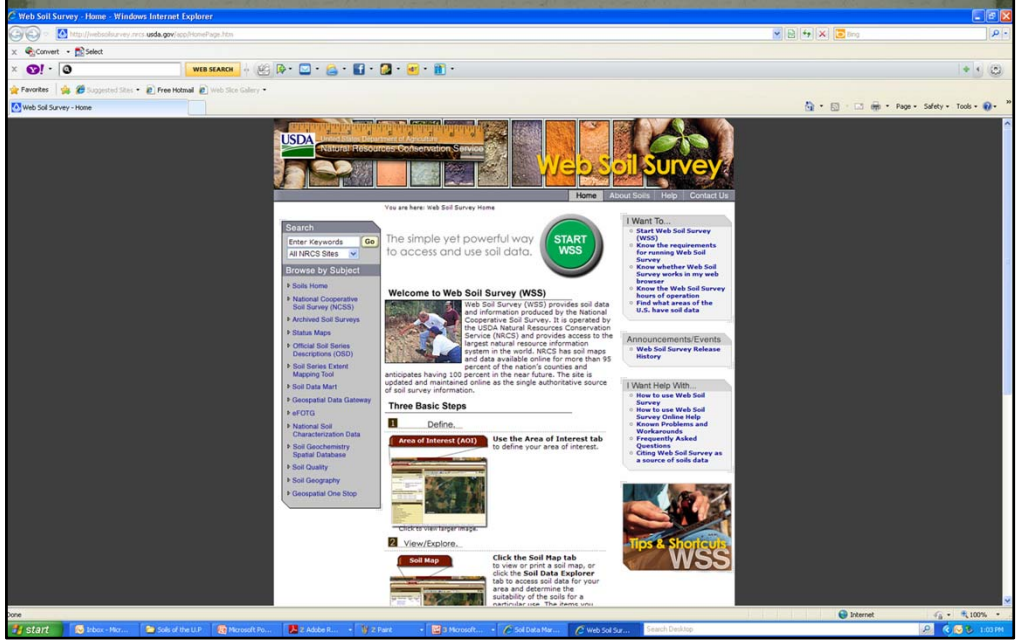
Where are you starting????

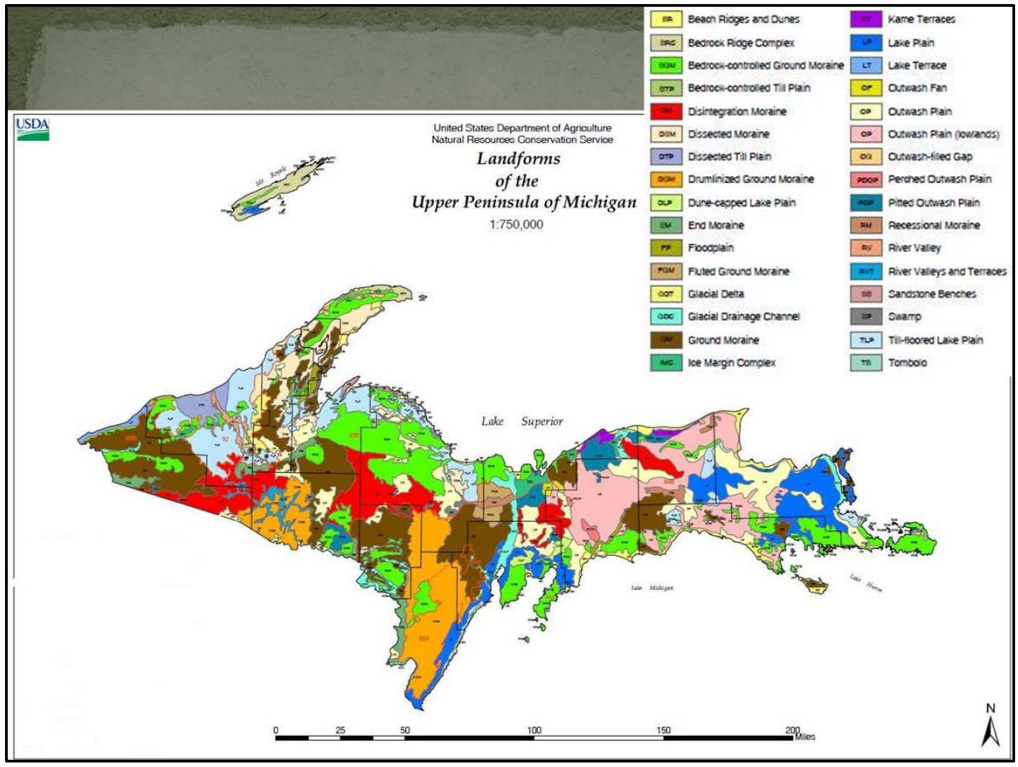
Learn about your 'native soil'

