

Introduction to Botany. Lecture 13

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Outline

- 1 Questions and answers
- 2 Morphology of stem and shoot
 - Phyllotaxis
 - Modifications of shoot
- 3 Life forms

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Previous final question: the answer

What is the difference between monopodial and sympodial branching?

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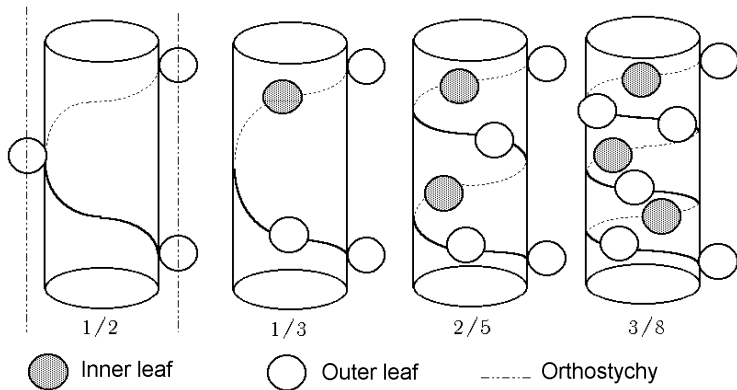
What is the difference between monopodial and sympodial branching?

- Degradation of terminal bud (in sympodial)
- Triangle-shaped crown (in monopodial)
etc.

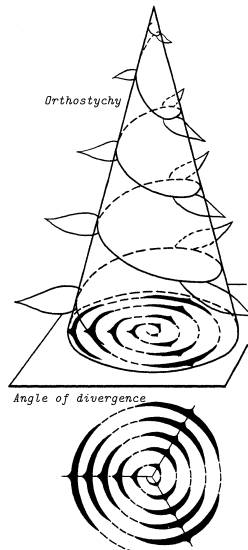
Spiral phyllotaxis: Fibonacci rule

- Multiple types of leaf spiral leaf arrangement mostly follow **Fibonacci rule**
- Formulas of leaf arrangements is very similar to Fibonacci fractions: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, *et cetera*
- Numerator is number of spiral circulations, denominator is number of leaves

Spiral phyllotaxis: orthostychy



Spiral phyllotaxis: angles of divergence for $1/3$



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” where all organs were modifications of one primordial organ.

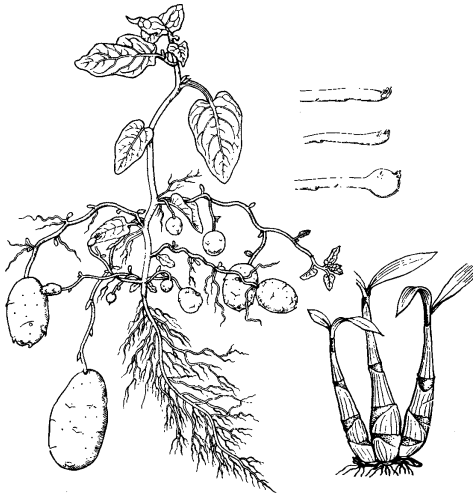
Modifications of shoots and stems

- **Rhizomes**: underground stems
- **Tubers**: enlarged portions of rhizomes
- **Bulbs**: storage shoots, leaves $> 50\%$ of mass
- **Corms**: storage shoots with minute leaves
- **Thorns**: defense shoots
- **Cladophylls**: leaf-like shoots
- **Stolons** (runners): aboveground horizontal shoots

Bulbs and corms



Tubers



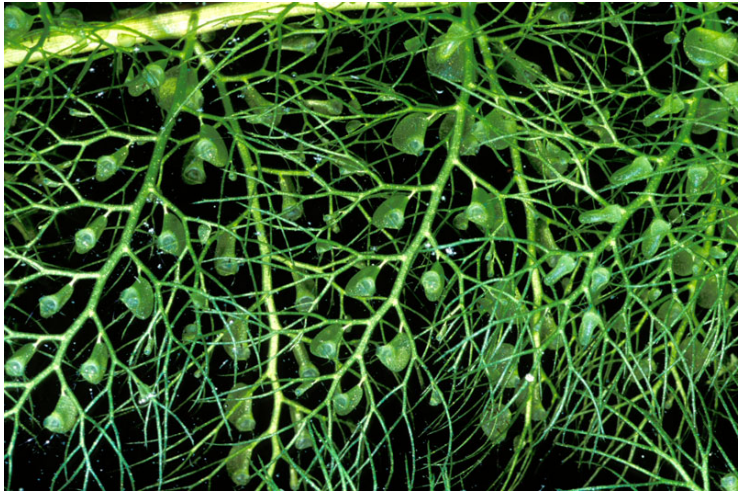
Thorns



Cladophylls



Traps of bladderwort (*Utricularia*)



External function and modifications

Each external function requires a specific modification of organ.

<i>Function</i>	Stem	Leaf	FU	Root
Anchoring	Rhizomes, stolons	...	...	DEFAULT
Storage	Bulbs, corms, tubers	...	...	Storage roots
Photosynthesis	Cladophylls	...	...	Green aerial roots
Defense	Thorns	...	...	Root spines
Support	DEFAULT	...	...	Aerial and contractile roots
Interactions	Traps (bladderwort)	...	...	Mycorrhizae, nodules

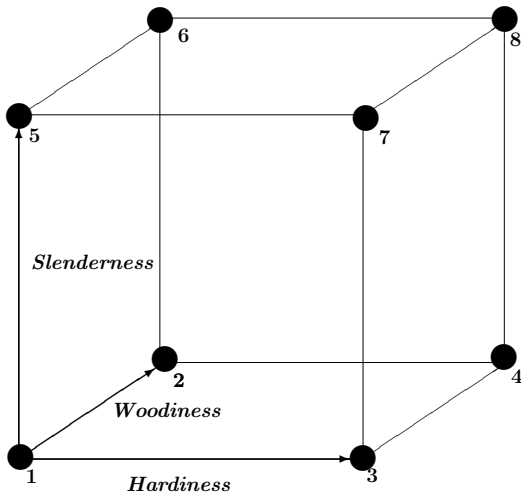
Life forms: ancient approach

- **Herbs:** soft stems
- **Shrubs:** multiple short-lived trunks
- **Trees:** one trunk

Life forms: dynamic approach

- **Hardiness:** sensitivity to all negative influence
- **Woodiness:** % of cells with secondary walls
- **Slenderness:** proportion of vertically ordered stems

Life form cube



Summary

- Spiral arrangement of leaves follows **Fibonacci** rule
- Storage, defense and underground growth result in extensive modification of shoot
- Life forms classifications are based primarily on characteristics of shoot

Final question (2 points)

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What are tubers?
(give a short definition)

For Further Reading



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 6.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 5.