



# Life In Extreme

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And its relation to Exobiology



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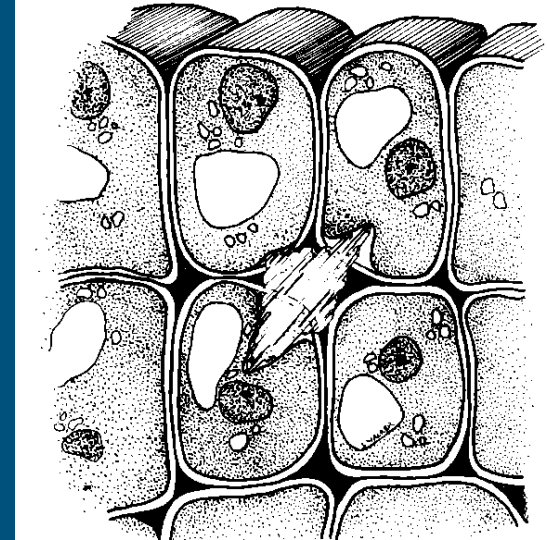
# Extreamophiles

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- Mostly micro-organisms who live in extreme conditions:
- Physical conditions: pressure, radiation, temperature
- Geochemical conditions: acidity, salinity
- “Phile”?

# Temperature - Cold

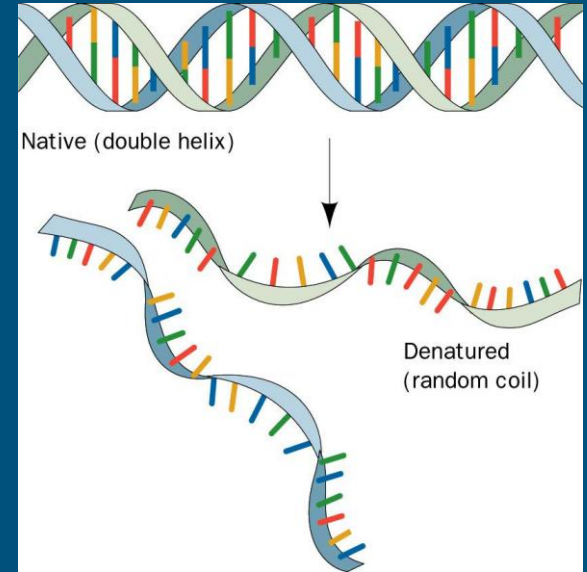
- Ice crystals
- Energetic barrier
- Good substrate-enzyme fit
- Reducing the freezing temperature by up to 18 degrees
- Freezing of the intercellular fluid
- Freezing and defrosting are possible
- [Video](#)
- Nematode *Panagrolaimus Davidi*



# Temperature - Heat

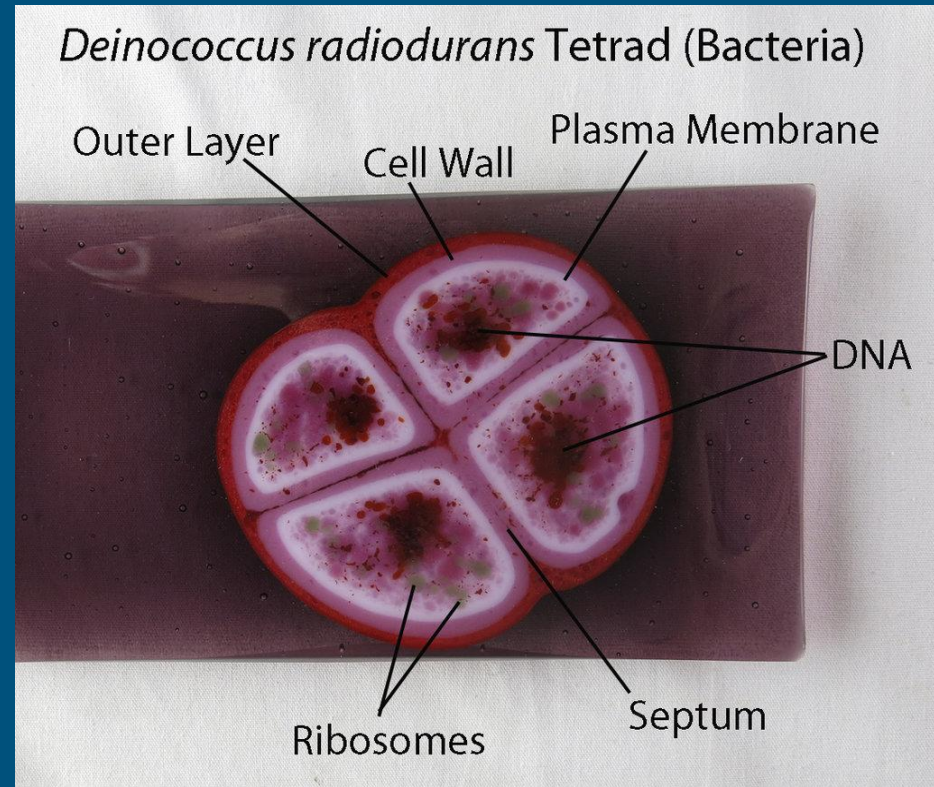
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- Protein and nucleic acid denaturation
- Membrane fluidity
- Protein structure change – more interaction
- Nucleic acid structure change – more interaction
- Membrane fats compound change



