



Principles of Soil Science

Introduction

Lecture -2-



Orders of Soil Taxonomy

- 1- Alfisols** high base saturation – areas with low rain fall, but wetter than deserts.
- 2- Andisols** volcanic ash affected
- 3-Aridosols** deserts
- 4- Entisols** “young” soils (floodplain ,mountains , desert, etc.)
- 5- Geisols** permafrost – affected soils
- 6- Histosols** Organic soils ,common in wet and cold areas (marshes ,muskeg, etc.)
- 7-Inceptisols** Fairly “young” soils – soil development more advanced than Entisols
- 8-Molisols** thick ,dark surface - humid and sub-humid grasslands(corn belt)
- 9- Oxisols** very low fertility ,very “old” soils -humid tropics
- 10-Spodosols** humid temperature woodlands, acidic
- 11-Ultisols** low base saturation – humid warm – temperature, sub- tropics and tropics
low fertility , acidic.
- 12-Vertisols**

Soil physics

- Soil physics is a branch of soil science which deals with the mechanical behavior (i.e. physical properties) of soils as well as mechanical processes that take place in and through the soil.
- One of the fundamental subject of soil science is soil physics which deals with the study of **mechanics**, **heat** ,optics as they related to soil.
- Soil physics is a branch of soil science dealing with the **state** and **movement of matter** and **transformation of energy** in the soil.

Soils are characterized in many ways

- Soils are classified by **Color**, Texture, **Structure**, and **pH**
- Soil color = indicates its composition and fertility
 - **Black** or dark brown = rich in organic matter
 - **Pale gray** or white = indicates leaching.
- Soil texture = determined by the size of particles
 - from smallest to largest: **clay, silt, sand**
 - **Loam** = soil with an even mixture of the three affects how easily air and water travel through the soil
 - Influences how easy soil is to cultivate

Soil Characterization

Soil can be characterized by color and several other traits

1. **Texture** (percentage of sand, silt, and clay).

2- Structure

3- Porosity

4- Cation exchange capacity

5- pH

6- Parent material.

7- Infiltration rate.

8- Nutrient concentrations.

Soil Texture

- Soil texture is the relative proportions of the various soil separates namely **sand**, **silt**, and **clay** in a given soil. Natural soils are the mixture of soil separates of infinite combinations.
- Therefore, it is necessary to have some limits of variations among the soil separates to group them into textural classes upon significant differences in physical properties of each textural class.
- So the proportion of each size group in a given soil can not be altered easily. That is why soil texture is considered as a basic property of a soil.

