

# Introduction to Botany. Lecture 22

Alexey Shipunov

Minot State University

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## 1 Questions and answers

## 2 Leaf

- Leaf morphology
- Modifications of leaf
- Anatomy of leaf



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## 2 Leaf

- Leaf morphology
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# Previous final question: the answer

How many levels of hierarchy has this leaf?



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How many levels of hierarchy has this leaf?



3

## *Lab 7*



# Leaf

## Leaf morphology



# Simple (one level) and compound (> 1 level) leaves





# Plan of leaf description

- 1 General characters (leaf as a whole):
  - A. symmetry (symmetrical / asymmetrical);
  - B. stipules (present / absent, deciduous / not);
  - C. base (sheath / no sheath, ligule / no ligule, auricles / no auricles)
- 2 First level of hierarchy: repetitive characters:
  - A. shape;
  - B. dissection;
  - C. petiole (length)
- 3 Second level of hierarchy
- 4 Third level of hierarchy and so on
- 5 Terminal characters (leaflets):
  - A. base [of leaf blade] (rounded, truncate, cuneate, cordate, sagittate);
  - B. apex (rounded, mucronate, acute, obtuse, acuminate, retuse);
  - C. margin (whole, dentate, serrate, crenate; degree of order);
  - D. surface (color, hairs etc.);
  - E. venation (apo-, hypho-, acro-, ptero-, actinodromous)



# Leaf

## Modifications of leaf



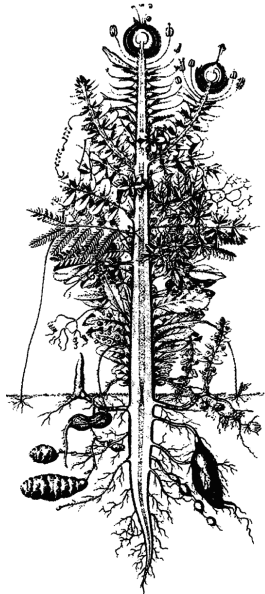
# Goethe's theory of modification



Famous German poet and writer Johann Wolfgang Goethe is also a founder of plant morphology. He invented an idea of “primary plant” (“Urpflanze”) where all organs were modifications of one primordial organ.



# Urpflanze (another interpretation)



# Leaf modifications

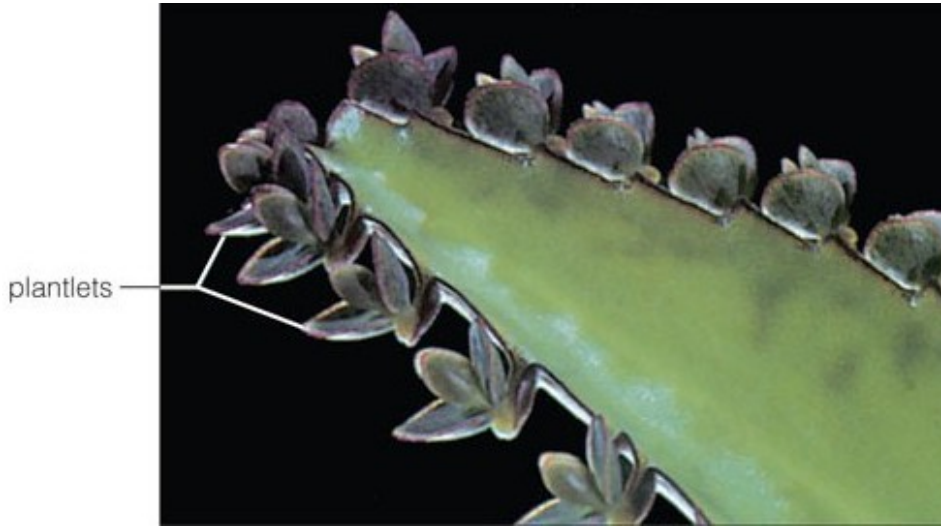
- Spines
- Tendrils
- Succulent leaves
- Traps
- Plantlets



# Tendrils of sweet pea (*Lathyrus odoratus*)



# Plantlets on the leaf of *Kalanchoe pinnata*



# Leaf of Venus flytrap (*Dionaea muscipula*)



Everything is possible when plant needs nitrogen!





