



Role of Microorganisms in Aquatic Chemical Reactions

Dr. R. Babu Rajendran

Professor

Dept. of Environmental Biotechnology

Bharathidasan University



Microbial Processes in Aquatic System

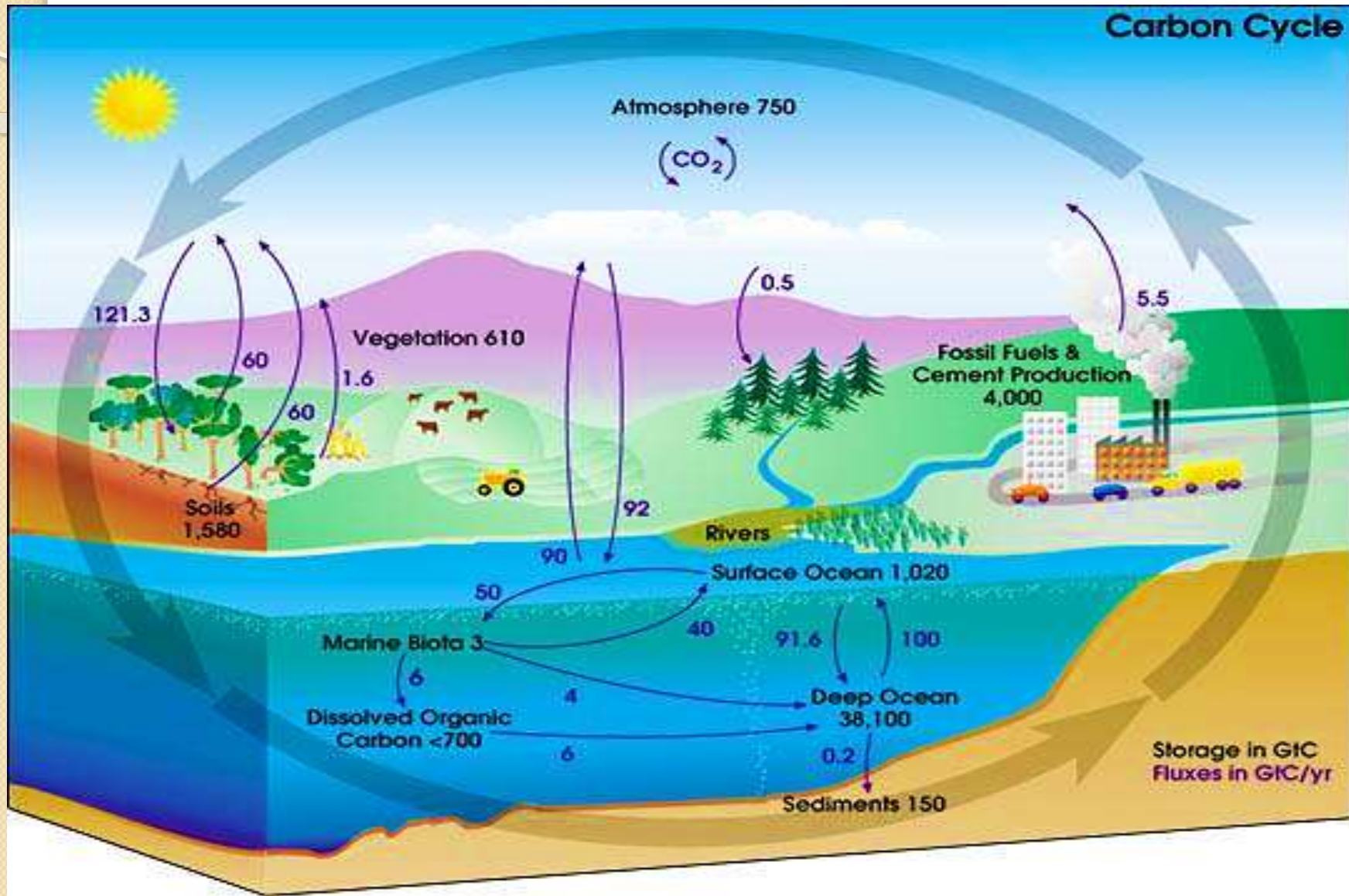
- The movement of elements through living matter, the atmosphere, oceans, and sediments is referred to as cycling.
- The carbon and nitrogen cycles are two of the most important global cycles, and bacteria play a key role every step of the way.
- Without bacteria, these cycles would not occur and life could not exist.
- Both these cycles affect the lives of the macro flora and fauna which share this habitat.



