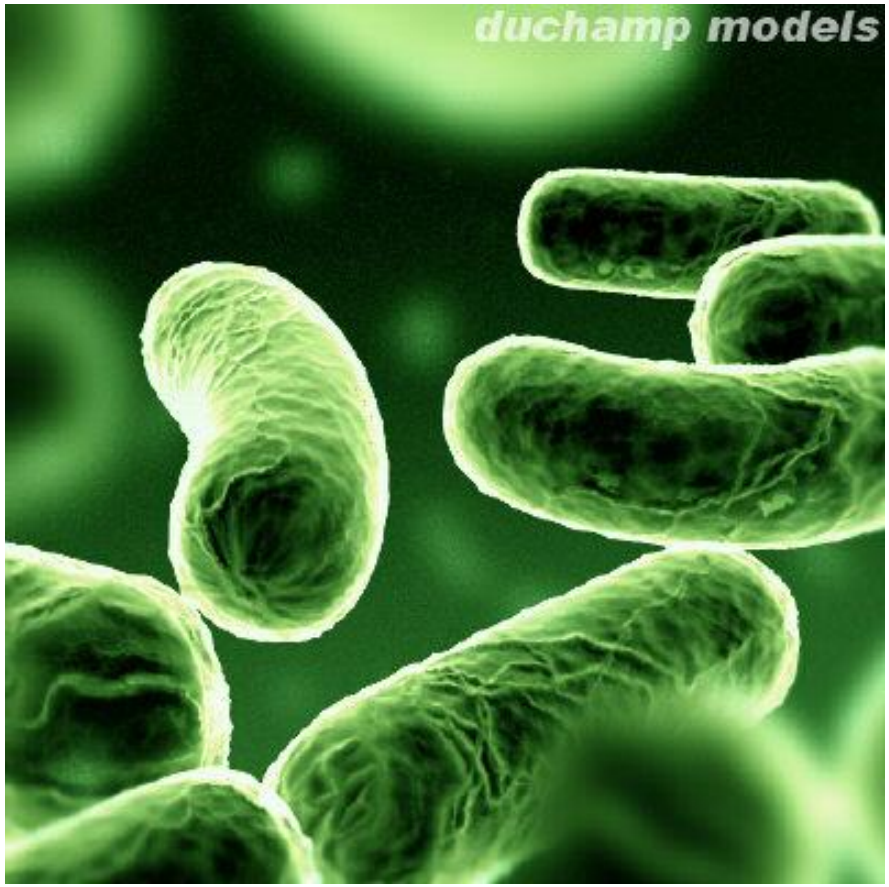
Types of Micro-Organism (Bacteria)

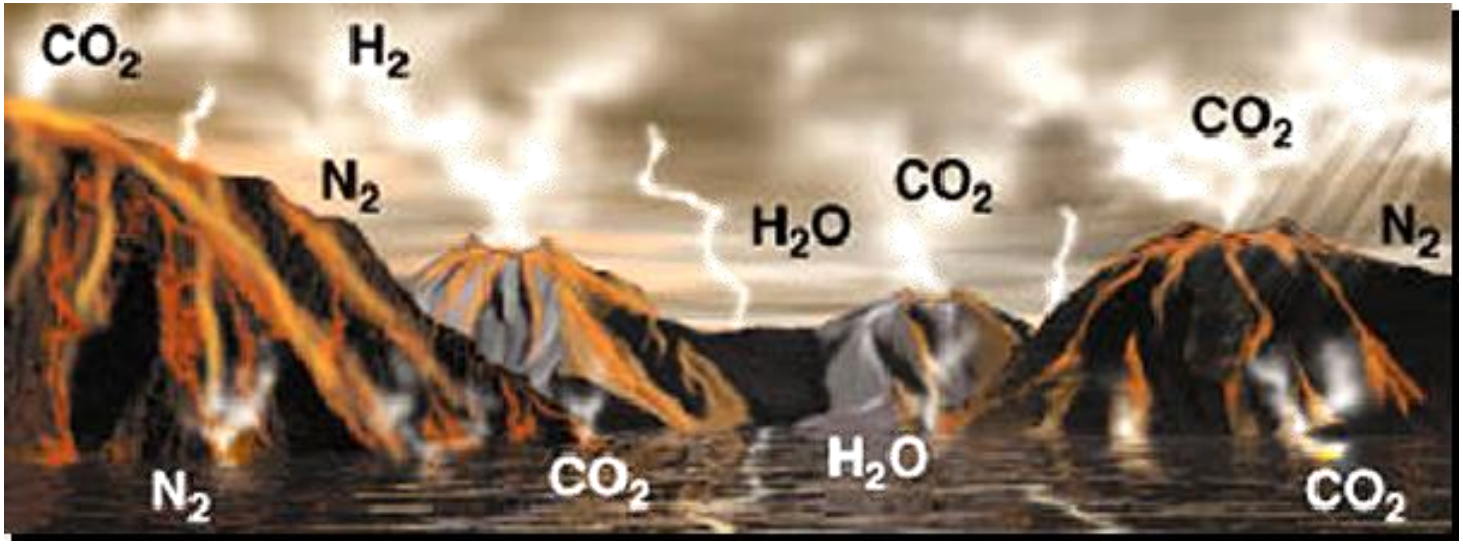


Origin of the Earth

- Universe formed 15 billion years ago (Big Bang)
- Galaxies formed from stars, dust and gas
- Earth formed 4.6 billion years ago

Origin of the Atmosphere

- Suns energy stripped away 1st atmosphere
- 2nd atmosphere formed from volcanic outgassing
- **Primitive atmosphere**: CO_2, water vapor, lesser amts of CO, N_2, H_2, HCl, and traces of NH_3 and CH_4 (3.5 bya)



Origin of the Atmosphere

- O_2 came in 1.5 bya
- Autotrophic Organisms: photosynthesis
- Another environmental change
- Result in evolution

Origin of the Atmosphere

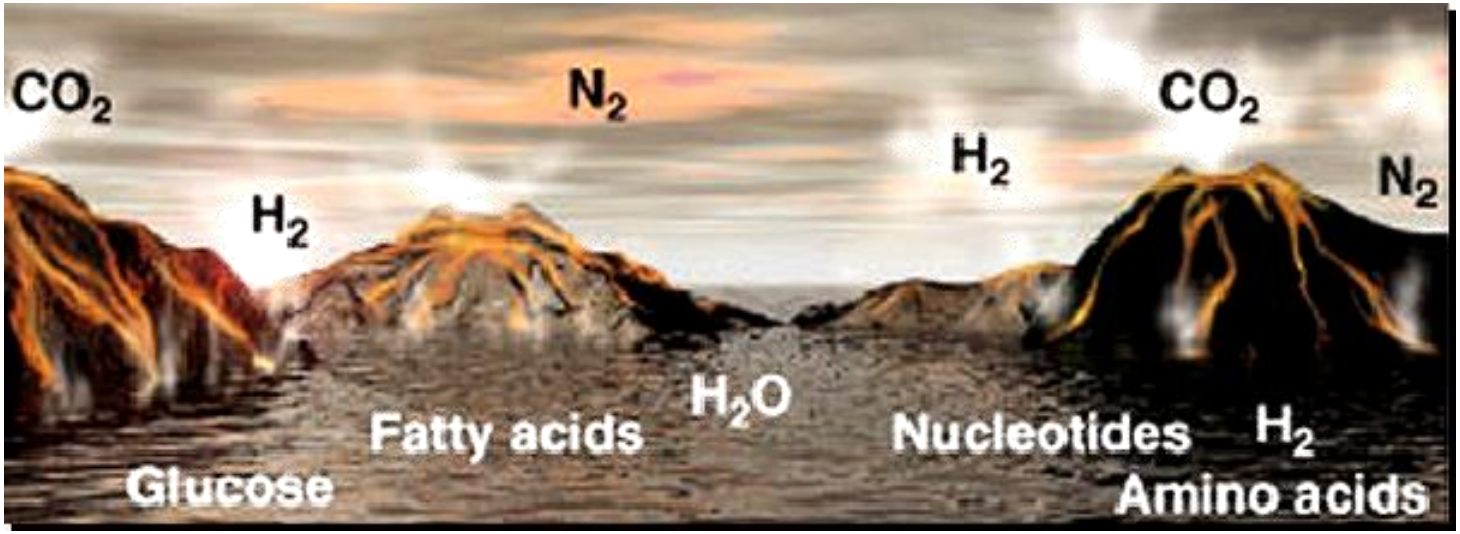
- 0.5 billion years ago
- Atmosphere O_2 to 1% current
- Compare to present: 78% N_2, 21% O_2, 0.04% CO_2, + trace gasses
- Relatively small, most single cell
- Start of multicellularity
- Increase in cell complexity

Origin of Life

Life began~ 3.5 bya

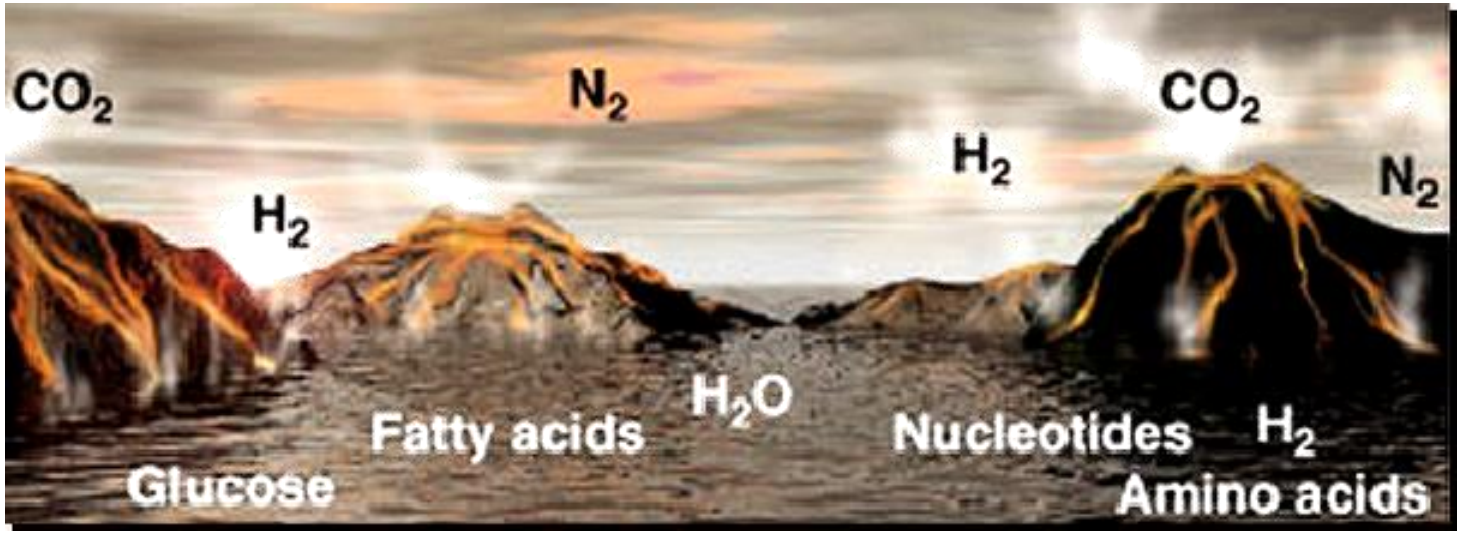
Organic molecules (C H O N P S) swimming in shallow seas

