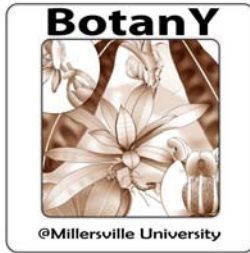


## Topic 13



## Angiosperms

Reading:  
Chapter 8: Flowers, Fruits and Seeds (pp. 125-139)  
Chapter 23: Angiosperms (pp. 433-445, plus Figure 23.18 on pp. 446-447)

Hartley, 2012. *Parkia* 2: 6-7. @ <http://herbarium.millersville.edu>

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### I. Characteristics of Angiosperms



- A. Vessels & Fibers in the wood
- B. Sieve tubes
- C. Flowers
- D. Angiospermous: carpels (megasporophylls) & fruits
- E. Endosperm (& Double Fertilization)

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### I. Characteristics of Angiosperms



- A. Vessels & Fibers in the wood
- B. Sieve tubes
- C. Flowers
- D. Angiospermous: carpels & fruits
- E. Endosperm (& Double Fertilization)

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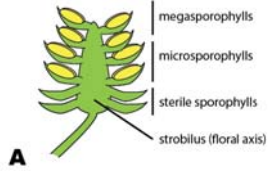
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I. Characteristics of Angiosperms

C. Flowers

1. Strobilus origin



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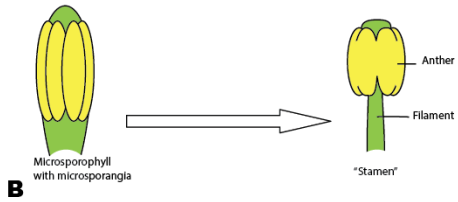
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I. Characteristics of Angiosperms

C. Flowers

1. Strobilus origin



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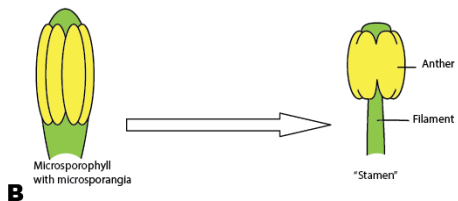
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I. Characteristics of Angiosperms

C. Flowers

1. Strobilus origin



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I. Characteristics of Angiosperms

C. Flowers

1. Strobilus origin

BotanY

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I. Characteristics of Angiosperms

C. Flowers

1. Strobilus origin

BotanY

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I. Characteristics of Angiosperms

C. Flowers

2. 4 Organ classes

a. Sterile classes (collectively part of the perianth)

