

Evolution of the Flowering Plants

Based on Michael G. Simpson

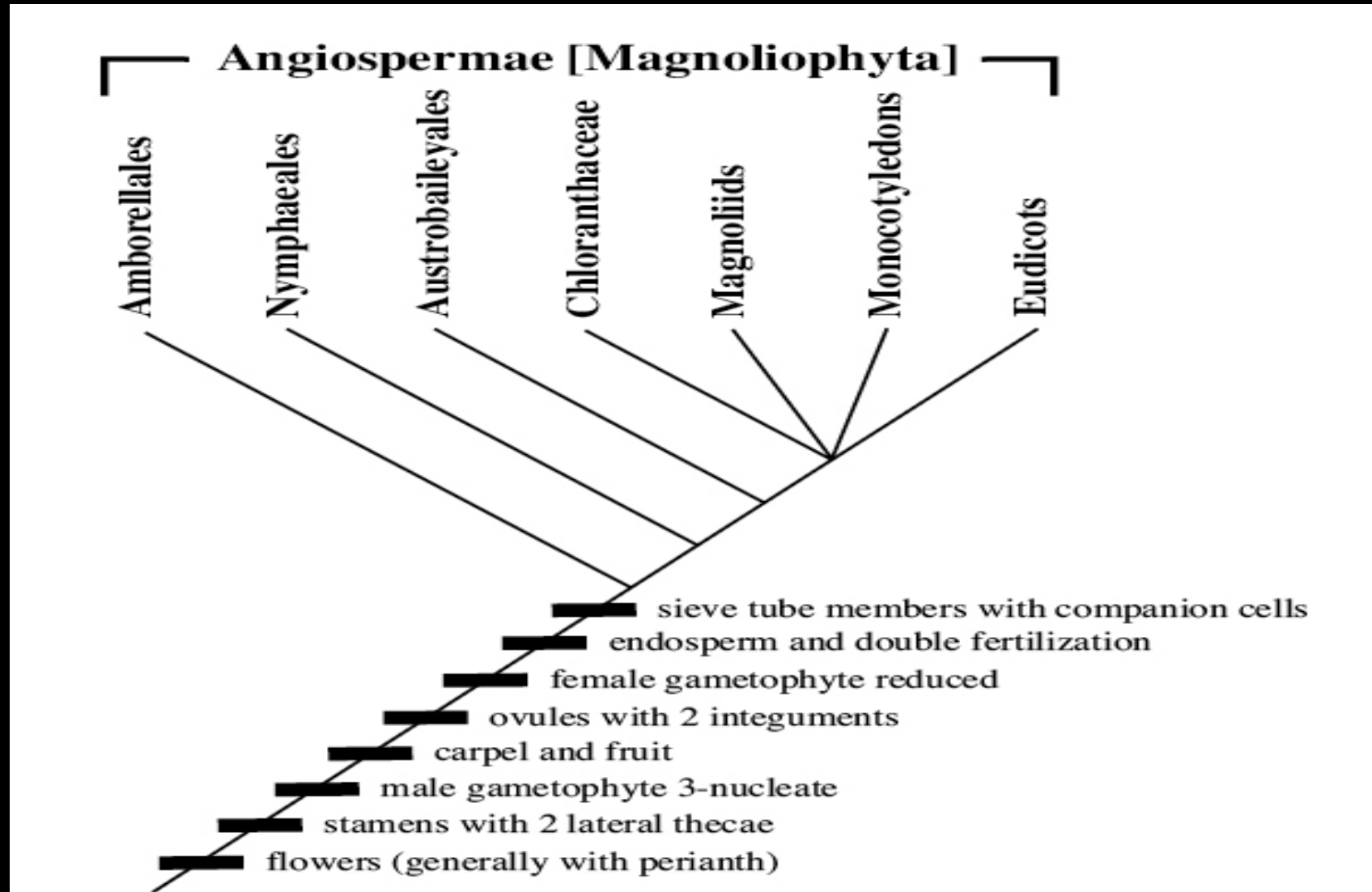
III MSc Botany

Dr Giby Kuriakose

Another name for the flowering plants?

Angiospermae / Magnoliophyta / angiosperms

2. Name the apomorphies of the flowering plants.



definition of a flower?

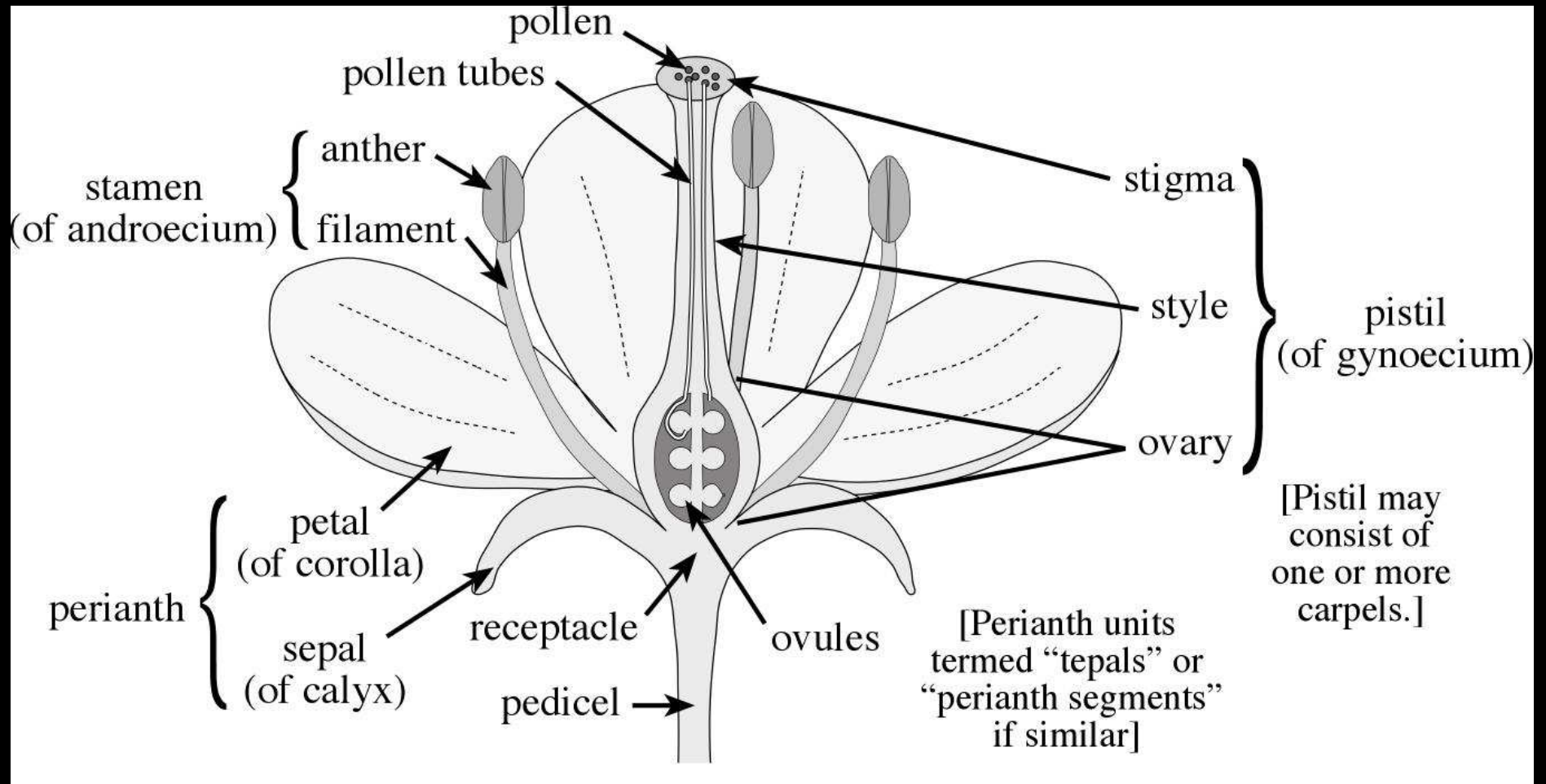
Flower: a determinate reproductive shoot bearing carpels &/or stamens

Petals

Tepals

- Flower development and arrangement is as that of leaves!
- Sepal primordial
- Petal primordial
- Stamen primordial
- Carpel primordial

4. Name the major components of a typical flower.



Morphology and adaptive significance of the
perianth.

