

Lecture 4:

Keeping things in proportion.

Again, these slides contain all of the text and important images, but not all of the simply illustrative images (for copyright reasons).

Why is the amount of skin always right for the leg length?

...or any other growth?

Why is the amount of skin always right for the leg length?

...or any other growth?

We can get a hint from the fact that applying a mechanical force (excessive stretch) to human skin drives skin growth

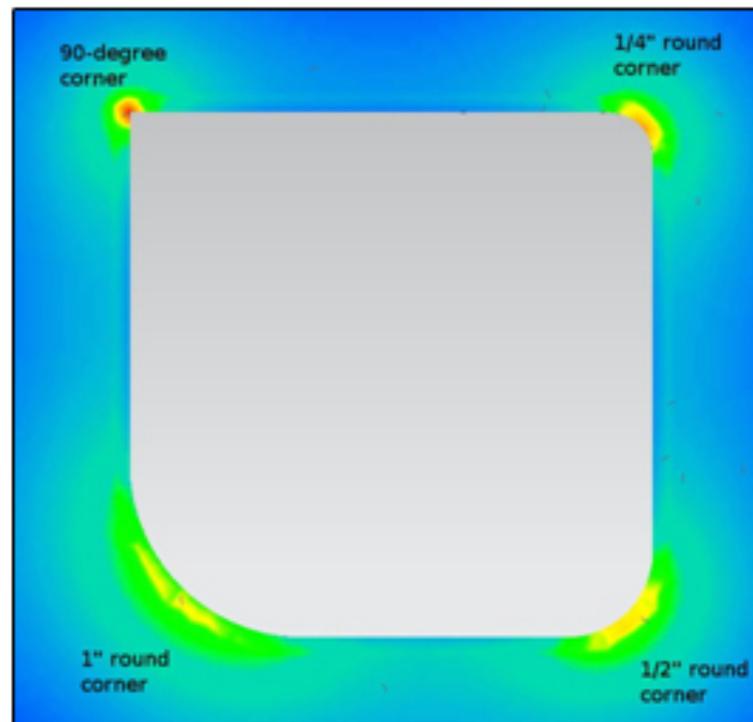
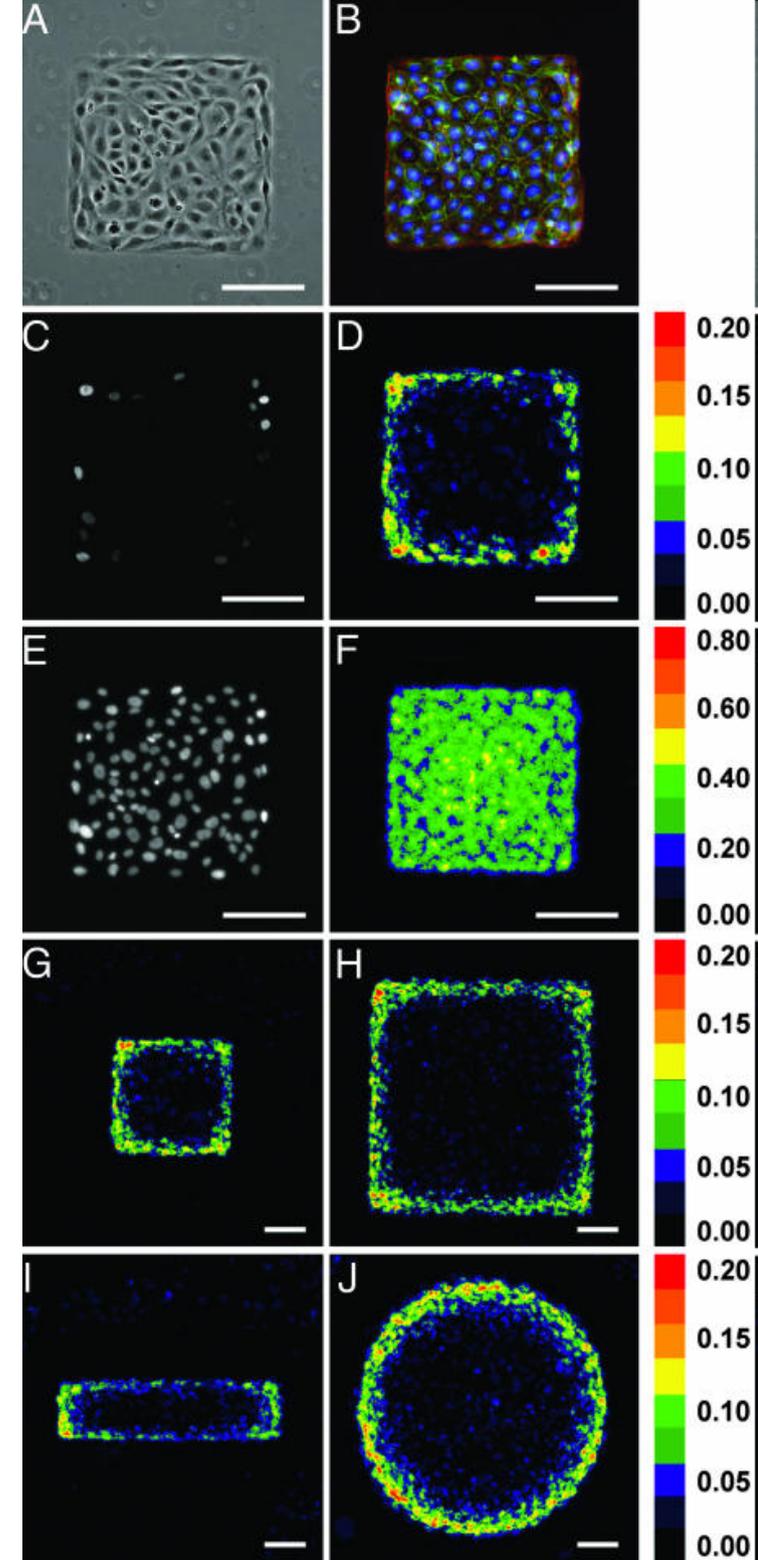


