

II- Mineral Nutrition and Absorption.

Criteria of essentiality:

Most of the plants require a relatively small number of nutrient elements in order to successfully complete their life cycle — (17) essential nutrient elements (9 macroelements and 8 microelements) — *Figure attached.*

Epstein (1972) listed two criteria for essentiality of an element:

1. In its absence, the plant is unable to complete a normal life cycle.
2. That element is a part of some essential plant constituent or metabolite.

Later Arnon and Stout suggested the third criterion:

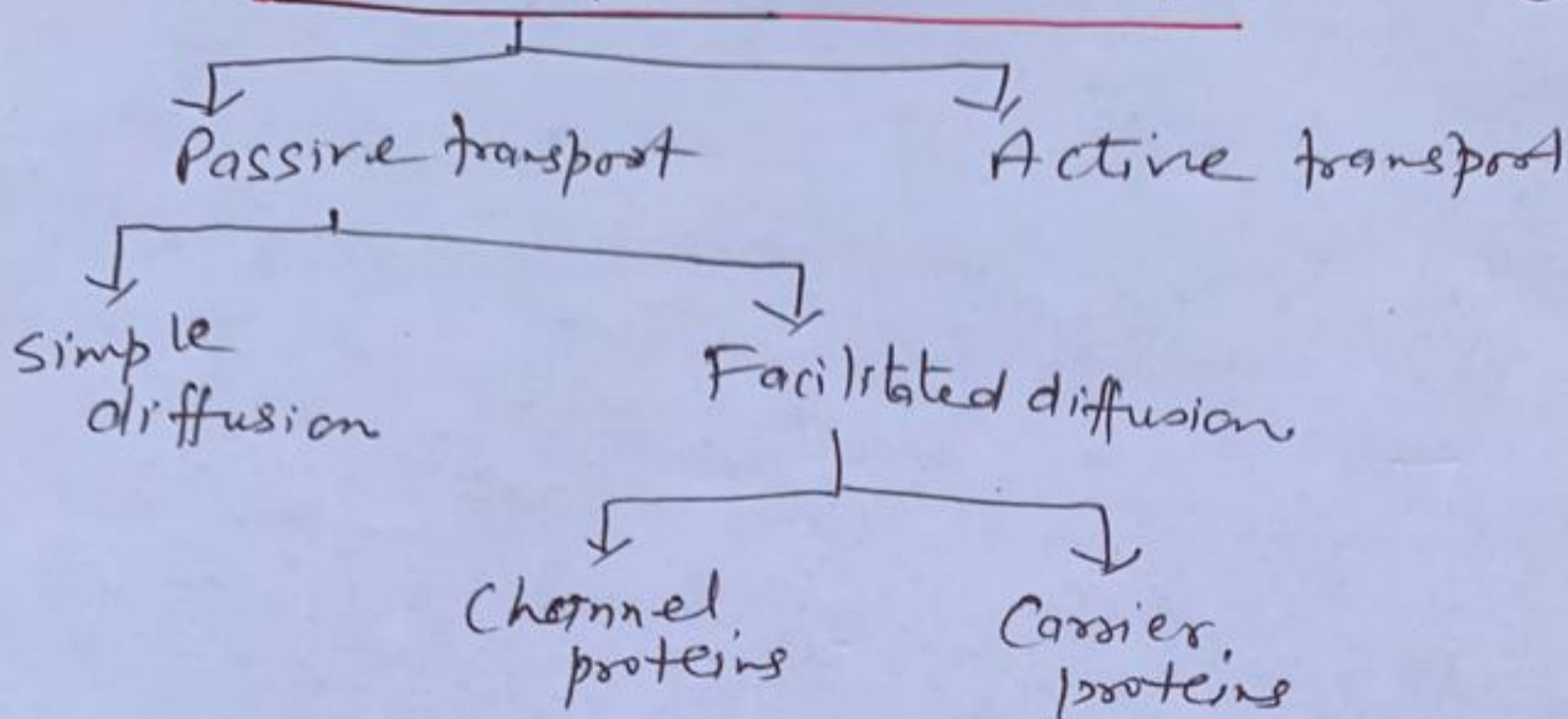
3. An essential element must act directly in the metabolism of the plant
- Macroelements (required in large amounts, > 10 mmole/kg dry weight), largely involved in the structure of molecules
 - Microelements (reqd in small quantities < 10 mmole/kg dry weight). Serve catalytic and regulatory roles.

Table 7.1 The essential nutrient elements of higher plants and their concentration considered adequate for normal growth

Element	Chemical symbol	Available form	Concentration in dry matter (mmol/kg)
<i>Macronutrients</i>			
Hydrogen	H	H ₂ O	60,000
Carbon	C	CO ₂	40,000
Oxygen	O	O ₂ , CO ₂	30,000
Nitrogen	N	NO ₃ ⁻ , NH ₄ ⁺	1,000
Potassium	K	K ⁺	250
Calcium	Ca	Ca ²⁺	125
Magnesium	Mg	Mg ²⁺	80
Phosphorous	P	HPO ₄ ⁻ , HPO ₄ ²⁻	60
Sulphur	S	SO ₄ ²⁻ , SO ₂	30
<i>Micronutrients</i>			
Chlorine	Cl	Cl ⁻	3.0
Boron	B	BO ₃ ³⁻	2.0
Iron	Fe	Fe ²⁺ , Fe ³⁺	2.0
Manganese	Mn	Mn ²⁺	1.0
Zinc	Zn	Zn ²⁺	0.3
Copper	Cu	Cu ²⁺	0.1
Nickel	Ni	Ni ²⁺	0.05
Molybdenum	Mo	Mo ₄ ²⁻	0.001

Nutrient uptake - mechanism

(2)



Simple Diffusion

- Bidirectional movement
- Can be explained by Fick's law

$$J = PA(c^o - c^i)$$

[$J = \text{flux}$; $A = \text{cross-sectional area of diffusion path}$; $P = \text{permeability coefficient}$
 $c^o \text{ \& } c^i = \text{conc. of solute on outer \& inner side of membrane.}$

- No input of metabolic energy
- solutes move down their electrochemical potential gradients (high \rightarrow low conc.)
- The process will continue until the equilibrium is attained between the external medium and the tissue (i.e. apoplastic spaces including intercellular spaces \& cell walls).