Stage 1: Abiotic synthesis of organic molecules such as proteins, amino acids and nucleotides



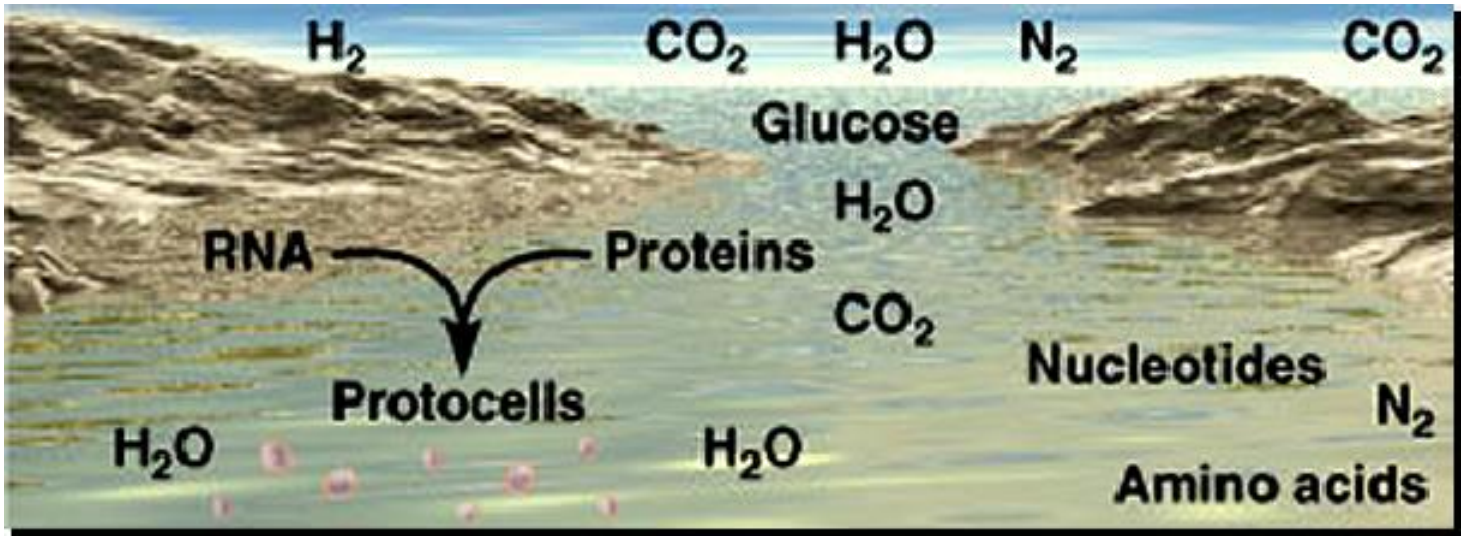
Origin of Life

Stage 2: joining of small molecules (monomers) into large molecules



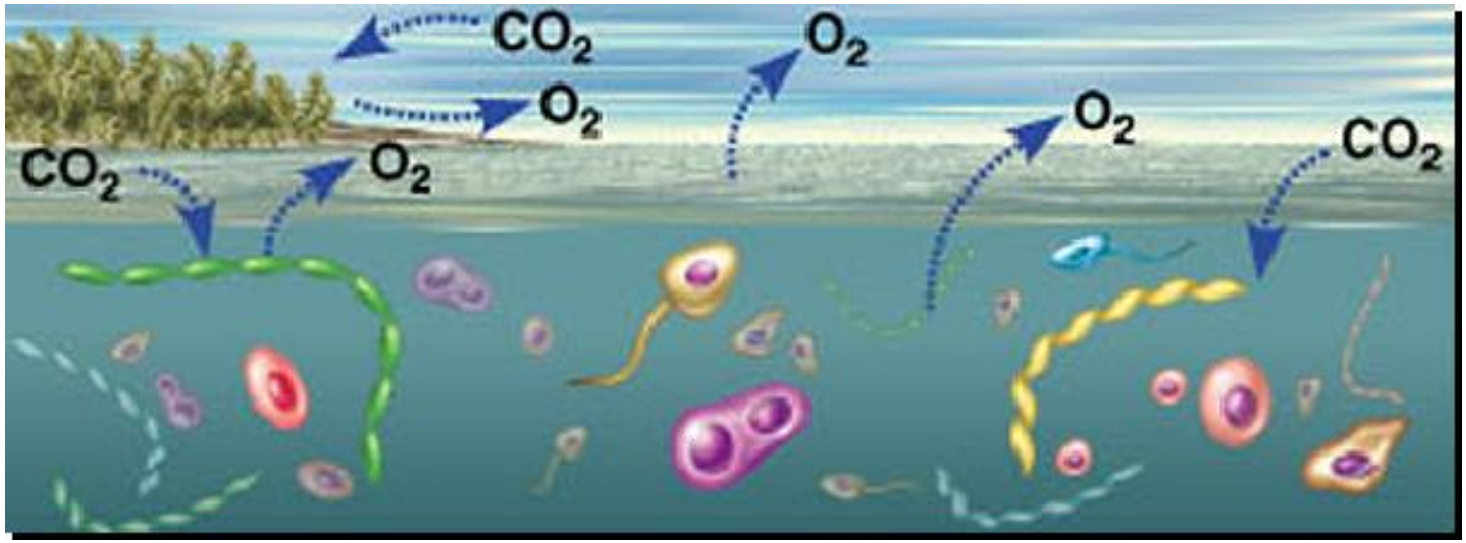
Origin of Life

Stage 3: origin of self-replicating molecules that eventually made inheritance possible



Origin of Life

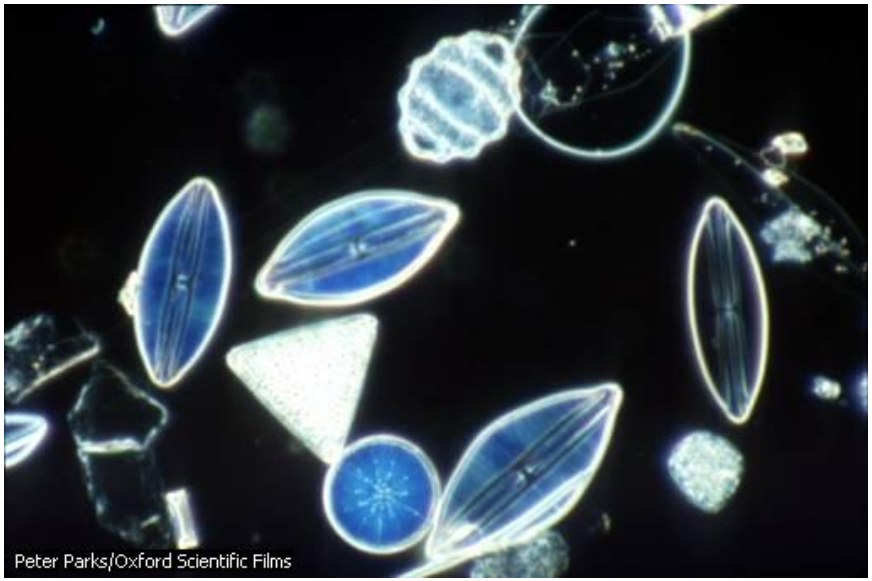
Stage 4: packaging these molecules into pre-cells, droplets of molecules with membranes that maintained an internal chemistry



