

Introduction to Soil Science

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Key concepts, terminology, and the role of soil in natural and managed ecosystems.

1. What Is Soil Science?

Term	Definition
Soil Science	The interdisciplinary study of soil as a natural resource, covering its formation, classification, physical and chemical properties, biology, and management.
Pedology	The branch that focuses on soil genesis, morphology, and classification.
Edaphology	The branch that examines the influence of soil on plants, animals, and human activities (e.g., agriculture, engineering).

2. Why Soil Matters

1. **Food Production** – Provides the medium for crop growth and supplies essential nutrients.
 2. **Water Regulation** – Stores, filters, and transmits water; mitigates flood and drought impacts.
 3. **Carbon Sequestration** – Holds more carbon than the atmosphere and vegetation combined.
 4. **Habitat** – Supports a vast diversity of organisms (microbes, insects, earthworms).
 5. **Infrastructure** – Influences foundation stability, road building, and landfill design.
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3. Soil Formation (Pedogenesis)

3.1 The Five Parent Factors

Factor	Influence on Soil Development
Climate	Temperature & precipitation control weathering rates and organic matter decomposition.
Organisms	Plant roots, microbes, and fauna contribute organic matter and bioturbation.

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Factor	Influence on Soil Development
Parent Material	Rock type (igneous, sedimentary, metamorphic) provides mineral base.
Topography	Slope, aspect, and drainage affect erosion, moisture, and deposition.
Time	Longer periods allow more extensive weathering and horizon development.

3.2 Soil Development Stages

1. **Weathering of Parent Material** – Physical (freeze/thaw, abrasion) and chemical (hydrolysis, oxidation).
 2. **Organic Matter Accumulation** – Litter → humus; enriches C, N, and nutrients.
 3. **Horizon Formation** – Distinct layers (O, A, E, B, C, R) develop with characteristic colors, textures, and structures.
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4. Soil Horizons (Typical Profile)

Horizon Symbol		Main Features	Typical Processes
O	O	Organic layer (leaf litter, decomposing material)	Decomposition, humus formation
A	A	Topsoil; mix of mineral particles & organic matter	Root growth, nutrient cycling
E	E	Leached (eluviated) layer; lighter color	Removal of silicate clays, iron, aluminum
B	B	Subsoil; accumulation (illuviation) of clays, iron, carbonates	Clay translocation, carbonate precipitation
C	C	Partially weathered parent material	Minimal biological alteration
R	R	Unweathered bedrock	Basal material

Not all soils contain every horizon; the sequence varies with environment.

5. Fundamental Soil Properties

Property	What It Describes	Measurement / Unit
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Texture	Proportion of sand, silt, clay particles	% by weight (feel test, laser diffraction)
Structure	Arrangement of peds (granular, blocky, platy)	Visual classification, aggregate stability tests
Bulk Density	Mass of dry soil per unit volume	g/cm^3 (core method)