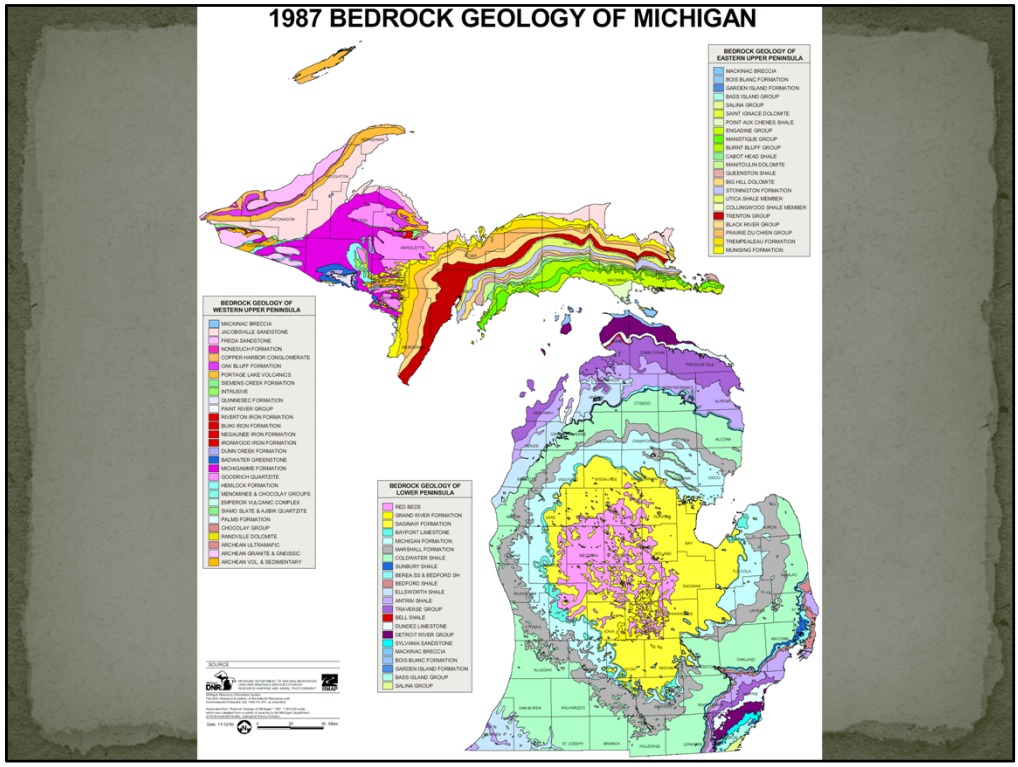
- County soil map

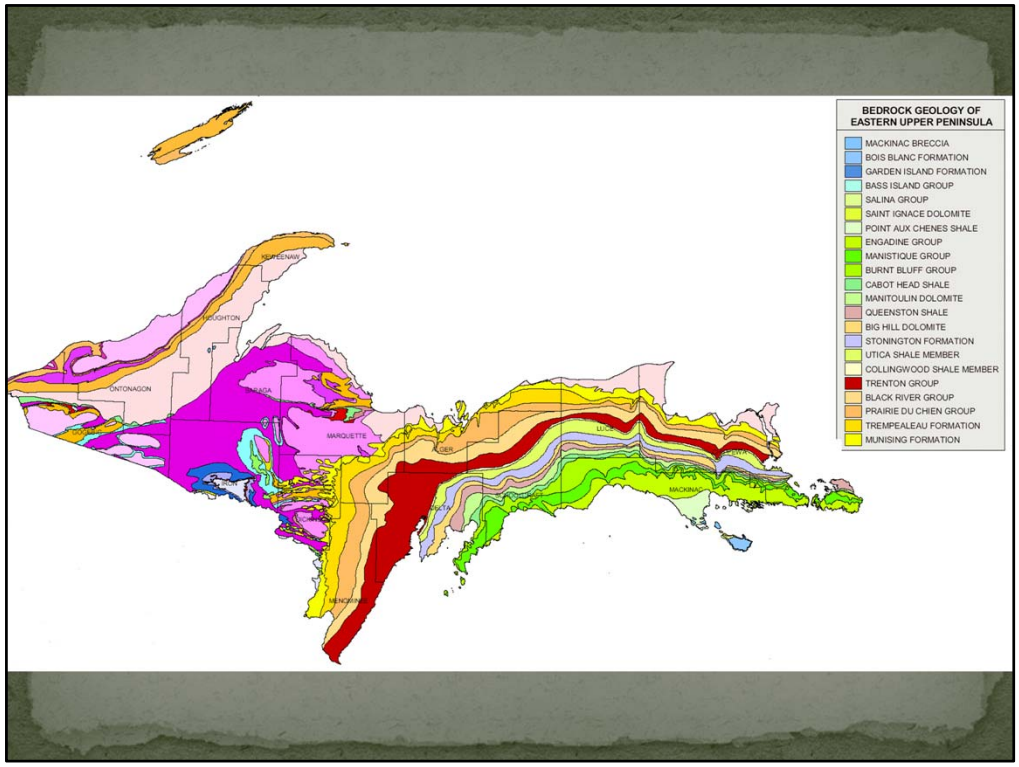


http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm




USDA
United States Department of Agriculture
Natural Resources Conservation Service
Landforms
of the
Upper Peninsula of Michigan
1:750,000
Beach Ridges and Dunes
Bedrock Ridge Complex
Bedrock-controlled Ground Moraine
Bedrock-controlled Till Plain
Disintegration Moraine
Dissected Moraine
Dissected Till Plain
Drumlinized Ground Moraine
Dune-capped Lake Plain
End Moraine
Floodplain
Fluted Ground Moraine
Glacial Delta
Glacial Drainage Channel
Ground Moraine
Ice Margin Complex
Kame Terraces
Lake Plain
Lake Terrace
Outwash Fan
Outwash Plain
Outwash Plain (lowlands)
Outwash-filled Gap
Perched Outwash Plain
Pitted Outwash Plain
Recessional Moraine
River Valley
River Valleys and Terraces
Sandstone Benches
Swamp
Till-floored Lake Plain
Tombolo
Lake Superior
Lake Michigan
0 25 50 100 150 200 Miles
N


1987 BEDROCK GEOLOGY OF MICHIGAN
BEDROCK GEOLOGY OF EASTERN UPPER PENINSULA
MACKINAC BRECCIA
BOIS BLANC FORMATION
GARDEN ISLAND FORMATION
BASS ISLAND GROUP
SALINA GROUP
SAINT IGNACE DOLOMITE
POINT AUX CHENES SHALE
ENGADINE GROUP
MANISTIQUE GROUP
BURNT BLUFF GROUP
CABOT HEAD SHALE
MANITOULIN DOLOMITE
QUEENSTON SHALE
BIG HILL DOLOMITE
STONINGTON FORMATION
UTICA SHALE MEMBER
COLLINGWOOD SHALE MEMBER
TRENTON GROUP
BLACK RIVER GROUP
PRAIRIE DU CHIEN GROUP
TREMPEALEAU FORMATION
MUNISING FORMATION
BEDROCK GEOLOGY OF WESTERN UPPER PENINSULA
MACKINAC BRECCIA
JACOBSVILLE SANDSTONE
FREDA SANDSTONE
NONESUCH FORMATION
COPPER HARBOR CONGLOMERATE
OAK BLUFF FORMATION
PORTAGE LAKE VOLCANICS
SIEMENS CREEK FORMATION
INTRUSIVE
QUINNESEC FORMATION
FAINT RIVER GROUP
RIVERTON IRON FORMATION
BIJIKI IRON FORMATION
MESAUNEE IRON FORMATION
IRONWOOD IRON FORMATION
DUNN CREEK FORMATION
BADWATER GREENSTONE
MICHIGAMME FORMATION
GOODRICH QUARTZITE
HEMLOCK FORMATION
MENOMINEE & CHOCOLAY GROUPS
EMPEROR VOLCANIC COMPLEX
SIAMO SLATE & AJIBIK QUARTZITE
PALMS FORMATION
CHOCOLAY GROUP
RANDVILLE DOLOMITE
ARCHEAN ULTRAMAFIC
ARCHEAN GRANITE & GNEISSIC
ARCHEAN VOL. & SEDIMENTARY
BEDROCK GEOLOGY OF LOWER PENINSULA
RED BEDS
GRAND RIVER FORMATION
SAGINAW FORMATION
BAYPORT LIMESTONE
MICHIGAN FORMATION
MARSHALL FORMATION
COLDWATER SHALE
SUNBURY SHALE
BEREA SS & BEDFORD SH
BEDFORD SHALE
ELLSWORTH SHALE
ANTRIM SHALE
TRAVERSE GROUP
BELL SHALE
DUNDEE LIMESTONE
DETROIT RIVER GROUP
SYLVANIA SANDSTONE
MACKINAC BRECCIA
BOIS BLANC FORMATION
GARDEN ISLAND FORMATION
BASS ISLAND GROUP
SALINA GROUP
SOURCE