Plate cells on to shaped islands

Emergent patterns of growth controlled by multicellular form and mechanics

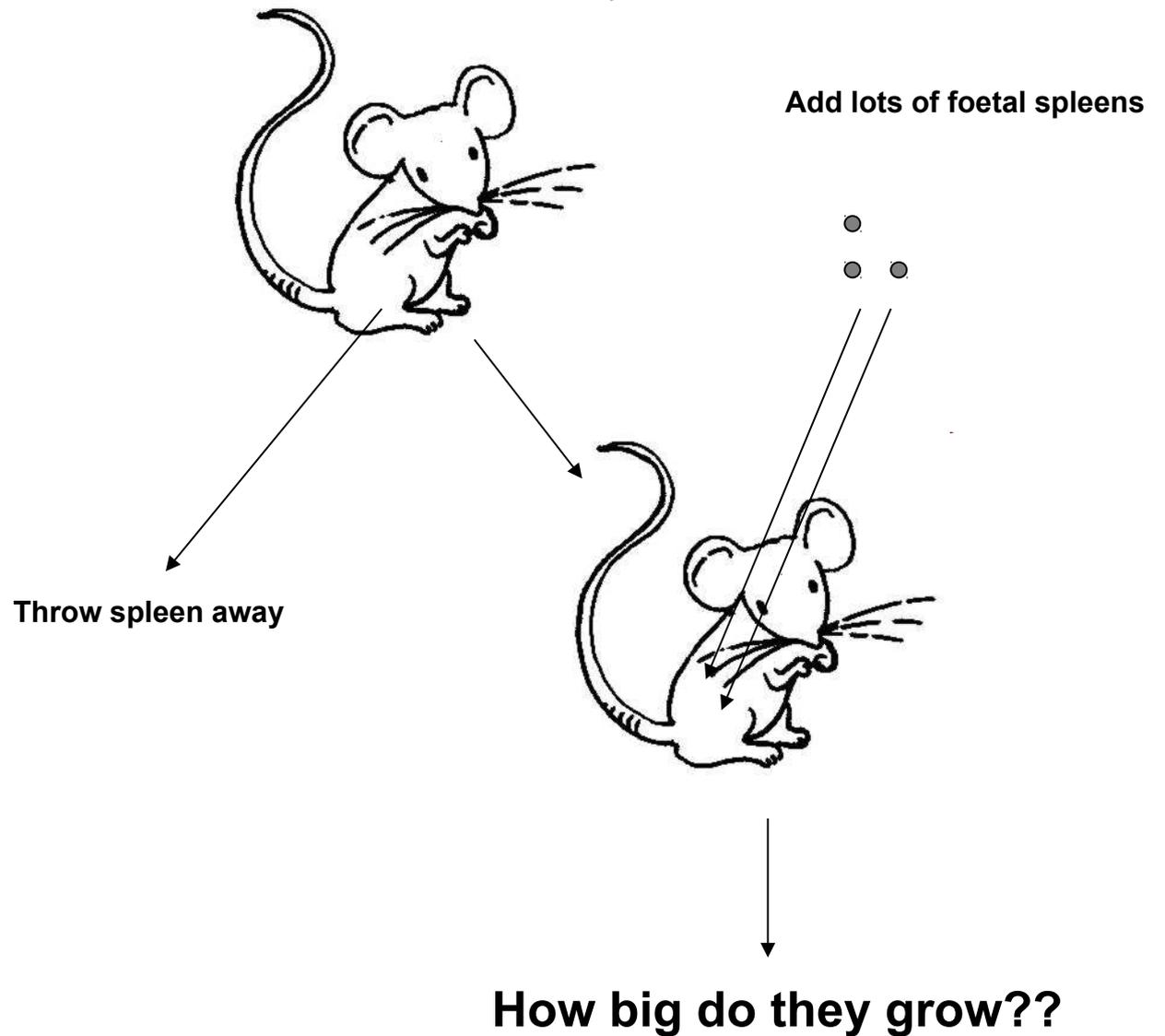
Celeste M. Nelson^{*†}, Ronald P. Jean^{*}, John L. Tan^{*}, Wendy F. Liu^{*}, Nathan J. Sniadecki^{*}, Alexander A. Spector^{*}, and Christopher S. Chen^{*†‡}



