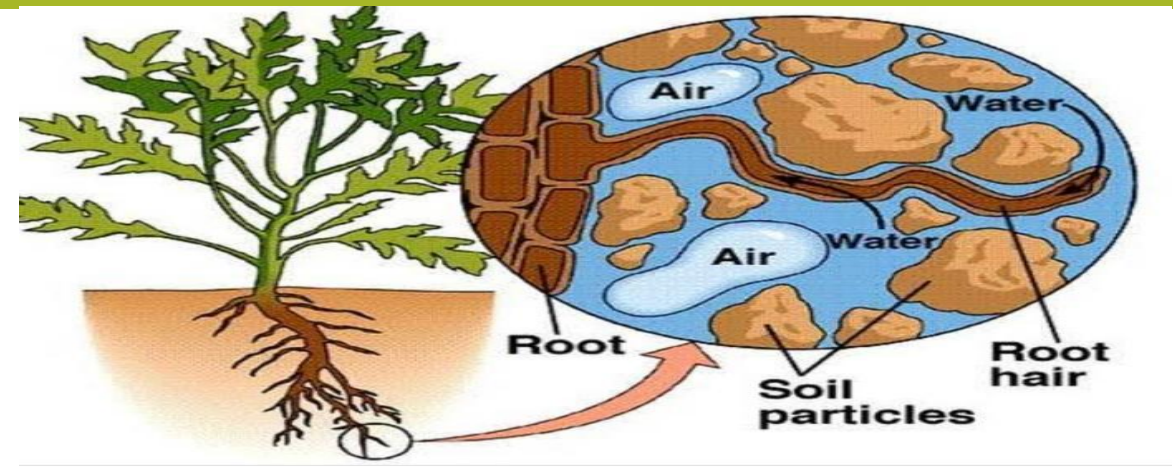


REACTION IN SOIL SOLUTION

What is soil ?



Soil is a loose material which lies on top of the land. It has many things in it, like tiny grains of rock, minerals, water and air. Soil has also living things and dead things in it: “ organic matter”. Soil is important for life on earth, because soil holds water and nutrient, it is ideal place for plants to grow.

Soil Chemistry

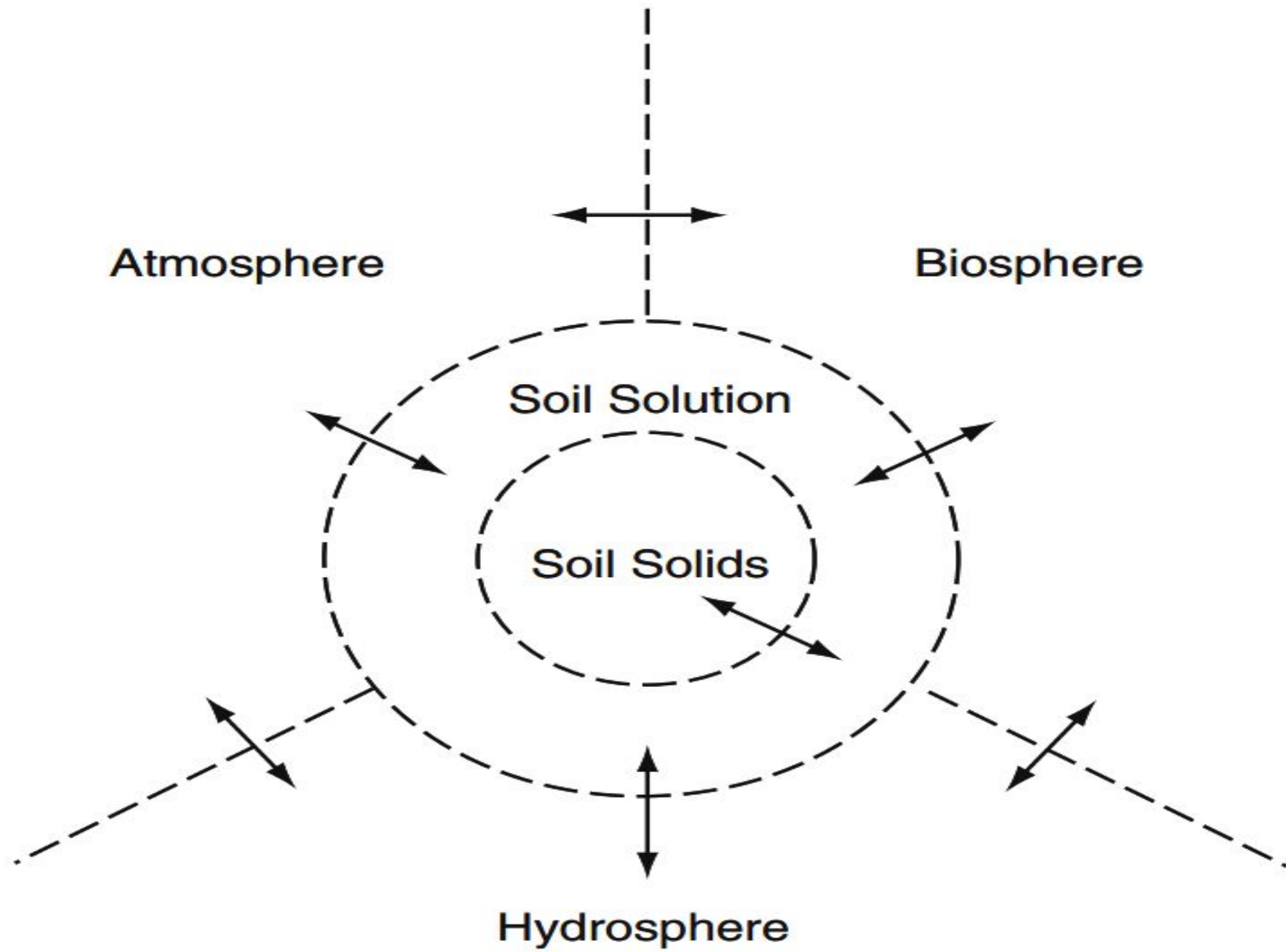
Soil transport and move water, provide homes for thousand of bacteria and other creatures, and have many different arrangement of weathered rock and minerals.

