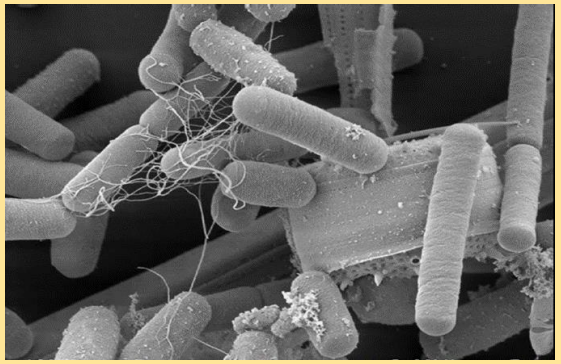
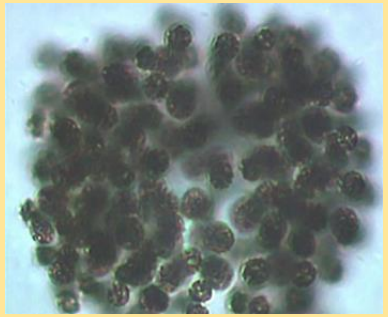
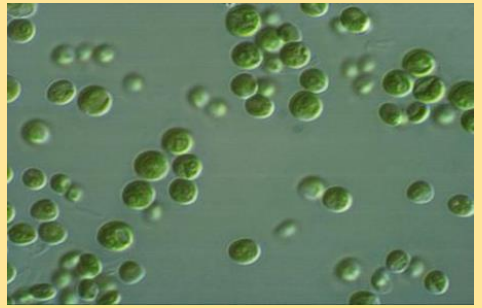
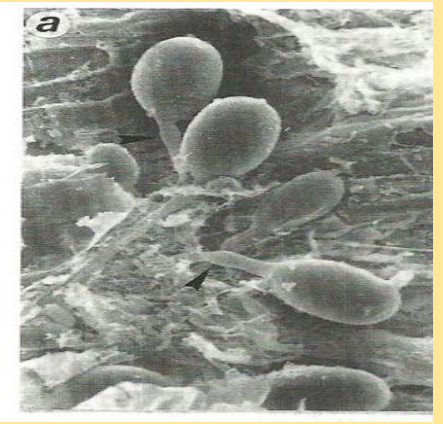
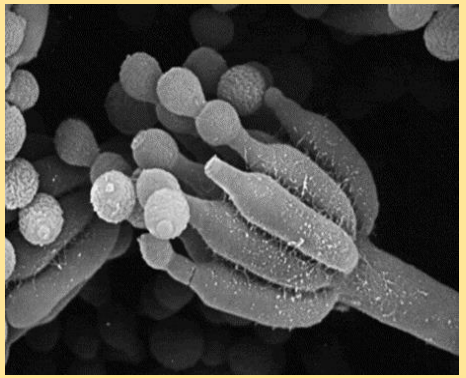



The microbial world : an unkown diversity of living beings essential for human, animal and plant life and sustainable development

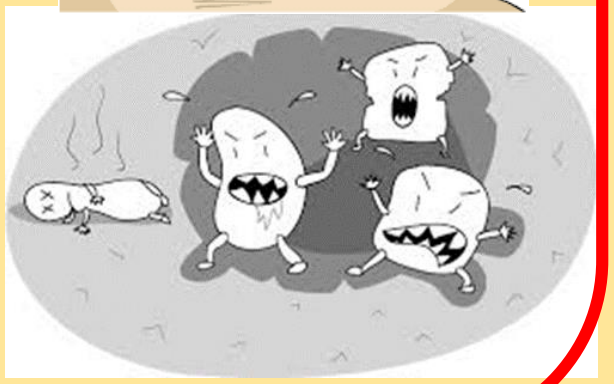
Gérard FONTY

GREFFE
Groupe Scientifique de Réflexion et d'Information pour un Développement Durable

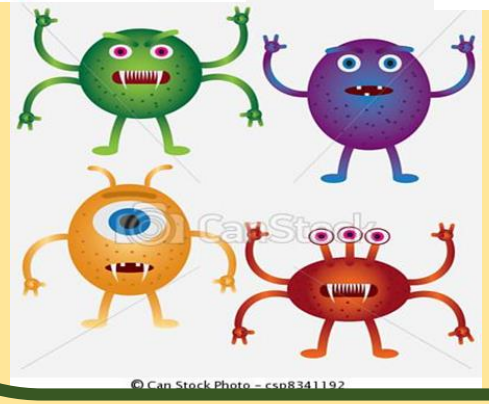


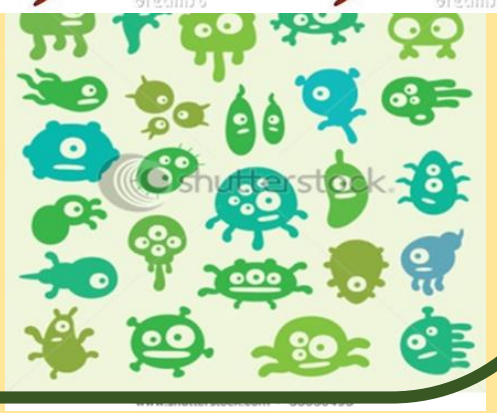
The microbes : a negative connotation .....