Soil texture classification

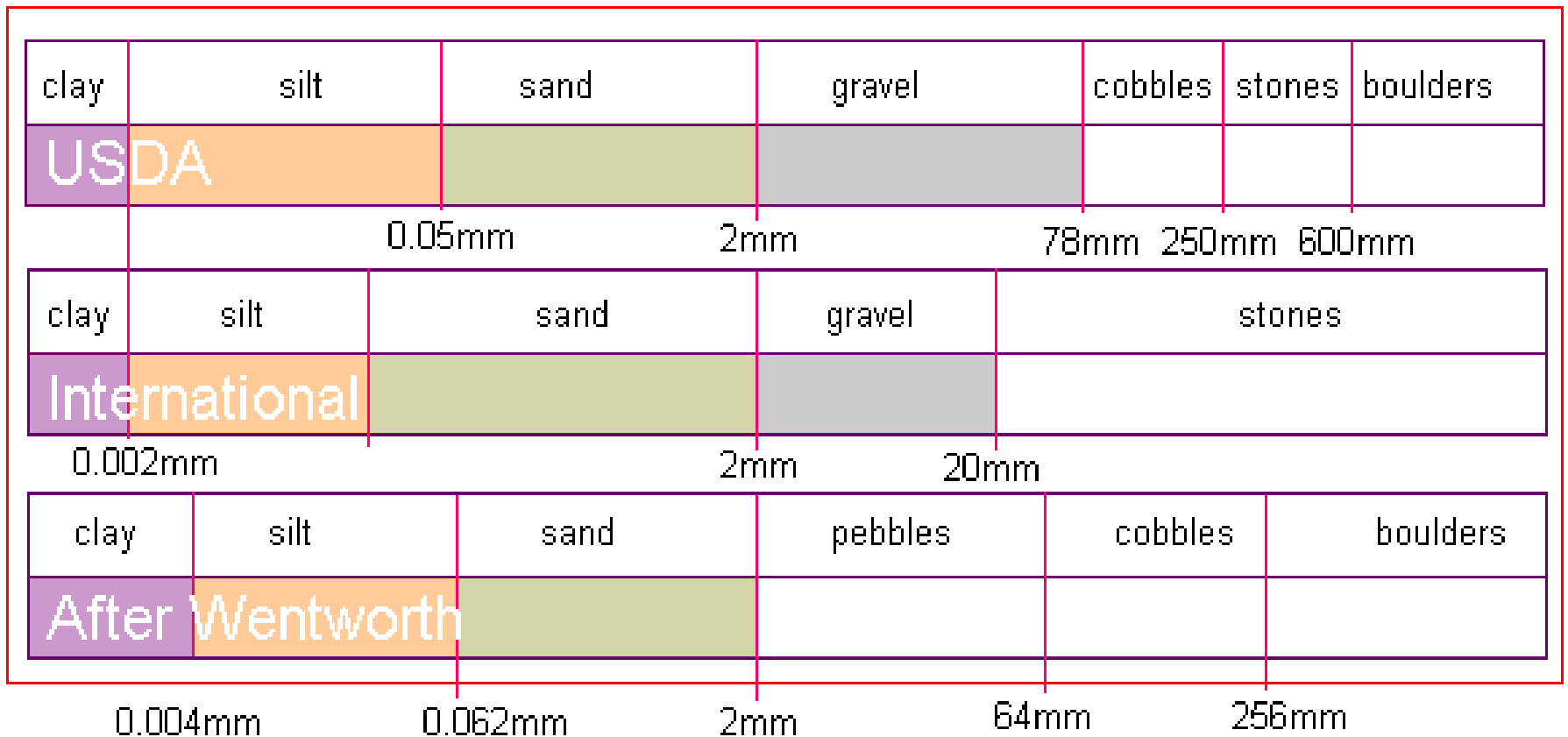
Silty soils with medium-size pores,

or

loamy soils with mixtures of pore sizes,

are

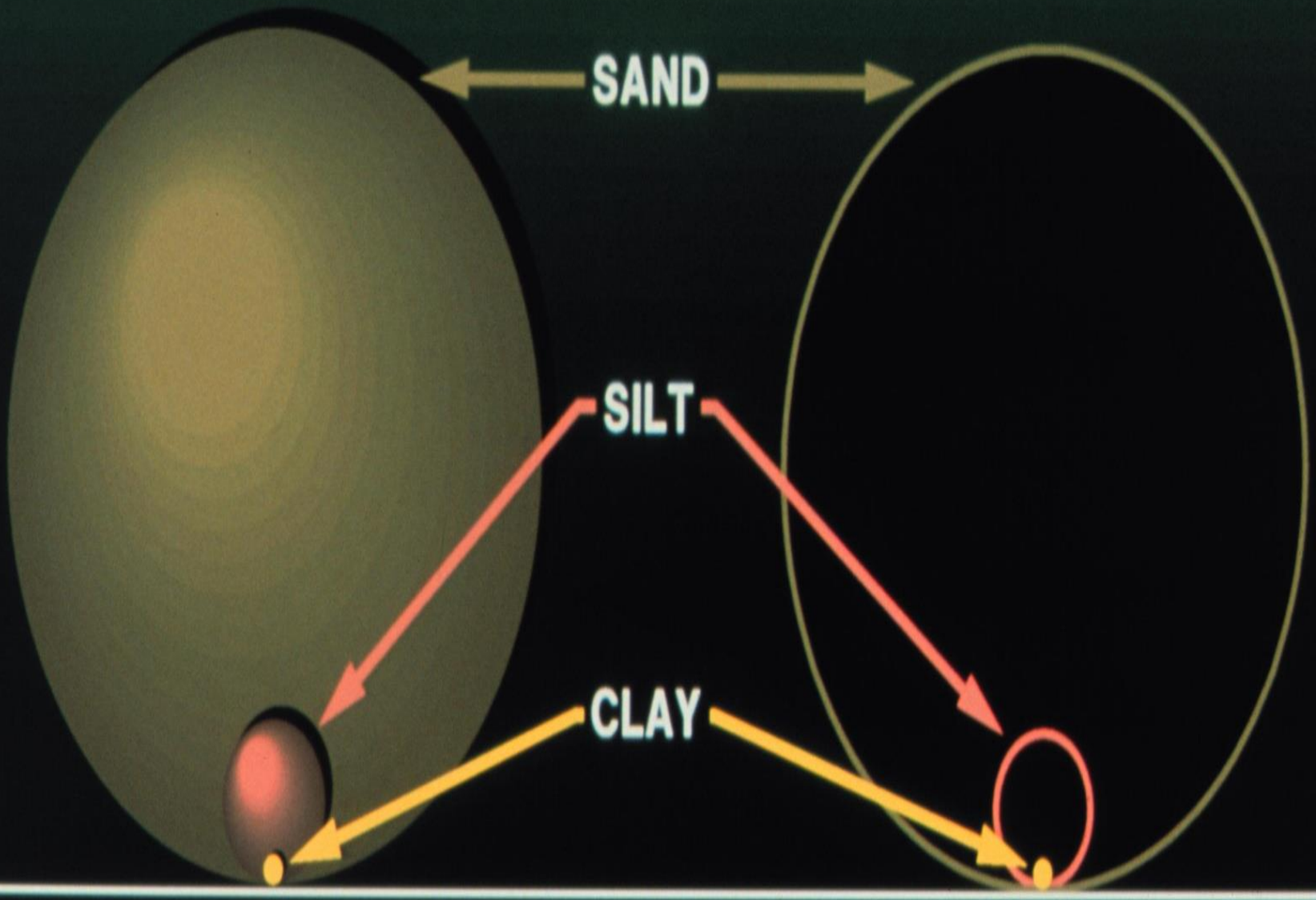
best for plant growth and agriculture.



