Physical Characteristics of Soil

- The physical characteristics of soils include all the aspects that you can see and touch such as:

- Texture
- Structure
- Colour
- Temperature
- Porosity (the space between the particles)
- Density

I. Soil Texture

- The particles that make up soil are categorized into three groups by size – sand, silt, and clay.

- Sand particles are the largest and clay particles the smallest. Most soils are a combination of the three.

- The relative percentages of sand, silt, and clay are what give soil its texture.

- Sand refers to soil that is loose and grainy.

- Sandy loam refers to soil containing a high percentage of sand but having enough silt and clay to make it somewhat coherent.

- Loam refers to soil having a relatively even mixture of different grades of sand, silt and clay.

- Silt loam refers to soil having a moderate amount of fine sand and only a small amount of clay; over half of the particles are of the size called silt.

- Clay loam refers to a moderately fine-textured soil that usually breaks into clods or lumps that are hard when dry.

- Clay refers to a fine-textured soil that usually forms very hard lumps or clods when dry, but is very pliable and usually sticky when wet.

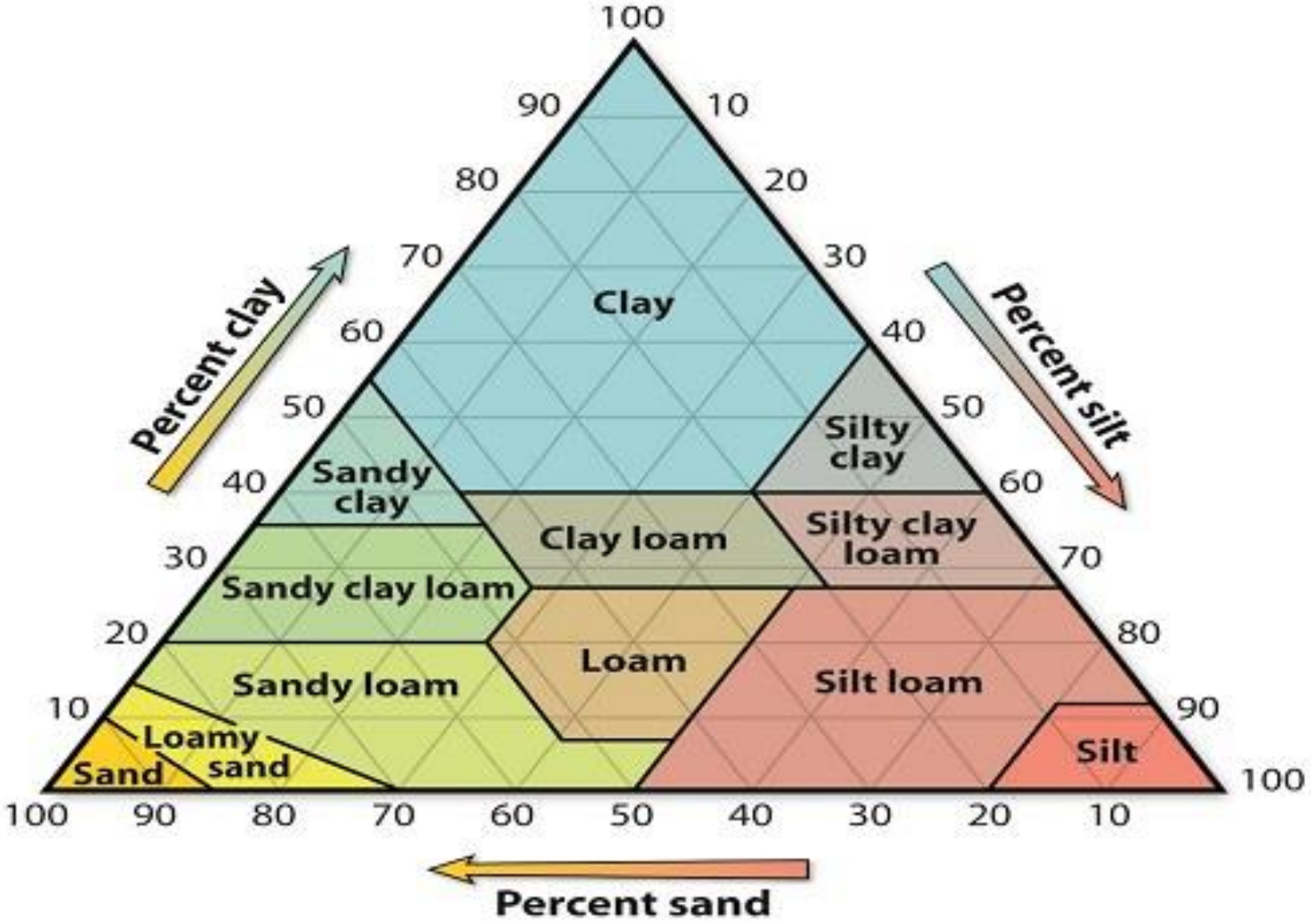


Fig. Soil textural triangle.

- The following particle size distribution, based on sieve analysis, is commonly used to define soil particles.

