

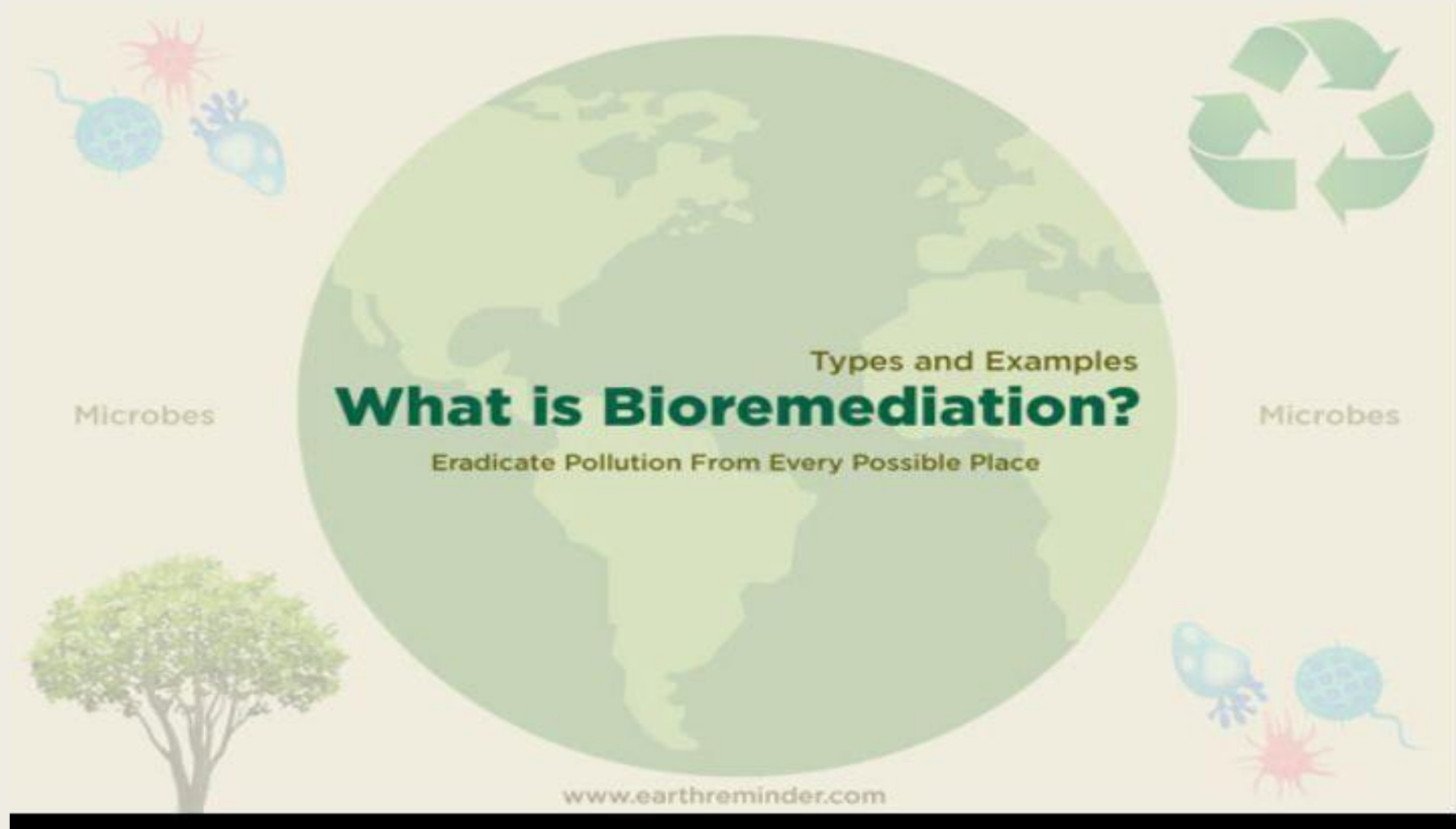


BIOREMDIATION

CHAPTER (9)



WHAT IS THE BIOREMDIATION?



■ Biodegradation the use of living organisms **such as:-**

■ 1-Bacteria.

■ 2-Fungi.

■ 3-Plant.

–To degrade chemical compounds.

BIOREMEDIATION

The process of cleaning up environment site contaminated with chemical pollutant by using living organisms to hazardous materials into less toxic substances..

hazardous materials into less toxic substances
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WHY USE BIOREMEDIATION?