Some commonly used soil particle size classification systems.

USDA: United States Department of Agriculture.

ISSS: International Society of Soil Science



SAND

SILT

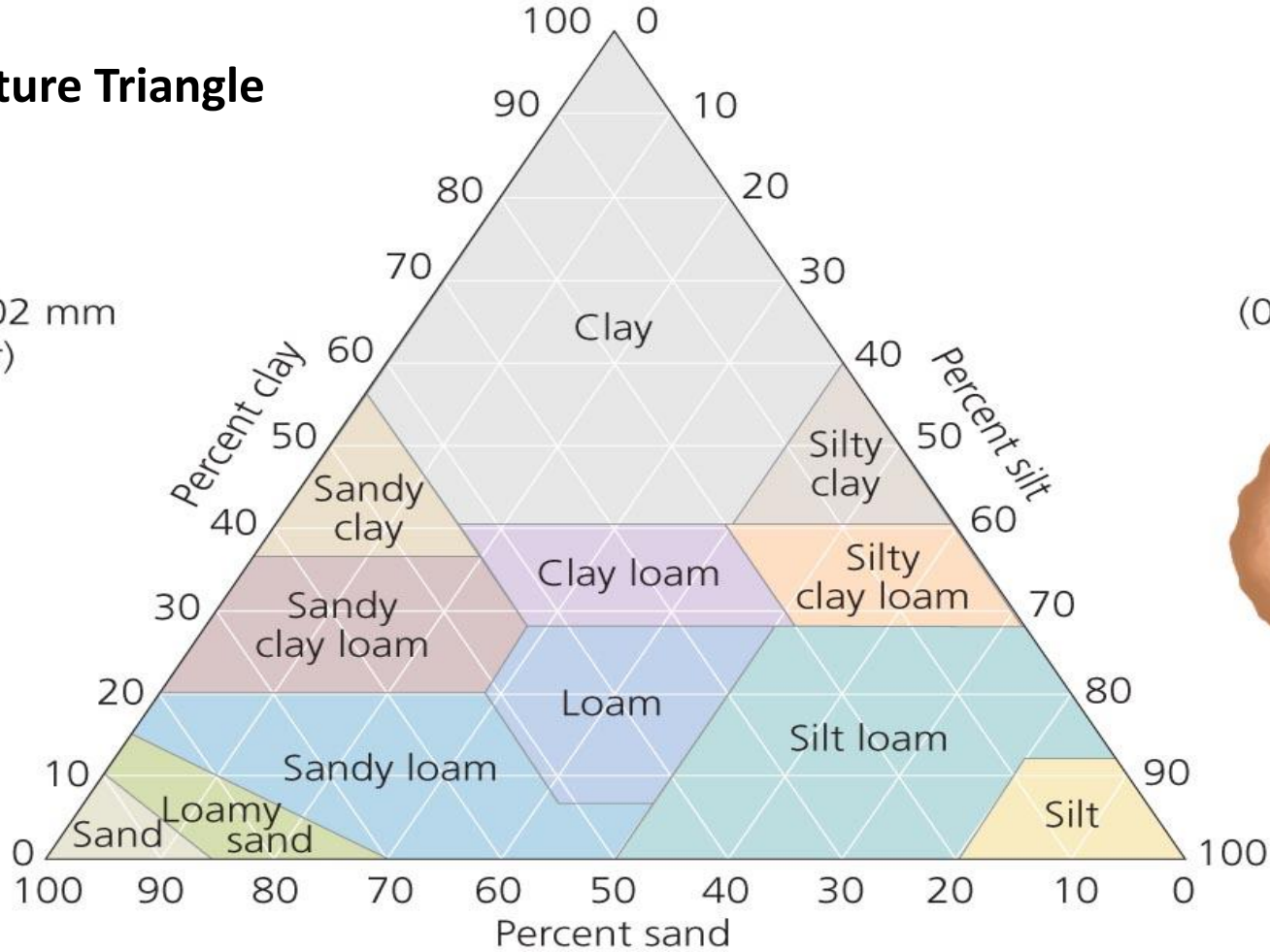
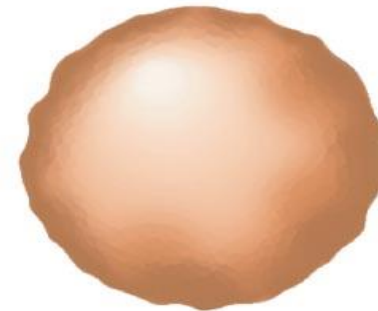
CLAY