BotanY

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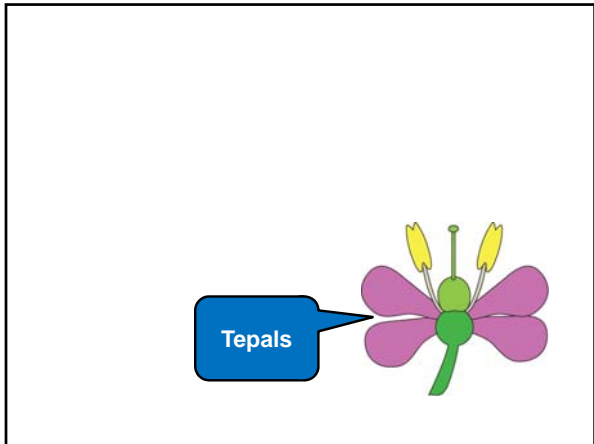
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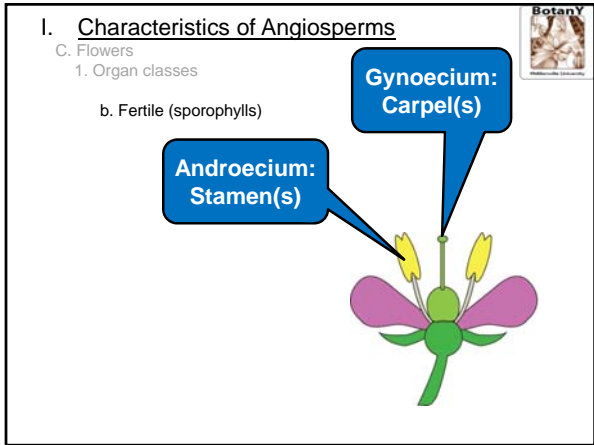
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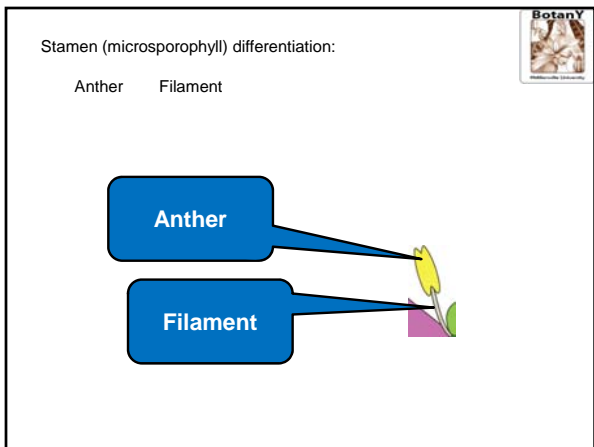
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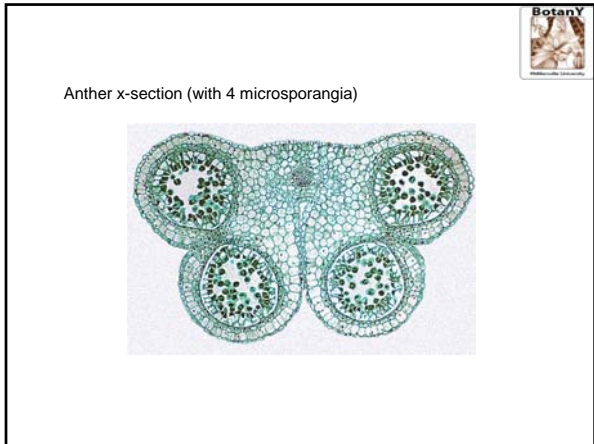
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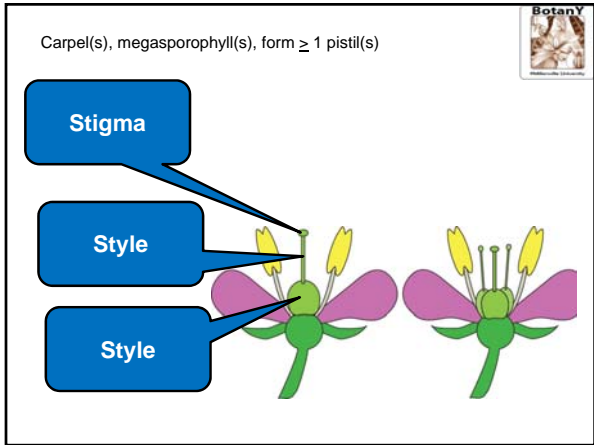
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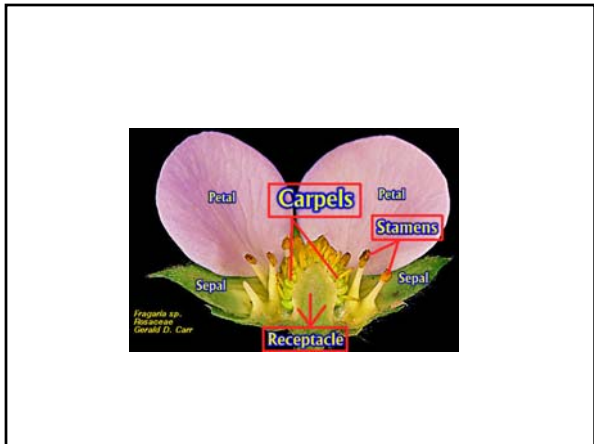
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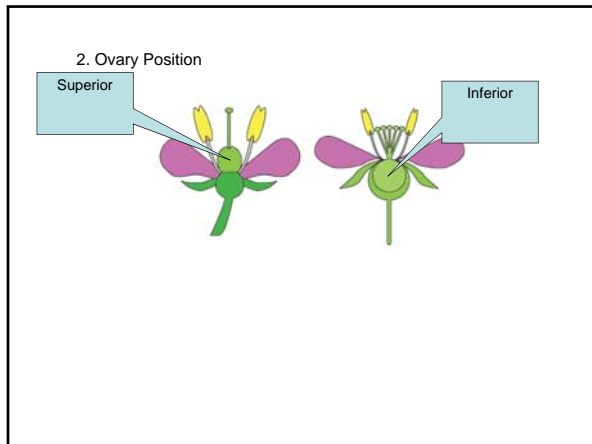
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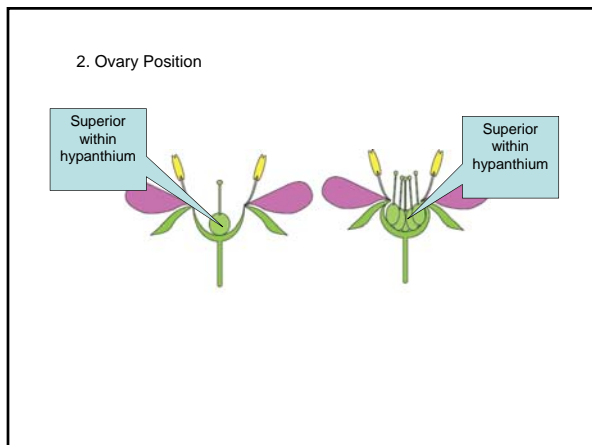
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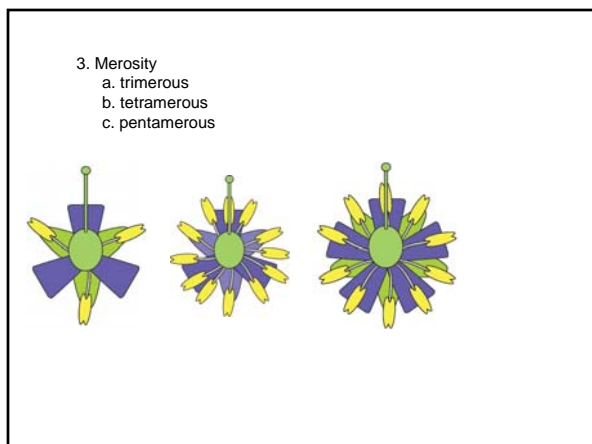
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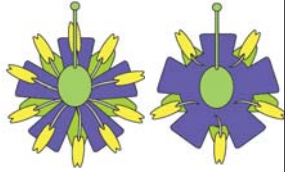