Origin of Life

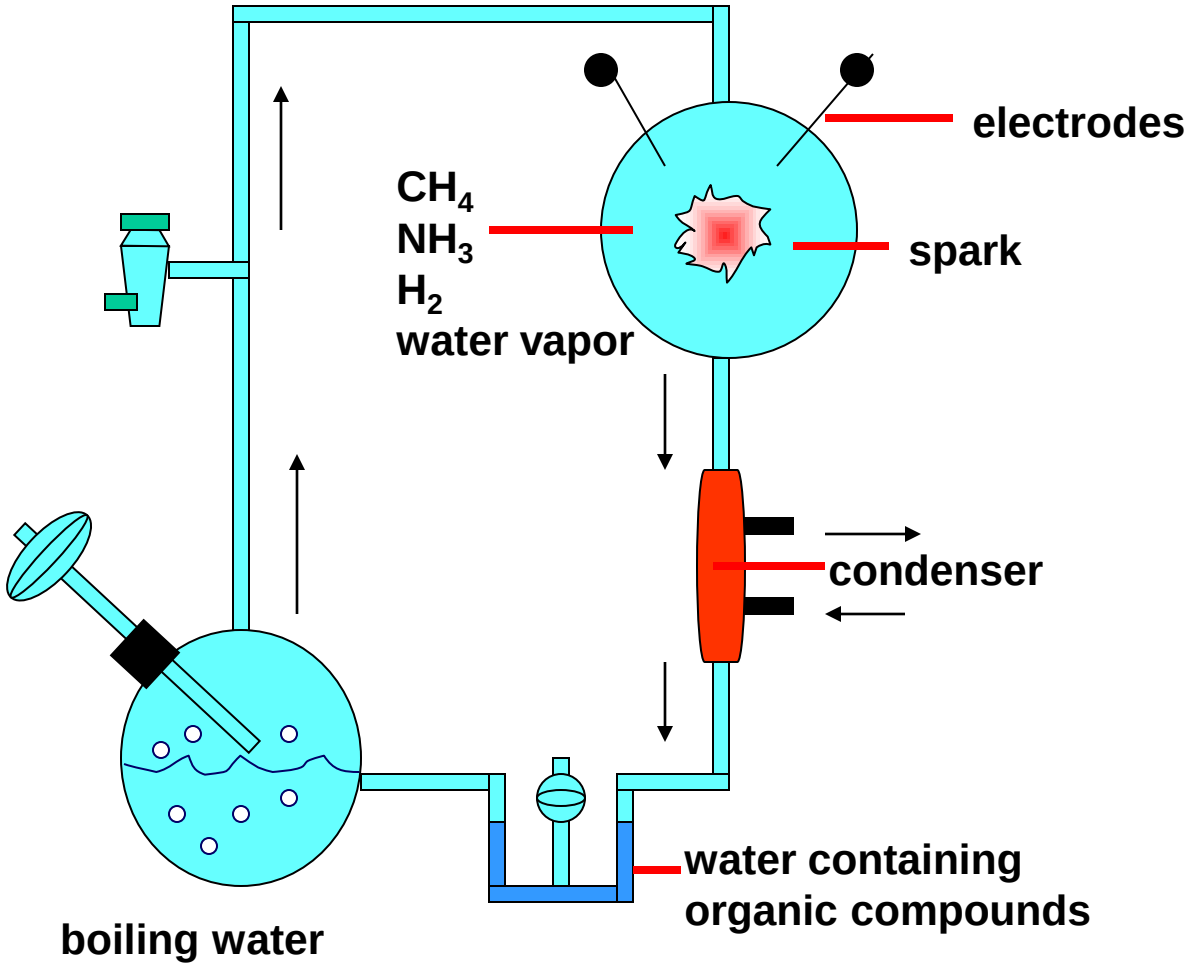
Thomas Huxley- Search for origin of life
Bathybias heckali- primordial ooze

Wyville Thompson: HMS Challenger (1872-1876) found it was actually diatomacous ooze reacting with seawater and ethyl alcohol



Origin of Life

Miller & Urey (1953)- mixed water vapor, NH_3, CH_4, H_2 + electric spark $\rightarrow$ amino acids and other organic compounds



Origin of Life

Produced:

- 20 amino acids
- Several sugars
- Lipids
- Purine and pyrimidine bases (found in DNA, RNA & ATP)

Kingdom Monera

- Species number low (~17, 000), but most numerous on Earth
- 3.5 byo
- Two Divisions
  - Eubacteria (Bacteria & Cyanobacteria)
  - Archaebacteria

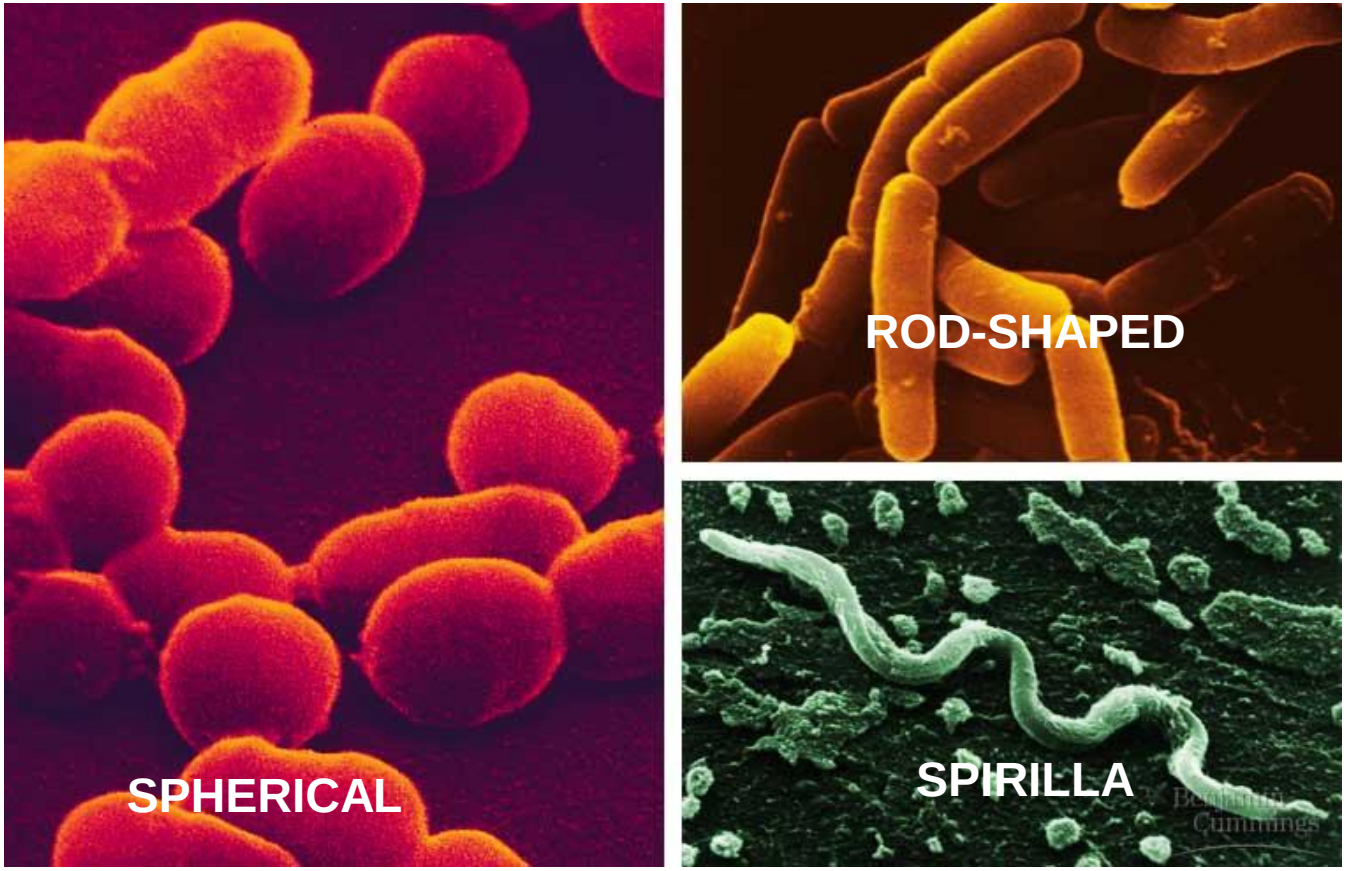
Kingdom Monera

- Prokaryotic
- Single-celled
- Diverse energy types:
  - Chemoautotrophic- Purple sulfur bacteria
  - Photoautotrophic- cyanobacteria
  - Heterotrophic- *E. coli*
    - *saprobes*
    - *parasites*

Kingdom Monera

- Some with cell walls, but cell walls composed of peptidoglycan, not cellulose (as in higher plants).
- Asexual and sexual reproduction

BASIC SHAPES OF EUBACTERIA

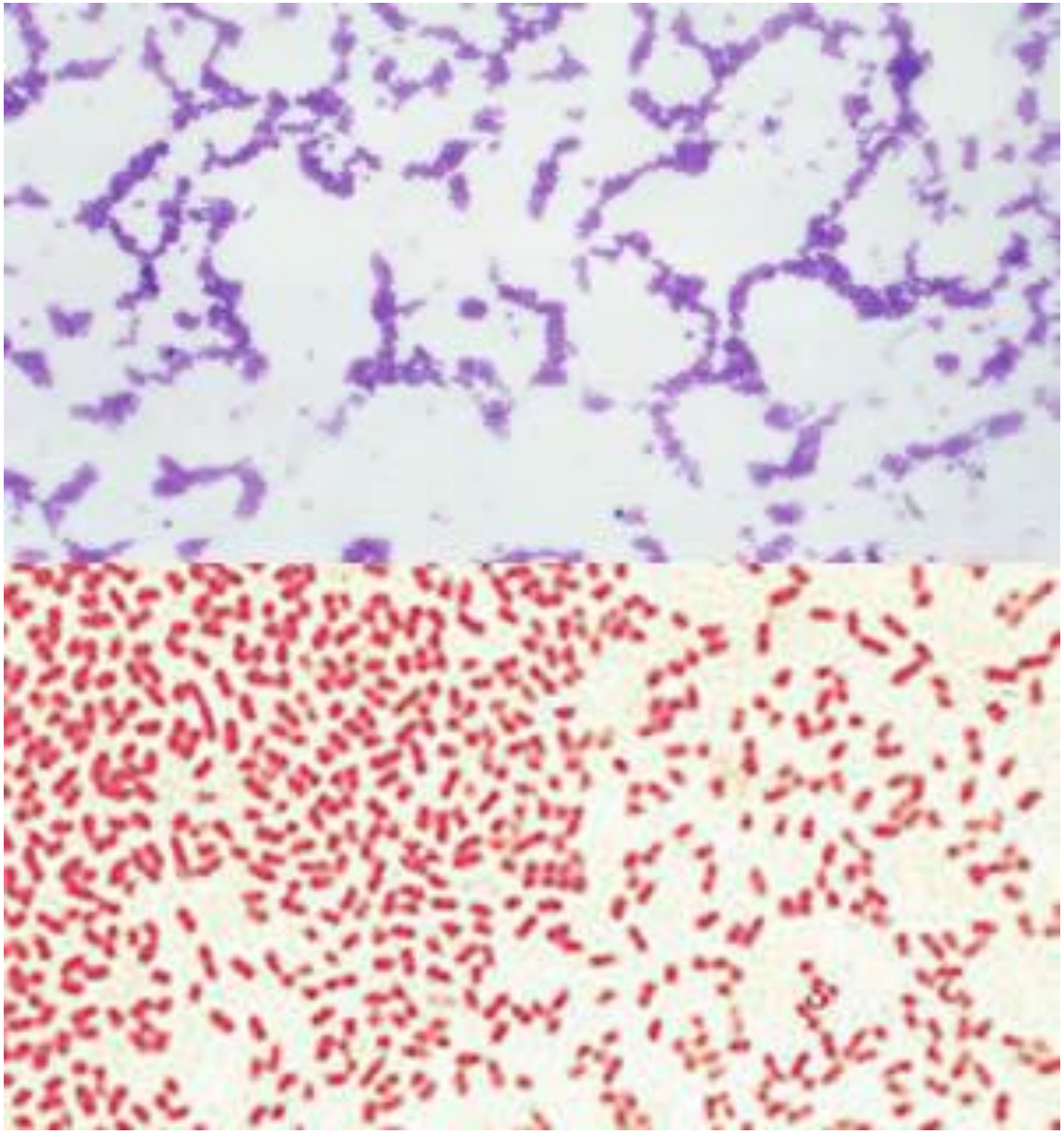


Most Species of Eubacteria may be Grouped Based on Staining

- Gram-Negative
  - thin layer of peptidoglycan
  - Stain pink
  - Endotoxins
- Gram-Positive
  - Thicker layer of peptidogycan
  - Stain purple
  - Exotoxins (released when bacteria die)