BEDROCK GEOLOGY OF
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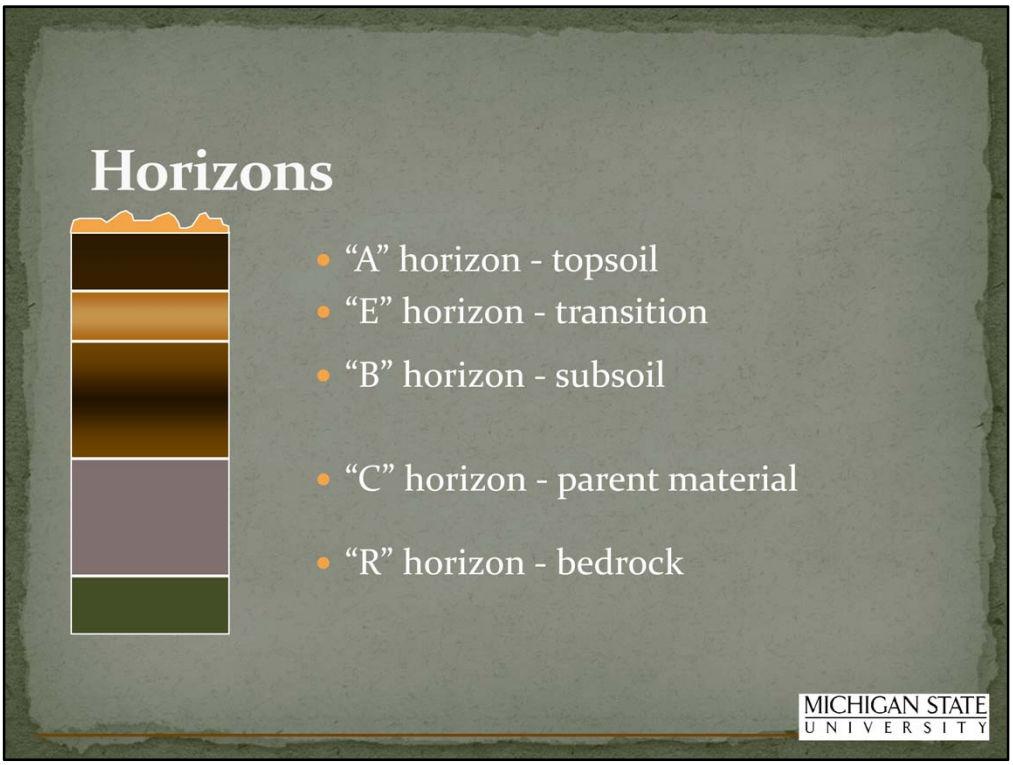
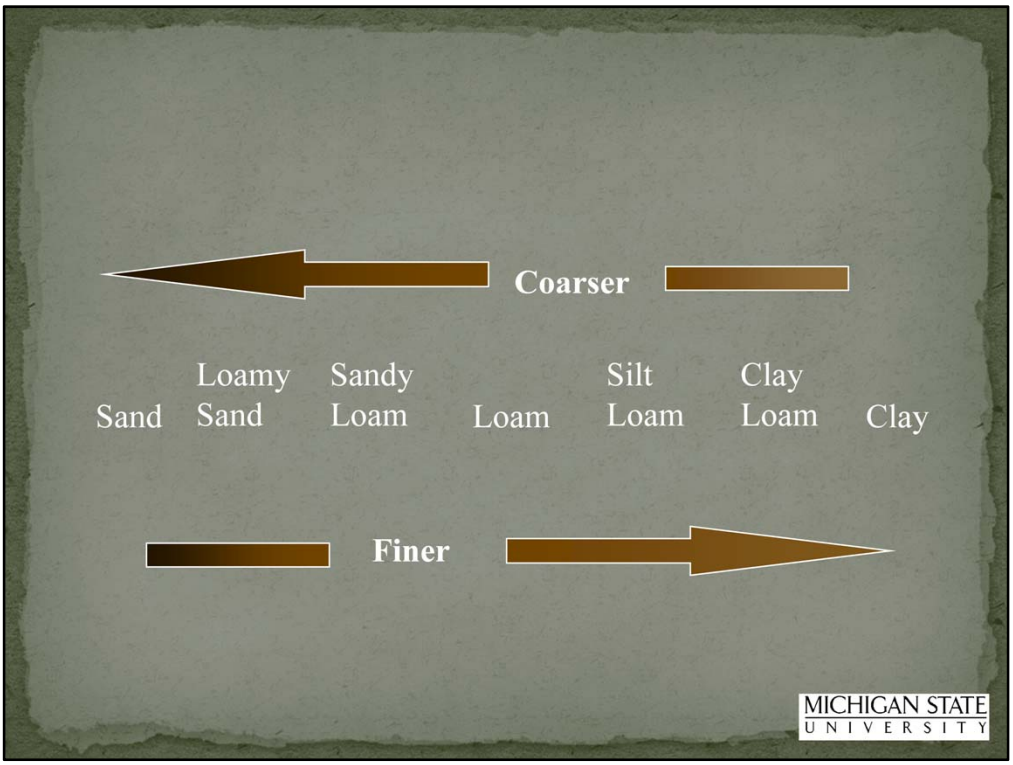
ONTONAGON
MARQUETTE
MACKINAC



Over the course of many years, horizons or horizontal bands develop. Each horizon has its own distinct physical and chemical characteristics as we have discussed. However, soil continues to be in a constant state of change as the forces of nature act on it.