Perianth

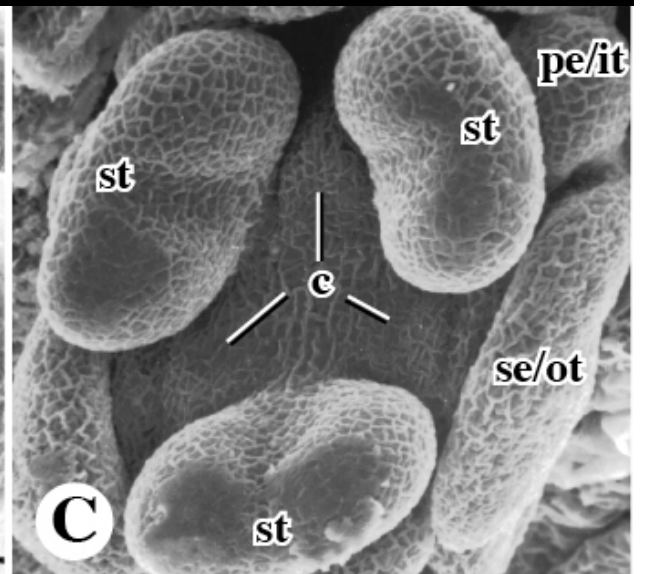
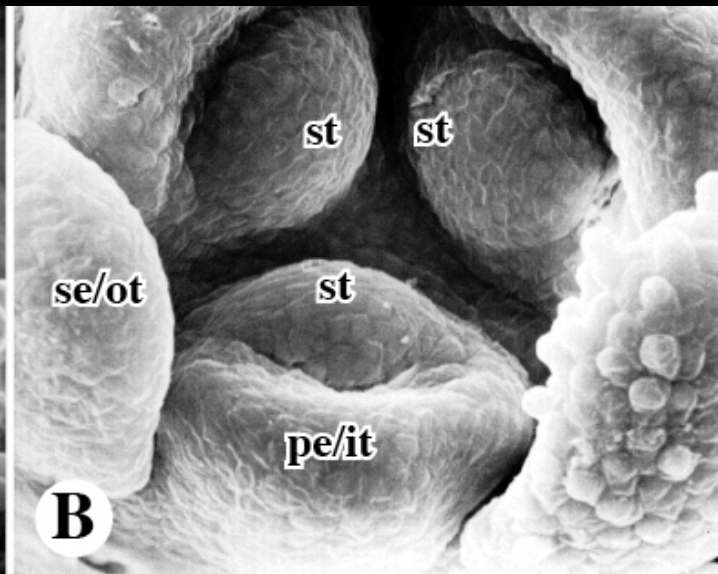
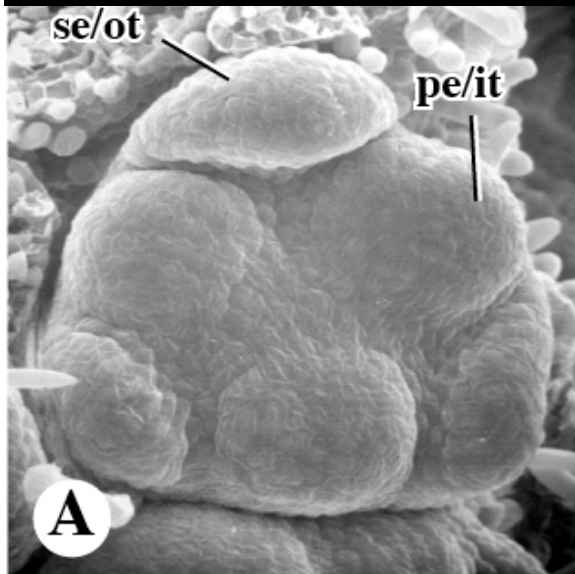
Adaptation: Attractant for pollinator



Whorled:
dichlamydeous

Whorled:
homochlamydeous

Spiral

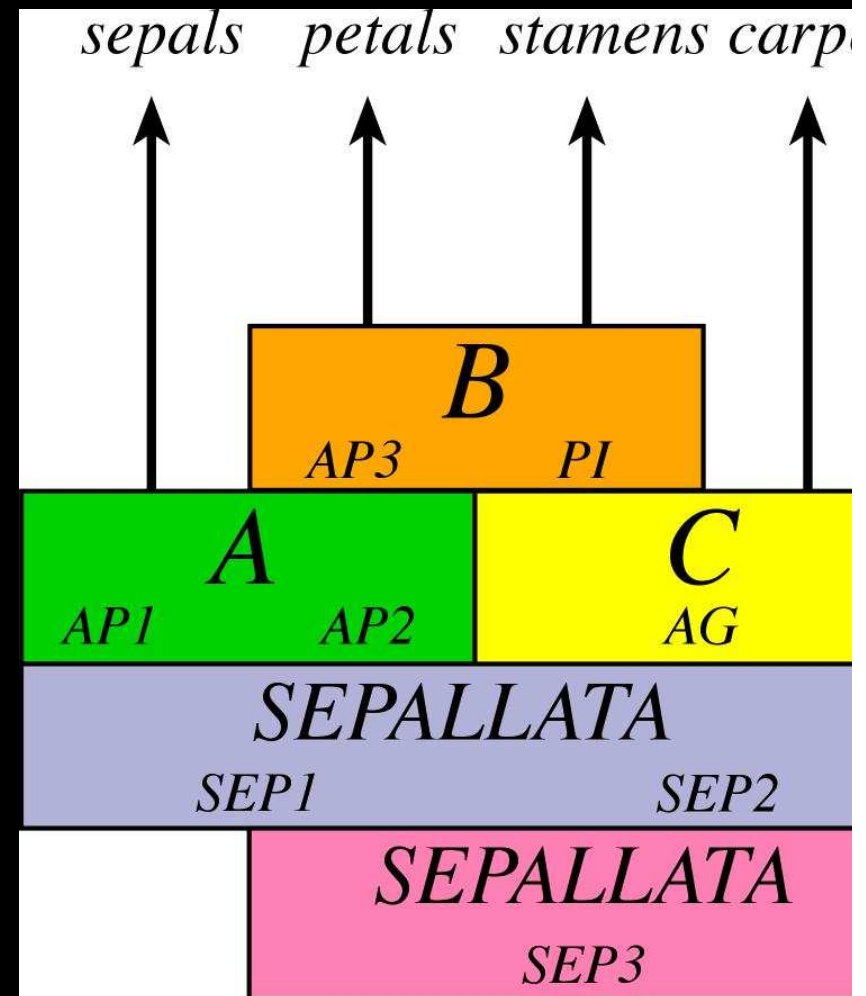


- Evolution of floral whorls are thought to be homologous to leaves (Goethe, 1790)

"ABC" model of floral development, and
what species served as the original exemplar
for this?

ABC Model (fr. *Arabidopsis thaliana*)

Genes produce
transcription factors
at 4 proper locations of the
flower:
induce expression
of genes that
induce organ
Formation/development



- Flower that is typically showy and often scented perianth (sepal and petal) are evolved in response to selective pressure to attract animal pollinators
- Animal pollination – primitive
- Wind pollination –gymnosperms
- Various precious pollination mechanisms in angiosperms develops variation in floral forms

Major selective pressure that resulted in the evolution of specialized types of flowers?

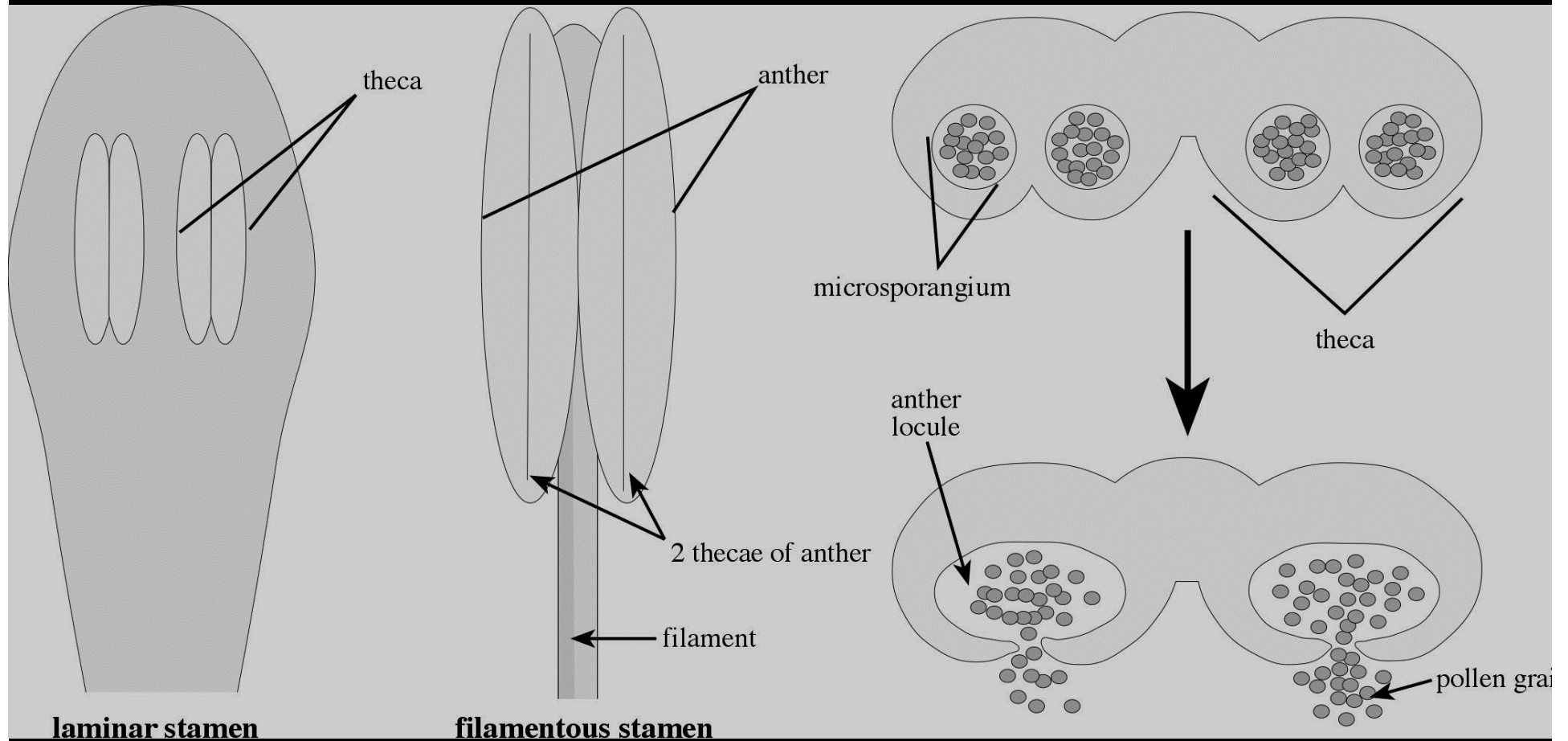
Specializations largely driven by **pollination**