When soil and minerals weather over time, the chemical composition of soil also change.

However, nothing changes the chemistry of soil faster than humans do.

Soil Solution

- ❑ (the liquid phase of soil), water with dissolved gases, minerals, and organic matter that reaches the soil after passing through the atmosphere and percolating through the soil horizons.
- ❑ The solution may be in a film, capillary, or gravitational form, depending on the moisture content of the soil.
- ❑ The soil solution is the interface between soil and the other three active environmental compartments, atmosphere, biosphere, and hydrosphere.



WHAT IS A SOIL SOLUTION

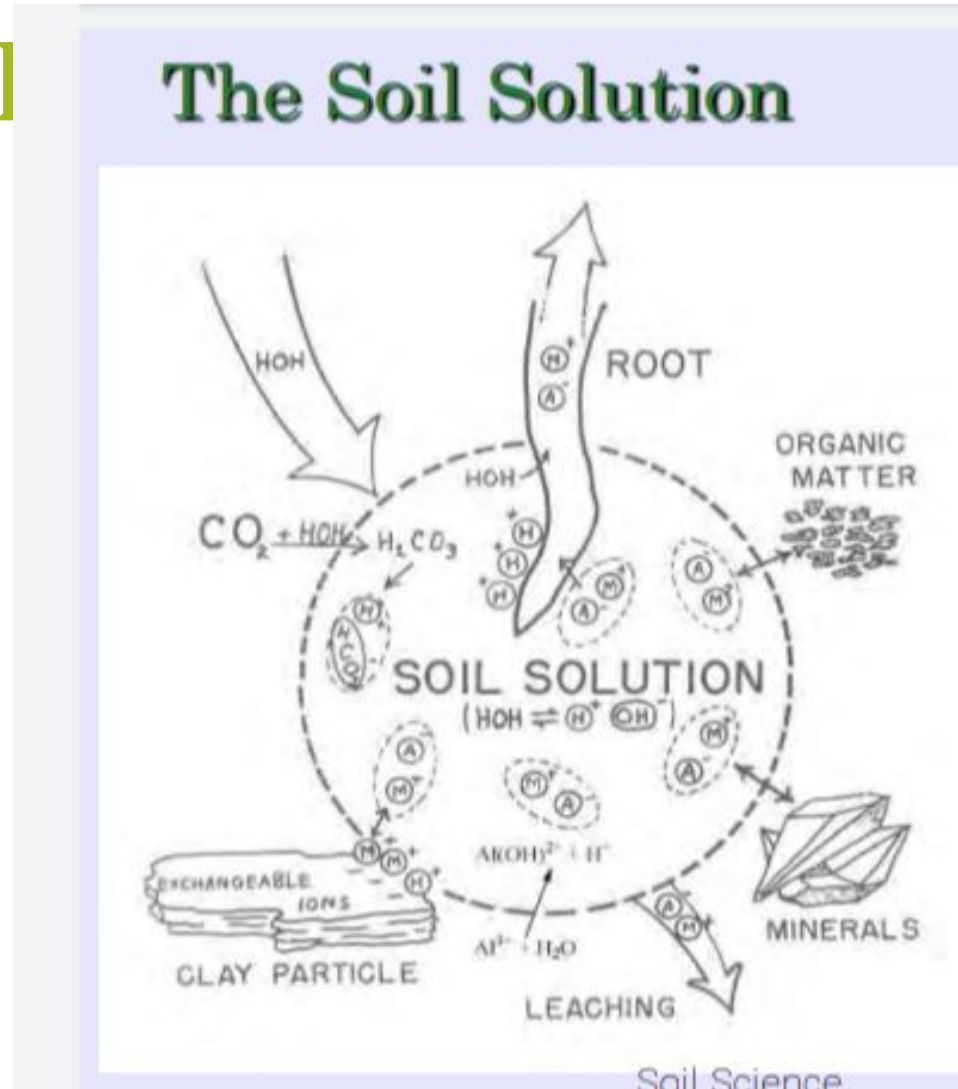
SOIL SOLUTION IS THE INTERFACE BETWEEN THE SOIL AND THE OTHER THREE ACTIVE ENVIRONMENTAL COMPARTMENTS WHICH ARE ATMOSPHERE , BIOSPHERE , AND HYDROSPHERE.