Carbon Cycle

- The carbon cycle allows carbon to be recycled and reused throughout the biospheres and all living organisms.
- It is essential for new life. Bacteria help breakdown dead and decaying organic matter.
- During decomposition, these bacteria will release carbon dioxide if oxygen is present, or methane if it is not.

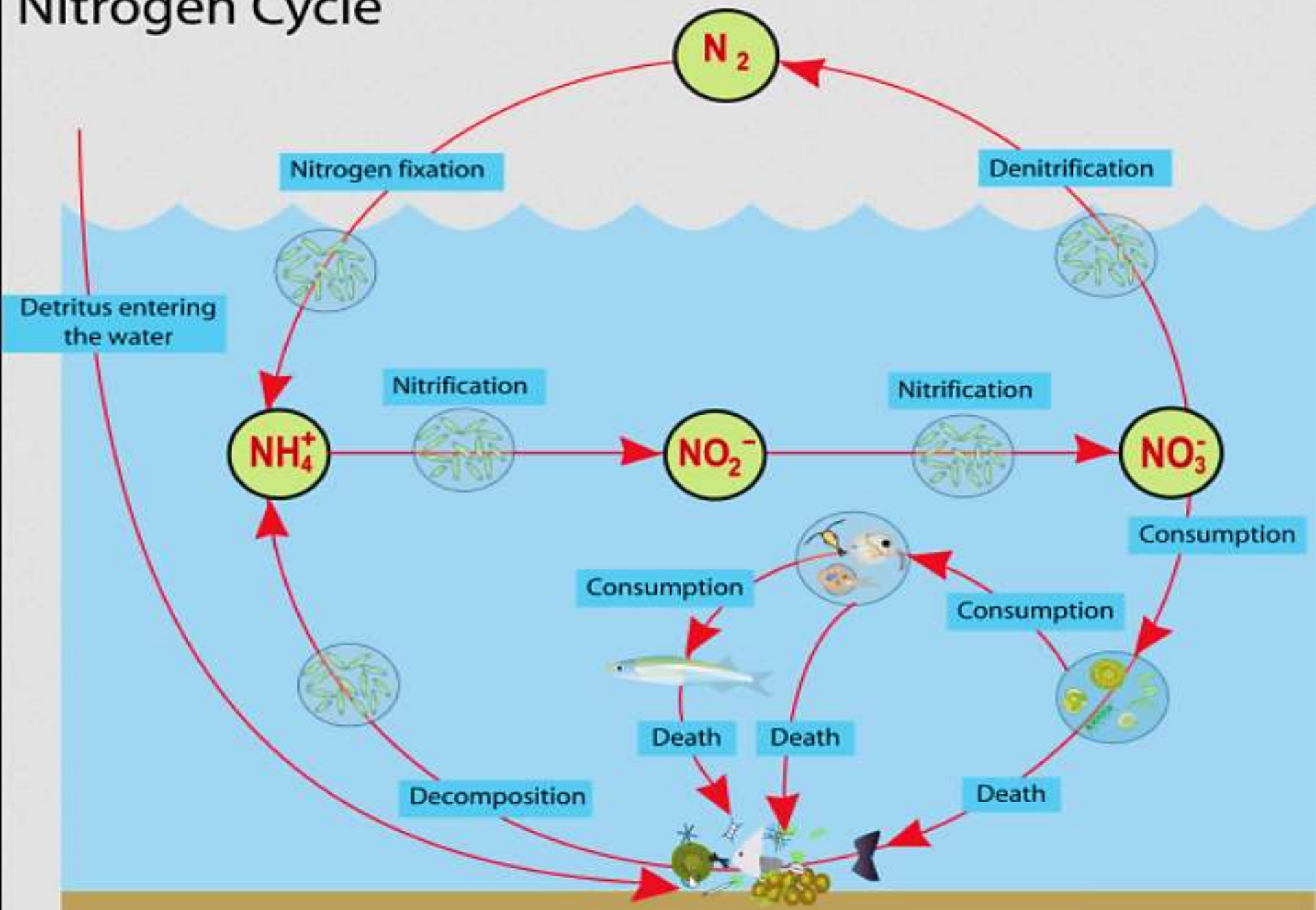
- While the diagram shows the carbon cycle in marine habitats, the same is true in freshwater lakes but at a much smaller scale.