Some rare ennemies…



….but mainly, an abundant crowd of true and noble friends

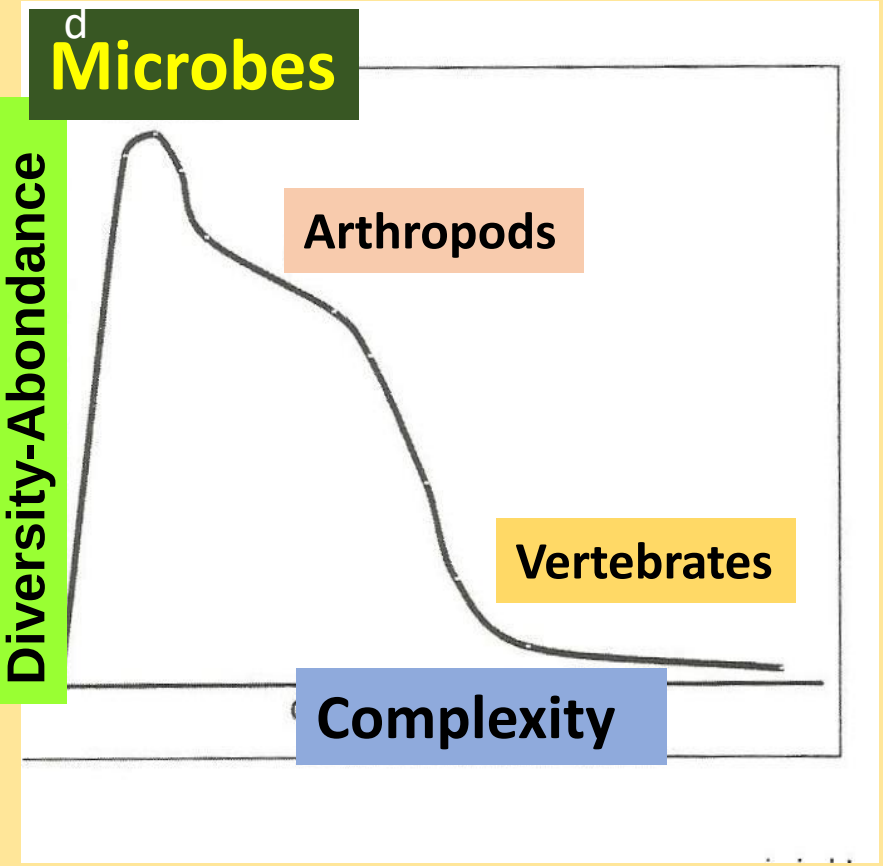




The microbes are the main colonisers of the earth planet

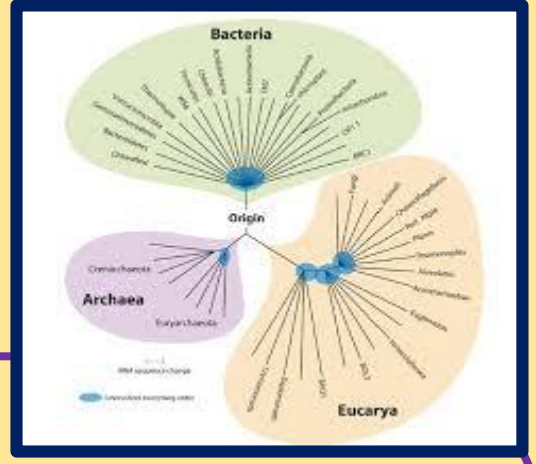
The microbial world :

- An unsuspected richeness and diversity
  - ➢ Thousands of species and biotypes
  - ➢ The most diversified part of the living beings
- An unsuspected abundance

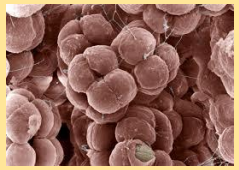
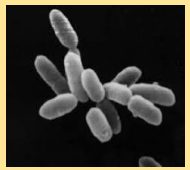


Microbes = approximately 50 % of the organic carbon on the earth

The microbial world: an exceptionnal diversity of species in the three domains of life

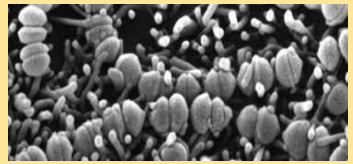


- **Archaea**

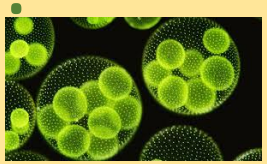
- **Bacteria**

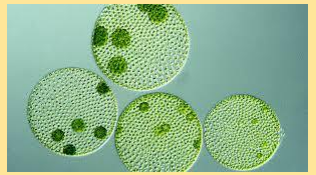




Prokaryotes

- **Eukaryotes :**
  - **Micro-algae,**

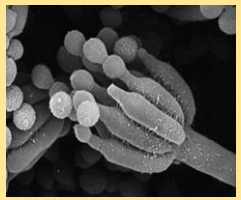
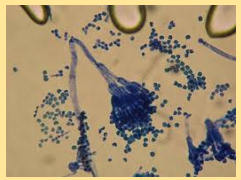





  - **Protozoa,**



  - **Microscopic fungi**

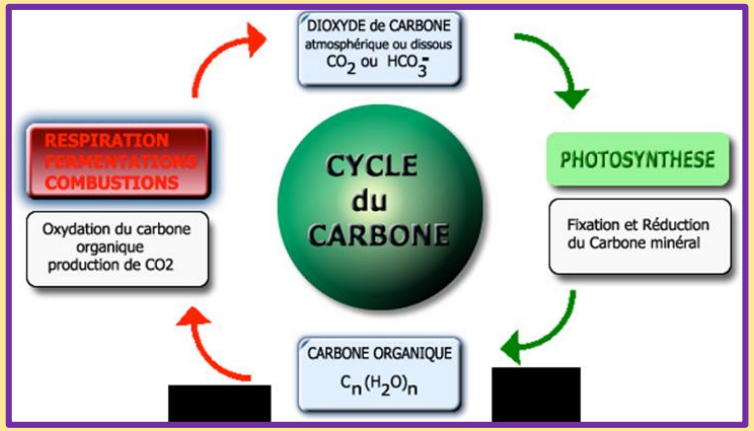

Microbes are everywhere

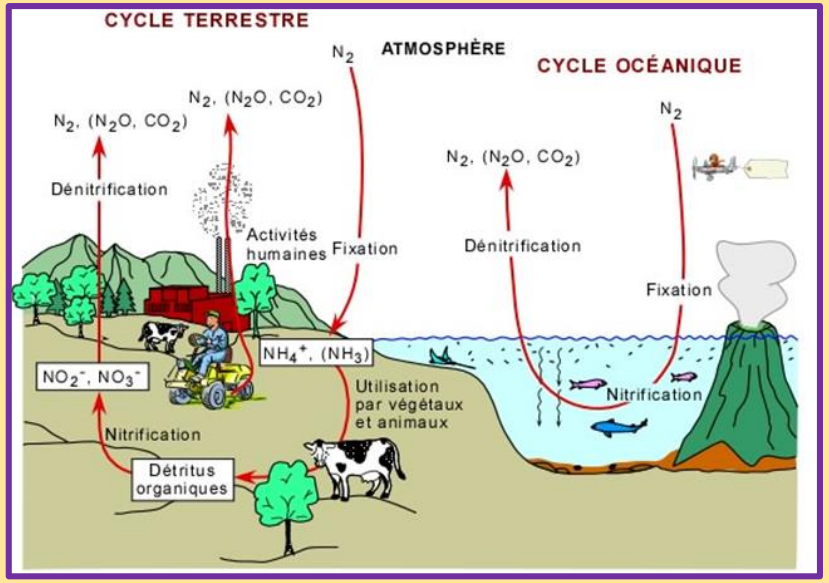
They are present in all biotopesand complex ecosystems including the most extreme ones

- Soils, sub-surfaces
- Oceanic and freshwater systems
- Sediments
- Atmosphere
- In association with plants (rirhosphere)
- Human and animal cavities
- Inert surfaces

The microbial world : an exceptionnal diversity of fundamental ecological functions

Microbes are involved in almost all biochemical cycles : C, N, O_2, P, … in terrestrial and oceanic ecosystems





