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## Soil Cores For Kentucky Science Education

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# Soil Cores For Kentucky Science Education

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2015

International  
Year of Soils

**UK**  
UNIVERSITY OF  
**KENTUCKY**  
College of Agriculture,  
Food and Environment

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# Rationale

- A thin layer of soil underpins life on Earth and human survival.
- Students do not have access to soil cores and the understanding they can infer from these cores.
- Next Generation Science Standards will address ecosystem relationships, ecosystem dynamics, function and resiliency, biogeology, natural resources, and human impacts on Earth systems.
- All these topics can be illustrated in soil forming factors evident in diverse features of soil cores.

# How Can You Use Soil Cores To Meet Progressions For Next Generation Science Standards?

# Soil Cores and Next Generation Science Standards

- ESS2.A  
Earth Materials and Systems
- ESS2.E  
Biogeology
- ESS3.A  
Natural Resources
- ESS3.C  
Human Impacts on Earth Systems
- LS2.A  
Interdependent Relationships in Ecosystems

# How To Use This Manual

- Soil and Soil Taxonomy are Briefly Introduced.
- Sample Questions (and Some Answers) Relating to Specific Topics of the Next Generation Science Standards are Presented.
- Individual Soil Series Are Characterized. (Each School Will Only Have Two of the Representative Cores.)



# What is Soil?

- Soil is organic and lithic material at the surface of planets and similar bodies that has been altered by biological, chemical, and/or physical agents.<sup>1</sup>
- Soil is the biologically excited layer of the Earth's crust.<sup>2</sup>

<sup>1</sup>Schaetzl, R.J. and M.L. Thompson. 2015. *Soils: Genesis and Morphology*, 2<sup>nd</sup> ed. Cambridge University Press, p. 8

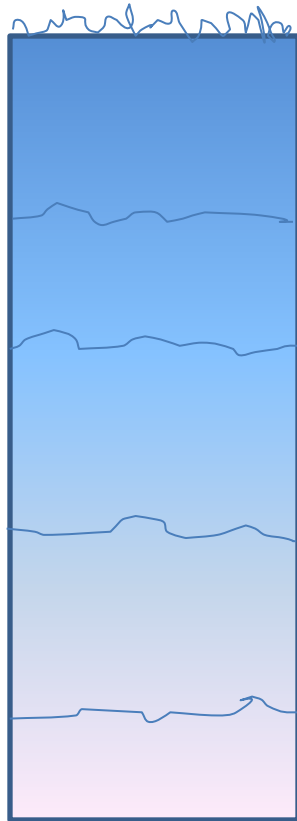
<sup>2</sup> Richter, D.D. and D. Markewitz. 1995. How deep is soil? *Bioscience*. 45:600-609.

# Profiles and Horizons

- A soil **Profile** is a vertical slice of the landscape revealing different soil layers called Horizons.
- A soil **Horizon** is a slice of the soil profile parallel to the land surface that has distinct biological, physical, structural, and chemical properties depending on soil type.



# Master Soil Horizons in a Soil Profile<sup>1</sup>



**O Horizon** - dominated by undecomposed or decomposed organic matter and plant debris; most common in uncultivated soil

**A Horizon** - dark topsoil rich in humus; the first mineral soil one sees in digging soil; often has fine granular structure; highly weathered and perturbed by animal activity

**E Horizon** - light colored quartz-rich zone from which many elements (like iron) have been leached (washed away); typical of cold, wet, coniferous forest soils (absent from the soil cores provided with this manual)

**B Horizon** - subsoil zone enriched in materials that have been leached from above or translocated from below; rich in clay; changes mostly due to mineral weathering

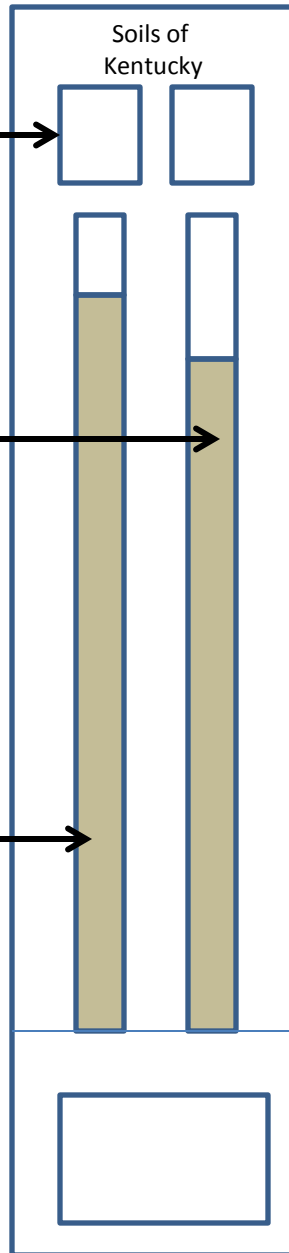
**C Horizon** - little altered parent material that maintains its geologic structure and fabric

**R Horizon** - regolith; unaltered bedrock/parent material

Soil Series Name and Taxonomic Classification

State Soil Crider Silt Loam

Alternate Soil Series for Comparison



Soil Taxonomy is organized much like you see in biology:

### Biological Taxonomy

Kingdom → Phylum → Class → Order → Family → Genus → Species

### Soil Taxonomy

Order → Suborder → Great Group → Subgroup → Family → Series → Type

Soil Taxonomic descriptions build pictures of a soil from its physical and chemical characteristics, to the environments that formed it, then to the Great Soil Groups to which it belongs:

For example

Fine, mixed, mesic Typic Argiudoll: Lanton Silty Clay Loam

Fine, mixed, mesic	<b>Family</b> (descriptive texture, mineralogy, and temperature features)
Typic	<b>Subgroup</b>
Argi	<b>Great Group</b> (weathering feature)
Ud	<b>Subgroup</b> (water feature)
Oll	<b>Order</b> (physiographic environment)
Woolper	<b>Series</b>
Silty Clay Loam	<b>Type</b>

# The Soil Orders

- Inceptisol (ept) – Recently formed/developing
- Andisol (and) – Volcanic
- Mollisol (oll) - Grassland
- Alfisol (alf) – Temperate forest
- Spodosol (od) – Cold and moist forest
- Ultisol (ult) – Weathered and wet
- Aridisol (id) - Dry
- Vertisol (ert) – Swelling clay dominated
- Entisol (ent) - Newly formed
- Histisol (ist) - Organic
- Oxisol (ox) – Highly weathered
- Gelisol (gel) - Frozen

Remember This Mnemonic: **I AM A SUAVE HOG**

# ESS2.A

## Earth Materials and Systems

- Grade K-2: Wind and Water Change the Shape of the Land
- Grade 3-5: Interaction of Four Major Earth Systems: Water & Wind, Temperature, Organisms, Gravity
- Grade 6-8: Energy Flows
- Grade 9-12: Feedback Among Earth's Systems

# ESS2.A

## Earth Materials and Systems

Grade K-2: Wind and Water Change the Shape of the Land

Where will you find these soils?

Does soil color say anything about where you might find them?

Are they deep or shallow?

Why will soil wash or blow away?

# ESS2.A

## Earth Materials and Systems

- Darker thicker soils often form in lowlands because they are wetter and collect eroded soil.
- Lighter thinner soils often form in uplands because they are drier and are more eroded.
- Dark colors typically come from plant material that has decomposed. Light colors show that there are elements like iron or minerals like quartz present.
- If the 'A' horizon is very thin it usually means that erosion has happened. If the 'A' horizon is thick, it often means deposition happened.
- If a soil has no horizons it usually means it is very young (Entisol/Inceptisol) or has been highly weathered for long periods (Oxisol).
- Different particles in the soil are at different risk of being blown away or washed away. Silt (flour-like) particles can be easily blown away by wind. This causes dust storms. When the particles fall to earth they form 'loess' deposits.



# ESS2.A

## Earth Materials and Systems

Grade 3-5: Interaction of Four Major Earth Systems:  
Water & Wind, Temperature, Organisms, Gravity

What are the soil forming factors?

How do the soil forming factors interact to make different soils?

Do soils form from the top down, or from the bottom up?

# The Soil Forming Factors

$$\text{Soil} = f(\text{Cl, O, R, P, T, + A})$$

Soil = f(Climate, Organic Matter, Relief, Parent Material, Time, + Anthropogenic)

Water  
Temperature

Vegetation  
Macrobiodiversity  
Microbiota

Slope  
Aspect  
Curvature

Igneous  
Metamorphic  
Sedimentary

Tillage  
Mining  
Irrigation  
Cropping

The type of soil that forms in any given place is a function of the climate, the type of vegetation, the topography (relief), the parent material, time, and human influences.

# ESS2.A

## Earth Materials and Systems

- Each of the soil forming factors influences the kind of soil that develops in a particular location – there are as many different kinds of soils as there are ways to combine the soil forming factors.
- Not all of the soil forming factors are equally important for a given location.
- Weathering happens because of time, temperature, water, wind and organisms. These are most active at the soil surface. So, soil forms from the top down not the bottom up.

# ESS2.A

## Earth Materials and Systems

### Grade 6-8: Energy Flows

What are the kinds of energy in soil ecosystems?

How does energy flow through soil?

Where does all the plant debris go?

# ESS2.A

## Earth Materials and Systems

- Energy is the capacity to do work.
- The most important kinds of energy for ecosystems are: mechanical, chemical, radiant, and heat.
- Kinetic energy is free energy
- Potential energy is stored energy

# ESS2.A

## Earth Materials and Systems

- Soils move down slopes due to the force of gravity.
- Water moves through soil because of the water's potential energy.
- Lots of water means lots of potential energy and lots of flow, which means:
  - Water erosion
  - Leaching
- Little water means water cannot move quickly through soil because chemical forces in soil hold it in place:
  - Plants wilt because water cannot move to roots quickly enough

# ESS2.A

## Earth Materials and Systems

- Radiant energy from the sun heats the soil surface and causes dramatic changes in soil temperature on a daily basis (diurnal changes).
- As one goes deeper and deeper into the soil profile the variations in soil temperature become less and less.
- Heat flows from warm to cold so . . . :
  - If soils freeze from the top down in winter . . .
  - In spring and summer, soils thaw from the bottom up.

# How is Soil Like the Human Body?

- It converts matter to energy
- It filters water
- It respire
- It contains multiple types of living cells
- It has a solid mineral phase
- It changes with time

**This All Requires Energy!**



# ESS2.A

## Earth Materials and Systems

- Organisms in soil use the potential energy stored in the chemical bonds of minerals and organic matter.
- The energy in organic matter can be released quickly (ex. fire) or slowly (ex. respiration).
- Respiration produces carbon dioxide (CO<sub>2</sub>) and heat.
- Compost piles are biological systems - decomposing and generating heat
  - Watch compost piles steam on a cold day.
- Dark colored soils with lots of organic matter will have more respiration than lighter colored soils.

# ESS2.A

## Earth Materials and Systems

### Grade 9-12: Feedback Among Earth's Systems

What are soil functions?

What are the roles of human influence on soil formation?

What is soil quality?

How does human activity change soil quality?