Gram +

Gram -



Kingdom Monera

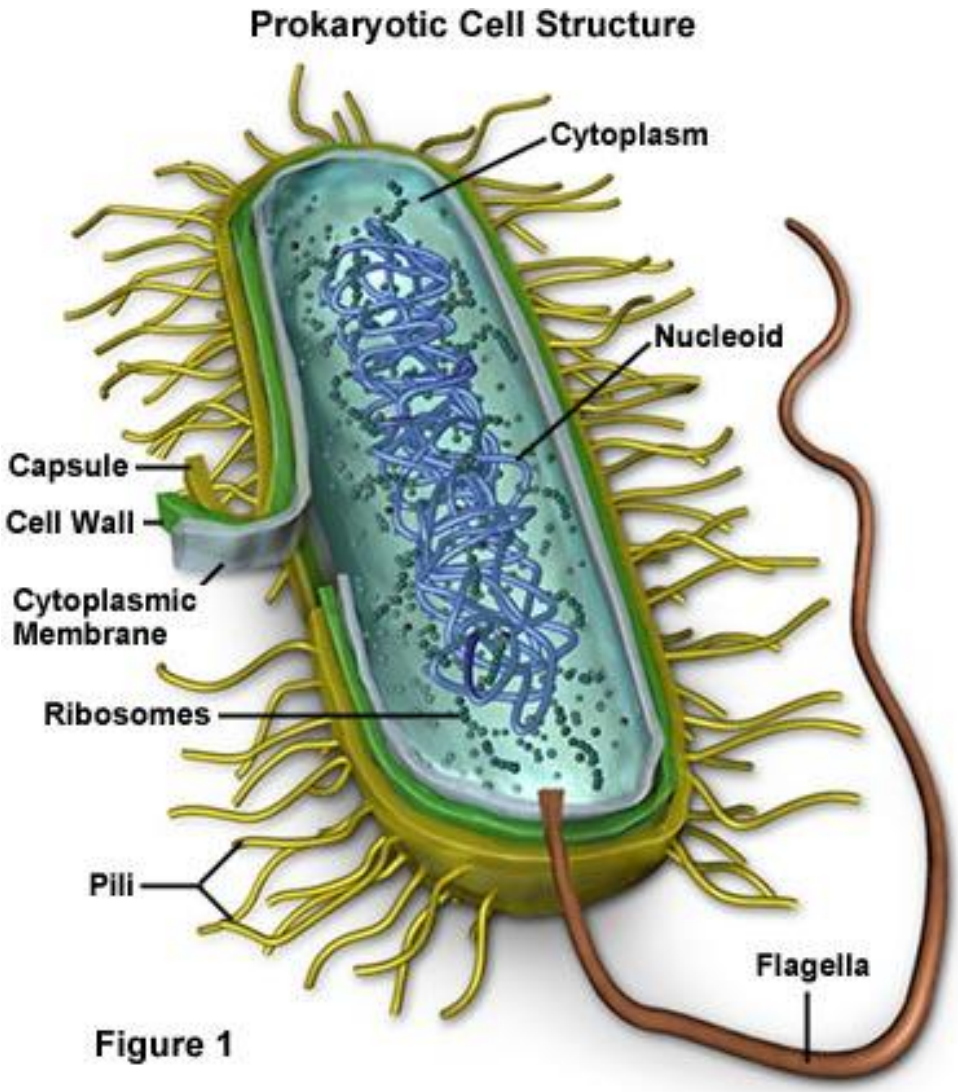
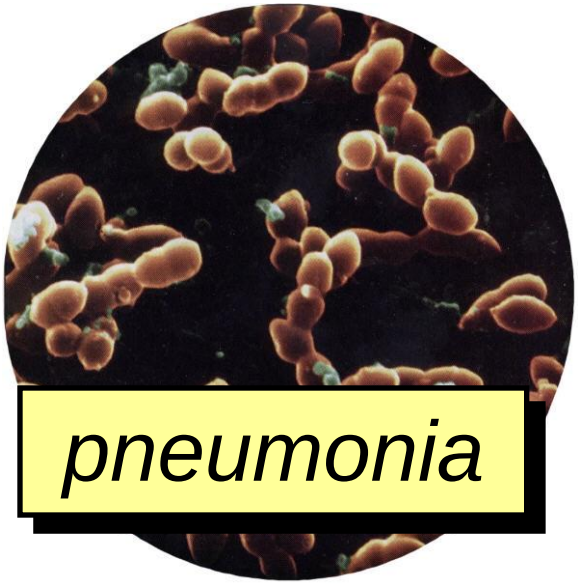
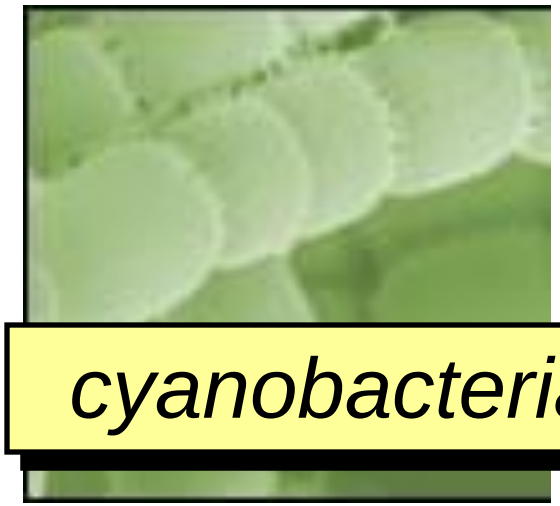


Figure 1

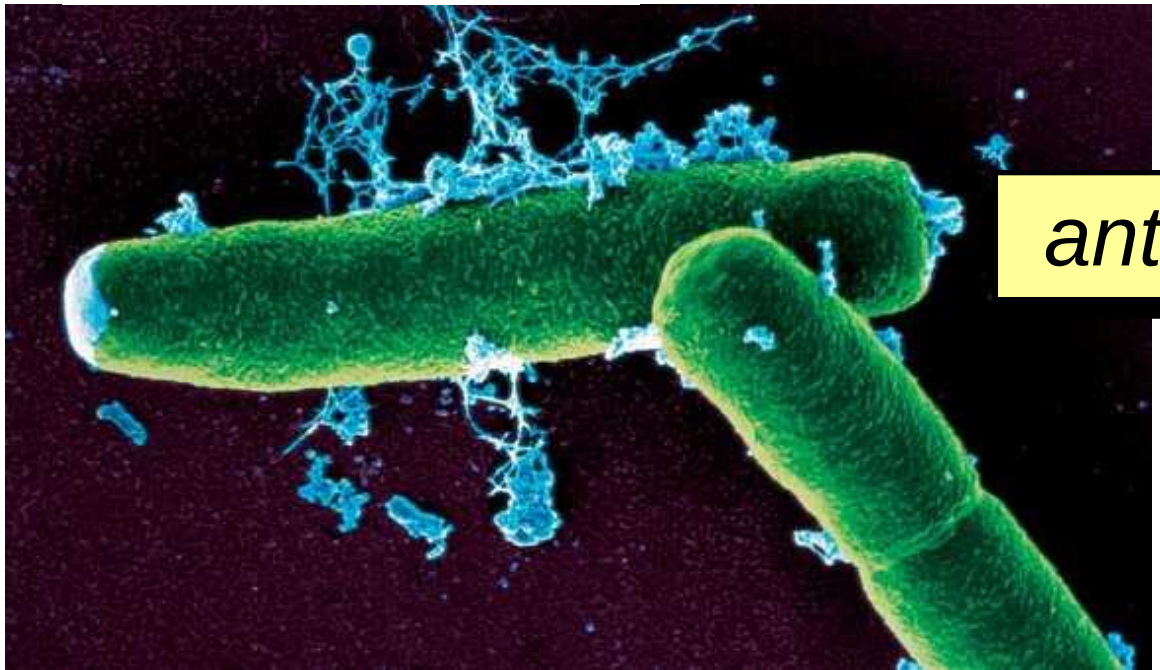
Eubacteria



pneumonia



cyanobacteria



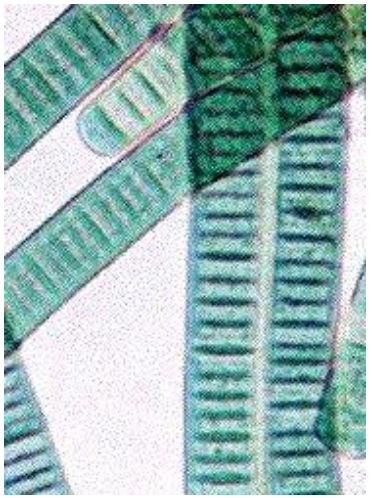
anthrax

Cyanobacteria

- “Blue-green algae”
- Only 200 species?
- In different conditions they grow differently
- Lots of colors
- Photosynthetic

