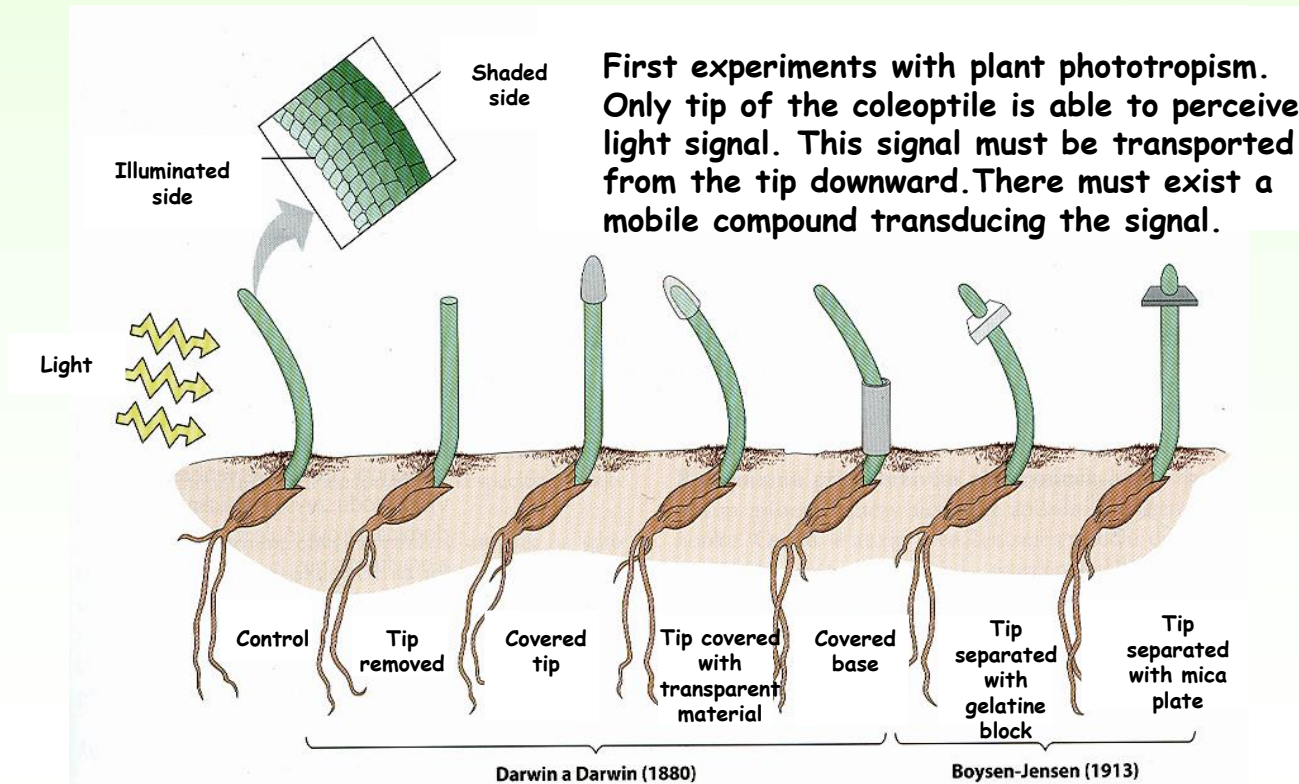


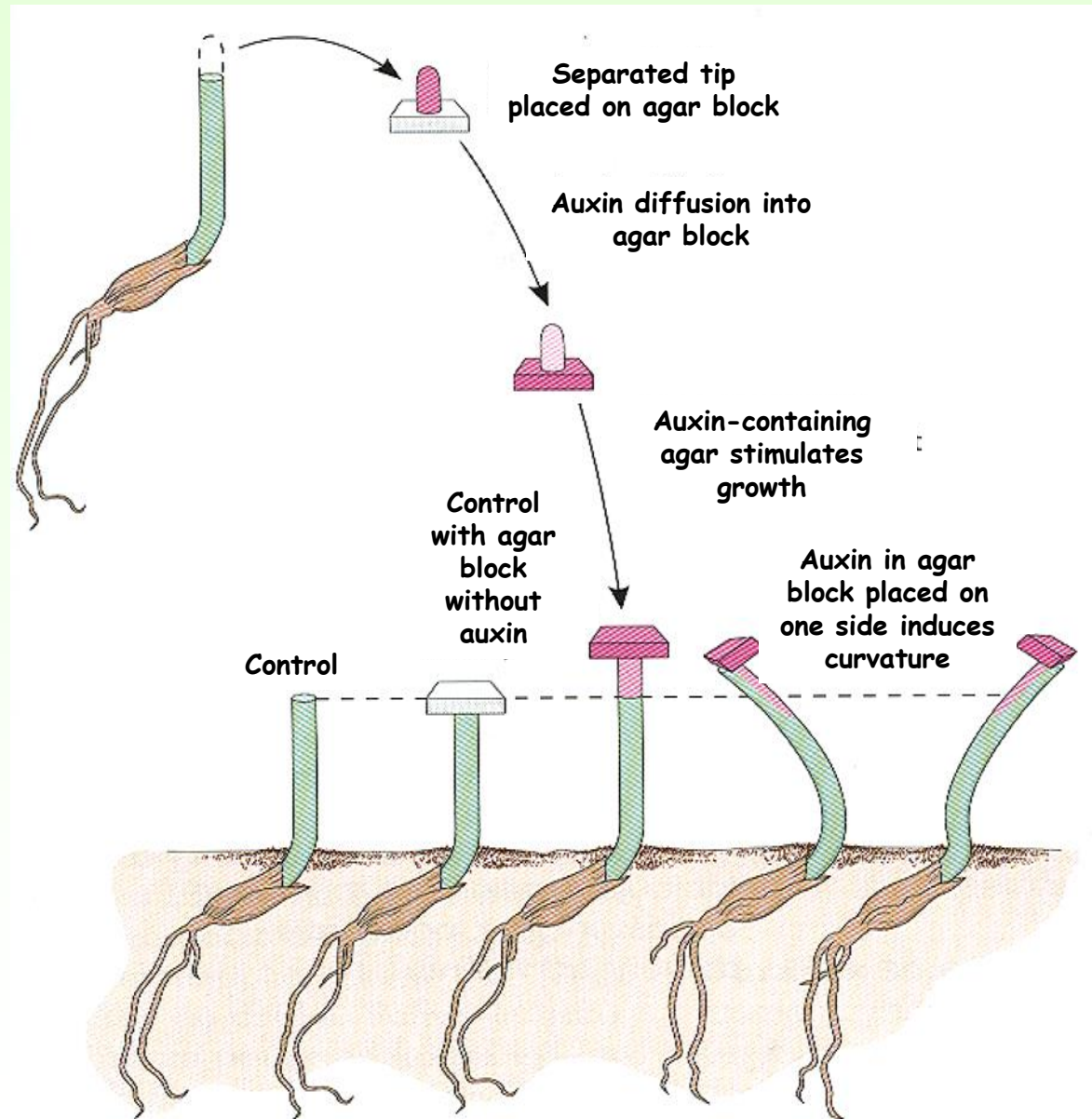
Auxin - discovery

- The oldest known phytohormone
- Darwin 1880, Boysen-Jensen 1913, Went 1928 - *Avena* coleoptile tests demonstrated the existence of the effective compound that induces cell elongation (auxein=growth in Greek)
- Kögl 1933 - identification of the compound in human urine as indole-3-acetic acid (IAA), 1946 confirmed in higher plants



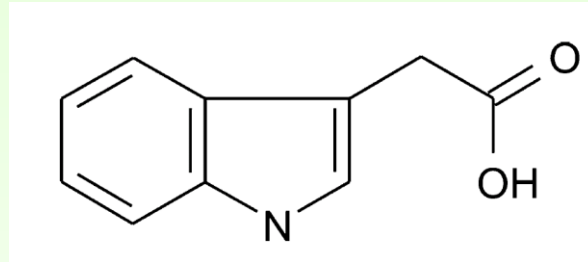
Auxin - discovery

- F.W. Went,
1924-1928, *Avena*
curvature test

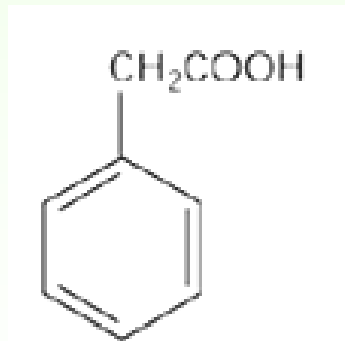


Auxins - low molecular weight organic acids

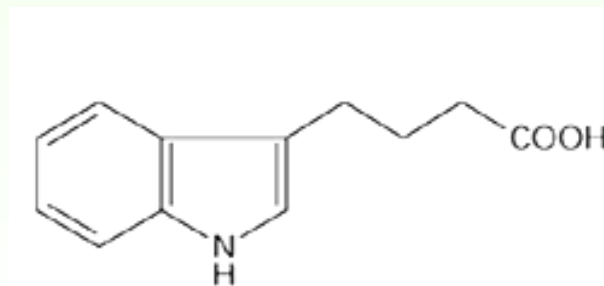
- Native auxins are weak organic acids, biosynthesis in young, dividing cells, i.e. in meristems, embryos and developing fruits.