USDA Texture Triangle

Clay
(less than 0.002 mm diameter)

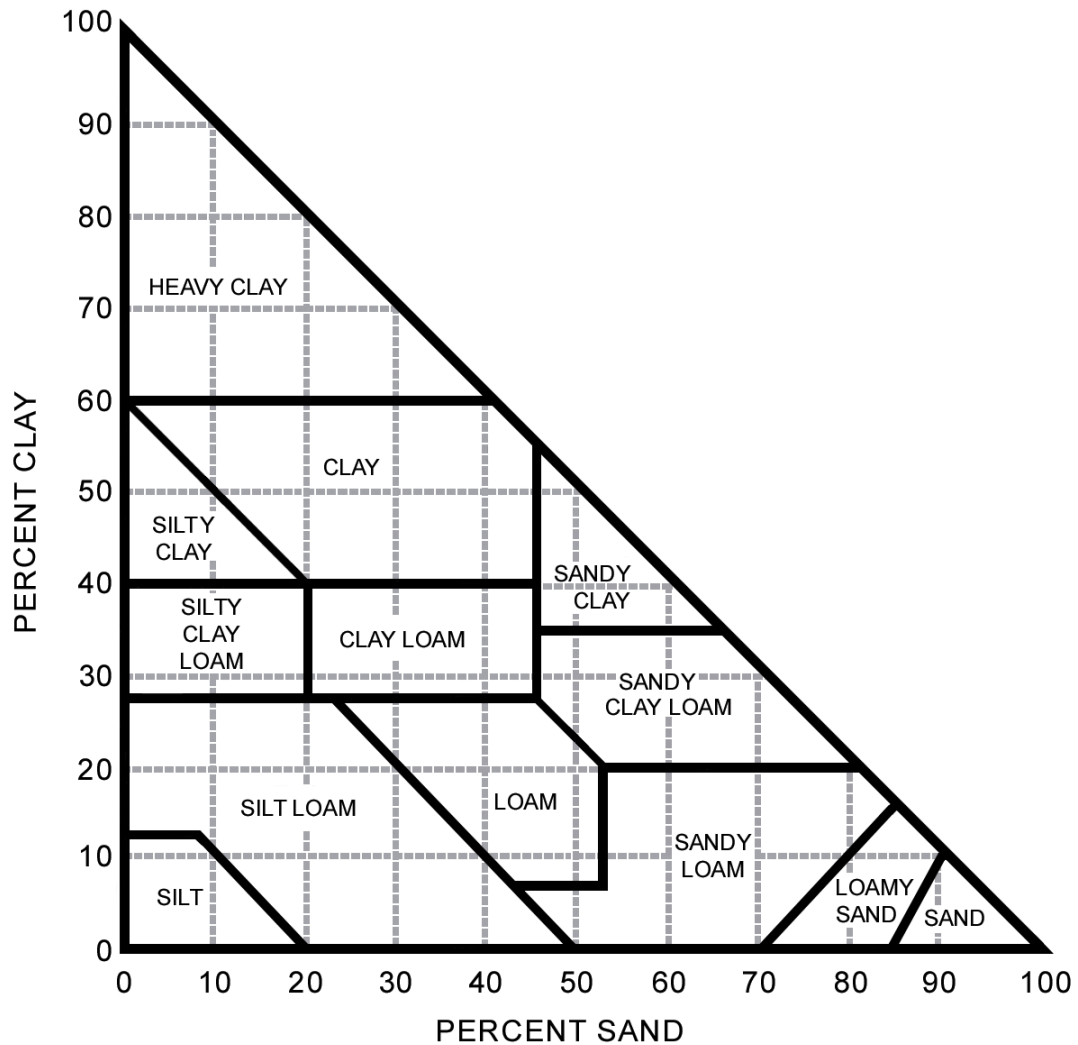


Silt
(0.002 – 0.05 mm diameter)



Sand
(0.05 – 2 mm diameter)