Soil : an eden for microbes

Per gram of soil :

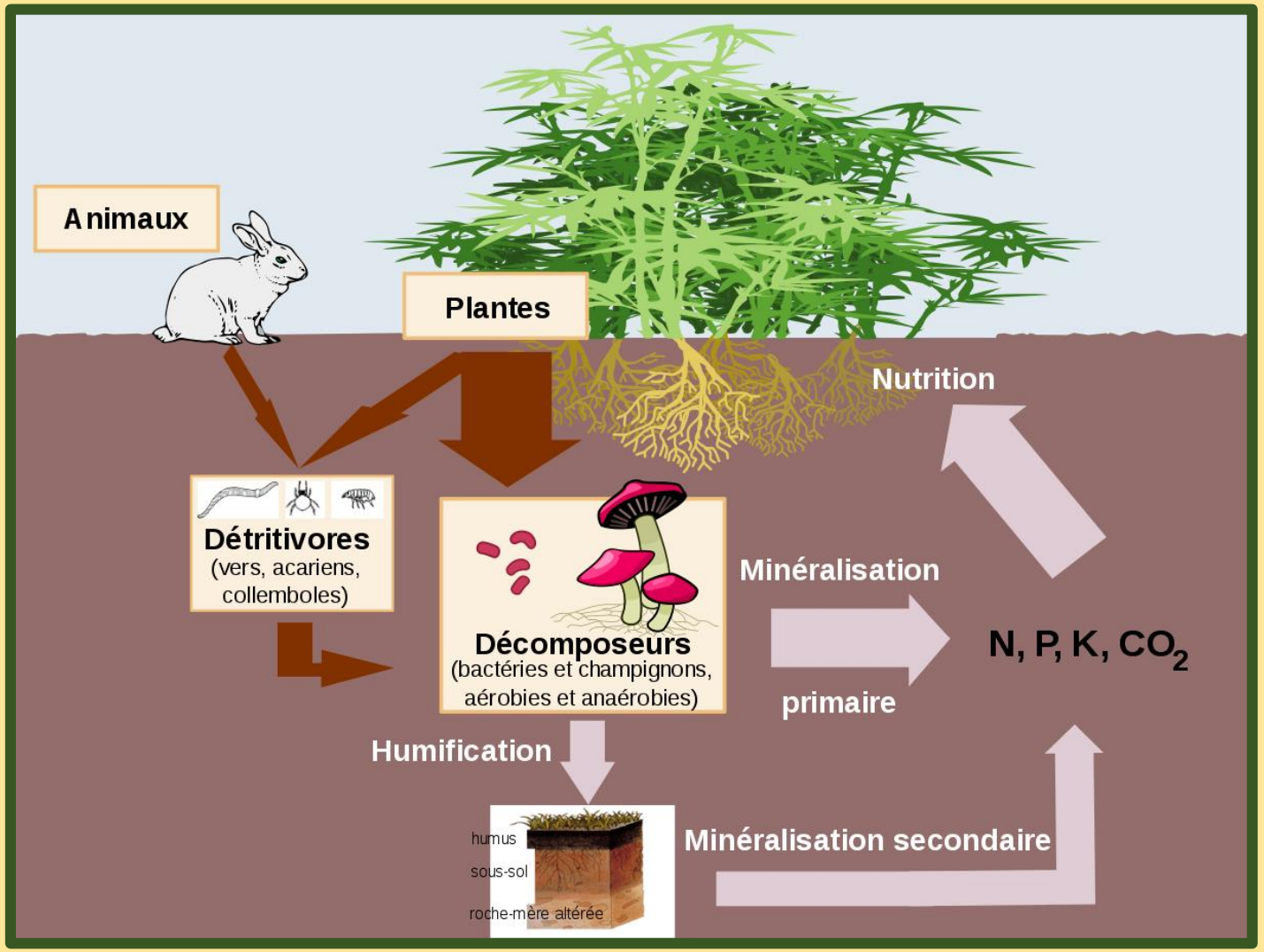
- 100 millions -10 Mds of Bacterial cells (25% of soil biomass)
- 10-20 millions of fungi (65% of soil biomass)
- 10 millions-100 Mds of protozoa
- 1000-100000 algaes

