

Introduction to Botany. Lecture 11

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Outline

1 Questions and answers

2 Stems

- Anatomy of stem
- Vascular bundles
- Anatomy of mature stem

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2 Stems

- Anatomy of stem
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Previous final question: the answer

What is a pericycle?

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What is a pericycle?

- Parenchymatic tissue originated from procambium
- Lays between vascular tissues and endoderm
- Initiates lateral roots and vascular cambium



Stems

Anatomy of stem

Stem: definition and functions

- Axial vegetative organ of shoot with functions of support and transportation
- Other functions:
 - ① Photosynthesis
 - ② Storage
- Features:
 - ① Radial structure
 - ② No root hairs
 - ③ Continuous growth



Protoderm to epidermis

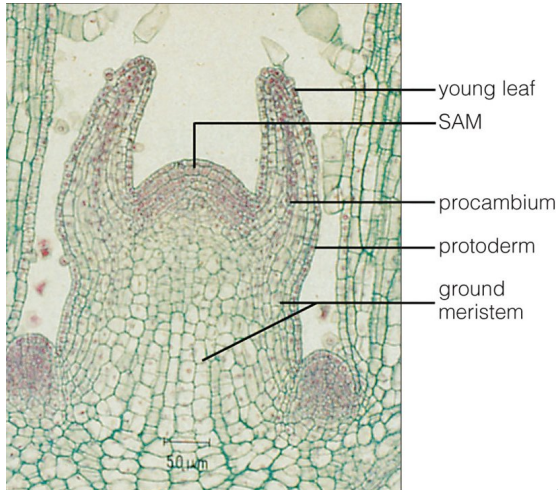
- Stem apex meristem (SAM) produces **protoderm**
- Protoderm cells differentiate into epidermal cells

Ground meristem to cortex and pith

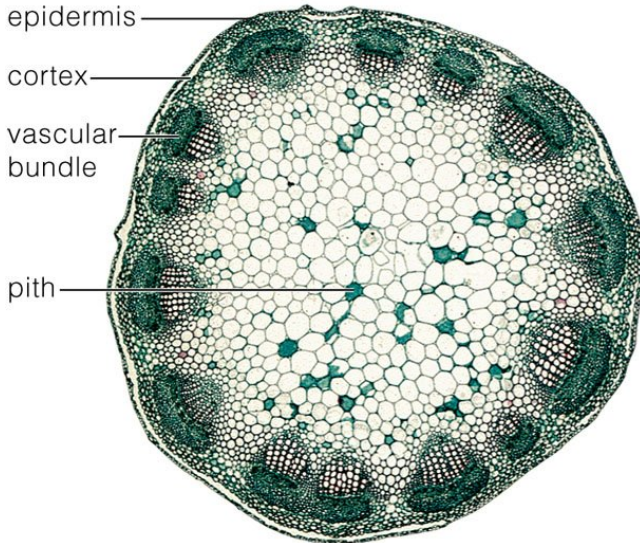
- SAM produces also **ground meristem**
- Ground meristem differentiates into **cortex** and **pith**
- Procambium raises between cortex and pith, it forms vascular bundles or vascular cylinder



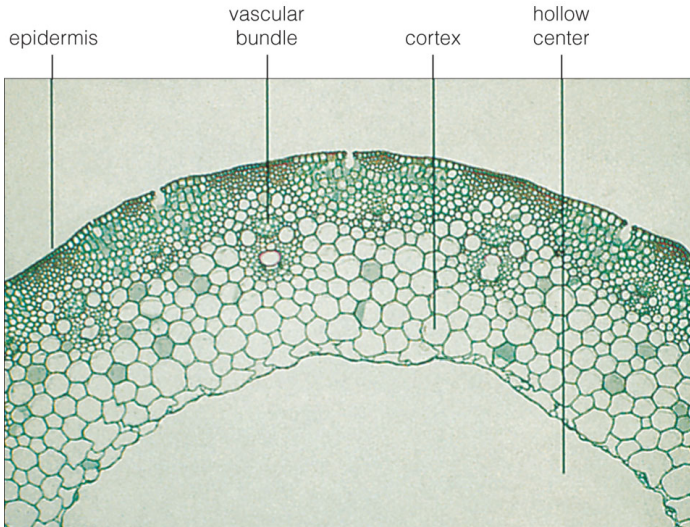
Three primary meristems: procambium, protoderm and ground meristem