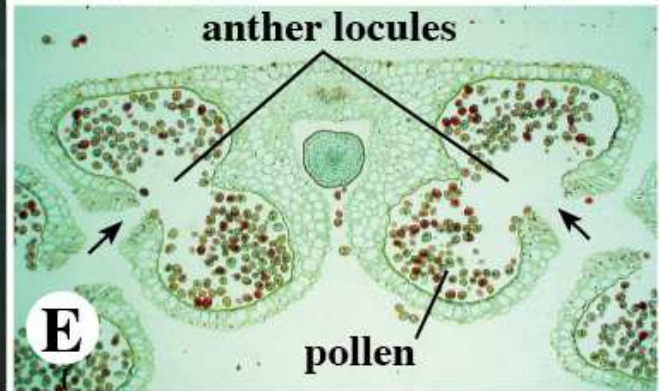
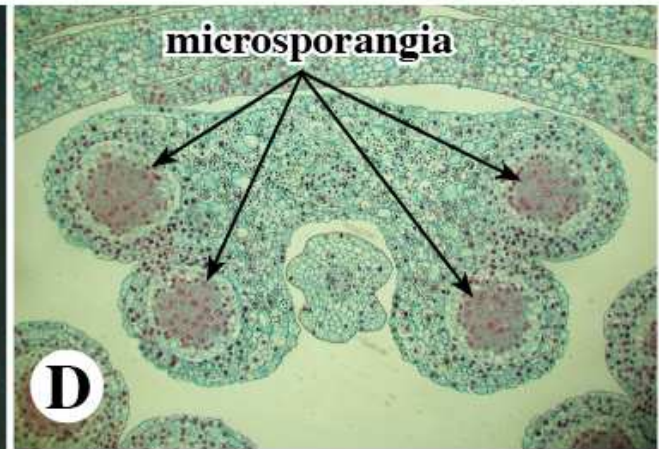
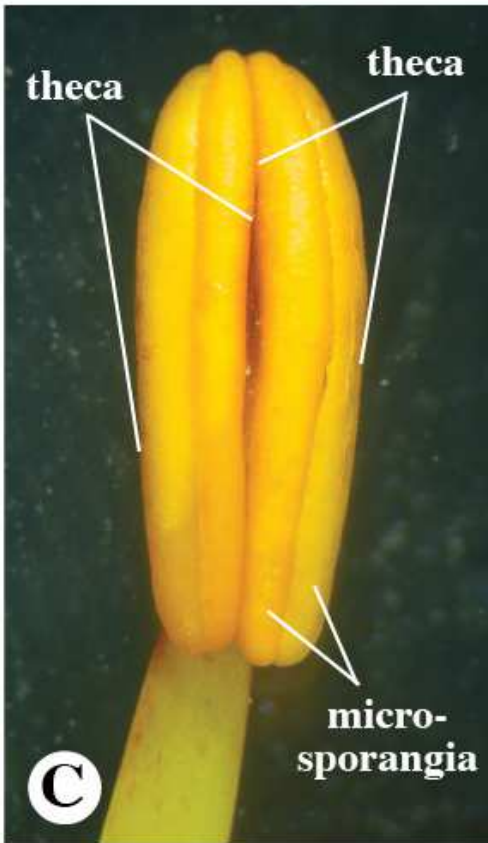
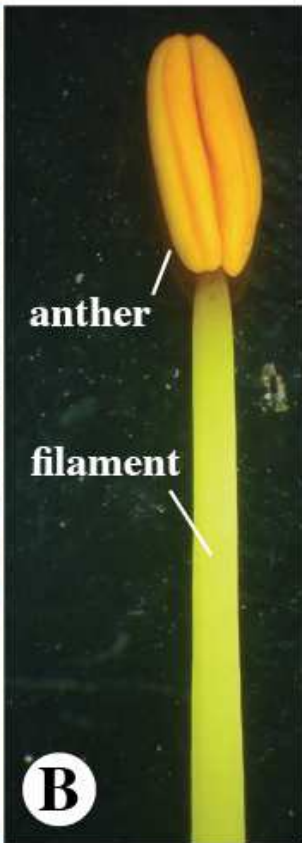


What is unique about the angiosperm stamen,
and what are the types and parts of a stamen?

What is a theca and of what is it composed?

Stamen: 2 thecae, each with 2 microsporangia

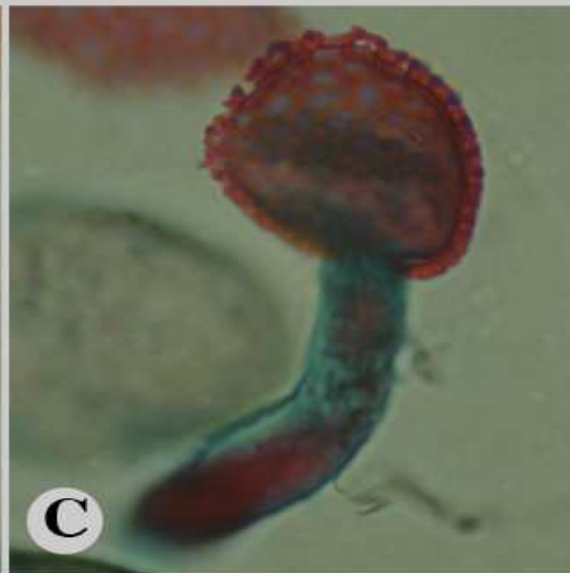
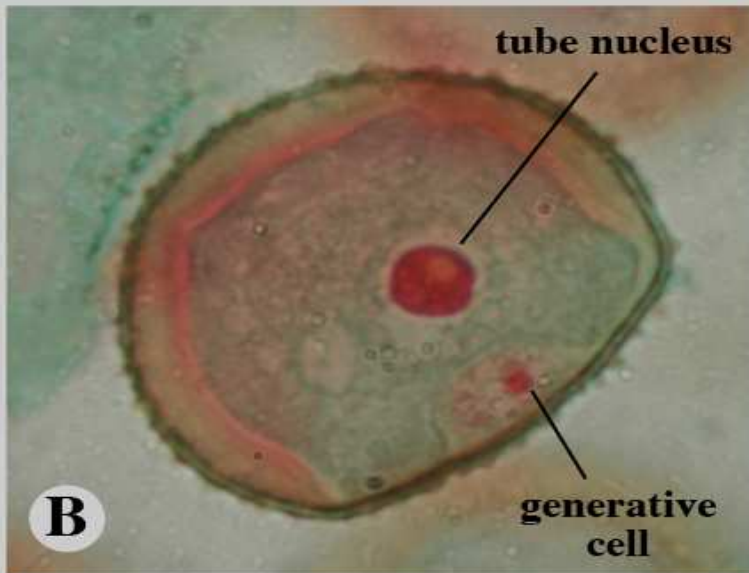
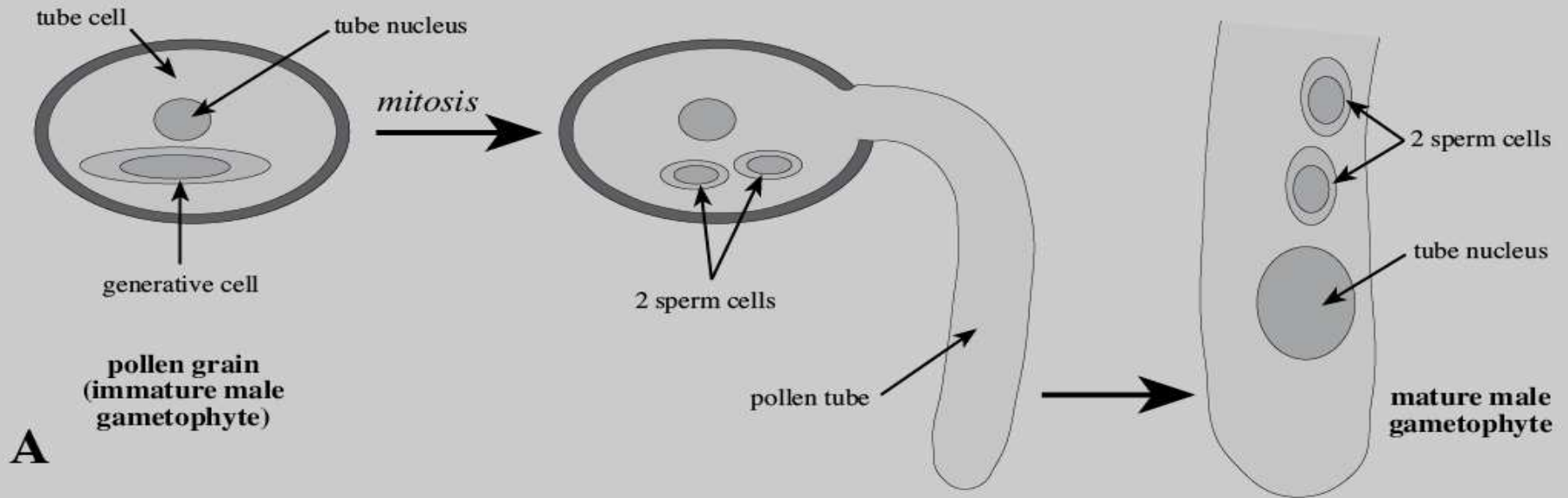




What about the male gametophyte of flowering plants is unique?

Describe the structure and function of a mature male gametophyte in the flowering plants.

