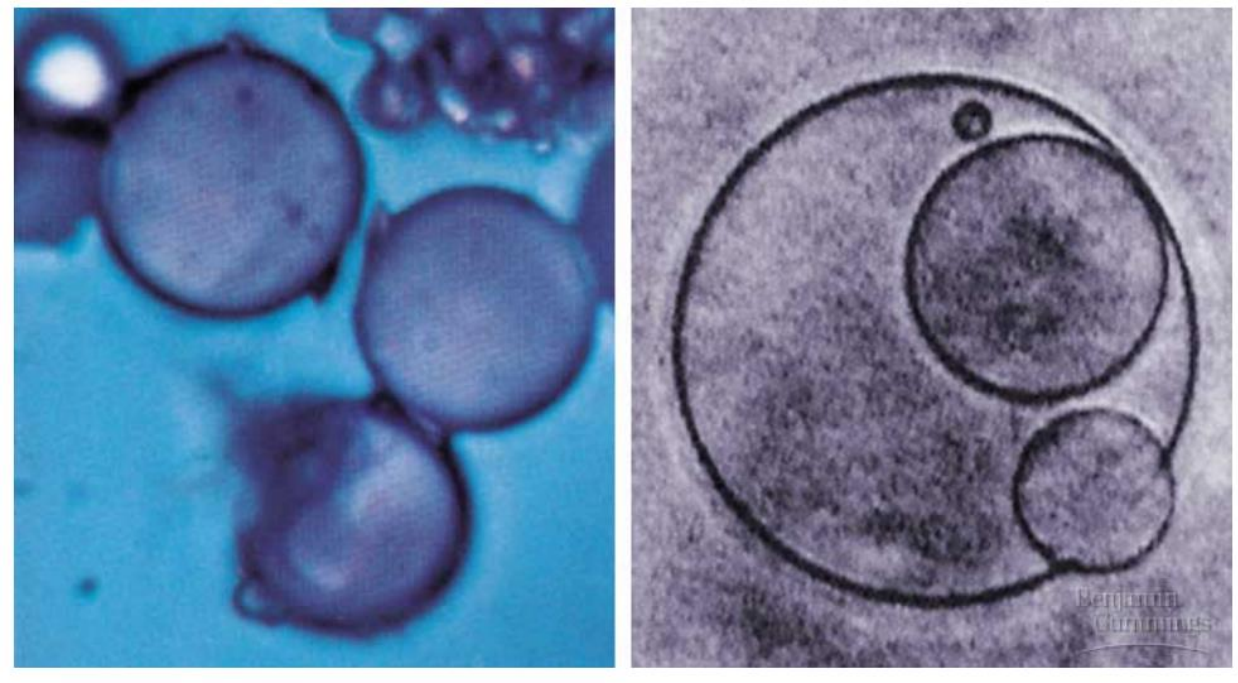


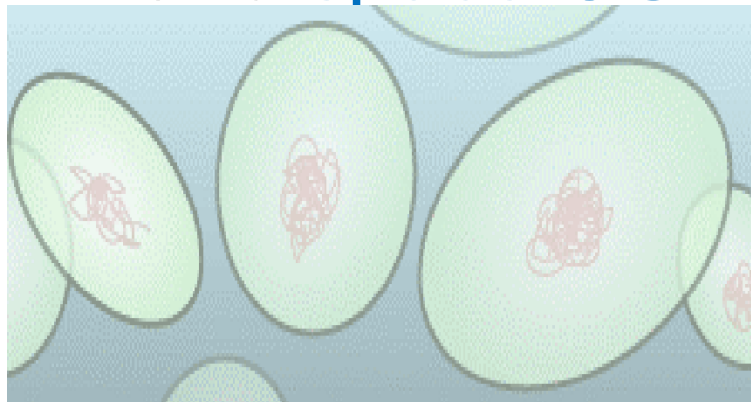
# BIOLOGY (Lecture 3)

