MESOCSM CONCEPT

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What is mesocosms?

- Mesocosms have been used to evaluate how organisms or communities might react to environmental change, through deliberate manipulation of environmental variables, such as increased temperature, carbon dioxide.

- A mesocosms is an experimental tool that brings a small part of the natural environment under controlled conditions.

- Mesocosms can be set up in open tanks, but sealed glass vessels are preferable because entry and exit of matter can be prevented but light can enter and heat can leave. Aquatic systems are likely to be more successful than terrestrial ones.

TYPES OF MESOCOSMS

- **Aqua mesocosms**
- **Terrestrial mesocosms**

The two key concepts addressed when studying a mesocosm include:

- A mesocosm as a model of a larger ecosystem

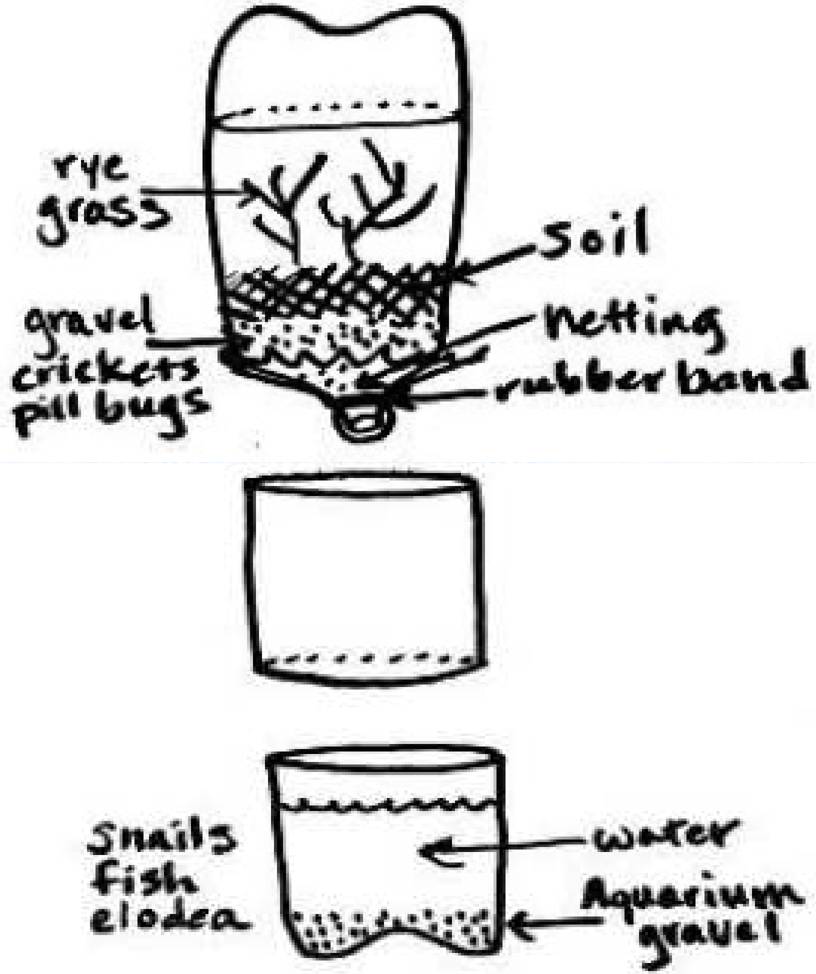
- A closed ecosystem, one in which energy enters and leaves but matter does not.

ADVANTAGES OF MESOCOSMS

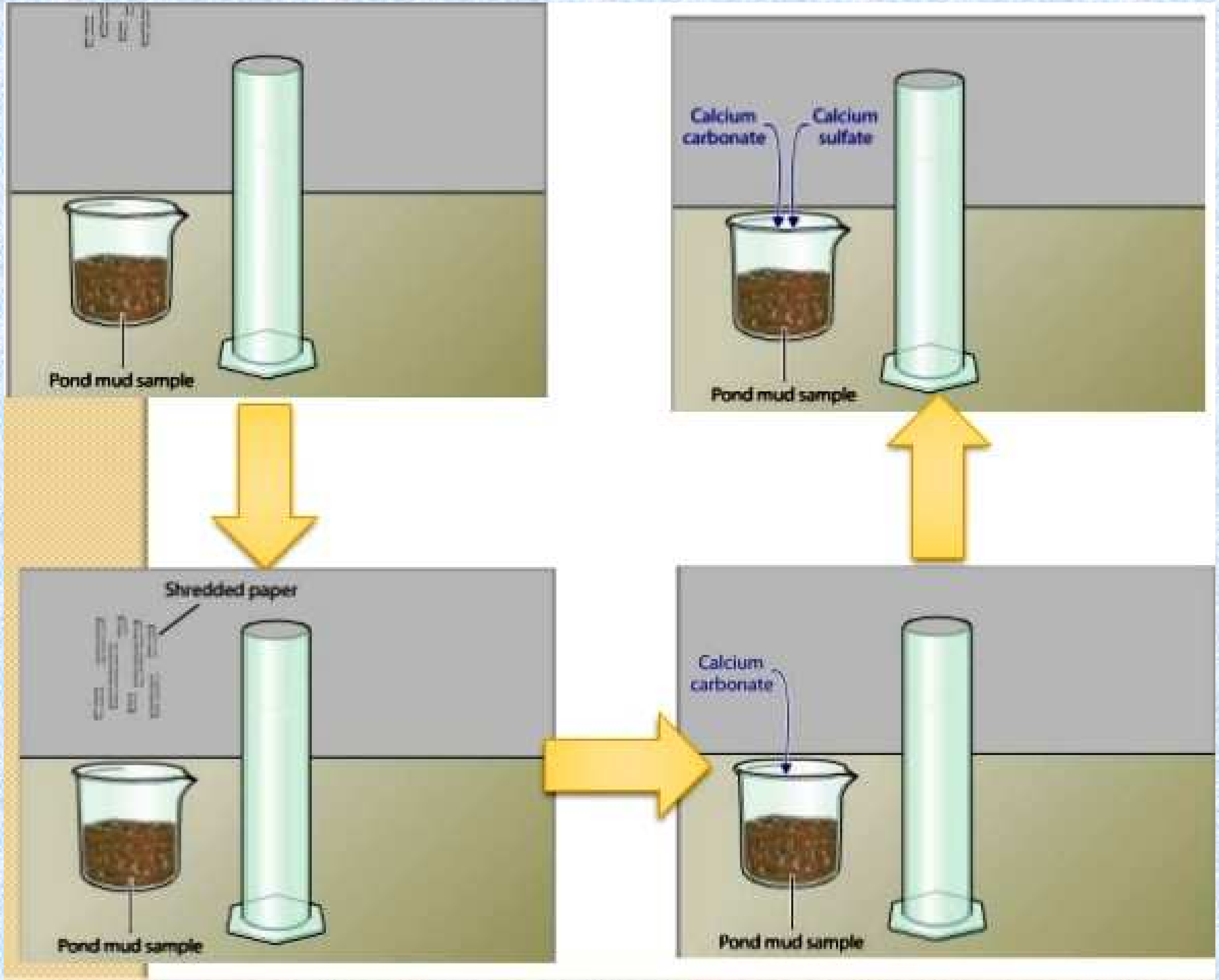
- Treatments are easily replicated.
- Multiple environmental factors can be manipulated.
- Food webs can be established.
- Direct and indirect effects can be examined.
- Contamination effects can be evaluated.