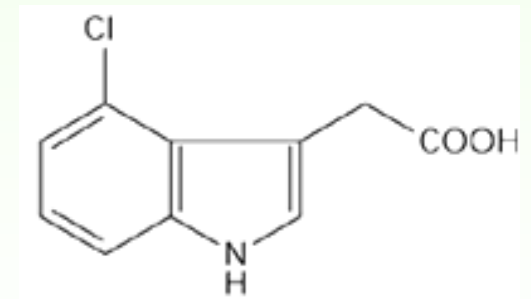
Indole-3-acetic acid (IAA)



Phenylacetic acid



Indole-3-butyric acid (IBA)



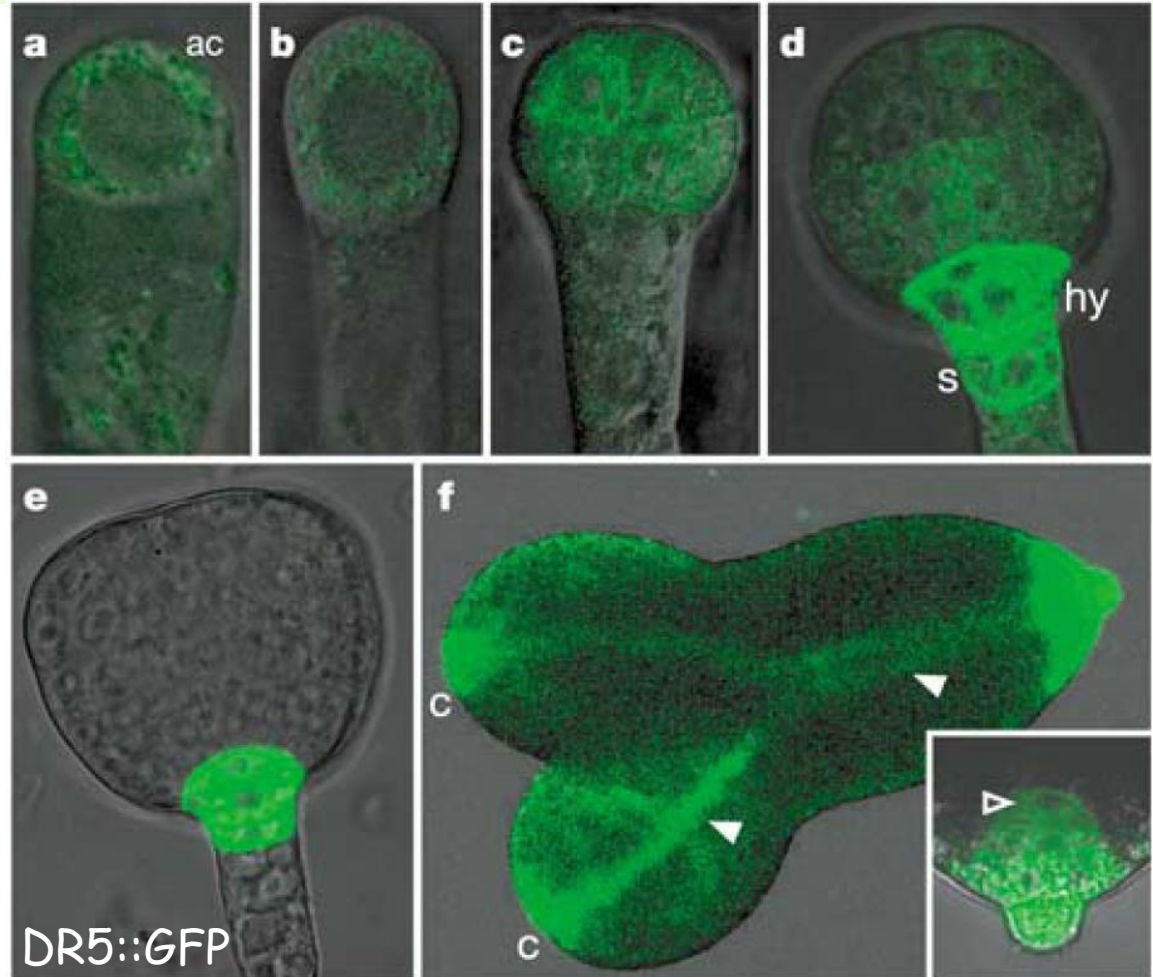
4-Chloroindole-3-acetic acid

Auxin - physiological effects

- It plays the role in almost all stages of plant development from the embryogenesis, through the correct development of roots, stems, leafs and flowers, to the fruit development and abscission

Embryogenesis

- auxin in the apical cell after the zygote cell division, later on the maximum is shifted into the hypophysis and uppermost suspensor cell



Auxin - physiological effects

- It is essential for the cell division in the in vitro-grown plant cell suspensions