THE SOIL SOLUTION IS THE MOST IMPORTANT TRANSFER MEDIUM FOR OF CHEMICAL ELEMENTS THAT ARE ESSENTIAL TO LIFE.

IT IS WATER WITH DISSOLVED GAS, MINERALS AND ORGANIC MATTER THAT REACHES THE SOIL AFTER PASSING THROUGH THE ATMOSPHERE AND PERLOCATING THROUGH SOIL HORIZON , IT MAYBE IN A FILM OR CAPILLARY FORM DEPENDING ON THE MOISTURE CONTENT OF THE SOIL AND CAN BE READILY TAKEN UP THE PLANT

IT DIFFERS FROM OTHER AQUEOUS SOLUTION IN THAT IT IS NOT ELECTRICALLY NEUTRAL BUT USUALLY CONTAINS MORE CATION THAN ANION.

SOIL SOLUTION



soil pH

The soil pH is a measure of soil acidity or alkalinity.

pH can range from 1 to 14, with values 0-7 being acidic, and 7-14 being alkaline.

soil usually ranges from 4 to 10.

The pH is one of the most important properties involved in plant growth, as well as understanding how rapidly reactions occur in the soil.

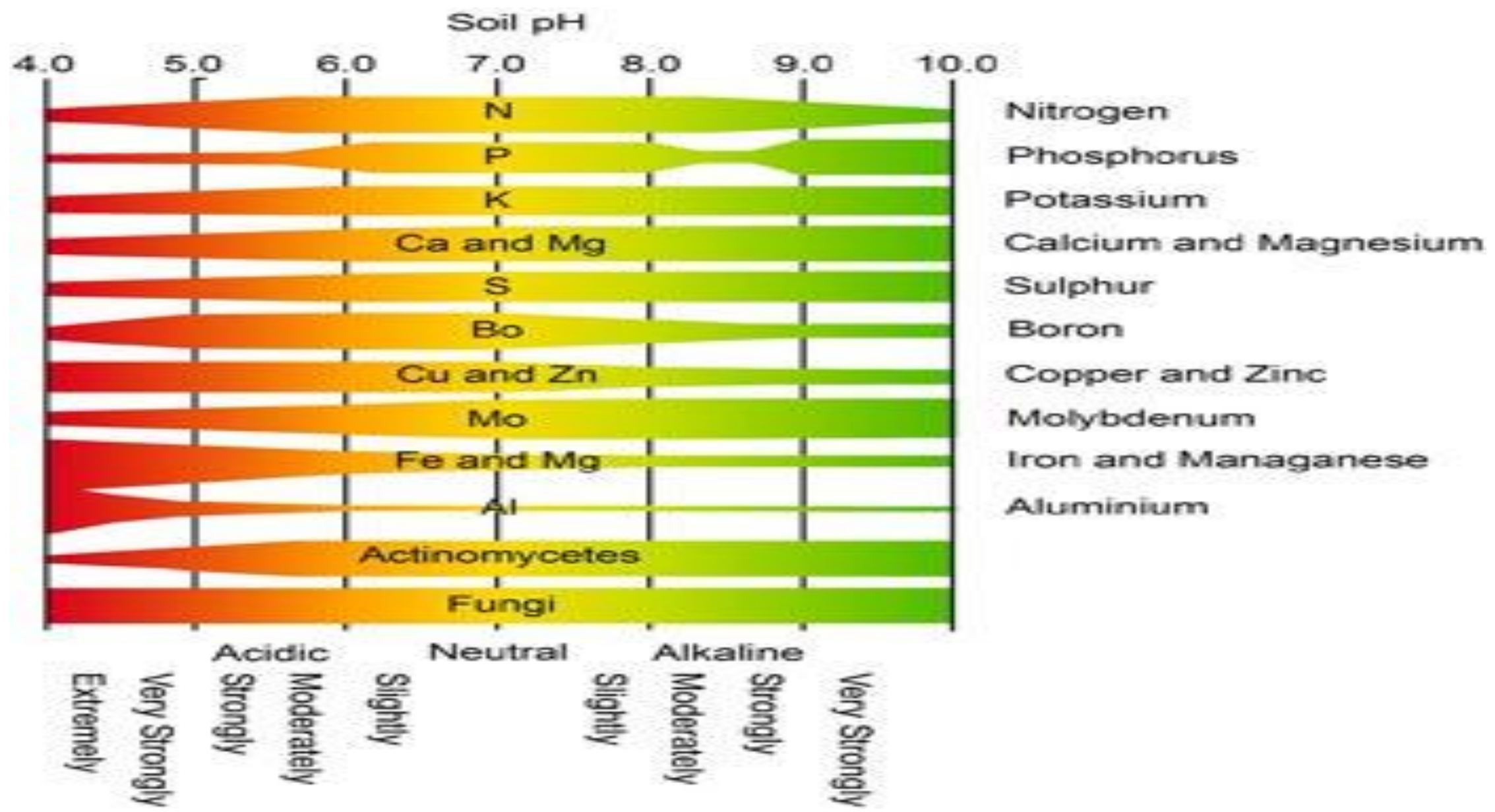
For example, the element iron becomes less available to plants as the pH increases.