## MEMBRANE and DIFFUSION (part I – creating of membrane and passive transport)



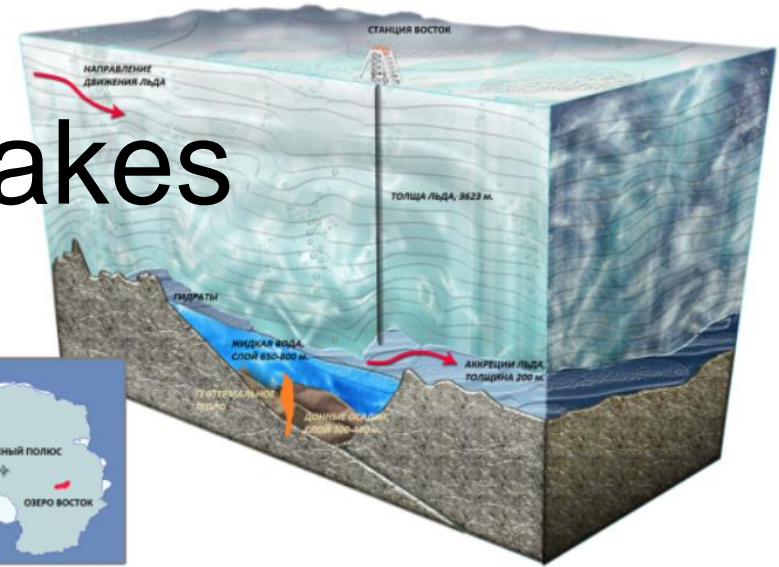


Primitive „border structure“ 4 billions years ago -- in water  
...space IN and space OUT

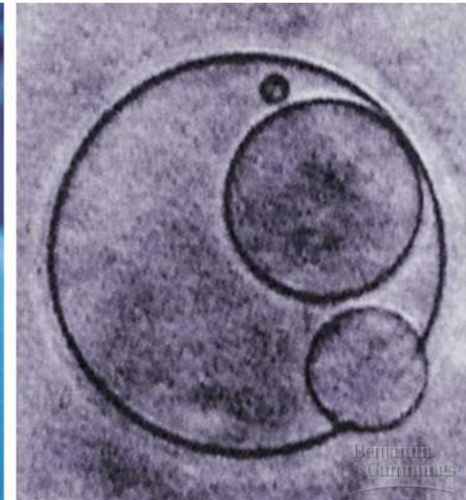
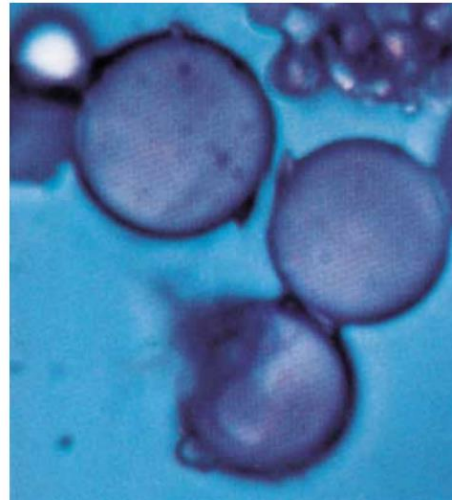


(nanometers/micrometers)

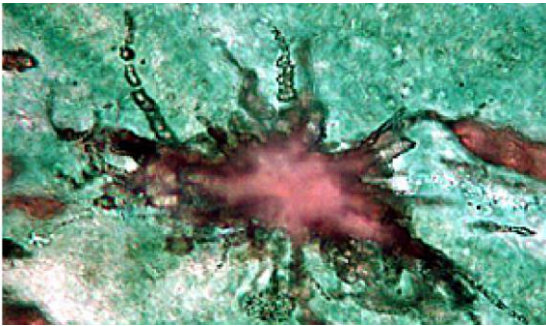
# Archaic sea and lakes



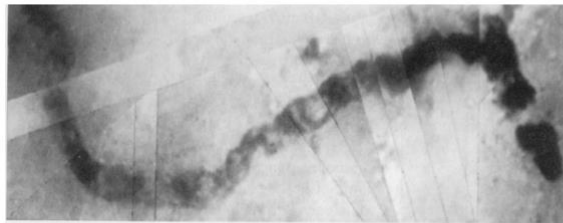
- Protobionta / Liposomes



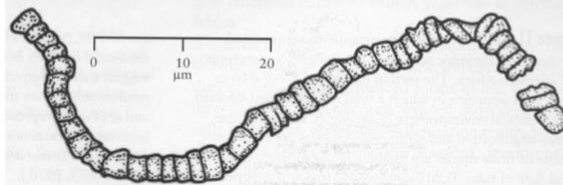
- Exact fossil arguments:



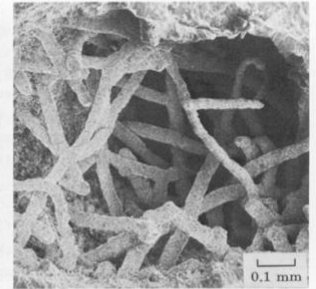
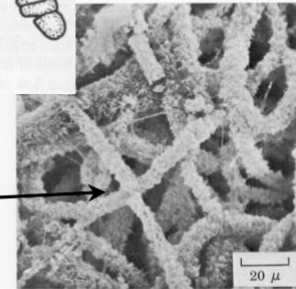
## The Archean fossil record (cont.)