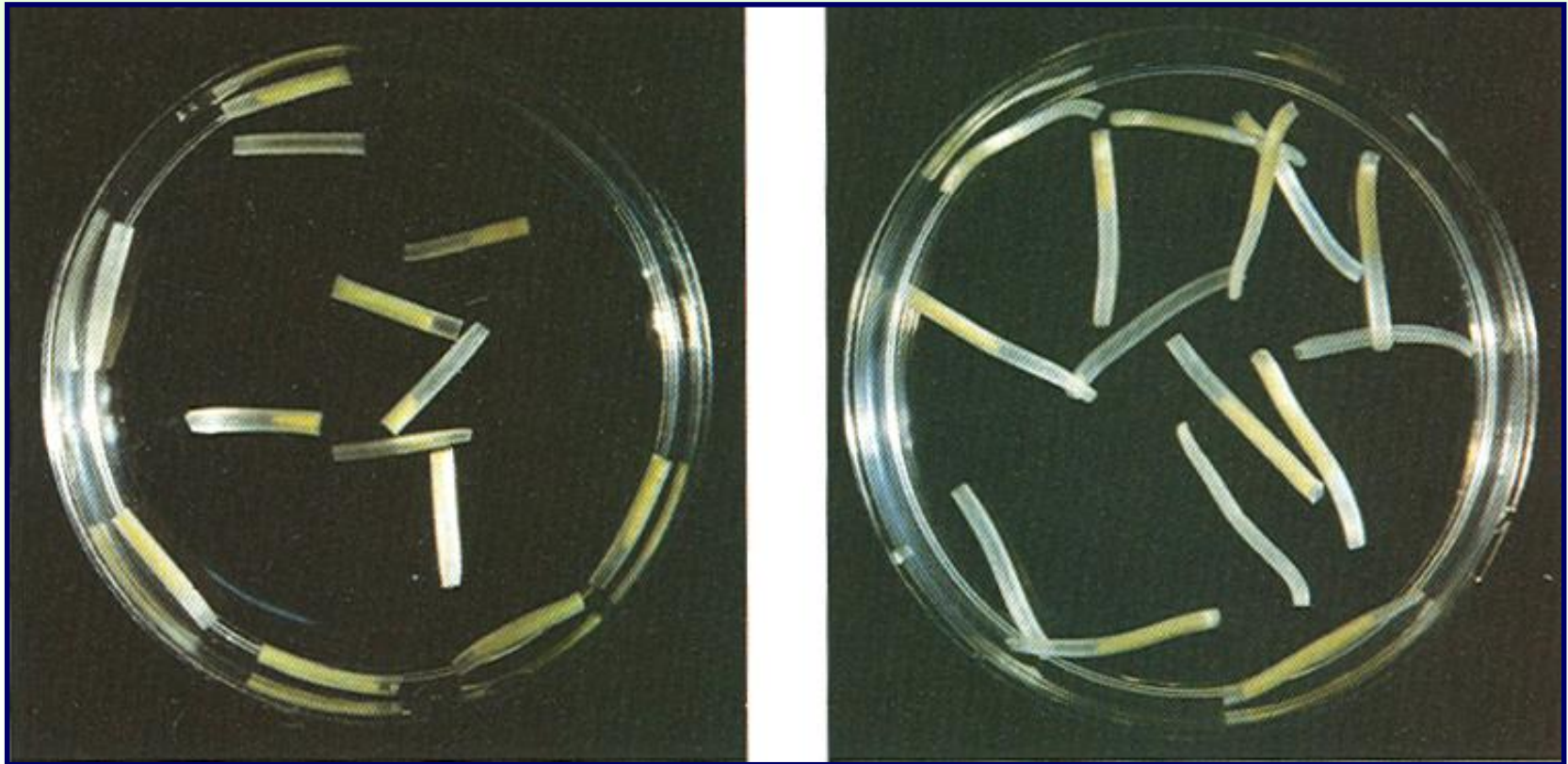
Suspension culture of tobacco BY-2

Auxin - physiological effects

- Stimulation of elongation growth - oat coleoptile segments

H₂O

IAA

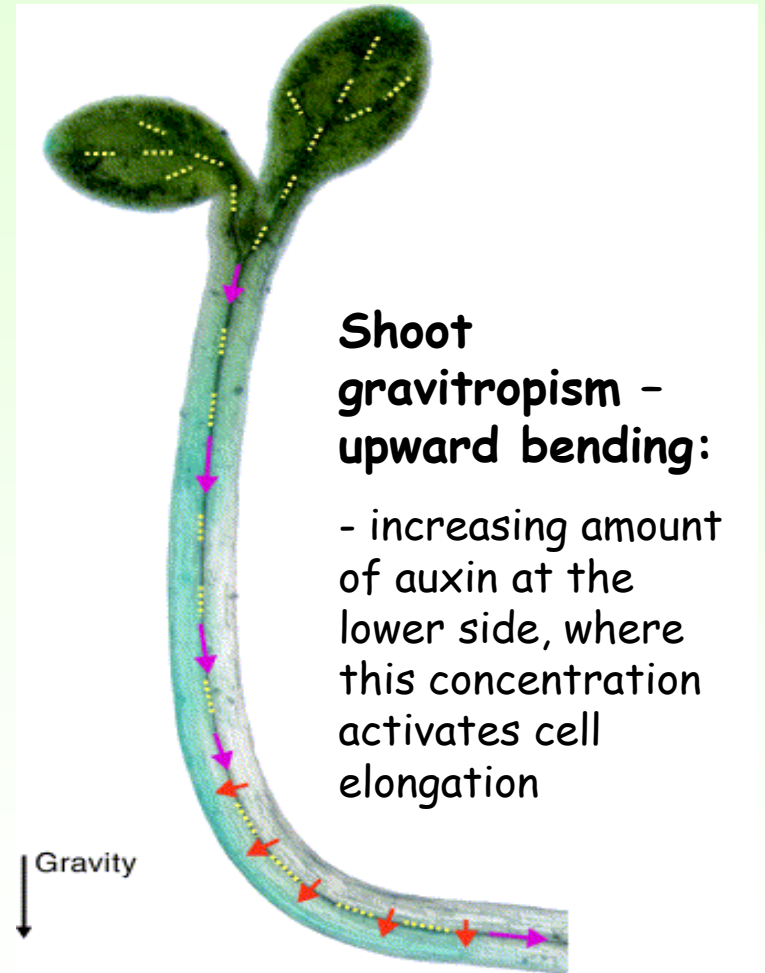
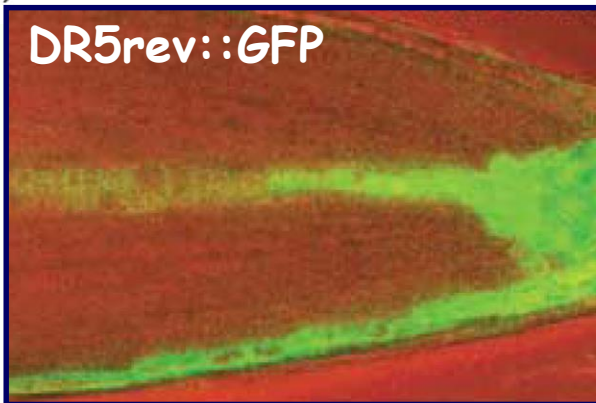
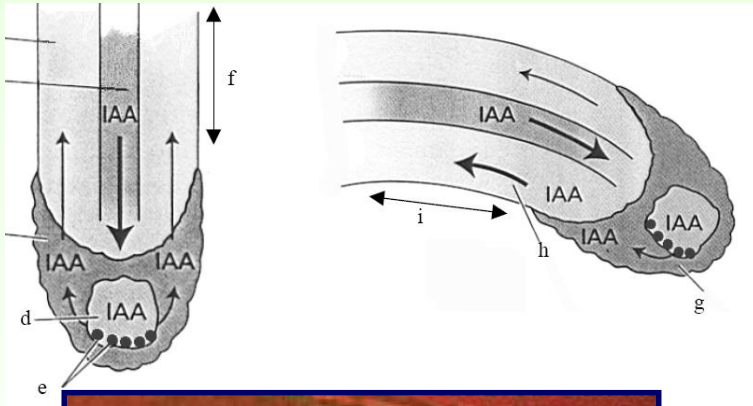


Auxin - physiological effects

- Regulation of tropisms - root positive gravitropism and shoot negative gravitropism

Root gravitropism - downward bending:

- increasing amount of auxin at the lower side, where this concentration inhibits cell elongation



Shoot gravitropism - upward bending:

- increasing amount of auxin at the lower side, where this concentration activates cell elongation

Auxin - physiological effects

- Regulation of tropisms - shoot phototropism:
 - accumulation of auxin at the shaded side of the stem, where this concentration stimulates cell elongation
 - auxin relocation is seemingly related to the phosphorylation cascades triggered by light perception with phototropin

