# BOT 331: Lecture 20
# **Growth and Development # 02**

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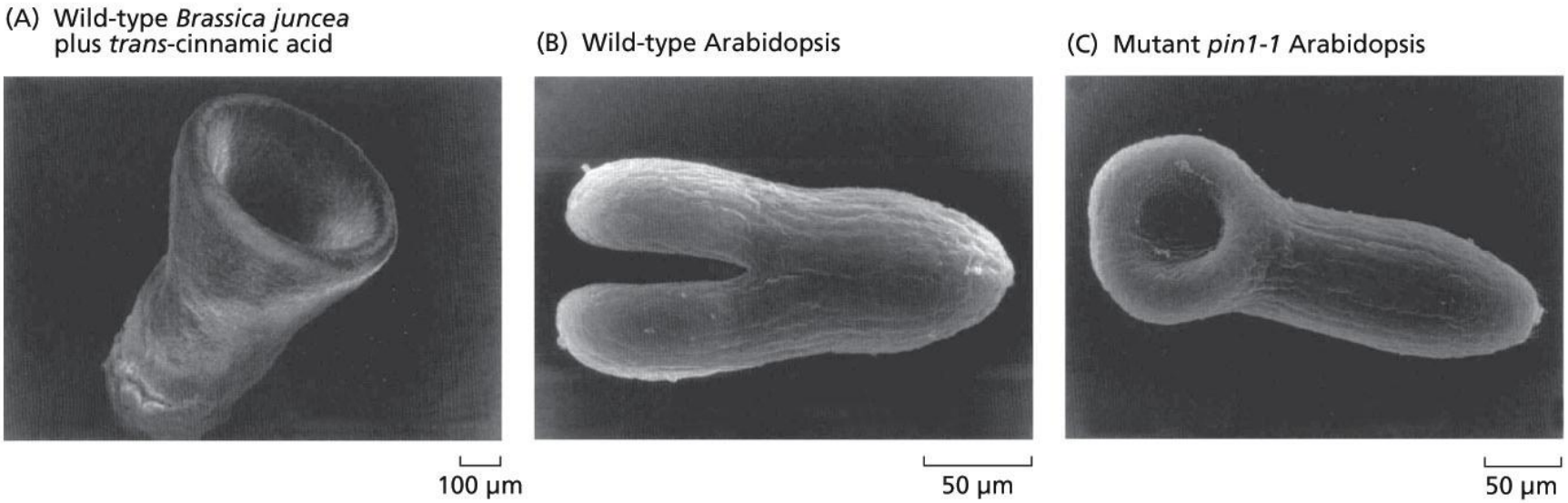
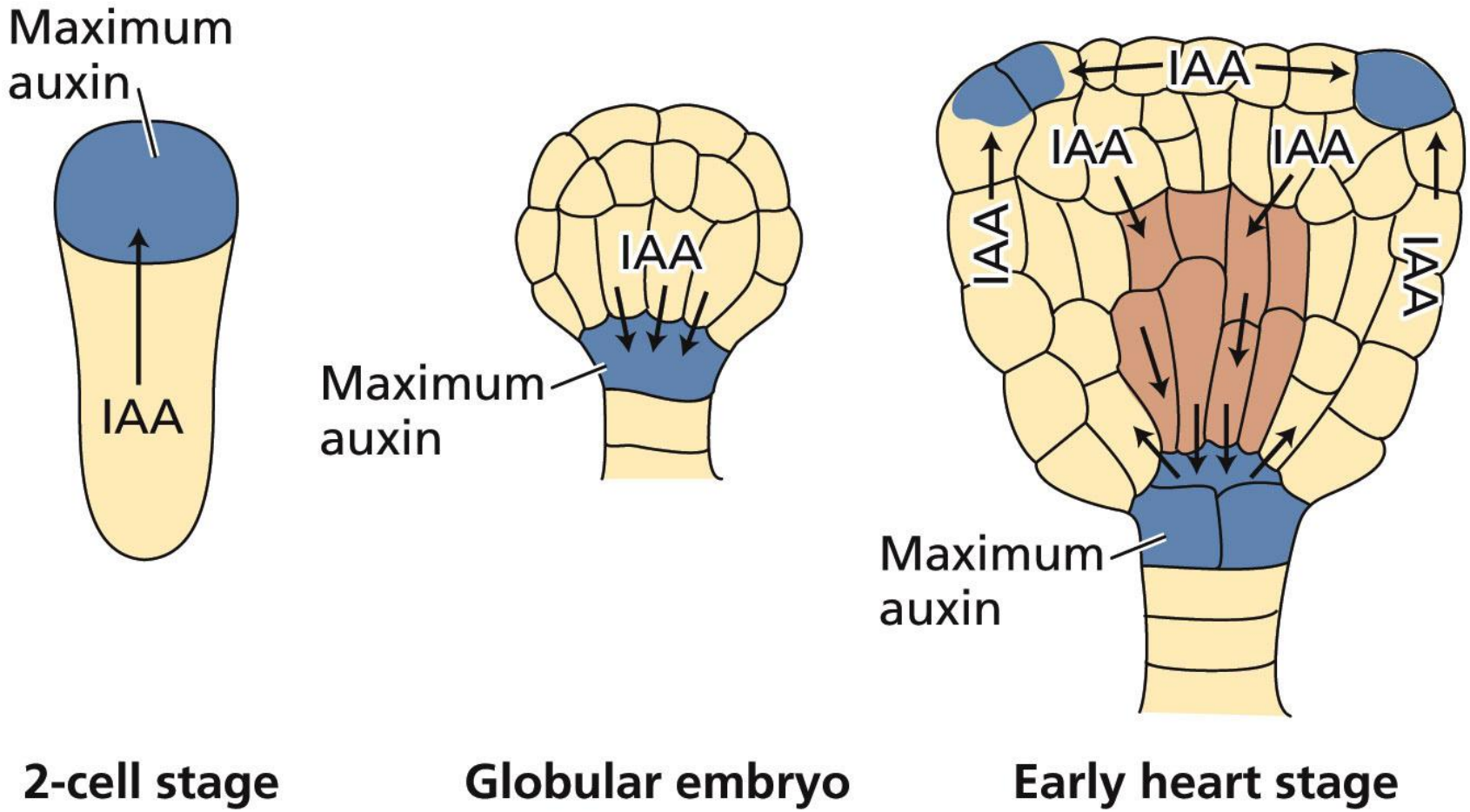
Winter 2011

# Figure 16.7 Evidence of a role for auxin in embryonic development



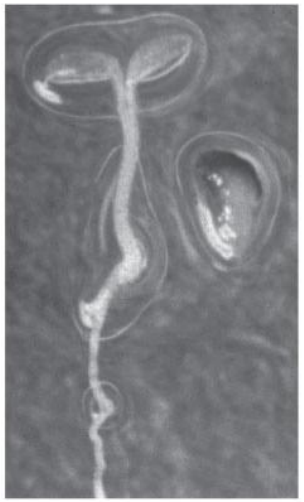

***PLANT PHYSIOLOGY*, 5e, Figure 16.7**

# Figure 16.8 PIN-dependent movement of auxin



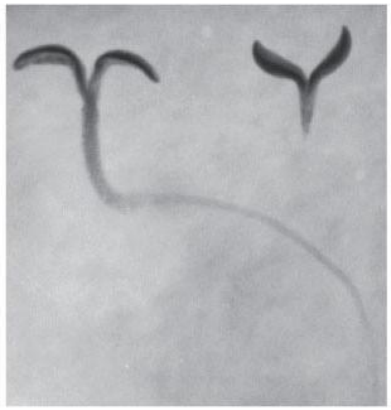
# Figure 16.9 Genes essential for Arabidopsis embryogenesis

(A) Wild type vs. *gnom* mutant



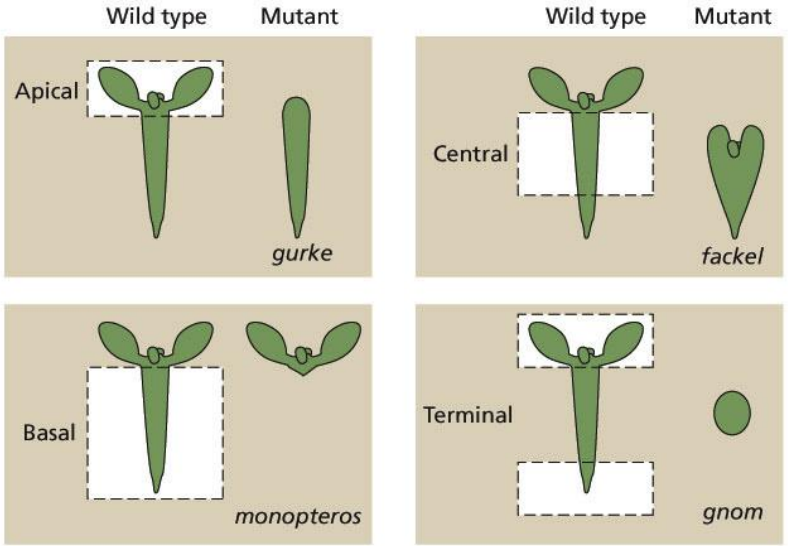
*GNOM* genes control apical–basal polarity