← 3.5 billion year old bacteria preserved in chert from Western Australia



Modern cyanobacterial filaments



Some additional interesting notes about special literature of early life and biological membrane (will not be in exam test) :

DEAMER, David W.; PASHLEY, R. M. Amphiphilic components of the Murchison carbonaceous chondrite: surface properties and membrane formation. *Origins of Life and Evolution of the Biosphere*, 1989, 19.1: 21-38.

[Evidence for early life in Earth's oldest hydrothermal vent precipitates](#)  
[MS Dodd, D Papineau, T Grenne, JF Slack, M Rittner... - Nature, 2017 -](#)  
[https://www.nature.com/articles/nature21377?source=post\\_page-----](https://www.nature.com/articles/nature21377?source=post_page-----)  
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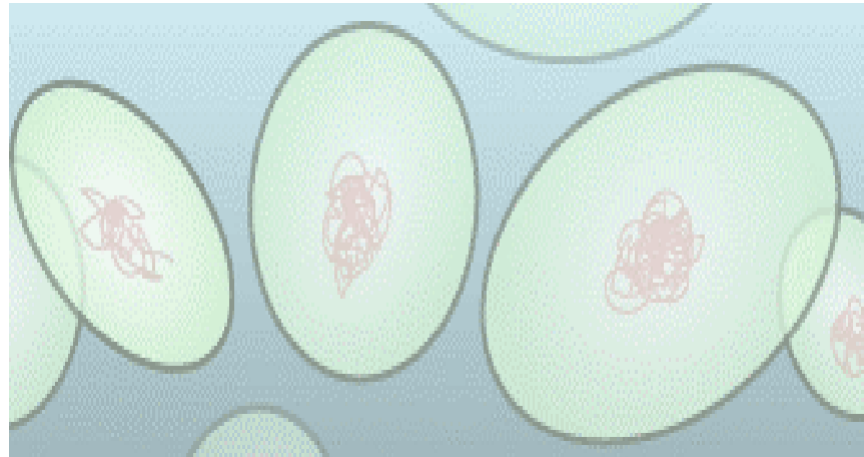
Cappellen, P. V. & Berner, R. A. A mathematical model for the early diagenesis of phosphorus and fluorine in marine sediments: apatite precipitation. *Am. J. Sci.* **288**, 289–333 (1988)

**[HTML]** [Did cyclic metaphosphates have a role in the origin of life?](#)  
T Glonek - *Origins of Life and Evolution of Biospheres*, 2021 - Springer

Da Silva JAL, Holm NG (2014) Borosilicates and silicophosphates as plausible contributors to the origin of life. *J Colloid Interface Sci* 431:250–254. <http://www.sciencedirect.com/science/article/pii/S0021979714001179>

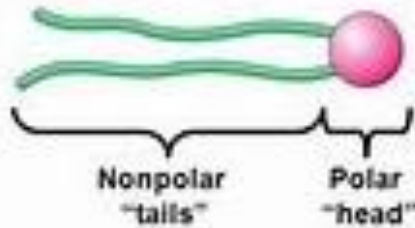
Border structure

...space IN and space OUT

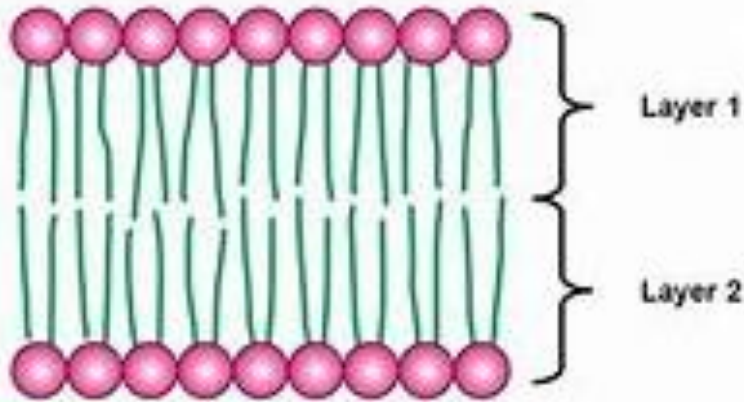


Recent animal and plant border structure – is called MEMBRANE. And key components are lipids...