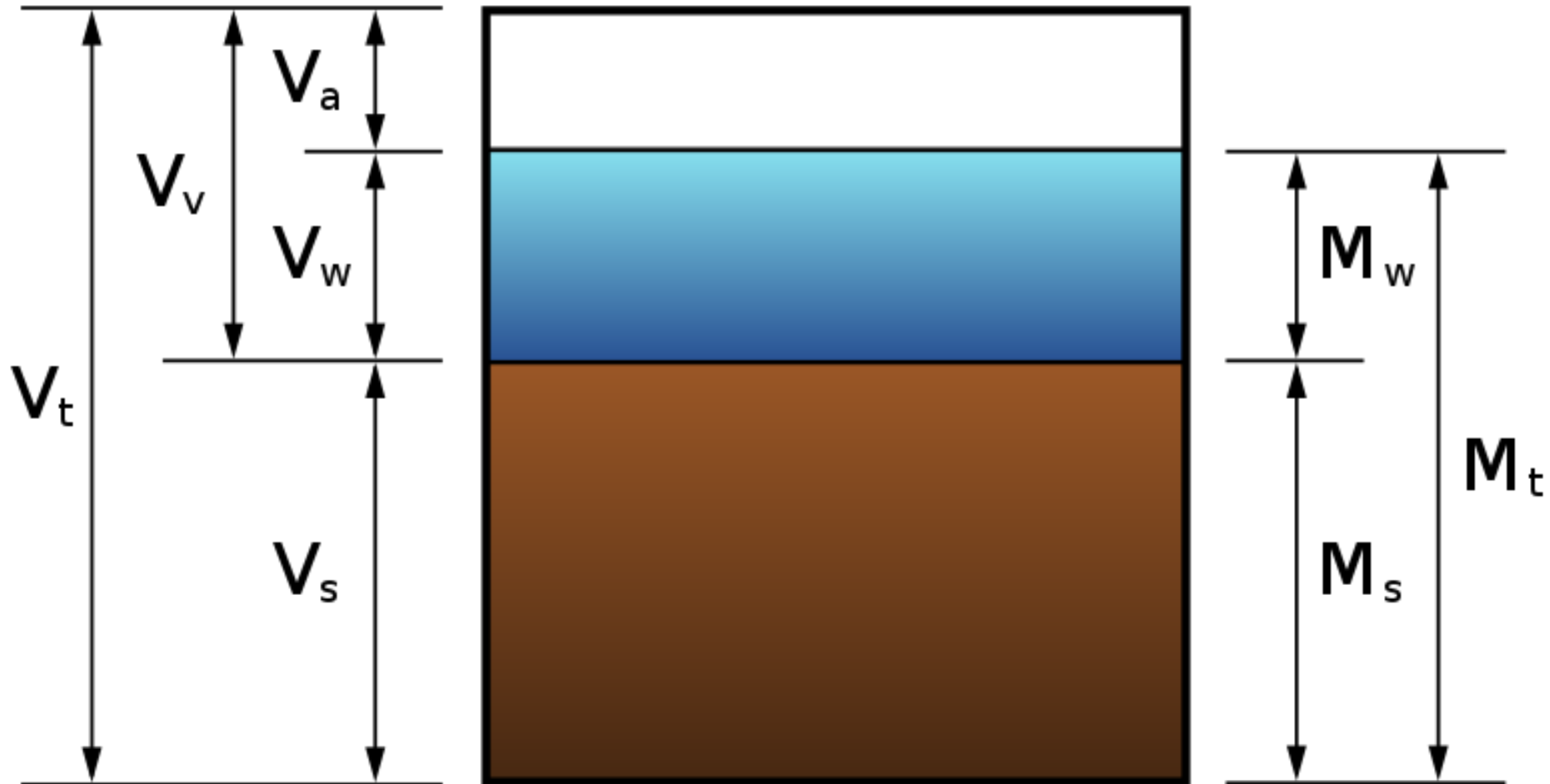


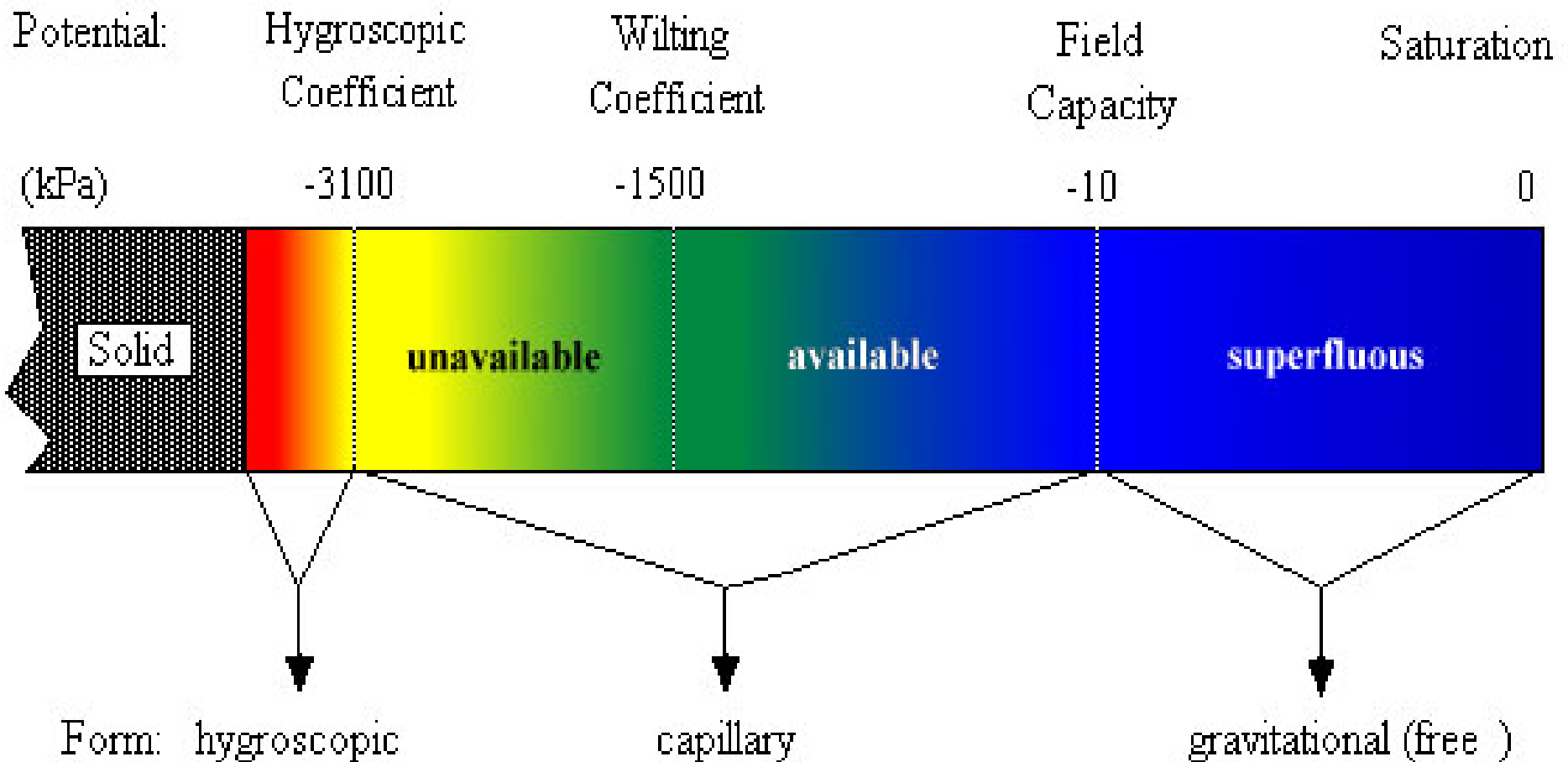
**Soil textural classes in the
Canadian System of Soil Classification**