Young stem with primary tissues



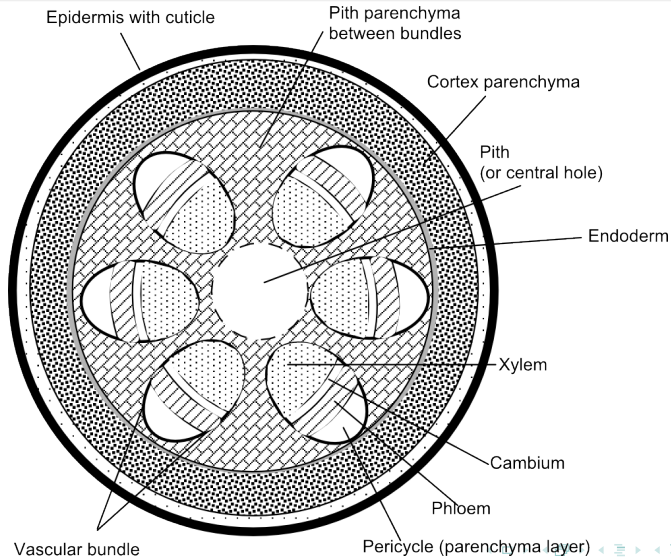
Older stem with hollow in the center



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Primary structure of stem



Procambium to xylem and phloem

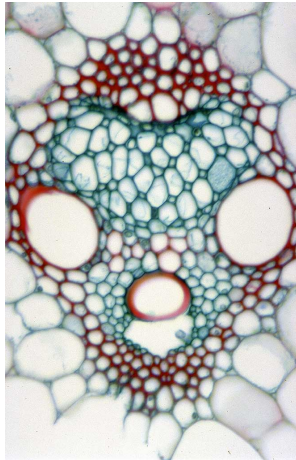
- Outer layers of procambium form **primary phloem**
- Inner layers become **primary xylem**
- Sometimes outermost layers of procambium form **pericycle** (parenchyma cells)
- In some cases, inner layers of cortex could form **endoderm**



Stems

Vascular bundles

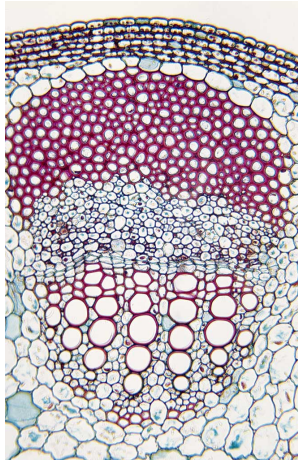
Vascular bundle (monocot)



Corn (*Zea mays*) mature stem cross-section showing single vascular bundle, Brightfield (LM $\times 400$)

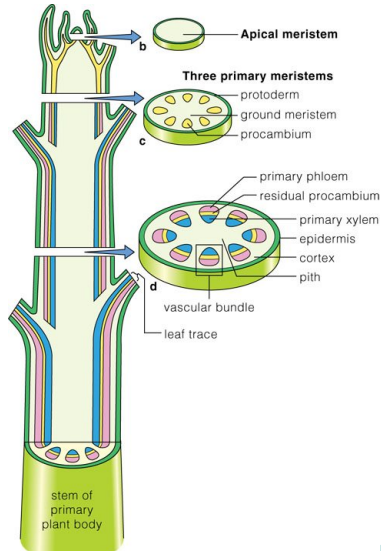


Vascular bundle (asterid)



Wild Sunflower (*Helianthus* sp.) with nearly mature vascular bundle (LM $\times 35$)