# Radiation

- Frequency
- Nucleic acid structure damage
- Nucleic acid repair mechanisms
- Bacterium *D. Radiodurans*



# Salinity

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- Solvent's concentration, osmotic pressure
- Protein denaturation
- Cell dehydration
  
- Salt / glycerin accumulation in the cell
- The genus *Dunaliella*



# Oxygen

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- Metabolism efficiency
- Free radicals
- Anaerobic - Nutrient consumption
- Neutralization mechanisms of free radicals



- Drought

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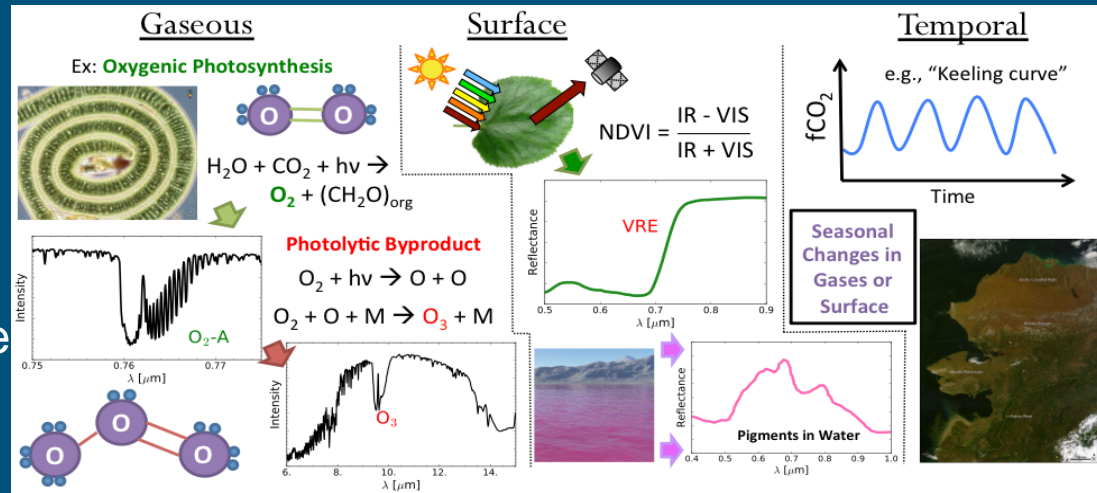
- Complete drought – unknown
- Have not evolved because was not needed?





