

# Soil Formation

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**Lesson Plan: NRES B2-4**

# Anticipated Problems



1. What are five different factors that affect soil formation?
2. What are some different types of parent material that affect soils?
3. What is topography, and how does it affect the development of soil?

# Anticipated Problems



4. How do living organisms affect the development of soil?
5. What is weathering? How does weathering and time affect soil?
6. How does climate affect soil development?

# Terms



- alluvium
- bedrock
- chemical weathering
- climate
- glacial till
- glacier
- loess
- native vegetation
- organic matter
- outwash
- parent material
- physical weathering
- prairie soil
- timber soil
- topography

# Factors that Affect Soil Formation



- Parent material—the type of rock material from which the soil is formed
- Topography—the slope characteristics of the soil
- Living organisms—the organisms, including plant material, that live within the soil

# Factors that Affect Soil Formation



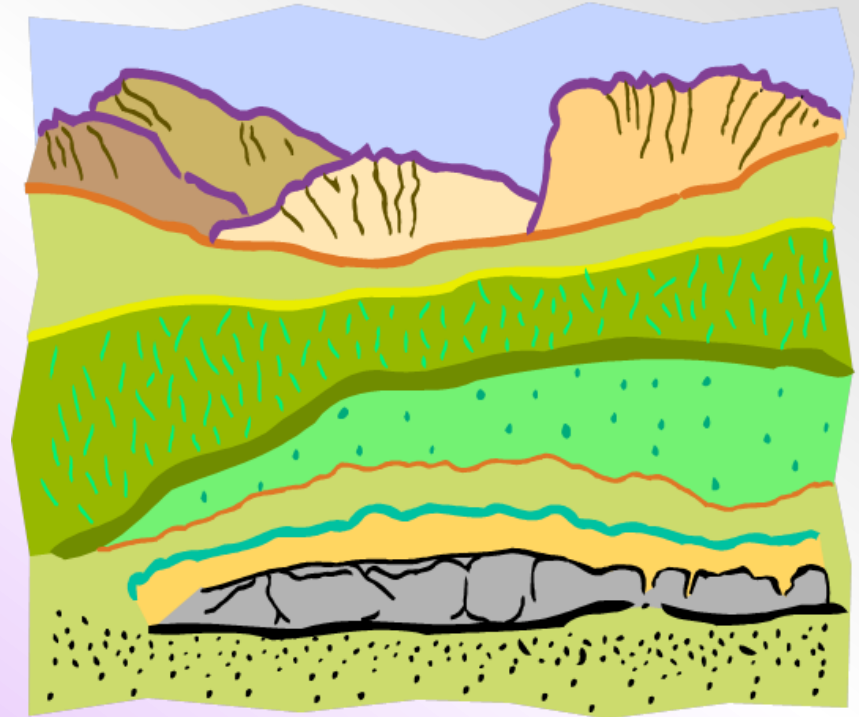
- Time or weathering—the age of the soil or the climate where the soil is found
- Climate—the temperature and moisture characteristics of the area where the soil was formed



# Types of Parent Material Affecting Soil



- ***Parent material*** is formed by the disintegration and decomposition of rock.
- Classified according to the way it was moved and scattered



# Types of Parent Material Affecting Soil



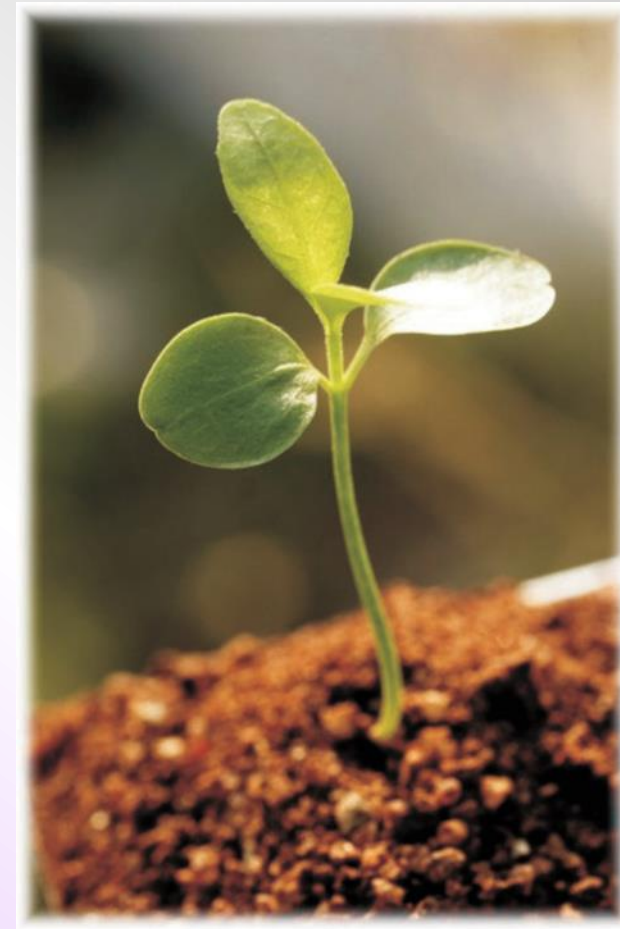
- A ***glacier*** is a large, long-lasting river of ice that is formed on land and moves in response to gravity.
- Two major glaciers, the Illinoisan and the Wisconsinan, had the greatest influence on present-day soils in Illinois.