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4. Fusion  
a. Connation  
b. Adnation



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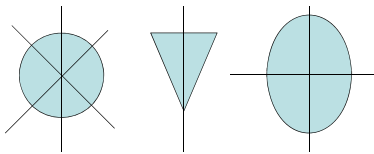
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5. Symmetry



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### D. Angiospermy

1. Fruit from ovary, seeds from ovules.



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## D. Angiospermy

1. Fruit from ovary, seeds from ovules.



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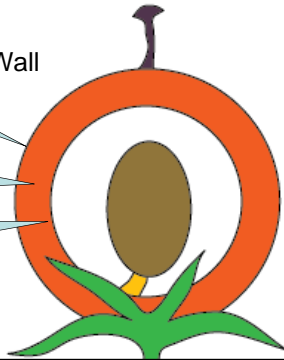
## D. Angiosperm:

2. Pericarp = Fruit Wall

Exocarp

Mesocarp

Endocarp



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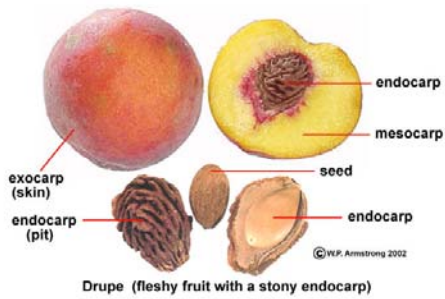
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2. Pericarp



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D. Angiospermy

3. Simple, Aggregate, vs. Multiple



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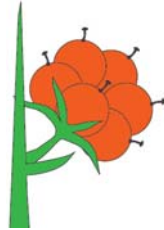
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D. Angiospermy

3. Simple, Aggregate, vs. Multiple



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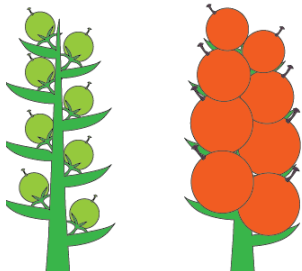
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D. Angiospermy

3. Simple, Aggregate, vs. Multiple



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3. Simple, Aggregate, vs. Multiple

Tomato = berry



Tomato (Potato Family)

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3. Simple, Aggregate, vs. Multiple

Citrus fruit =  
hesperidium



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3. Simple, Aggregate, vs. Multiple

Blueberry =  
Berry from  
inferior ovary



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3. Simple, Aggregate, vs. Multiple



Raspberry = aggregate of drupelets.

