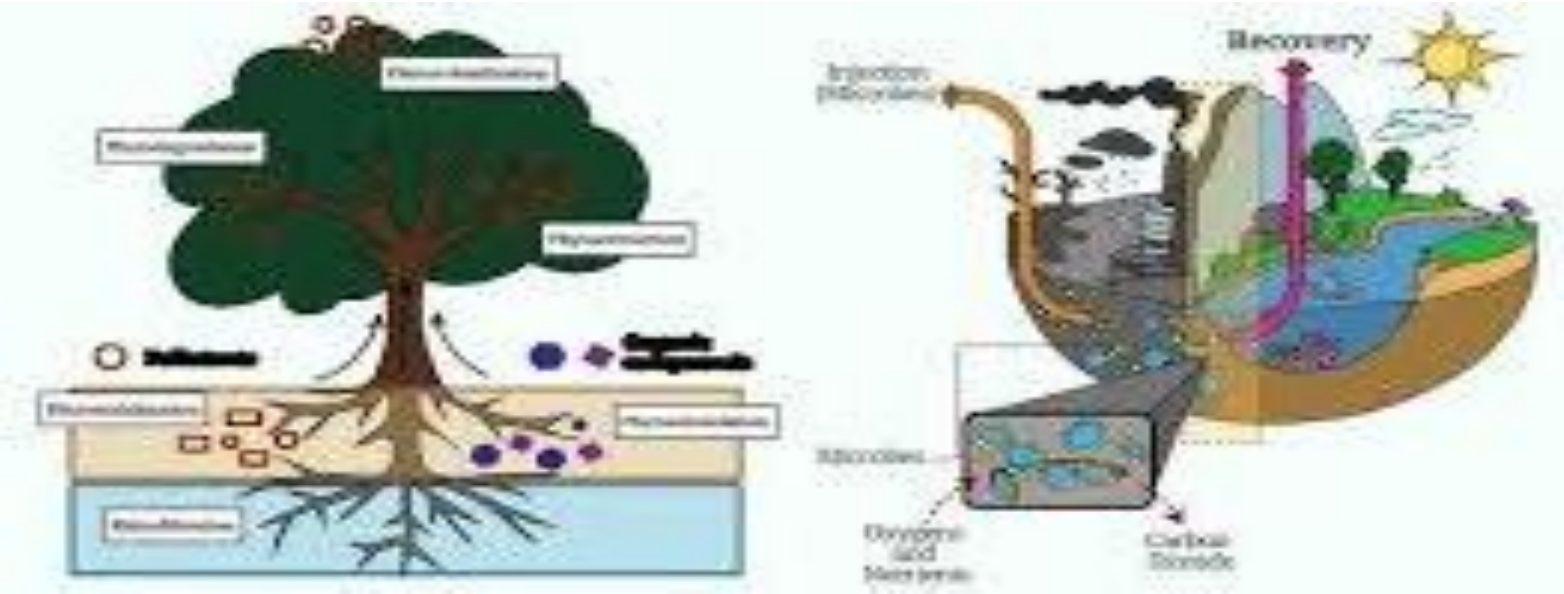
BIOREMEDIATION
Types and Mechanism



Bioremediation: Definition

Bio means microorganism/microbes

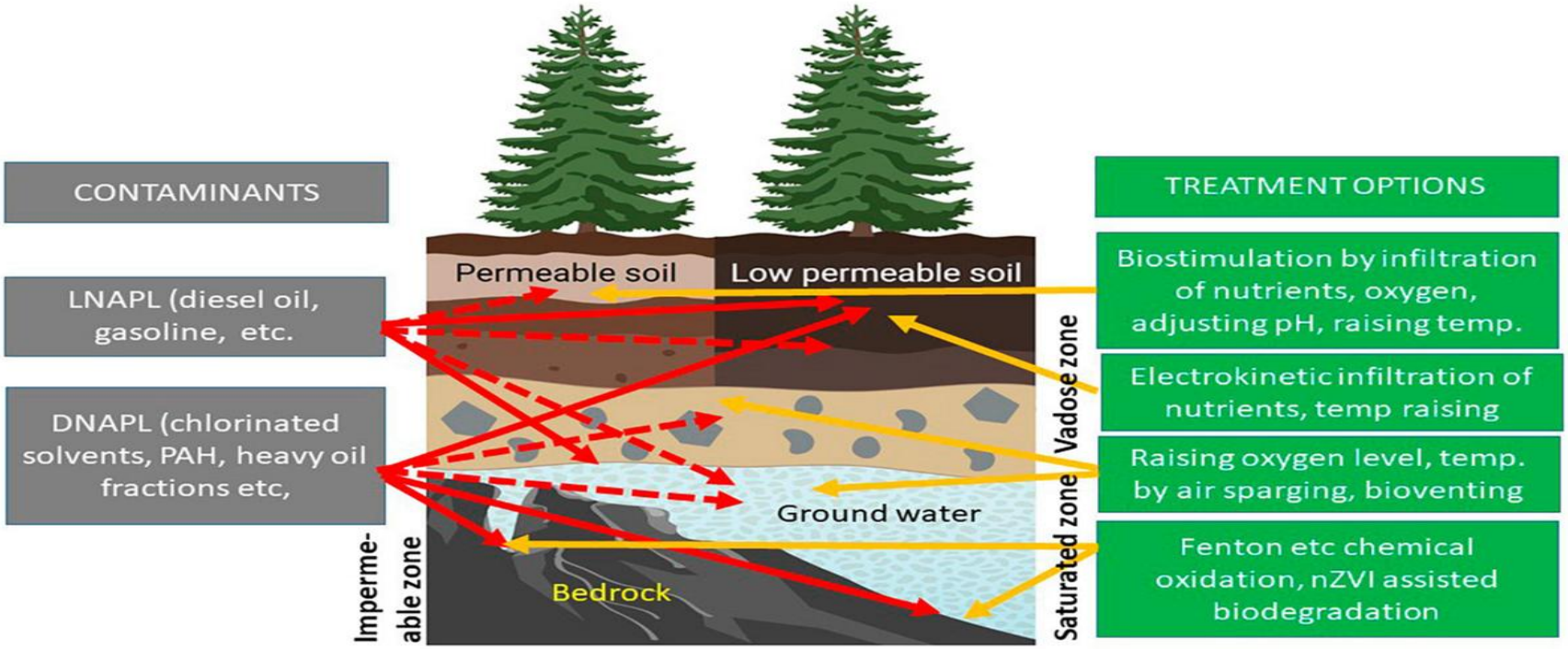
Remediation means to remove out(pollutants)