• This creates iron deficiency problem.

• crops usually prefer values between 5.5-8, but the values depends on the crop .

• The pH soil comes from the parent material during soil formation, but humans can add things to soil to change them to better suit plant growth.

• Soil pH also effects organisms.



Oxidation and Reduction

- Soils that alternate between wet and dry go from having a lot of oxygen to not a lot of oxygen.
- The presence or absence of oxygen determines how soils chemically react.
- **Oxidation** is the loss of electrons, and **reduction** is the gaining of electrons at the soils surface.
- These type of reaction occur everyday, and responsible for creating things like rust, or if they contain a lot of water, can turn a light gray color.
- This is partially responsible for all of the different colors that are found, and creates the speckles usually found deeper in the soil.

REACTIONS IN SOIL SOLUTION

DISSOLUTION

PRECIPITATION

ADSORPTION

HYDROLYSIS

ION EXCHANGE

COMPLEXATION

Dissolution

- The process in which solids (like minerals) are dissociated and the ionic component are dispersed in a liquid(usually water).
- Limestone and rock high in salt dissolve when exposed to water.
- The water carry away the ions.



*Example of Limestone
Dissolution in the
Cathedral Room at Florida
Caverns State Park. Credit:
State Archives of Florida,
Florida Memory, Mark
Ludlow.*

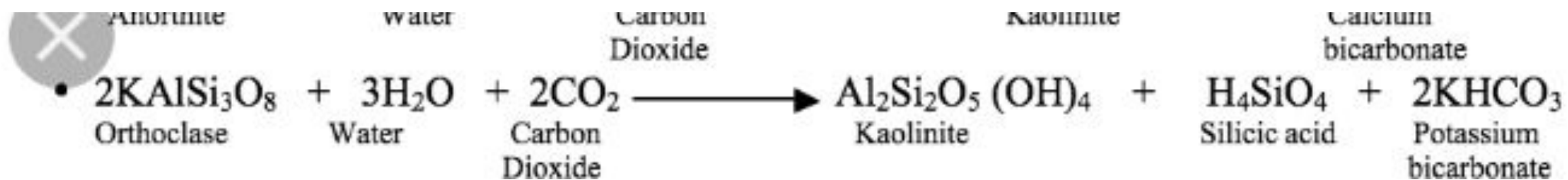
DISSOLUTION

IT IS THE DISINTEGRATION OR DISSOLVING OF A MINERAL OR A COMPOUND INTO A SOLUTION , IT OCCURS WHEN THE SOIL SOLUTION IS UNDERSATURATED. Ex , water , carbon dioxide and carbonic acid dissolve rocks and soil minerals and release ions into soil solution.