7,500 ? species

Cyanobacteria

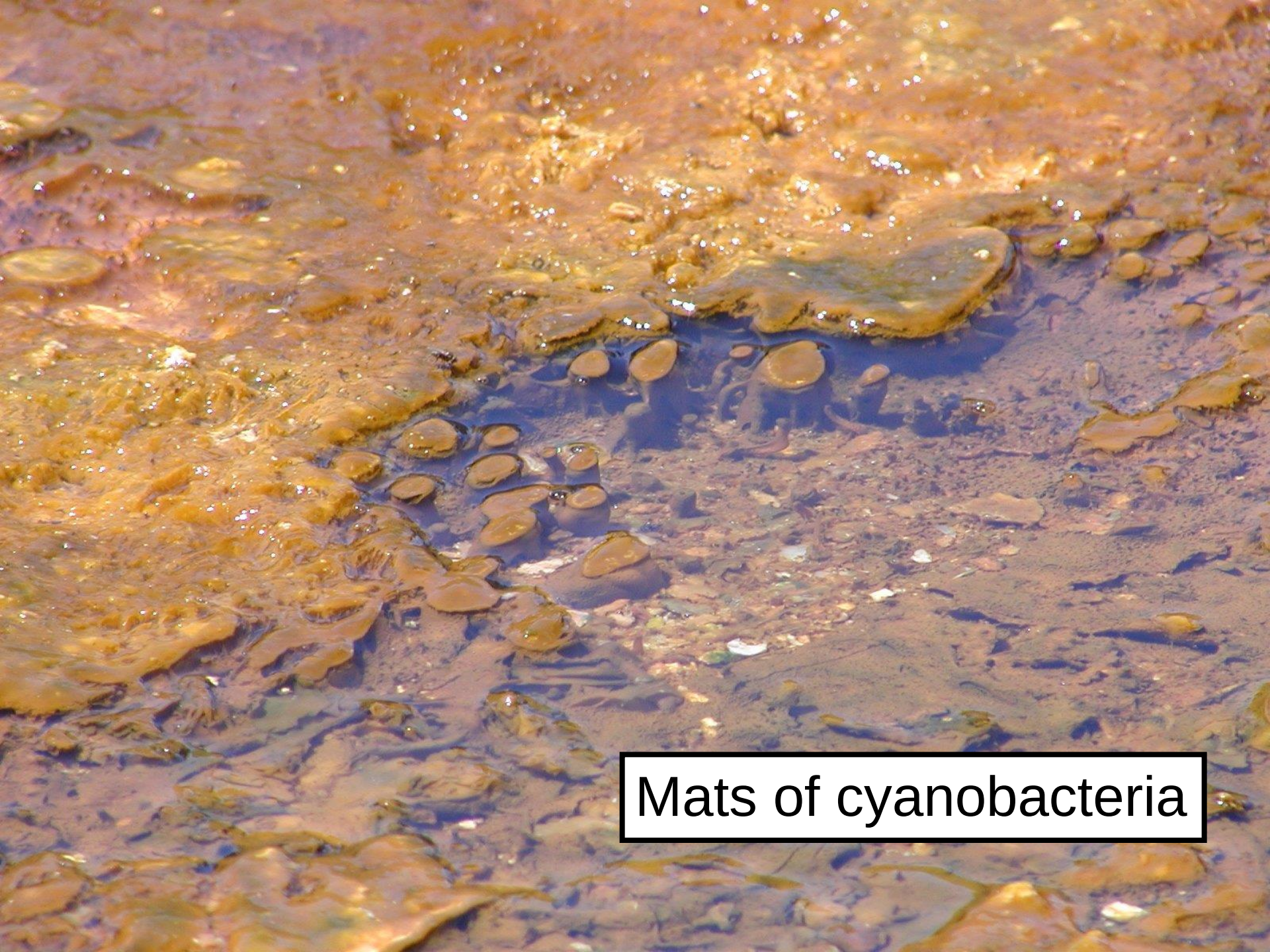


- 3.5 byo
- O_2 levels increase by 1.5 bya

Cyanobacteria were the first organisms on Earth to do modern photosynthesis and they made the first oxygen in the Earth's atmosphere.

Stromatolites

- mainly cyanobacteria
- 2.8 bya in fossil record
- Dominant, no herbivores


Mats of cyanobacteria

Red Sea

Red-pigmented cyanobacteria floating on the surface

Archaebacteria

Archaebacteria are CHEMICALLY DISTINCT from other BACTERIA in several ways:

1. The Cell Walls, Cell Membranes, and Ribosomal RNA are different from those of other BACTERIA. No PEPTIDOGLYCAN.
2. Extremophiles
3. The PREFIX "**ARCHEA**" means **ANCIENT**.
4. Archaebacteria live in conditions similar to when life first appeared and began to evolve.