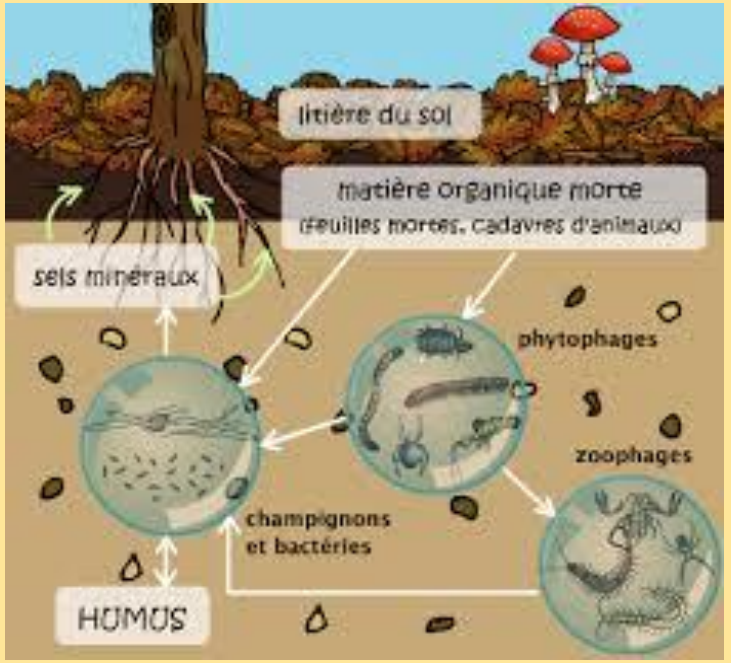
An haven of microbial diversity

Bacteria impact all biogeochemical cycles

Microbes in soils : acters of organic matter mineralisation

Recycling and renewal of nutritive ressources

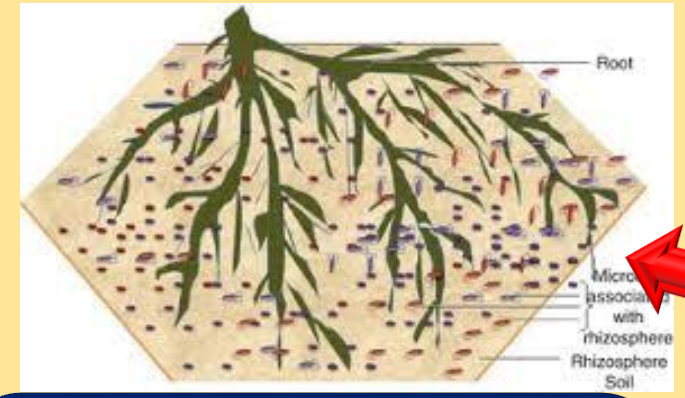


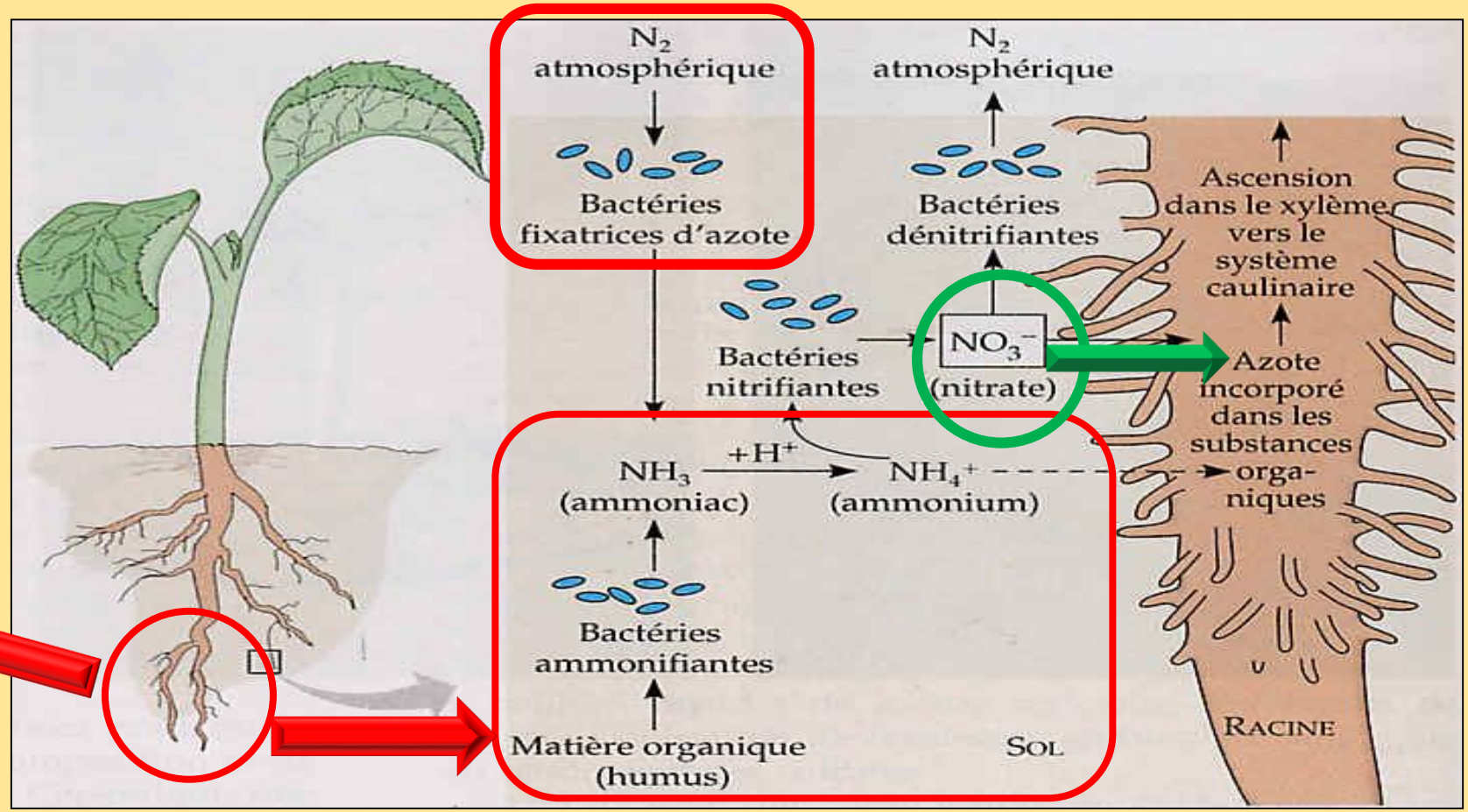


Microbes complete the actions of the micro-invertabres

Microbes at service of plants

Rhizosphere:
an ecosystem constituted by roots and firmly-associated microbes to them