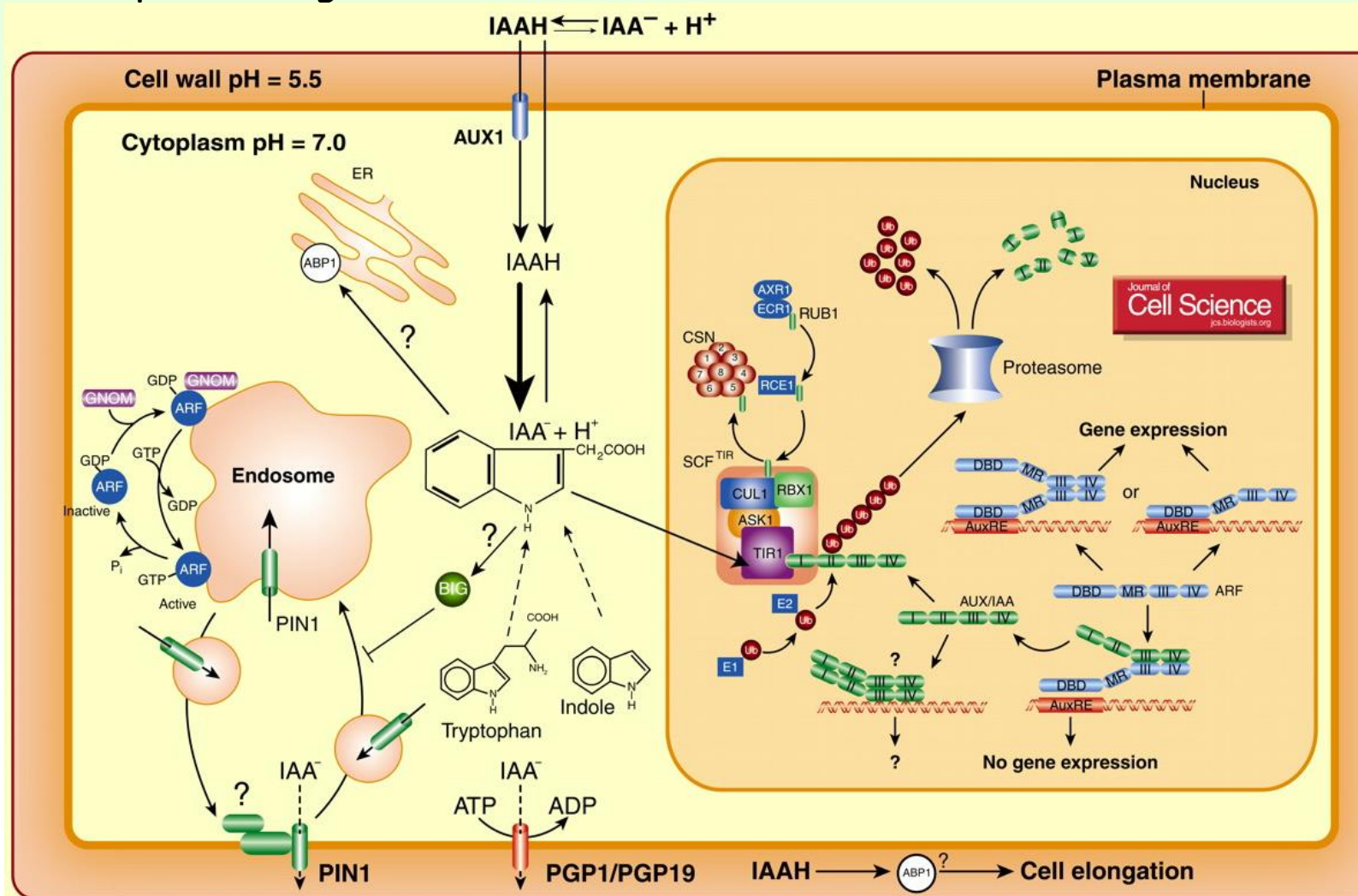
DR5::GUS

← light



Auxin – summary of mechanisms

- Mechanism of action - the activation of the specific degradation of transcriptional regulators



Auxin - directional transport

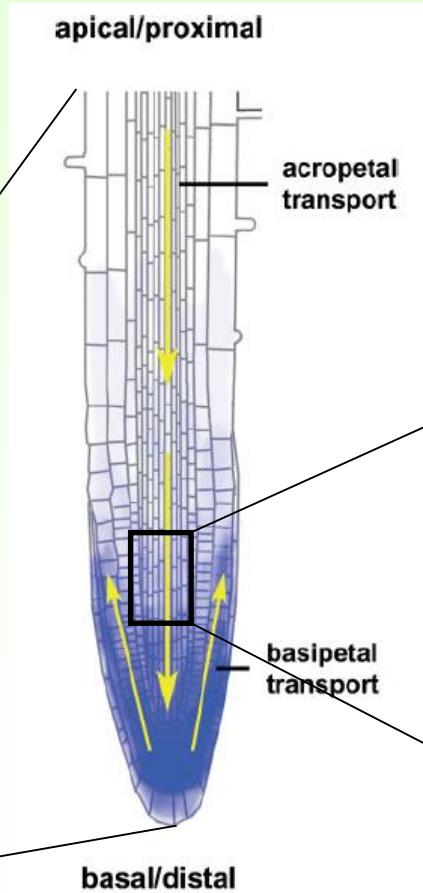
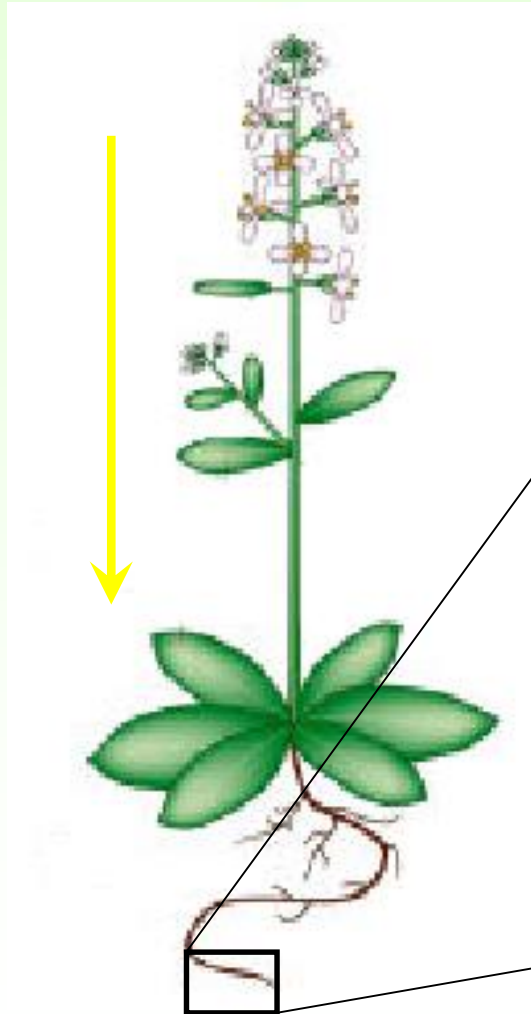
Plant