How about 'mechanically isolated' organs?

Spleen:

**TOTAL mass = mass
of one normal spleen.**

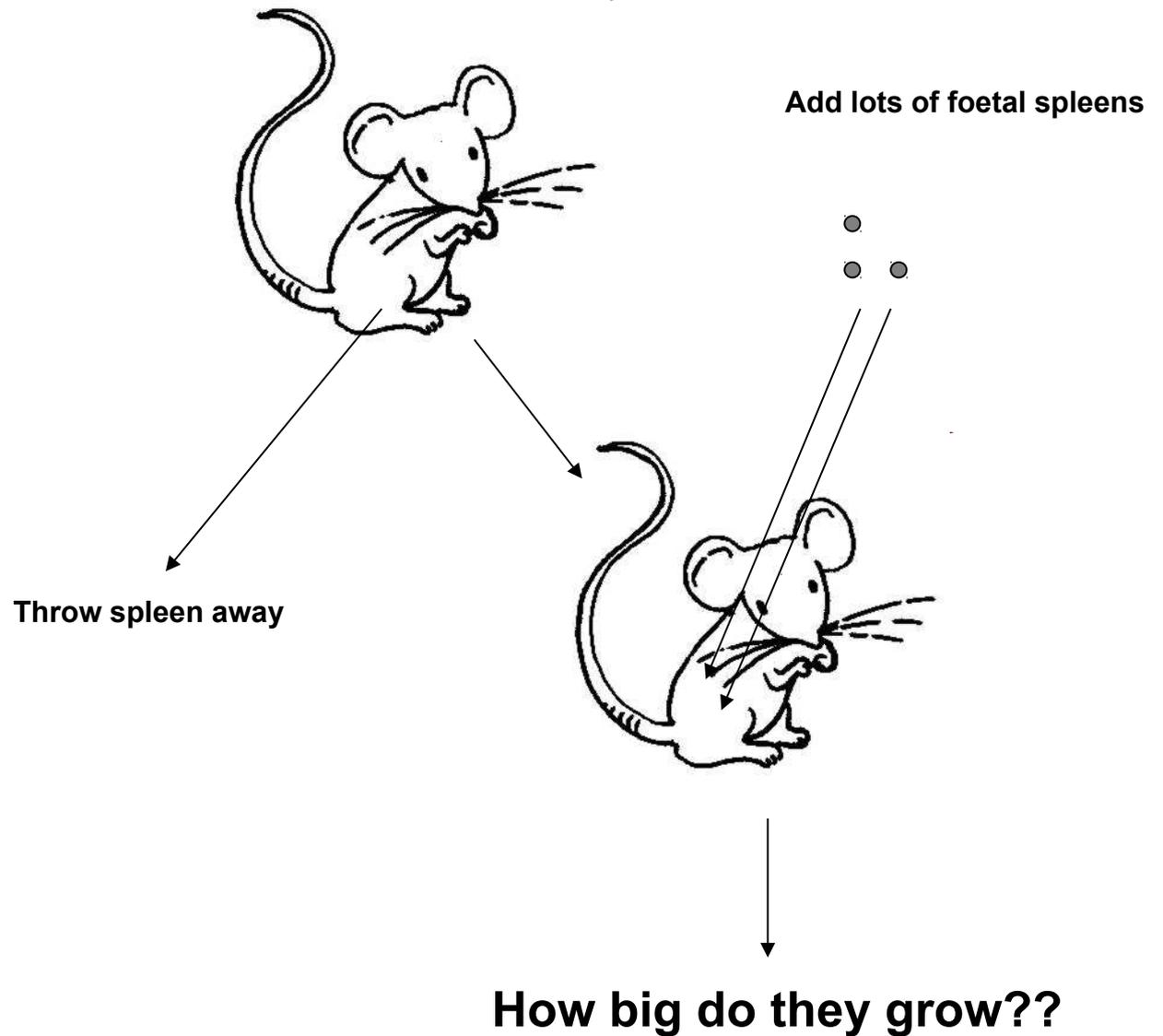


How about 'mechanically isolated' organs?

Spleen:

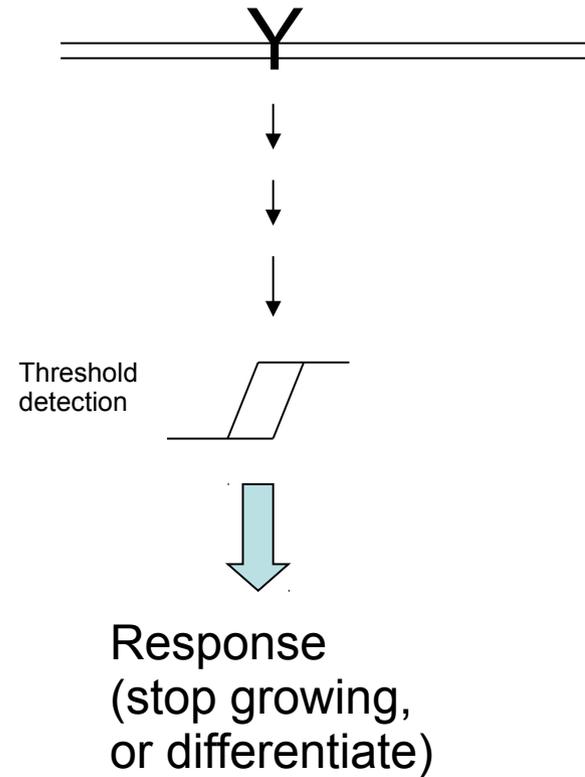
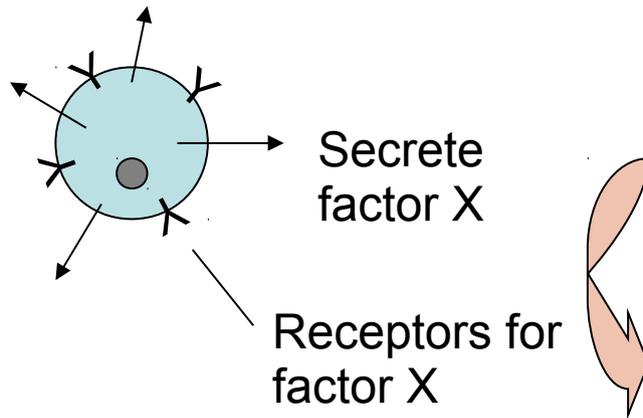
**TOTAL mass = mass
of one normal spleen.**