1. Bioremediation is the process of reduction, elimination, alteration and transformation
2. contaminants present in the natural environment like soil sediments, air and water
3. Microorganisms: fungi, green plants or their enzymes.
4. Waste management techniques
5. Remove pollutant and restoring contanimants

Types of bioremediation

Basis of removal and transportation of waste for treatment

1. In-situ bioremediation
2. Ex-situ bioremediation



In-situ bioremediation

1. In site or on-site remediation treatment of contaminants using biological agents.
2. Cleanup approach between microbes and the contaminants directly to transformation.

Intrinsic bioremediation- used microoraganism already present in the environment to biodegrade harmful contaminant.
No human intervention involved, cheapest means of bioremediation.

- **Engineered bioremediation-** accerates the degradation process by enhancing the physio-chemical conditions to encourage the growth of microorganisms.

In situ bioremediation techniques

1. Bioagumentation
2. Biostimulation
3. Bioslurping
4. Bioventing
5. Phyto-remediation

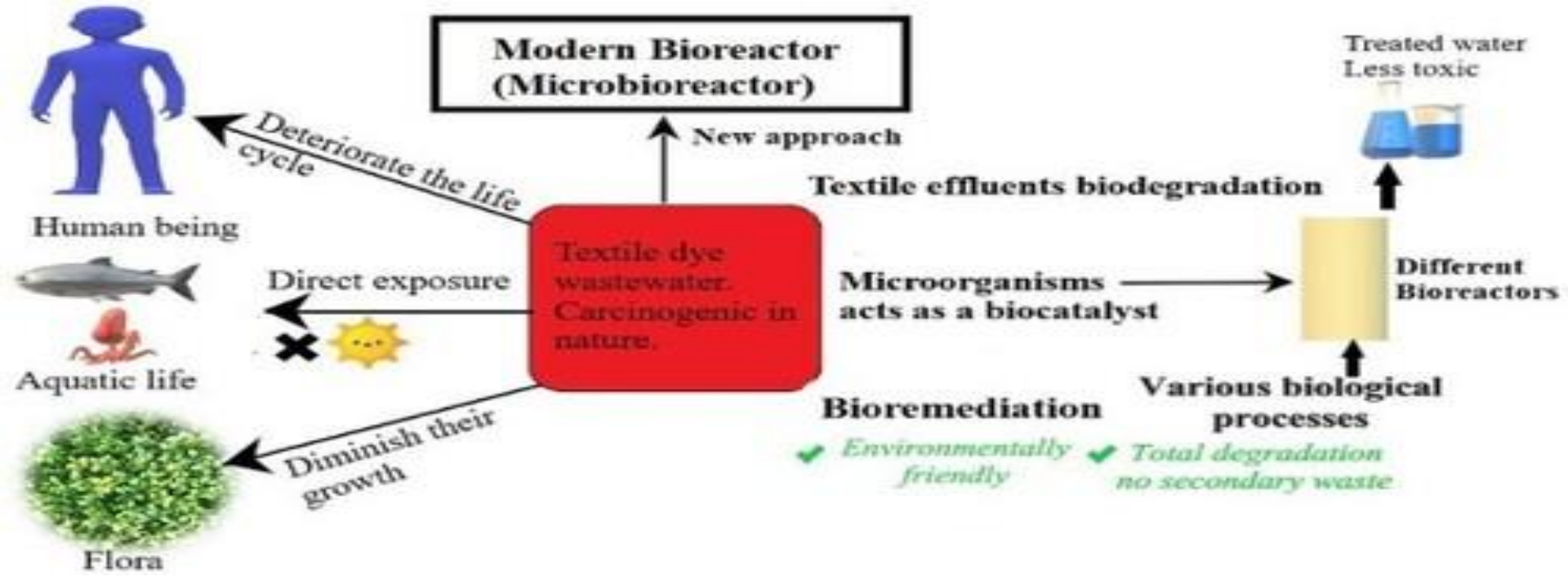
Bioaugmentation

- Another bioremediation method which frequently involves the addition of microorganisms indigenous and exogenous to the contaminated site.