Gravel > 2 mm

Sand 0.05 - 2 mm

Very coarse 1 - 2 mm

Coarse 0.5 - 1 mm

Medium 0.25 - 0.5 mm

Fine 0.1 - 0.25 mm

Very fine 0.05 - 0.1 mm

Silt 0.002 - 0.05 mm

Clay < 0.002 mm

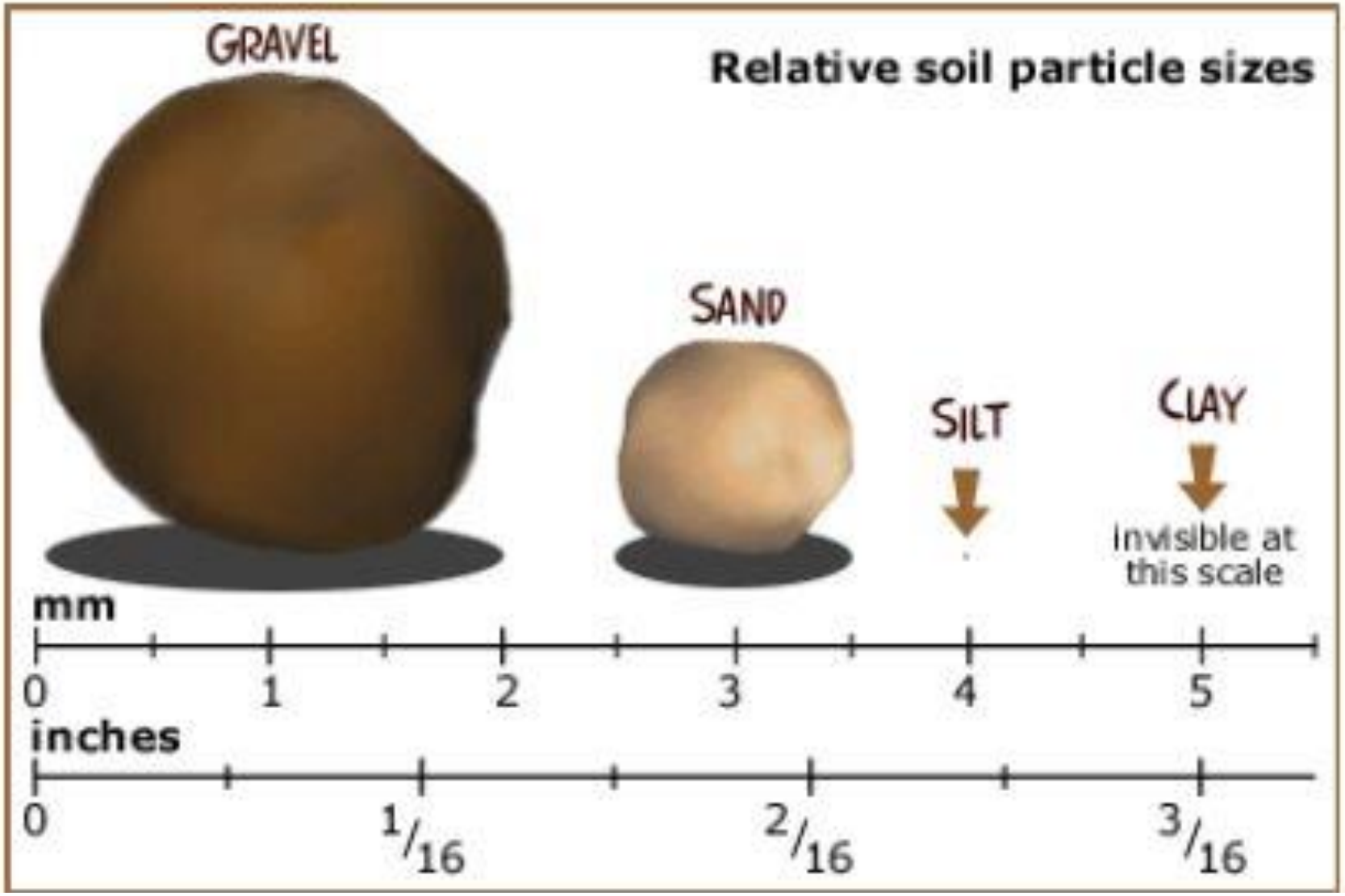


Fig. Relative soil particle sizes.

II. Soil Structure

- In all soils except sands, soil particles tend to stick together or aggregate. The arrangement of soil particles into aggregates of definite shape is known as soil structure. Soil structures are also known as peds.

- Soil structure is important because it affects water movement into and through the soil, root penetration, porosity or aeration, and bulk density of the soil.

Types of soil structures:

- Prismatic – aggregates that are tall and narrow, similar to a quartz prism. This structure is found in young soils or in dry/arid regions.

