

Introduction to Botany. Lecture 19

Alexey Shipunov

Minot State University

October 12, 2012

Outline

- 1 Questions and answers
- 2 Leaves
 - Ecological adaptations of leaves
- 3 Photosynthesis
 - Animals can do that, too
 - History

Outline

- 1 Questions and answers
- 2 Leaves
 - Ecological adaptations of leaves
- 3 Photosynthesis
 - Animals can do that, too
 - History

Outline

- 1 Questions and answers
- 2 Leaves
 - Ecological adaptations of leaves
- 3 Photosynthesis
 - Animals can do that, too
 - History

Previous final question: the answer

Why plants are dying in the flood?

Previous final question: the answer

Why plants are dying in the flood?

- Deficit of oxygen and carbon dioxide
- Fungi and bacteria
- Soil removal



Leaves

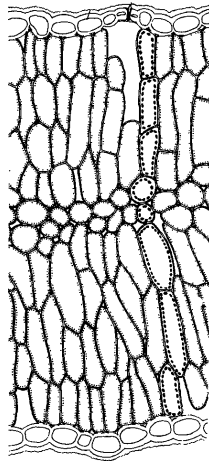
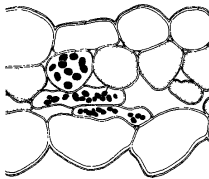
Ecological adaptations of leaves

Plants and light

- Sciophytes
- Heliophytes



Sciophyte and heliophyte



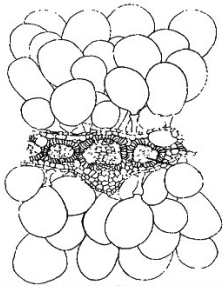
Oxalis acetosella and *Sylphium laciniatum*

Plants and soil

- Halophytes (accumulate, excrete or avoid NaCl)
- Nitrate halophytes (grow on soils rich of NaNO_3)
- Oxylophytes (grow on acidic soils)
- Calciphytes (grow on chalk soils rich of CaCO_3)



Leaf of salt-accumulating halophyte



Atriplex prostrata

Plants and substrate

- Psammophytes (grow on sand)
- Petrophytes (grow on rocks)
- Rheophytes (grow in fast springs)

Rheophyte



Rhyncholacis penicillata from Venezuela

Plants and metabolism

- Mycoparasites
- Hemiparasites
- Phytoparasites (root and stem)



Mycoparasite



Triuris hyalina from South America

Hemiparasite



Krameria parvifolia from southern Texas

Root parasite



Hydnora africana from South Africa

Stem parasite



Cuscuta europaea from Germany

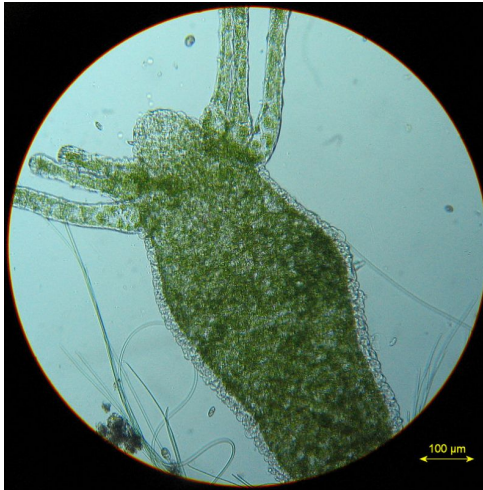
Photosynthesis

Animals can do that, too

Green slugs



Green *Hydra*



Photosynthesis

History

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
 - CO₂ is assembled
- Antoin-Laurent Lavoiser (1783) found that the “revived air” is a separate gas, **oxygen**

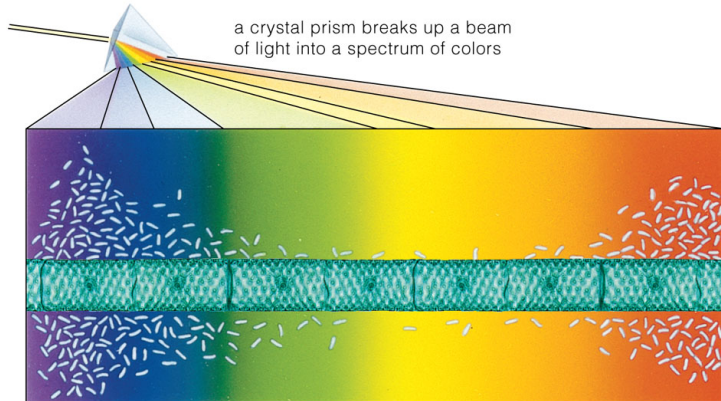


Engelmann

- 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



© 2006 Brooks/Cole - Thomson



Blackman

- In 1905, Frederick Blackman discovered that if light intensity is low, increase of temperature has a little effect on the rate of photosynthesis
- Consequently, photosynthesis has two stages:
 - 1 Light stage which relates more with light intensity
 - 2 “Dark” (now called *enzymatic* or *light-independent*) stage which relates more with temperature



Final question (2 points)

Final question (2 points)

Which conclusions can be drawn from Priestley's experiments?
Please list more than one.

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



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 10.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 10.