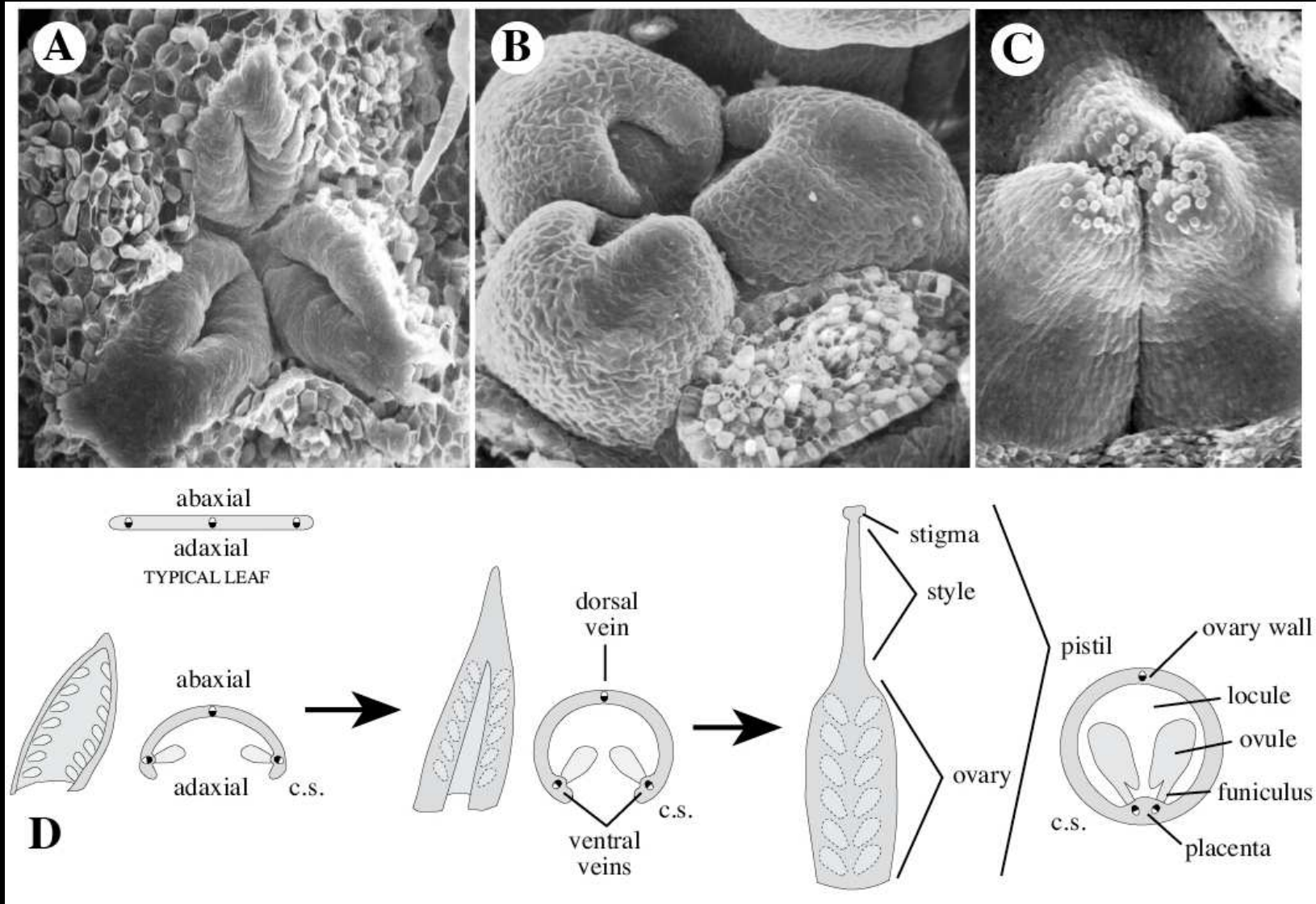
Reduced (3-celled) male gametophyte



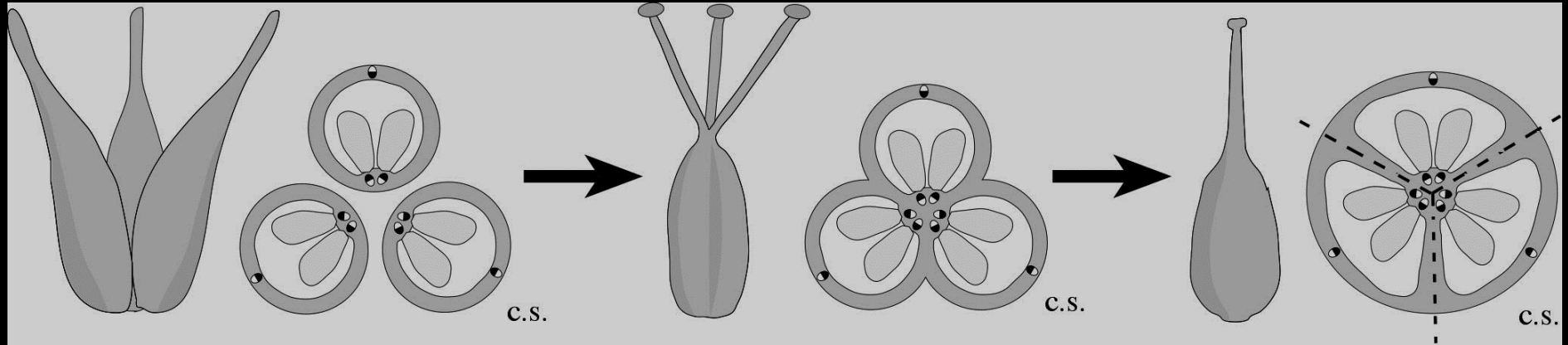
What is the definition of a carpel?

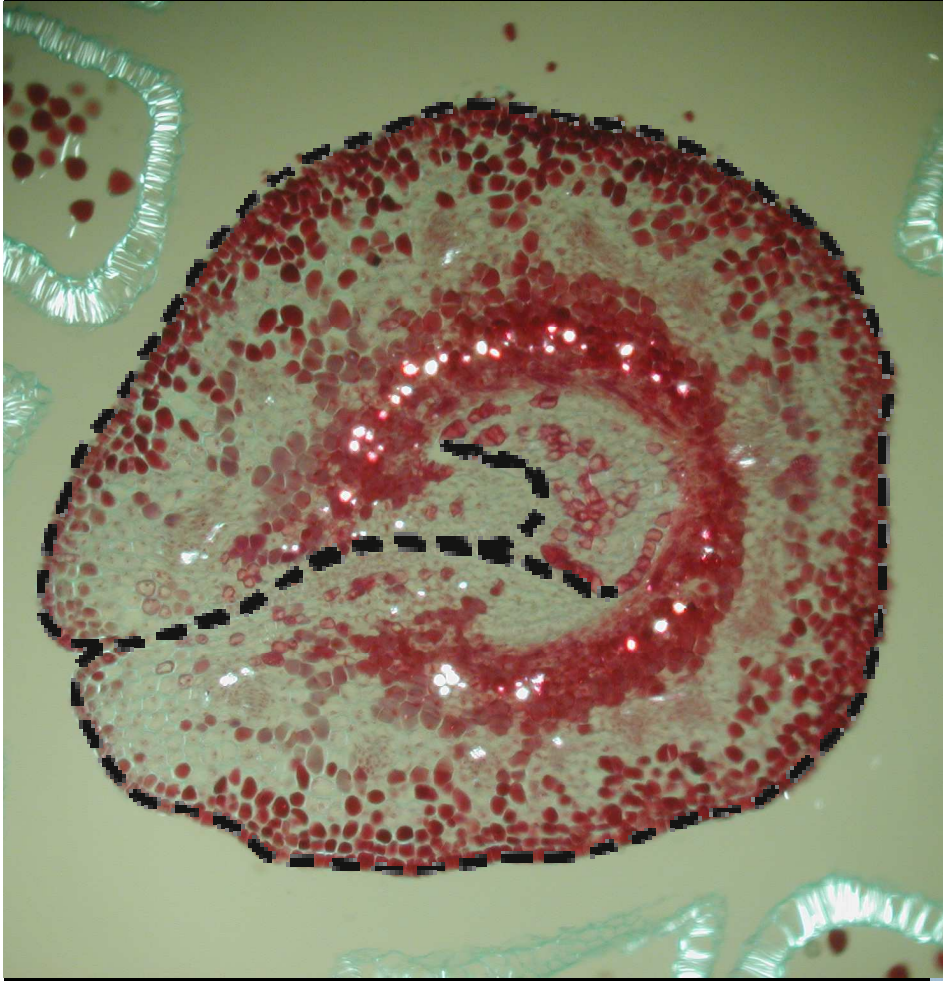
What is the difference between carpel, pistil,
and gynoecium?

Carpel - modified conduplicate, megasporophyll bearing ovules



Carpel fusion apocarpous to syncarpous





Two major adaptive features of the carpel.

1) Site for pollen germination and pollen tube growth.

Greater selective control as to which pollen can fertilize the ovules.

2) Fruit formation.

Dispersal of seeds (via fruit) by:

wind

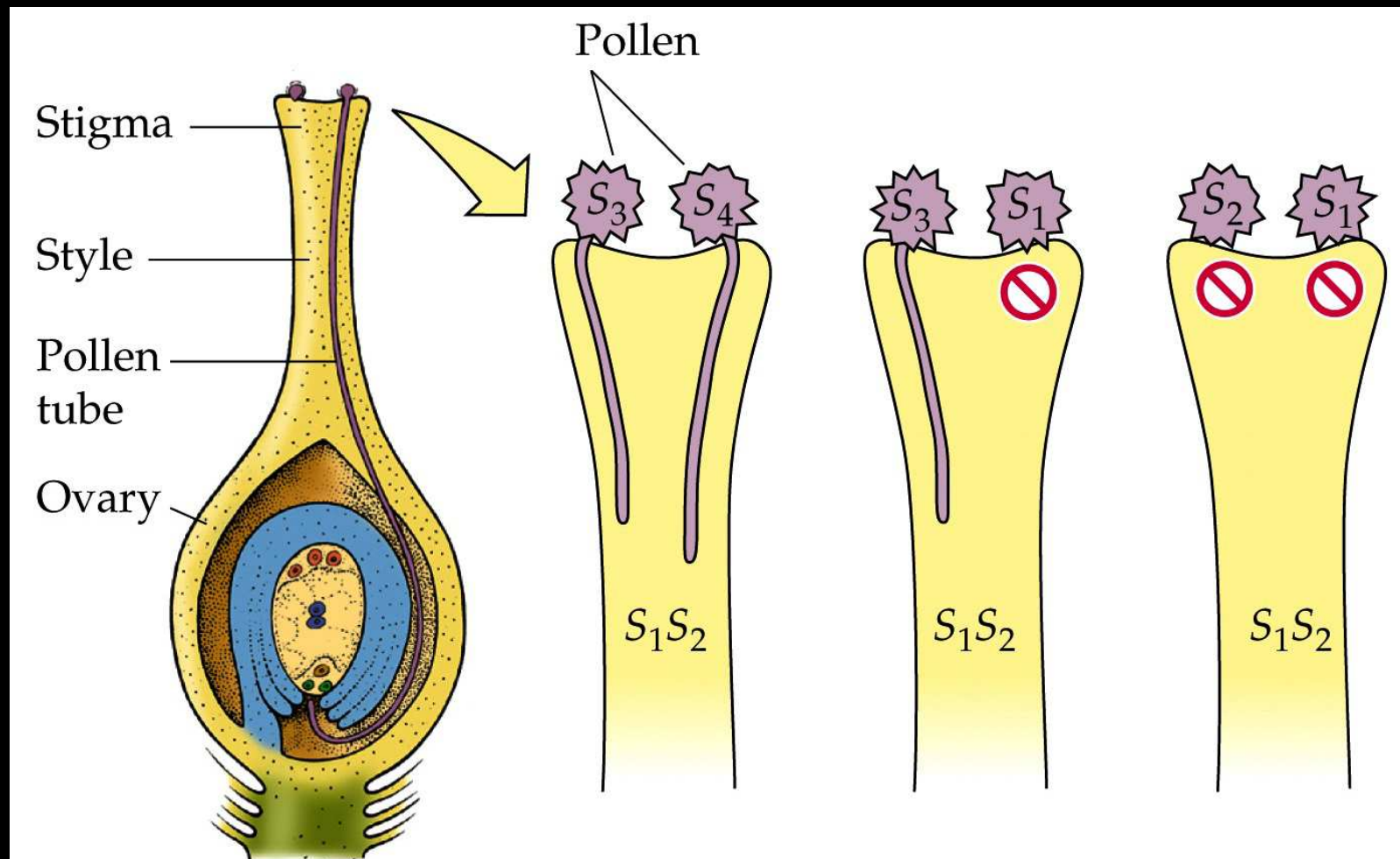
water

animals

mechanical means

Self-incompatibility

- Pollen will not germinate on genetically similar individuals
- Promotes outcrossing