Nitrogen cycle

- The Nitrogen cycle is the process in which nitrogen is converted into different forms.
- The majority of nitrogen is found in the atmosphere where it is unusable by plants, but through the processes of microbes, such as nitrification and denitrification, it can be converted into a form plants can consume.
- Nitrification is performed by *Nitrospira* is the oxidation of ammonia into nitrate.
- Denitrification is performed by *Flexibacter* converts nitrate in to nitrogen gas.

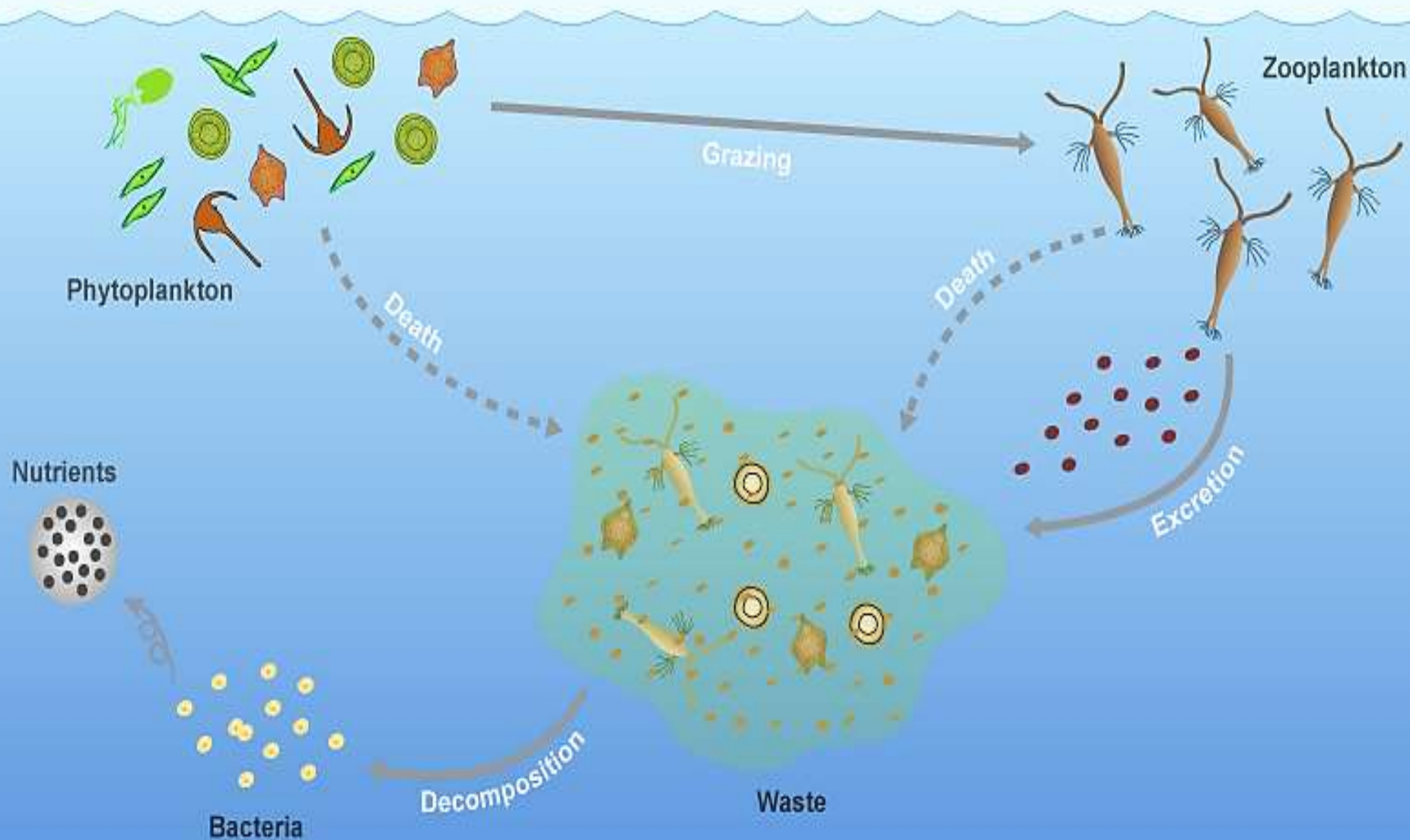
Nitrogen Cycle



Bacterial decomposition

- Bacterial decomposition is an important part of nutrient cycling, and bacteria can decompose dead organisms as big as whales or as small as other microbes.
- They break down organic molecules formed by biological processes, making the nutrients in these molecules available for use by other organisms.