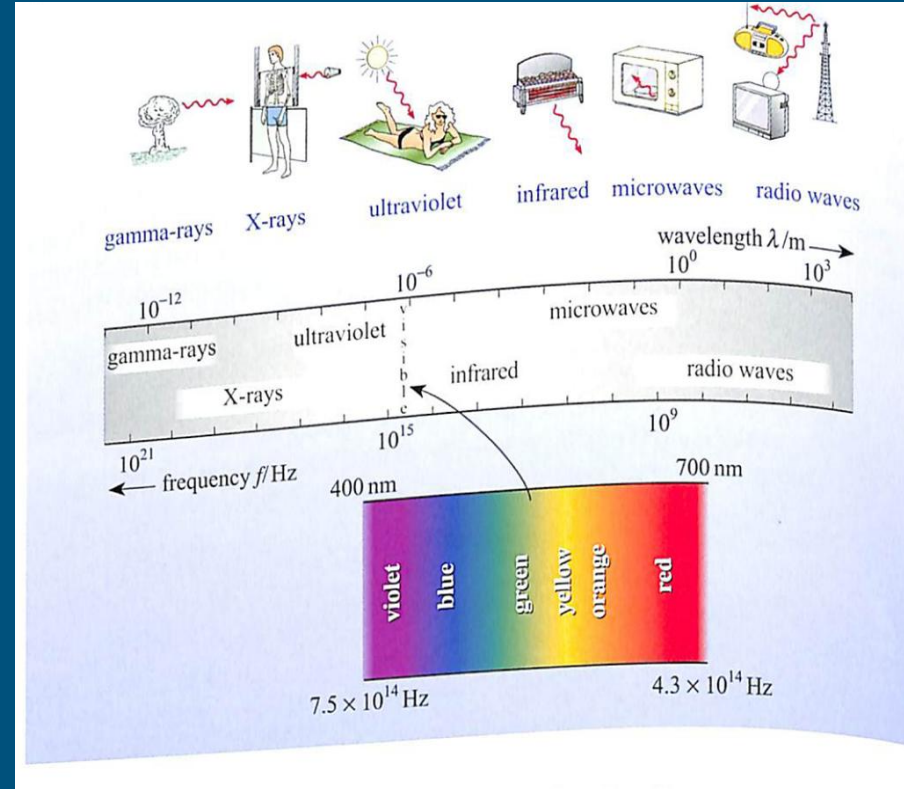
# Life searching today - biosignature

- Biosignature - object, substance or pattern that require a biological factor to its creation
- False positive
- 3 kinds
  - atmosphere gases
  - Reflected radiation over area
  - Temporal – changes over time



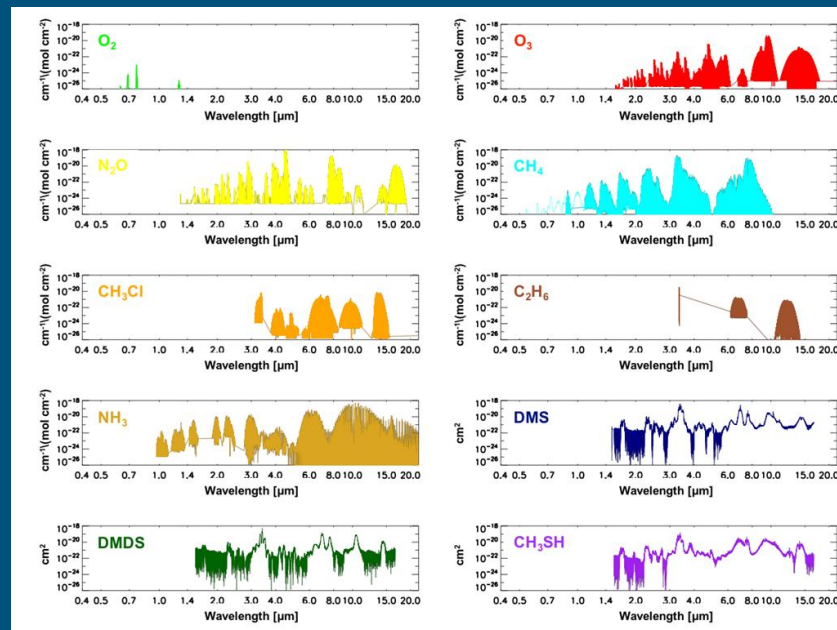
# Physical tools

- Surface sampling
- Electromagnetic radiation analyzing



# • Electromagnetic radiation analyzing

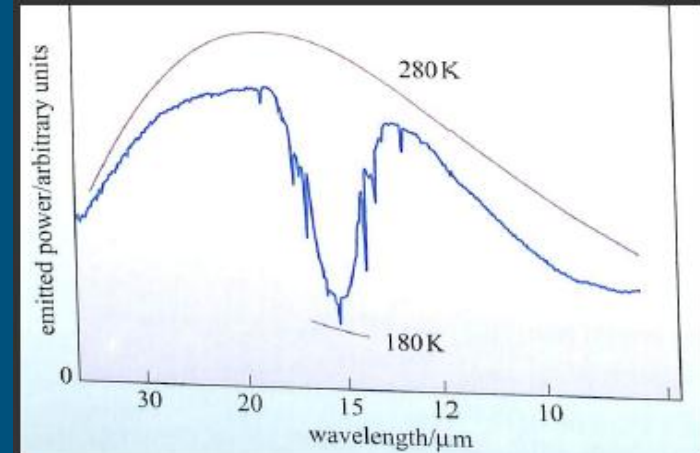
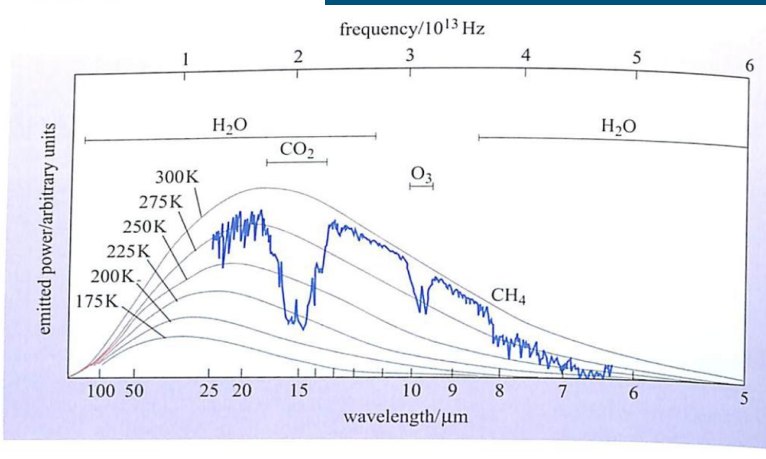
- Focus on the IR radiation
- Reflected from planet's surface
- Indicate compounds and elements in the atmosphere



# Surface's temperature

- Temperature effects absorption

**Figure 8.7** The Earth's infrared spectrum, as obtained in daytime by the Nimbus-4 satellite over a cloud-free part of the western Pacific Ocean in the 1970s.