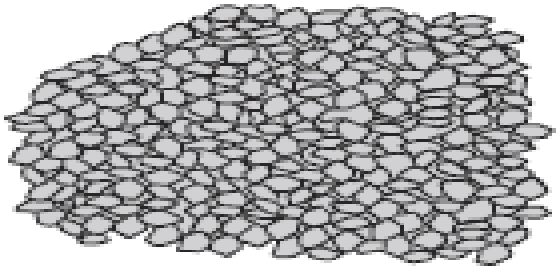
- Blocky – aggregates with sides that are more or less equal. Block-like structure is usually found deep in the soil horizon (profile).

- Platy – aggregates that are much wider than tall (like a dinner plate). This structure occurs on or near the soil surface and is caused by water pooling or impact from rain (crusting).

- Granular – aggregates that are more or less rounded, granular and crumb-like. This structure is found under grass stands near the surface.

Examples of Soil Structure Types

Granular

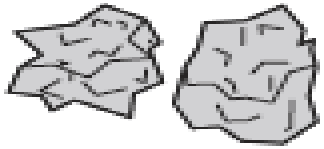


(Soil aggregates)

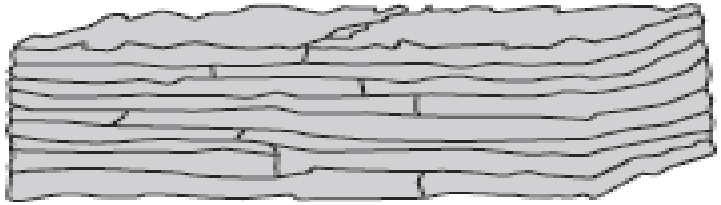
Blocky

(Subangular)

(Angular)