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3. Simple, Aggregate, vs. Multiple



Morinda or Noni (Coffee Family)

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Pineapple (Bromeliad Family)  
Simple, Aggregate, or Multiple Fruit?

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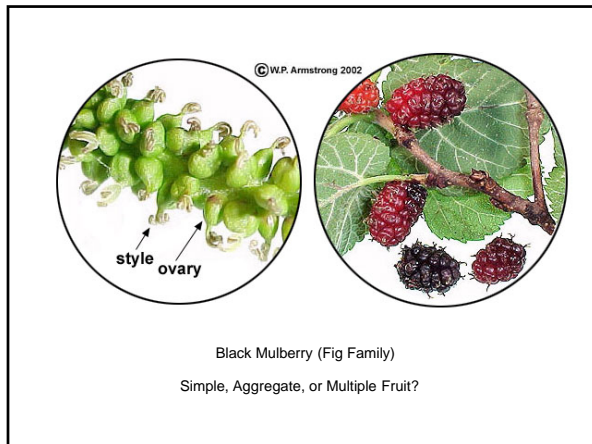
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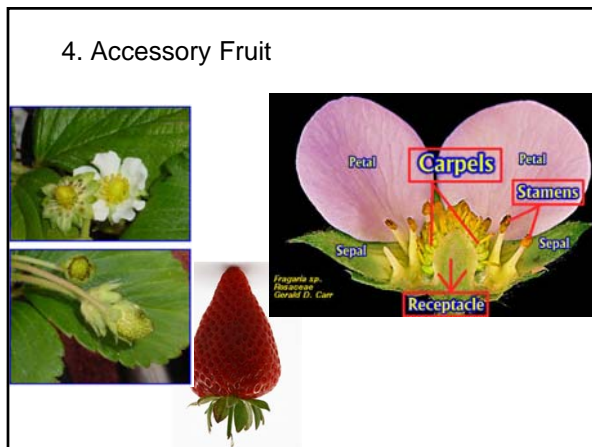
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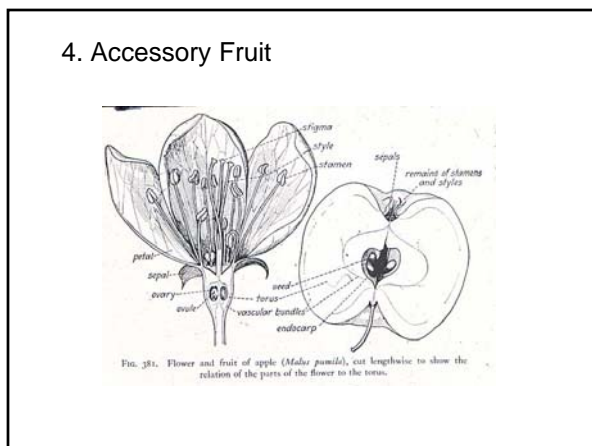
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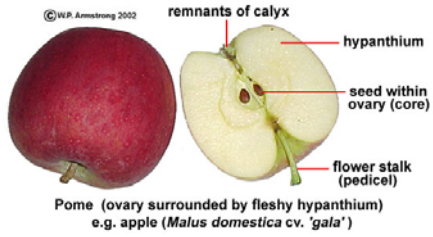
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#### 4. Accessory Fruit



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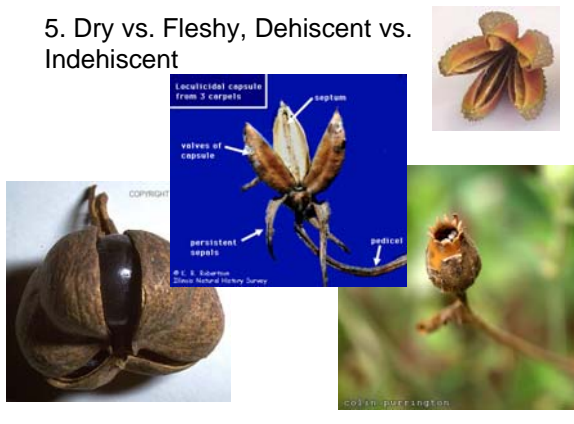
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#### 5. Dry vs. Fleshy, Dehiscent vs. Indehiscent