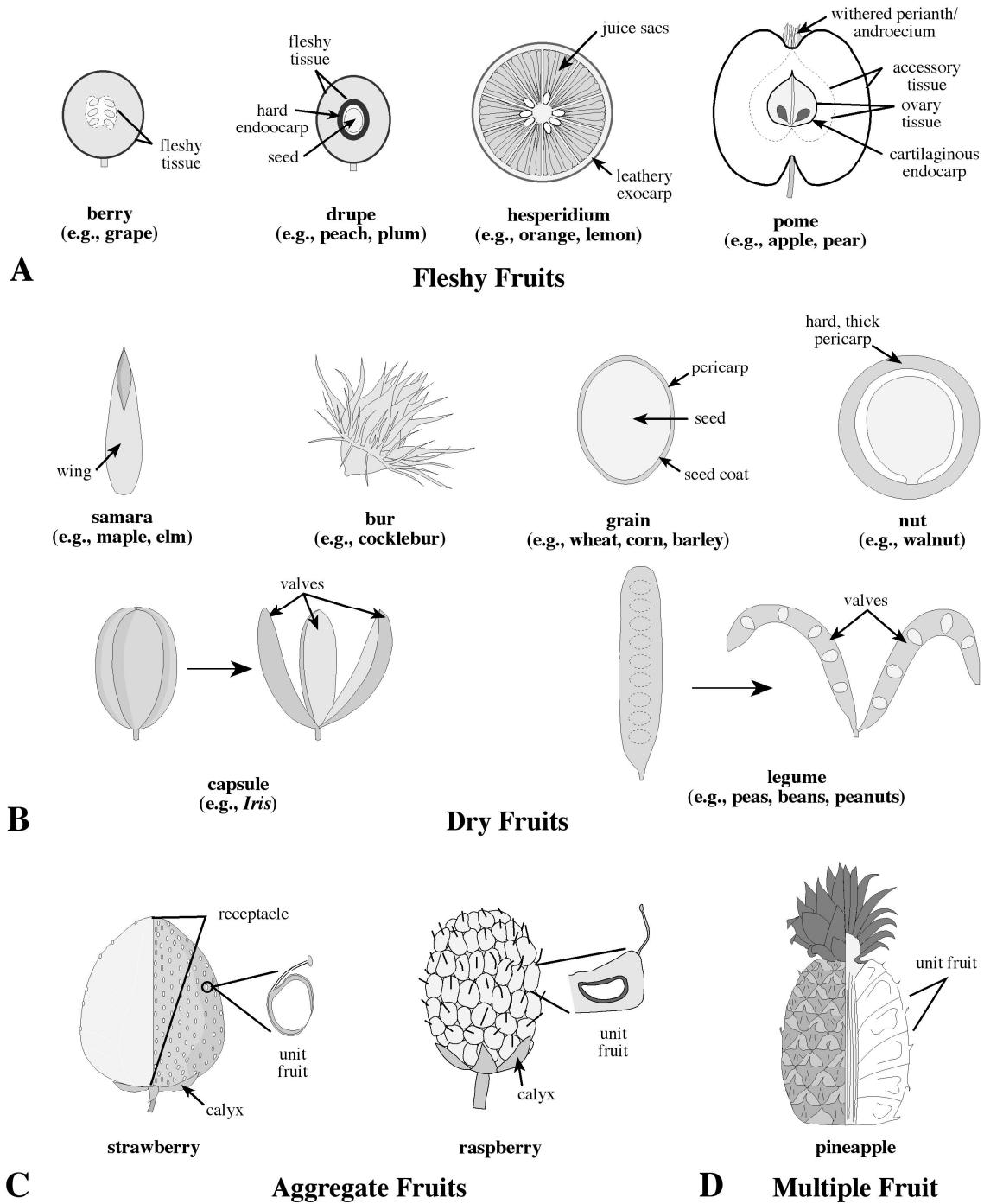
Fruit = mature ovary
(plus accessory parts)

Function: seed dispersal

Fruit types:

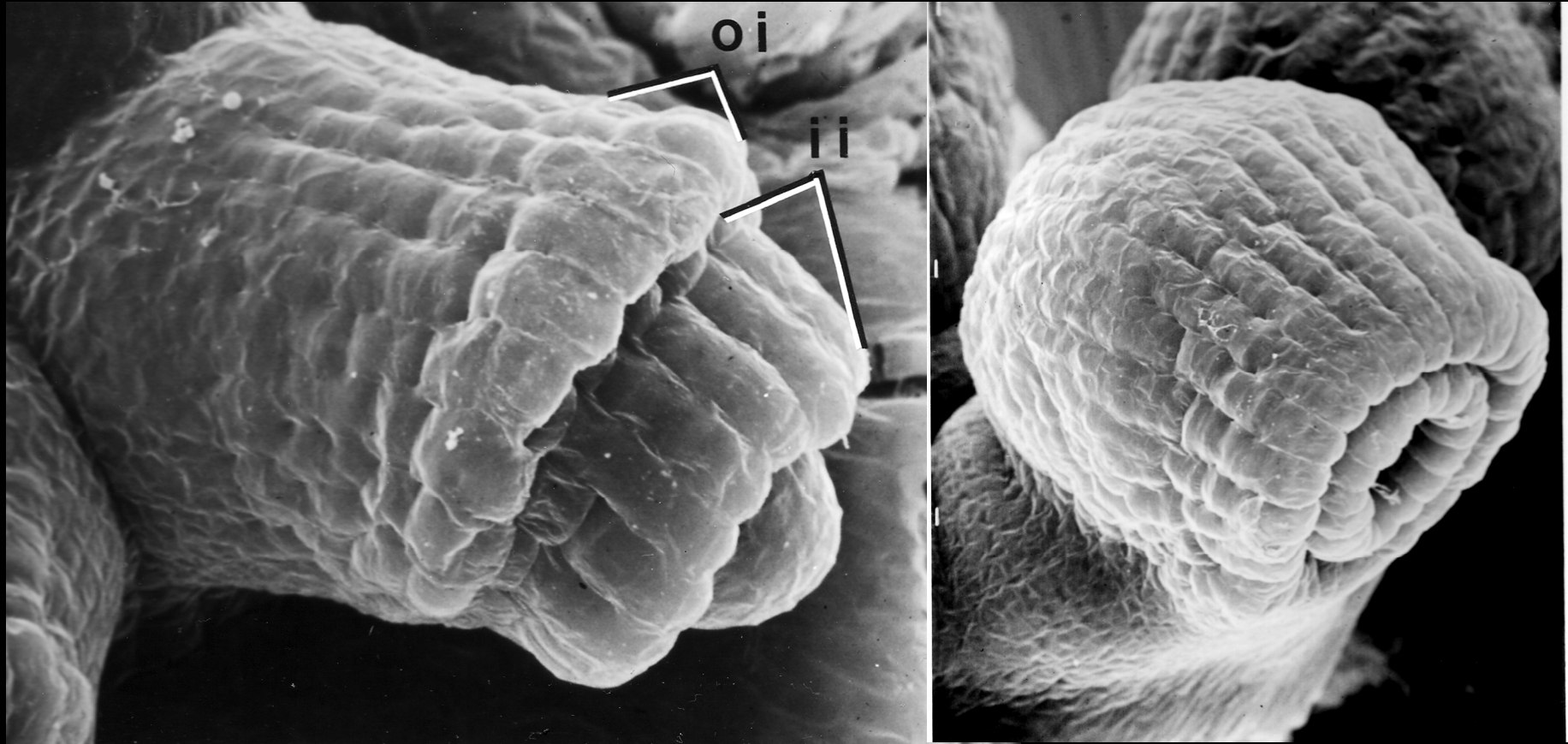
dry
- dispersed
mechanically,
by wind, water,
etc.

fleshy
- dispersed by
animals



Contrast integument number in gymnosperms versus that in angiosperms.