Origin of vascular bundles

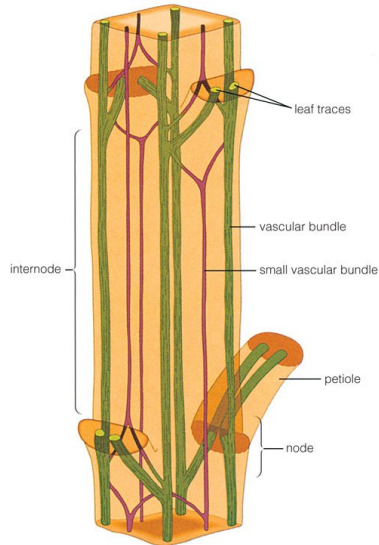


Vascular bundles

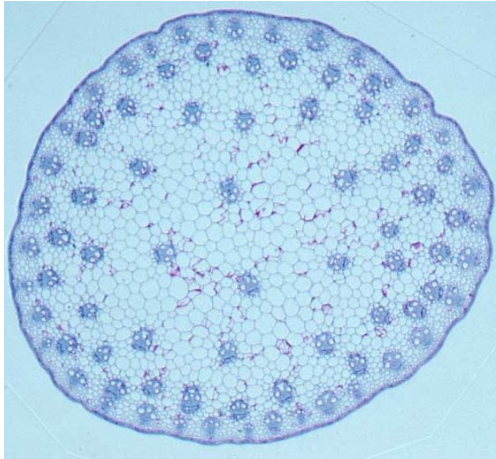
- Vascular bundles connect leaves and stems
- In many plants, they form **ring** on the cross-section of stem (“dicot” stem)
- Monocot stems usually have **dispersed** vascular bundles



Vascular bundles and leaf traces



Monocot stem



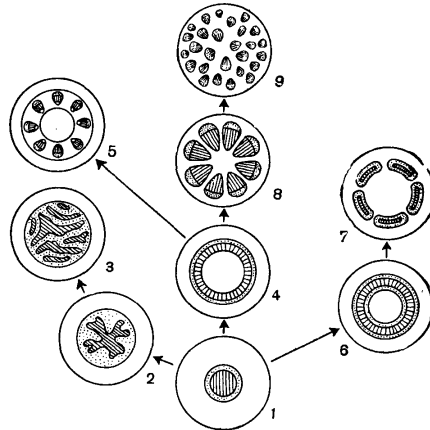
Corn (*Zea mays*) stem (LM $\times 4$)

Steles

- **Stele** is an overall configuration of primary vascular system of plant stem
- The most important kinds of steles are: **protostele**, **siphonostele**, **eustele** and **ataktostele***

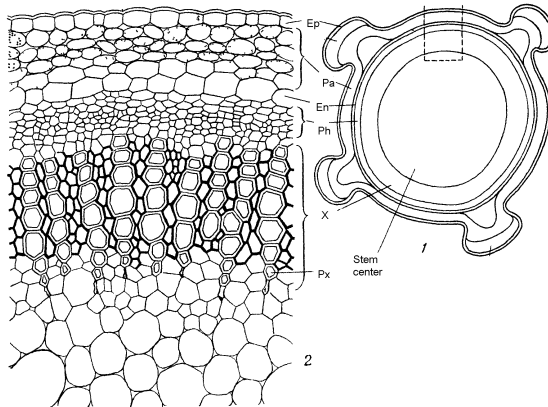


Diversity of steles



(1) is protostele, (7) siphonostele (occurs in ferns), (8) eustele (“dicot” stem), (9) ataktostele (monocot stem)

Vascular cylinder: alternative to ring of bundles



Sometimes, vascular bundles are so dense that they form almost a cylinder. We may call this vascular cylinder “solenostele” (#4 on the scheme of steles)

Stems

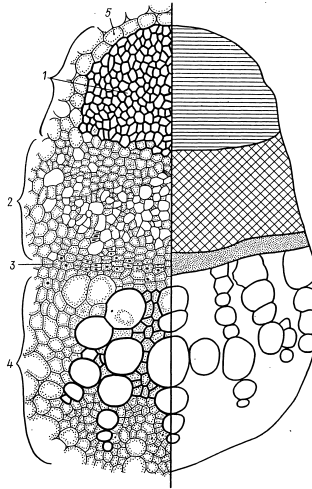
Anatomy of mature stem

Vascular cambium

- In many plants, residuals of procambium transform into fascicular cambium
- Parenchyma cells between vascular bundles produce inter-fascicular cambium



Fascicular cambium is #3



Final question (1 point)

Final question (1 point)

What is ataktostele?

Summary

- SAM produces **protoderm** and **ground meristem**, ground meristem differentiates into **cortex** and **pith**
- Procambium forms **vascular bundles** or vascular cylinder
- Outer layers of procambium transform into primary phloem, inner layers — into primary xylem
- Monocot stem usually has dispersed vascular bundles (**ataktostele**)



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.