THERE ARE TWO TYPES OF DISSOLUTION REACTIONS

1-INCONGRUENT DISSOLUTION ,THIS IS THE DISSOLUTION OF A MINERAL OR REACTION IN THE PRESENCE OF A LIQUID , CONVERTING ONE SOLID PHASE INTO ANOTHER . E.g , the conversion of orthoclase into kaolinite.

2-CONGRUENT DISSOLUTION, A SOLID DISSOLVES ADDING ELEMENTS TO THE WATER ACCORDING TO THEIR PROPORTIONS IN THE MINERAL. E.g , dissolution of gypsum in water



Gypsum dissolution in water



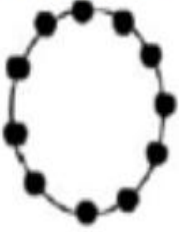

More Ca^{2+} or SO_4^{2-} in solution drives eqn to the left = lower solubility

Sorption and Precipitation

- Soil particles have the ability to capture different nutrients and ions.
- Sorption** is the process on which one substance takes up or holds another.
- In this case, soils that have high sorption can hold a lot of extra environmental contaminants, like phosphorus, onto the particle.

Sorption = absorption + adsorption

Difference between adsorption and absorption:-

Adsorption	Absorption
<p data-bbox="315 773 1151 882">1. It involves attraction or retention of the molecules on the surface.</p>  <p data-bbox="657 1139 835 1210">Adsorption on surface</p>	<p data-bbox="1212 773 2150 882">1. In absorption the substance is gets uniformly distributed through the liquid or solid.</p>  <p data-bbox="1600 1139 1778 1210">Adsorption in the interior</p>

PRECIPITATION

IT IS THE FORMATION AND SEPARATION OF AN INSOLUBLE SOLID FROM SOIL SOLUTION DUE TO A CHEMICAL CHANGE.

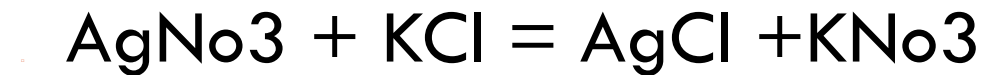
THREE TYPES OF PRECIPITATION REACTION ARE USUALLY FOUND TO TAKE PLACE IN SOIL SOLUTION

1-PRECIPITATION OF AN ELEMENT DUE TO ITS SUPER SATURATION IN THE SOLUTION

2-SURFACE PRECIPITATION DUE TO THE THREE DIMENSIONAL GROWTH OF A SOLID ON THE SURFACE OF A SOLID PARTICLE, OFTEN TRACE ELEMENTS SUCH AS LEAD , CADMIUM WILL BECOME IMMOBILIZED

3-COPRECIPITATION, IT IS THE INCORPORATION OF A TRACE ELEMENT INTO A MINERAL STRUCTURE DURING SOLID SOLUTION FORMATION AND RECRYSTALLIZATION OF MINERALS

Soil **precipitations** occurs during chemical reactions when a nutrient or chemical in the soil solution (water around soil particles) transforms into a solid.



this is really important if soils are really salty.