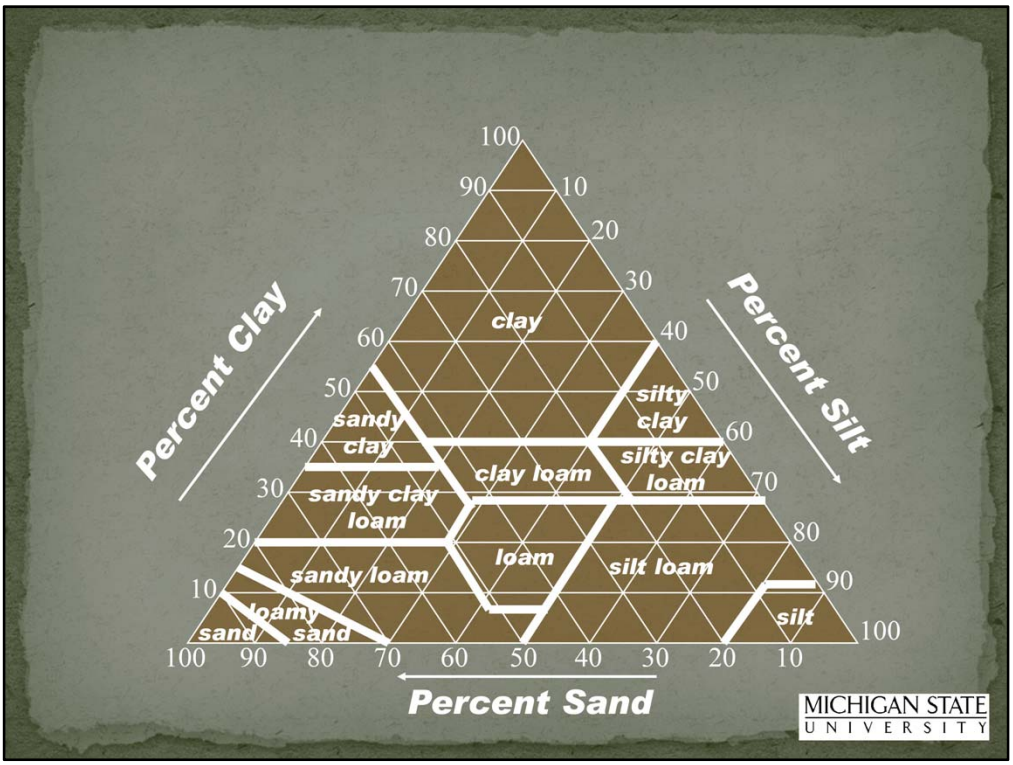
A typical soil, developed under Michigan forest conditions would possess a sequence of horizons, called a soil profile, as illustrated here and in your notebook.

- At the surface there are living plants and loose organic debris, shown in green.
- The "A" horizon consists of accumulated organic matter, dark-colored topsoil.
- The "E" horizon is a transition zone where organic matter does not accumulate and where clays and mineral compounds, such as iron and aluminum, leach out.
- The "B" horizon is the subsoil where clays and other mineral compounds accumulate.
- The parent material from which the soil above has been formed is found in the "C" horizon.
- And finally the "R" horizon is bedrock from which the parent material was derived.



As you just experienced working with examples representing sand, silt and clay, soils can be divided into textural classes according to how they are dominated by one particle size or another.

Soils that are influenced equally by sand, silt and clay are called loams. If sand becomes dominant, the soil may be termed a sandy loam or loamy sand. If more silt is present, it may be called a silt loam. If more clay particles are present, a soil may be called a clay loam.



Presenter: Explain the set-up of the triangle.

Let's use the Textural Triangle to determine the texture of a soil.

If the soil is 60 percent sand, 10 percent clay and 30 percent silt, what is its texture? Answer: sandy loam

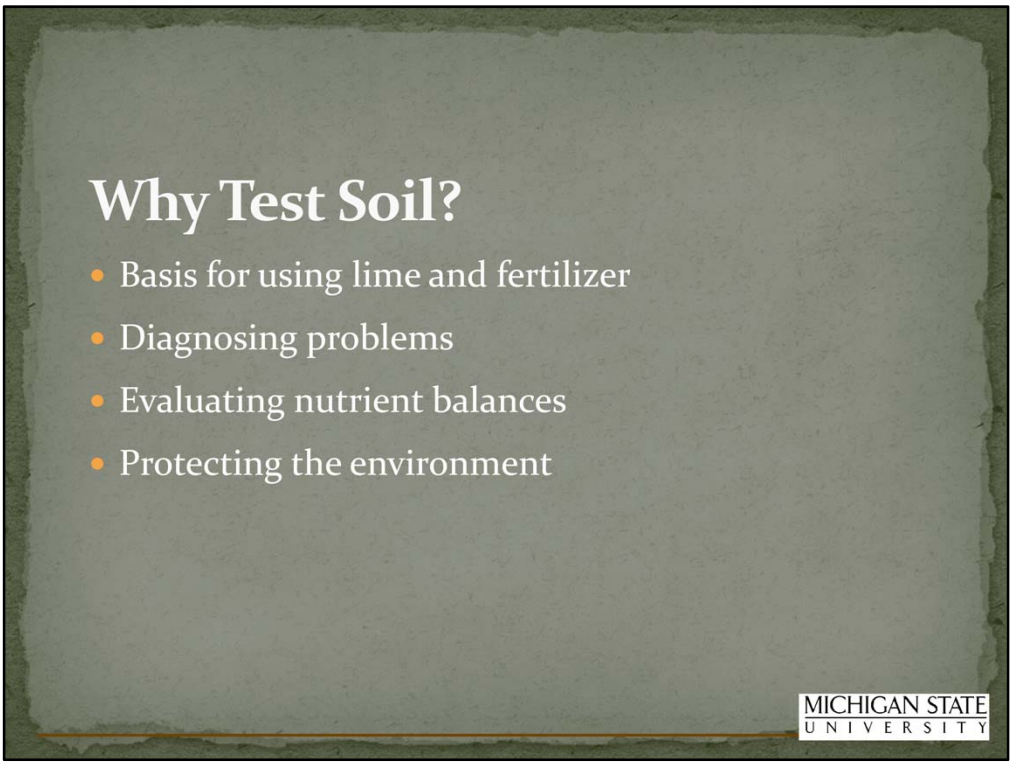
If the soil is 40 percent sand, 20 percent clay and 40 percent silt, what is its texture? Answer: loam

If a soil is 20 percent sand, 10 percent clay and 70 percent silt, what is its texture? Answer: silt loam

If a soil is 20 percent sand, 60 percent clay and 20 percent silt, what is its texture? Answer: clay

Add to general information about your 'native soil'…

- Soil test
  - Initial test gives a baseline
  - If big improvements are needed, re-test after 2-3 years
  - Re-test every 5 years to monitor soil fertility
  - Request a 'normal' soil test (include OM if desired)
  - Soil test recommendations are crop specific and tillage depth specific



Why is it important to test soil?

Basis for applying lime and fertilizer - Too often gardeners apply fertilizer and lime as an activity, not based on what is actually needed. You may know someone who applies lime and 12-12-12 fertilizer every year without having the soil tested. If this person had a soil test done, it would probably show high pH and phosphorus levels.