**But if you do it with a
THYMUS, each one
grows normal size**



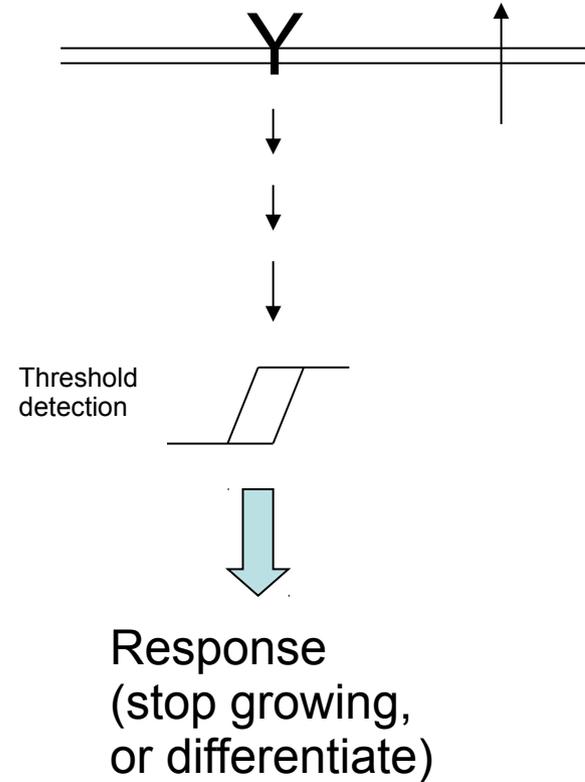
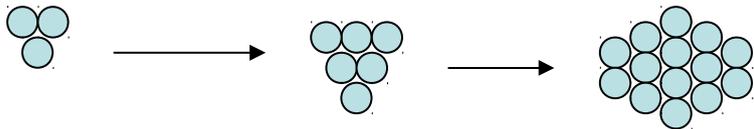
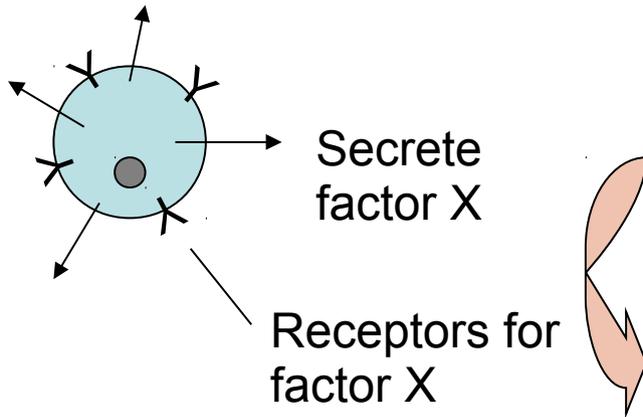
Quorum-sensing

Autocrine signalling:



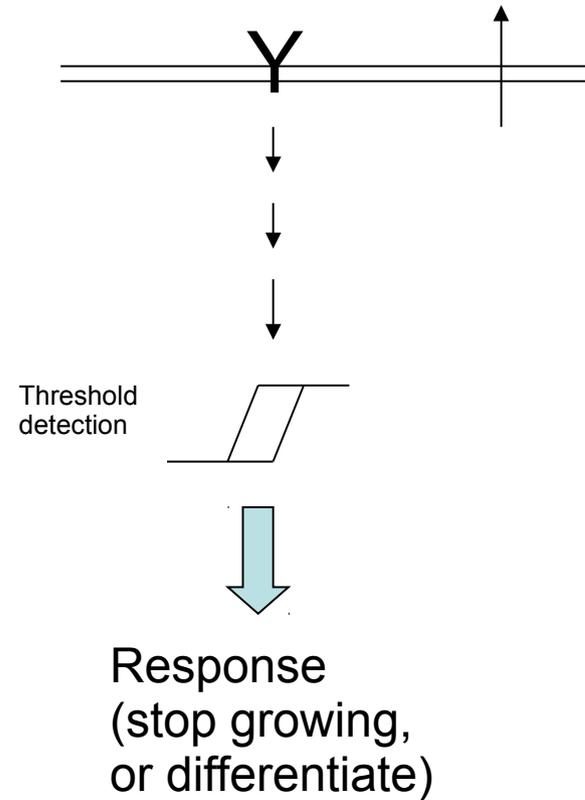
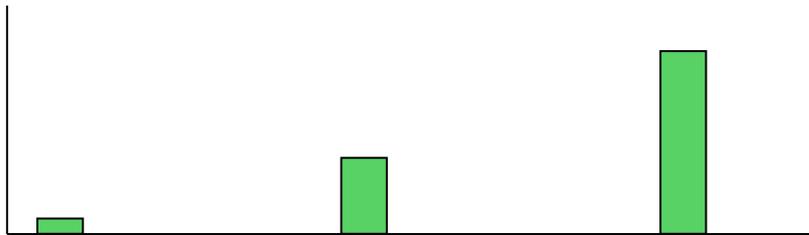
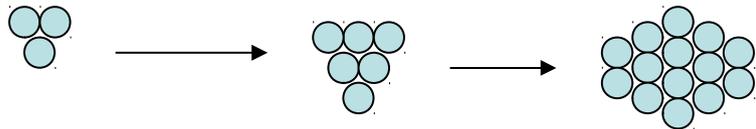
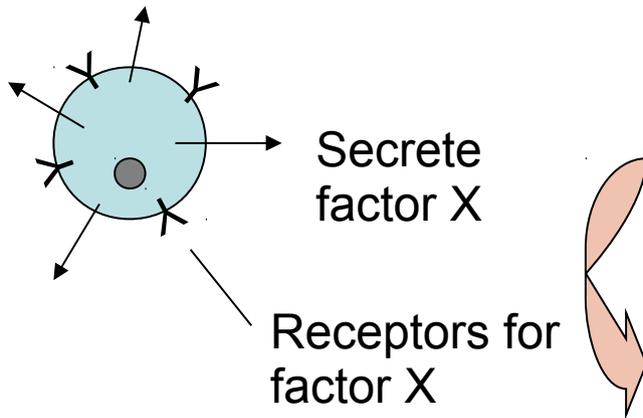
Quorum-sensing