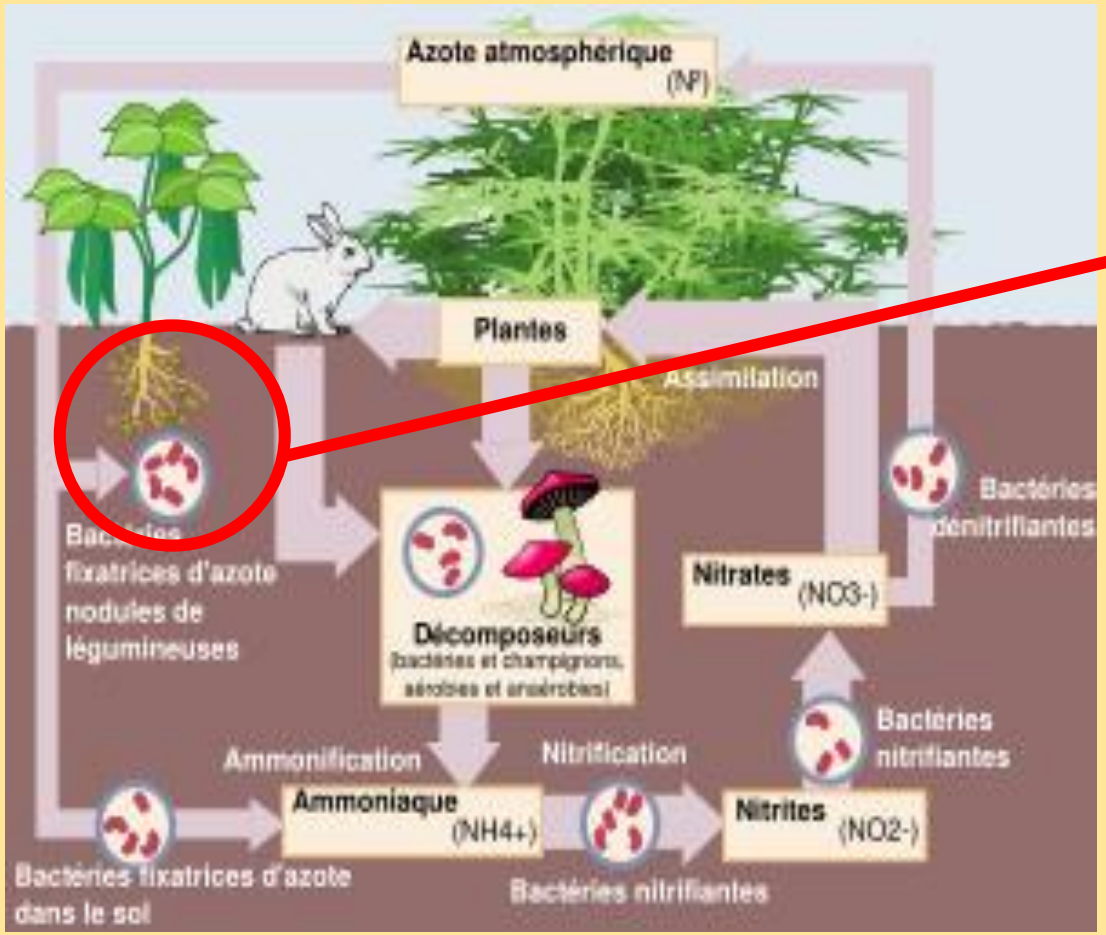


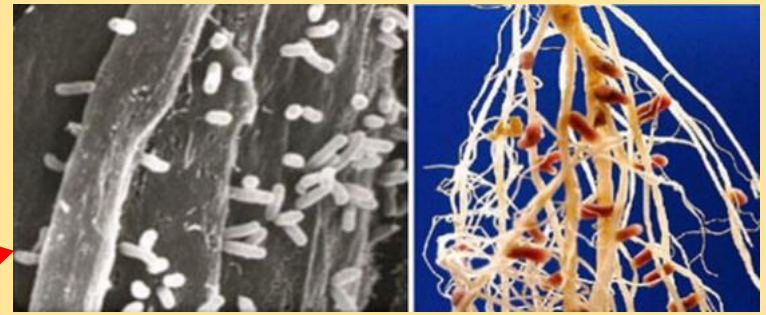


A very intimate and strong communication plant-microorganisms

Microbes provide vital and sustainable ressources to plants

Microbes at service of a sustainable agriculture





Nodules =
Nitrogen-fixing bacteria

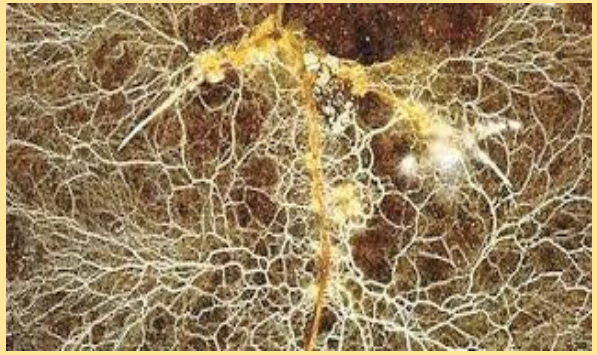
A very powerfull association
(50-100 kgN/ha/year)

= efficient alternative to chemical fertilizer

The symbiotic association between leguminous plants and microbes : at service of farmers and gardeners

Microbes at service of trees and plants

Fungi associated with roots : the mycorhizes
A fundamental role

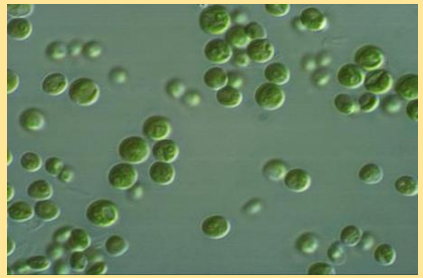


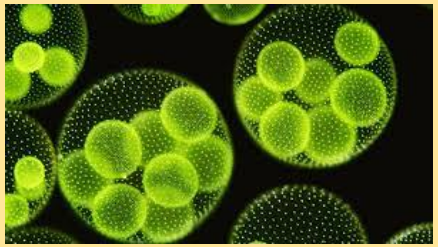
Without mycorhize

With mycorhizes

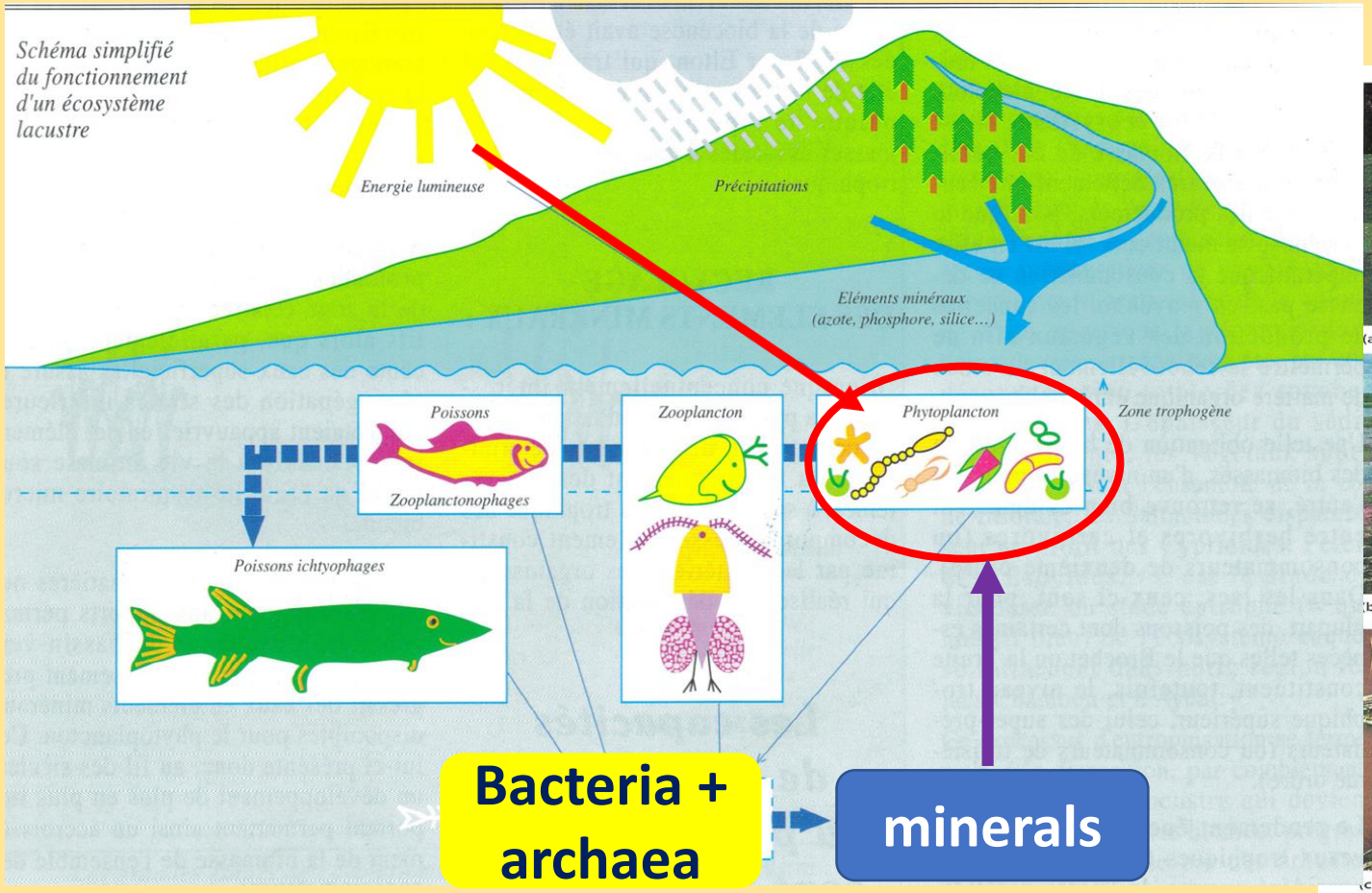
Microbes insure entrance of energy in aquatic ecosystems and recycle organic matter