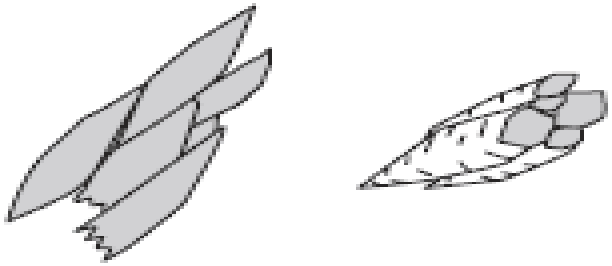


Platy

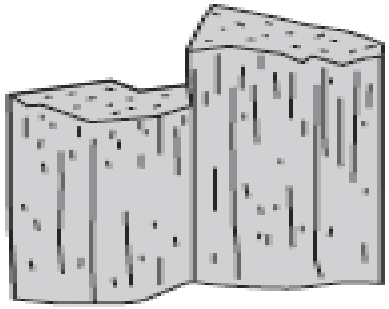


Lenticular

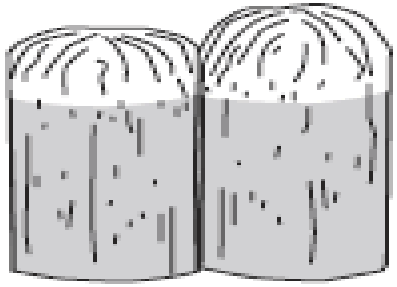
Wedge



Prismatic

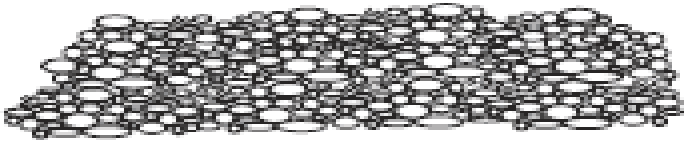


Columnar



Structureless Types

Single Grain



(Loose mineral/rock grains)

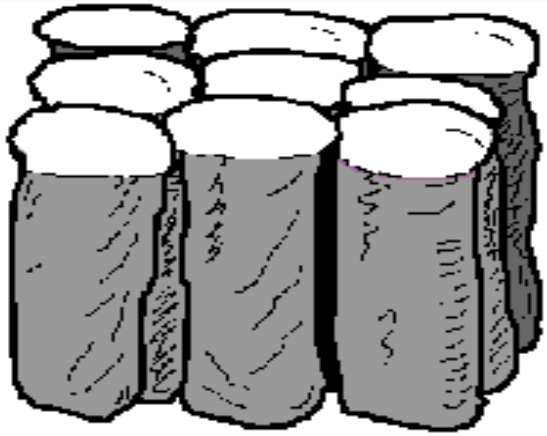
Massive

(Continuous, unconsolidated mass)

Granular: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing.

Blocky: Irregular blocks that are usually 1.5 - 5.0 cm in diameter.

Prismatic: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.



Columnar: Vertical columns of soil that have a salt "cap" at the top. Found in soils of arid climates.

Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.

Single Grained: Soil is broken into individual particles that do not stick together. Always accompanies a loose consistence. Commonly found in sandy soils.