(B) Wild type vs. *monopteros* mutant



*MONOPTEROS* genes control formation of the primary root

(C) Schematic of mutant types



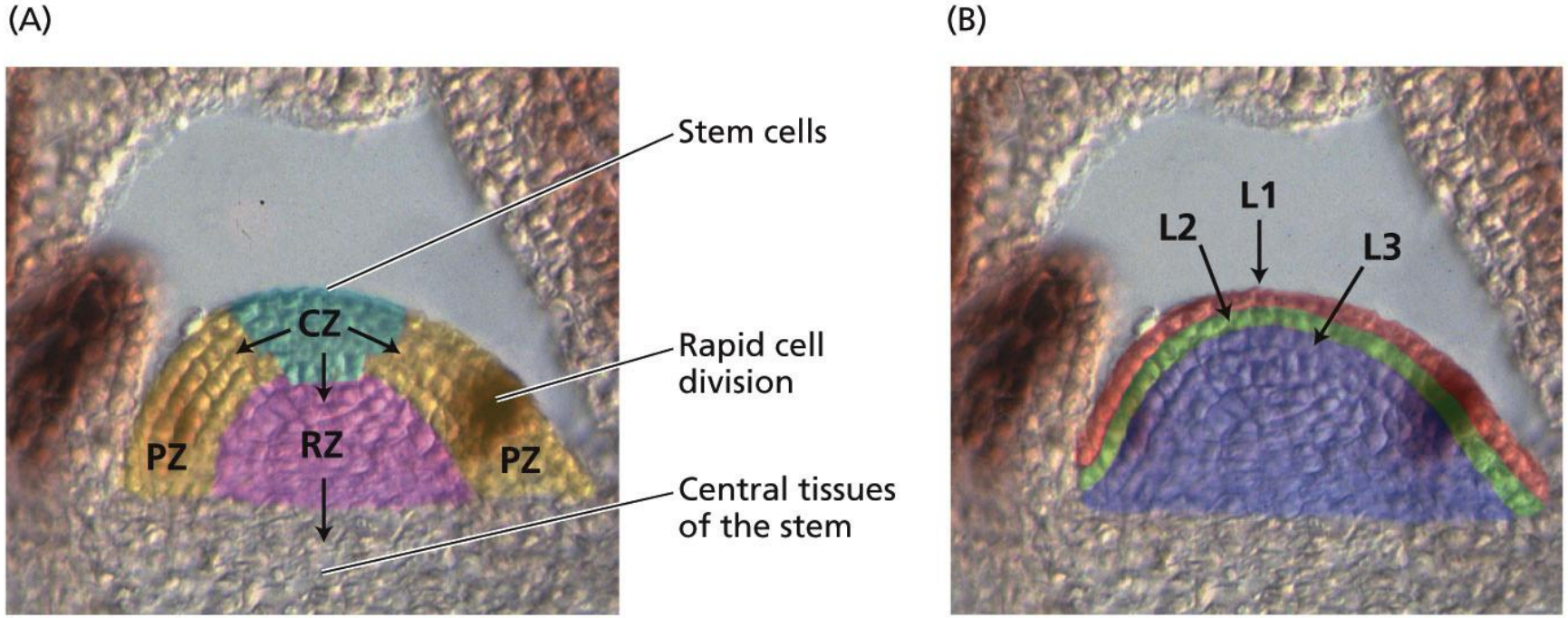

Acetyl Co-A carboxylase

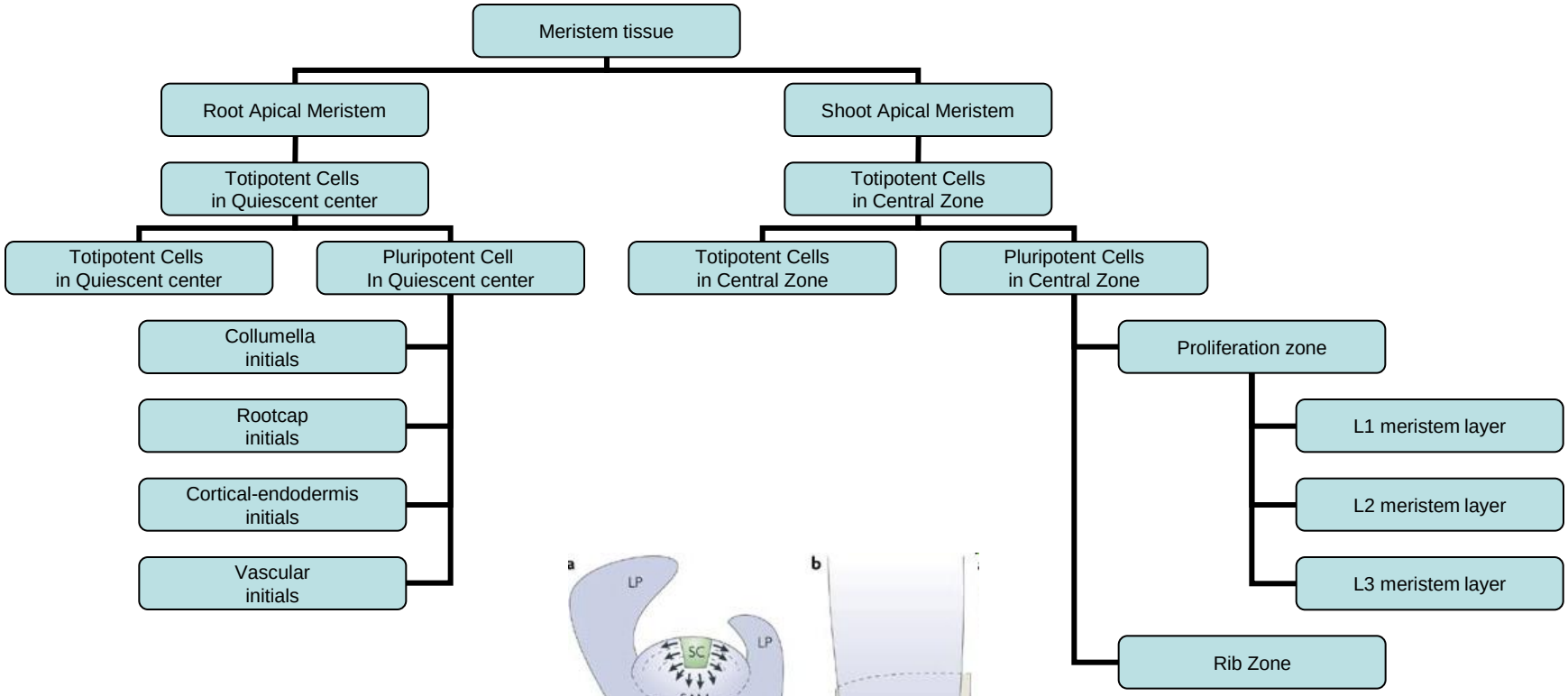
Sterol C-14 reductase

Auxin response factor and transcription factor

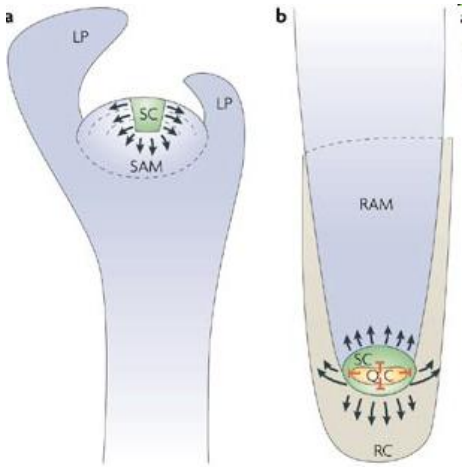
Guanine nucluotide exchange factor

# Figure 16.22 The Arabidopsis shoot apical meristem

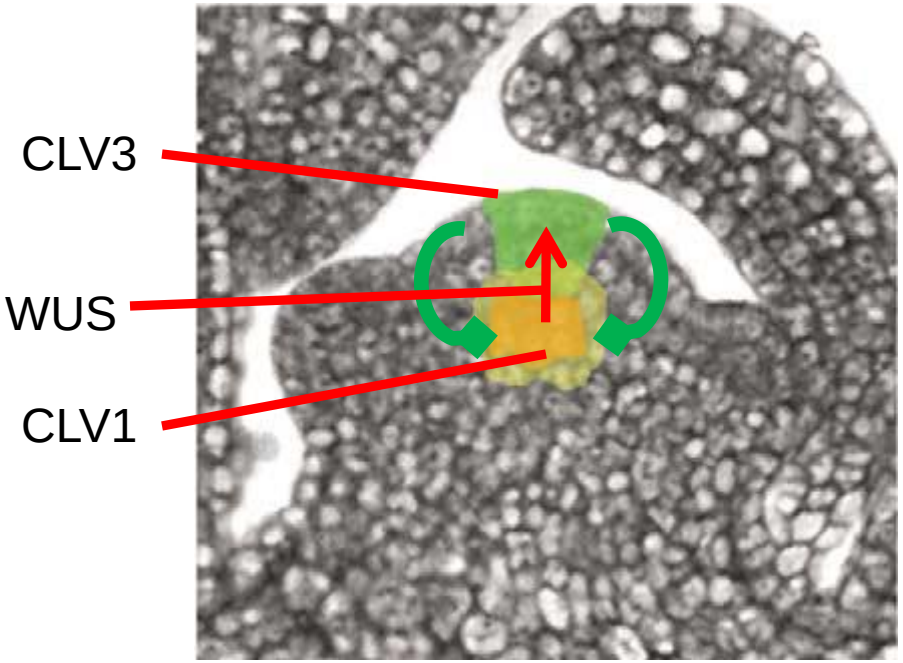





Apical meristem maintains Totipotency



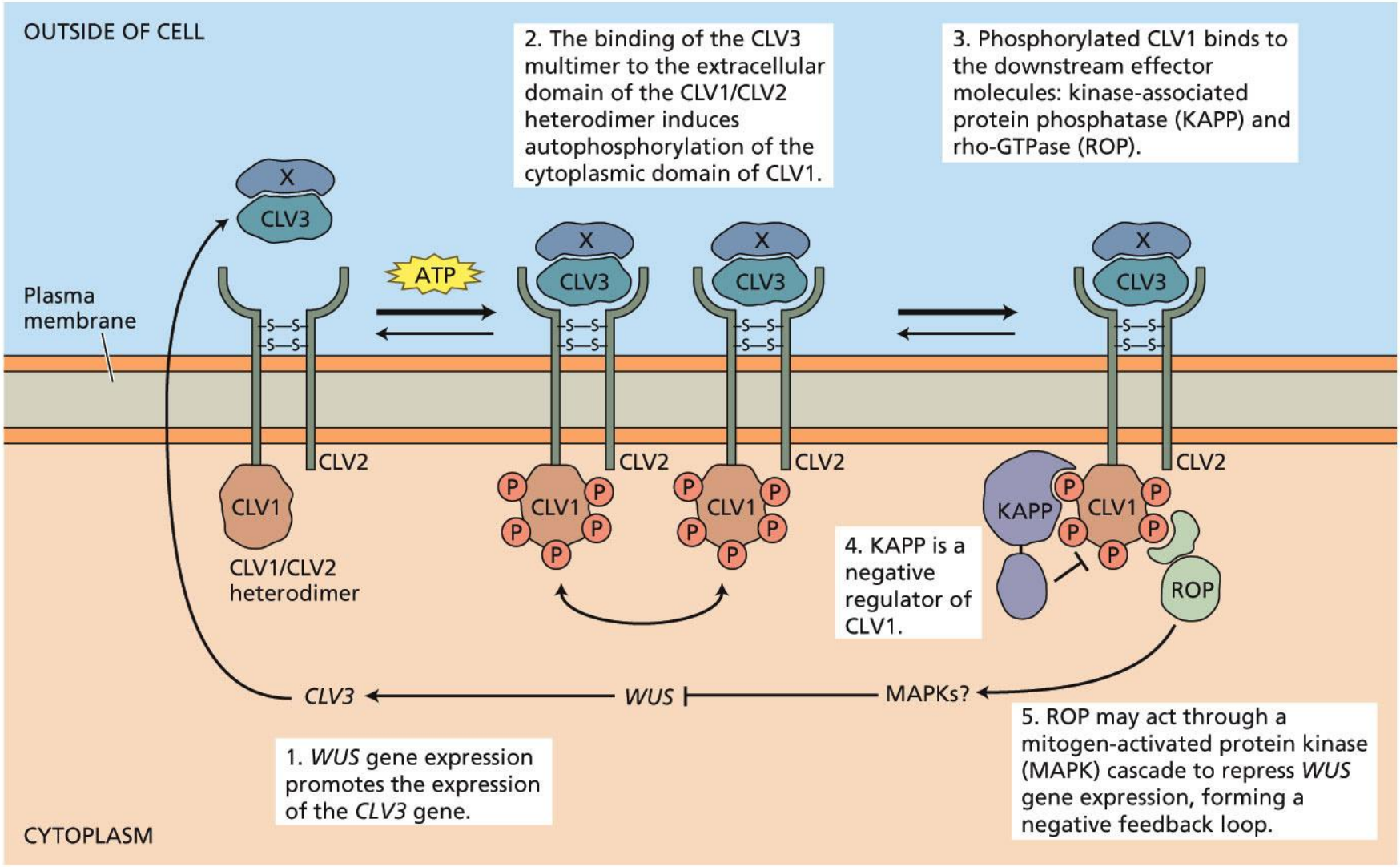