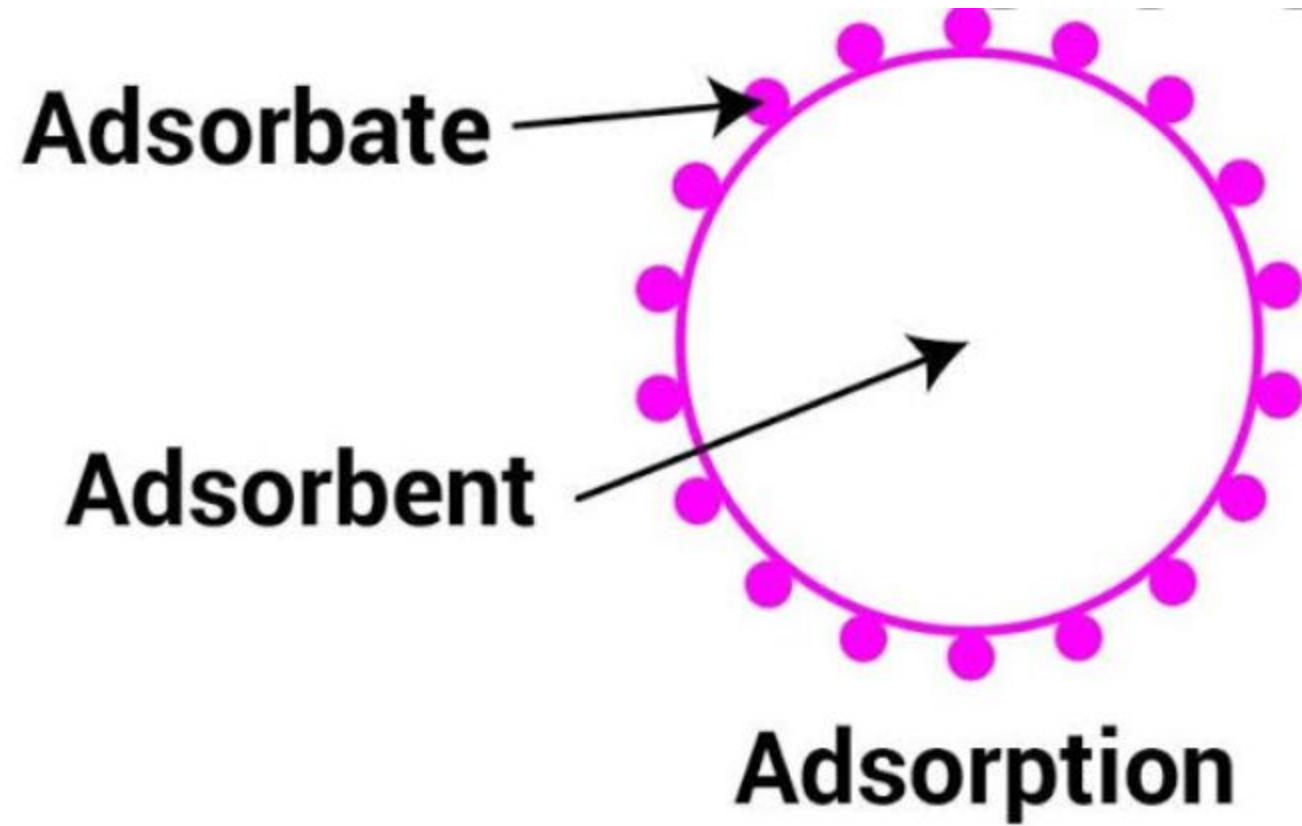
Soil chemists study the speed of these reactions under many different conditions

ADSORPTION

ADSORPTION IS THE ADHESION OF ATOMS , IONS OR MOLECULES OF GAS , LIQUID OR DISSOLVED SOLIDS. THE SUBSTANCE THAT IS ABSORBED IS CALLED ADSORBATE AND THE SURFACE ON WHICH ADSORPTION TAKES PLACE IS CALLED ADSORBENT. THIS PROCESS CREATES A FILM ON THE SURFACE OF THE ADSORBENT.

SOIL SOLIDS PARTICULARLY THE COLLOIDS ACT AS ADSORBENTS AND IONS, POLAR MOLECULES COLLOIDS MAYBE ADSORBATE

CLAY AND HUMUS ARE ELECTRICALLY CHARGED PARTICLES AND AGAINST THESE CHARGES WATER, IONS ARE ADSORBED



HYDROLYSIS

IT IS THE PROCESS OF EXCHANGE REACTIONS BETWEEN THE BASE OF THE MINERALS AND THE HYDROGEN ION OF THE ELECTRICALLY DISSOCIATED PART OF THE WATER.

AS WE ALL KNOW WATER IS AN ACTIVE CHEMICAL AGENT BECAUSE IT IS ALWAYS TO SOME EXTENT DISSOCIATED INTO H AND OH IONS

THE MOST CHARACTERISTIC EXAMPLE OF HYDROLYSIS IS OF POTASH FELDSPAR , WHERE REACTION OF ORTHOCLASE RESULTS INTO THE FORMATION OF POTASIUUM HYDROXIDE AND ALUMINO SILCIC ACID

ION EXCHANGE REACTION

EXCHANGE OF IONS ON SOIL SURFACES WITH IONS IN SOIL SOLUTION. BOTH CATIONS AND ANIONS ARE INVOLVED

ON SOIL SURFACE THERE ARE EXCHANGEABLE AND NONEXCHANGEABLE IONS , AMONG THEM ONLY EXCHANGEABLE IONS ARE AVAILABLE FOR ION EXCHANGE , THEY ARE READILY AVAILABLE TO THE PLANT , WEAKLY HELD AND IN CONTACT WITH THE SOIL SOLUTION.

THIS PROCESS IS REVERSIBLE AND HOMOGENOUS , THAT IS A ANION IS REPLACED BY ANION AND A CATION IS REPLACED BY A CATION

Ion Exchange

Ion exchange involves the movement of cations (positively charged elements like calcium, magnesium, and sodium) and anions (negatively charged elements like chloride, and compounds like nitrate) through the soils.

In the united states, cation exchange is much more common.

Diagram represents soil cations attached firmly to the soil



Cation exchange is the interchanging between a cation in the solution of water around the soil particle, and another cation that is stuck to the clay surface.