# Types of Parent Material Affecting Soil



- Soils of glacial origin are classified:
  - Loess
  - Outwash
  - Glacial till



# Soils of Glacial Origin



- ***Loess*** originated from the blowing of the soil after the glaciers melted and dried.
  - The single most desirable soil parent material.
  - Well-balanced mineral content
  - Medium texture
  - Excellent water-holding capacity

# Soils of Glacial Origin



- ***Outwash*** originated when the glaciers melted.
  - Melted waters carried the gravelly materials away to be deposited below the glacial ridges.
  - Sandy outwash was carried farther downstream
  - The finer materials—silt and clay—were deposited in lakebeds or slow-moving streams.

# Soils of Glacial Origin



- ***Glacial till*** is parent material that was physically moved and deposited by the glacier itself.
  - Often contains a variety of sizes of soil particles that have not been layered from the effects of wind or water (as have the other two types of glacial soils)
  - Pebbles and various sizes of boulders are common in till.

# Types of Parent Material Affecting Soil



- ***Alluvium*** is generally a water-borne material deposited on bottomlands.
- Results of recent sediments deposited by streams as they flood



# Types of Parent Material Affecting Soil



- ***Bedrock*** is solid rock usually under the soil or other loose material.
  - Often buried by loess, outwash, glacial till, or alluvium

# Types of Parent Material Affecting Soil



- ***Organic matter*** is decayed or partially decayed plants and animals, roots, and living organisms.
  - Organic soil is found where formerly shallow ponds supported swamp vegetation.
  - The wet conditions slowed decay of the dead plants so that organic matter could accumulate.
  - Two types: peat and muck





**Technicians process soil samples for organic matter analysis. (courtesy USDA)**



# What is Topography?

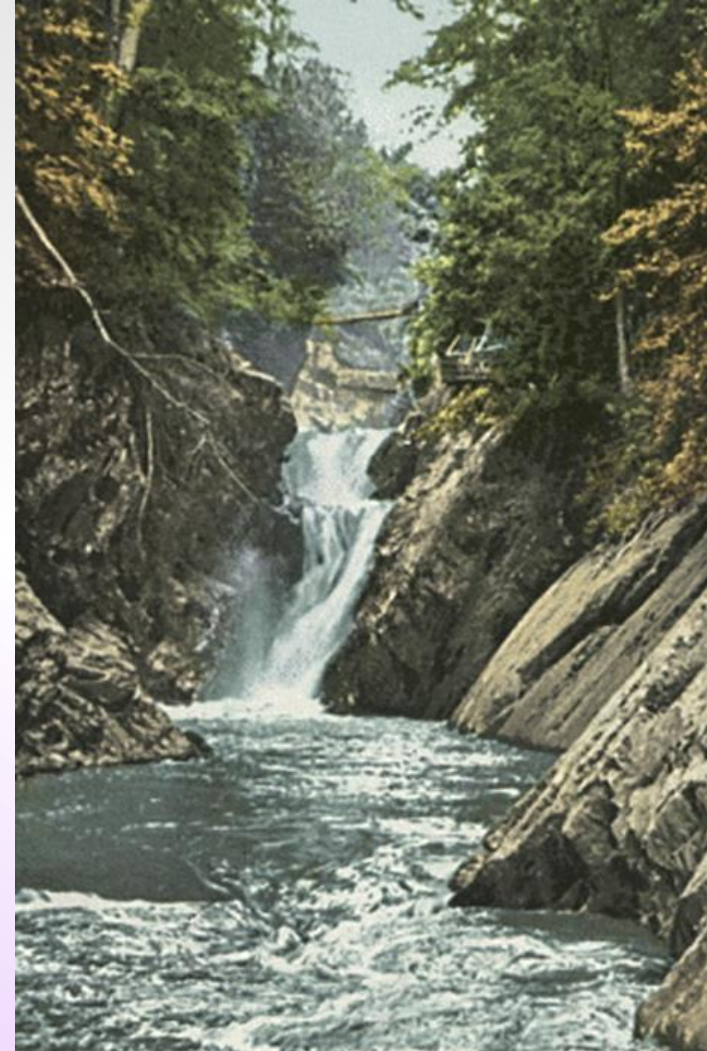


- ***Topography*** is the slope characteristics of a soil.
  - Degree or steepness
  - Length
  - Shape
  - Direction of a slope

# What is Topography?



- These factors influence the amount of rainwater runoff or the amount that enters the soil or collects in small depressions on the soil surface.



# What is Topography?



- Soils on steep slopes have higher amounts of runoff and erosion than those on level topography.
- Soils in depressions and on nearly level topography are likely to have poor or very poor natural drainage.
- Soils on moderately sloping to steep topography are usually well drained.

# Types of Organisms Affecting Soil



- Organisms that live in soil—plants, animals, and microbes—actively affect soil formation.
- The greatest effect on the development of soil is from plants that once grew in it. These plants are referred to as ***native vegetation***.