DISADVANTAGEOUS OF MESOCOSMS

- Using growth chambers for a laboratory experiment is sometimes a disadvantage due to the limited amount of space.
- Not adequately imitating the environment, causing the organism to avoid giving off a certain reaction versus its natural behavior in its original environment.


rye grass
soil
gravel
netting
crickets
pill bugs
rubber band
Snails
fish
elodea
water
Aquarium gravel

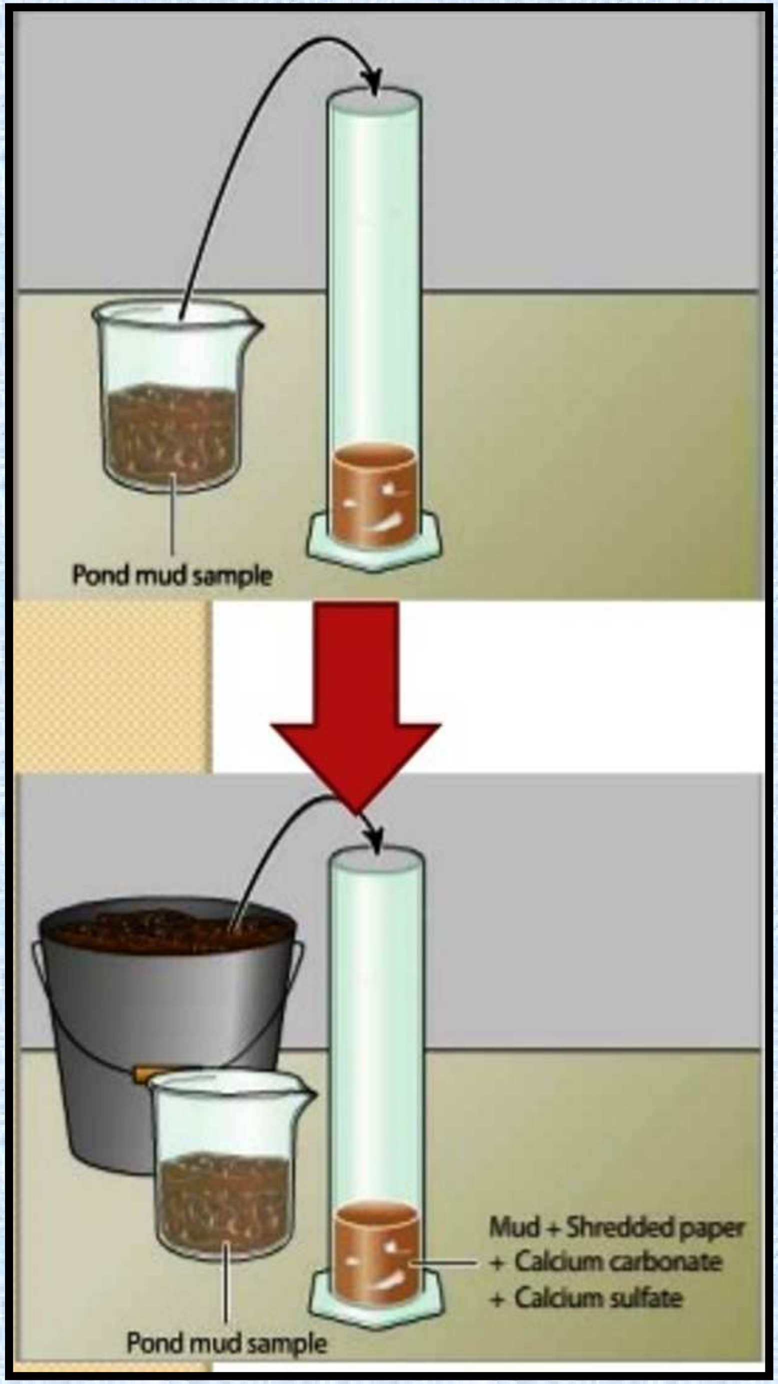
- The natural environment teems with microorganisms.
- Every ecological niche provides a specific combination of nutrients and oxygen that allows only certain bacteria to survive.
- We can use bacteria from pond mud to create and study a mini-ecosystem, called a Winogradsky column , in the laboratory.
- The Winogradsky column enriches for the mud’s anaerobic microorganisms.


Pond mud sample
Shredded paper
Pond mud sample
Calcium carbonate
Pond mud sample
Calcium carbonate
Calcium sulfate
Pond mud sample

- In this procedure, the mud is mixed with several ingredients to provide food and other substrates for the bacteria to use.
- Shredded paper provides a carbon source in the form of cellulose.
- Calcium carbonate yields carbon dioxide, which provides another source of carbon.
- Calcium sulphate provides a source of Sulphur

- The mud mixed with carbon and sulphur compounds is packed into the bottom of a cylinder, taking care to eliminate air pockets.