Autocrine signalling:



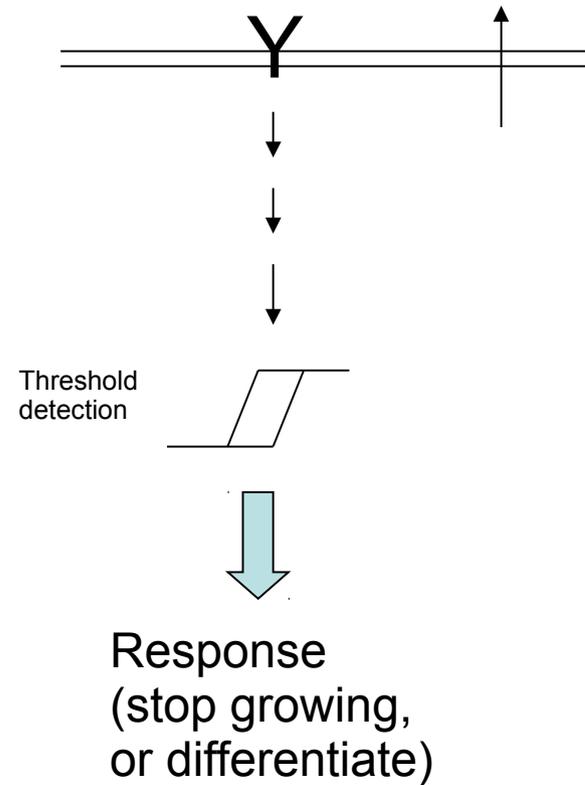
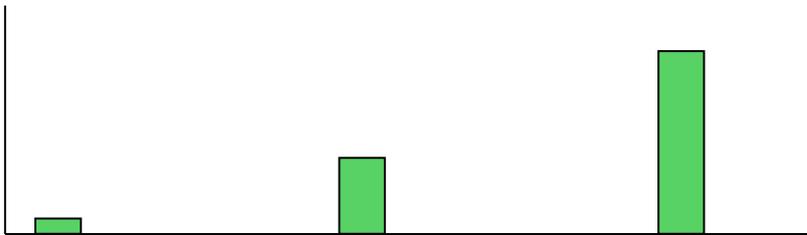
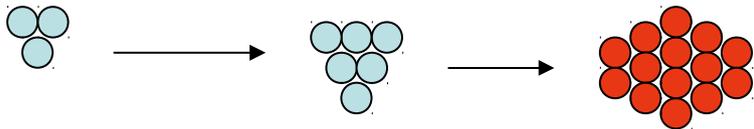
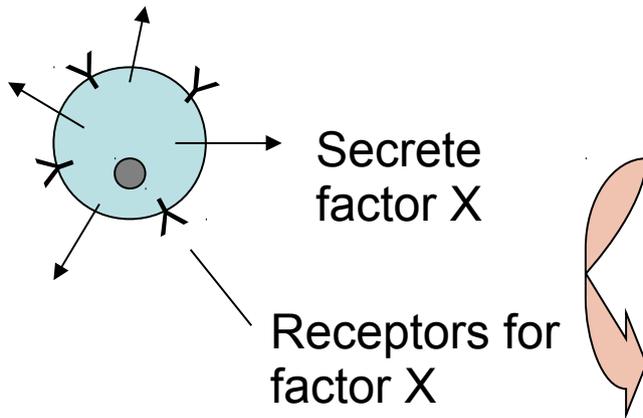
Quorum-sensing