Diagnosing problems - There are instances in which soil tests will show deficiencies or pH levels that can be corrected to solve a problem in the landscape. For example, remember the hydrangea that wasn't the color expected or the chloratic pin oak?

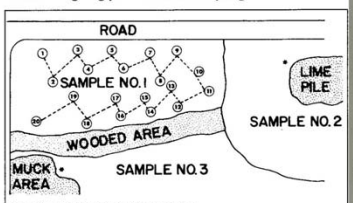
Evaluating nutrient balances - What did we say about the imbalances of potassium, magnesium and calcium? Answer: When an imbalance occurs, a deficiency of one element may be induced or caused by high rates of another.

Protecting the environment - Often homeowners along streams and lakes are applying phosphorus when a soil test would indicate that the current levels are more than adequate. Homeowners with sandy soils take the risk of having excess nitrogen leached into their groundwater. Wherever there is a potential pollution problem, soil testing should be part of the nutrient management scheme.

How do you take a soil sample?

- When: For most homeowners, once every three years is adequate.
- Where: If your lot has a distinct variation in soil types, take a composite sample from each predetermined area.
- How: A composite sample includes not less than 20 samples randomly from each predetermined area. A sample consists of a vertical column or core of soil approximately ½ inch square. For crops other than lawns, the depth should be eight inches. For lawns, the depth should be 4 inches. The soil samples should be broken up in a plastic pail – do not use a metal pail if the sample is to be tested for micronutrients because you can get contamination from the metal. If the soil is very wet, air dry it – do not use artificial heat.
- Amount: One pint of soil from the composite sample
- Preparing and packaging: There are instructions for preparing and packaging your sample in Addendum B of your Master Gardener manual. It is advisable to work with the MSU Extension office in your county. Most counties have staff who will package and send your soil samples to Michigan State University for analysis.
- Fill out the form completely. The more complete the information you provide, the more accurate the recommendations will be.

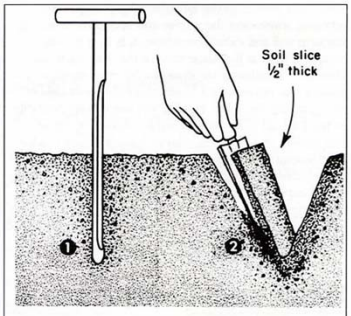
Follow a Zig-Zag pattern when sampling.



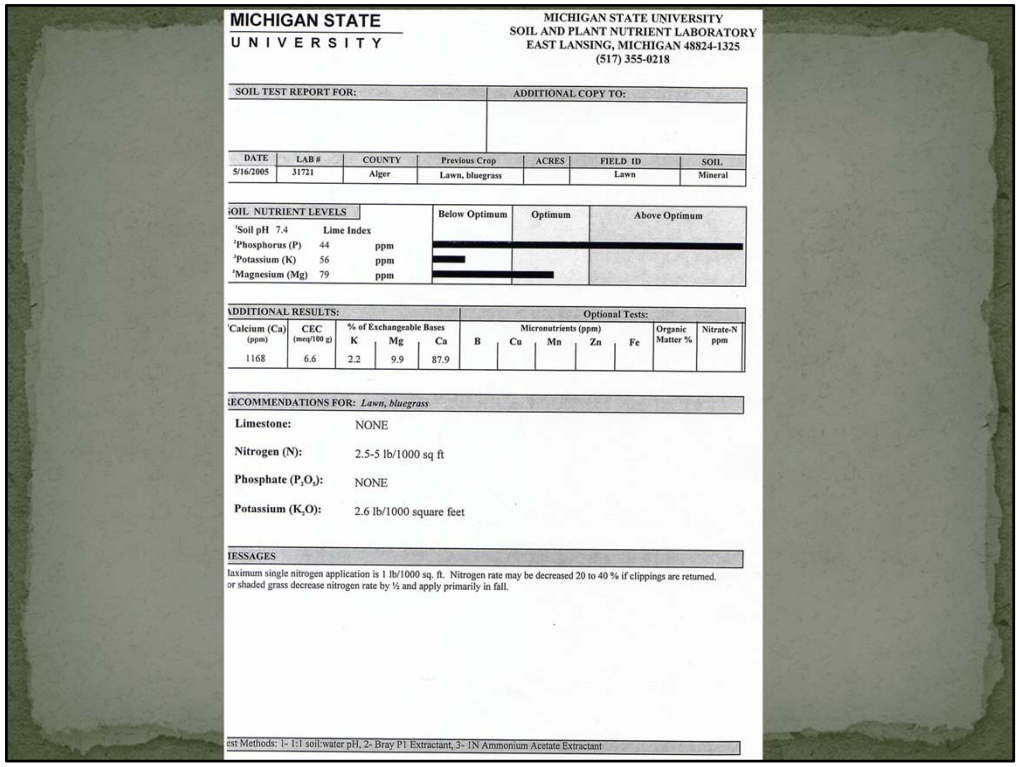
*Omit or take separate samples

In a non-uniform field, as shown above, a minimum of 3 samples are required to adequately represent the area. Sample numbers 1, 2 and 3 represent 3 different soil management groups. This condition is common in glaciated areas such as Michigan.
Each composite sample is made up of 20 borings taken as in sample No. 1.

How To Use Sampling Tools



1. Sampling probe provides uniform sampling cores—easy to use—saves time—best tool for sampling farm soils.
2. Use a narrow (1½ inch) garden dibble to take a slice of soil ½ inch thick.



MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY
SOIL AND PLANT NUTRIENT LABORATORY
EAST LANSING, MICHIGAN 48824-1325
(517) 355-0218

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:

DATE	LAB #	COUNTY	Previous Crop	ACRES	FIELD ID	SOIL
5/16/2005	31721	Alger	Lawn, bluegrass		Lawn	Mineral

OIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH 7.4	Lime Index				
[3]Phosphorus (P)	44	ppm			
[2]Potassium (K)	56	ppm			
[2]Magnesium (Mg)	79	ppm			

DDITIONAL RESULTS:					Optional Tests:						
[1]Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases K	Mg	Ca	Micronutrients (ppm) B	Cu	Mn	Zn	Fe	Organic Matter %	Nitrate-N ppm
1168	6.6	2.2	9.9	87.9							