Micro-algaes (phytoplanton)



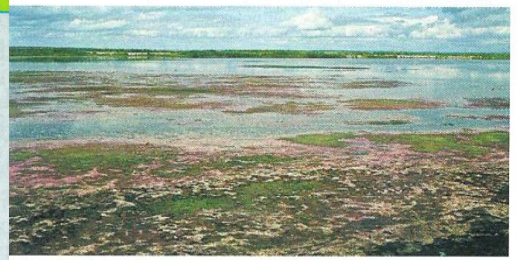


Photosynthetic microbes



Bacteria

(a) Efflorescence de cyanobactéries (des bactéries photolithoautotrophes)

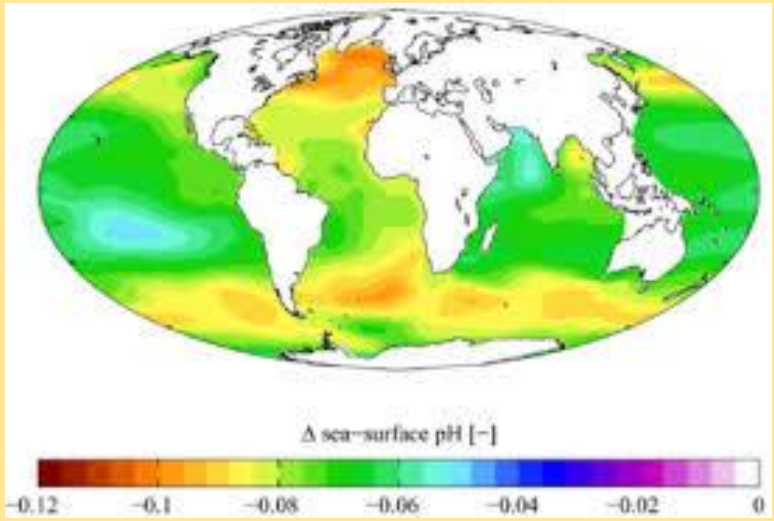


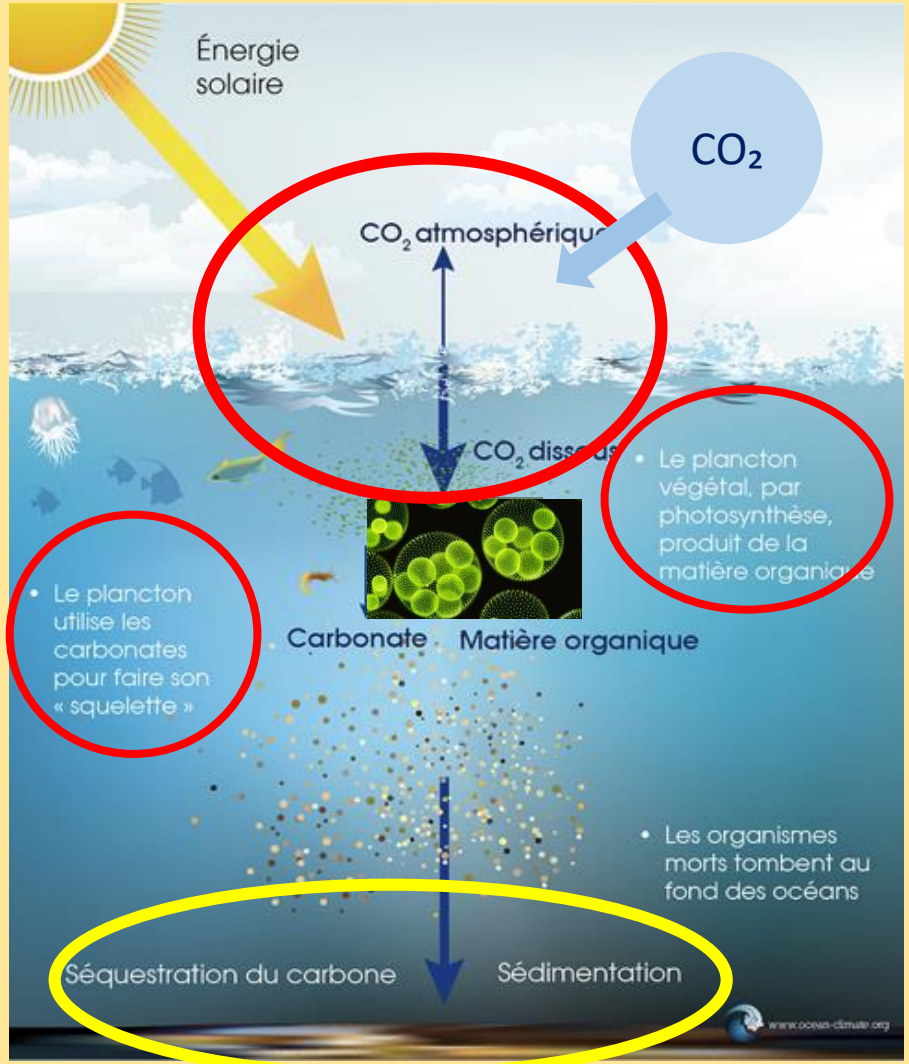
(b) Des bactéries sulfureuses pourpres (des photohétérotrophes)