# Soil Functions

- Production of food and biomass
- Storage, filtration, and transformation of foreign compounds
- Habitat/gene pool
- Physical and cultural environment
- Source of raw materials
- Carbon storage
- Archive of geological and archeological heritage

# Soil Quality

The capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health.

# Soil Health

The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

# ESS2.E

## Biogeology

- Grade K-2: Plants and Animals Can Change Their Environment
- Grade 3-5: Living Things Can Affect Physical Characteristics of Their Environment
- Grade 6-8: Changes in Biodiversity Can Influence Humans' Resources and Ecosystem Services They Rely On
- Grade 9-12: The Biosphere and Earth's Other Systems Have Many Interconnections that Cause a Continual Co-Evolution of Earth's Surface and Life On It

# ESS2.E

## Biogeology

### Grade K-2: Plants and Animals Can Change Their Environment

What happens when a ground hog digs a burrow?

How can you tell where an ant nest is?

How can you tell where a worm is burrowing?

Do you see any roots in the soil core? What happens when the root dies?

# Bioturbation

- When animals disturb the soil it is called bioturbation.
- They can be big animals: ground hogs, moles, prairie dogs.
- They can be small animals: earthworms, ants, termites.
- Tree fall is another way in which soil is mixed.
- Burrowing creates big holes and moves lots of soil.
- You can discover ant nests by looking for small piles of granular, light colored soil.
- You can see earthworm burrows by looking for dark-colored mounds of round soil called 'casts.'
- These burrows make channels in the soil called 'macropores' that let water move into the soil quickly.

# ESS2.E

## Biogeology

### Grade 3-5: Living Things Can Affect Physical Characteristics of Their Environment

What is bioturbation?

- The mixing and disturbance of soil by big and small animals.

What do ants, termites, and earthworms all have in common?

- They all move soil from the subsurface to surface. This recycles soil nutrients.
- There is a special name for the soil in and around an earthworm burrow: it is called the drilosphere. It is more biologically active than the surrounding soil.
- The zone of soil around plant roots is called the rhizosphere.



“The plough is one of the most ancient and most valuable of man’s inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earthworms. It may be doubted whether there are many other animals that have played so important a part in the history of the world, as have there lowly organized creatures.”

(Charles Darwin. 1881 The Formation of Vegetable Mold Through the Action of Worms).

# ESS2.E

## Biogeology

Grade 6-8: Changes in Biodiversity Can Influence Humans' Resources and Ecosystem Services They Rely On

What are the soil Ecosystem Services?

What happens to the soil surface when different types of plants are grown?

How deep would roots penetrate these soil cores if only one plant species were present?

How could changing crop production and management on each of these soils influence soil function?

# Ecosystem Services of the Natural Environment

- Produce biomass – Food, fiber, and forage
- Regulate climate change
- Water conservation and protection
- Source of green energy (biofuels)
- Biodiversity/Source of new products
- Guide to natural development – link between urbanization and the natural environment
- Cultural heritage – Construction, art, literature, archeology

# ESS2.E

## Biogeology

### Grade 9-12: The Biosphere and Earth's Other Systems Have Many Interconnections that Cause a Continual Co-Evolution of Earth's Surface and Life On It

What is the Gaia Hypothesis?

Aridisols (desert soils) frequently have biological crusts made out of lichen that protect the soils from erosion. What will happen if off-road vehicles destroy those crusts?

Gelisols (frozen soils) store large amounts of methane (CH<sub>4</sub>) and carbon. What happens if climate change means soil temperatures become warmer for longer?

Tillage accelerates soil organic matter decomposition and fungal hyphal networks. What happens if farming practices reduce the amount of tillage?

# ESS2.E

## Biogeology

- The Gaia hypothesis – described by James Lovelock – argues that the Earth is a self-regulating super organism that responds via feed-back mechanisms to perturbations.
- Aridisols (desert soils) frequently have biological crusts made out of lichen that protect the soils from erosion. They are the major source of primary productivity in such environments. Off-roading destroys the crusts and these two important functions.
- Gelisols (frozen soils) store large amounts of methane (CH<sub>4</sub>) and carbon. Warming climates means that the permafrost can melt releasing these gases. Because they are greenhouse gasses, they accelerate trapping of solar radiation and make warming even more likely.
- No-tillage is a soil management technique to preserve soil structure and plant residue, which minimizes erosion. It also helps to increase the amount of Carbon that is stored in soil.

# ESS3.A

## Natural Resources

- Grade K-2: Humans Use Natural Resources For Everything They Do
- Grade 3-5: Some Resources are Renewable Over Time, Others Are Not
- Grade 6-8: Resources Are Distributed Unevenly Around the Planet as a Result of Past Geologic Processes
- Grade 9-12: Resource Availability Has Guided the Development of Human Society and Use of Natural Resources Has Associated Costs, Risks, and Benefits

# ESS3.A

## Natural Resources

Grade K-2: Humans Use Natural Resources For  
Everything They Do

What are different ways people use soils?

# ESS3.A

## Natural Resources

- In addition to growing plants in soil, people use soil to:
  - Make bricks and pottery
  - Build shelters
  - Filter water and other liquids (kaolin)
  - Kill insects (diatomaceous earth)
  - Make pigments for painting
  - Protect health (geophagy is eating soil – clays in soil absorb toxins and can provide essential minerals)



# ESS3.A

## Natural Resources

Grade 3-5: Some Resources are Renewable Over Time,  
Others Are Not

Is soil a renewable resource?

How long does it take to make soil?

How long does it take to lose it?