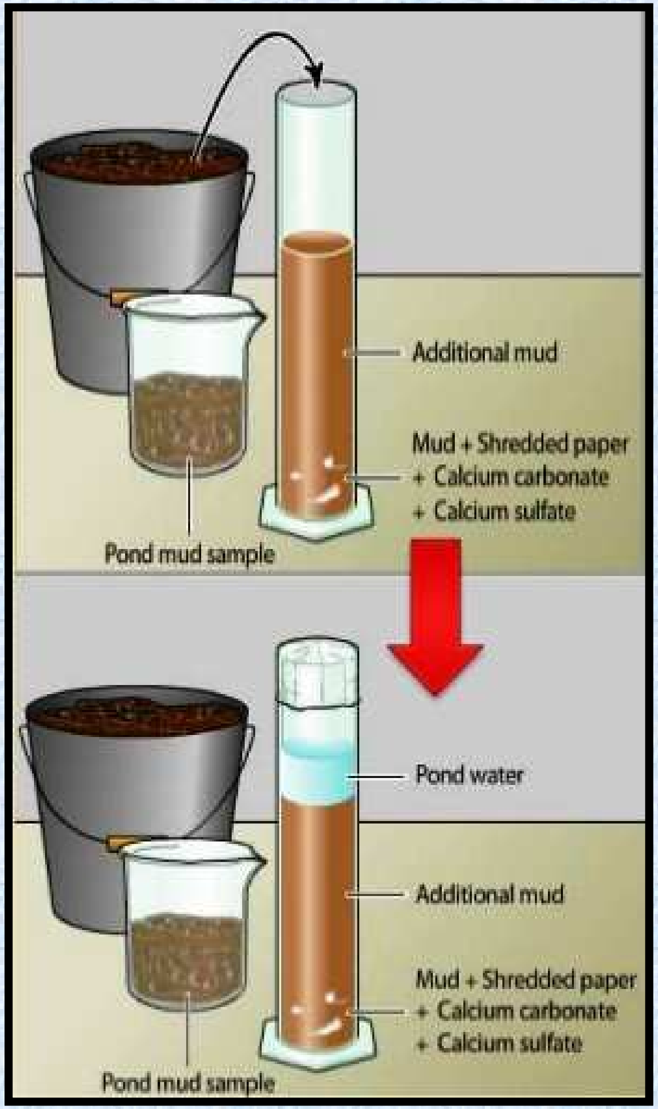
- Additional mud is added to fill the column to 2/3 of its capacity.



- Above the mud, pond water is added.

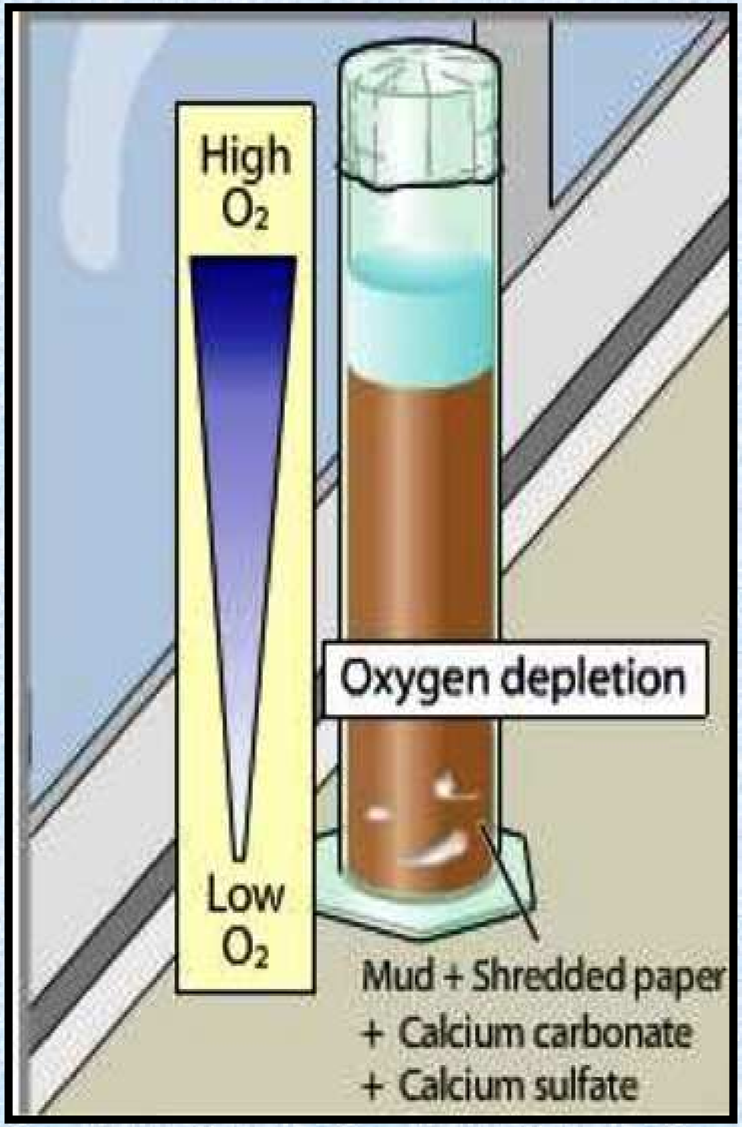
- Then, the top of the column is sealed.

- The column is placed next to a window for several weeks.

