Soils differ strikingly from each other. This week we illustrate the great differences and ask you to learn how they differ and to become skilled in describing the differences.

Objectives (To be able to):

1. Use the Munsell system to describe soil color and explain the Munsell code including the concepts of hue, value, and chroma.

2. Name and explain the origin of the colors in soil which are caused by iron, by organic matter, and the colors observed in the absence of iron and organic matter.

3. Discuss how and why surface and subsoil soil colors change as one goes from well drained to poorly drained soil.

4. List the particle size limits for sand, silt, and clay.

5. Given an unlabeled textural triangle, explain its general organization and label the 12 textural classes.

6. Given a sample of soil, determine its texture by feel, placing it in its correct textural class.

7. Define "texture" and "structure".

8. Define "ped", and discuss how peds are formed.

9. Identify and describe the two "structureless" conditions in soil: single grained and massive.

10. Identify and describe granular, platy, blocky, and prismatic soil structures either when given sample peds or in a monolith.

11. Define the soil horizons listed in the study guide and recognize them when obviously present in a profile (monolith).

12. Distinguish and describe soil horizons in the 0-122 cm (0-4 ft.) cores provided.

13. Identify, name, and discuss the visible features such as structure, color, and obvious horizon boundaries in the "Soil-of-the-Week".

14. Given several soil profile descriptions, select the one which matches a soil core using the characteristics of color, texture, and horizon boundaries.

Reading Assignment:

Spring 2015
I. Concepts of Soils

A. What is soil?

B. Soil Names (Series Names)

C. Soil Patterns (p. 17)

D. Soils in Profile

E. Soil Horizons in a Miami Silt Loam Soil

F. Pedons and Polypedons

G. Monoliths

H. Observing Soil Horizons (Notes not necessary – Read pages 11-14)

I. Karad Soil Profile (Can you identify the horizons?)

J. Slides (look at the next few photographs while listening to my comments on each; they are designed to illustrate what we've talked about above). Notes not necessary on these slides.

II. What Do You See in Soil Profiles? (The Soil Monoliths at the center of the Front Bench)

A. The soil profiles displayed here are undisturbed soil samples taken from the surface down to 4 feet (122 cm). Stand back several feet to get a general look at the soils. List 5 of the distinct colors that the soils display.

_________________________

_________________________

_________________________

_________________________

_________________________
B. Which soil would you like for your garden? _________________________
   Why? __________________________________________________________________

C. How many distinctive layers, based solely on color, do you think you see in each of the following soils?
   Zanesville silt loam _____________ Houghton Muck _____________
   Cecil silt loam _____________ Watseka sand _____________

D. Which soil on the front display was formed over gravel? _____________

E. Discuss your decisions with the tutor.

RETURN TO THE COMPUTER

III. Soil Color (description, origin, use) (p. 97)

A. The Munsell System (Computer Presentation and Bench 1)
   Hue
   Value
   Chroma

B. How to Read Soil Color Using the Munsell System (e.g. 10YR6/4)

C. Soil color read using moist soil

D. Sources of Soil Color: organic matter (humus) and iron oxides

E. Sample Munsell code description of moist soils on display (Bench 1)
   Munsell Code          Color Name
   Unk. Soil 1           __________  __________
   Unk. Soil 2           __________  __________

F. Soil Iron Colors (Bench 1)
   Oxidized Iron (Fe+++): red, brown, tan, yellow
   Mottling
   Reduced Iron (Fe++)
   The Pembroke has been separated into its individual components, notice the changes in color.

G. Soil Humus Color (Bench 1)
   As residues decompose, the resulting humus causes the soil color to become ____________.
   Compare the Maumee soil color before and after burning.
   What gives the color before burning? ______________;
   after burning? ______________
What gives the color to each horizon of the Saugatuck?
A ______________________________
E an absence of iron or humus color
B ______________________________

Soil Color as a measure of organic matter content: (Using the Munsell chart)

Unk. Soil 1 _____ % organic matter

Unk. Soil 2 _____ % organic matter

H. **Color - Soil Drainage and Vegetation** (right end of bench 1)
Forest soils vs. Prairie soils.

Compare the colors of the **subsoil** of the four soils.

What colors do you see in the well drained soils? ________________

What colors do you see in the poorly drained soils? ________________

Compare the depth and darkness of the **surfaces** of these four soils.