Nature Reviews | Molecular Cell Biology




The gene expression patterns underlying shoot apical meristem organization.

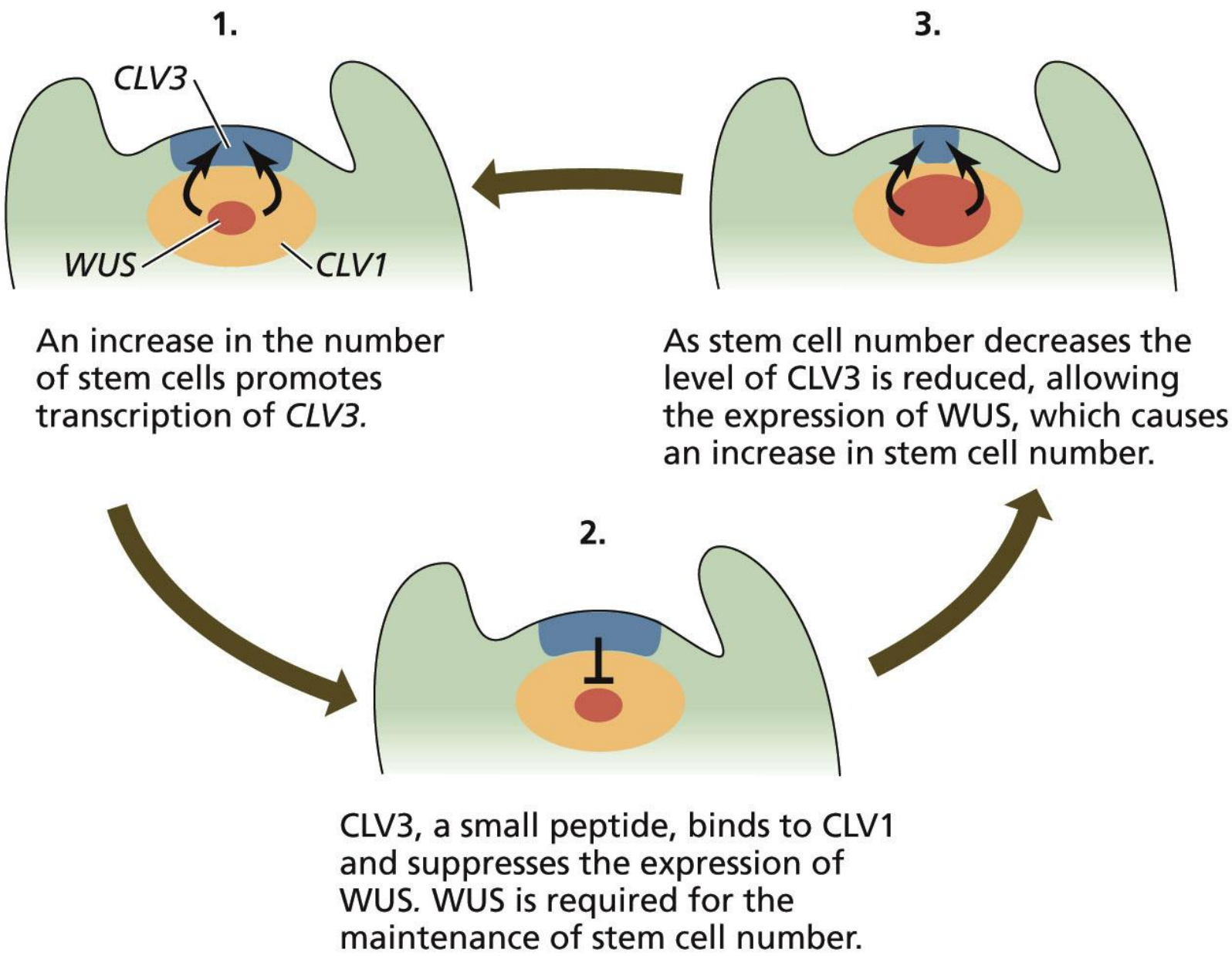
In the shoot CLAVATA3 gene (CLV3 (green)) is expressed in the central zone in the upper layers. CLAVATA1 gene (CLV1) is expressed subterminally (yellow) and overlaps with WUSHEL gene (WUS) expression (red). WUS promotes CLV3 function in the cells above it (arrow) and CLV3 signals through CLV1 to repress spreading of WUS (green bars). **Current Opinion in Genetics & Development 2003, 13:551–557**