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#### 5. Dry vs. Fleshy, Dehiscent vs. Indehiscent



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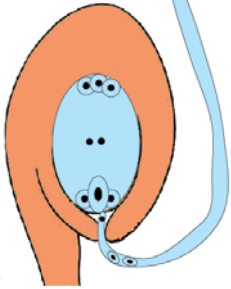
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## D. Double "Fertilization"



1. Zygote ( $2n$ )
2. Endosperm ( $3n$ )

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## II. Pollination

### A. Bee Pollination

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- Blue and/or yellow
- open (or short tubular)
- nectar and/or pollen as reward



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II. Pollination  
B. Bird Pollination

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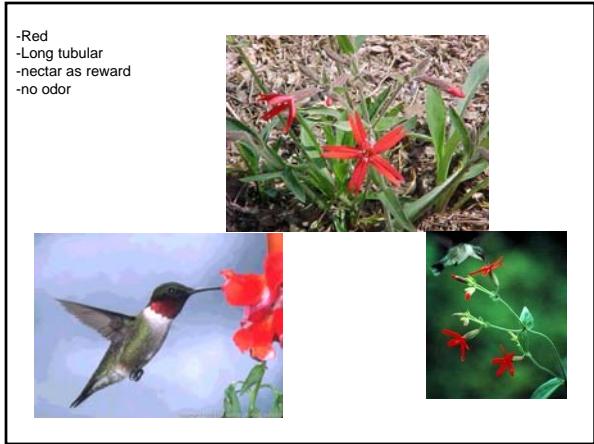
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II. Pollination  
C. Bat Pollination

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## II. Pollination

### D. Wind Pollination

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- Perianth highly reduced, green or otherwise inconspicuous.
- stamens and stigmas exerted
- Nectarless
- No reward
- No odor



The flowers of grasses are located at the top of the plant where they are exposed to the wind.



The anthers and feathery stigmas of grasses hang out of the flowers where they can be blown by the wind. Petals are absent.

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*Acer saccharum* (sugar maple) - The anthers as well as the flower itself hang down where they can be blown by the wind. The flower has no petals.



*Acer saccharum* (sugar maple) - The flowers of *A. saccharum* as well as many other wind-pollinated trees appear in the early spring when leaves are not yet present to interfere with pollen movement.

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**Wind-pollinated flowers**

In general, wind-pollinated flowers are green, small, and often lack petals. The anthers and stigmas generally hang outside the flowers to allow the wind to carry the pollen.



*Juglans nigra* (black walnut) - Male flowers are arranged in catkins which hang down to be blown by the wind.



*Juglans nigra* (black walnut) - Female flowers are green, with no petals or sepals to attract pollinators. The stigmas are relatively large to catch pollen.

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## II. Pollination

### E. Deceptive Pollination

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#### 1. Sexual Deception in Some Orchids

Reward: **Nothing.**

Flower Form: **Lower tepal ("labellum") mimics female bee in color, texture, & phermones.**

Pollinator Behavior: **Male bees attempt to mate with labellum.**

Research Underway: Dr. Florian Schiestl (Institute for Systematic Botany, University of Zurich)

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2. Carrion flowers

Reward: **Nothing.**

Flower Form: **Petals, inflorescence, or spathe mimics rotting flesh in color, texture, & odor.**

Pollinator Behavior: **Flies, beetles lay eggs on flower thinking it is larval food.**

Research Underway: Dr. Denis Barabe' (Montreal Botanical Garden, Univ. of Montreal).

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In Aroids: e.g., *Amorphophallus*  
(aka titan arum, dead-horse-lily)



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In Aroids: e.g., *Dranunculus*



*Dranunculus vulgaris* - The "flower" consists of a purple leafy bract ("spathe") that wraps around the inflorescence.