Angiosperms - 2 integuments (ancestrally)
contributes the seed coat

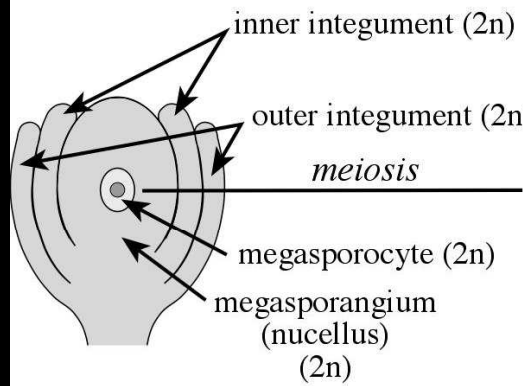


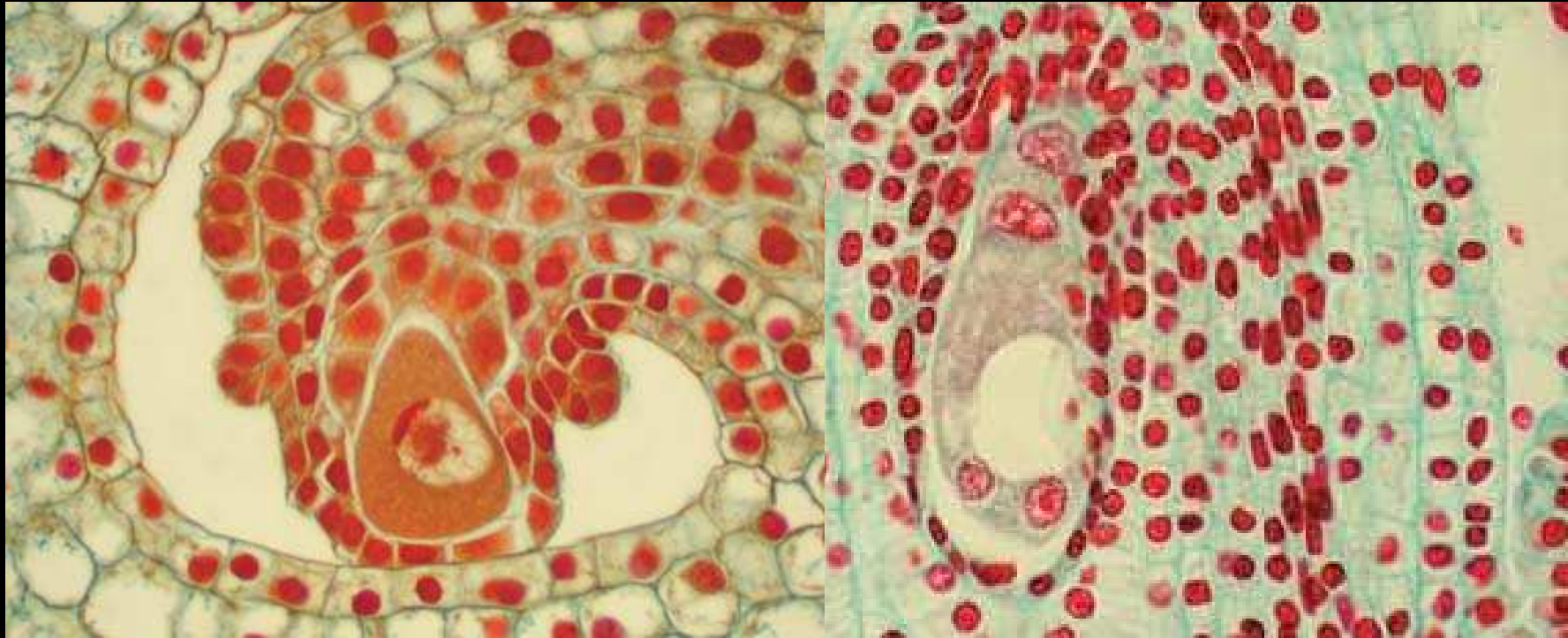
Gymnosperms – 1 integument Unitegmic

Mature female gametophyte in the flowering plants.

Number of cells and nuclei are present in a typical, mature, female gametophyte of the flowering plants?

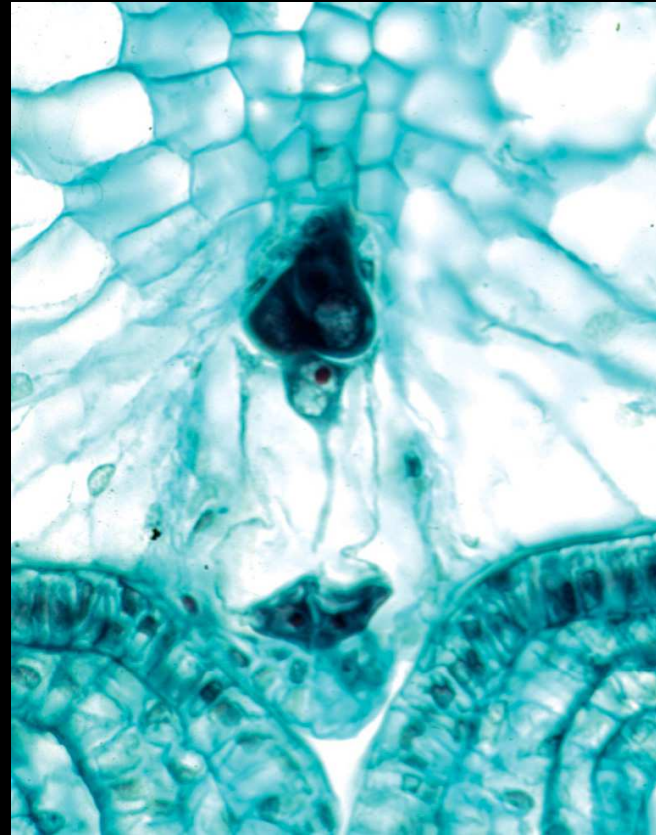
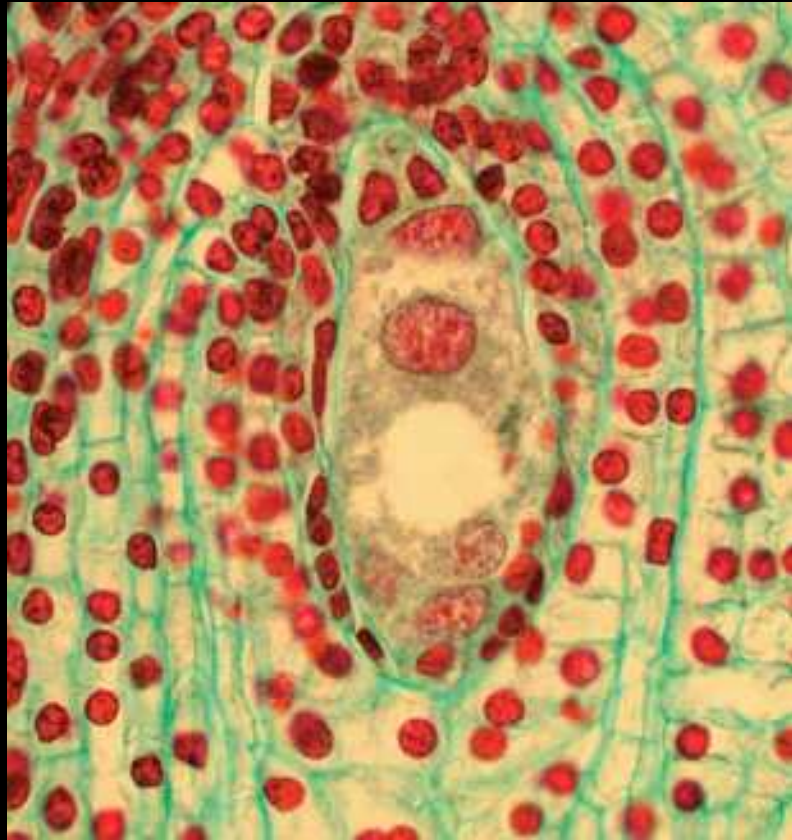
Angiosperms: reduced (8 nucleate) female gametophyte



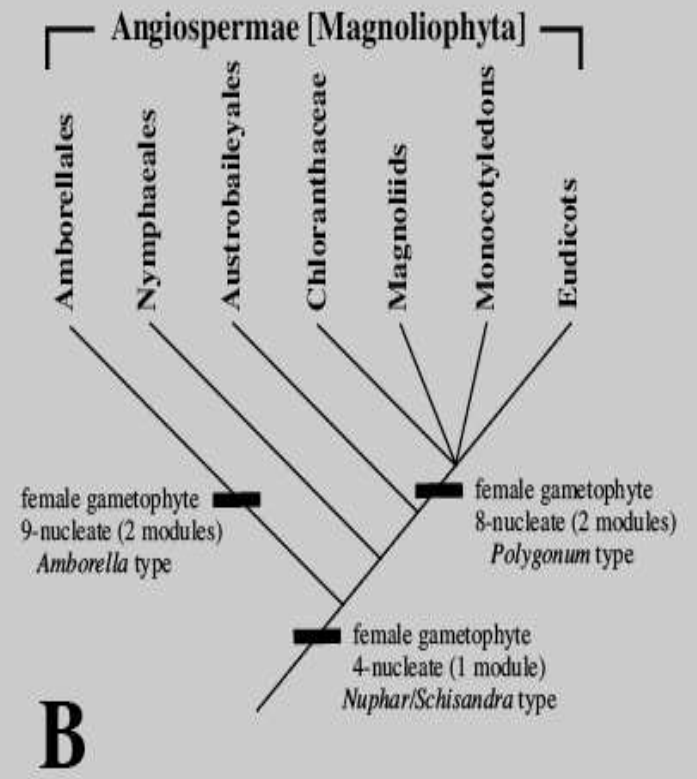
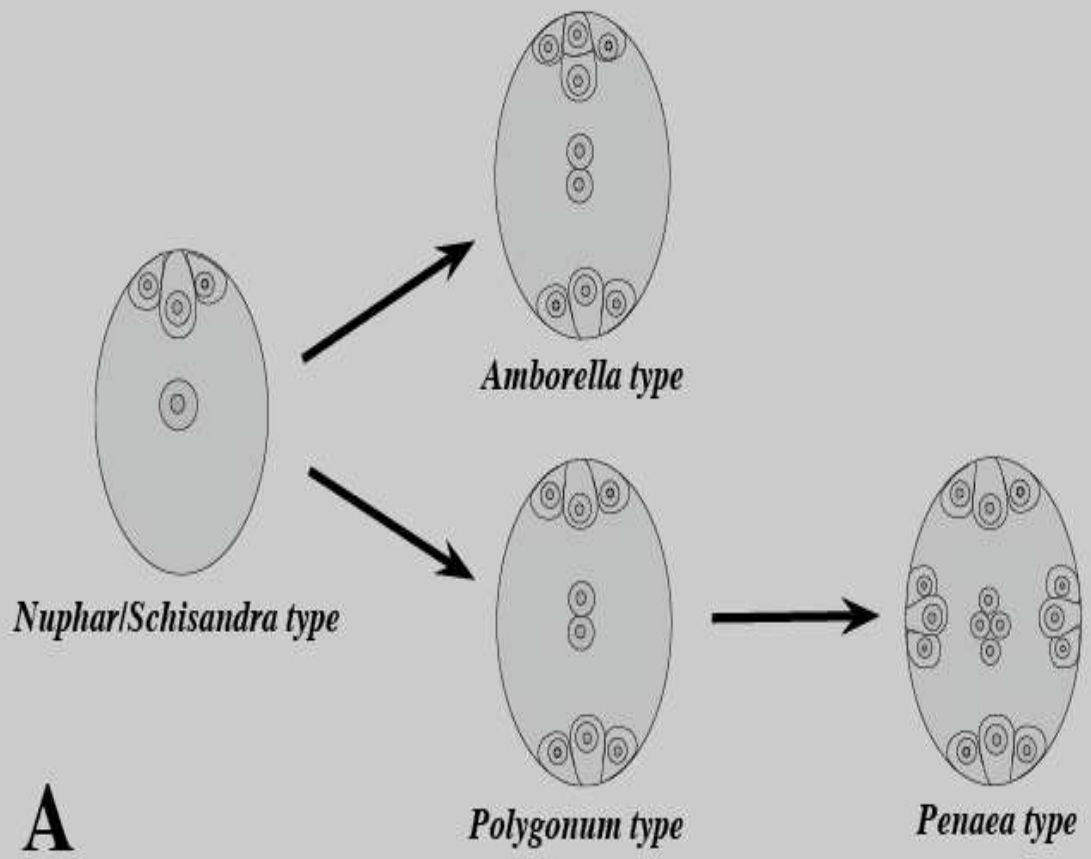