- Most approaches convert harmful pollutants into Relatively
 - Harm less material such as:-
 - 1-Carbon dioxide.
 - 2-Chloride.
 - 3-Water .
 - 4-Simple organic molecules.

Processes are generally cleaner

- Can be conducted at the site of pollution.

-Bioremediation basics

–What needs to be cleaned up?

Almost everything

Oil, water, air, and sediment are most common •

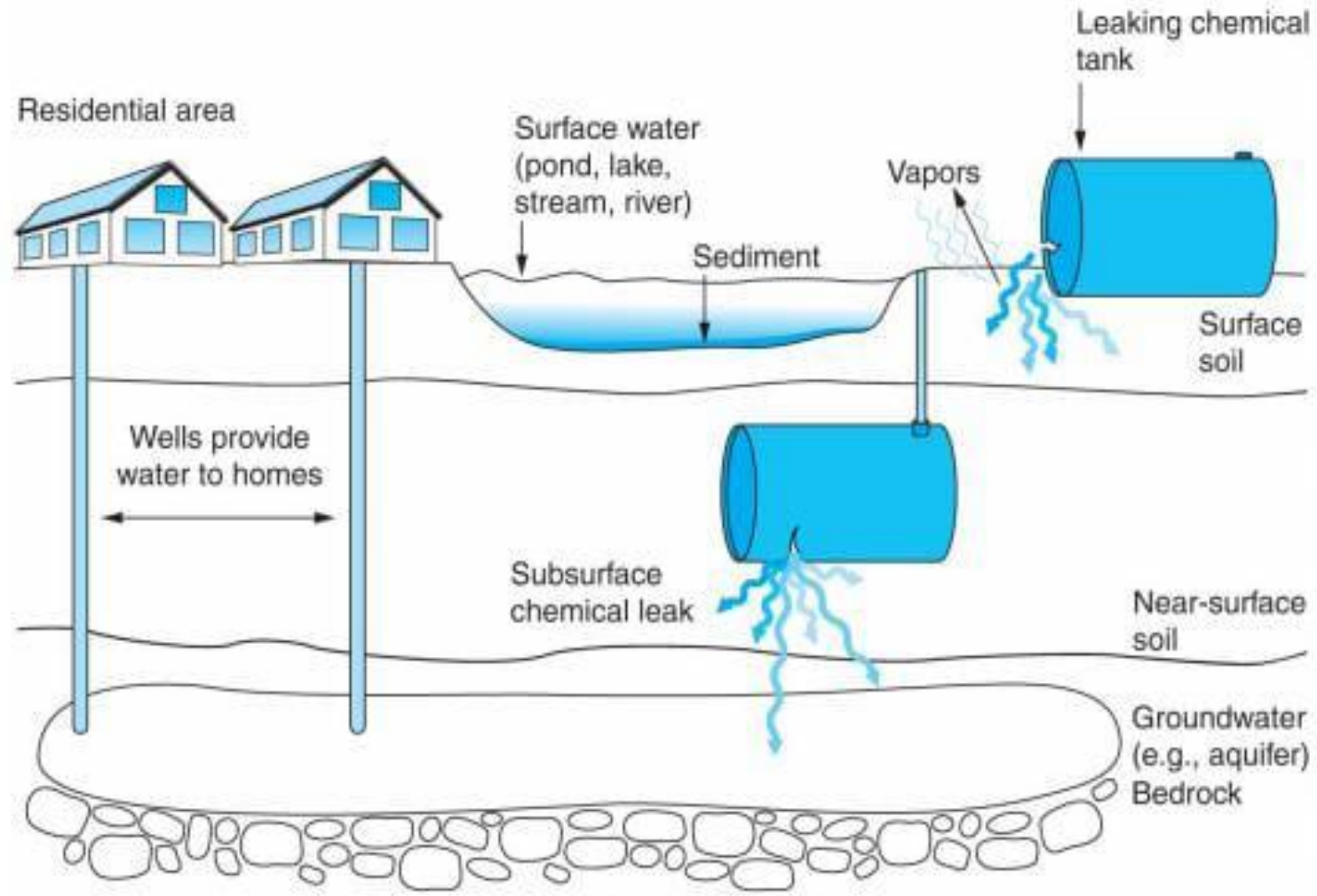
–Each presents its own complexities for cleanup
because the type of bioremediation approach used
Depends on site conditions

BIOREMEDIATION BASIC

- Pollutants enter the environment in many different ways
 - Tanker spill, truck accident, ruptured chemical industrial site, release of pollutants into air
 - Location of accident, the amount of chemicals released, and the duration of the spill impacts the parts of the environment affected

Of the example of bioremediation

- Chemical contamination of surface soil > deep soil
contaminated groundwater provide house drink water so; air
environment they water on the surface water,
groundwater. some chemical vapor. We well taken about of
surface water, surface soil, near surface soil, groundwater. all
thes contaminated with pollutant of the job (clean
environment)



9.2 BIOREMEDIATION BASICS

Chemicals in the environment

- Carcinogens .(cancer)
- Compounds that cause cancer
- Mutagens.(mutations).
- Cause skin rashes, birth defects
- Poison plant and animal life .(Stock animal).