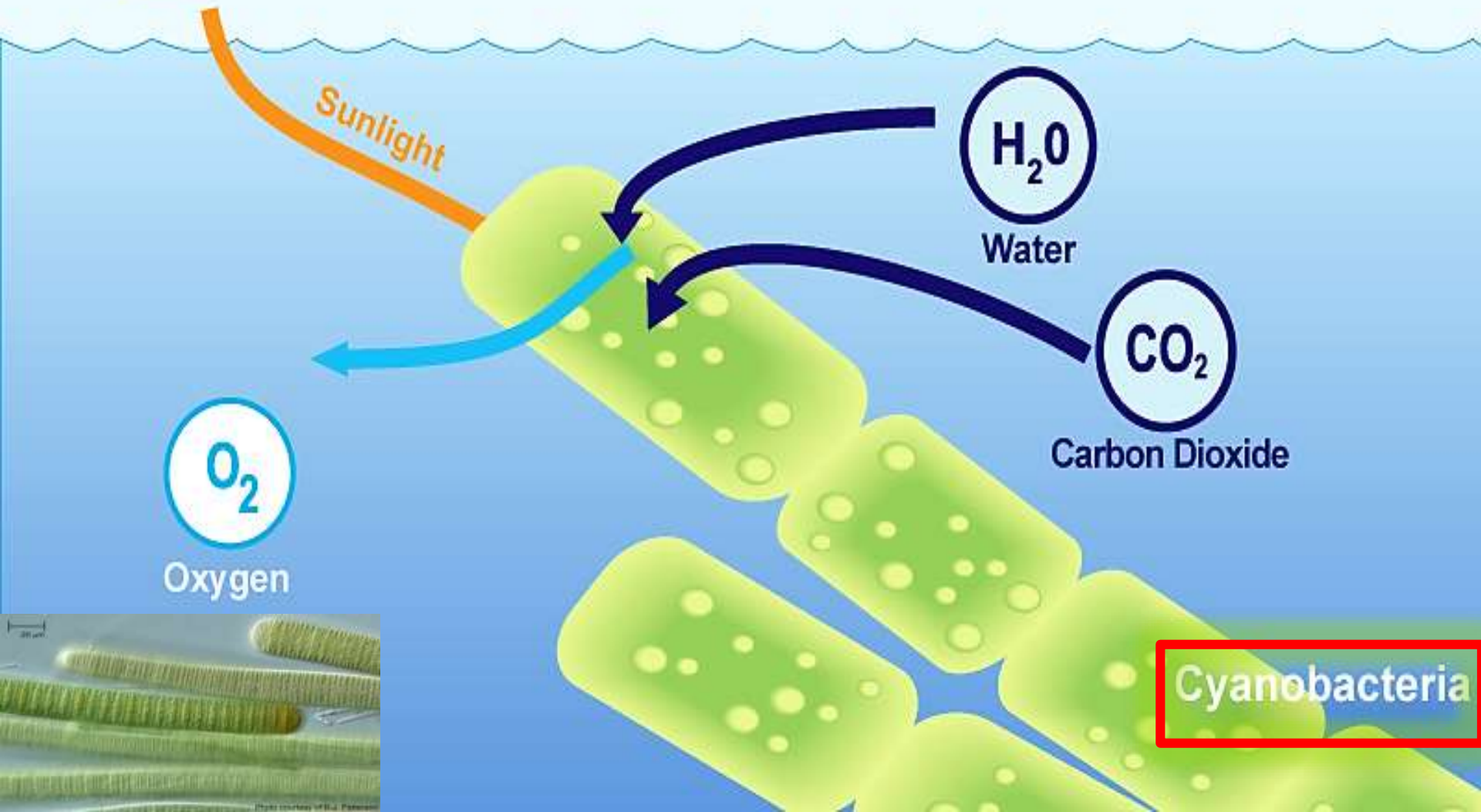
Bacteria make nutrients available to other organisms through decomposition



Photosynthesis

- One group of bacteria called cyanobacteria carry out photosynthesis.
- They take carbon dioxide (CO_2) from the air, turn it into organic parts of their own cells, and release oxygen (O_2) just like plants.
- Half of the primary production, done on Earth is in the ocean, and half of that is done by bacteria.