# Figure 16.26 Model of the CLAVATA1/CLAVATA2 receptor kinase signaling cascade




***PLANT PHYSIOLOGY*, 5e, Figure 16.26**

# Figure 16.27 Model of the feedback loop that maintains initial cells in the SAM




***PLANT PHYSIOLOGY*, 5e, Figure 16.27**

# Apical Meristem

FROM THE FOLLOWING ARTICLE:

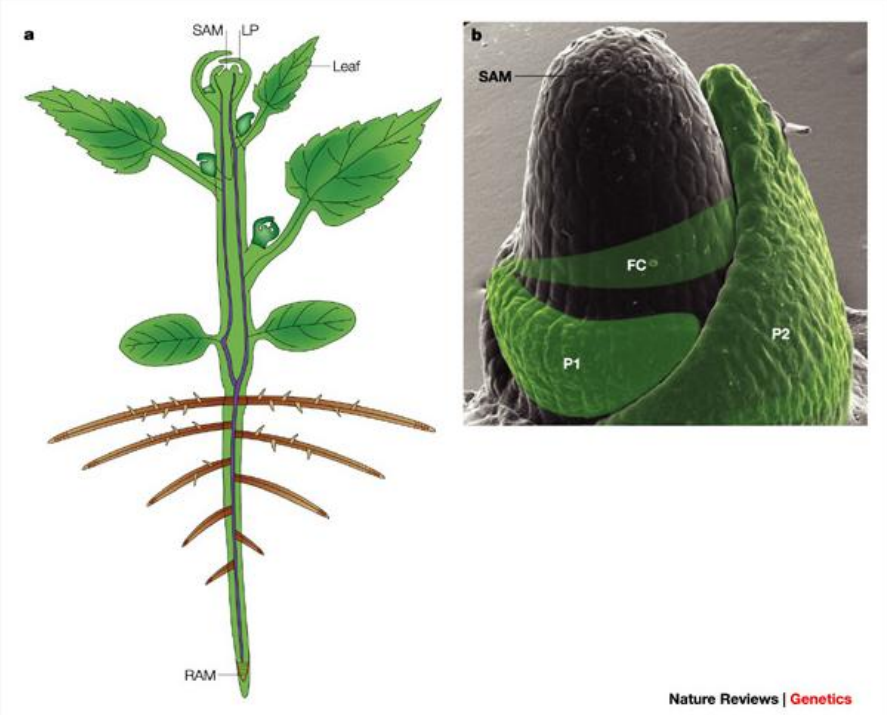
**Comparative plant development: the time of the leaf?**

Miltos Tsiantis & Angela Hay

*Nature Reviews Genetics* **4**, 169-180 (March 2003)

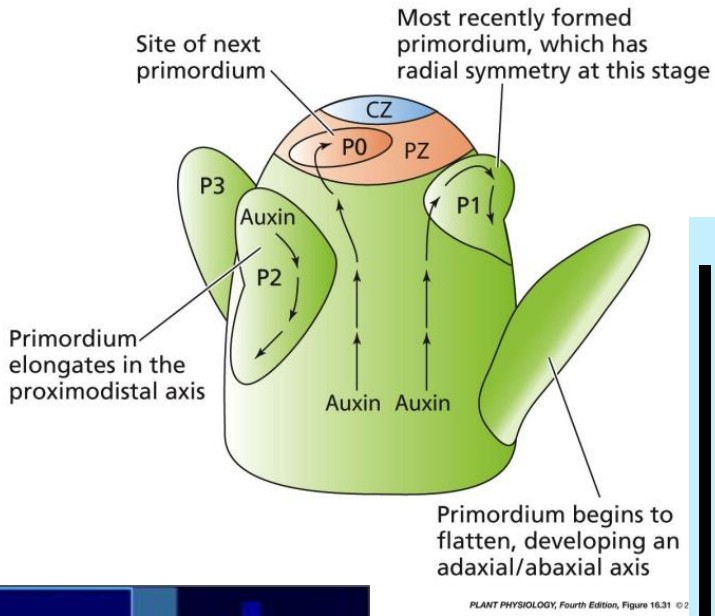
doi:10.1038/nrg1002

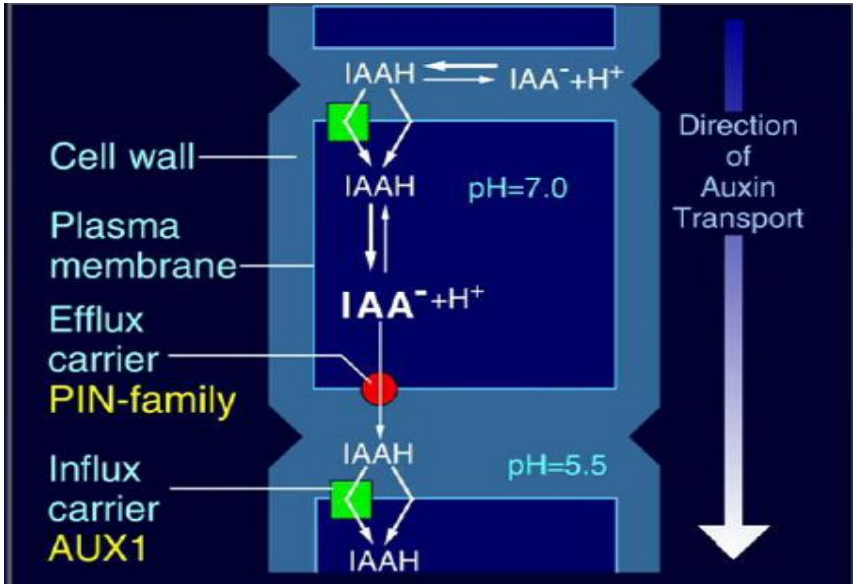
‹ Back to article | ‹ Back to figures and tables | Next figure ›




**a** | Diagram of a whole plant showing the shoot apical meristem (SAM) at the above-ground growing tip and the root apical meristem (RAM) at the below-ground growing tip. A leaf primordium (LP) is indicated at the flanks of the SAM and a mature leaf is indicated further away from the SAM. **b** | Scanning electron micrograph of a young maize apex showing the SAM with the two youngest leaf primordia — PLASTOCHRON 1 (P1) and P2, indicated in green — initiating on its flanks. The founder-cell population (FC) that will give rise to the next leaf primordium is also indicated in green. Panel **a** modified with permission from Ref. 121 © (1994) Elsevier Science.

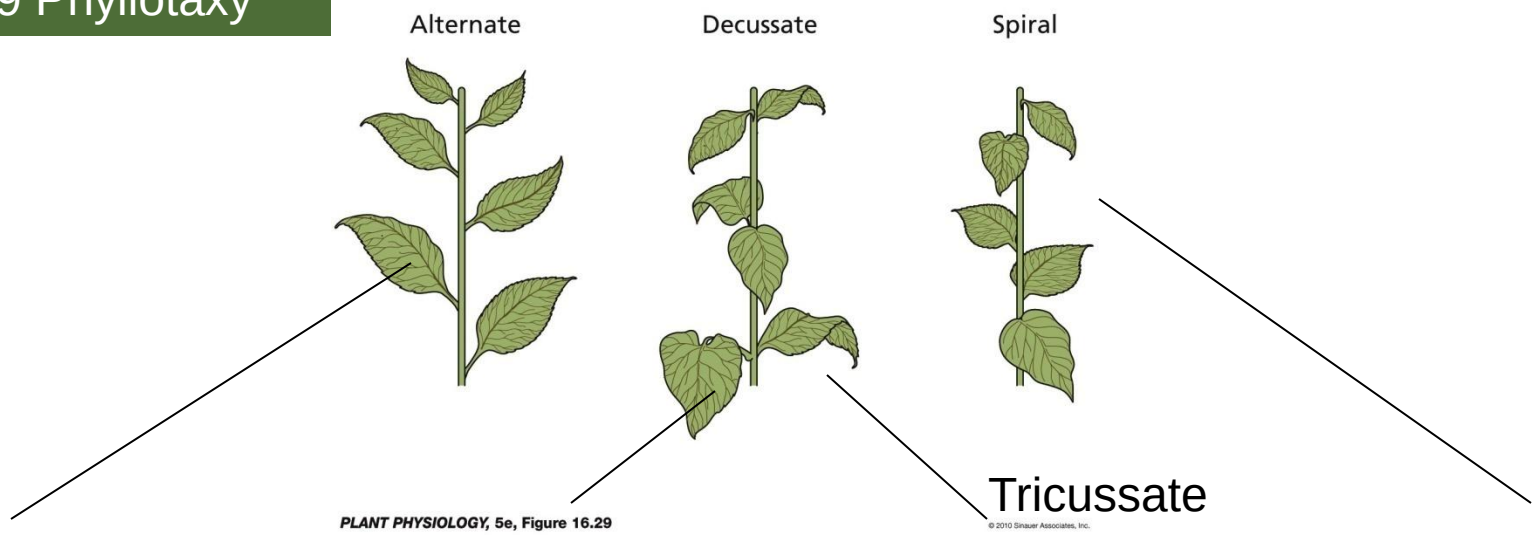
# Fig 16.30 Leaf Development and Auxin Transport



