

Introduction to Botany. Lecture 36

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1 Questions and answers

2 Magnoliopsida

- Flower transformations
- Inflorescences
- Seeds
- Fruits

1 Questions and answers

2 Magnoliopsida

- Flower transformations
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- Fruits



Previous final question: the answer

What is a flower?



Previous final question: the answer

What is a flower?

- FU with sterile, male and female zones



Magnoliopsida

Flower transformations

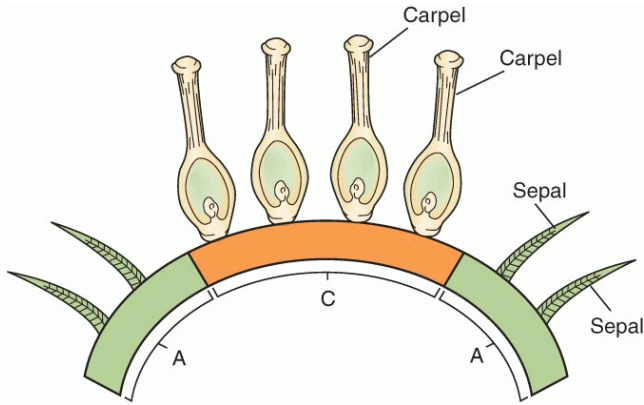


ABC-genes

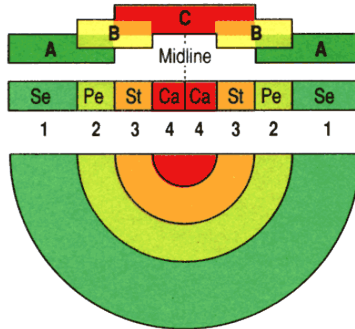
- There are 3 classes of genes expressed in overlapping, concentric rings.
- The A class (like *apetala2* gene) is expressed in the outermost ring and C (like *agamous*) is expressed in the center; B (e.g., *apetala3*) is expressed at the boundary of A and C.
- If A is expressed in a cell, it goes on to form a sepal.
- If C is turned on, it forms a carpel.
- Petals are formed where both B + A are active.
- Stamens are formed with the combination B + C.



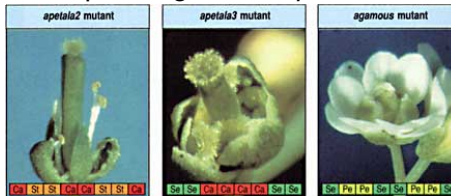
A and C genes “make” sepals and pistils



B genes “transform” them into petals and stamens



Corresponding *Arabidopsis* mutants:



Directions of flower evolution

- Fixation: from indefinite to definite
- Connation
- Reduction
- Differentiation



Magnoliopsida

Inflorescences



Inflorescence in general

- Isolated generative shoot bearing flowers
- Open and closed
- Bracteolate and non-bracteolate
- Transformations are similar to flower, plus *aggregation* and *formation of bracts*
- Sometimes flowers and inflorescences are hard to distinguish, these structures are **non-flowers**





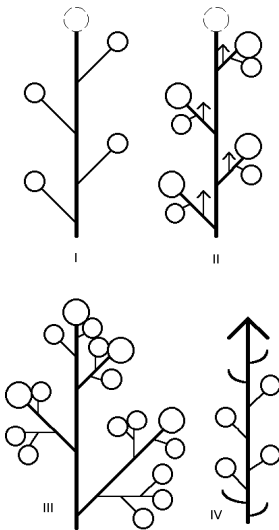
Trithuria non-flowers: one stamen (reduced staminate flower?)
surrounded by multiple pistils (reduced pistillate flowers?)

Types of inflorescences

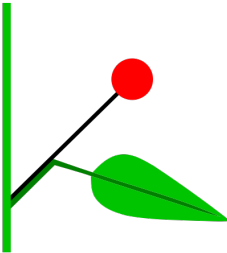
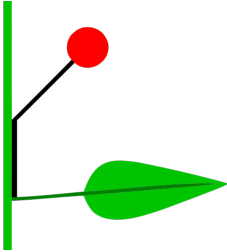
- Model I. Raceme and its derivatives
 - Simple: raceme (developed main axis, developed lateral axes: 11), spike/catkin (developed main axes, reduced lateral axes: 10), umbel (01), head (00)
 - Compound: compound raceme (11/11), compound umbel (01/01) etc.
- Model II. Thyrsus and its derivatives
 - Reduced (cymes): dichasium, cincinnus (scorpioid inflorescence) etc.
 - Thyrses in a strict sense
- Model III. Closed panicle (also umbel-like panicles)
- Model IV. Intercalary inflorescences