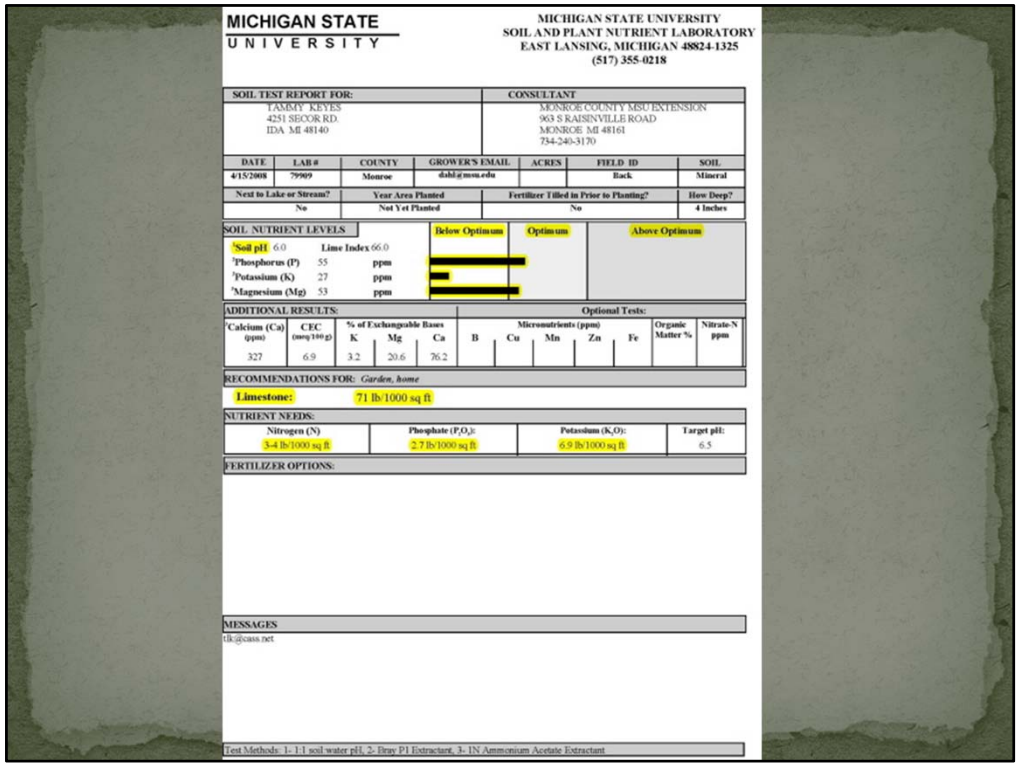
ECOMMENDATIONS FOR: *Lawn, bluegrass*

Limestone:	NONE
Nitrogen (N):	2.5-5 lb/1000 sq ft
Phosphate (P_2O_5):	NONE
Potassium (K_2O):	2.6 lb/1000 square feet

ESSAGES

laximum single nitrogen application is 1 lb/1000 sq. ft. Nitrogen rate may be decreased 20 to 40 % if clippings are returned.
or shaded grass decrease nitrogen rate by ½ and apply primarily in fall.

est Methods: 1- 1:1 soil:water pH, 2- Bray P1 Extractant, 3- 1N Ammonium Acetate Extractant



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SOIL AND PLANT NUTRIENT LABORATORY
EAST LANSING, MICHIGAN 48824-1325
(517) 355-0218

SOIL TEST REPORT FOR:
TAMMY KEYES
4251 SECOR RD.
IDA MI 48140

CONSULTANT
MONROE COUNTY MSU EXTENSION
963 S RAISINVILLE ROAD
MONROE MI 48161
734-240-3170

DATE	LAB #	COUNTY	GROWER'S EMAIL	ACRES	FIELD ID	SOIL
4/15/2008	79909	Monroe	dabl@msu.edu		Back	Mineral

Next to Lake or Stream?	Year Area Planted	Fertilizer Tilled in Prior to Planting?	How Deep?
No	Not Yet Planted	No	4 Inches

SOIL NUTRIENT LEVELS

			Below Optimum	Optimum	Above Optimum
[1]Soil pH	6.0	Lime Index 66.0			
[2]Phosphorus (P)	55	ppm			
[2]Potassium (K)	27	ppm			
[2]Magnesium (Mg)	53	ppm			

ADDITIONAL RESULTS:

[2]Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases K	Mg	Ca	Optional Tests: Micronutrients (ppm) B	Cu	Mn	Zn	Fe	Organic Matter %	Nitrate-N ppm
327	6.9	3.2	20.6	76.2							

RECOMMENDATIONS FOR: *Garden, home*

Limestone: 71 lb/1000 sq ft

NUTRIENT NEEDS:

Nitrogen (N)	Phosphate (P_2O_5):	Potassium (K_2O):	Target pH:
3-4 lb/1000 sq ft	2.7 lb/1000 sq ft	6.9 lb/1000 sq ft	6.5

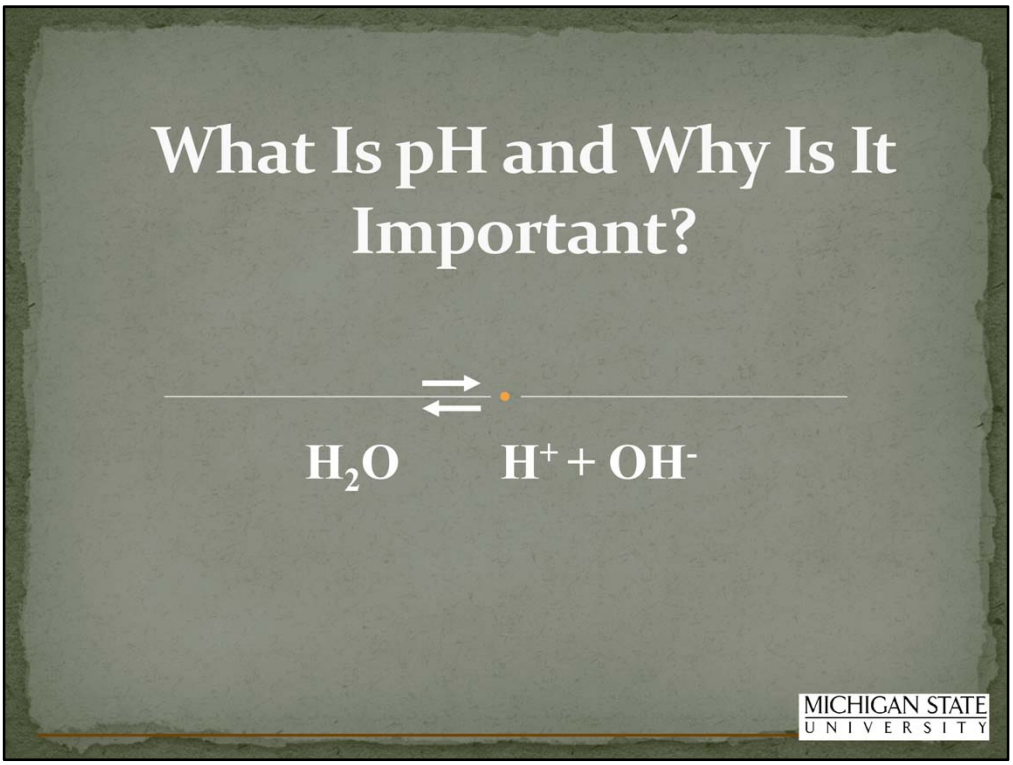
FERTILIZER OPTIONS:

MESSAGES
tlk@cass.net

Test Methods: 1- 1:1 soil water pH, 2- Bray P1 Extractant, 3- 1N Ammonium Acetate Extractant

Interpreting your report

- http://web1.msue.msu.edu/monroe/soilweb2/

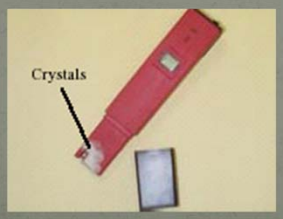


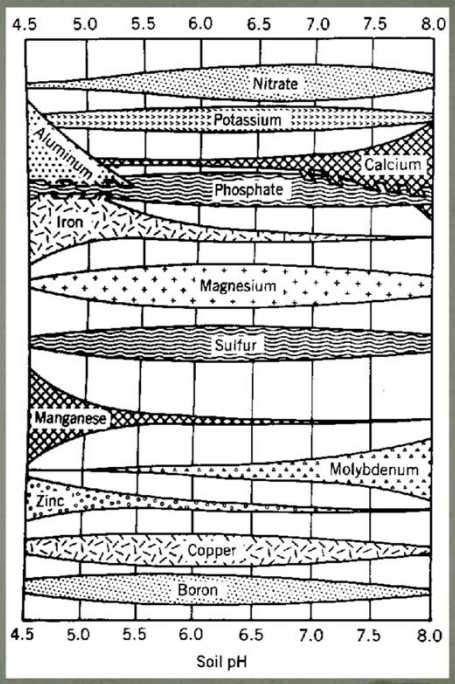
The pH of a solution tells us something about the water (H_2O) and what will dissolve in it.

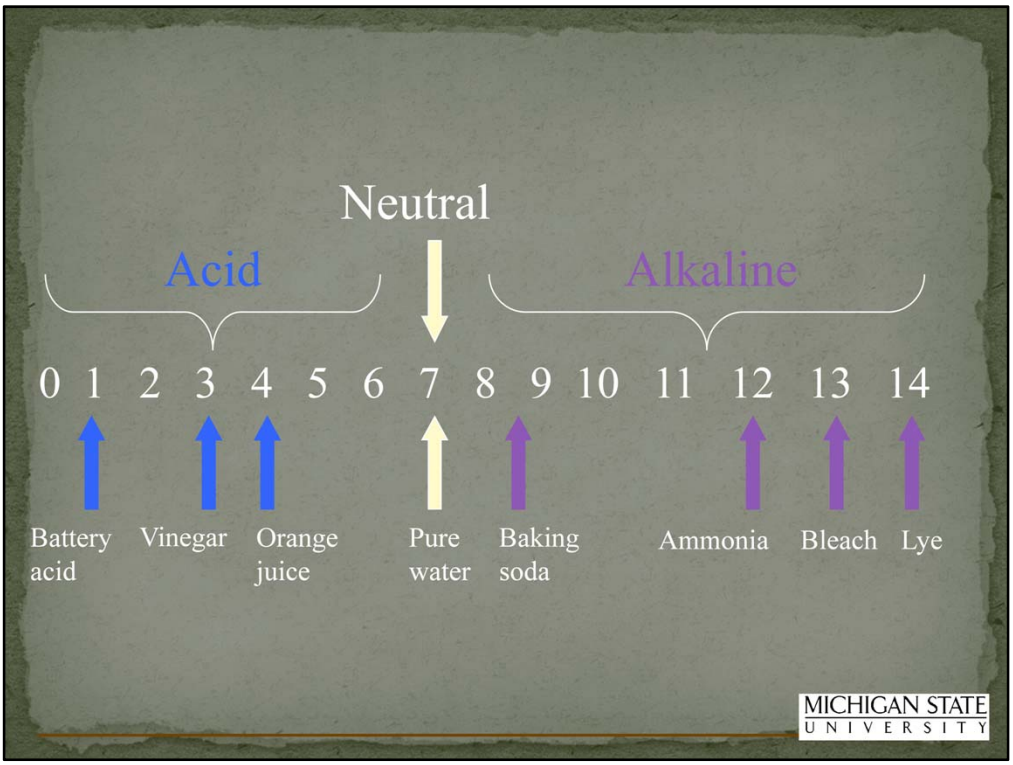
Remember that water is made up of two atoms of hydrogen and one atom of oxygen. These atoms can exist as a hydrogen cation (a hydrogen atom with a positive charge) and a hydroxyl anion (an atom of hydrogen and an atom of oxygen with a negative charge). The pH is a measure of how much water is split this way, or to be more correct, the concentration of the hydrogen cation. So as the hydrogen ion concentration increases, the soil becomes more acid; as it decreases, the soil becomes more alkaline.

Soil pH

- Relates to nutrient availability and plant growth
- Can be estimated with a pocket tester