# ESS3.A

## Natural Resources

- Soil is a renewable resource – but it takes a long, long time.
- Soil typically forms at rates of 1-2 mm per decade
- Tons of top soil per acre can be lost in a day through wind and water erosion.
- Because most of the useful and available plant nutrients are in topsoil, that resource is lost and has to be replaced by added fertilizers to maintain soil fertility.
- Stopping erosion is a lot easier, and in the long term a lot cheaper, than continually replacing nutrients.

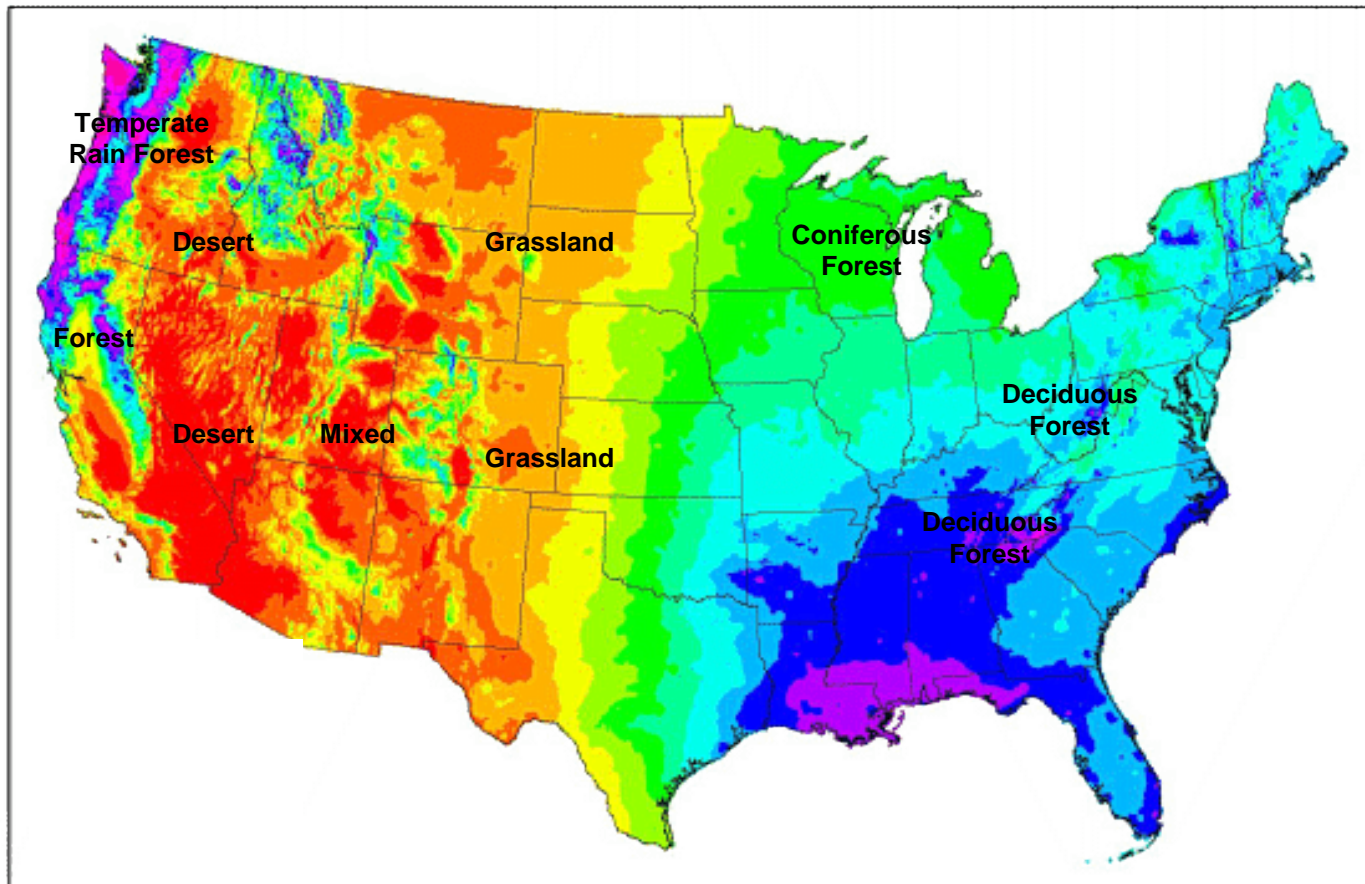
# ESS3.A

## Natural Resources

Grade 6-8: Resources Are Distributed Unevenly Around the Planet as a Result of Past Geologic Processes

What makes the Corn Belt so productive?

Why is the Bluegrass so good for raising thoroughbred horses?