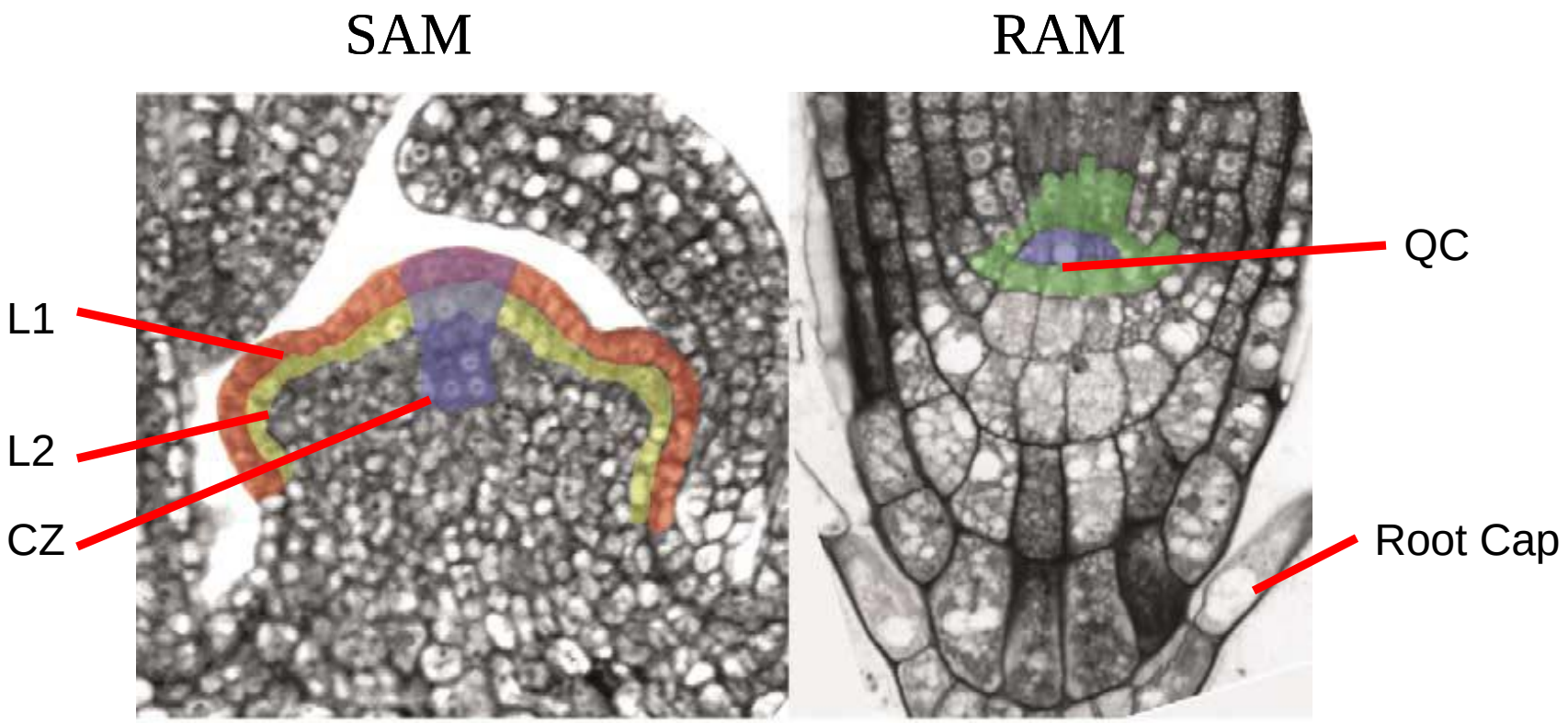




- Collection of founder cells and choice of site
- Commitment to initiate
- Primordium formation
- Establishment of radial symmetry
- Primordium elongation
- Primordium expansion and development of abaxial and adaxial surfaces
- Leaf growth in size
- Mature leaf

# Fig 16.29 Phyllotaxy

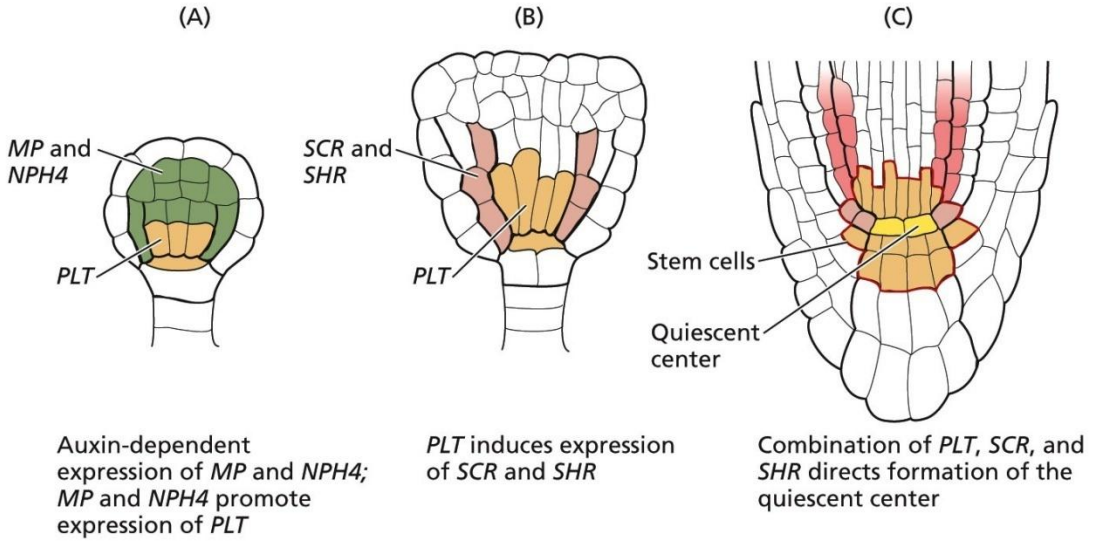



**Source: A plausible model of phyllotaxis**
Smith *et al*. 10.1073/pnas.0510457103.
http://www.pnas.org/content/103/5/1301/suppl/DC1



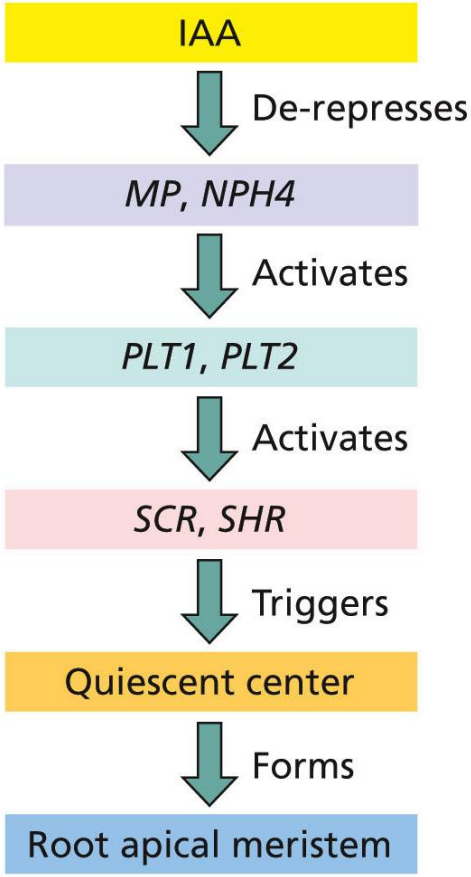

The shoot and root apical meristems. (a) The layered structure of the shoot apical meristem (SAM). The outermost layer (L1) is shown in red, the second (L2), in yellow. Blue marks the slowly dividing central zone (CZ). (b) The root apical meristem (RAM) is subterminal, but like the shoot apical meristem has a layered structure and a center of slowly dividing cells (the Quiescent Center (QC, shown in blue) surrounded by the initials for individual tissue (shown in green). **Current Opinion in Genetics & Development 2003, 13:551–557**