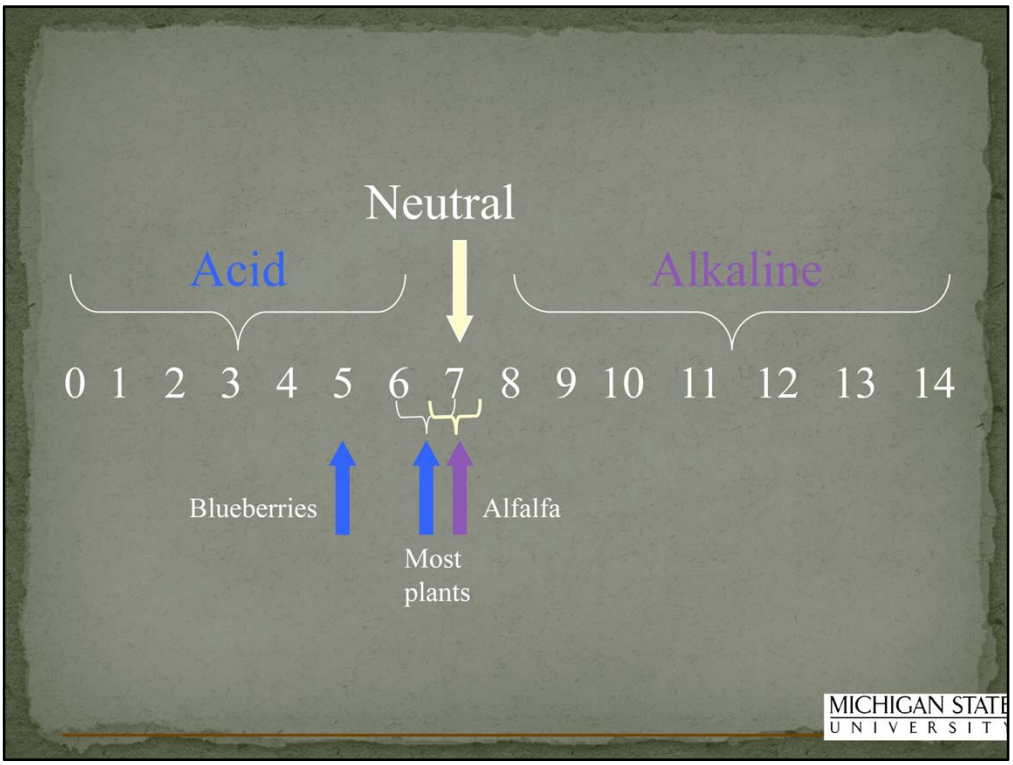




Presenter: Review the chart with participants.
The absolute range of pH is from 0 to 14. A pH of 7 is neutral, meaning the amount of hydrogen cation is equal to the amount of hydroxyl anion. Pure water has a neutral pH. When the pH is less than 7, the solution is said to be acidic. There are more hydrogen cations than hydroxyl anions. When the pH is greater than 7, the solution is said to be alkaline or basic. There are more hydroxyl anions than hydrogen cations.

Let's look at the pH of some common materials. (Click mouse to reveal materials and arrows, or review materials on slide or overhead.)

Optional: Demonstrate the pH of a number of these substances using litmus paper.



Most plants grow best at a pH between 6.0 and 7.0, slightly acidic. Blueberries, on the other hand, are best adapted to a pH near 5.0, an acidic soil. Alfalfa thrives at 6.5 to 7.5, slightly basic or alkaline.

As we said earlier, pH affect the availability of essential nutrients to the plant. It can also create an environment where certain ions, such as aluminum and manganese, become toxic. As the pH drops below 5.5, aluminum and manganese become increasingly insoluble and toxic to many plants.

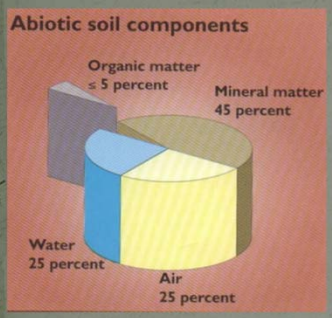
MEDIAN SOIL TEST VALUES FOR MINERAL SOILS IN MICHIGAN COUNTIES 2003 - 2008

"F" = FARM ONLY

"F+H" = FARM and HOMEOWNER

	2.5+ tons						
County	Lime/A	pH	P	K	Ca	Mg	# tests
Alger F	47.0	6.1	51	64	769	109	217
Alger F+H	35.2	6.3	58	62	820	111	383
Marquette F	44.0	6.2	64	66	741	80	141
Marq. F+H	39.9	6.3	69	62	749	87	431
State F	14.5	6.6	51	95	945	143	37542
State F+H	N/A						

Soil Composition

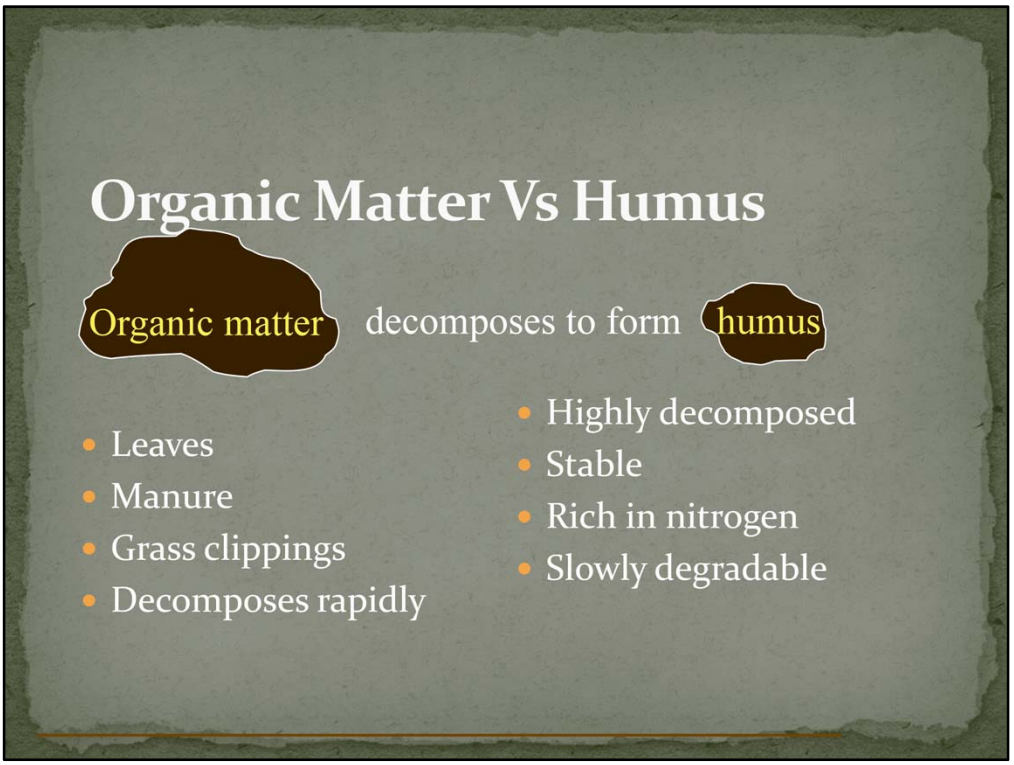


Organic Matter
(<1% to about 10%)

Air
(about 25%)

Water
(about 25%)

Mineral Matter
(about 45%)



Organic matter and humus relate to another physical property of soil. The word "humus" is often used to describe the organic matter of a soil. In fact, humus and organic matter are not exactly the same!

When leaves, manure, grass clippings and so on are added to the soil, they decompose quite rapidly. After the initial decay, all the easily broken down substances are gone. What remains is quite stable and resistant to further decomposition. This slowly degradable organic matter is called humus. It is rich in nitrogen and acts as a slow-release fertilizer. Humus also has the capacity to absorb and retain water and nutrients. It's good for the soil!

So all humus is organic matter, but not all organic matter is humus!