

# Introduction to Botany. Lecture 6

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# Questions and answers

## Quiz



# Final question (1 point)

How do you characterize water with  $\text{pH} = 5$ ?



# Final question (1 point)

How do you characterize water with pH= 5?

- Acidic
- Concentration of protons ( $H^+$ ) is  $10^{-5}$  which is 100 more than concentration of protons in the distilled water ( $10^{-7}$ )



Excursion?





# Basics of life

## Molecules of life



# Organic chemistry: chemistry of carbon

- Carbon skeleton
- And H, O, N, P, S



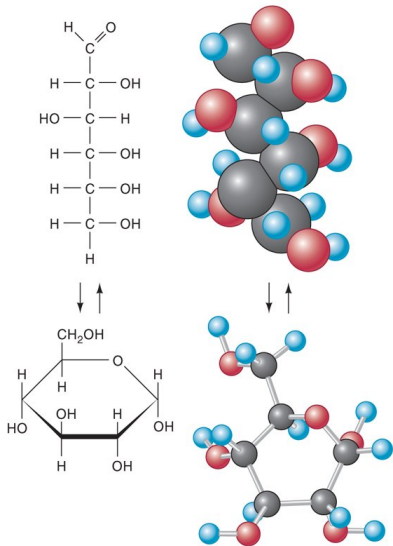
# Four types of biomolecules

- Lipids: hydrophobic
- Carbohydrates (sugars): multiple –OH groups
- Amino acids: N + C + O and hydrogen
- Nucleotides: cycle with nitrogen (heterocycle), sugar and phosphoric acid

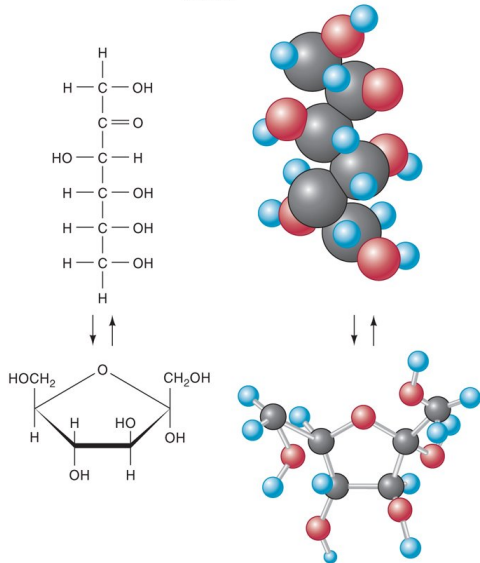


# Carbohydrates

glucose



fructose

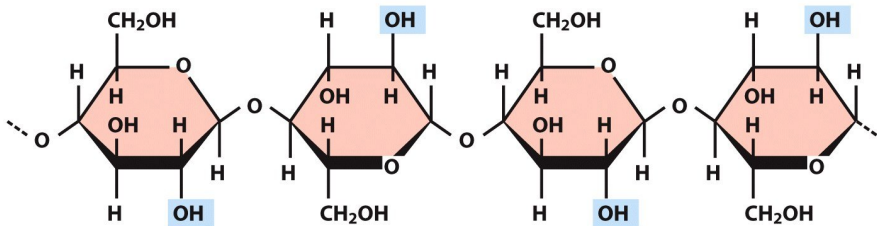


# Organic polymers

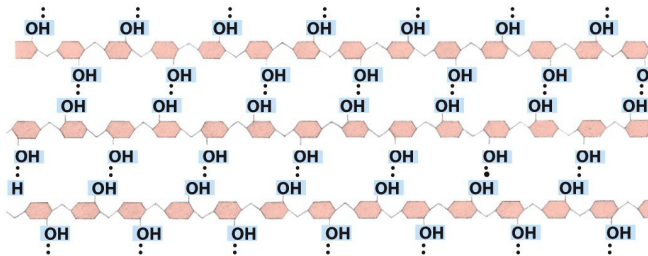
- Polymeric carbohydrates: polysaccharides (like cellulose and starch)
- Polymeric amino acids: proteins
- Polymeric nucleotides: nucleic acids (DNA and RNA)