Soil Water

- Water affects soil formation, structure, stability and erosion but is of primary concern with respect to plant growth. Water is essential to plants for four reasons:
 - 1- It constitutes **80%-95%** of the plant's protoplasm.
 - 2- It is essential for **photosynthesis**.
 - 3- It is the solvent in which **nutrients** are carried to, into and throughout the plant.
 - 4- It provides the turgidity by which the plant keeps itself in proper position

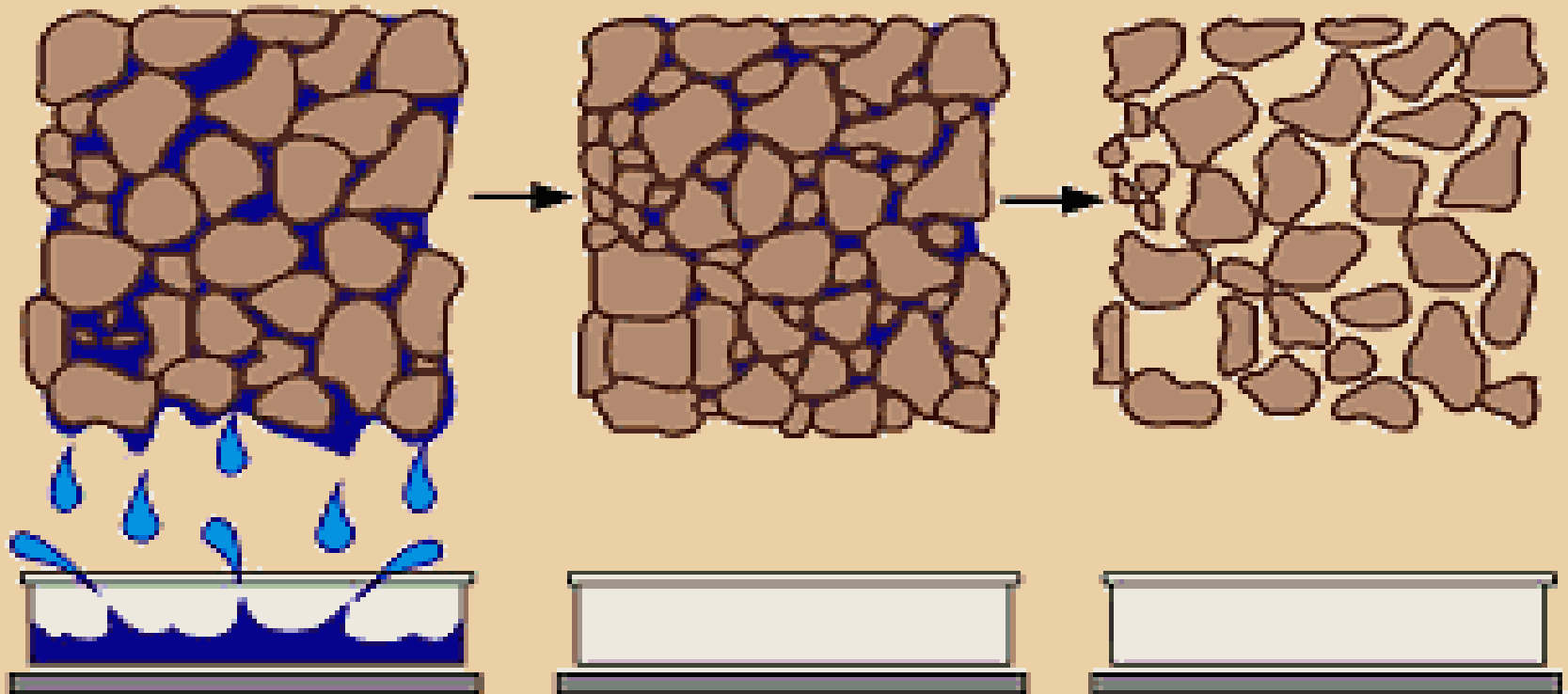
Soil composition by phase: s-soil (dry), v-void (pores filled with water or air), w-water, a-air. V is volume, M is mass