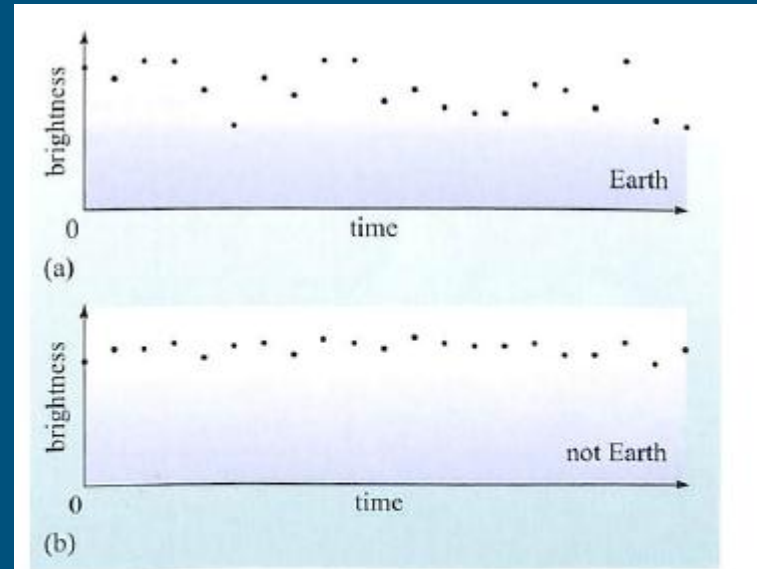
# NIR - Near InfraRed (Near visible wavelenghts)

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- The red edge of the spectrum
- On earth - chlorophyll
- 10 M diameter telescope
- False positive

# Visible light over time

- Different surface reflect different amount of light
- Ocean - 10%,  
snow – 60%  
desert and plants – in between
- Stabil Vs. periodic brightness



**Figure 8.14** Light curves that typify the sunlit hemisphere of (a) the Earth and (b) a terrestrial body with a more uniform surface.

# Visible light absorption

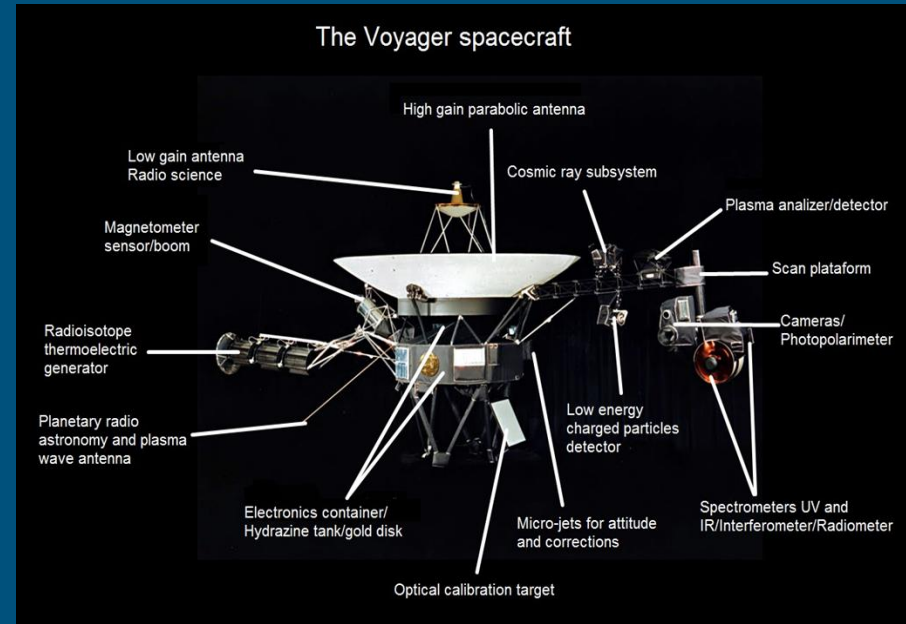
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- Indicate compounds and elements in the atmosphere
- Recognize  $H_2O$ ,  $CO_2$ ,  $O_2$
- 10 M diameter telescope

# Inter-stellar telescopes

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- Accuracy
- Landing?
- Speed and acceleration limit





# Discovery of life forms that are different from us

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- Non water-based biosphere
- Photosynthesis that not produce  $O_2$
- And more..
- Relay on extreme life forms known on earth
- Light reflected from planets over time