- These two consists very similar ,but different the
 - Bioremediation(general enjennring)
 - Biodegradation (natural process).
- What the difference between the biodegradation and bioremediation?

****Defintion:-**

- **Bioremediation**:-waste management techniques results of active human .that enplays organisms to clean the environment.
- **Biodegradation**:-decomposing organic matter and chemical recycling such as bacterial and fungi.

****Nature of the process:-**

- **Bioremediation:-**engineering process design and executed by science.
- **Biodegradation:-**natural process not use human.

****Speed:-**

- **Bioremediation:-**faster health livestock.
- **Biodegradation:-**slow.

****CONTROL:-**

- **Bioremediation:-controlling.**
- **Biodegradation:-natural.**

****EFFECTIVE:-**

- **Bioremediation:-always beneficial.**
- **Biodegradation:-both beneficial and harmful .**

****TIME , LOCATION :-**

- **Bioremediation**:-site specific area.
- **Biodegradation**:- every where anytime.

****THE NEED FOR EXPERTISE:-**

- **Bioremediation**:-scientis required experts.
- **Biodegradation**:- nature.

- SO, this table commonly of chemical pollutants found environment they source.

TABLE 9.1 TWENTY OF THE MOST COMMON CHEMICAL POLLUTANTS IN THE ENVIRONMENT

Chemical Pollutant	Source
Benzene	Petroleum products used to make plastics, nylon, resins, rubber, detergents, and many other materials
Chromium	Electroplating, leather tanning, corrosion protection
Creosote	Wood preservative to prevent rotting
Cyanide	Mining processes and manufacturing of plastics and metals
Dioxin	Pulp and paper bleaching, waste incineration, and chemical manufacturing processes
Methyl t-butyl ether (MTBE)	Fuel additive, automobile exhaust, boat engines, leaking gasoline tanks
Naphthalene	Product of crude oil and petroleum
Nitriles	Rubber compounds, plastics, and oils
Perchloroethylene/ tetrachloroethylene (PCE), trichloroethene (TCE), and trichloroethane (TCA)	Dry cleaning chemicals and degreasing agents TCE is present in some 34% of U.S. water supplies and 60% of Superfund sites
Pesticides (atrazine, carbamates, chlordane, DDT) and herbicides	Chemicals used to kill insects (pesticides) and weeds (herbicides)
Phenol and related compounds (chlorophenols)	Wood preservatives, paints, glues, textiles
Polychlorinated biphenyls (PCBs)	Electrical transistors, cooling and insulating systems
Polycyclic aromatic hydrocarbons (PAHs) and polychlorinated hydrocarbons	Incineration of wastes, automobile exhaust, oil refineries, and leaking oil from cars
Polyvinylchloride	Plastic manufacturing
Radioactive compounds	Research and medical institutions and nuclear power plants
Surfactants (detergents)	Manufacturing of paints, textiles, concrete, paper
Synthetic estrogens (ethinyl estradiol)	Female hormone (estrogen)-related compounds created by a variety of industrial manufacturing processes
Toluene	Petroleum component present in adhesive, inks, paints, cleaners, and glues
Trace metals (arsenic, cadmium, chromium, copper, lead, mercury, silver)	Car batteries and metal manufacturing processes
Trinitrotoluene (TNT)	Explosive used in building and construction industries