# Cellulose



(a)



(b)



# Summary

- Most important bonds: polar and non-polar covalent (intramolecular) and hydrogen (intermolecular)
- Obligatory biogenic elements: C, H, O, N, P
- Most important monomers: lipids, carbohydrates, amino acids, nucleotides
- Most important polymers: polysaccharides, proteins, nucleic acids



# Photosynthesis

## History of photosynthesis studies





# van Helmont

- Johannes van Helmont (17th century) rejected the idea that plants take most of their biomass from soil
- Willow (*Salix* sp.) tree of 2.27 kg grew to 67.7 kg in five years, but weight of soil decreased only by 57 g
- van Helmont concluded that plants take most of their weight from water



# Pristley

- Famous Joseph Priestley in 1772, made series of experiments with mouse, candle and sprig of mint (*Mentha* sp.)
- Mouse behave similar to candle, they both “spent” air
- Plant revives the air for both candle and mouse



# Further history

- Jan Ingenhousz (1779–1796) and Jean Senebier (1780) found that:
  - Only in day time the air is reviving
  - CO<sub>2</sub> is assembled
- Antoin-Laurent Lavoiser (1783) found that the “revived air” is a separate gas, **oxygen**

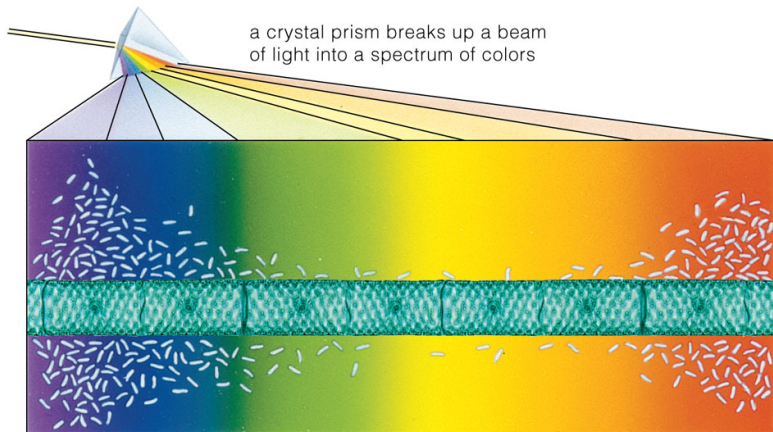


# Engelmann

- Thomas Engelmann in 1884 found that *Spirogyra* alga produce oxygen mostly in blue and red parts of spectrum
- Therefore, the key photosynthetic pigment should accept blue and red rays and reflect green rays
- Chlorophyll fits best to this description



# Experiment of Engelmann



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# Blackman

- In 1905, Frederick Blackman discovered that if light intensity is low, increase of temperature has a little effect on the rate of photosynthesis
  - 1 If light and temperature were *independent*, this could not happen
  - 2 If temperature and light were *components of the chain*, than light was first and temperature second
- Consequently, photosynthesis has two stages:
  - 1 Light stage which relates more with light intensity
  - 2 “Dark” (now called *enzymatic*) stage which relates more with temperature



# Light and enzymatic (“dark”) reactions

- Light reactions depend on the light and water, they produce oxygen and energy (in form of ATP)
- Enzymatic reactions depend on carbon dioxide and water, they take energy from light reactions and result in production of carbohydrates



# Final question (2 points)





# Final question (2 points)

Why did Engelmann decide that photosynthetic pigment has a green color?



# Summary

- From 17th century, it constantly became clear that plants make their biomass from light, water and carbon dioxide
- **Photosynthesis** is a sum of light-dependent and light-independent reactions



# For Further Reading



A. Shipunov.

*Introduction to Botany* [Electronic resource].

2016.

Mode of access:

[http://ashipunov.info/shipunov/school/biol\\_154](http://ashipunov.info/shipunov/school/biol_154)