The number of cation in the soil water solution is much smaller than the number that is attached to soil particle.

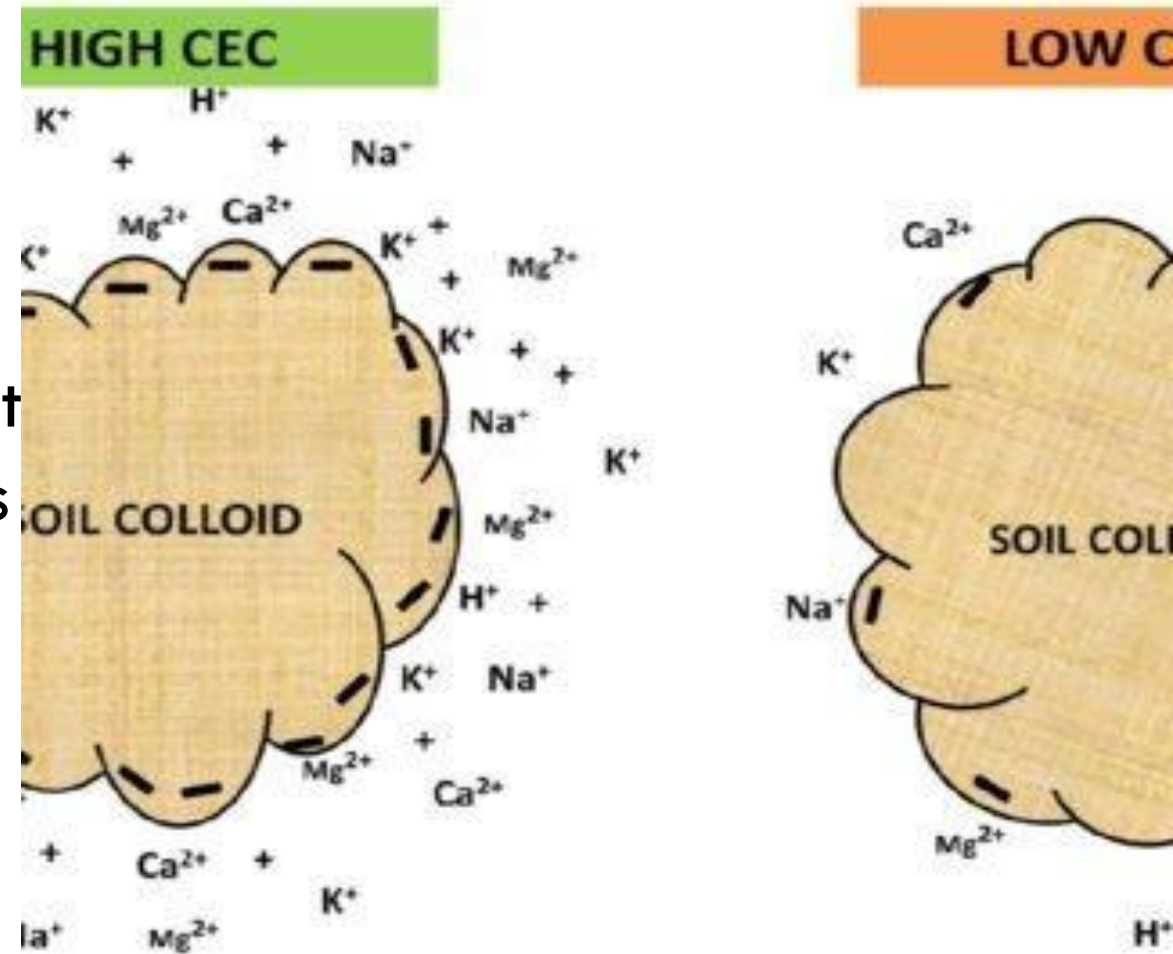
the total amount of positive charge that the soil can absorb is called the **cation exchange capacity(CEC)**.