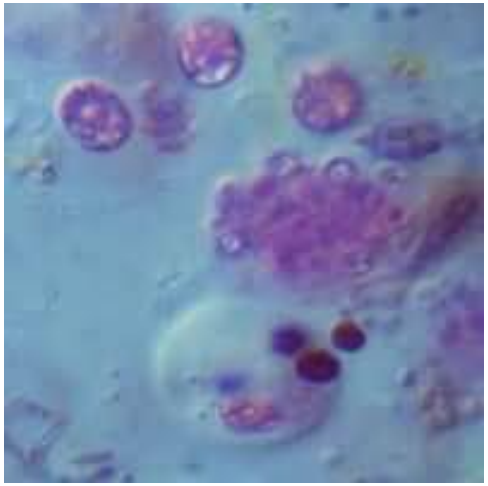
Archaebacteria Types

Methanogens

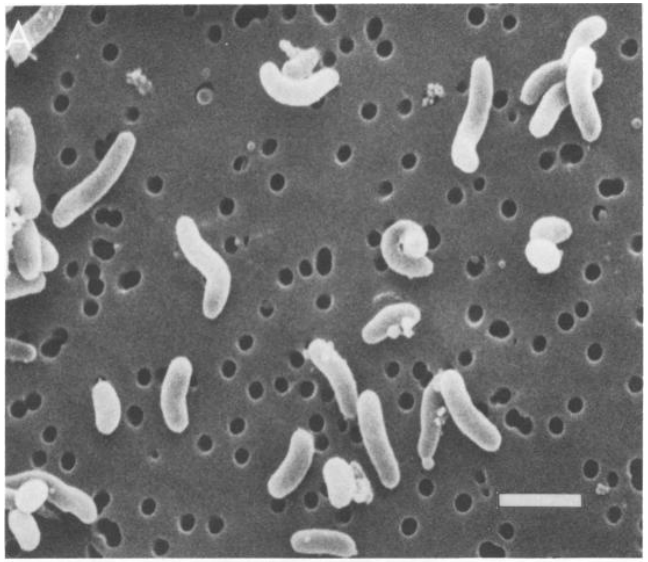
Thermoacidophiles

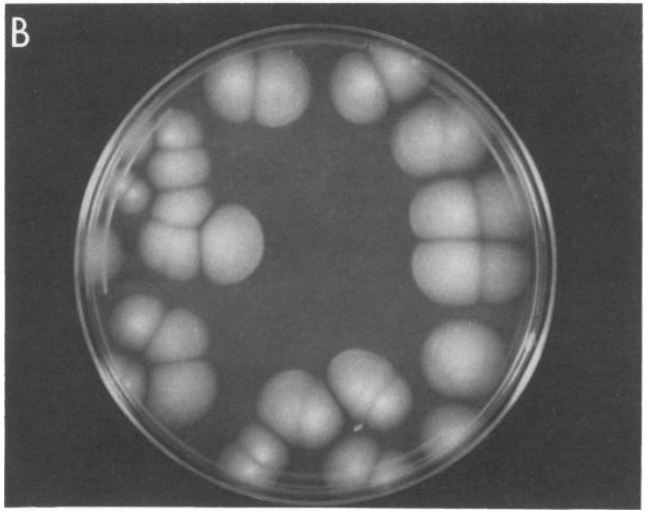
Extreme Halophiles

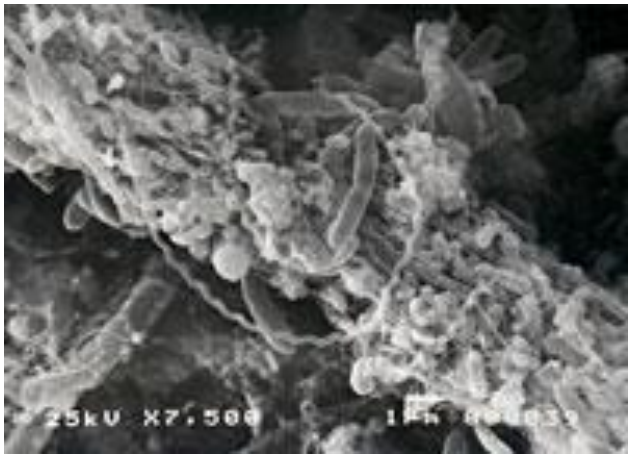
Archaebacteria



Purple sulfur bacteria

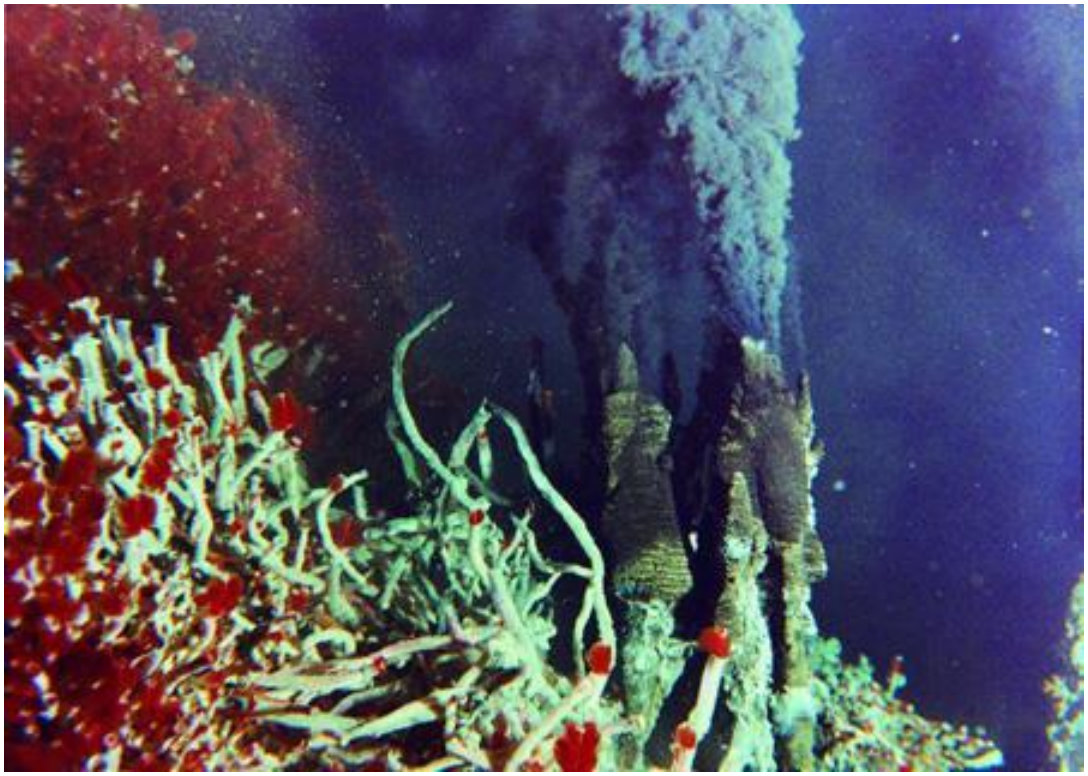






Chemosynthesis

$$6CO_2+6H_2O+3H_2S \rightarrow C_6H_{12}O_6+3H_2SO_4$$



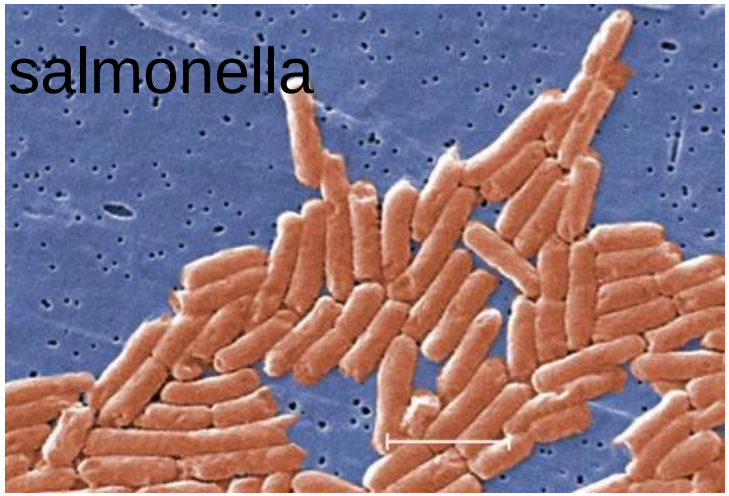
Bad Bacteria!

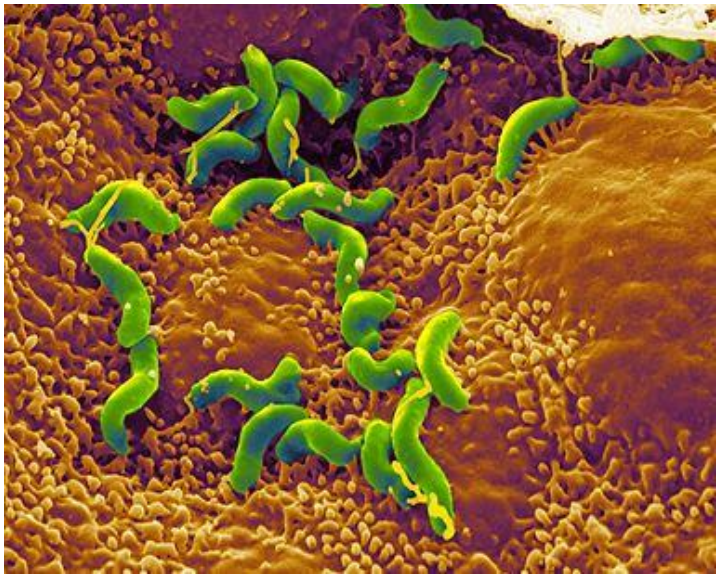
Bacteria Caused Diseases

- Bacteria can cause the following diseases:
  - Tuberculosis
  - Pneumonia
  - Strep throat
  - Staph infections
  - Scarlet fever
  - Syphilis
  - Gonorrhea
  - Chlamydia
  - Boils
  - Tetanus
  - Lyme disease
  - Ear infections

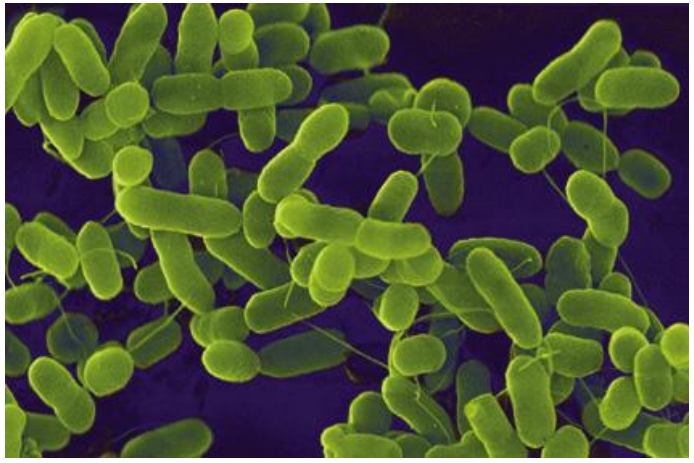
Many sexually transmitted diseases (STD's) are caused by bacteria.

- Gonorrhea
- Syphilus
- Chlamydia

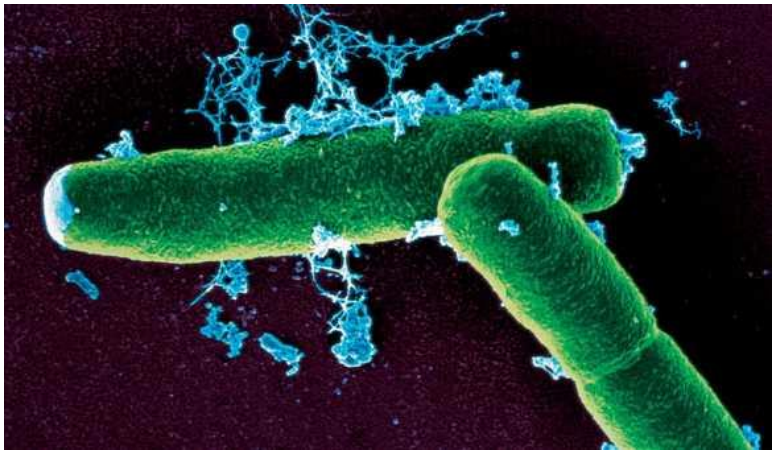




Helibacter pilori



E. coli



anthrax

Black Band disease

Botulism

- One group of bacteria called **clostridia**, can form endospores. Clostridium botulinum, produces a toxin. If canned food is not properly sterilized these endospores can become active inside a can and the disease "**botulism"** can occur.

Antibiotics

- Antibiotics are drugs that combat bacteria by interfering with cellular functions
  - Penicillin – interferes with cell wall production
  - Tetracycline – interferes with protein production
  - Sulfa drugs – produced in the laboratory
  - Broad-spectrum antibiotics will affect a wide variety of organisms

Penicillin, an antibiotic, comes from molds of the genus *Penicillium* Notice the area of inhibition around the *Penicillium*.

Bacteria aren’t all Bad!

Root Nodules

Atmospheric N_2

↓

N “fixer”