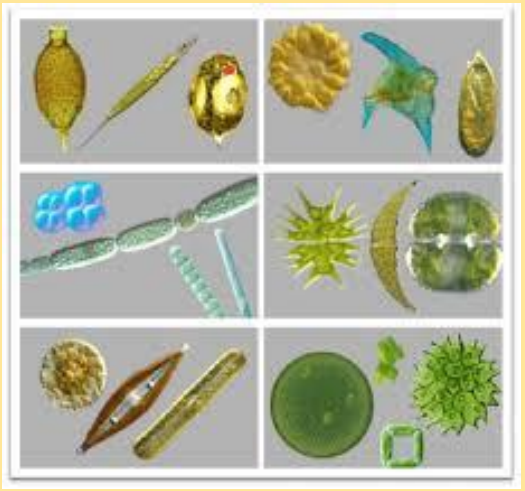
(c) Des bactéries sulfureuses pourpres

Microbial ecosystems are at service of climate

Ecological role of phytoplancton: carbon captation







Microbial digestive ecosystems at service of all animals especially herbivores

Microbes are acters of plant polymers digestion in all gastrointestinal tracts





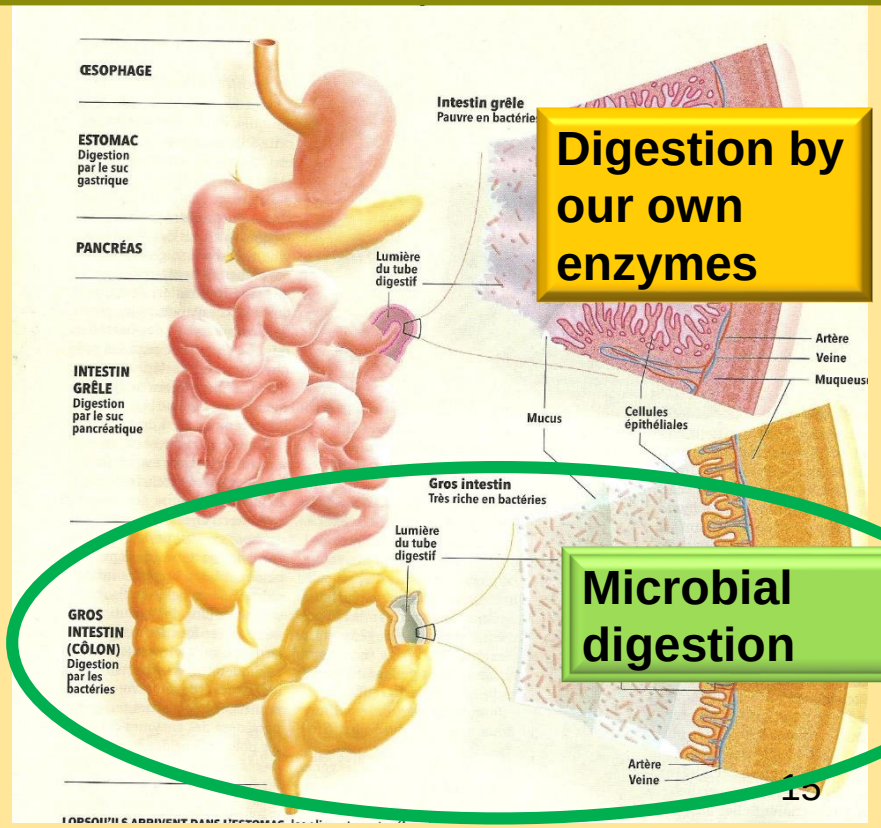





Without microbes : no herbivore

Microbial ecosystems at the service of human digestion, nutrition and health

Human intestinal microbiote : a large diversity of species, enzymes and functions



The microbial cells we harboured in our digestive tract are much more numerous than our own cells

Human beings carry 150 fold more bacterial genes than human genes

Intestinal microbial ecosystem at service of human nutrition and sustainable health

We are a symbiotic association

digest plant fibres (cellulose, pectins, hemicelluloses,)

Provide : energy, vitamins,

Prevent entrance of pathogens

Optimize immune system

Prevent chronic deseases, obesity

Interact positively with brain

A diversified and stable microbiote : our precious friend

Microbial ecosystems at service of human sustainable alimentation

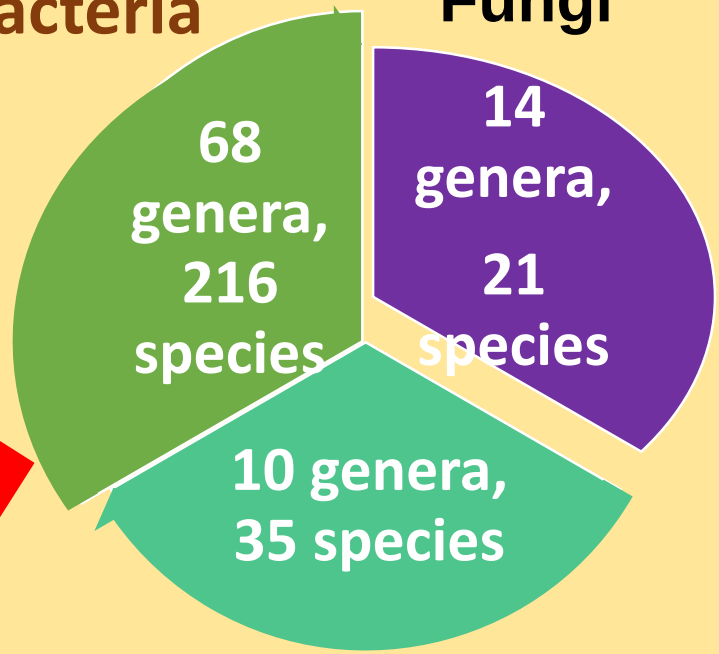
Microbes are the basis of our civilization