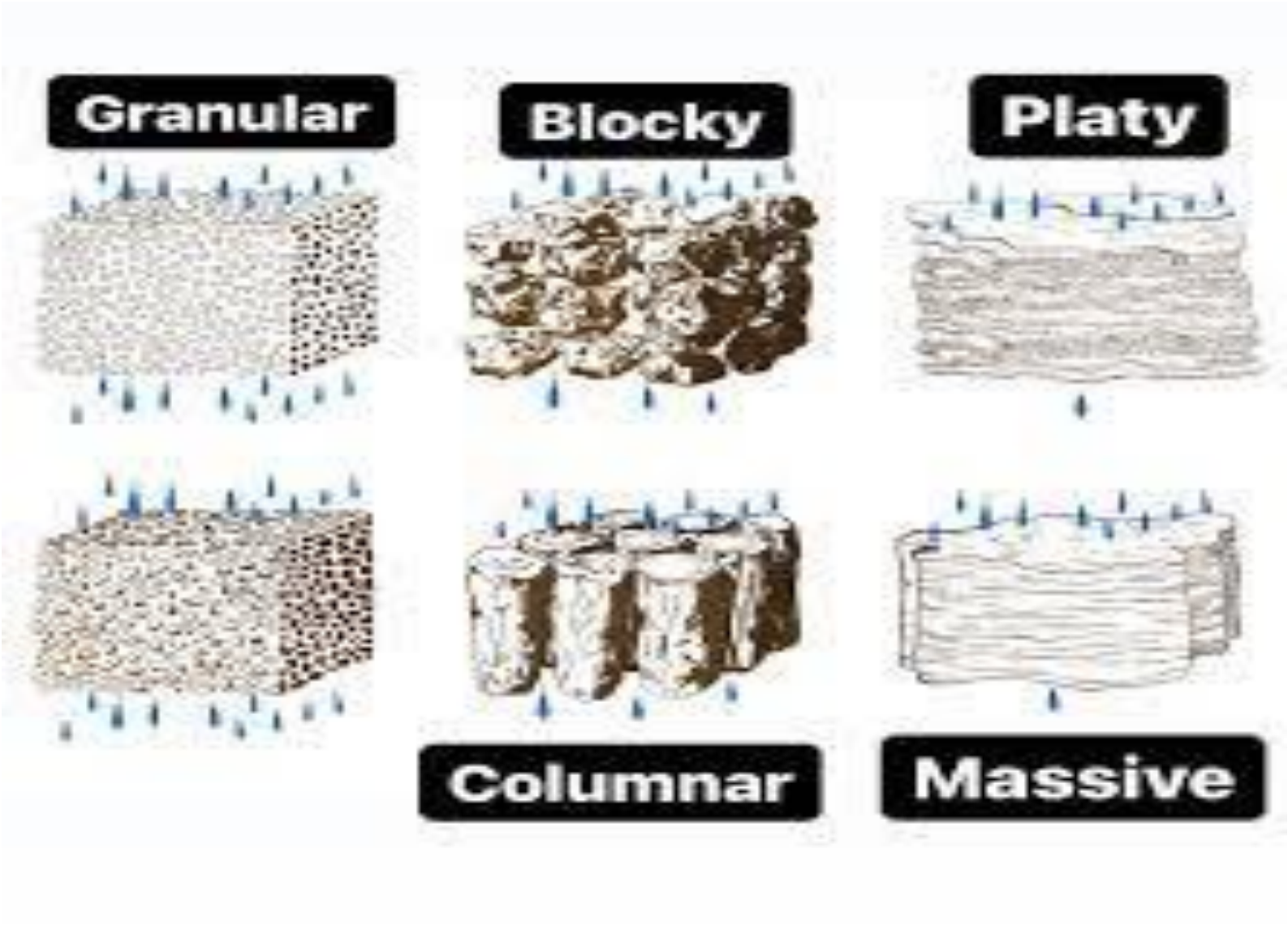


Fig. Soil structure.

III. Soil Colour

- Soils are of different colours (brown, yellow, red) depending on oxidised or ferric iron compounds.

- The darker the colour of the soil, the more organic content it contains.

- The red colour of the soil is due to the presence of iron oxide and the black colour soil is rich in minerals and humus.


LOR CHART
10R
5YR
7.5Y
VALUE
6/
5/
4/
3/
2.5/
/1
/2
/3
/4
/6
/8
CHROMA
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IV. Soil Porosity

- Pore space is that part of the bulk volume of soil that is not occupied by either mineral or organic matter but is open space occupied by either gases or water.

- In a typical soil, there will be about 50 to 60 percent solid material and 40 to 50 percent pore space, or gaps between the particles. In an ideal soil, about half of the pore space is filled with water and half with air.

- Pore space is essential for plant growth, providing space for plant roots to grow.

- Soil pore space also provides a home for living organisms, many of which remove nutrients from organic matter and make them available to the crop.