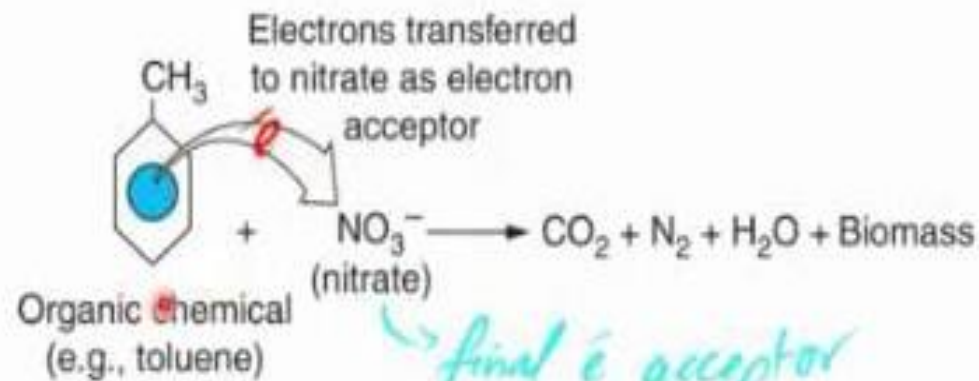
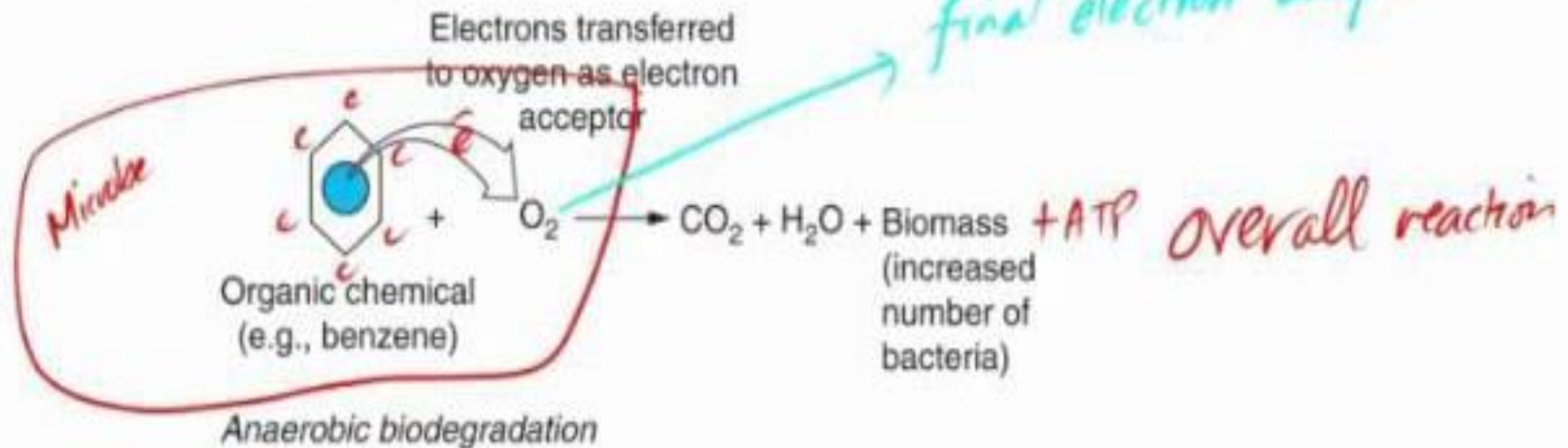
- Mainly only biochemical reaction on metabolic reaction carry out organisms these because, metabolic reaction. and one of major of microbes convert Chemical (food, nutrients, energy sources).
- Both of 1-aerobic. 2-anaerobic.. and two type reaction are used typically chemical environment. oxidation, and reduction reaction

9.2 BIOREMEDIATION BASICS

- Fundamentals of cleanup reactions.
- Microbes convert chemicals into harmless substances by either.
 - Aerobic metabolism (require oxygen) or anaerobic metabolism
 - (DO NOT REQUIRE OXYGEN)

- Both processes involve oxidation and reduction reactions
- (Oxidation) – removal of one or more electrons from an atom or molecules.
- (Reduction) – addition of one or more electrons to an atom or molecules.

Aerobic biodegradation



- **Aerobic biodegradation**

- Happiness of present oxygen organic chemical (benzene), of contaminated soil and well happen by transfer electron benzene contains of (6) carbon and we have covalent bonds between atom.

- Covalent bounds :-carry of high energy basically.

These of results breakdown covalent bonds releasing the carbon from the organic matter finally product (CO₂) release.

- Of course, overall reaction this of understand not single step.