Flavours

Prevent pathogens

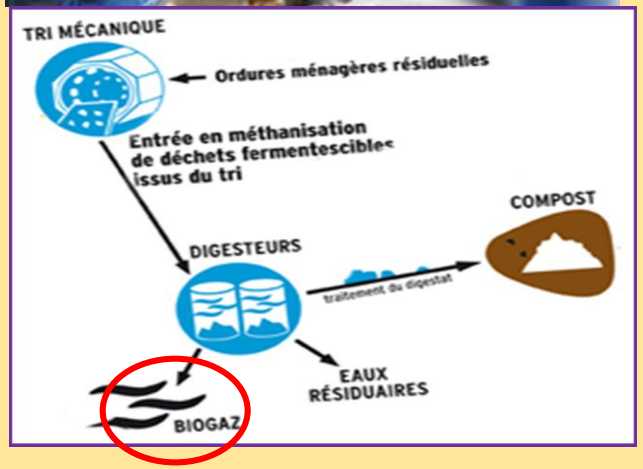
Bacteria

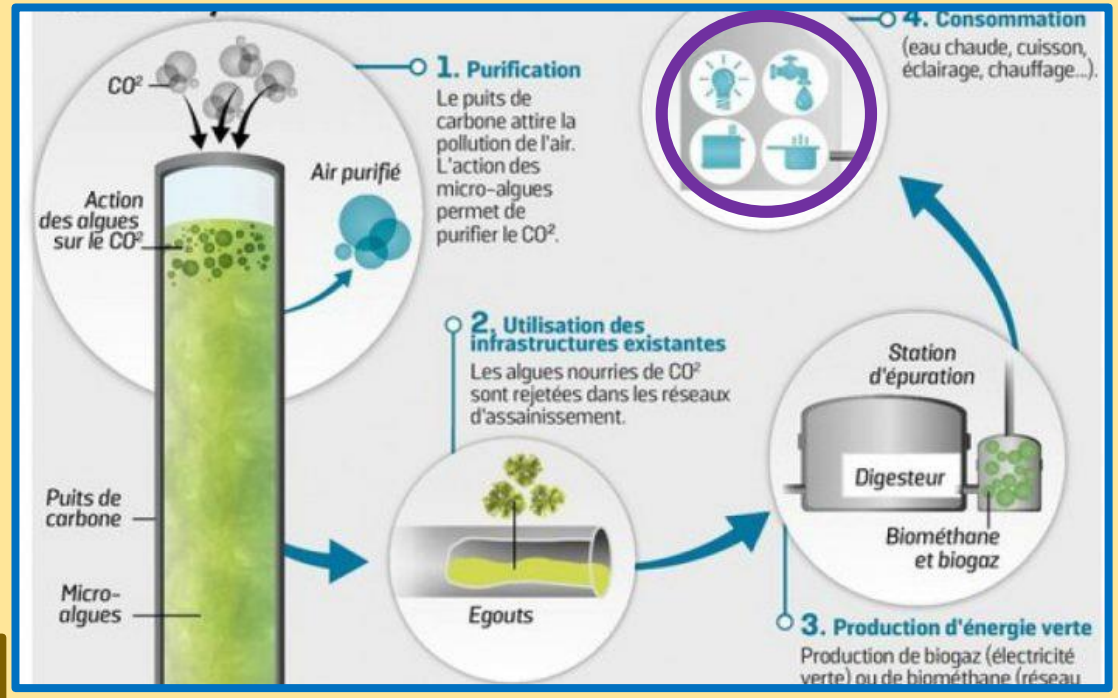
Fungi

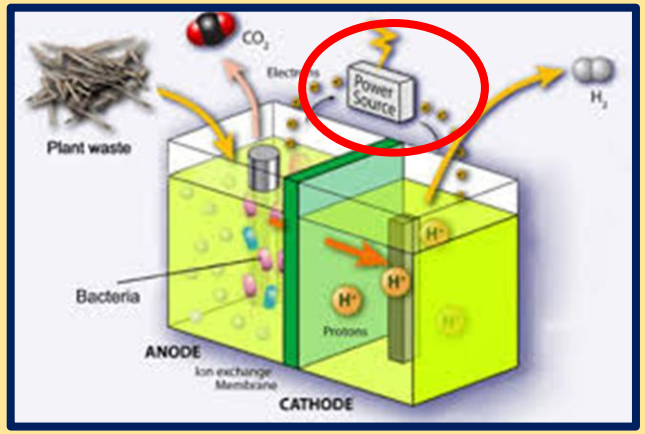


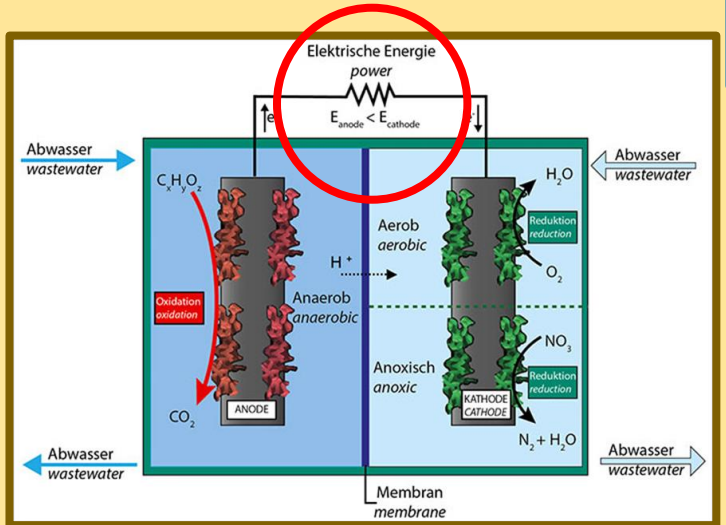
Yeasts

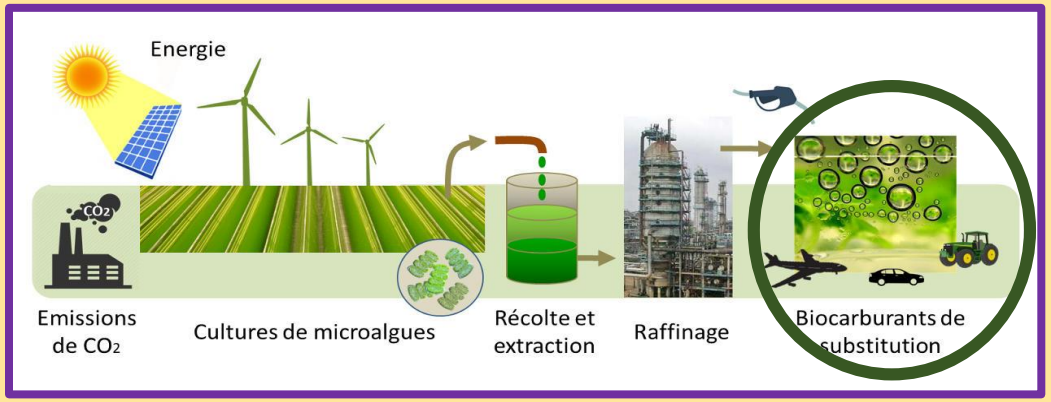
Microbes at service of renewable energy production









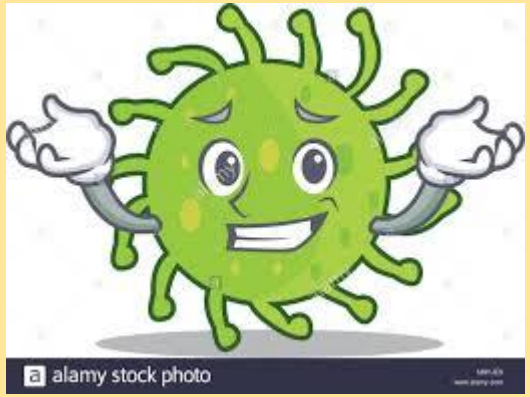


conclusion

- **Microorganisms** are essential to vegetal, animal and human life and to the equilibrium of the biosphere

- Services provided by microbial ecosystems have an inestimable value,

- The sustainable dévelopment must absolutely take into consideration fonctions realised by these live beings called « primitive » and avoid harmfull practices



Thank you for attention

The microbial ecosystems are at the service of treatement and purification of water and sewages

Epuration aérobie

Epuration anaérobie