Models of inflorescences



Metatopy: concaulescence and recaulescence



Magnoliopsida

Seeds



Definition

- “Mature ovule”
- Chimeric organ consists of seed coat, endosperm and embryo



Origin of seed layers

Layer	Ploidy	Origin
Seed coat	$2n$	Integument of ovule
Endosperm ₂	$3n$, sometimes $2n$	Fertilized central cell of embryo sac
Embryo	$2n$	Fertilized egg
Endosperm ₁	n	Female gametophyte (gymnosperms!)
Perisperm	$2n$	Nucellus of ovule

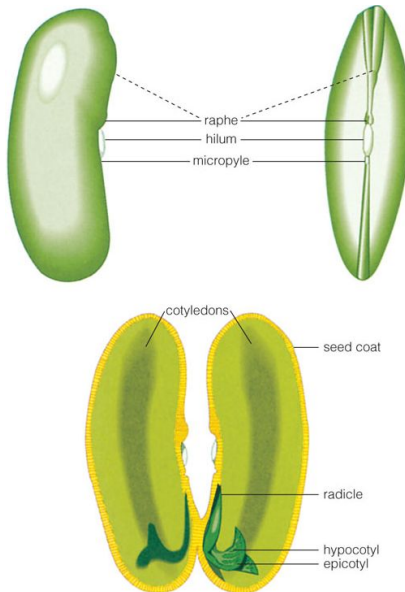


Seed structure variations

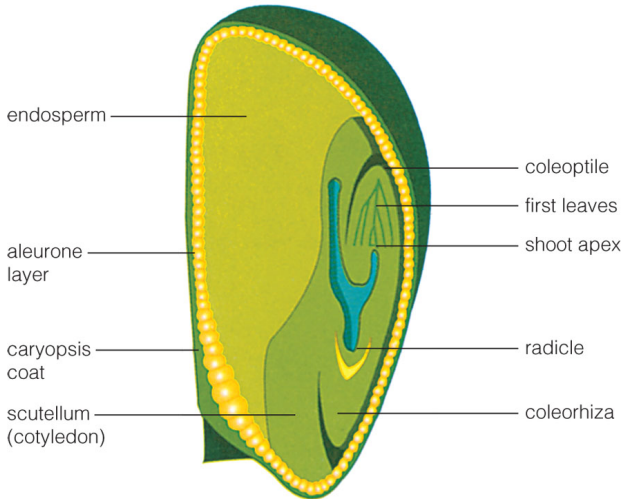
- Seed with endosperm (onion): cotyledon, radicle, apex
- Seed without endosperm (beans and other Leguminosae): cotyledons, radicle, hilum, raphe
- Grass (Gramineae) seeds: coleoptile, coleorhiza, scutellum



Bean seed



Grass seeds



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Cotyledons

- Monocots have lateral bud and terminal primary leaf (cotyledon)
- Other seed plants have terminal bud and multiple (2 to many) primary leaves (cotyledons)



Pinus sp.: multiple cotyledons

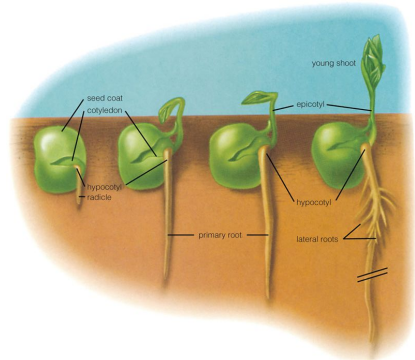
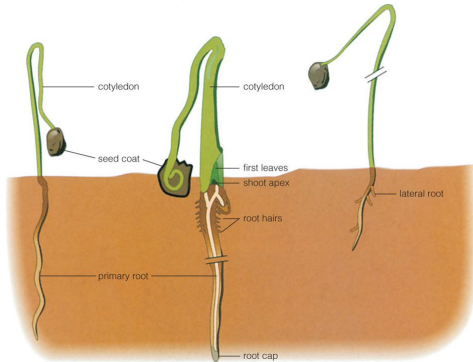


Germination

- Epigeal (e.g., onion, pea)
- Hypogeal (e.g., bean, grasses, palms)



Epigeal *versus* hypogeal germination



Magnoliopsida

Fruits



Definition and origin

- **Fruit** is a ripened ovary, flower or inflorescence
- Fruit coat and pericarp (exocarp + mesocarp + endocarp) origin mostly from pistil wall



Trivial classification: criteria

- Simple, multiple (aggregate) or compound
- Dry or fleshy
- Dehiscent, indehiscent or schizocarpic



Multiple fruit of *Fragaria* sp. (strawberry)



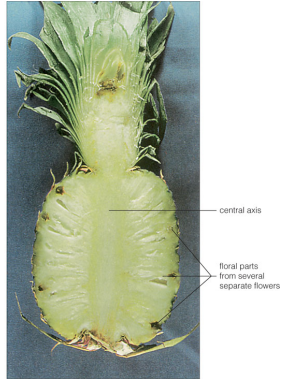
Multiple fruit of *Rubus* sp. (raspberry)