**Classification of soil water
(after Heaney, Crown and Palylyk, 1995).**

Classification of soil water



Saturation

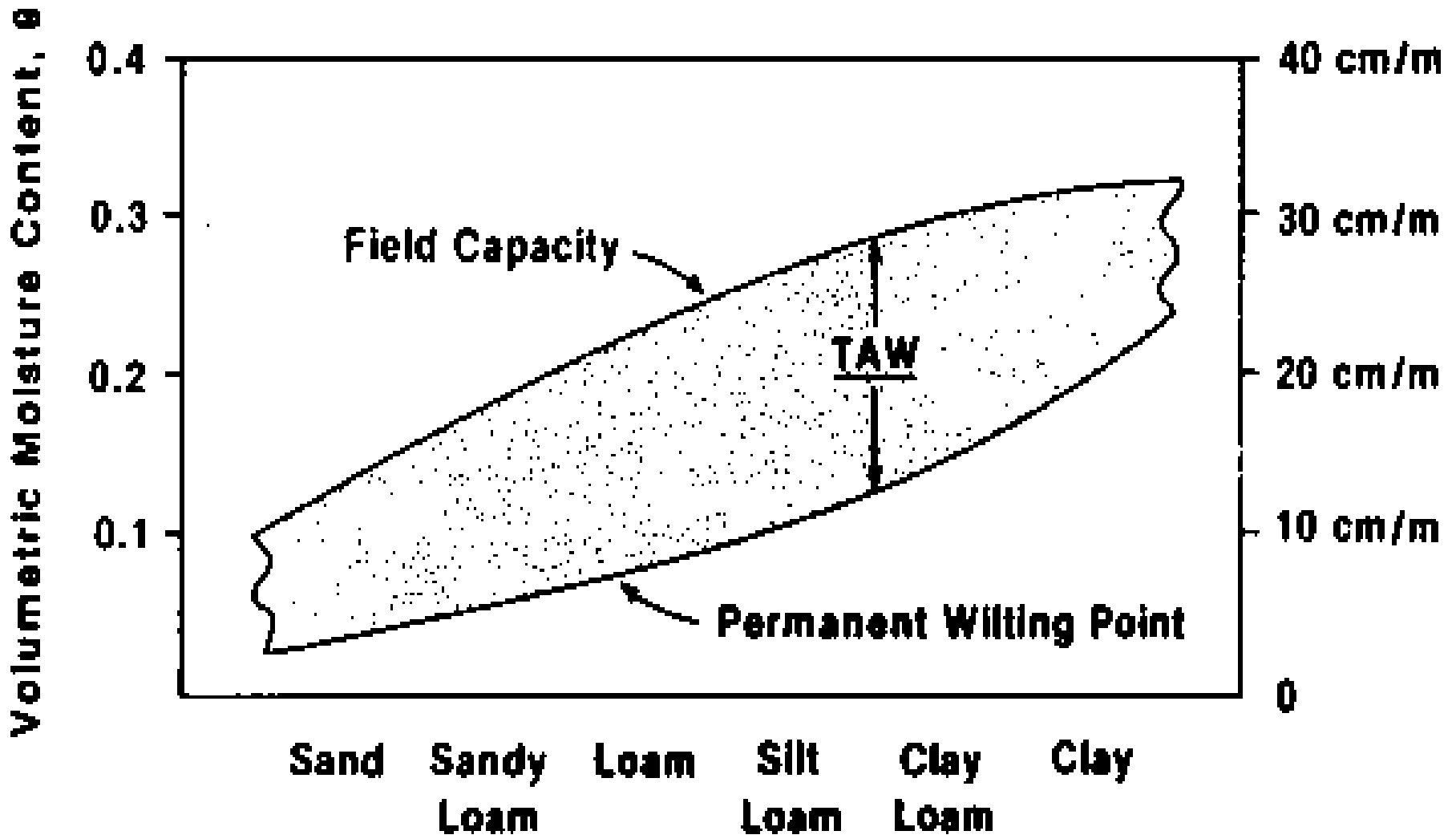
All pores are full of water. Gravitational water is lost

Field Capacity

Available water for plant growth

Wilting Point

No more water is available to plants



Relationships between soil types and total available soil moisture holding capacity, field capacity and wilting point