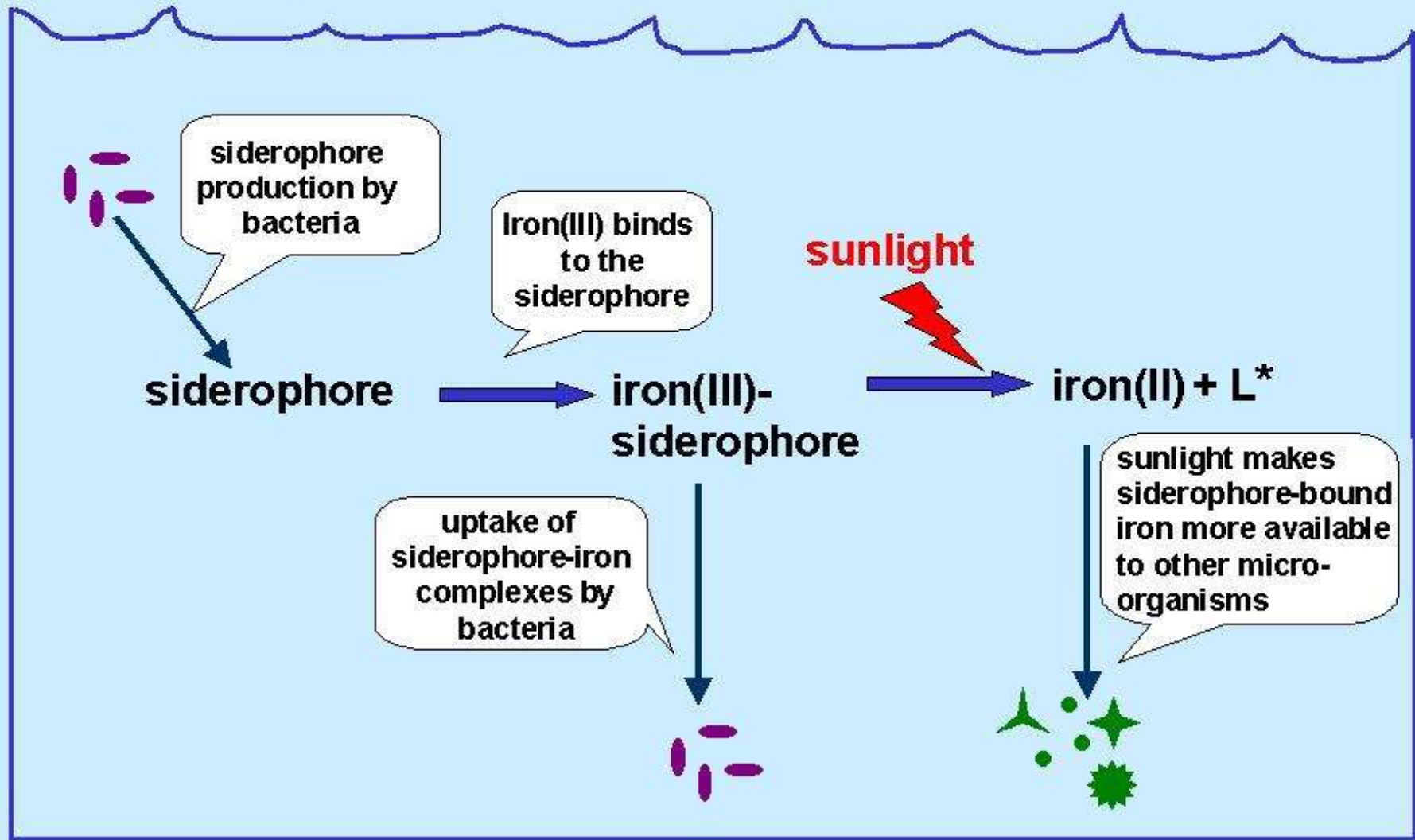
Some bacteria make oxygen available to other organisms through photosynthesis.



