

CTO2 growth section – Learning Outcomes

NB – in case you are not familiar with this kind of list, it represents the material that we expect you to know and about which we might ask you in exams. Things not on this list are good to know, but will not turn up in exams.

- General features/ problems of growth: anisotropy, proportionality, adaptability and discontinuous scaling (students need to know what each of these terms means, and be able to give/ recognize an example)
- Reasons that cells do not grow with tissues (generally, tissues get larger by adding cells not by making each cell that much larger, although plants do show significant cell expansion and a few specialized animal systems show the effect modestly).
- Ways that some cells manage to grow unusually large (vacuoles, syncytia, endoreduplication of DNA, helper cells)
- The 4 phases of the cell cycle and their order.
- Cleavage division and how it differs from normal division.
- Cyclins and cdks (the general properties of these two classes of proteins: you are not expected to remember the letters and numbers and know which goes with which).
- Sequential control of the cell cycle by cyclins and cdks
- Checkpoints, particularly the control of the G1-S checkpoint by pathways responsive to growth factors, inhibitors of proliferation and physical contact/ restraint.
- Paracrine control
- Neoplasia as a consequence of cells acquiring autocrine control of their own proliferation.
- Sources of anisotropic growth: diffusion limited growth, directed cell division.
- Unequal growth as a mechanism of morphogenesis: gut looping from the gut trying to grow faster than the mesentery.
- Planar cell polarity (recognize the general principles: you do not need to memorize the molecules in a way that would let you draw the whole pathway, but you should recognize their names)
- Coupling of the planar cell polarity to the orientation of mitosis by trapping of microtubules
- Orientated cell division in neural tube closure (and the spina bifida story, including the fact that it may not be a direct effect of folate on division rates after all).
- Control of body size – environmental and endogenous
- Environmental control by nutrition, including effect of foetal transfusion syndrome
- Endogenous control including sexual dimorphism
- Vitruvian proportions (do not learn the actual proportions, just know what the phrase means)
- Vitruvian and non-Vitruvian phenotypes.
- The Growth Hormone → IGF I/II cascade, effects of mutations in it.
- Rabbit leg experiment showing catch-up growth of limbs
- The growth plate in long bones: control by feedback
- The significance of a long feedback loop in providing feedback between size-achieved and growth rate
- Pycnodysostosis (Toulouse-Lautrec syndrome) as an example non-Vitruvian mutation.
- The primacy of the skeleton in setting limb size.
- Mechanical regulation of soft tissue growth (and evidence for it)
- Quorum sensing (what it is, how it works)
- Elective cell death and the trophic theory
- Control of fruitfly imagine disc growth by dpp (including scaling of the gradient with the disc size)
- D'Arcy Thomson-type transformations of body shape

We will not examine you on anything not on this list. Do other people give you these lists? If not, you may want to ask for them.