*Venus flytrap in work*



# Urn leaf of yellow pitcher plant (*Sarracenia flava*)



# *Sarracenia flava* on Buttercup Fields, Mississippi



# Prey in the urn



# Urn leaf of purple pitcher plant (*Sarracenia purpurea*)



Hairs prevent insects from climbing out of leaf



# “Cobra Lily” (*Darlingtonia californica*)



# Sticky tape leaf of butterwort (*Pinguicula* sp.)



Leaf margins are slowly rolling



# Sticky tape/trap leaf of sundew (*Drosera intermedia*)



Leaves are constantly open and close and finally digest the glued insects





# Table of modifications

<i>Function</i>	Stem / shoot	Leaf	Root
Expansion		Plantlets	
Storage		Succulent leaves	
Photosynthesis		DEFAULT	
Defense		Spines, scales	
Support		Leaf tendrils	
Interactions		Traps, “sticky tapes”, urns	



# Leaf

## Anatomy of leaf

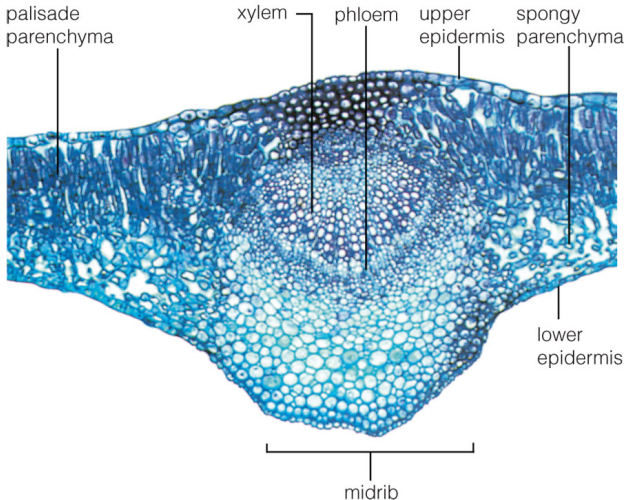


# General leaf anatomy

- Epidermis with stomata
- Mesophyll
- Vascular bundles, or veins



# Lilac (*Syringa vulgaris*) leaf in cross-section



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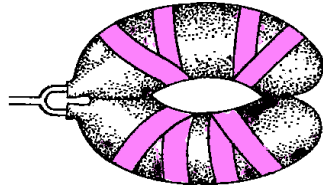
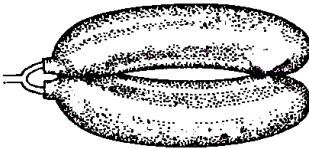
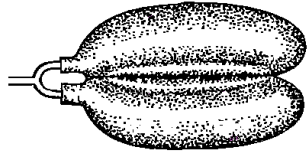
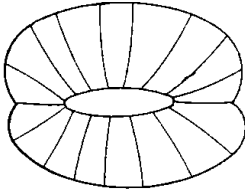


# Epidermis and stomata

- Covered with cuticle
- Include stomata with guard cells and (often) subsidiary cells and trichomes
- Opening of stomata is a result of exchange of  $K^+$ , osmosis and uneven cell wall
- Lower epidermis in most cases contain more stomata



# Stomata as balloons

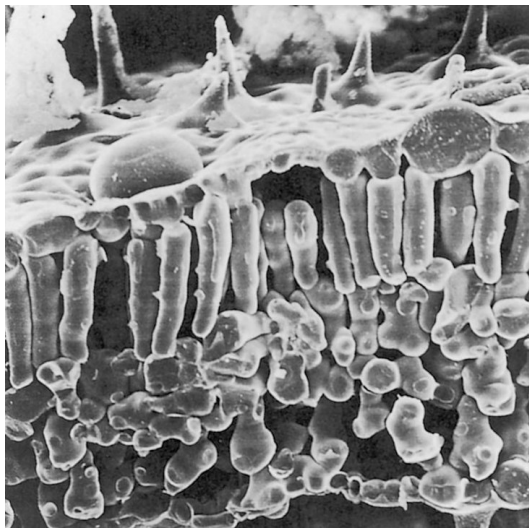


# Mesophyll

- Palisade mesophyll consists of tightly arranged elongated cells with less chloroplasts
- Spongy mesophyll consists of loosely attached cells rich of chloroplasts



# Palisade and spongy cells



palisade  
mesophyll

spongy  
mesophyll



# Final question (3 points)



# Final question (3 points)

Please draw the **entire** (not dissected), **ovate** leaf with **acute** apex, **cordate** base, **smooth** margin and **hypodromous** venation.



# Summary

- Internally, leaves are segregated into epidermis, mesophyll (parenchyma) and vascular bundles
- *Osmotic processes in guard cells* result in opening and closing of stomata
- The differentiation of mesophyll to **palisade** and **spongy** cells helps to acquire different types of sun rays
- Water deficit results in either sclerophyte or succulent adaptations
- Water excess results in hygrophyte or even hydrophyte adaptations



# For Further Reading



A. Shipunov.

*Introduction to Botany* [Electronic resource].

2010—onwards.

Mode of access:

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



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

*Plant Biology*. 2nd edition.

Thomson Brooks/Cole, 2006.

*Chapter 6.*