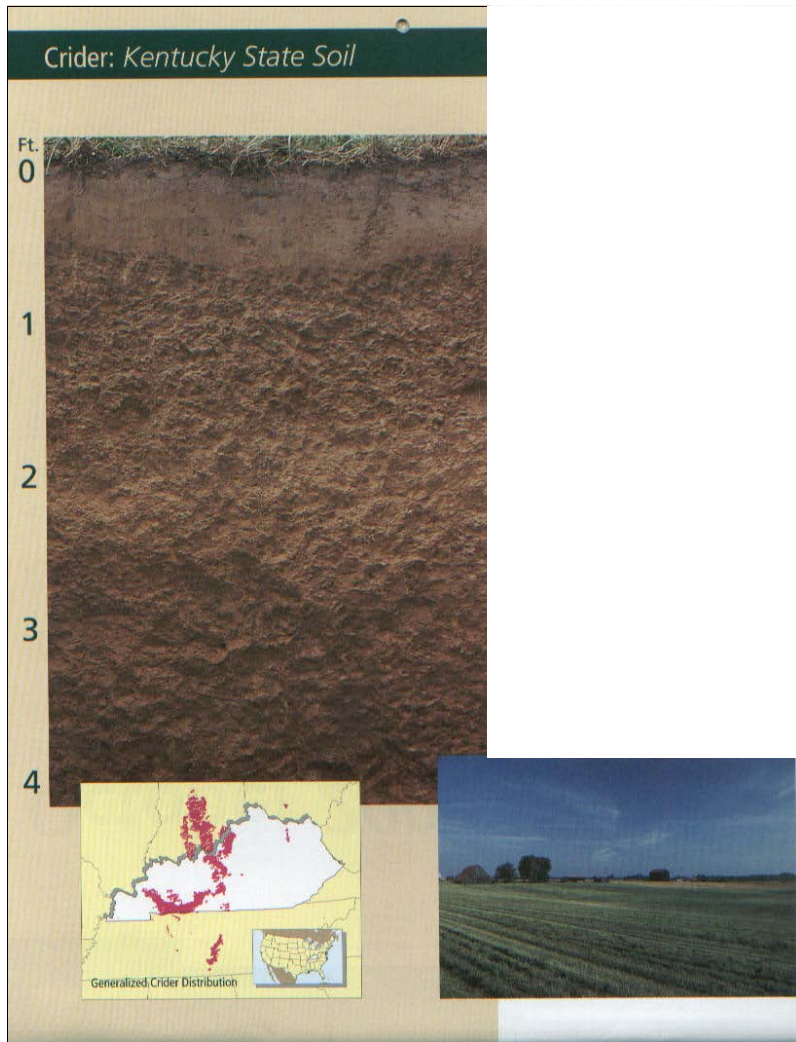
<sup>1</sup>Map courtesy of the USDA-NRCS

# ESS3.A

## Natural Resources

- Deep, fertile, rich soils are a tremendous natural resource.
- The U.S. prairies are incredibly productive because the Mollisols present in are deep and rich in organic matter from the original prairie vegetation.
- The soils of the central bluegrass developed from limestone and in some cases phosphatic limestone.
- This means they are rich in calcium (Ca), magnesium (Mg), and phosphorus (P). These are three elements important for making strong bones and buffering the acidity of the soil, which promotes abundant forage growth – an ideal environment for raising thoroughbred horses.

## Developed Under Forest (Crider soil)



## Developed Under Prairie (Harney soil)



<sup>1</sup>Photographs courtesy of the USDA-NRCS

# ESS3.A

## Natural Resources

Grade 9-12: Resource Availability Has Guided the Development of Human Society and Use of Natural Resources Has Associated Costs, Risks, and Benefits

Before the 1930's, what was the prevailing attitude about soil as a resource?

What events changed national policy toward soil conservation?

Who has a stake in preserving and paying for soil resources?

# ESS3.A

## Natural Resources

- Federal acts such as the Homestead Act (1862) and the Reclamation Act (1902) actively promoted and subsidized population movement into the American West.
- Soil was regarded as an inexhaustible resource “The soil is the one indestructible, immutable asset that the nation possesses. It is the one resource that cannot be exhausted; that cannot be used up.” (Bureau of Soils, 1909)
- The Dust Bowl Era proved that mismanaged soil can wash away or blow away rendering productive farmland useless.
- If soil provides ecosystem benefits for everyone, doesn't everyone have a stake in its preservation?





<sup>1</sup>Photographs courtesy of the USDA-NRCS

# ESS3.C

## Human Impacts on Earth Systems

- Grade K-2: Things People Do Can Affect The Environment But They Can Make Choices to Reduce Their Impacts
- Grade 3-5: Societal Activities Can Affect and Help Protect Earth's Resources and Environments
- Grade 6-8: Human Activities Have Altered the Biosphere But Activities and Technologies Can Be Engineered to Reduce People's Impacts on Earth
- Grade 9-12: Sustainability of Human Societies Requires Responsible Management of Natural Resources, Including the Development of Technologies

# ESS3.C

## Human Impacts on Earth Systems

Grade K-2: Things People Do Can Affect The Environment But They Can Make Choices to Reduce Their Impacts

Why should you stay on marked trails?

Why should you leave the soil and vegetation around streams alone?

Would you dump anything on soil that you wouldn't dump on yourself?

# ESS3.C

## Human Impacts on Earth Systems

- Marked trails through natural areas serve a purpose – they protect natural vegetation from destruction and they protect soil from erosion.
- Maintaining the soil and vegetation around streams – even small streams – helps to increase land value, reduce problems like erosion, improve water quality, and provide wildlife habitat. These are all ecosystem functions that benefit us.
- Soil is alive. If you dump something harmful on you, what do you think will happen to the living things in soil?

# ESS3.C

## Human Impacts on Earth Systems

Grade 3-5: Societal Activities Can Affect and Help Protect Earth's Resources and Environments

Why is Kentucky one of the national leaders in no-tillage?

What is the reason for restoring wetlands?

Why is promoting soil conservation good for agriculture?

# ESS3.C

## Human Impacts on Earth Systems

- Prior to the 1950's Kentucky had serious problems with soil erosion. Kentucky farmers were among the earliest adapters of no-tillage, which preserves soils structure and organic matter and reduces the effects of water erosion.
- Much of Kentucky relies on surface water or shallow well water for its potable water. Soil acts like the 'kidneys' of the Earth to filter and transform harmful compounds. Wetland soils are even more important in this function because they are so close to the waters we use.
- Soil erosion removes nutrients and organic matter that would make a farm fertile and productive. Promoting soil conservation means those farms can remain productive with fewer fertilizers, lime, herbicides, and pesticides. It is a key to long term sustainability of agriculture.