*Dranunculus vulgaris* - The actual flowers are tiny and located on the cylindrical "spadix" inside the spathe. Here you see beetles that have been attracted to the rotten smell. In attempting to locate the dead flesh, they have been coated with pollen from the flowers.

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*Symplocarpus*  
(skunk-cabbage)

*Arisaema*  
(Jack-in-the-pulpit)



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## PARKSIA

Dedicated to the dissemination of useful information regarding plants

@ <http://herbarium.millersville.edu>

### SKUNK-CABBAGE: A HOMEOTHERMIC PLANT IN THE PENNSYLVANIA FLORA

NATHAN P. HARTLEY

James C. Parks Herbarium, Biology Department, Millersville University of Pennsylvania, PO Box 1002, Millersville, Pennsylvania, 17551, United States of America

Thermogenesis in plants is a rare phenomenon in which a plant actively works to

woods, marshes and stream sides (Fig. 1). Skunk-cabbage is unusual among thermogenic plants in

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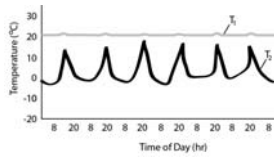


Fig. 1. A skunk-cabbage plant (*Symplocarpus foetidus*). Photo from the Public Domain. [This and other images are in color on the Web version of this article.]

Eastern skunk-cabbage, *Symplocarpus foetidus* (Araceae), is a perennial forb native to eastern North America and is found in wet



Fig. 2. A skunk-cabbage inflorescence. The spadix is concealed by the carrion-colored spathe. Photo © Sue Sweeney.



a relatively constant, high temperature that may be optimal for its unseasonably early pollen and ovule development which, in turn, can determine

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### III. Angiosperm Diversity

A. Primitive Dicots

B. Monocots

C. Eudicots

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### III. Angiosperm Diversity

	Primitive Dicots	Monocots	Eudicots
Cotyledon Number	2	1	2
Stele	Eustele	Atactostele	Eustele
Leaf Venation	Reticulate (pinnate or palmate)	Parallel	Reticulate (pinnate or palmate)
Flw. Merosity	Many, 3's	3's	4's and 5's
Whorlar Differentiation	Poor	Poor to Good	Good
Pollen Apertures	1	1	3

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**Primitive Dicotyledons**  
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Magnolia Family

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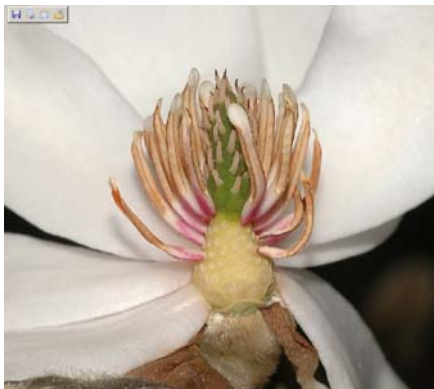
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*Magnolia*




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*Liriodendron*



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*Liriodendron*



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**Primitive Dicotyledons**

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Star Anise Family

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Star anise (*Illicium*; SW China)