Root

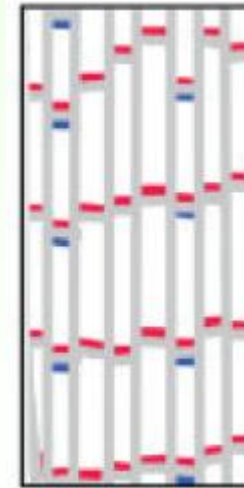
→ Direction of auxin flow

■ Auxin efflux carrier

■ Auxin influx carrier



**Parenchyma
protophloem cells**

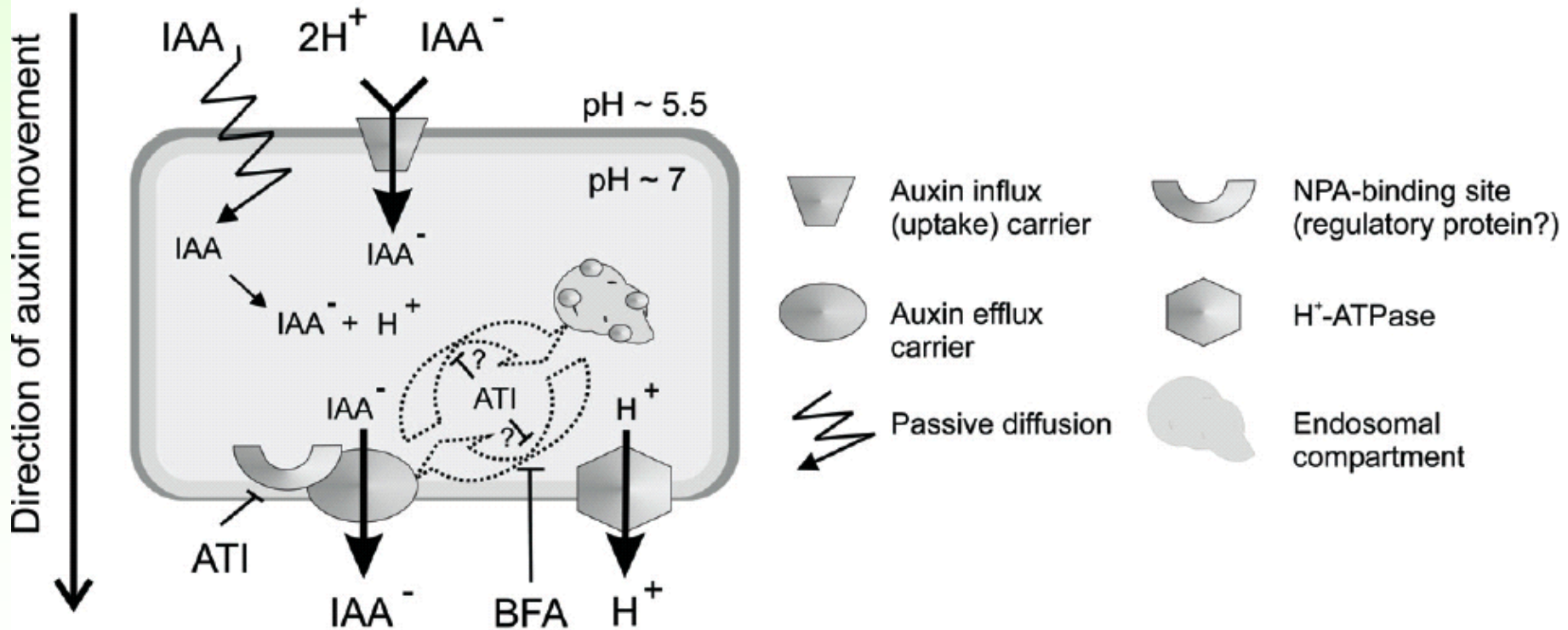


(Modified from Grebe, BioEssays 26, 719, 2004)



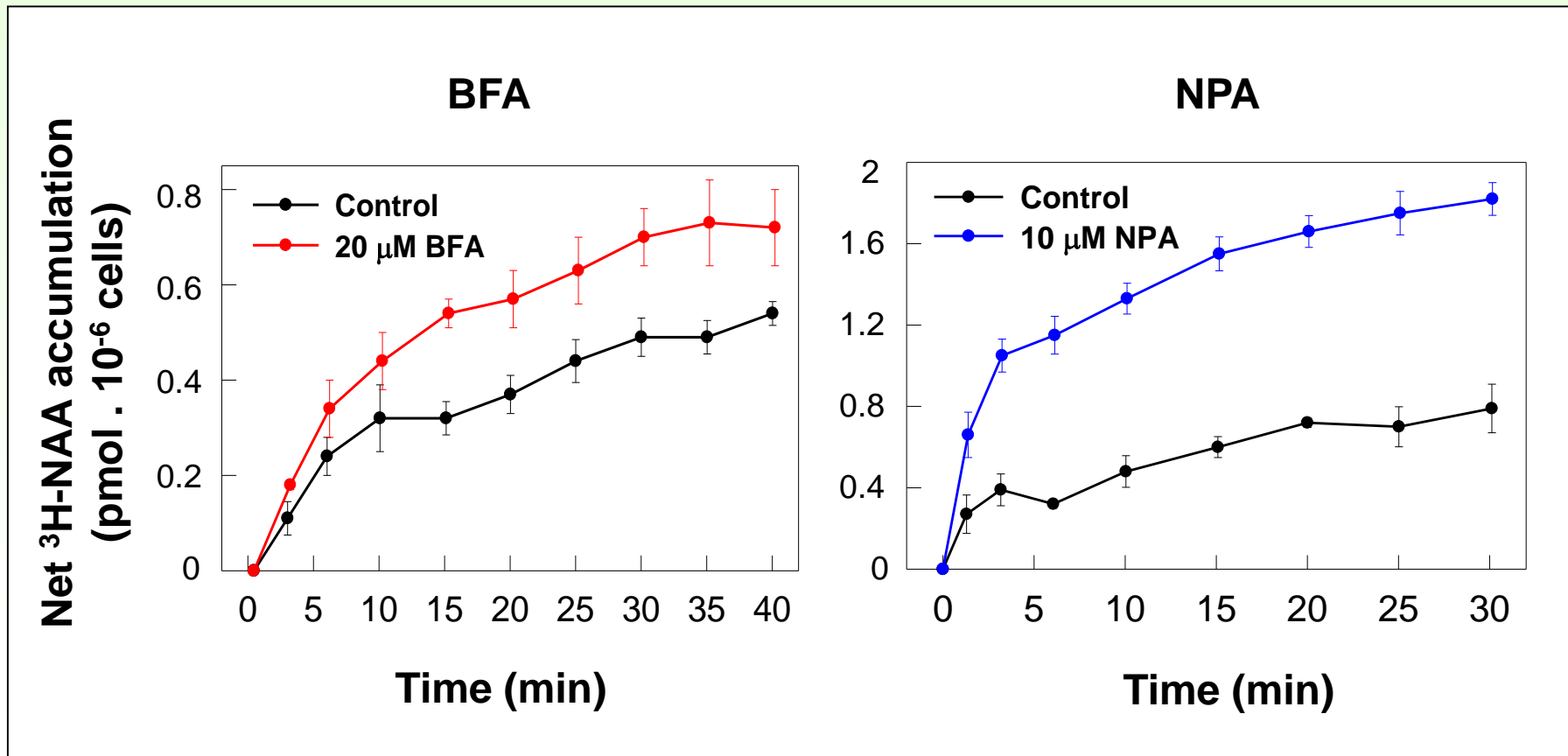
Auxin - directional transport

- Besides long distance transport in vasculature, specializes auxin influx and efflux carriers are used for transport of auxin across membrane



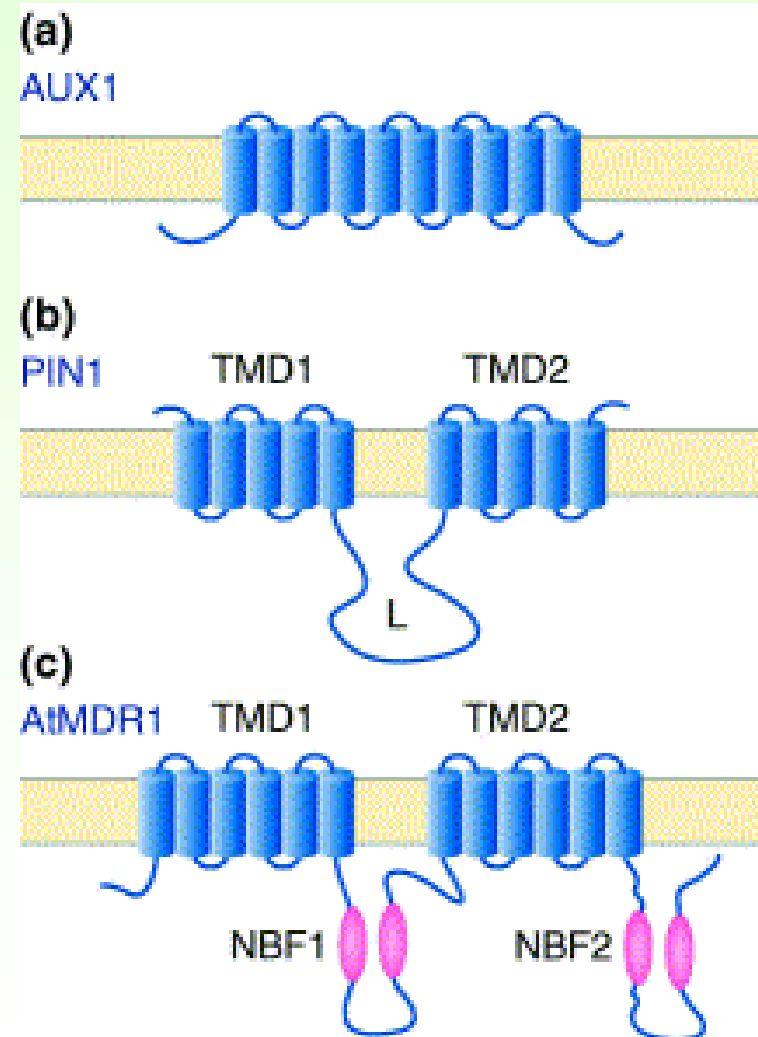
Auxin - directional transport

- The dynamics of the accumulation of radiatively-labelled auxin inside tobacco cells reflects the activity of auxin carriers as well as diffusion across membrane. After inhibition of auxin efflux carrier with NPA or BFA auxin is accumulated inside cells.