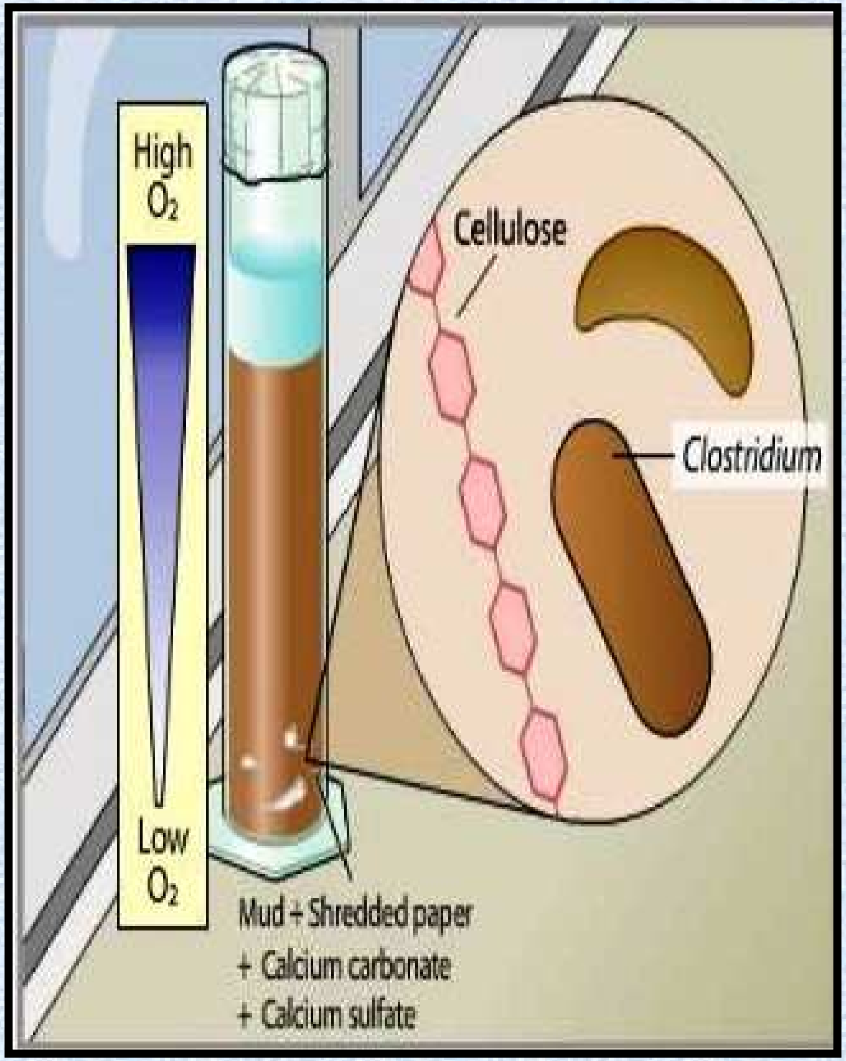


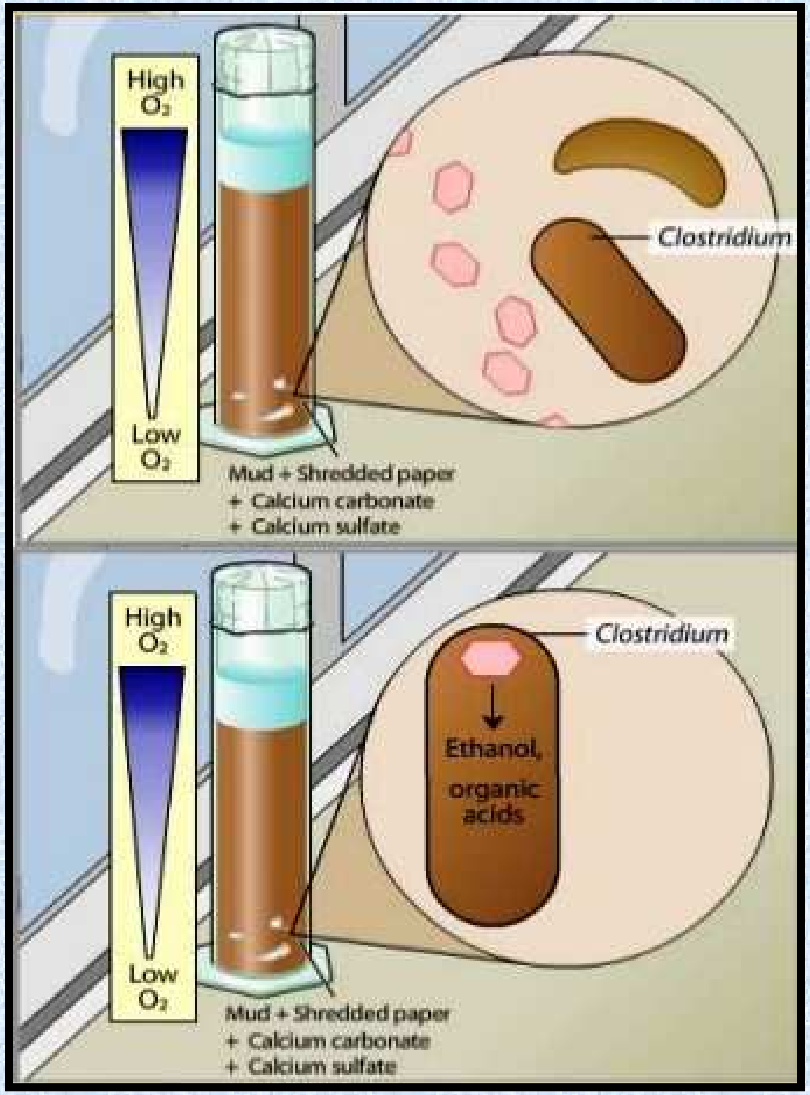
- The added organic material initially triggers microbial activity that depletes the oxygen in the mud.

- The loss of oxygen creates an oxygen gradient in the column, with low O_2 at the bottom and high O_2 at the top.