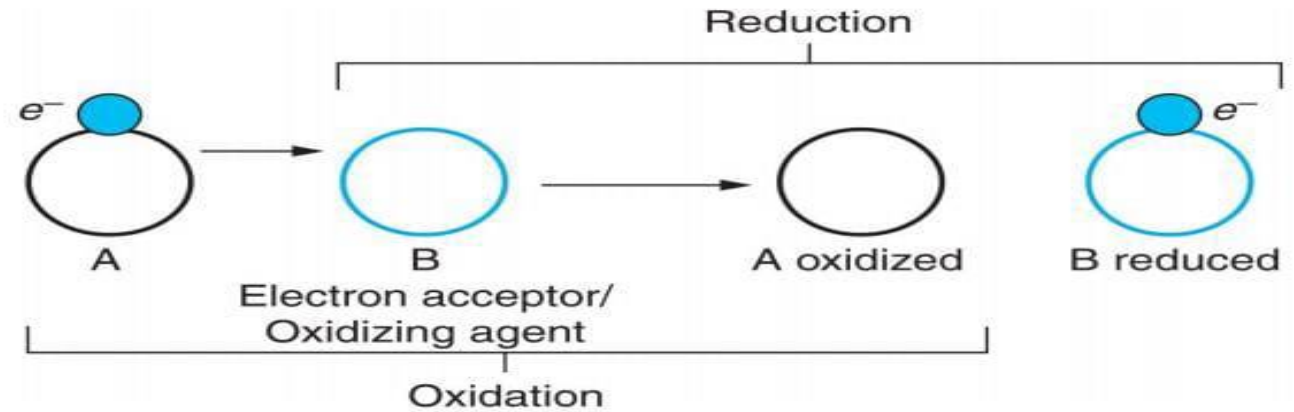
– Chemical reaction will lead degradation benzene and formations water, formations oxygen .

- These microbes use oxygen to make two other molecules.
- They also will use energy here use (ATP).
- These microbes carry out and divide increase the number.

#SO,, 100 this organic matter as carbon and energy sources of microbes use the carbon and energy of release from degrade organic molecules of aerobic respiration to increase the number of grow.

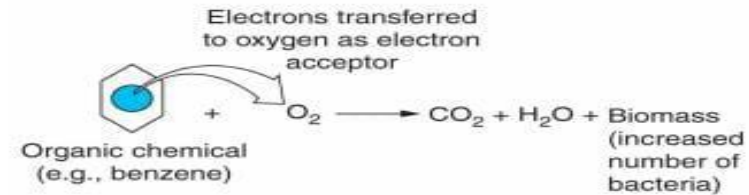
- The anaerobic biodegradation happens in the absence of oxygen.
- We have biodegradation chemical bonds or covalent bonds found in these organic molecules broken only if the electrons are taken from these organisms.
- **Notes 1 (O₂):** - final electron acceptor.
- **Notes 2 (NO₃⁻):** - final electron acceptor.
- The players: metabolizing microbes.
 - Scientists use microbes, especially bacteria, as tools to clean up the environment.

- May involve combined AC<ON of both aerobic and anaerobic bacteria to fully decontaminate

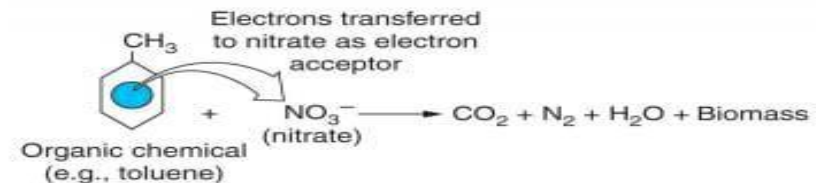


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Aerobic biodegradation



Anaerobic biodegradation



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*So this figure, how one type of microbes in the soil good use degrade lets see chemical they soil near surface soil well aerobic bacterial okay.

Anaerobic bacteria :- use (O_2) release (CO_2), (H_2O). But we have other anaerobic bacteria .

- 1- (NO_3^-), nitrate reducing anaerobes .
- 2- iron (Fe). (111):- reducing anaerobea.
- 3- sulfate (SO_4^{2-}):- reducing anaerobea
- 4- methanogenic carbon dioxide (CO_2):- reducing anaerobea

Reducing anaerobes because, use these molecules, inorganic molecules we use electron acceptor will be reduced.

#(CO₂):- product gas methane (CH₄).

- Indigenous microbes – those found naturally at a polluted site are often isolated, grown and studied in a lab and then released back into treatment environments in large number.
- For example the, bacterial, *Pseudomonas* and *E. coli*..

- The quest for new metabolizing microbes is an active area of bioremediation research.

- In 2010, US Geological Survey identified a bacterial form from California's Mono Lake which may metabolize arsenic and incorporated it into biomolecules such as .