Compound fruit of *Ananas comosus* (pineapple)



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Compound fruit of *Ficus carica* (fig tree)



Schizocarp of *Zizia*

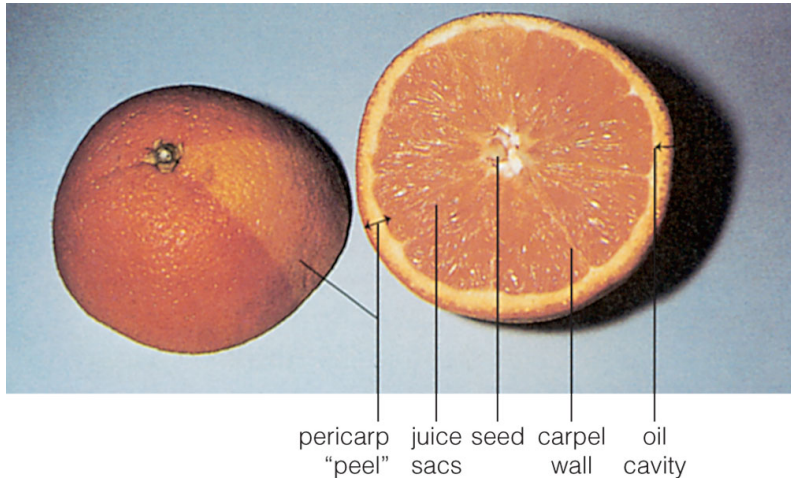


Trivial classification: examples

Type	Consistency	Opening	Example
Simple	Fleshy	Indehiscent	Drupe, Berry, Hesperidium, Pome
Simple	Dry	Dehiscent	Legume (pod), Capsule, Silique
Simple	Dry	Schizocarpic	Regma, Samara, Shizocarp
Simple	Dry	Indehiscent	Caryopsis (grain), Nut (incl. acorn), Achene
Multiple	Fleshy	Indehiscent	Multiple drupe
Multiple	Dry	Dehiscent	Follicle
Multiple	Dry	Indehiscent	Multiple nut
Compound	Fleshy	Indehiscent	Compound berry
Compound	Dry	Indehiscent	Compound nut



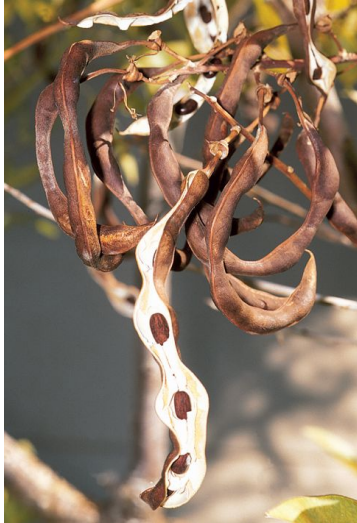
Simple, fleshy, indehiscent: **hesperidium** of *Citrus*



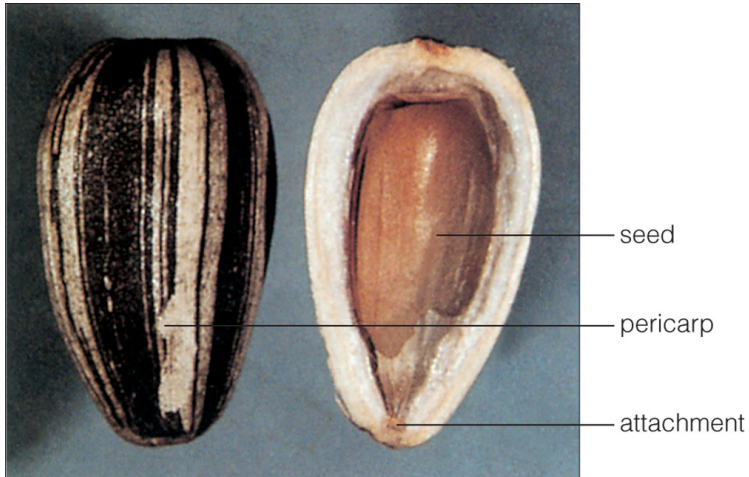
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Simple, dry, dehiscent: **legume** of *Erythrina*



Simple, dry, indehiscent: **achene** of *Helianthus*



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Final question (3 points)



Final question (3 points)

Why sporophytes are better than gametophytes?



Summary

- **ABC-genes** determine the fate of cells which are forming flower
- **Inflorescence** is an isolated generative shoot bearing flowers
- **Seed** is a chimeric organ consists of seed coat, endosperm and embryo
- **Fruit** is a ripened ovary, flower or inflorescence



For Further Reading



J. E. Bidlack, Sh. H. Jansky.

Stern's introductory plant biology. 12th edition.

McGraw-Hill, 2011.

Chapters 8 and 23.



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

Plant Biology. 2nd edition.

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Chapters 13, 14 and 25.