# ESS3.C

## Human Impacts on Earth Systems

Grade 6-8: Human Activities Have Altered the Biosphere But Activities and Technologies Can Be Engineered to Reduce People's Impacts on Earth

What are 'plaggen' and 'terra preta' soils?

How are soils restored during surface mining?

# ESS3.C

## Human Impacts on Earth Systems

- These soil cores were removed from continuous sod or no-tillage fields. Plaggen soils have a human-made surface horizon, often > 50 cm deep, that forms from centuries of tillage and manuring.
- Terra Preta soils or Amazonian Dark Earths, are soils from the Amazon rain forest that are artificially enriched in persistent organic matter. It is thought the indigenous people engineered these soils by continual addition of charcoal/biochar to increase their fertility.
- Prime farmland reclamation in western Kentucky required that the surface soil of a mine be removed – by horizon – and stockpiled for replacement once mining was completed so that the agricultural value of the soil could be preserved as much as possible once the coal resources were removed.



# ESS3.C

## Human Impacts on Earth Systems

Grade 9-12: Sustainability of Human Societies Requires Responsible Management of Natural Resources, Including the Development of Technologies

What is no-tillage?

Why is biochar added to soil?

What is 'swidden' agriculture?

# ESS3.C

## Human Impacts on Earth Systems

- No tillage is the planting of seeds and the addition of fertilizers to row crops without tilling the soil to prepare a seedbed or mix fertilizers. It preserves soil structure and plant residue. But it requires new technologies in equipment and herbicides to control weeds or remove the previous crop without tillage.
- Biochar – organic matter combusted without air – is added to soil because it has extremely high surface area and capacity to retain nutrients and contribute to improved soil structure.
- Swidden agriculture (slash and burn) if properly done recovers fertility from aboveground vegetation while preserving seed-producing species to revegetate the soil.

# ESS3.C

## Human Impacts on Earth Systems

- Native Americans used periodic fires to keep trees from growing in grasslands and preserve the grasslands for bison, which were a major food source.
- Today, controlled fires are used to manage forests and grasslands.



# LS2.A

## Interdependent Relationships in Ecosystems

- Grade K-2: Interdependence of Plants and Animals
- Grade 3-5: Primary Productivity and Decomposition
- Grade 6-8: Ecological Relationships
- Grade 9-12 Ecosystems and Carrying Capacity

# LS2.A

## Interdependent Relationships in Ecosystems

Grade K-2: Interdependence of Plants and Animals

How is soil essential for plants and animals?

If water fell on these cores, what would happen to it?

# LS2.A

## Interdependent Relationships in Ecosystems

- Soil is like the lungs, and stomach, and kidneys of the Earth.
- Soil provides the medium in which plants grow. Animals need the plants for food and the oxygen from plants to breathe.
- Dead plants and animals decompose in the soil and turn into nutrients that new plants can use.
- Dirty water filtering through soil becomes cleaner so animals can drink it
- Soil stores water after rain so plants can grow when there is no rain.

# LS2.A

## Interdependent Relationships in Ecosystems

Grade 3-5: Primary Productivity and Decomposition

If nothing decomposed, what would happen?

How much undecomposed material is on top of these cores?



# LS2.A

## Interdependent Relationships in Ecosystems

- Life on Earth depends on cycles; if the cycles break, everything breaks.
- If plants and animals did not decompose in soil, then none of the carbon they contain would return to the atmosphere for new plants to grow; none of the nutrients they contain would be recycled to make new life.
- Every naturally occurring compound on Earth decomposes.
- This is the theory of microbial infallibility; otherwise, the Earth's surface would be covered deep in undecomposed material.

# LS2.A

## Interdependent Relationships in Ecosystems

### Grade 6-8: Ecological Relationships

How is soil like a house?

What are the ecological interactions of organisms in soil?

Does the structure of these soil cores seem to change as you increase depth?

# LS2.A

## Interdependent Relationships in Ecosystems

- Soil has different sized particles: sand ( $< 2$  mm but  $> 0.05$  mm), silt ( $> 0.002$  mm), and clay ( $< 0.002$  mm)
- These particles are put together into aggregates.
- Putting aggregates together makes voids called pores that can be very small (nanopores) or very large (macropores)
- Water and air fill these pores and moved through them
- Soil organisms and decomposed organic matter are also in the pores.

# LS2.A

## Interdependent Relationships in Ecosystems – Key Ecological Relationships

Neutralism – organisms do not influence one another.

Commensalism – one organism benefits from the activities of another organism.

Amensalism – one organism is harmed by another organism.

Mutualism (Synergism, Symbiosis) – two organisms working together either because of interaction or vicinity grow better than either alone.

Parasitism – one organism uses another organism for food without necessarily killing it.

Predation – one organisms eats another.

Competition – two organisms compete with one another for scarce resources and neither grows as well as when alone.

# LS2.A

## Interdependent Relationships in Ecosystems

### Grade 9-12: Ecosystems and Carrying Capacity

What are 'Resistance' and 'Resilience?'

How do you determine the carrying capacity of soil?