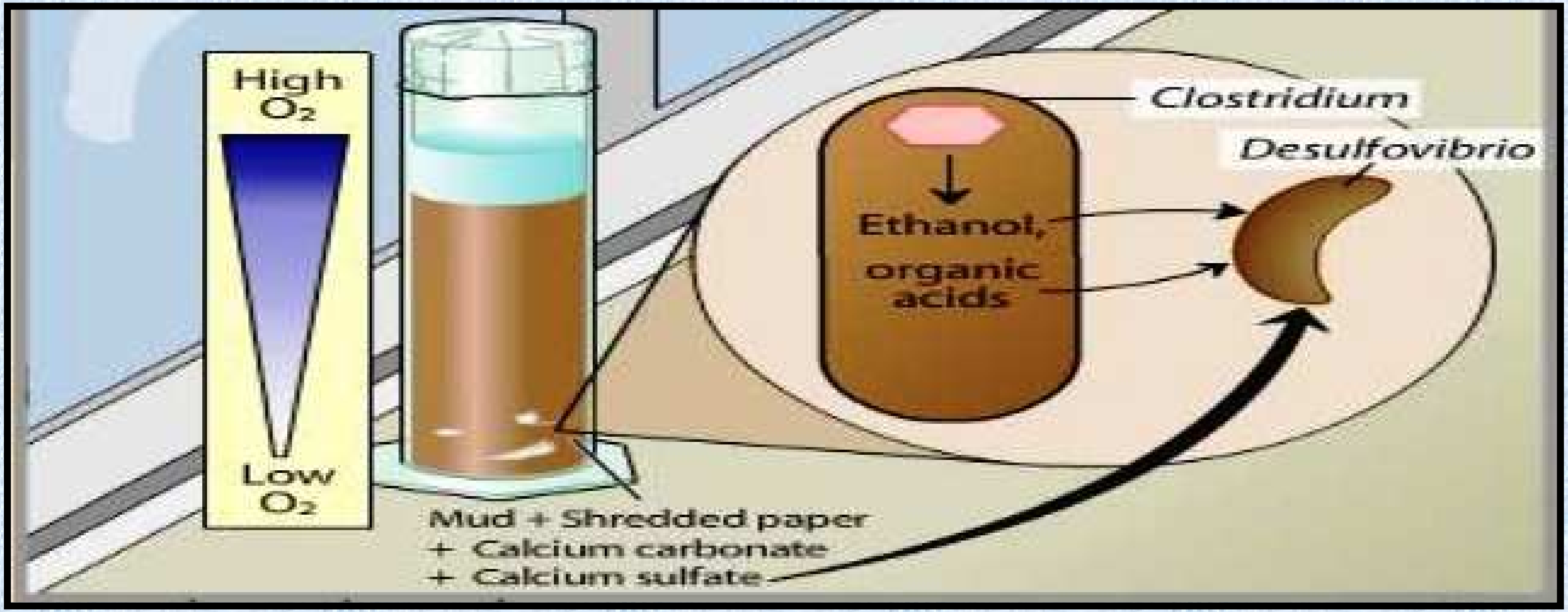
- Although a complex mixture of species exists in the mud, under these anaerobic conditions, Clostridium and other anaerobic bacteria predominate.



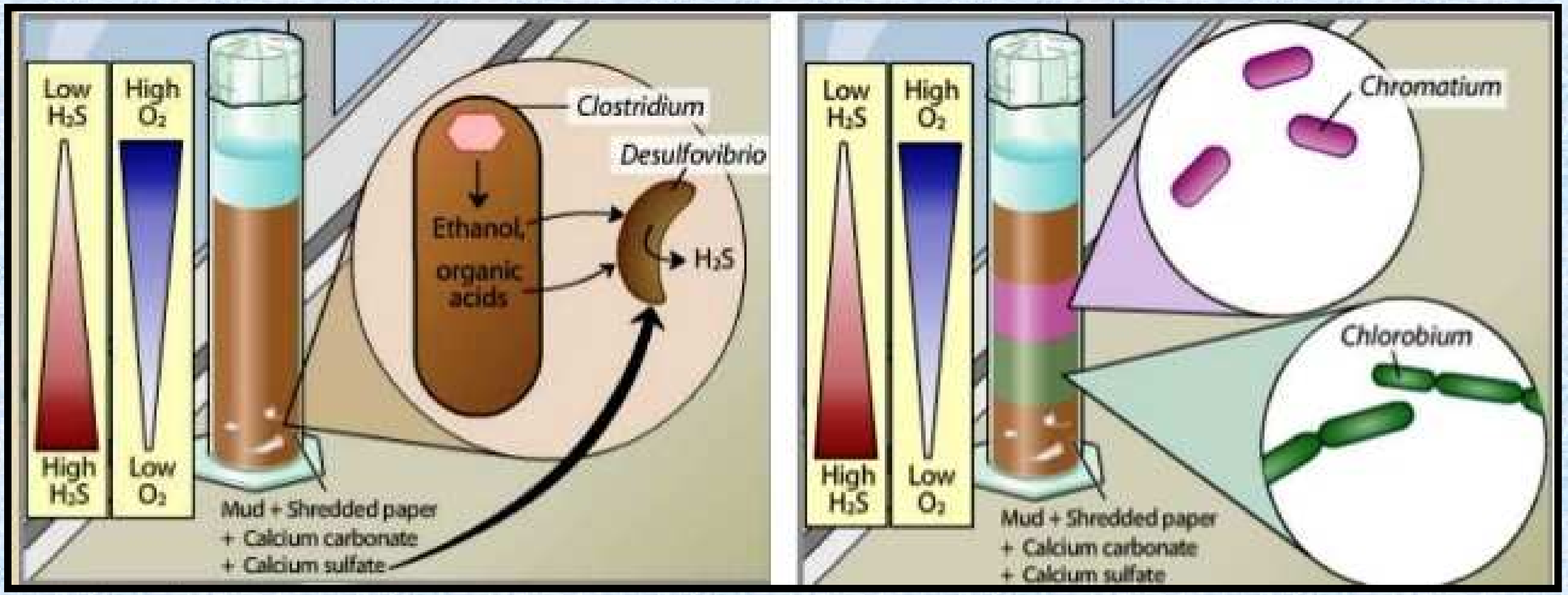


- Clostridium breaks down the cellulose from the paper into glucose subunits.