# FIG 16.19 Role of MP, PLT and SCR, SHR proteins in RAM maintenance

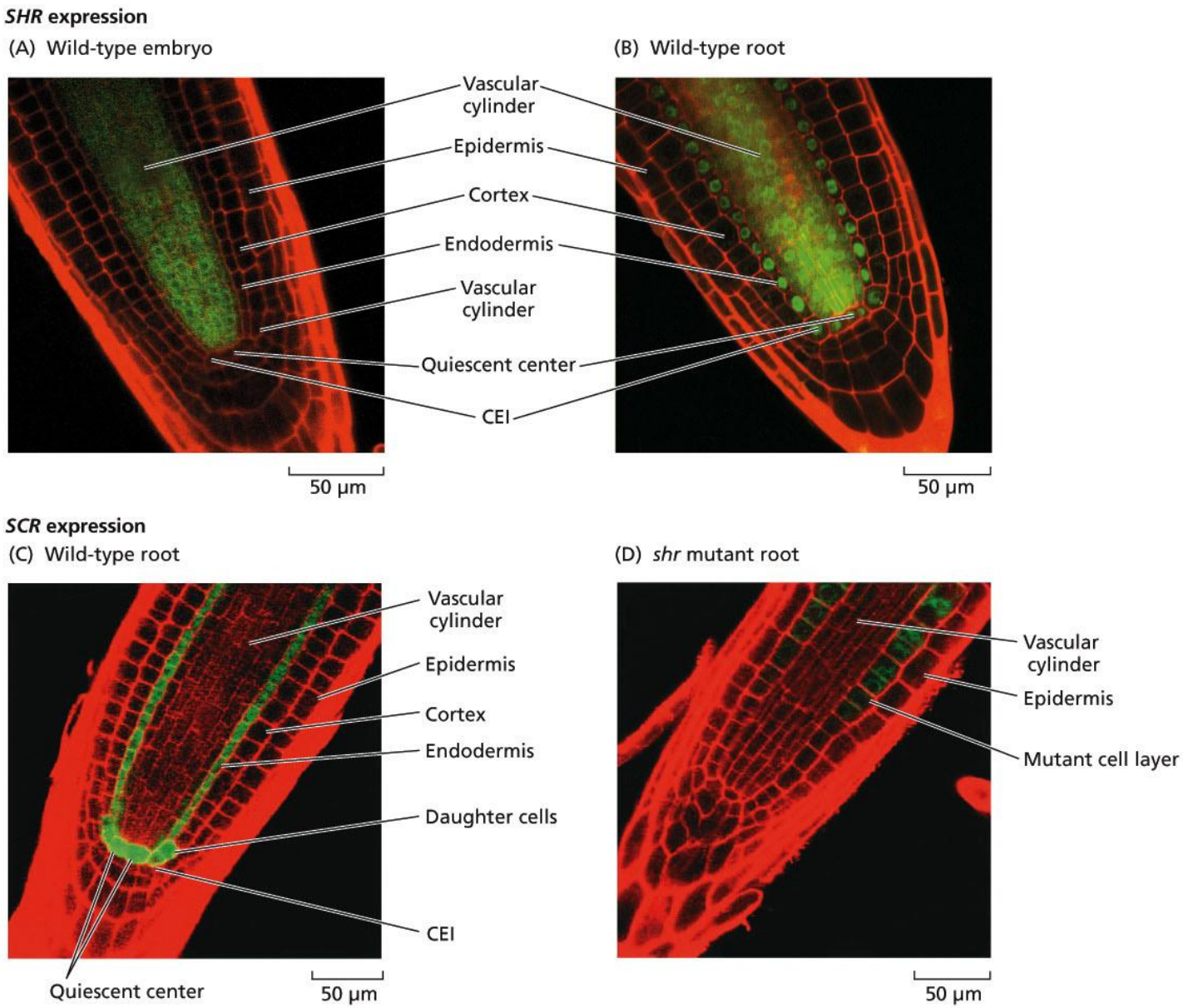



**PLANT PHYSIOLOGY, 5e, Figure 16.19**

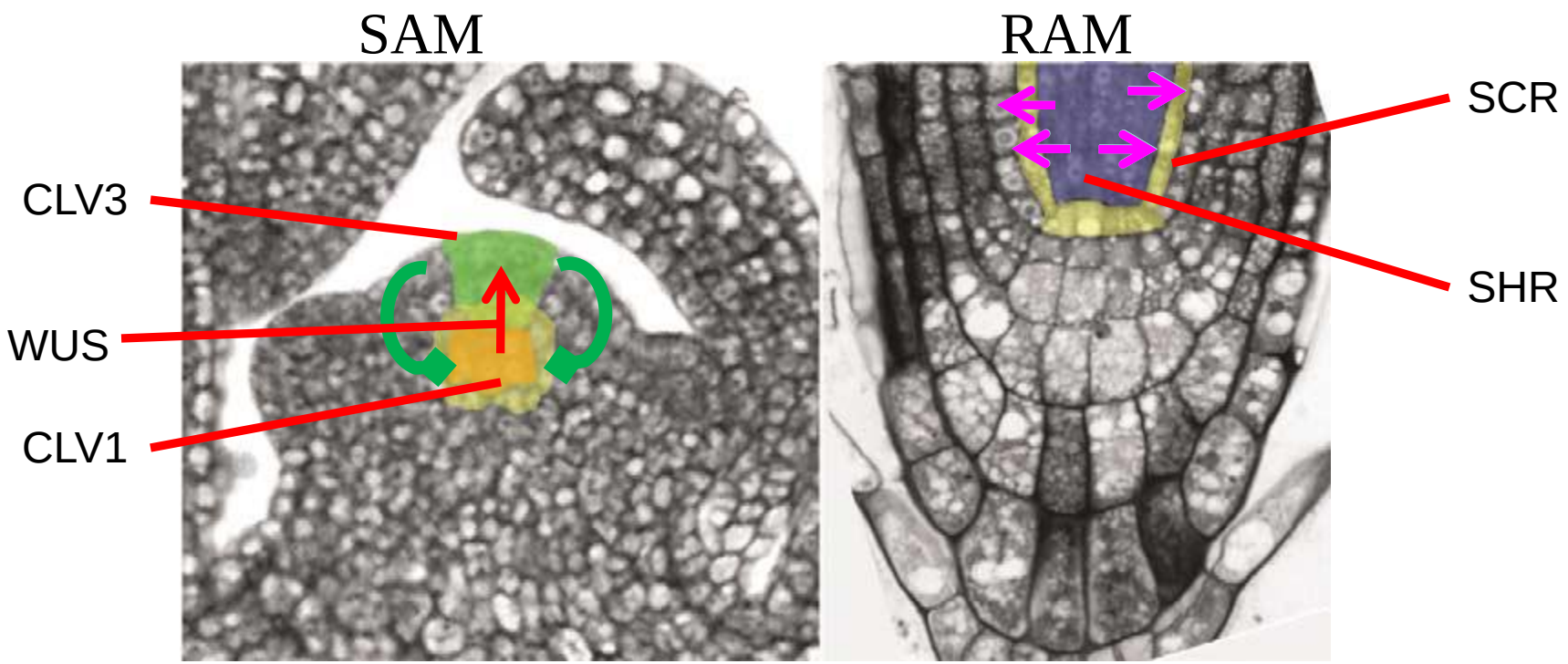




# Figure 16.14 *SHR*, *SCR* in Arabidopsis control tissue patterning during root development

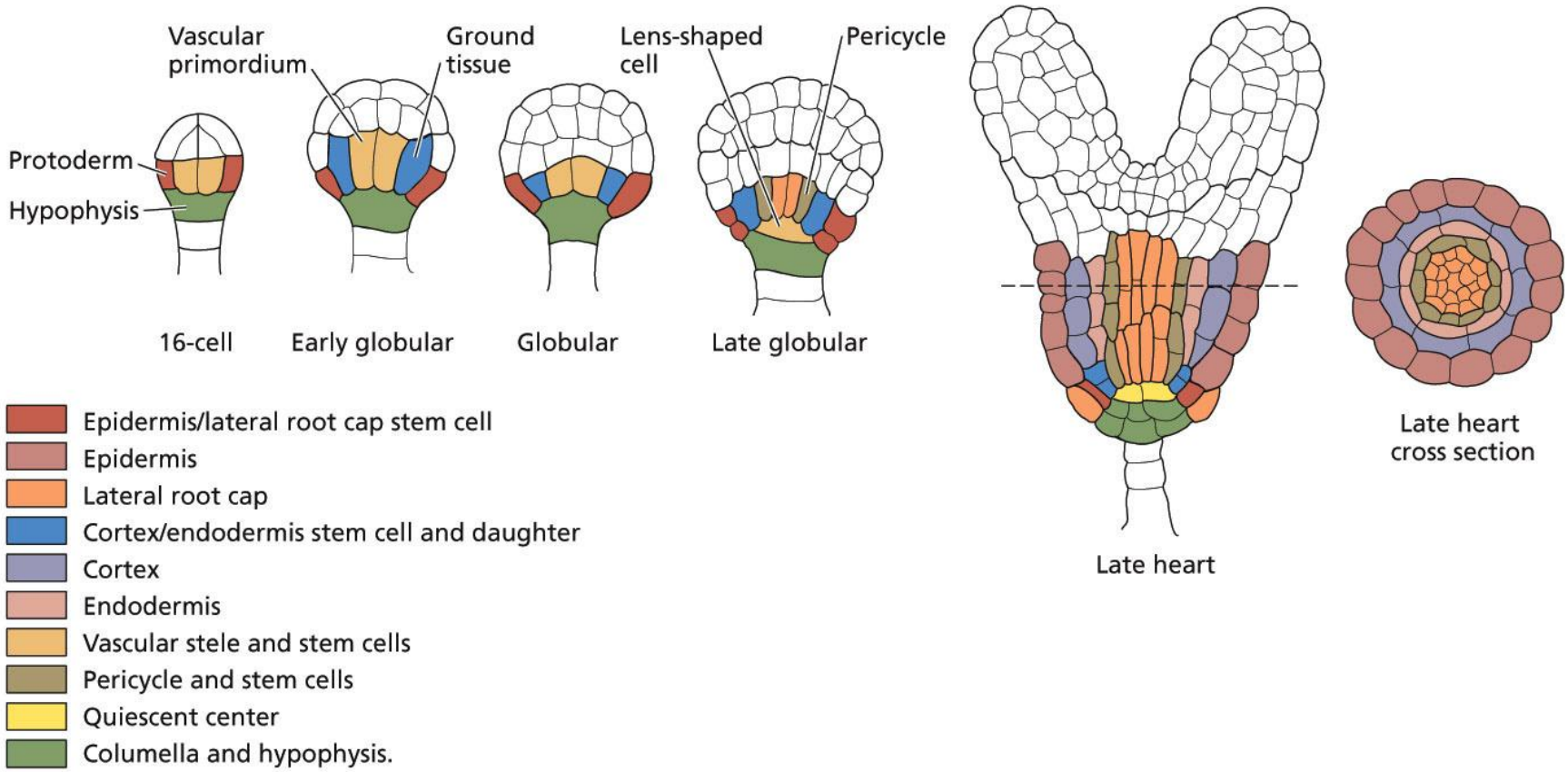



**PLANT PHYSIOLOGY, 5e, Figure 16.14**



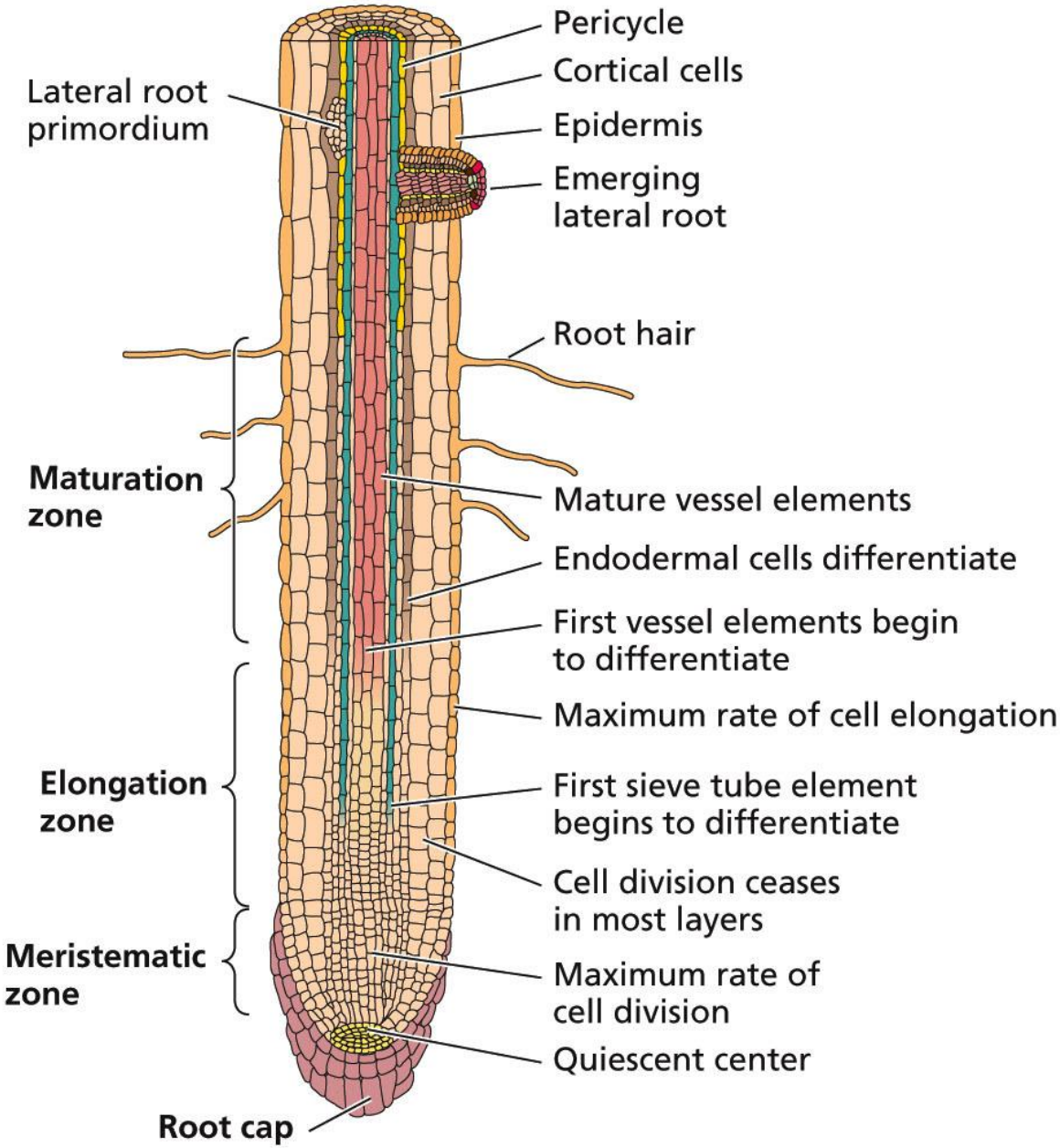

The gene expression patterns underlying meristem organization. (a) In the shoot CLV3 (green) is expressed in the central zone in the upper layers. CLV1 is expressed subterminally (yellow) and overlaps with WUS expression (red). WUS promotes CLV3 function in the cells above it (arrow) and CLV3 signals through CLV1 to repress spreading of WUS (bars). (b) in the root apical meristem SCARECROW/SCR gene (yellow) is expressed in the QC, adjacent ground tissue initials and the endodermis, SHOOT-ROOT/SHR gene (blue) is expressed in the stele and is trafficked into the adjacent cell layer, the endodermis, where it directs cell fate (purple arrows). **Current Opinion in Genetics & Development 2003, 13:551–557**