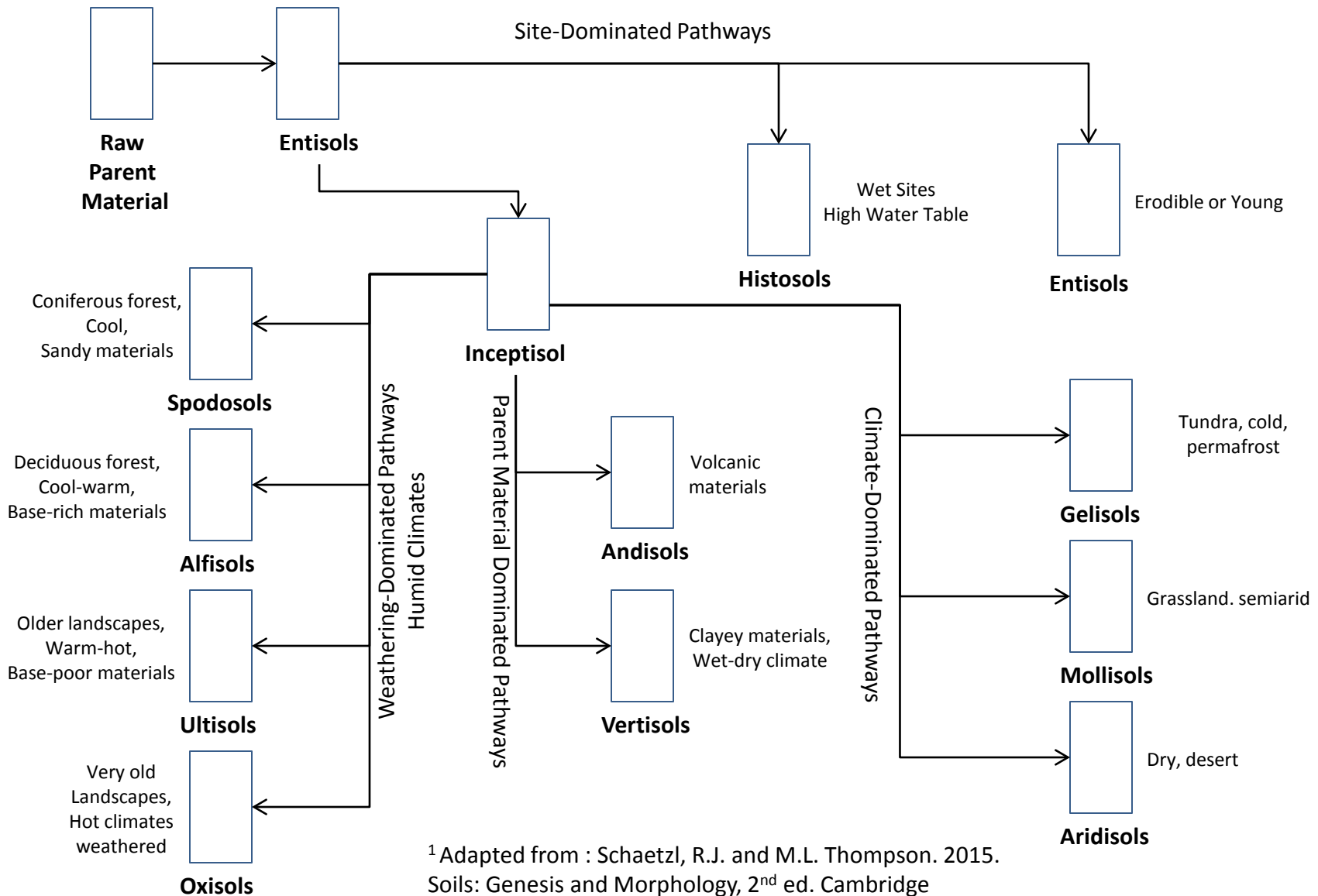
What influences Soil Health (the sustainability of a soil's ecosystem functions) and Soil Quality (the capacity to perform a desired function)?

# LS2.A

## Interdependent Relationships in Ecosystems

- All soils do not have the same carrying capacity.
- Carrying capacity depends on the soil forming factors and the development of the soil.
- Resistance is the capacity of a soil to 'resist' disturbance and maintain its basic functions.
- Resilience is the capacity of a soil to bounce back from a disturbance to approach its original ecosystem functions.
- Resistant and resilient soils are both characterized by high species diversity.
- One of the best measures of soil activity is respiration (CO<sub>2</sub> production).

# Soil Development Pathways<sup>1</sup>



<sup>1</sup> Adapted from : Schaetzl, R.J. and M.L. Thompson. 2015. Soils: Genesis and Morphology, 2<sup>nd</sup> ed. Cambridge University Press, p. 127.

# Your Soil Cores – Crider Silt Loam

(Google 'Web Soil Survey')

(<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>)

- **Taxonomic class**  
Fine-silty, mixed, active, mesic Typic Paleudalfs
- **Taxonomic description**  
The Crider series consists of very deep, well drained, moderately permeable soils on uplands. They formed in a loess mantle and the underlying residuum from limestone.
- **Where will you find this soil?**  
Crider soils are on nearly level to moderately steep uplands. Slopes commonly range from 0 to 12 percent, but the range allows to 30 percent. Many areas are undulating to rolling karst topography. The upper 20 to 45 inches of the soil formed in loess and the lower part formed in limestone residuum or old alluvium. Near the type location, the mean annual temperatures is 57° F and the mean annual precipitation 48 inches.
- **How widely is it distributed?**  
The Pennyroyal and the western Outer Bluegrass of Kentucky; the northern part of the Highland Rim of Tennessee, Illinois and possibly northeast Arkansas. The soil is of large extent.
- **What would you see if you dug into this soil?**  
Thickness of the soil ranges from 60 to more than 100 inches. Depth to bedrock ranges from 60 to more than 160 inches; commonly more than 100 inches. Fragments of chert ranges from 0 to about 15 percent. Reaction is from neutral to strongly acid to a depth of 40 inches, and from moderately acid to very strongly acid below 40 inches.
- **What will happen if you pour water on this soil?**  
Well drained. Runoff ranges from low to high. Permeability is moderate.
- **Under what conditions did this soil develop?**  
The original vegetation was mixed hardwood forest, chiefly of oaks, maple, hickory, elm, ash, and hackberry.
- **What is this soil's current land use?**  
Nearly all of the soil is used for growing crops and pasture. The chief crops are corn, small grains, soybeans, tobacco, and hay; truck crops are grown in a few places.