megaspore (prior to meiosis)

female gametophyte (4-celled stage)



female gametophytes (mature, 8-nucleate, 7-celled stage)



Modular Theory of evolution of the angiosperm female gametophyte

18. How might the reduced angiospermous female gametophyte be adaptive?

No time lag between pollination and fertilization

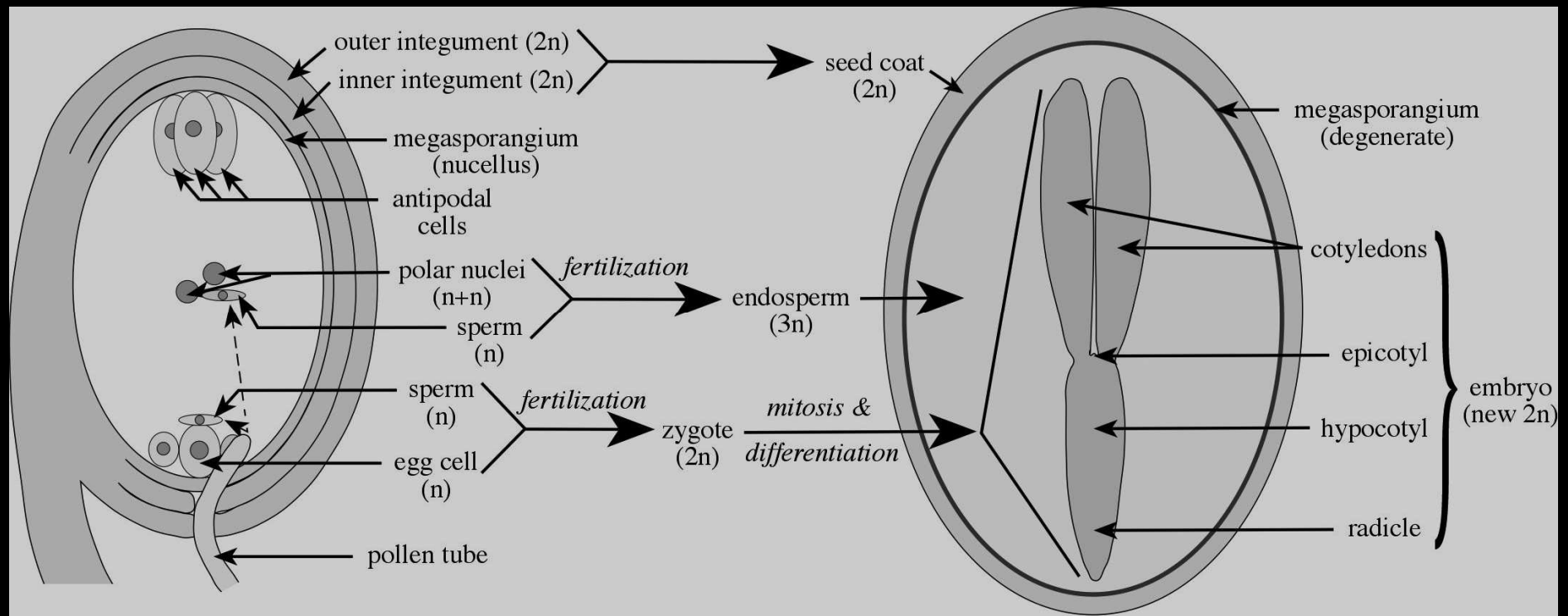
Seeds may be generated rapidly, enabling the evolution of annual herbs, a new plant habit.

Conservation of resources

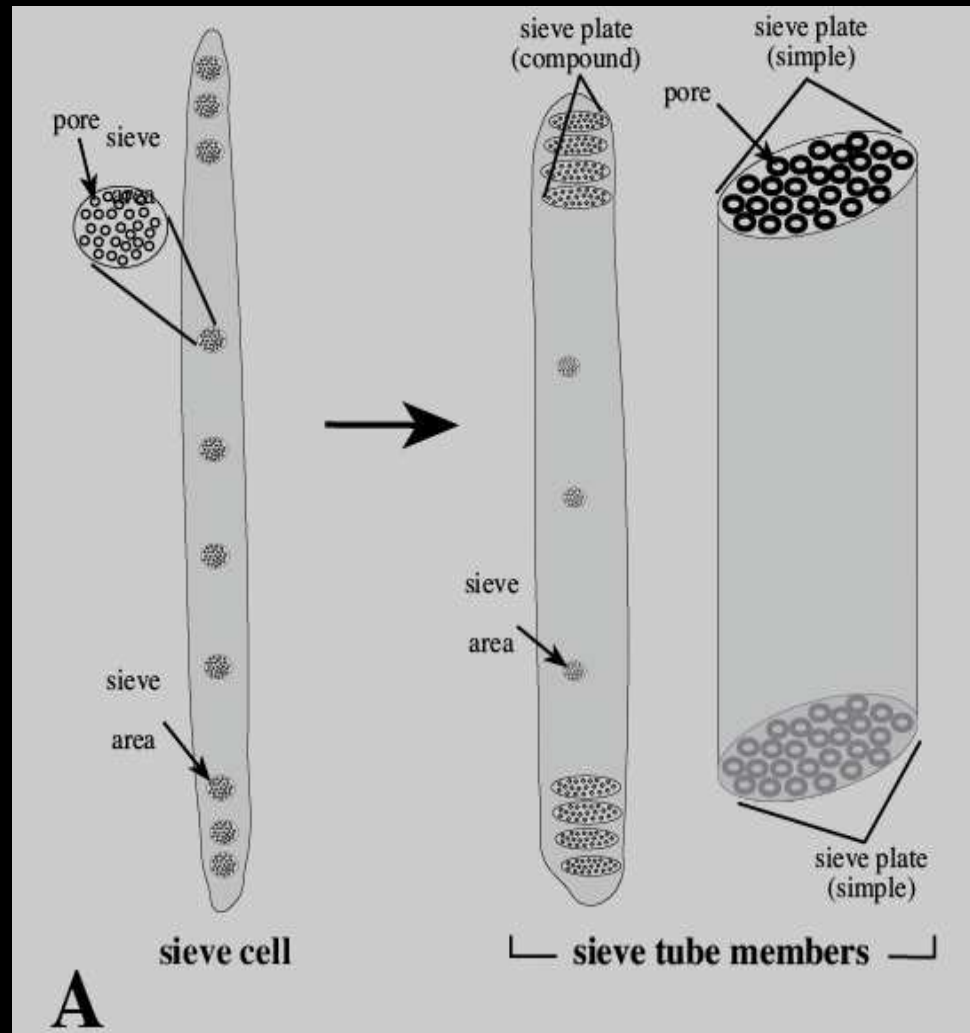
Nutritive cells (endosperm) not formed until after fertilization in angiosperms