# Types of Organisms Affecting Soil



- Native vegetation determines the kind and amount of organic matter in the soil. Two types in Illinois:
  - Tall prairie grass
  - Deciduous-hardwood forests

# Types of Organisms Affecting Soil



- Soils in the areas of this vegetation are called:
  - Prairie soil
  - Timber soil

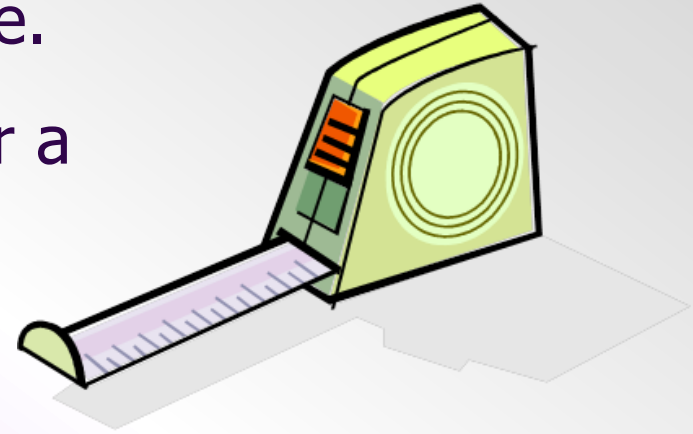




# Types of Organisms Affecting Soil



- ***Prairie soil*** has a dark and deep surface layer.
  - Roots from the prairie grass filled the top of the soil to a depth of 1 to 2 feet or more.
  - Partial decay of these roots over a long period gave the soil high organic-matter content



# Types of Organisms Affecting Soil



- ***Timber soil*** tends to have a thin, moderately dark layer.
  - Due to organic matter accumulating on the surface, where decay occurs more rapidly.
  - When tilled, this dark material is mixed with the soil below to produce a lighter color.



# Types of Organisms Affecting Soil



- Other living matter that influences the development of soil includes various kinds of animal life.
  - Earthworms, crawfish, ground squirrels and other burrowing animals, and various insects that incorporate organic matter into the soil.



# How Weathering & Time Affects Soil



- Weathering plays a major role in the formation of soil. Weathering is the decomposition of rocks.
  - Physical weathering
  - Chemical weathering

# How Weathering & Time Affects Soil



- ***Physical weathering***—the effects of climatic factors, such as temperature, water, and wind.
  - Freezing and thawing is a major contributor

# How Weathering & Time Affects Soil



- ***Chemical weathering***—the effects of factors that change the elemental makeup of rock and break it down.
  - Rainwater is mildly acidic and can slowly dissolve many soil minerals.
  - Some minerals react with oxygen in the atmosphere.
  - Oxidation further acts to decompose rock.



# How Weathering & Time Affects Soil



- Weathering causes soil to develop, mature, and age.



**FIGURE 2.** The force from waves causes physical weathering.

# How Weathering & Time Affects Soil



- Develop—Soil develops rapidly.
  - Plant nutrients are released, and organic matter accumulates.
  - Soils will develop faster in humid regions than in arid regions.

# How Weathering & Time Affects Soil



- Mature—Mature soil is at peak productivity, with a high amount of organic matter.
  - Water begins leaching away nutrients
  - Plant growth starts to decline.
  - This results in less organic matter.



# How Weathering & Time Affects Soil



- Age—Minerals continue to break down, and clay is leached into the subsoil.
- The soil becomes lighter in color from less organic matter.



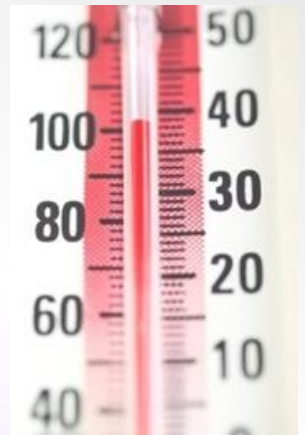
Courtesy USDA



# Climate Affects Soil



- Elements of climate influence soil formation.  
***Climate*** is the weather in a region over a long period.
- Three elements of climate related to soil development are temperature, rainfall, and wind.



# Climate Affects Soil



- These factors are either directly or indirectly responsible for the breakdown of rocks and minerals, the release of plant nutrients, and many other processes affecting the development of soils.

# Climate Affects Soil



- The climate in Illinois is said to be of the continental type.
  - Characterized by hot summers and cold winters.
  - Enhances the weathering process through freezing and thawing.



# Climate Affects Soil



- Rainfall during the growing season is similar across the state; however, southern Illinois receives more rainfall during the winter and early spring.
  - Soils in humid regions are subject to more leaching than soils in dry regions.
  - Rainfall wears the rock away a little at a time.

# Climate Affects Soil



- Wind also wears the rock away. Particles carried by the wind strike the rock and wear it down.





# Review

- How are the soils of glacial origin classified?
- What is topography and the factors that describe it?
- What various kinds of animal life might influence the development of soil?
- Name the two types of weathering that play a major role in the formation of soil.