Between the two prairie soils, which one has the greater accumulation of organic matter? ________________

Between the two forest soils, which one has the greater accumulation of organic matter? ________________

Compare the **surface horizons** of the well drained prairie and the well drained forest soil, do soils developed under prairie vegetation or forest vegetation contain more organic matter? ________________

**RETURN TO THE COMPUTER**

IV. **Soil Texture** (p. 97-104)

A. A definition: _______________________________________________________
   ___________________________________________________________________

B. Particle size limits (United States Department of Agriculture System)
   sand ______ mm    silt ______ mm    clay ______ mm

C. Soil Textural Triangle
   How many textural class categories are there? ______

D. Description of a simplified textural triangle
   Loam _____________________________________________________________
   Clay Loam ______________________________________________________
   Clay ___________________________________________________________
E. Texture by Feel—study this prior to doing the known & unknown texture sample

1. Moisten a sample of soil the size of a golf ball but don't get it very wet. Work it until it is uniformly moist; then squeeze it out between the thumb and forefinger to try to form a ribbon.

2. Our first decision: If the moist soil is:
   
   (a) Extremely sticky and stiff = CLAYS
   (b) Sticky and stiff to squeeze = CLAY LOAMS
   (c) Soft, easy to squeeze, only slightly sticky = LOAMS

3. Our second decision: Do we need an adjective to refine our description?
   
   (a) The soil feels very smooth = SILT OR SILTY
   (b) The soil feels somewhat gritty = adjective
   (c) The soil feels very very gritty = SANDY

4. Our final refinement: The true texture triangle has two small additional changes.
   
   (a) The lines jog a little
   (b) There are three additional (and less common) classes: sand, loamy sand and silt.

5. Beware, the feel of a soil is modified by:
   
   (a) The amount of moisture present. Compare them at like moisture contents.
   (b) The amount of organic matter. This especially affects clayey soils. Very high amounts of organic matter cause the soil to be "smooth", causing an over-estimation of silt content.
   (c) The kind of clay. In tropic and subtropic regions different types of clay, particularly kaolinite, predominatate and give a less sticky feel.
F. Soil Texture Practice Session:

1. Work first on the known texture samples located on the large wooden textured triangle on the table. As you work with them, notice where they fall on the triangle.

   (a) Learn the feel of soils with different clay content by:
       1. comparing the loam, clay loam, and clay.
       2. comparing the silt loam to the silty clay loam.
       3. comparing the sandy loam to the sandy clay loam.

   (b) Learn the feel of soils with similar amounts of clay; i.e. compare loam, silt loam and sandy loam.

   (c) Practice with the knowns until your fingers are educated.

2. Now try the "unknowns" on the front bench. If in doubt about one, then compare it back to the practice samples on the triangle. Record the texture which you think each of the unknowns has.

<table>
<thead>
<tr>
<th>TEXTURE UNKNOWN</th>
<th>TEXTURAL CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

   Now that you have this completed check with the tutor to see if you are correct.

SELF TEST: Label the textural triangle below with the correct textural class name in each of the 12 areas.

RETURN TO THE COMPUTER FOR A DISCUSSION OF STRUCTURE AND HORIZONS
V. **Structure** (Bench 2 and p. 104-106)

A. Definition of soil structure: ____________________________________________
   _______________________________________________________________________
   What is a Ped (Aggregate)? ______________________________________________

B. Photographs of Granular, Platy, Blocky, and Prismatic. 
   (no notes necessary)

C. Structureless (Bench 2 – Take notes on how they appear to you at Bench 2)
   1. single grain 
      Example:

   2. massive 
      Example:

D. Common Structures (Bench 2 – Take notes on how they appear to you)
   1. granular

   2. platy

   3. blocky
      a. subangular

      b. angular

   4. prismatic

   5. Peds (soil structural units) come in all sizes

E. Special structural cases – not often found in Indiana (Bench 2)
   1. Columnar

F. Observe the sequence of structure types in a soil profile: (i.e. smaller structure is found in the surface horizon) (Bench 2)

A_____________________________________________________________________

E

BE(EB)

B

RETURN TO THE COMPUTER
VI. Soil Horizons (p. 52-56 and Bench 2)

A. Definitions:

A hypothetical soil profile with all master horizons and some transitional horizons. The thickness of the horizons varies as indicated.

Observe these horizons on the computer and make notes about their characteristics in the blanks below and the next page. After looking at the computer images and taking notes, you will go to Bench 2 to observe these horizons in the soil monoliths and perhaps make some additional notes (in your own words)

1. **Organic Horizons:**

   **Oi**: Loose leaves and undecomposed organic debris.
   **Oa**: Matt and decomposed organic material.

A mineral horizon containing Humus (highly decomposed organic matter) and consequently dark in color.