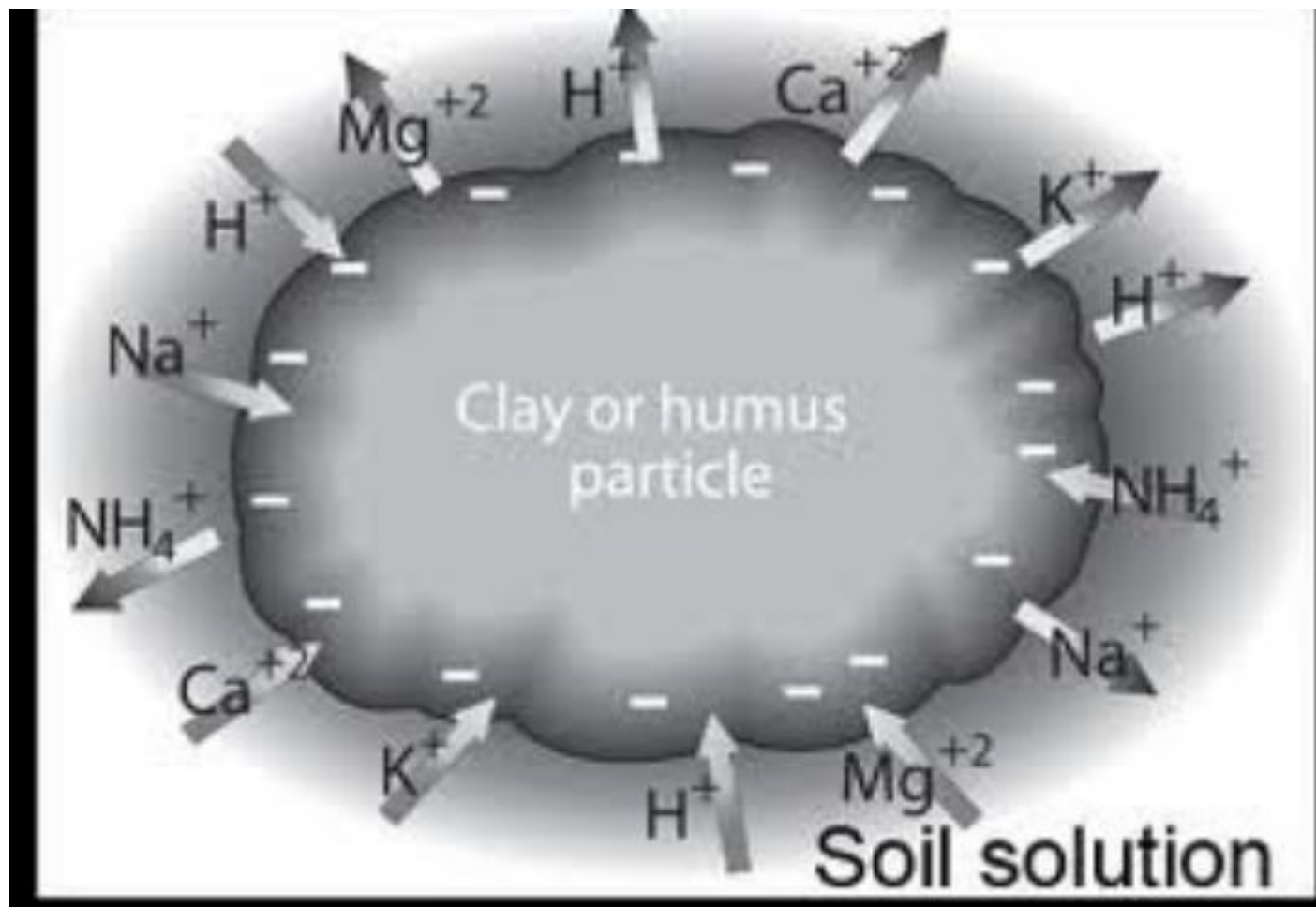
CEC impacts how quickly nutrient move through the profile .

A soil with a low CEC is much less fertile because it cannot hold on to many nutrient, and they usually contain less clays.

If your soil has a low CEC, it is important to apply fertilizer small doses so it does not infiltrate into the groundwater.

A soil with low CEC is less able to hold spilt chemicals .





COMPLEXATION

THE CONCENTRATION OF TRACE ELEMENTS IN THE SOLUTION ARE GOVERNED BY A VARIETY OF REACTIONS THAT ALSO INCLUDE COMPLEXATION ALONG WITH ADSORPTION ION EXCHANGE AND DISSOLUTION

THE ORGANIC COMPOUNDS IN THE SOIL SOLUTION THAT FORM STABLE COMPLEXES WITH TRACE ELEMENTS ARE OF TWO MAIN KIND

(a) biochemicals of the type known to occur in living organisms such as simple aliphatic acids , amino acids and polyphenols

(b) a series of acidic , yellow to black colored polyelectrolytes referred to as Fa's

Fa's are fulvic acids , they are predominant form of humic matter , they are responsible for forming mobile complexes in the soil solution.

complexation

Reaction of a metallic ion and a molecular or ionic ligand containing at least one atom with an unshared pair of electron is called as complexation .

In complexation process, individual atom groups , ion or molecules combine to form one large ion or molecule.

The most commonly used complexing agent is EDTA .