Schematic Structure of a Membrane Lipid



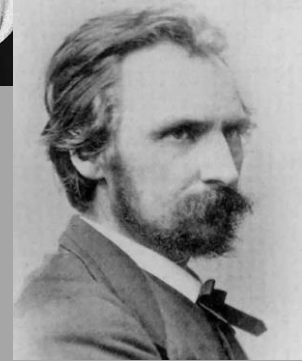
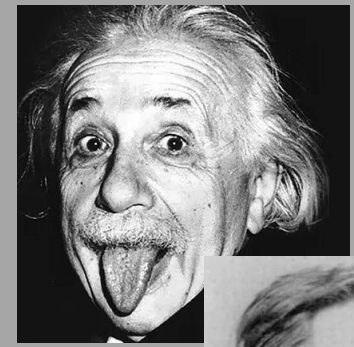
Schematic Structure of a Lipid Bilayer



- The phospholipids are the critical units of the cell membranes protecting the cells. These units are also responsible for the sustainability of the cells. The inflow and outflow of different biomolecules are controlled by the cell membrane. In fact, these units also host a flexible gate for the entry and exit of the organic molecules.

Due to the excellent structure, the prime phospholipid function is a selective passage.

. These units are also floating and moving. It gives the cell membrane a quasi-fluid structure letting them execute this function. The cell membranes have specific channels for various organic compounds such as proteins, fats, steroids, carbohydrates, etc.



# \*EXTRA NOTE\*

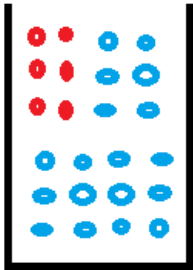
## PHYSICS OF DIFFUSION

- Before description of biological function of membranes, we will make some on 4 pages extra physical description of diffusion and concentration principles.  
(Some of students could have some theory in previous high school study, some not)

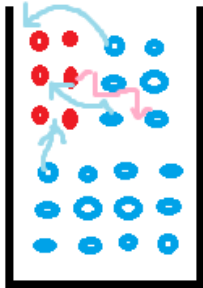


# DIFFUSION in simple basin (without any membrane)

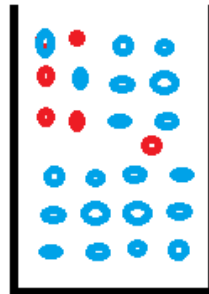
- Red molecules are dropped to water.



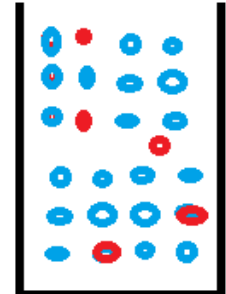
What will be happen?



later



and finally



concentration of RED and WATER

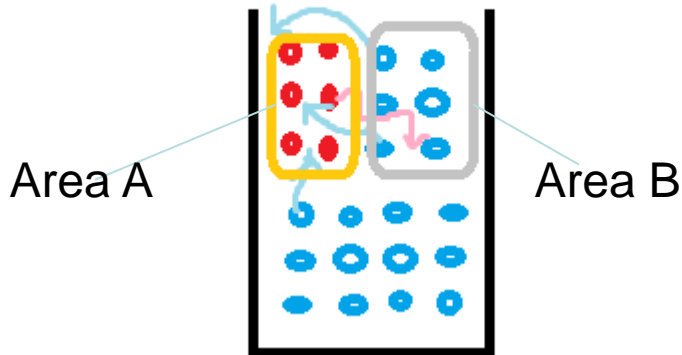
are finally homogenous

- Why RED and WATER molecule diffuse?

there exist place with high concentration and

near place with low concentration . This gradient of concentration caused the molecule movement

*high*  $[red]$  *low*  $[red]$



This movement is quantified by FICK LAW

$$J = S \cdot D \cdot \text{grad} [red]$$

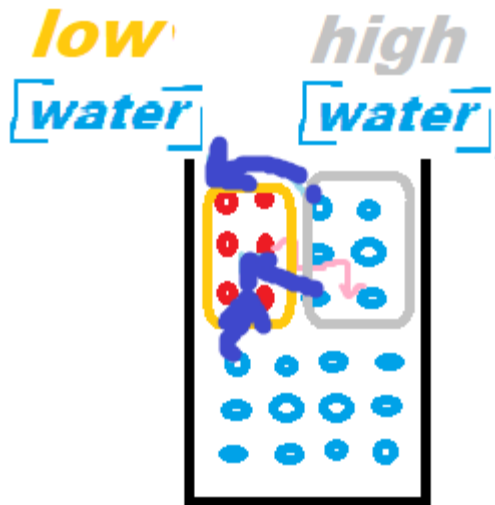
where S is the “contacting area of drop (area with red molecules)”