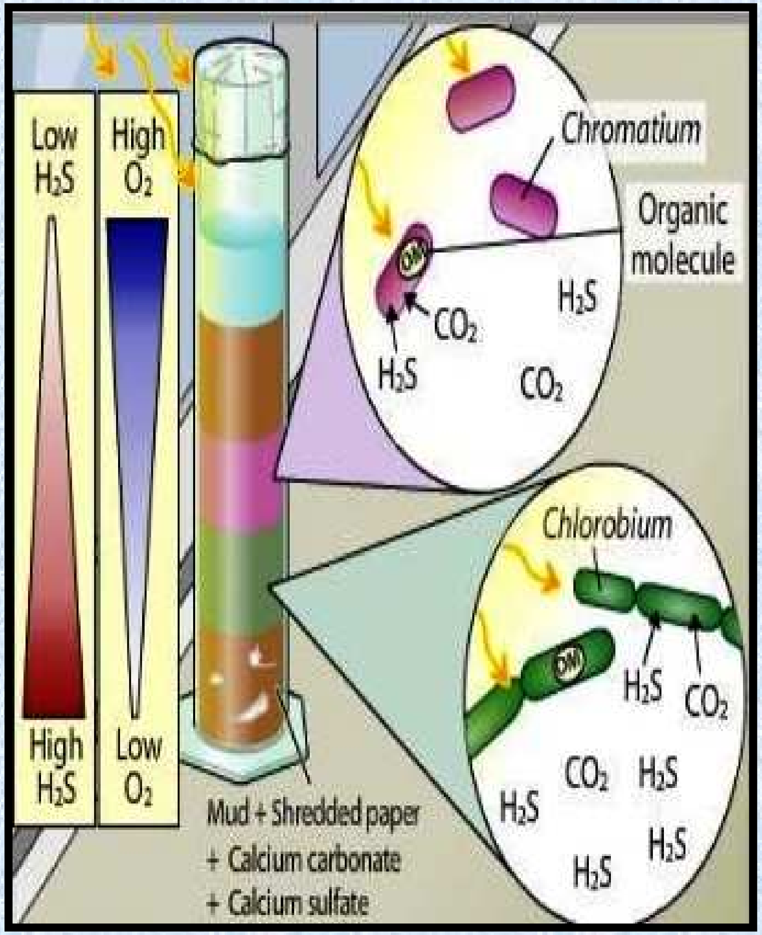
- The bacteria take in the glucose and partially break it down by fermentation to gain energy, producing ethanol and organic acids as by- products.



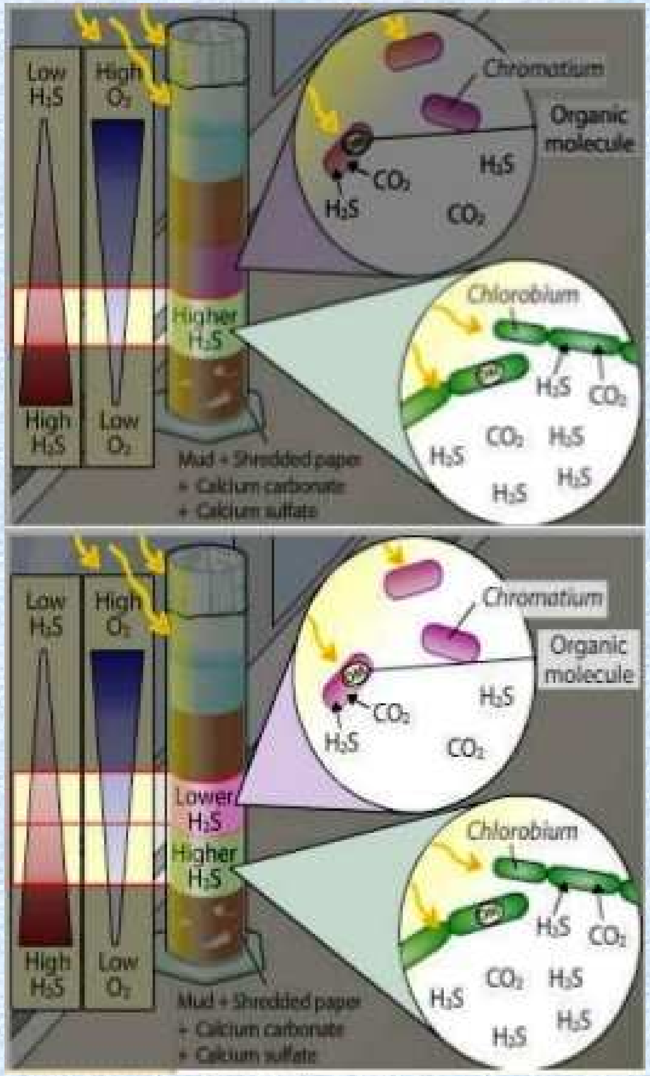
- The by products from Clostridium feed into other bacteria nearby in the deep mud of the column.
- Desulfovibrio bacteria use these organic molecules as carbon sources.
- Desulfovibrio uses sulphate, rather than O_2, as a final electron receptor in respiration, producing H_2S.
- The activity of Desulfovibrio creates a gradient of H_2S in the column, with high H_2S at the bottom, and low H_2S at the top.



- H_2S feeds into the metabolism of two types of photosynthetic bacteria : the green sulphur bacteria (e.g.,Chlorobium) and the purple sulphur bacteria (e.g.,Chromatium).
- These bacteria begin to proliferate as they use CO_2 from calcium carbonate as a carbon source, H_2S from Desulfovibrio as an electron donor, and light as the energy source needed to produce organic molecules (OM).