#So, another contaminated happen in indigenous microbes of (slow rate) any organisms special microbes find contaminated site chemical pollutant

#Order efficiency increase degrading chemical pollutant mapy, speed up process contaminated clean.

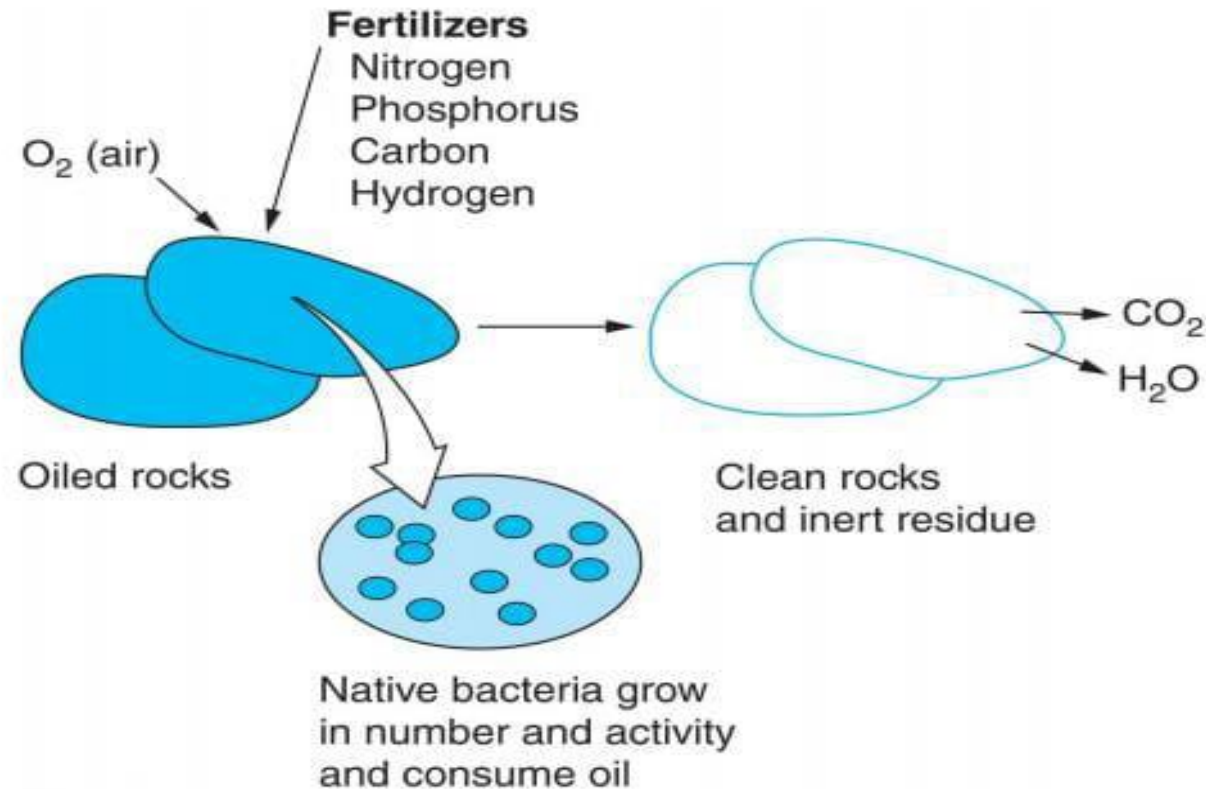
– Of course new metabolizing microbes that able enzyme degrade indigenous microbes they arobic bacterial...process very slow.

– Fertilizer (food):-essential atom of nitrogen, phosphorus, carbon,hydrogen of these (rate limiting nutrients).

- Fertilizer increase native bacterial that degrade chemical this process of biostimulation:- involved modified to the environment to stimulate existing microbes to do bioremdiation.