Indigenous = naturally present in environmant

Exogenous = introduced from outside

Bacteria: bacillus sp, pseudomonas sp, rhodococcus spp, clostridium, cellulolyticum



Enzyme: versatile peroxidase(VP) – heme conatining enzyme can oxidase a variety of compounds.

Involves fungi: aspergillus, penicillum and verticillum(used to treat heavy metals from wastewater.

Biostimulation

Involves supplying oxygen and nutrients(N,P,O,C) by circulating aqueous solutions through contaminated soils to stimulate occuring bacteria to degrade organic contaminants

Example: bentazone, mecoprop and dichloroprop was stimulated in anaerobic aquifer material.

Phytoremediation

- Consists of mitigating pollutant concentration in contaminanted soil, water or air with plants able to contain, degrade or elimiate metals, pesticides, solvents, explosives

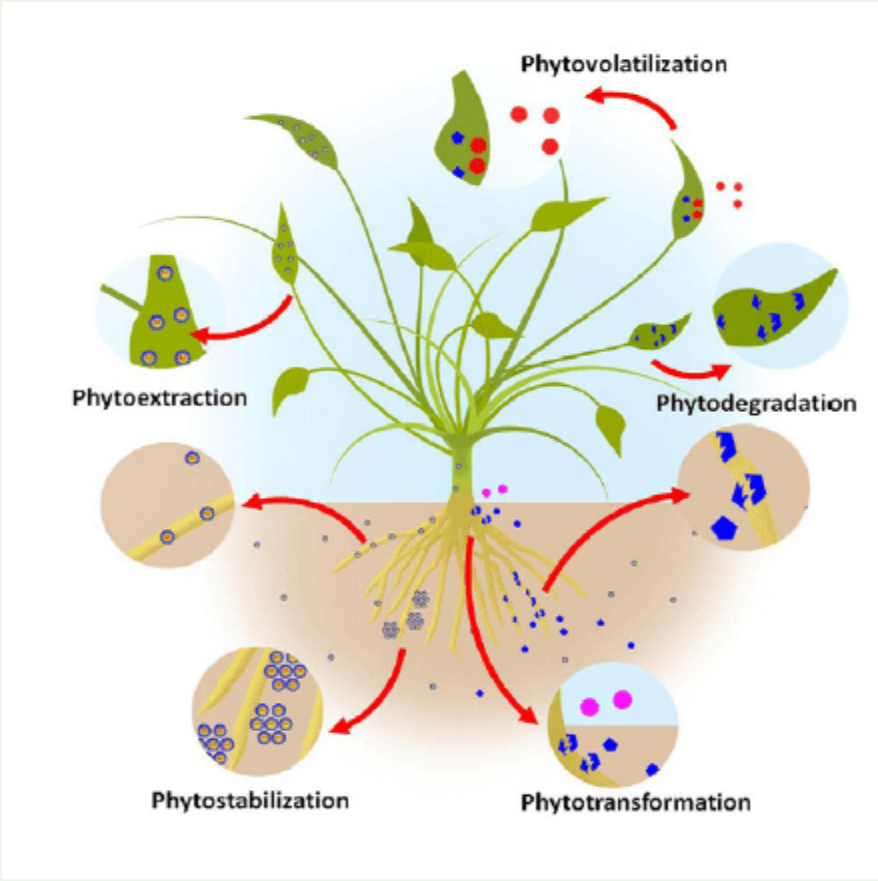


Figure 1: Schematic representation of phytoremediation approaches.

Ex-situ bioremediation

Waste or toxic material can be collected from polluated site. This process is certainly an inprovement over in-situ bioremediation.

Ex-situ bioremediation is only used when necessary because it’s expensive and damaging to the area

Techniques in ex-situ bioremediation:

1. Biofiltration
2. Biopile
3. Bioreactor
4. Composting
5. Land forming

Biofiltration

- Biofiltration is an air pollution control technique. Which involves biodegration of contaminants under the action of microorganisms diffused in a thin layer of moisture known as “biofilm”
- Eliminate gaseous emission and low concentration of volatile organic compounds (VOCs) such as, CO, CO2, Carbonic acid, carbonates.
- Bacteria: nocardioides, microbacterium, micrococcus from soil
- Bacteria: flavobacterium, pseudomonas aerginosa and bacillus subtilis