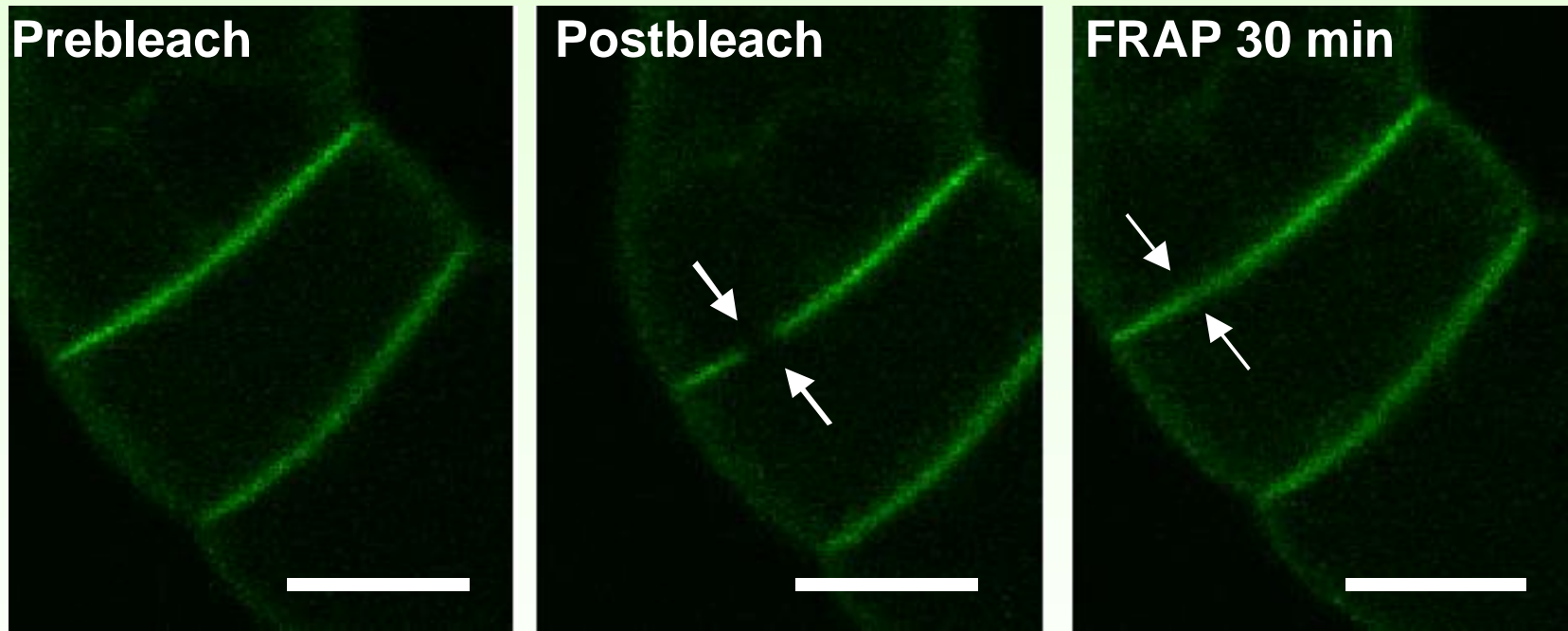
Auxin - directional transport

- Besides passive diffusion in undissociated form molecules of auxin (**IAA⁻**) are transported across membrane by specialized active transporters:
 - **AUX1/LAX** - auxin influx carriers **(a)**
 - **PINs** - auxin efflux carriers **(b)**. Contain two transmembrane domains and one hydrophilic regulatory loop.
 - **MDRs (PGPs)** - auxin efflux carriers **(c)**. Contain two transmembrane domains (**TMD**) and two nucleotide binding folds (**NBF**) for ATP binding.



Auxin – directional transport

- Auxin efflux carriers PIN localized in the plasma membrane undergo the processes of constitutive recycling in the endosomal space

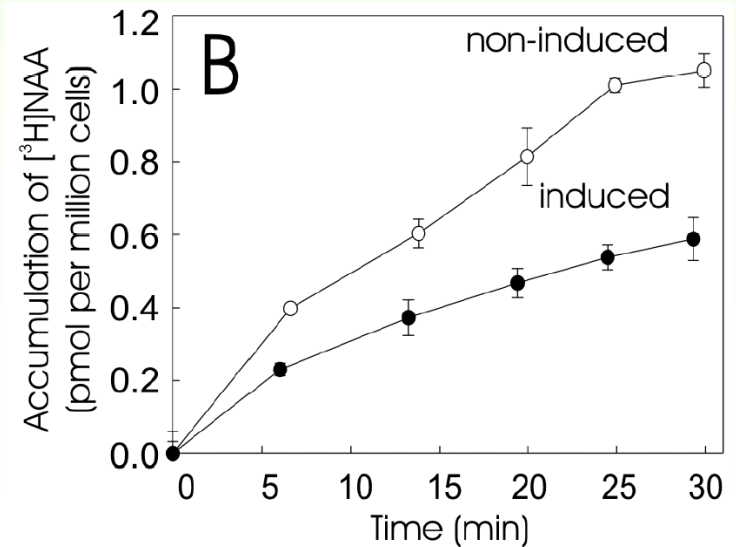
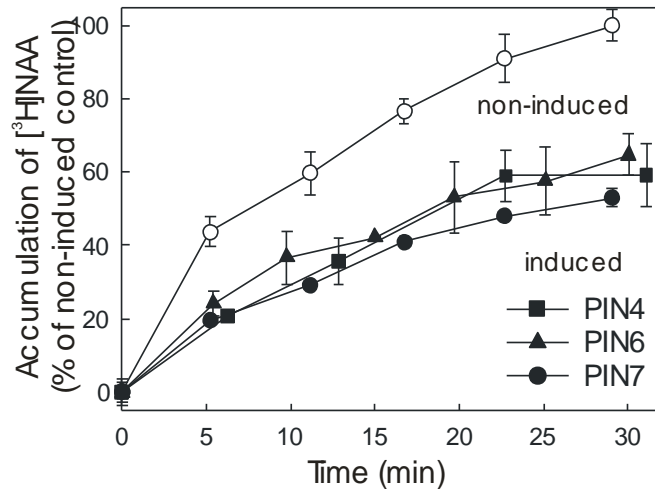
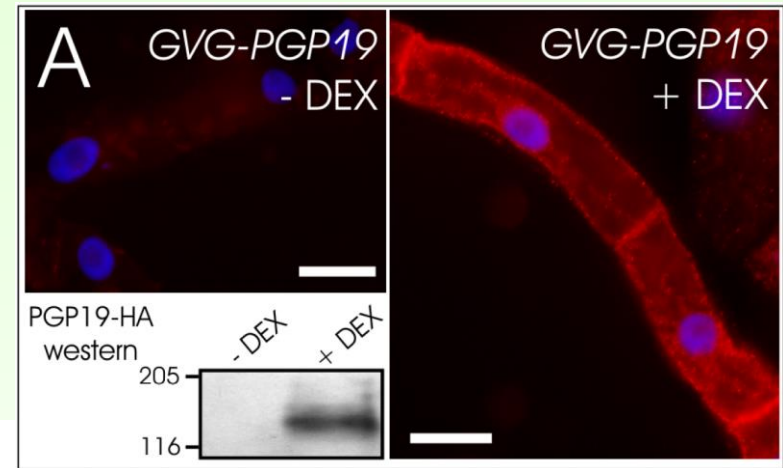
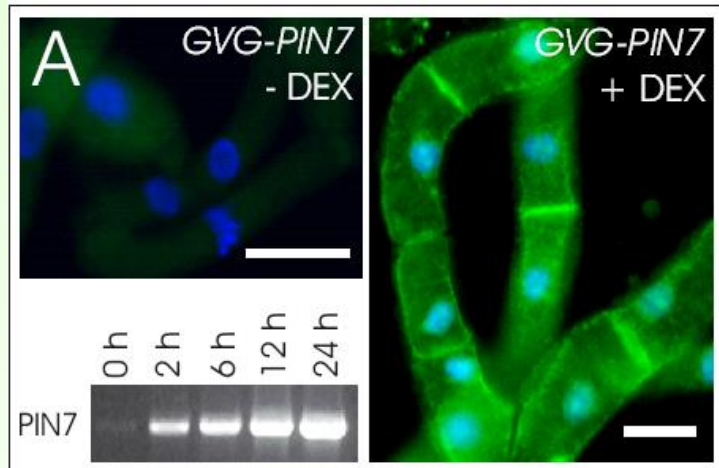