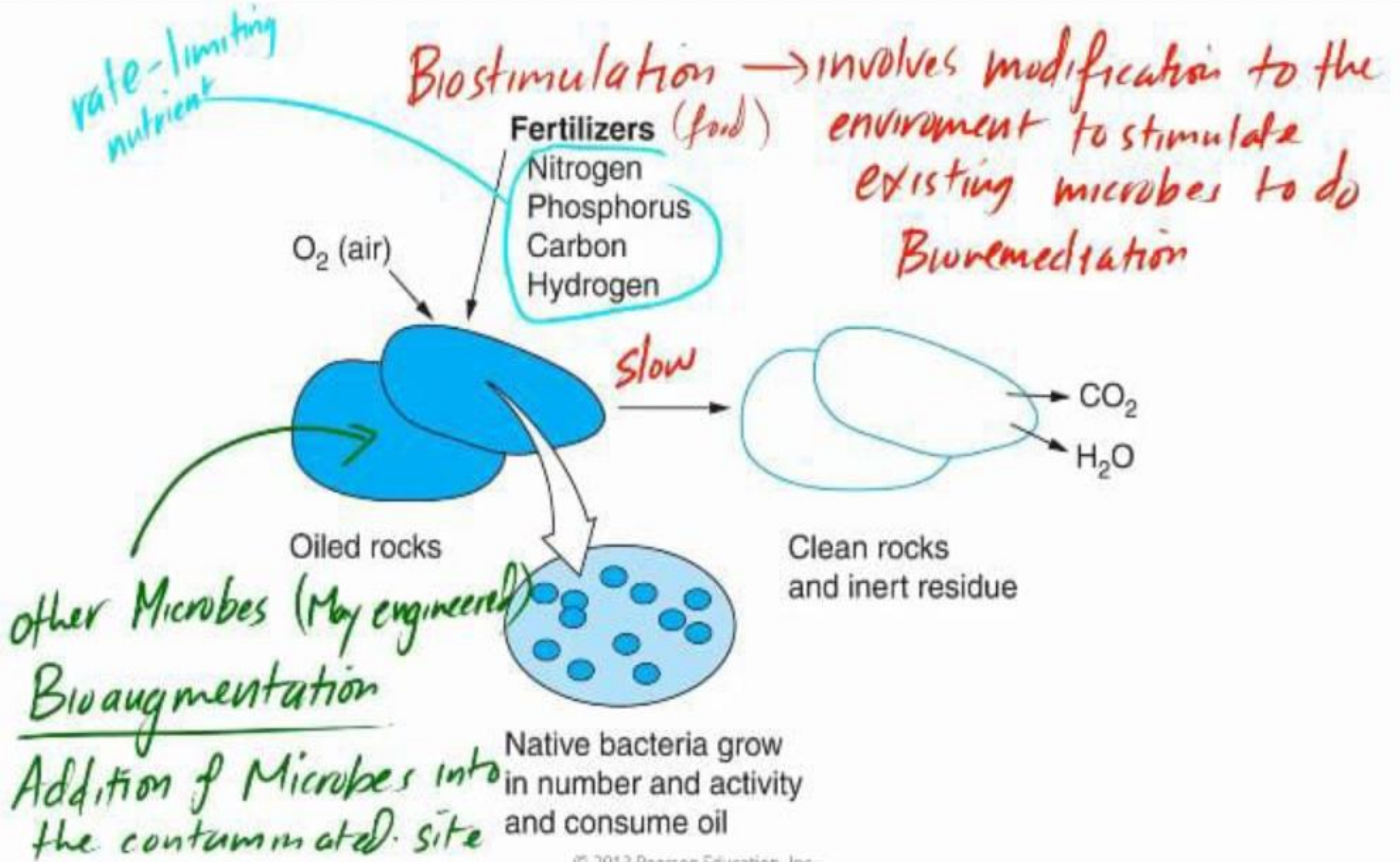
Sometimes we added others microbes (may enjennring), clean process help.

- This process bioaugmentations is the additions of microbes in to the contaminated.



BIOREMEDIATION GENOMICS PROGRAMS

- Scientists are studying the genomes of organisms that are currently used or may be used for bioremediation (remember the microbial genome program) possible to identify novel genes and metabolic pathways used to detoxify chemicals could help develop improved strains through genetic engineering.