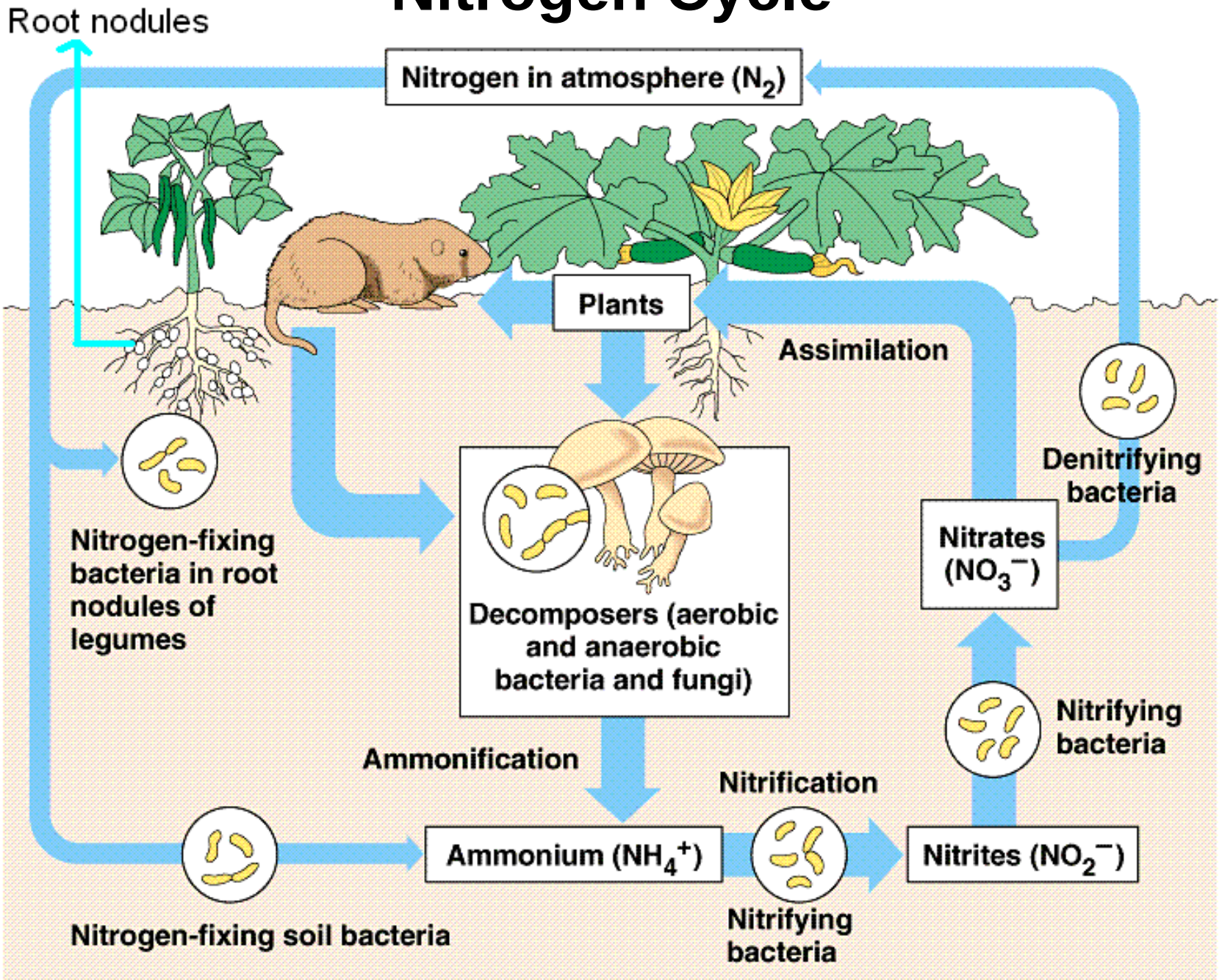
↓

Plant roots

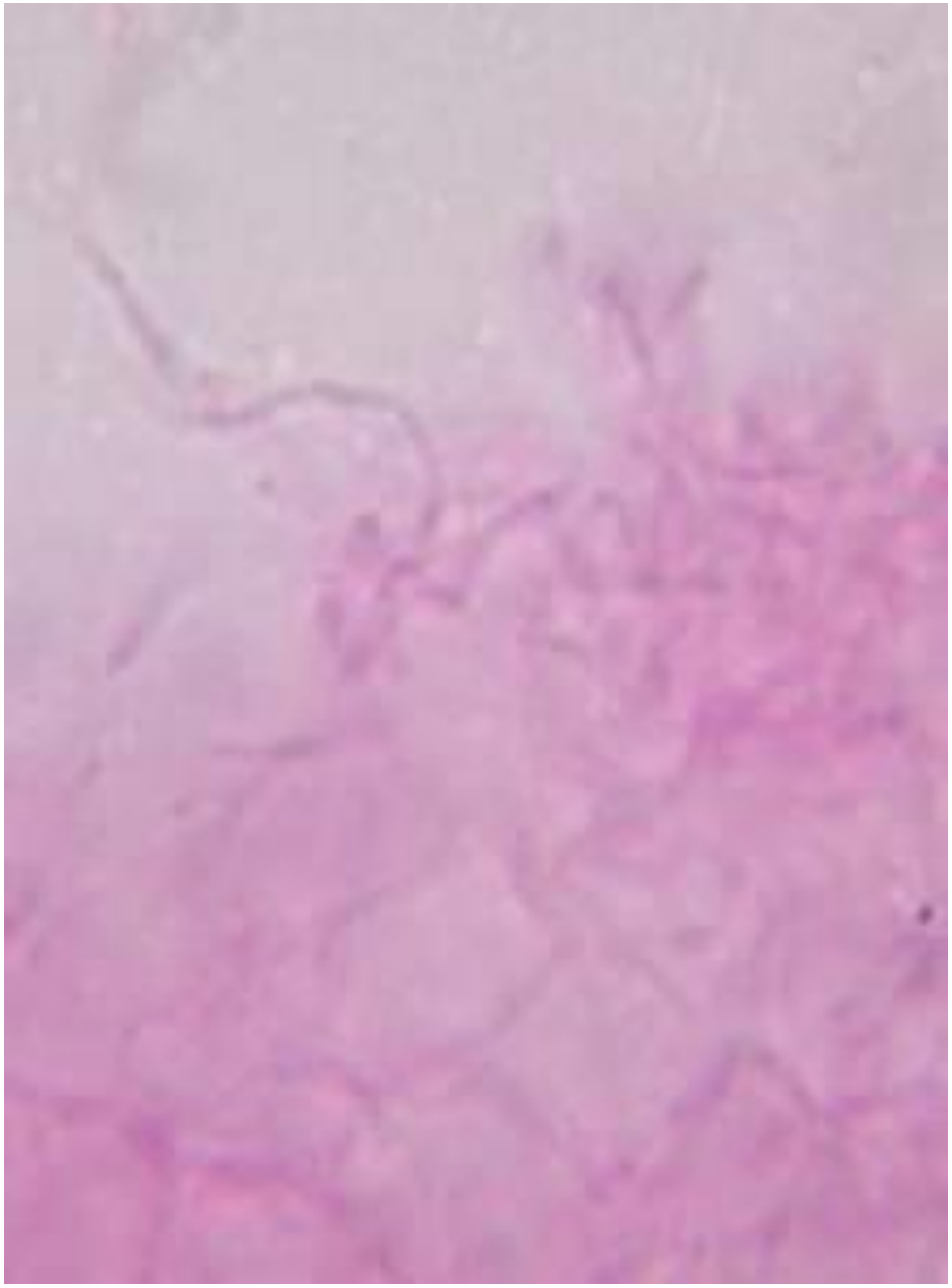
50% to 70% of the biological nitrogen fixation

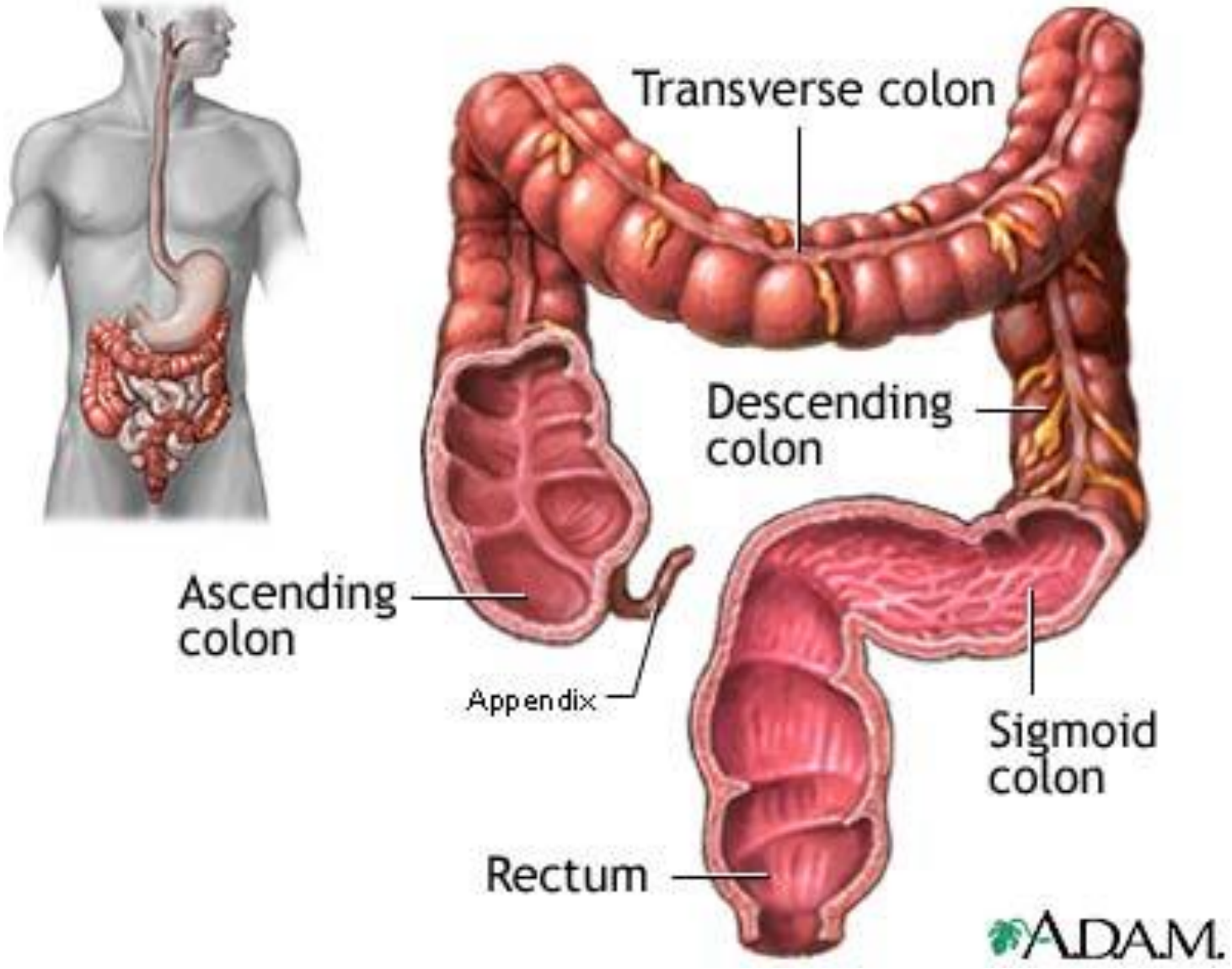
NifTAL: Nitrogen Fixation of Tropical Agricultural Legumes

Nitrogen Cycle



- Actinomycetes, produce antibiotics such as streptomycin and nocardicin.