Role of Bacteria in Making Iron Available

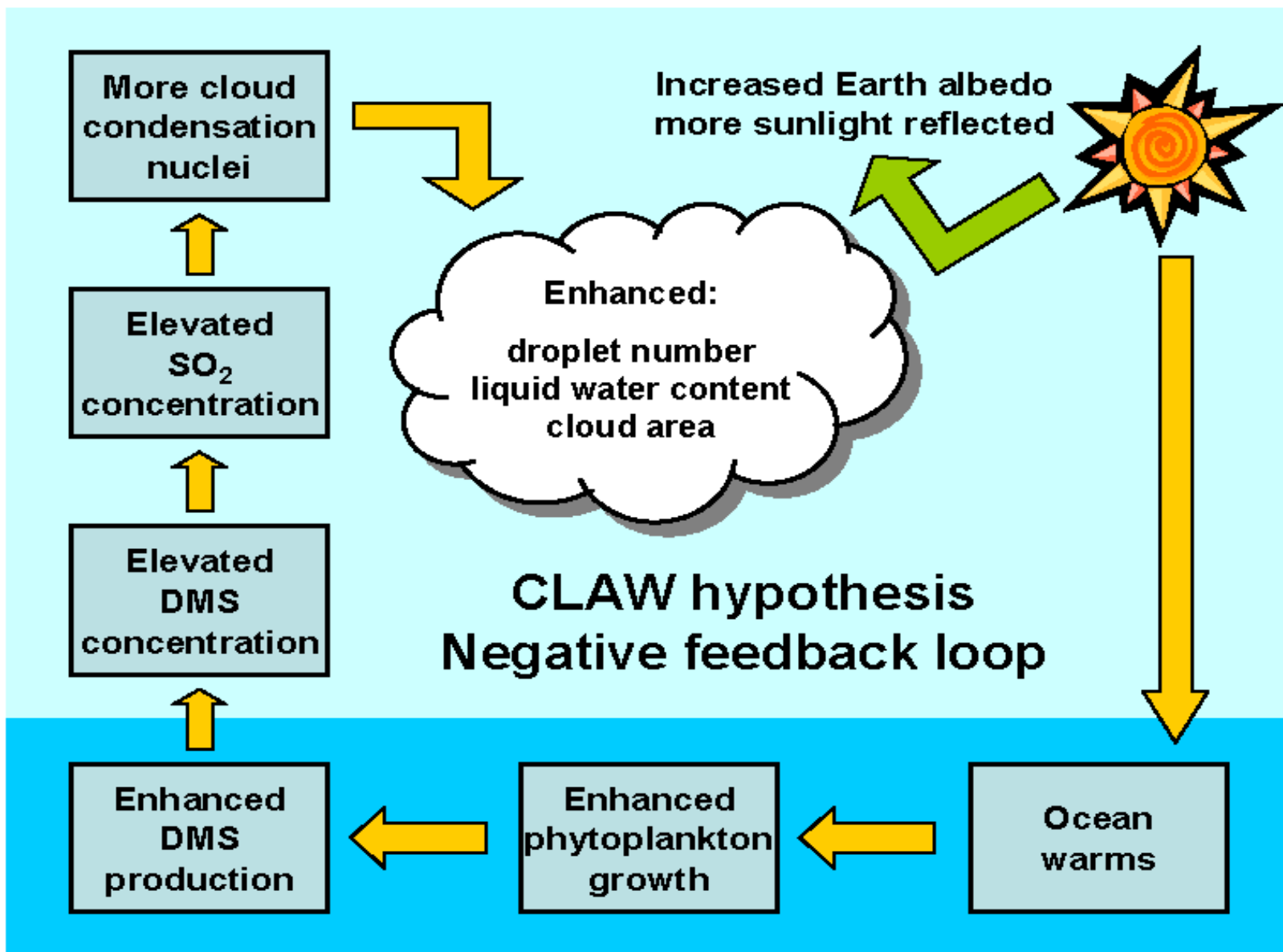
- Some elements, such as iron (Fe) are rare but important in the ocean, making it important to recycle them.
- When an organism dies or releases an iron-containing compound, microbes "catch" that and get all the iron out of it before it can sink too deep.
- Siderophores are chelating agents secreted by microorganisms under low iron stress.
- They scavenge Fe from the environment and form Fe(III)-siderophore complexes, available for bacterial uptake.
- The complex can be photolysed, resulting in the reduction of Fe(II) and a ligand, thus becoming available for planktonic communities.