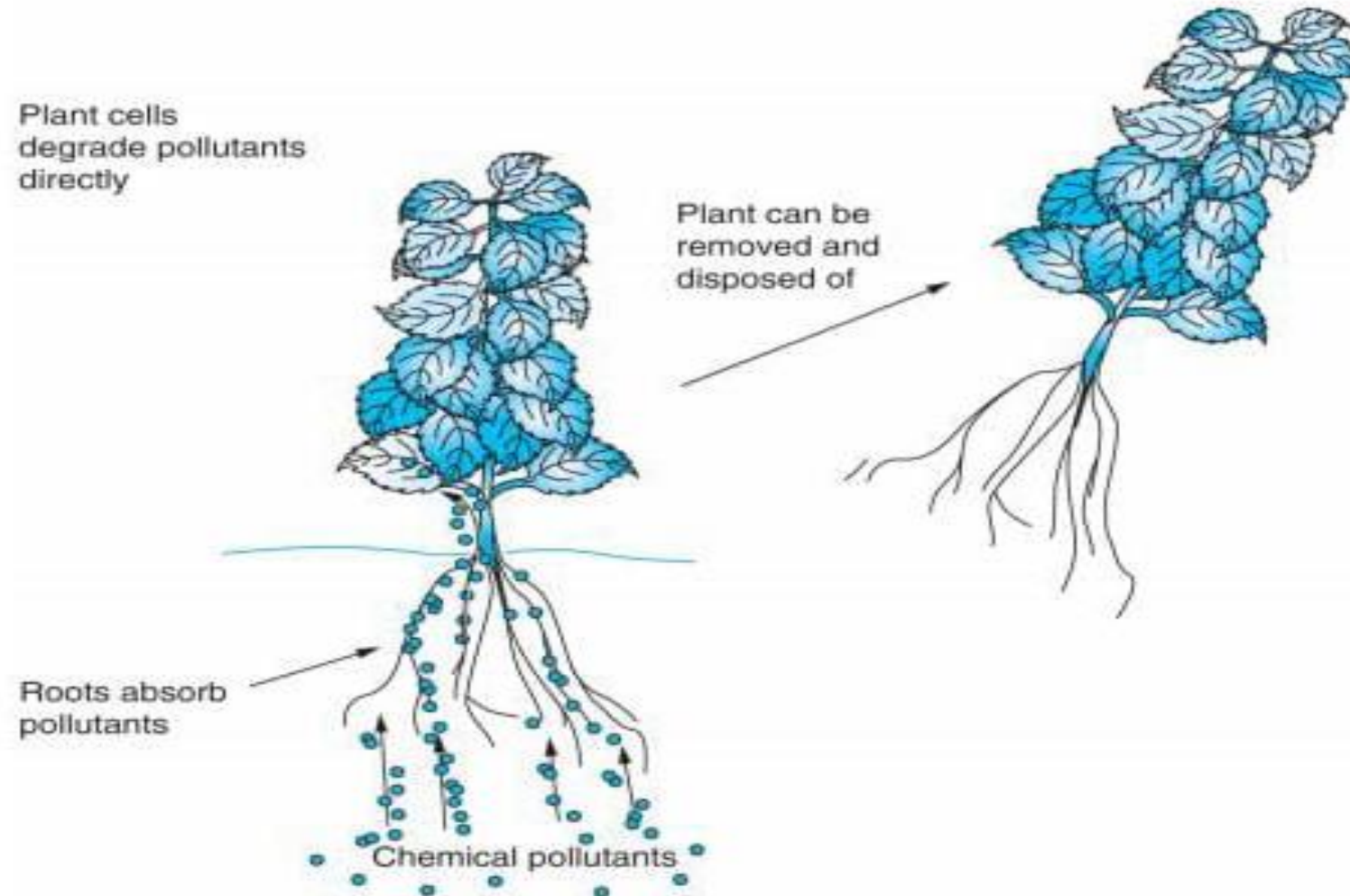


PHYTOREMEDIATION(PLANT)

–Utilizing plants to clean up chemicals in the soil, water and air
an estimated 350 plant species naturally take up toxic materials.
The following have been successfully used:

- 1- Polar and juniper trees, certain grasses and alfalfa
- 2- Sunflower plants removed radioactive cesium and strontium at the chernobyl nuclear power plant in ukraine
- 3- Water hyacinths(type of flower growth the surface of water).
removed arsenic from water supplies in bangladesh.

- **NOTES***arsenic of the very toxic human.



- Typically this plant used phytoremediation (plant). here good be used root can absorb the chemical pollutant of soil the plant clean remove discard and sometimes chemical absorb plant degrade inside cell plant by sometime biochemical reactions.

- So, chemical pollutant absorb from soil and from water by plant and then some chemical degrade inside plant

- Sponge:- absorb chemical

PHYTOREMEDIATION

- Chemical pollutants are taken in through the roots of the plant as they absorb contaminated water from the ground after toxic chemicals enter the plant, the plant cells may use enzymes to degrade the chemicals in other cases, chemicals can be concentrated in the plant cells the entire plant serves as 'Sponge' contaminated plants treated as waste high concentrations of chemicals kill most plants, so works best where amount of contaminated is low.

- Phytoremediation can be an effective, low-cost, lowmaintenance, and eye-appealing strategy.
- Two drawbacks are that only surface layers (to around 50cm deep) can be treated and cleanup typically takes several years.

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