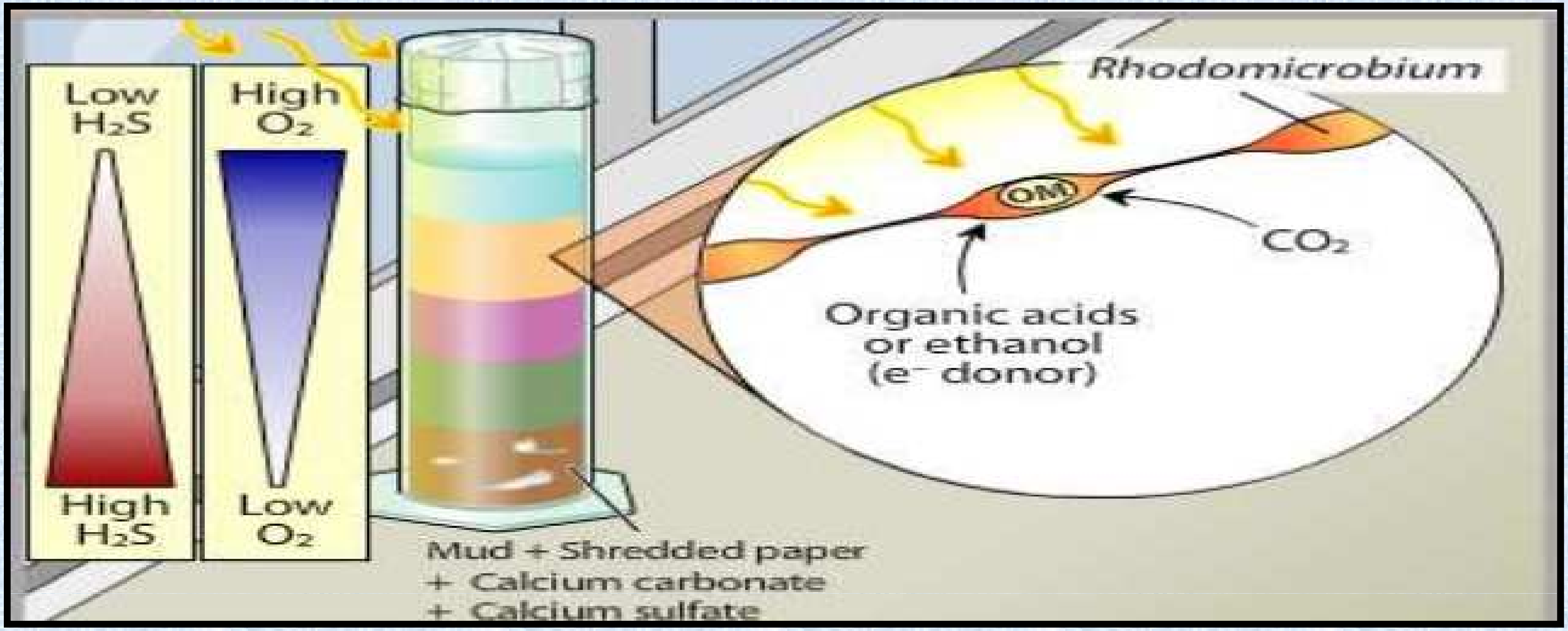


- These bacteria begin to proliferate as they use CO_2 from calcium carbonate as a carbon source, H_2S from Desulfovibrio as an electron donor, and light as the energy source needed to produce organic molecules (OM).
- *proliferate : increase rapidly in number; multiply.

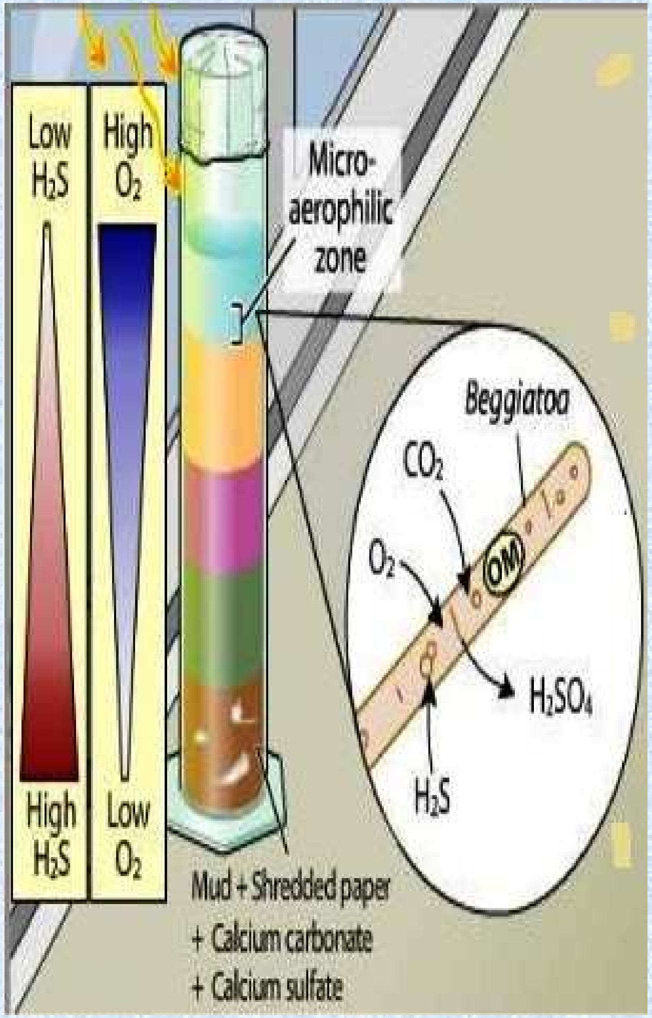


- The green sulphur bacteria can tolerate higher concentration of H_2S than the purple sulphur bacteria can tolerate.