D is special physical constant for this type of molecules (will be shown in next pages)

$\text{grad} [red]$  is gradient of concentration in place A and place B  
(if concentration is the same, there is gradient = 0 and no movement of molecules)

- However the same situation can be seen also from opposite site of view:

ALSO WATER MOLECULES are driven from place B (high concentration of WATER to A (low concentration of water)



$$J = S \cdot D \cdot \text{grad}[w]$$

# DIFFUSION in basin with the membrane

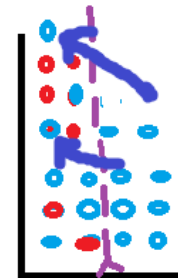
Variant 1: Membrane is permeable **only** for RED



THE PHYSICAL FORCE FOR MOVEMENT OF RED MOLECULES are the same like in basin without membrane.

Concentration of RED and WATER will be finally homogenous in both compartments.

Variant 2: Membrane is permeable **only** for WATER



Water is moving through the membrane and „wants to made“ oncentration of „RED so much low as possible“ (idealy press to zero = total water).

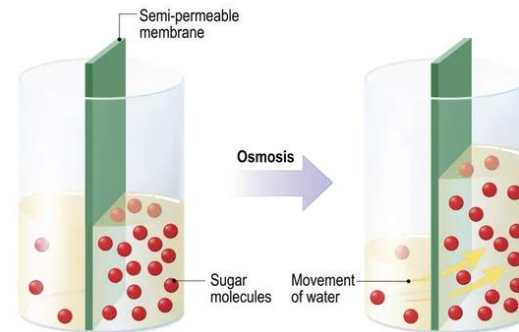
In some time it is stoped in equilibrium (because of external hydrostatic pressure)

# Prectical example

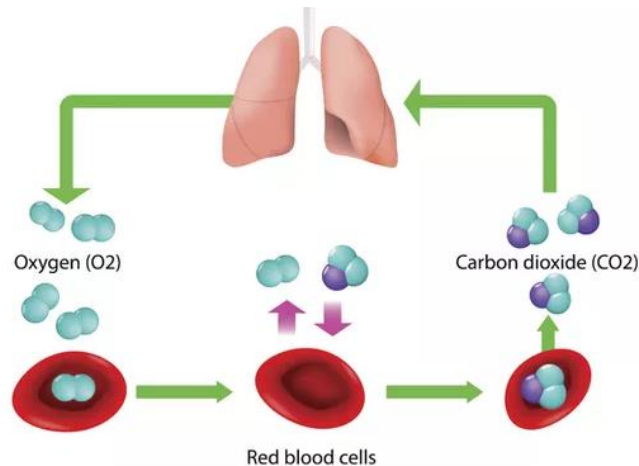
- Diffusion of sugar molecules to pure water



water molecules to high concentrated sugar compartment



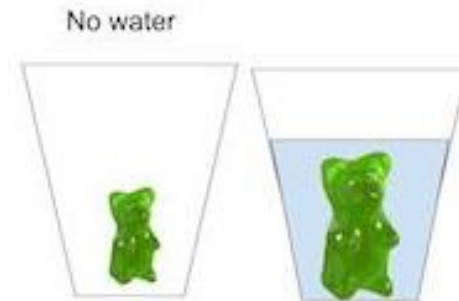
- Diffusion of oxygen molecules



# Practical example

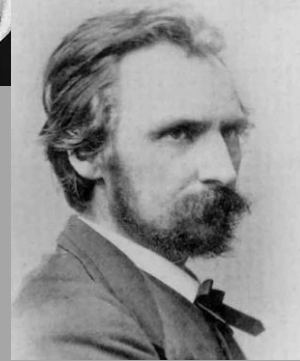
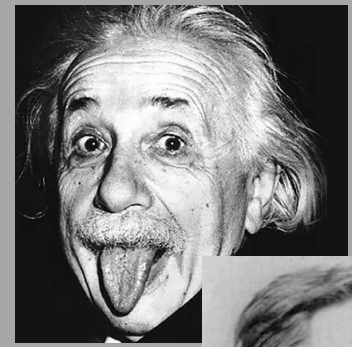
- Homework:

Why bears body will be grow in water ?



Can you arranged the chemical to change the bear body volume back?

THE END OF



\*EXTRA NOTE\*

PHYSICS OF DIFFUSION