# Figure 16.10 The sequence of radial patterning events during *Arabidopsis* embryogenesis



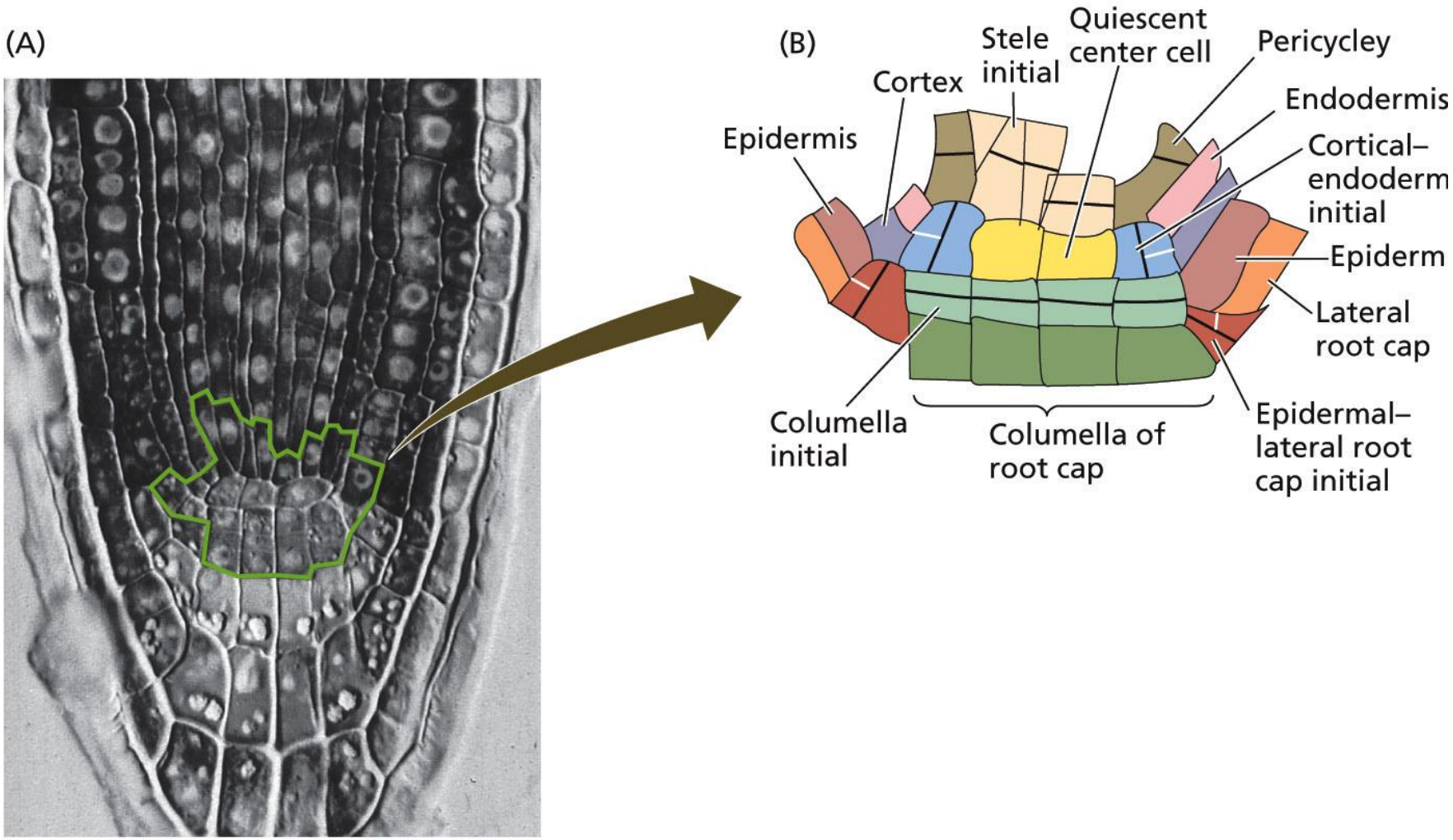

***PLANT PHYSIOLOGY*, 5e, Figure 16.10**

# Figure 16.16 Simplified diagram of a primary root



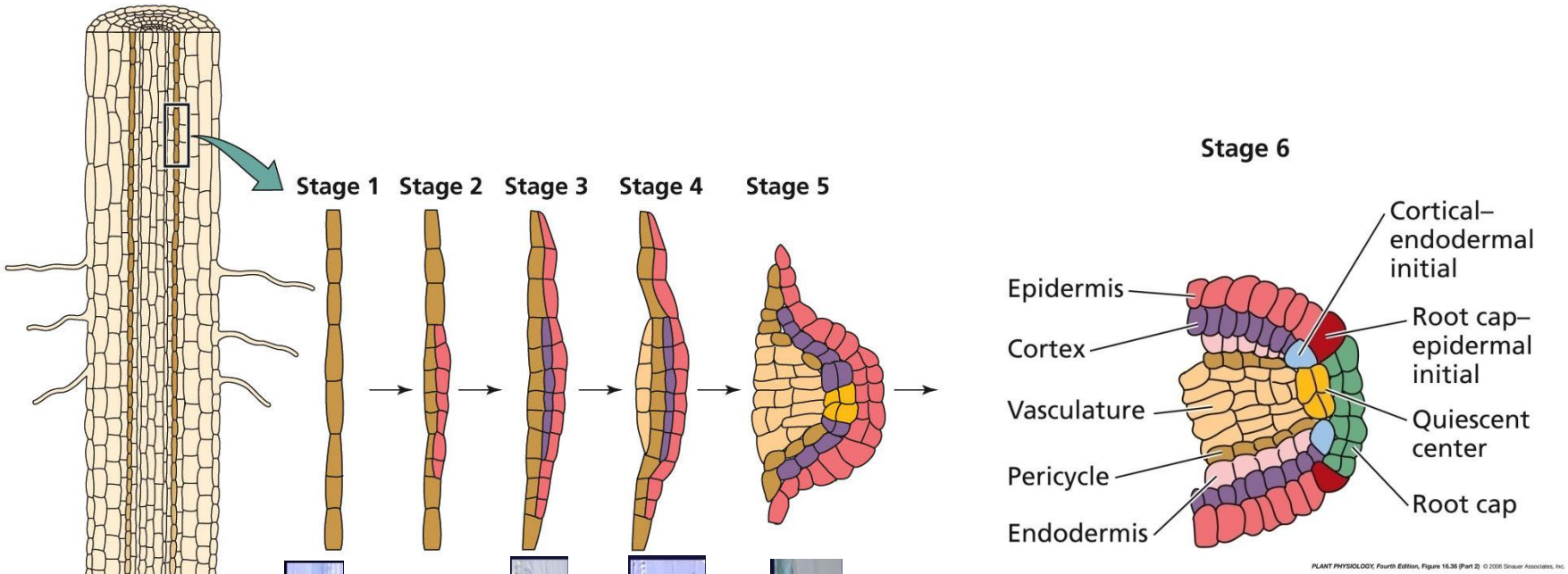

***PLANT PHYSIOLOGY*, 5e, Figure 16.16**

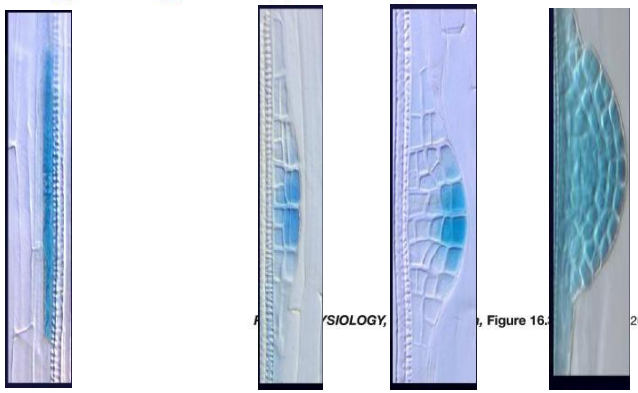
# Figure 16.17 All tissues in Arabidopsis root are derived from a small number of initial cells




***PLANT PHYSIOLOGY*, 5e, Figure 16.17**

# Fig 16.34 Lateral root Development

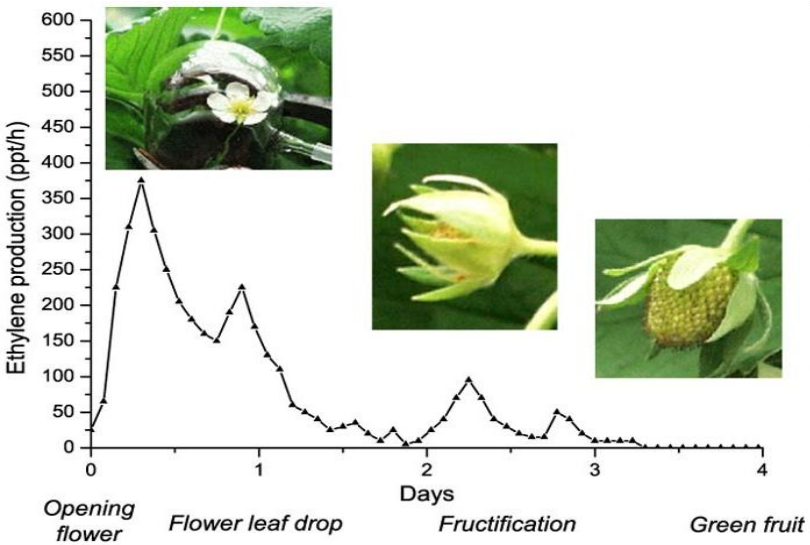


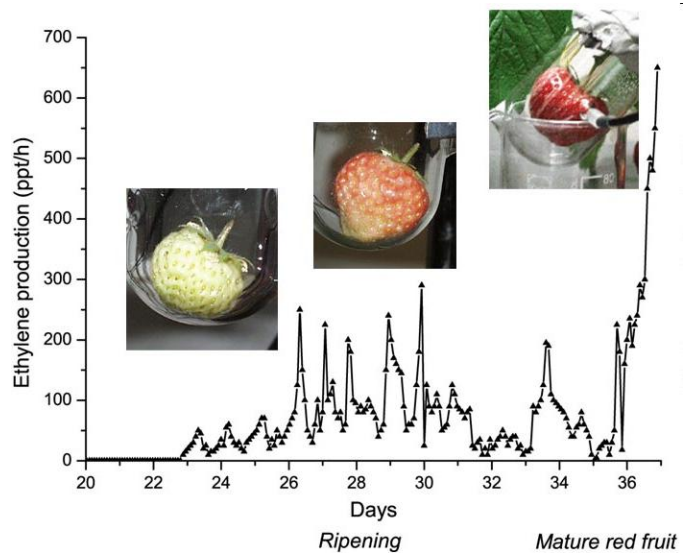



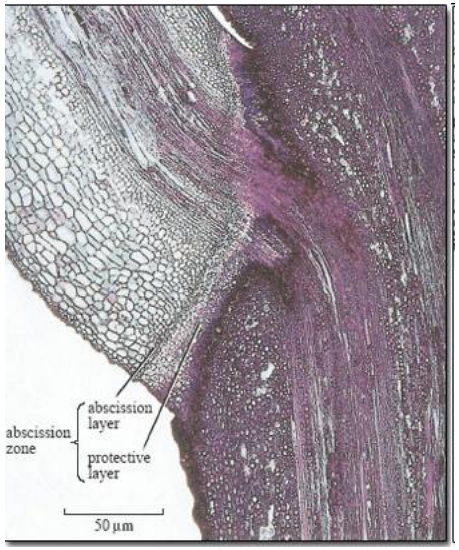
DR5-GUS

PIN-GFP

# Senescence and Ripening






Images from Google

## Growth and Development
## Things to Remember

- Mutations: insertion, deletion, frameshift, substitution (SNP and FNP)
- LifeCycle various stages
- Growth, Development, Morphogenesis, Embryogenesis (difference in rice and Arabidopsis), fertilization, Double fertilization.
- Determinate and indeterminate growth
- Apical and basal cell function
- Plant Structures: Cotyledon, scutellum, Caryopsis, Silique, Shoot and Root apical meristems, lateral root, Primary root zones, Potent cells, adaxial and abaxial surfaces, sporophyte, gametophyte, plastochron.
- Genes: WUSCHEL, CLAVATA1/2/3 , SCR, SHR, PIN1, Homeobox genes
- Phenotypes:
  - Embryo lethal (e.g. Gurke, Monopteris, Gnom, Frackel), Phyllotaxy,
- Morphogens
- Uses of reporter genes (GUS and GFP)
- Gene to gene interactions (protein-protein, protein-DNA, RNA-RNA)