# Your Soil Cores – Lanton Silt Loam

(Google 'Web Soil Survey')

(<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>)

- **Taxonomic class**  
Fine-silty, mixed, superactive, thermic Cumulic Epiaquolls
- **Taxonomic description**  
The Lanton series consists of very deep, poorly and somewhat poorly drained soils that are dark in the surface layer and to a depth of 24 inches or more. These soils formed in alluvium on flood plains and in depressions. They have moderately slow permeability in the surface soil and slow permeability in the clayey substratum.
- **Where will you find this soil?**  
Lanton soils are on nearly level flood plains and in depressions. Slopes range from 0 to 3 percent. The soil is formed in alluvium. Near the type location, mean annual temperature is 59° F and mean annual precipitation is 47 inches.
- **How widely is it distributed?**  
The Nashville Basin and Highland Rim of Tennessee, the Bluegrass region of Kentucky, and in Missouri and Kansas. The series is of small extent.
- **What would you see if you dug into this soil?**  
Soil thickness ranges from 24 to 45 inches and depth to bedrock is more than 60 inches. This soil is slightly acid or neutral throughout. The mollic surface layer is more than 24 inches in thickness.
- **What will happen if you pour water on this soil?**  
Poorly drained and somewhat poorly drained; slow runoff; moderately slow permeability except that the lower, clayey part is slow.
- **Under what conditions did this soil develop?**  
The original vegetation was hardwood forest.
- **What is this soil's current land use?**  
Nearly all of the acreage is cleared and used for growing corn, soybeans, hay, and pasture.

# Your Soil Cores – Maury Silt Loam

(Google 'Web Soil Survey')

(<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>)

- **Taxonomic class**

Fine, mixed, active, mesic Typic Paleudalfs

- **Taxonomic description**

The Maury series consists of very deep, well drained, moderately permeable soils that formed in silty material over residuum weathered from phosphatic limestone. These soils are on uplands.

- **Where will you find this soil?**

Maury soils are on nearly level to moderately steep uplands. Slopes are commonly 0 to 12 percent, but range to 20 percent. The underlying limestone is cavernous and some areas have karst topography. The upper 10 to 20 inches of the soil formed in silty material and the lower part formed in residuum weathered from phosphatic limestone. The mean annual precipitation is about 45 inches and the mean annual temperature is about 54° F.

- **How widely is it distributed?**

The Inner Bluegrass Physiographic Region of Kentucky.

- **What would you see if you dug into this soil?**

Thickness of the soil ranges from 60 to 120 inches or more. Depth to bedrock ranges from 60 to 200 inches or more. Chert fragments, less than 3 inches in diameter, range from 0 to 5 percent in the lower horizons. The reaction of the upper soil ranges from neutral to strongly acid. The phosphate content in the soil is variable but is typically medium or high.

- **What will happen if you pour water on this soil?**

Well drained. Runoff is slow to medium and permeability is moderate to moderately rapid.

- **Under what conditions did this soil develop?**

Native vegetation was dominated by oaks, elm, ash, black walnut, black and honey locust, hackberry, black cherry, and Kentucky coffee tree. Glades of native grasses and canes were reported by early settlers.

- **What is this soil's current land use?**

Most areas are used for crops such as burley tobacco, corn, small grains, and alfalfa; and for pasture. Bluegrass and white clover are the most common pasture plants.

# Your Soil Cores – Zanesville Silt Loam

(Google 'Web Soil Survey')

(<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>)

- **Taxonomic class**  
Fine-silty, mixed, active, mesic Oxyaquic Fragiudalf
- **Taxonomic description**  
The Zanesville series consists of deep, moderately well drained soils in uplands. These soils formed in loess overlying residuum from sandstone, siltstone, and shale parent material. They have a characteristic fragipan horizon.
- **Where will you find this soil?**  
Zanesville soils are found in uplands on the summits, shoulders, and backslopes of smooth convex ridgetops in cultivation. Slopes range from 0 to 30 percent. Near the type location, mean annual temperature is 53- 59° F and mean annual precipitation is 39-54 inches.
- **How widely is it distributed?**  
The Zanesville soil is found in Kentucky, Illinois, Indiana, and Ohio. The series is of large extent.
- **What would you see if you dug into this soil?**  
Soil thickness ranges from 39 to 60 inches and depth to bedrock is more than 60 inches. This soil is slightly acid. The dominant feature is a distinct fragipan at 28-39 inches that is strongly acid, distinctly grey and retards root penetration. Rust-colored mottles appear over this layer because of wetting and drying.
- **What will happen if you pour water on this soil?**  
Although it drains well, because of an impermeable fragipan, saturated hydraulic conductivity is very low and the potential for runoff is high as well as the potential for standing water.
- **Under what conditions did this soil develop?**  
The original vegetation was hardwood forest.
- **What is this soil's current land use?**  
Much of the acreage is cleared and used for growing corn, soybeans, hay, and pasture. Where wooded it is dominated by white and black oak, shagbark hickory, sugar maple, and tulip poplar.

# For More Information/Quick Answers

- [www.soils.org](http://www.soils.org)  
Soil Science Society of America
- [www.fao.org/soils-portal/en/](http://www.fao.org/soils-portal/en/)  
Food and Agriculture Organization



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