Endosperm and its function

Endosperm (3n) formation via double fertilization



Difference between a sieve cell and a sieve tube member



SIEVE CELLS

**Unspecialized sieve plates:
in all other vascular plants**

SIEVE TUBE MEMBERS

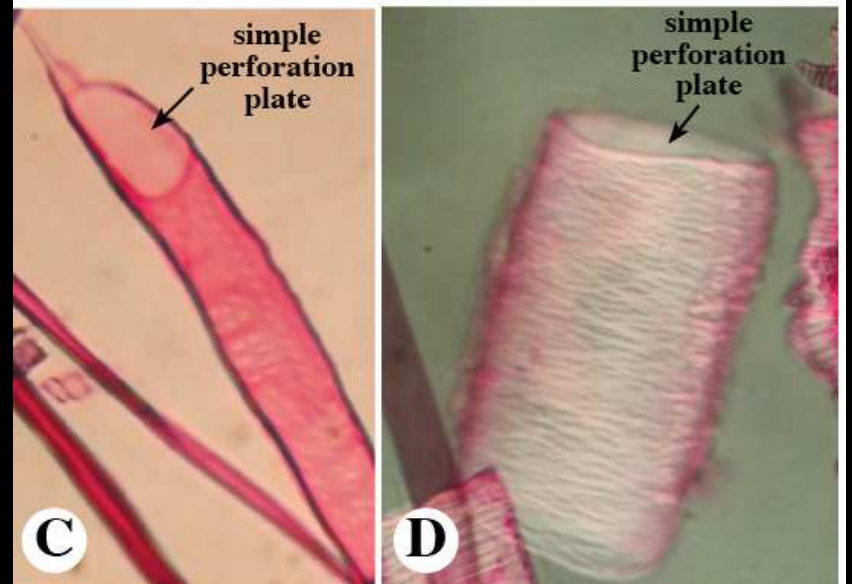
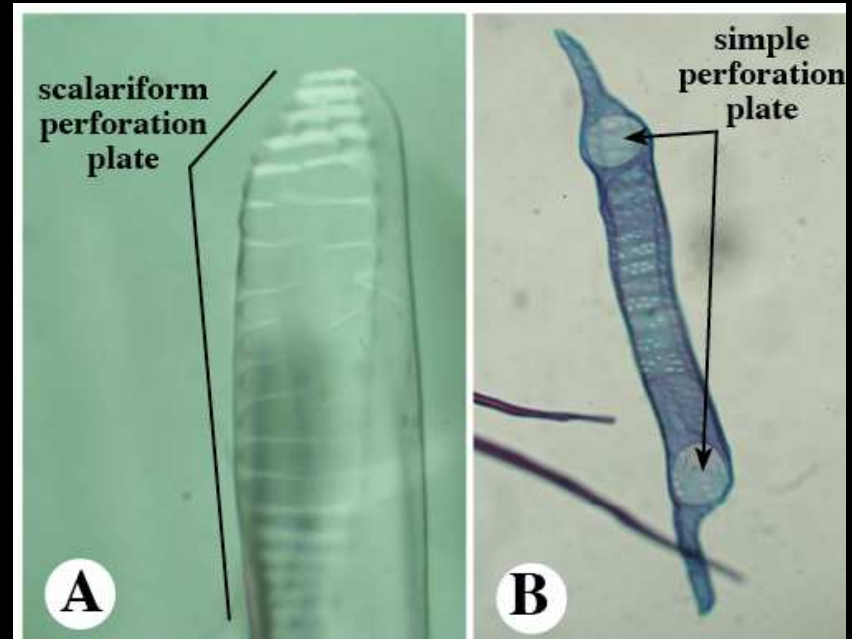
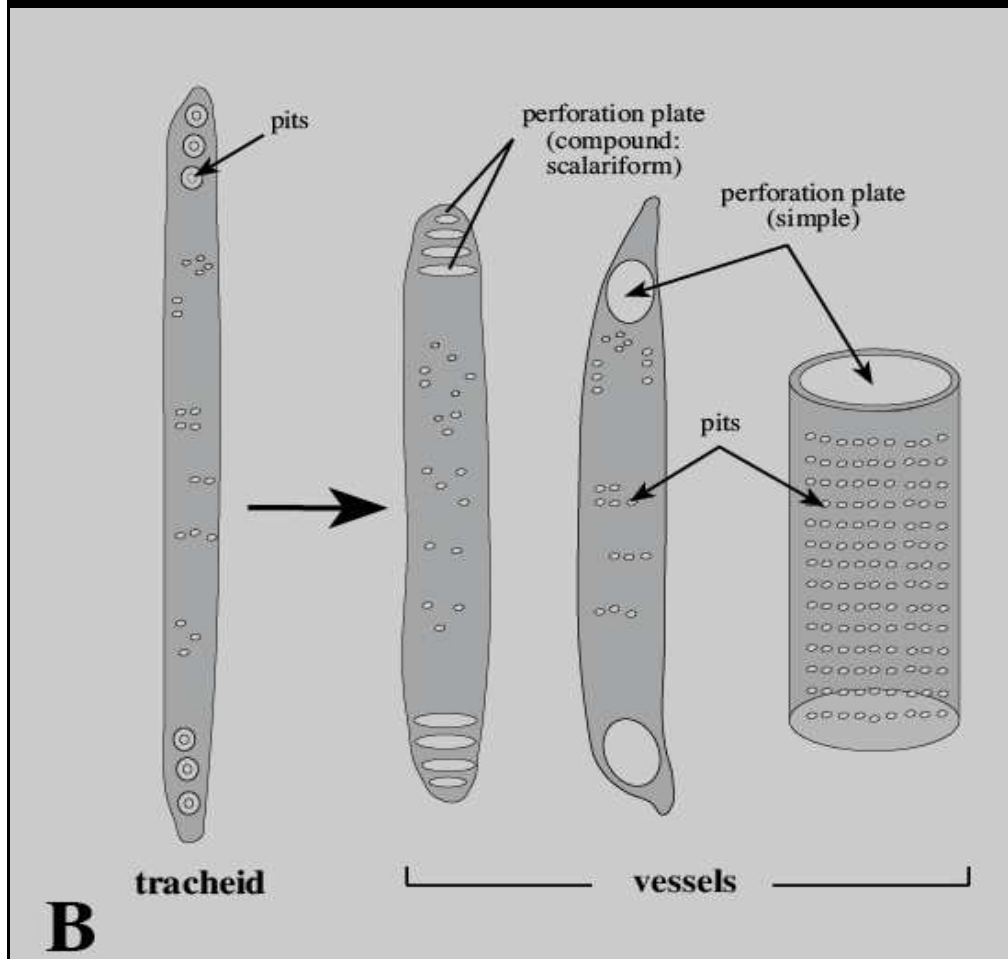
Specialized sieve plates: only in angiosperms

21. What type of tracheary element do most angiosperms have and what is its adaptive significance?

VESSELS

Perforation plates at end walls

More efficient water conduction



When are the earliest definitive angiosperm fossils found?

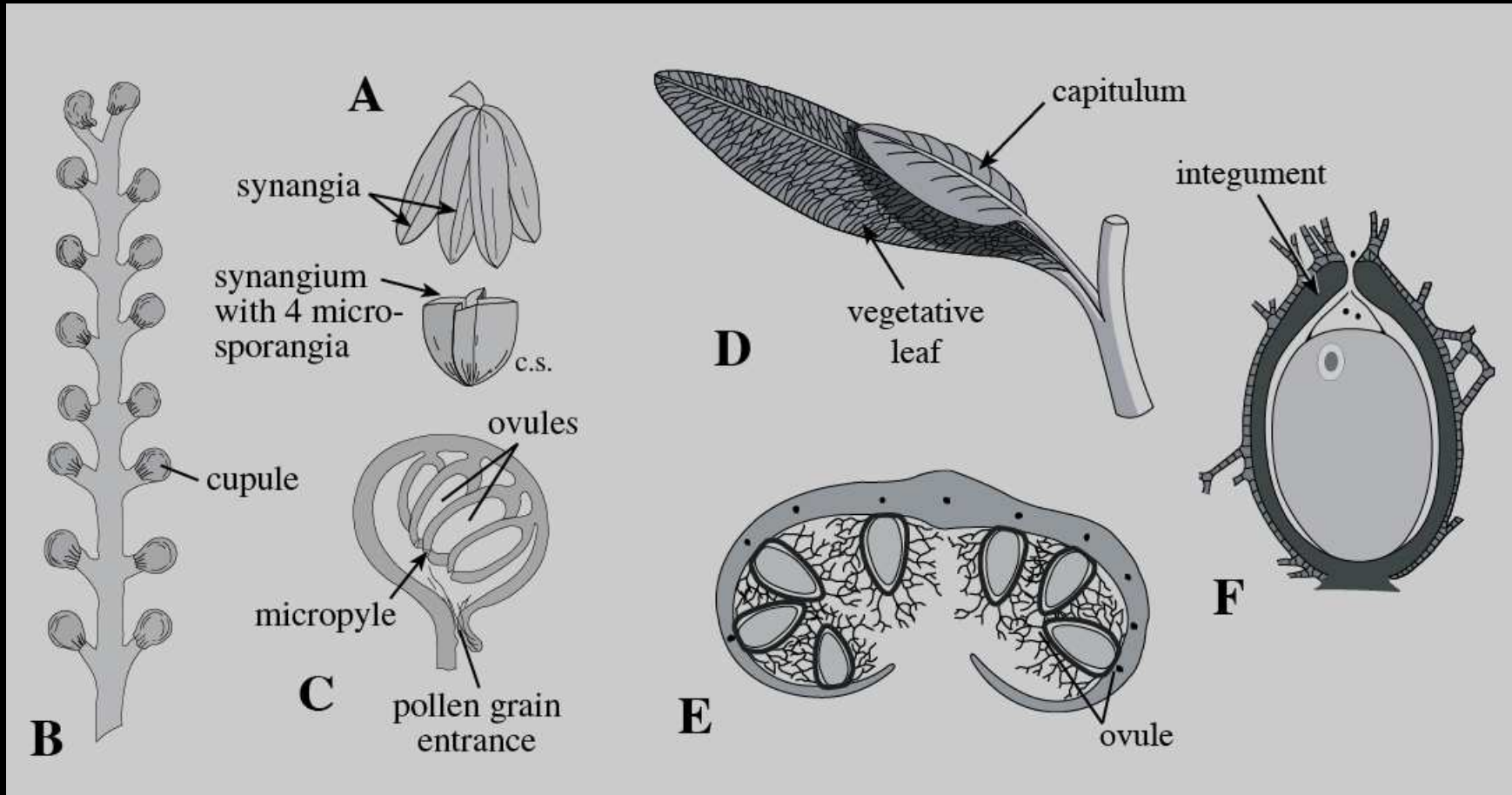
Pollen – ca. 140 million years ago

Flowers – ca. 130 million years ago

Origin of the Angiosperms?

- "The rapid development as far as we can judge of all the higher plants within recent geological times is an abominable mystery."
- —Charles Darwin in a letter to Sir Joseph Hooker, 1879.

Example of *Caytonia* and glossopterids as putative angiosperm progenitors, citing evidence for or against this idea.



Caytonia

Glossopteris

Describe the reproductive structure of *Archaeofructus* and indicate two competing hypotheses for its homology



Archaeofructus liaoningensis close up view of the fruits that contain seeds. Fruits containing seeds is a defining character of flowering plants and the reason that this fossil could be reported as the worlds oldest flowering plant. The type of fruits show some similarities to the magnolian line of evolution. [photo: David Dilcher and Ge Sun]