A layer lighter in color and lower in organic matter than the overlying A whose main feature is loss of silicate clay, iron, aluminum, and leaving a concentration of sand and silt particles of quartz or other resistant minerals.

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**Oi**: more high decomposed organic matter

**Oa**: more high decomposed organic matter
2. **Mineral Horizons** (Examples from Selected Soil Profiles) (Bench 2)

**Well Drained Forest Soils** (Light colored soils)

<table>
<thead>
<tr>
<th>A</th>
<th>Ap</th>
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<tbody>
<tr>
<td>E</td>
<td></td>
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</table>

**BE Transition** – more like B

<table>
<thead>
<tr>
<th>Bt</th>
<th>Bhs</th>
<th>Bs</th>
</tr>
</thead>
</table>

**EB Transition** – more like E

<table>
<thead>
<tr>
<th>C</th>
<th>R Bedrock</th>
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</table>

**Prairie Soils and Poorly Drained Forest Soils** (Dark colored soils)

<table>
<thead>
<tr>
<th>A</th>
<th>Ap</th>
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</thead>
<tbody>
<tr>
<td>AB</td>
<td></td>
</tr>
</tbody>
</table>

| B | |

<table>
<thead>
<tr>
<th>C</th>
<th>R Bedrock</th>
</tr>
</thead>
</table>

3. Additional Horizon Nomenclature from the display on Bench 2.

<table>
<thead>
<tr>
<th>Bg</th>
<th>Bx</th>
<th>Ck</th>
</tr>
</thead>
</table>

**Most Common Subordinate Distinctions within Master Horizons.** Lower case letters are used as suffixes to designate specific kinds of master horizons. The symbols and their meanings are as follows:

- **a**—Highly decomposed organic material (contrast with e and i).
- **b**—Buried genetic horizon.
- **c**—Concretions or hard nonconcretionary nodules (iron, aluminum, manganese or titanium).
- **e**—Organic material of intermediate decomposition.
- **f**—Frozen soil (permanent ice).
- **g**—Strong gleying (reduction of iron and other compounds and development of gray colors due to poor drainage).
- **h**—Illuvial accumulation of organic matter.
- **i**—Slightly decomposed organic material.
- **k**—Accumulation of carbonates.
- **m**—Cementation or induration.
- **n**—Accumulation of sodium.
- **o**—Residual accumulation of sesquioxides (mainly oxides of iron and aluminum).
- **p**—Plowing or other disturbance.
- **q**—Accumulation of silica.
- **r**—Weathered or soft bedrock.
- **s**—Illuvial accumulation of sesquioxides and iron oxides.
- **t**—Accumulation of silicate clay.
- **v**—Plinthite (subsoil material enriched with iron becoming hard or brick-like due to repeated drying and wetting).
- **w**—Weak development of color or structure.
- **x**—Fragipan character (brittle with high bulk density).
- **y**—Accumulation of gypsum.
- **z**—Accumulation of salts more soluble than gypsum.
C. Horizon sequences that are commonly found in light colored forest soils and in dark colored prairie or forest soils are presented. Observe the horizon changes in the monoliths and compare them to the sequences below. (See Forest and Prairie Soils at north end of Bench 1. Notes may not be necessary.)

<table>
<thead>
<tr>
<th>Light Colored Well Drained Forest Soil</th>
<th>Dark Colored Well or Poorly Drained Prairie or Poorly Drained Forest Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>E</td>
<td>AB</td>
</tr>
<tr>
<td>Bt</td>
<td>Bt</td>
</tr>
<tr>
<td>BC</td>
<td>BC</td>
</tr>
<tr>
<td>C (may not be visible at depth of monolith)</td>
<td>C (may not be visible at depth of monolith)</td>
</tr>
</tbody>
</table>

RETURN TO THE COMPUTER FOR FINAL INSTRUCTIONS

VII. Your hand-in exercise. You will work on Bench 3 with soil cores 1 and 2. (We have a repeat set on each half of the bench to make room for more students). Turn it in upon completion by putting it in the slot for your discussion instructor in the box labeled "Hand-In Box".

VIII. Soil of the Week (Front Bench by check-in area)

- Don't memorize!
- Look to be sure you can see the horizons and structural units.

What are the horizons observable and their ped structures?

<table>
<thead>
<tr>
<th>horizon</th>
<th>structure</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>structureless</td>
</tr>
</tbody>
</table>

IX. Computer Self-Testing

For practice on this week's work, use "SELFTEST" on the computers located at bottom of screen.

X. Check the bulletin board by the Study Center entrance, for information on your discussion.

Friday - Hour -
Room Number - Instructor's Name