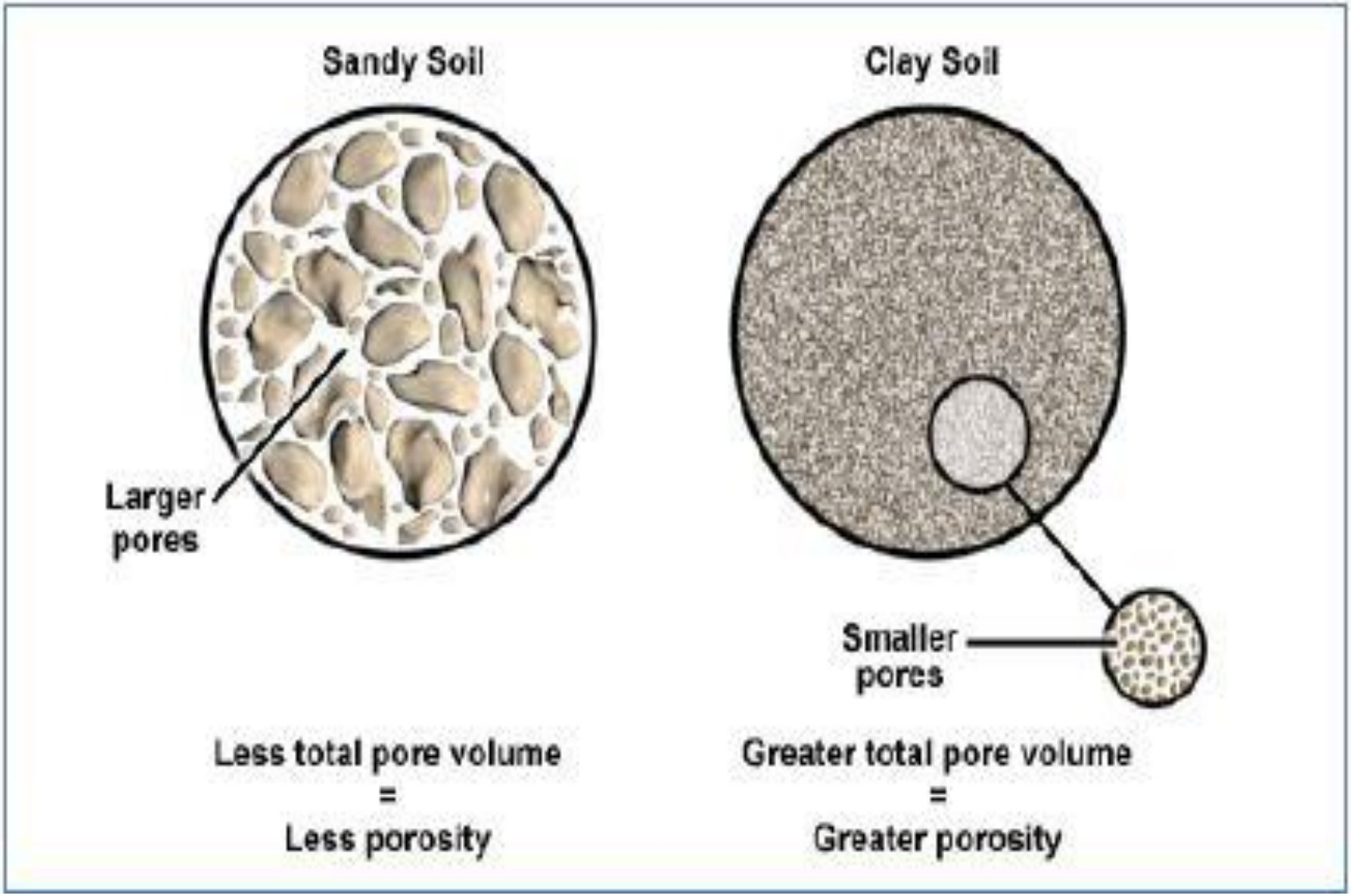


Fig. Pore space in sandy soil vs. clay soil.

V. Soil Density/Bulk Density

- Soil density is related to the mineral and organic composition of a soil and to soil structure.

- The standard measure of soil density is bulk density, defined as the proportion of the weight of a soil relative to its volume.