New concepts for iron cycling in the ocean



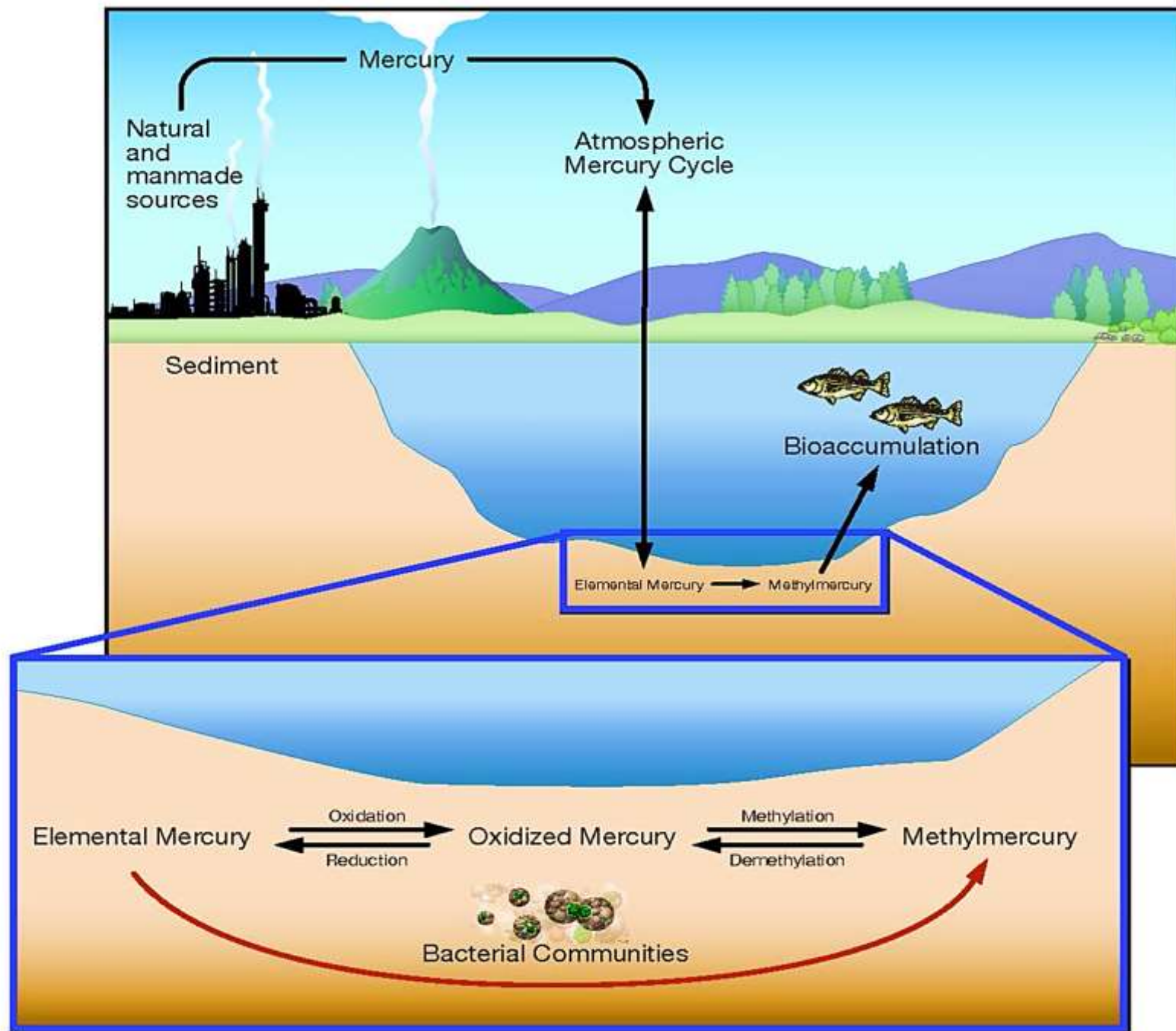
Phytoplankton & Cloud Formation

- Phytoplankton play a key role in the sulfur (S) cycle, which is linked to cloud formation, so even though they are tiny can affect the weather of our planet.
- Warming oceans lead to more growth of green phytoplankton, which in turn release a precursor to Dimethylsulfide (DMS) when they die.
- DMS in the atmosphere helps cause cloud formation, and clouds reflect sunlight, helping to cool the planet. It's a negative feedback loop to control the planet's temperature.



Biotransformation

- Biotransformation is the chemical modifications made by an organism on a chemical compound.
- Inorganic mercury is converted to methylmercury (MeHg) by microorganisms living in the sediments by a process called methylation.
- MeHg bioaccumulates in phytoplanktons and biomagnifies in food chain.
- MeHg is extremely toxic even in low concentration and cause Minamata disease.





Thank You....