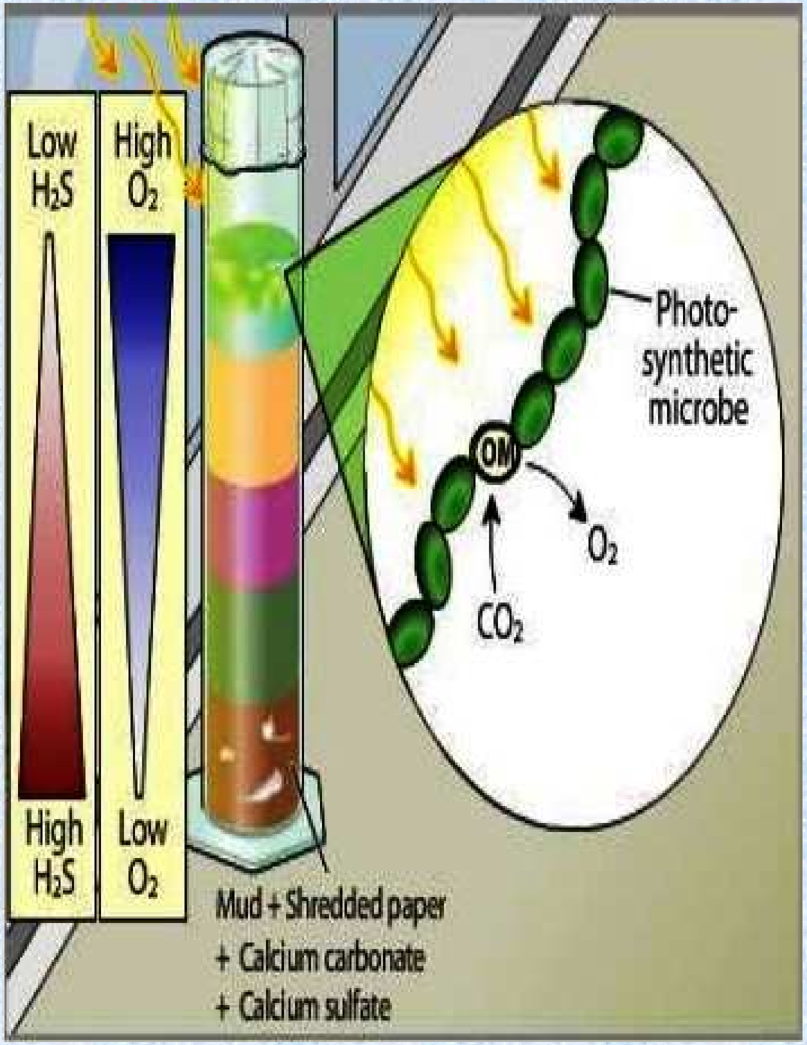
- This explains why the purple bacteria proliferate in a region farther away from the source of H_2S.



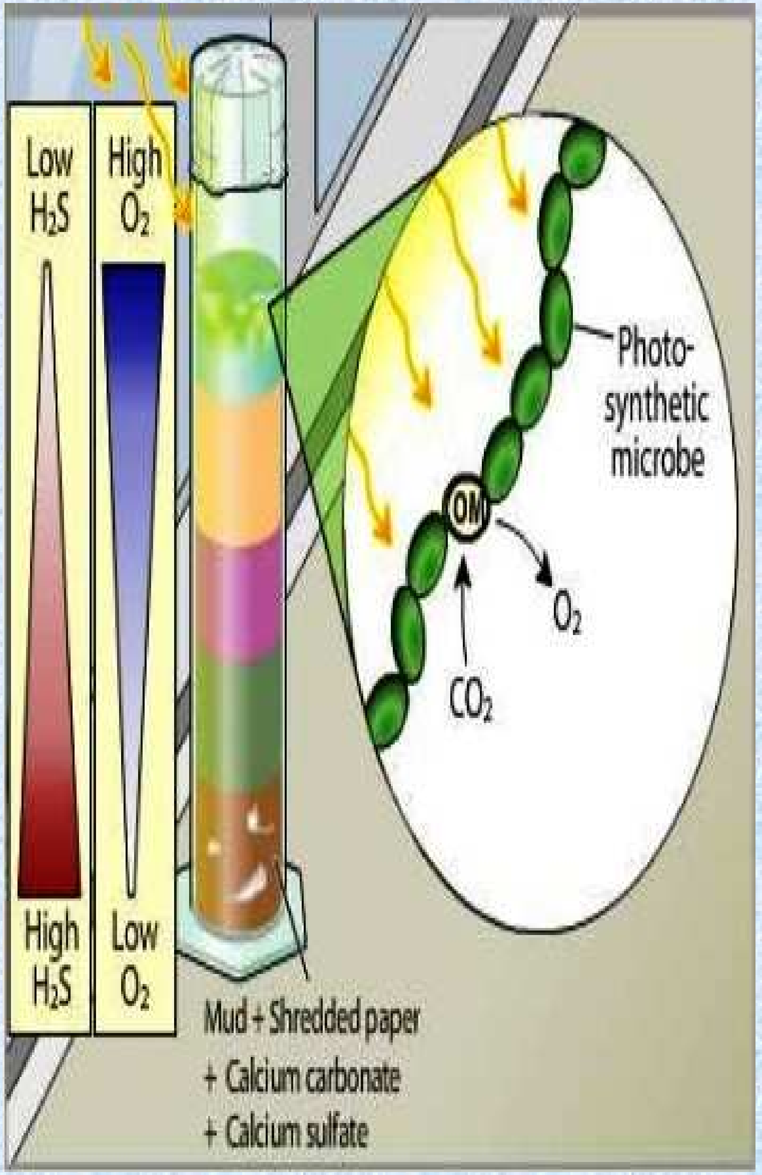
- Further up, where the sulphide levels are low, purple nonsulfur bacteria grow.
- An example is Rhodomicrobium.
- In the absence of O_2 and in the presence of light, purple nonsulfur bacteria carry out photosynthesis much like the purple sulfur bacteria do.
- However, when they fix CO_2 to produce organic molecules (OM), they use organic acids or ethanol as electron donors rather than H_2S.



- At the interphase of sulfide- containing mud and the more aerobic pond water, bacteria grow that can oxidise sulfur.
- An example is the filamentous bacterium Beggiatoa.
- In one metabolic strategy for survival, Beggiatoa uses H_2S as an energy source and oxidizes it to sulfuric acid.
- The energy released by this process is used to fix carbon and produce organic



- In the pond water, aerobic photosynthetic microbes abound.
- These microbes include cyanobacteria and algae, which harvest light energy and release O2 as a by-product.
- With the energy from sunlight, the microbes fix CO2 and produce organic molecules.
- The production of oxygen gas at the top of the column helps maintain the O2 gradient.



- Each layer of Winogradsky column supports certain types of bacteria, which come to dominate the culture in that region .
- From this enriched layer, organisms can be isolated by aerobic or anaerobic techniques.