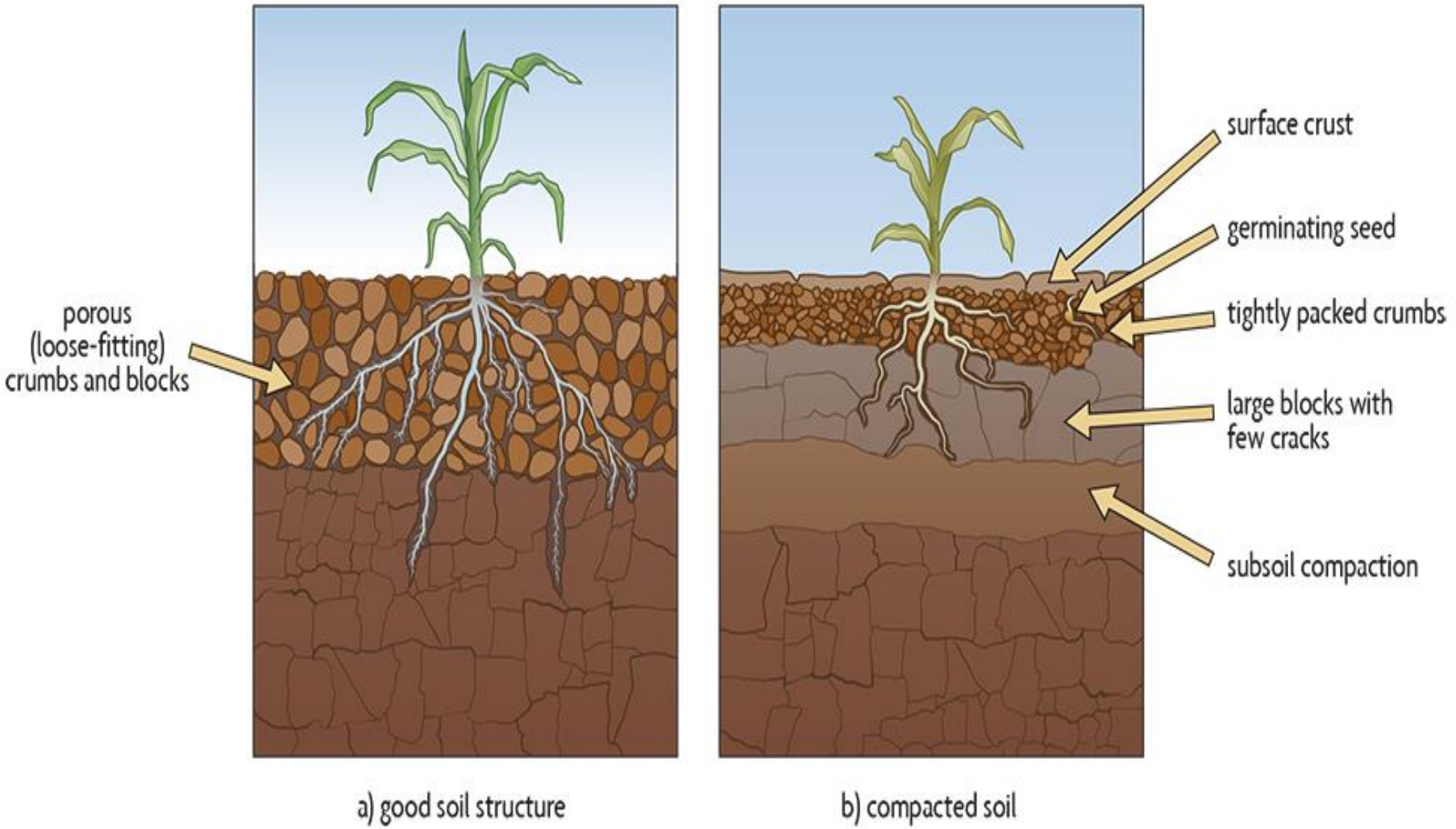
- It is expressed as a unit of weight per volume, and is commonly measured in units of grams per cubic centimeter (g/cm^3).

- Bulk density affects water and air transport in soils. Soils with high densities resist water and air transport. Soils with high density may also impede root growth.

VI. Soil Compaction

- Compaction of soils reduces air space and porosity of the soil.

- The air space may be reduced to as little as 5 percent, reducing the soil's ability to support plant growth.


porous
(loose-fitting)
crumbs and blocks
surface crust
germinating seed
tightly packed crumbs
large blocks with
few cracks
subsoil compaction
a) good soil structure
b) compacted soil

VII. Soil Temperature

- Soil temperature is affected by climate, water content of a soil, soil colour, soil cover (e.g. presence or absence of mulch), depth in the soil profile, and air and water flow within a soil.

- Dark coloured soils warm more quickly and attain higher temperatures than light coloured soils.

- Organic matter imparts a darker colour to soil, leading to increased warming, but also retains water, which can slow warming.

- Soils with high porosity and well connected pores will warm faster and cool quicker.

- Soil temperatures fluctuate less with depth in the soil profile.