proPIN1::PIN1:GFP (*Arabidopsis thaliana*)
in BY-2 cells



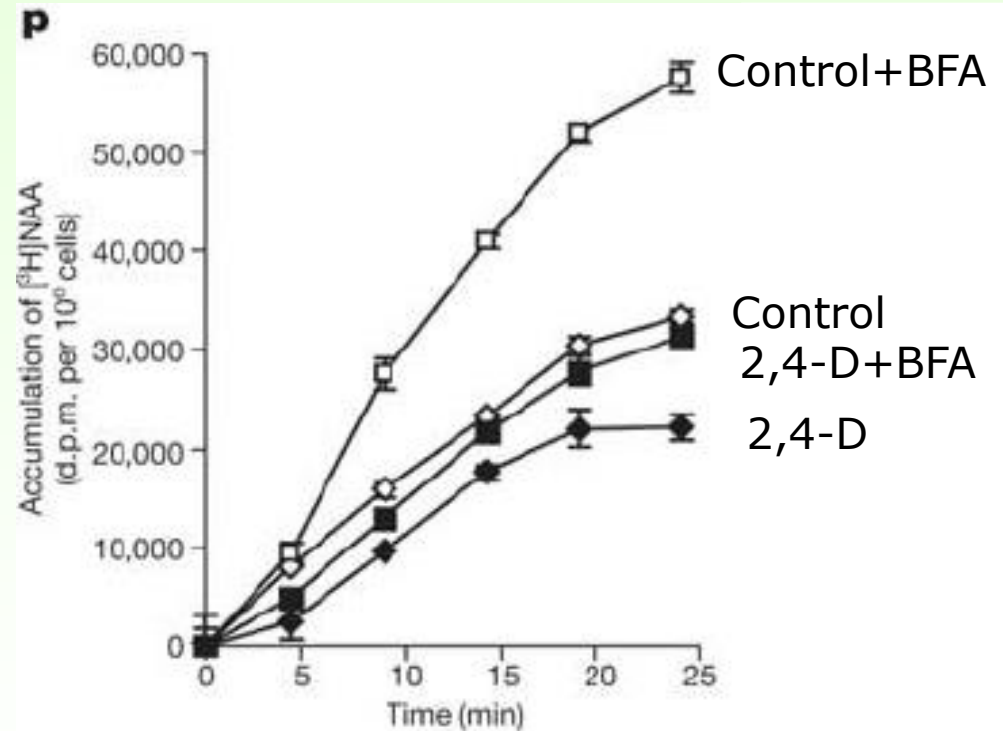
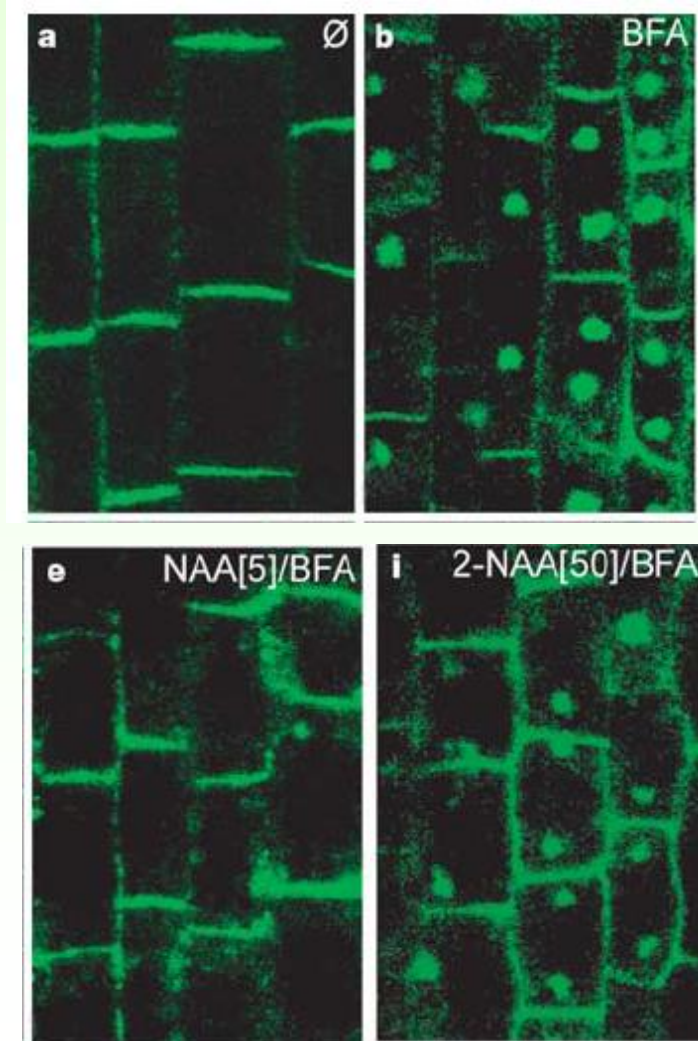
Auxin – directional transport

- Přenašeče PIN a PGP transportují auxiny přes plazmatickou membránu



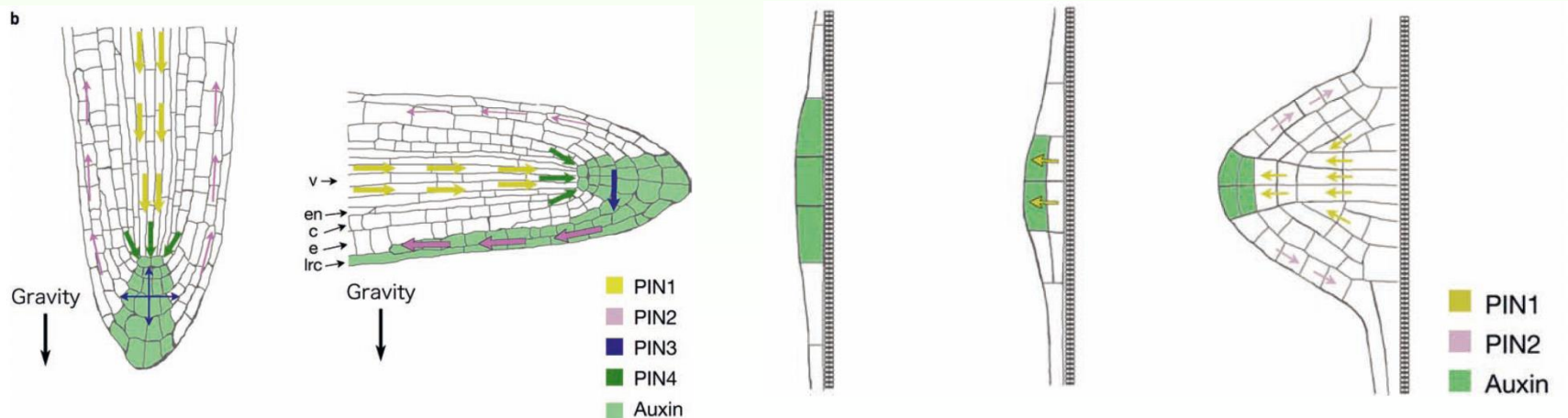
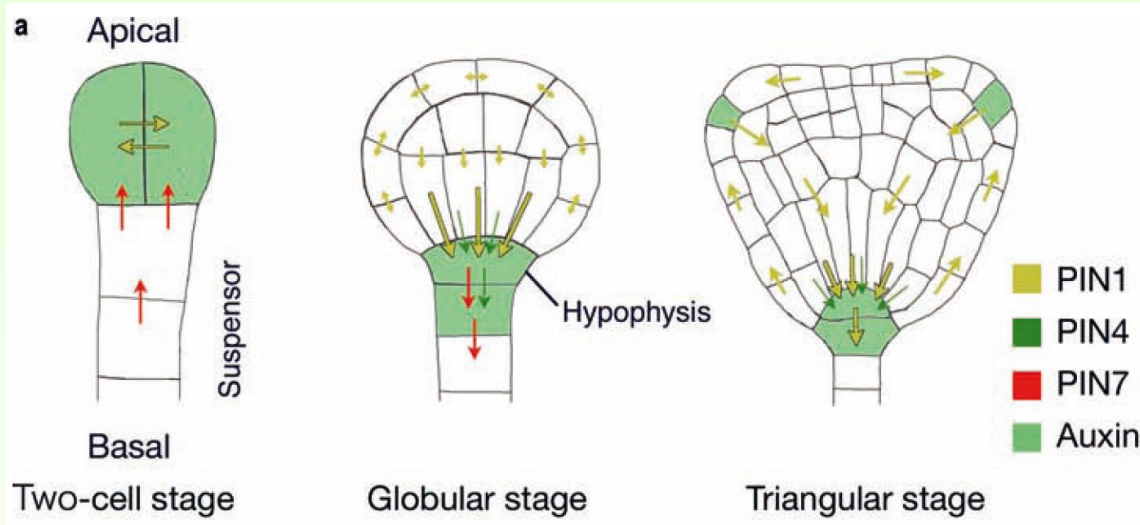
Auxin inhibits endocytosis