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**Primitive Dicotyledons**

Water Lily Family

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*Nymphaea*



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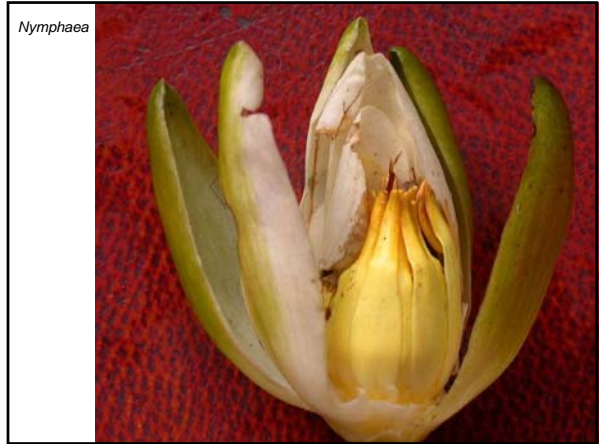
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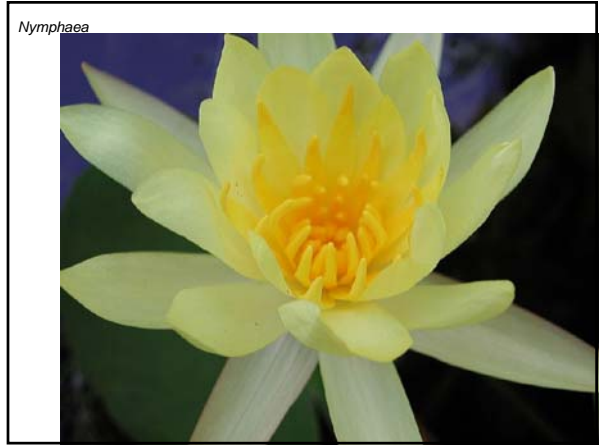
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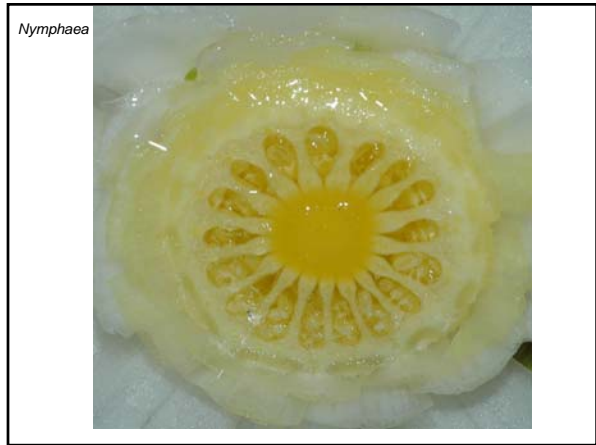
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Victoria



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Victoria



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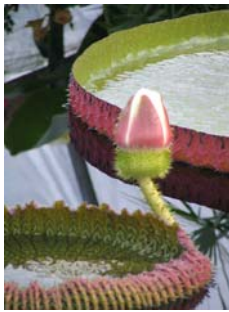
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Victoria



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Victoria



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**Monocotyledons**  
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**Monocotyledons**  
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Water-Plantain Family

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**Monocotyledons**  
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Lily Family

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Asparagus



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**Monocotyledons**

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Grass Family

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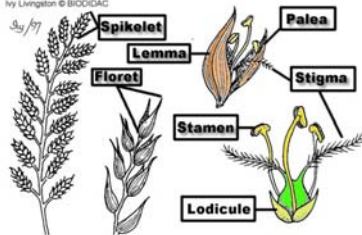
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by Livingston © BIODIDAC

3/1/17



Grass spikelets and flowers

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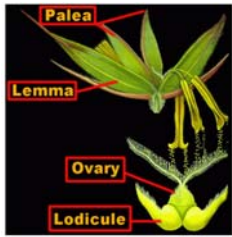
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Grass family



Grass spikelets and flowers

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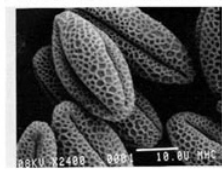
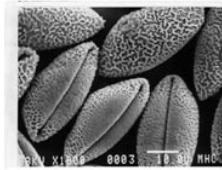
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Eudicotyledons



Mono- vs. Tri-aperturate Pollen

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Eudicotyledons

Rose Family

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Blackberries (*Rubus*)



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Roses (*Rosa*)



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Roses (*Rosa*)



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**Eudicotyledons**

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Legume Family

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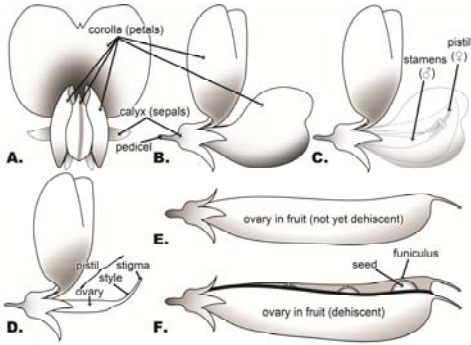
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Legume Family (see Legumes / Seeds lab)



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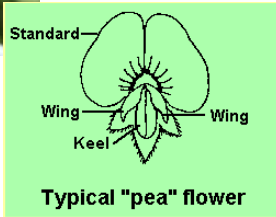
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Legume Family



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**Eudicotyledons**  
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Blueberry & Rhododendron Family

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Blueberry family (e.g., *Vaccinium*)



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**Eudicotyledons**  
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Sunflower Family

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Sunflower family (e.g., *Helianthus*)



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