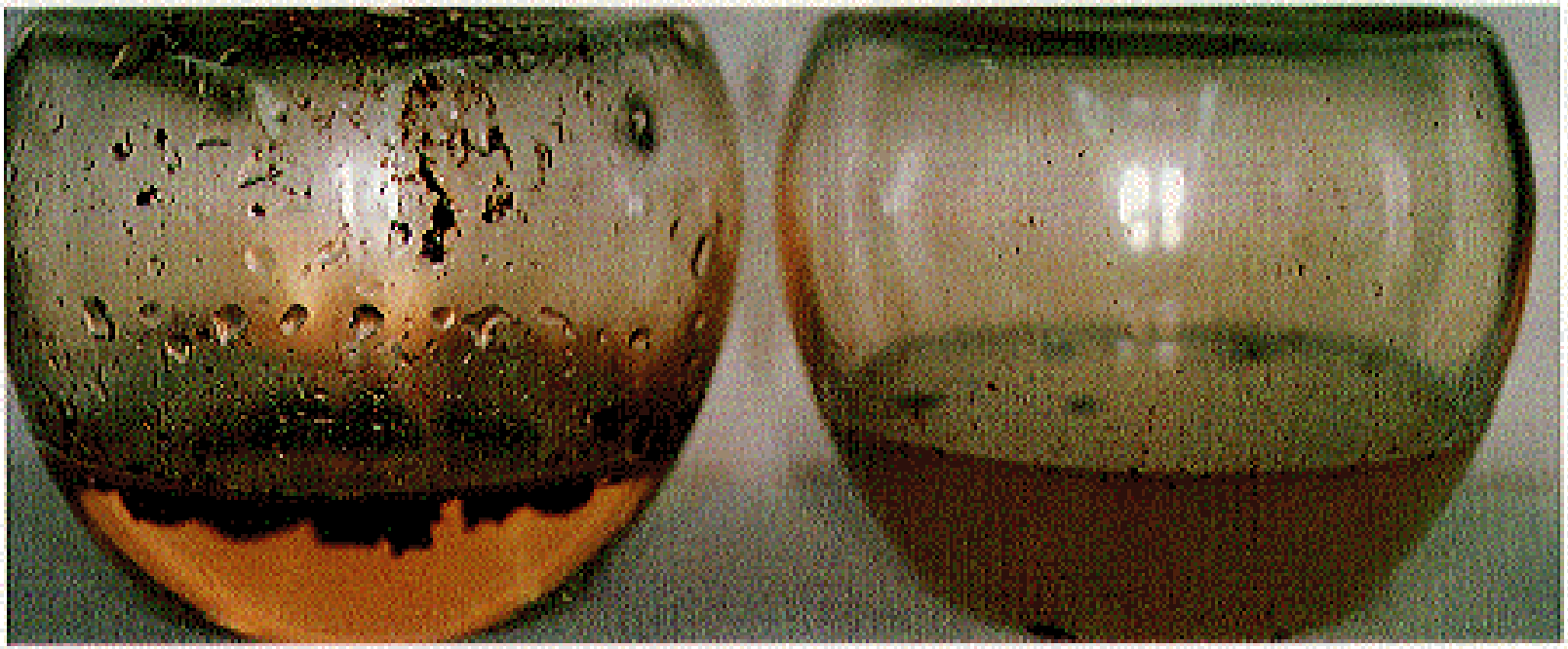
Bacteria make Vitamin K

- Bacteria put the tang in yogurt and the sour in sourdough bread.
- Saprobes help to break down dead organic matter.
- Bacteria make up the base of the food web in many environments.

Streptococcus thermophilus in yogurt

Sewage treatment

Oil Spills



Before adding the bacteria
微生物添加前

7 days later
7日後

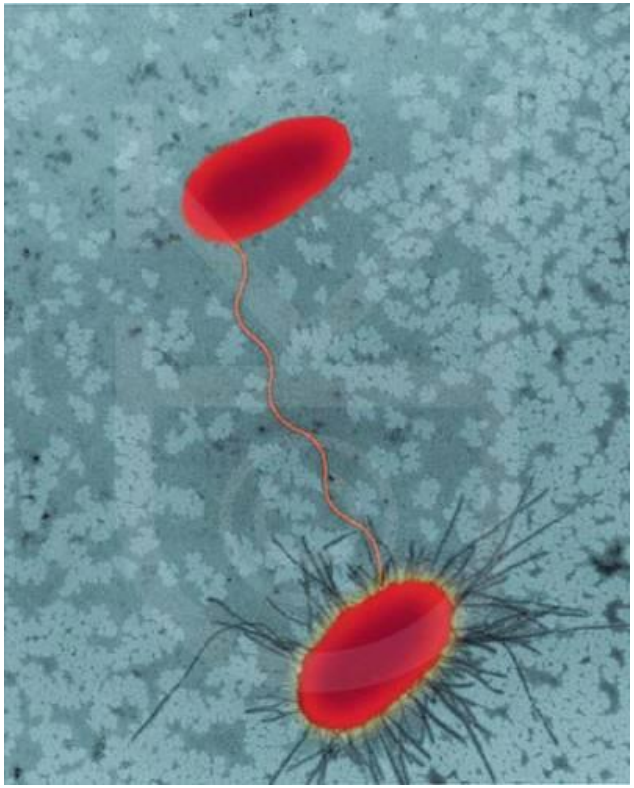
Bioluminescence

Bacteria Reproduction

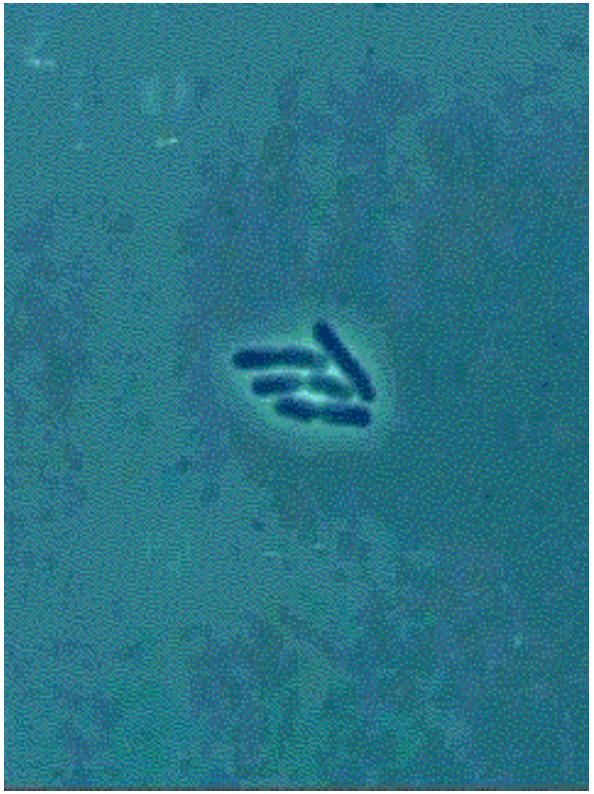
- Under optimum conditions bacteria can reproduce every 20 minutes.
- Bacteria reproduction is controlled by various factors including : temperature and food availability.

Bacteria Reproduction

Asexual:binary fission

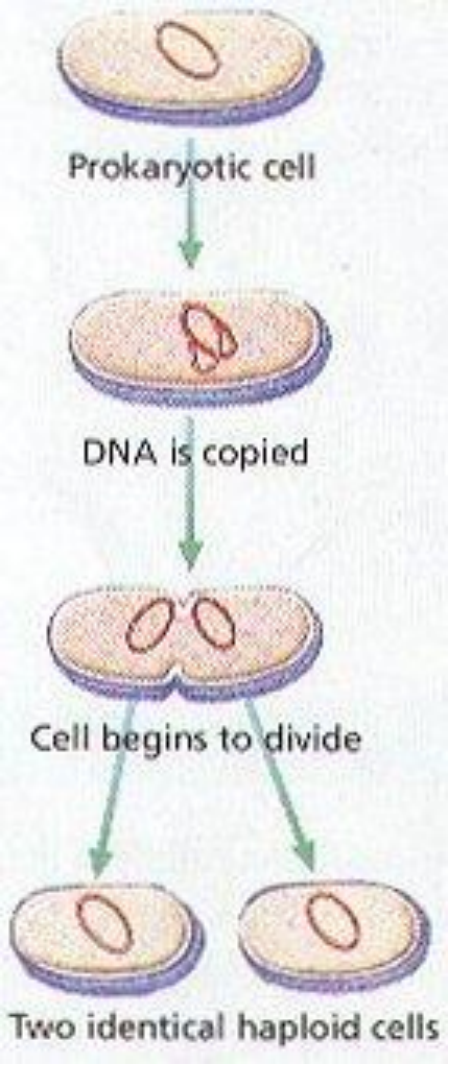


Sexual: conjugation



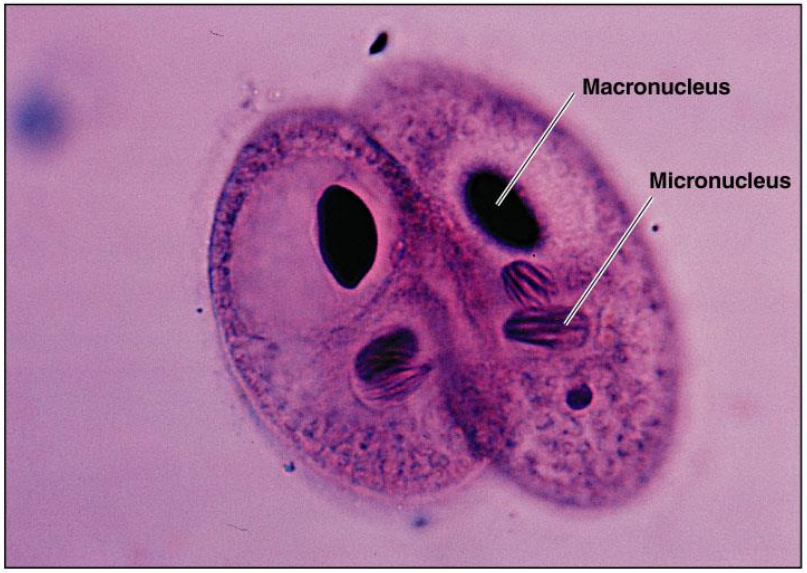
Binary Fission

- It involves the copying of the DNA and the splitting into two new cells.



Conjugation

- Sexual reproduction
- One bacteria is able to transfer its DNA into another bacteria by means of a pilus (pili)



It's not that easy

bein' green.....

but it is essential

for life on earth !

Thanks.....End!