- Auxin stabilizes PIN carriers in the plasma membrane by the inhibition of their endocytosis



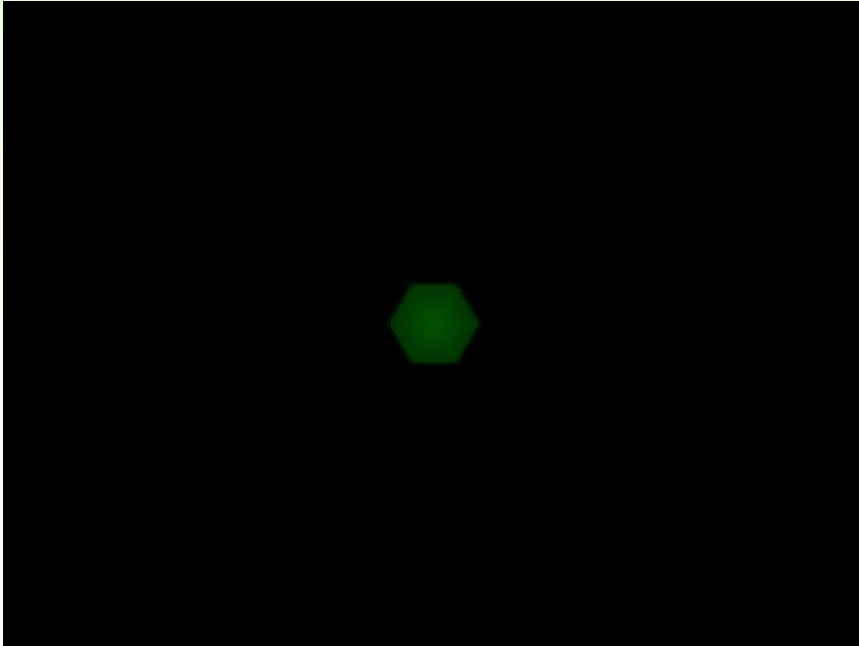
Auxin as morphogen

- Setting and maintenance of plant morphogenesis is under the control of IAA gradients

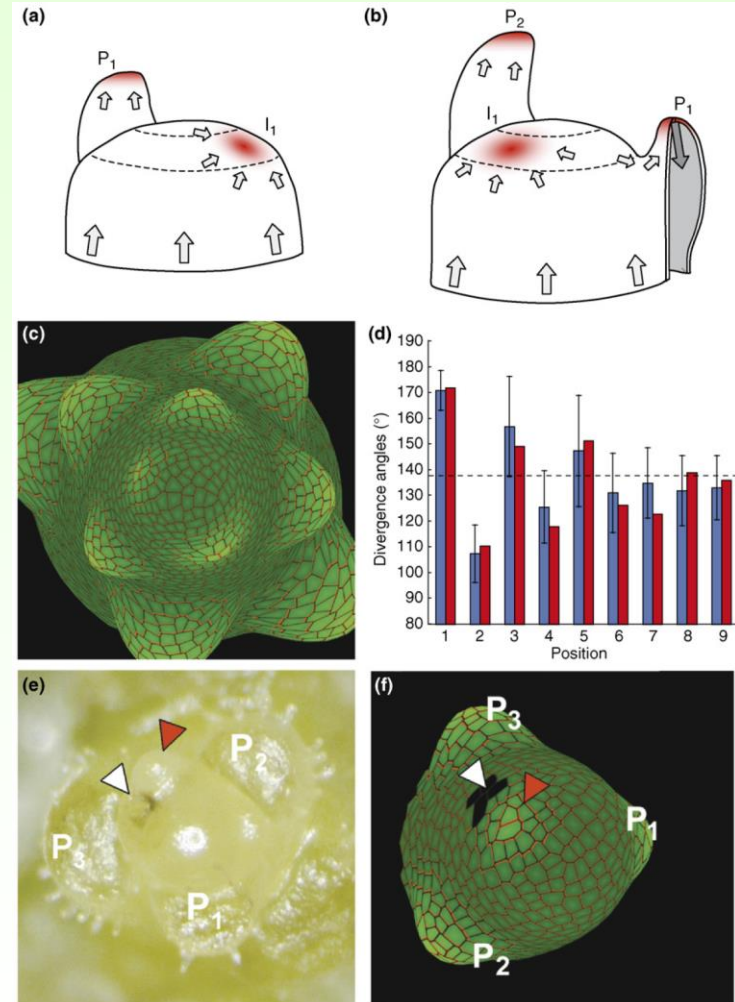


Auxin as morphogen

- Phyllotaxis is influenced by the directional flow of auxin maintained by auxin transporters



Smith, R.S. et al. PNAS 103, 1301–1306, 2006

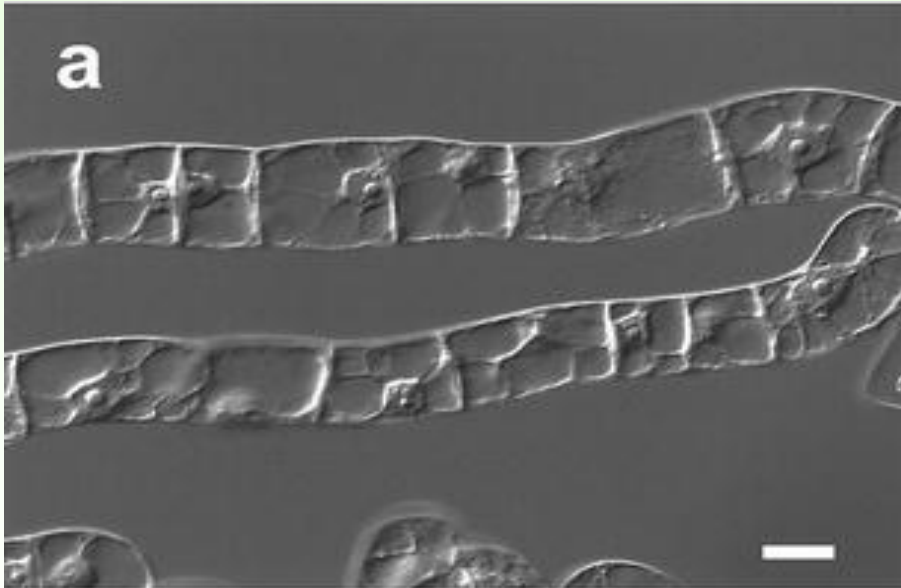


Kuhlemeier et al., Trends Plant Sci 12, 143 -150, 2007.

Auxin as morphogen

- NPA as the inhibitor of auxin efflux carrier disturbs the polarity of directional auxin transport in cell chains of tobacco

VBI-0, control, day 6



VBI-0, 10 μ M NPA, day 6