Autocrine signalling:

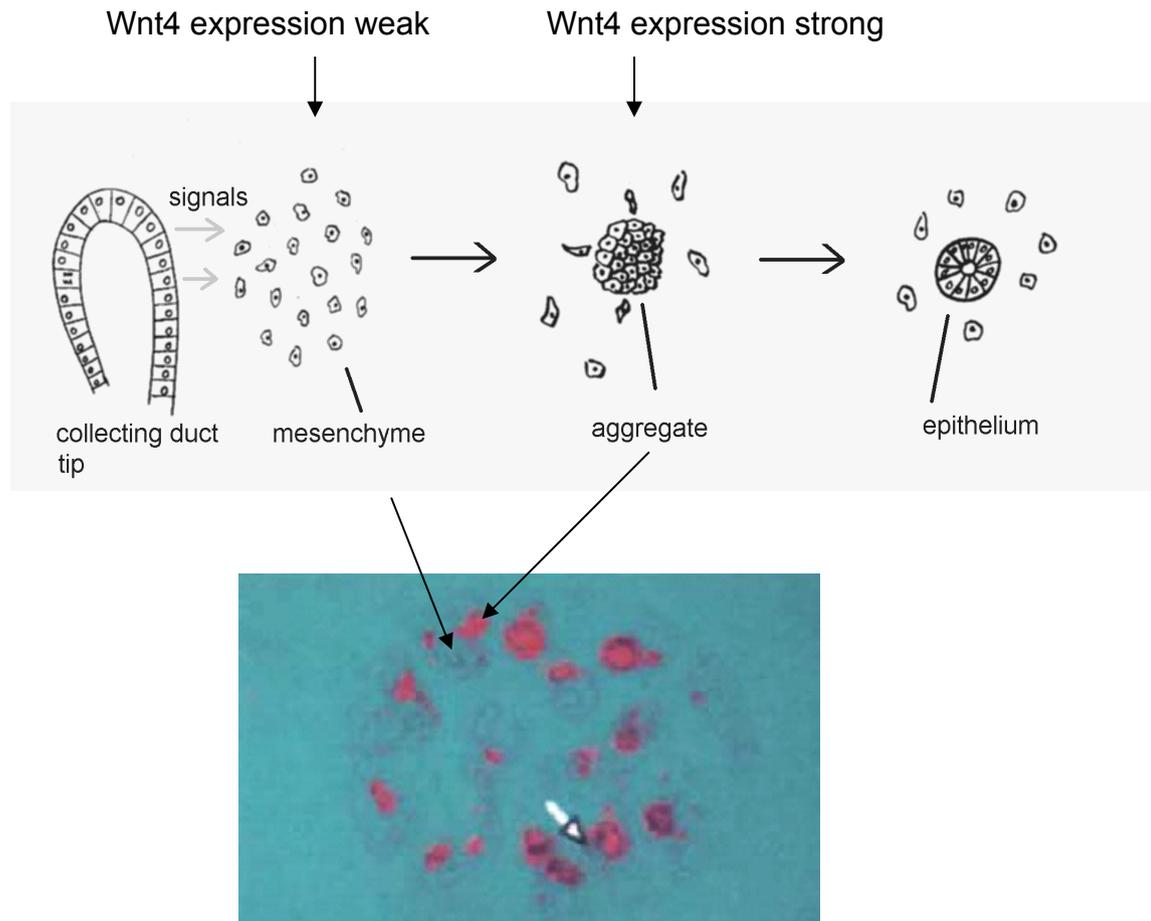


Quorum-sensing

Autocrine signalling:

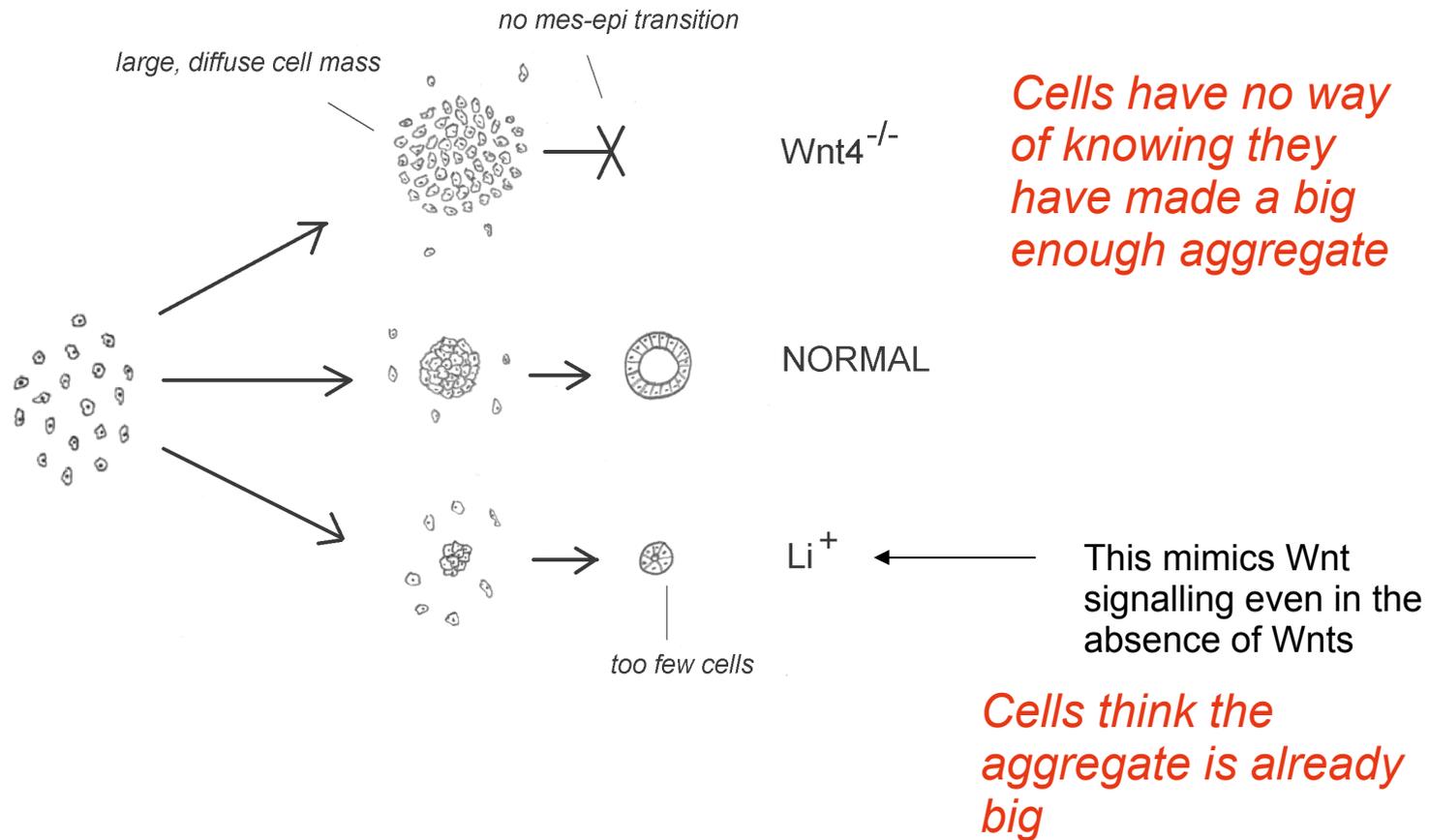


Evidence for quorum sensing: the kidney



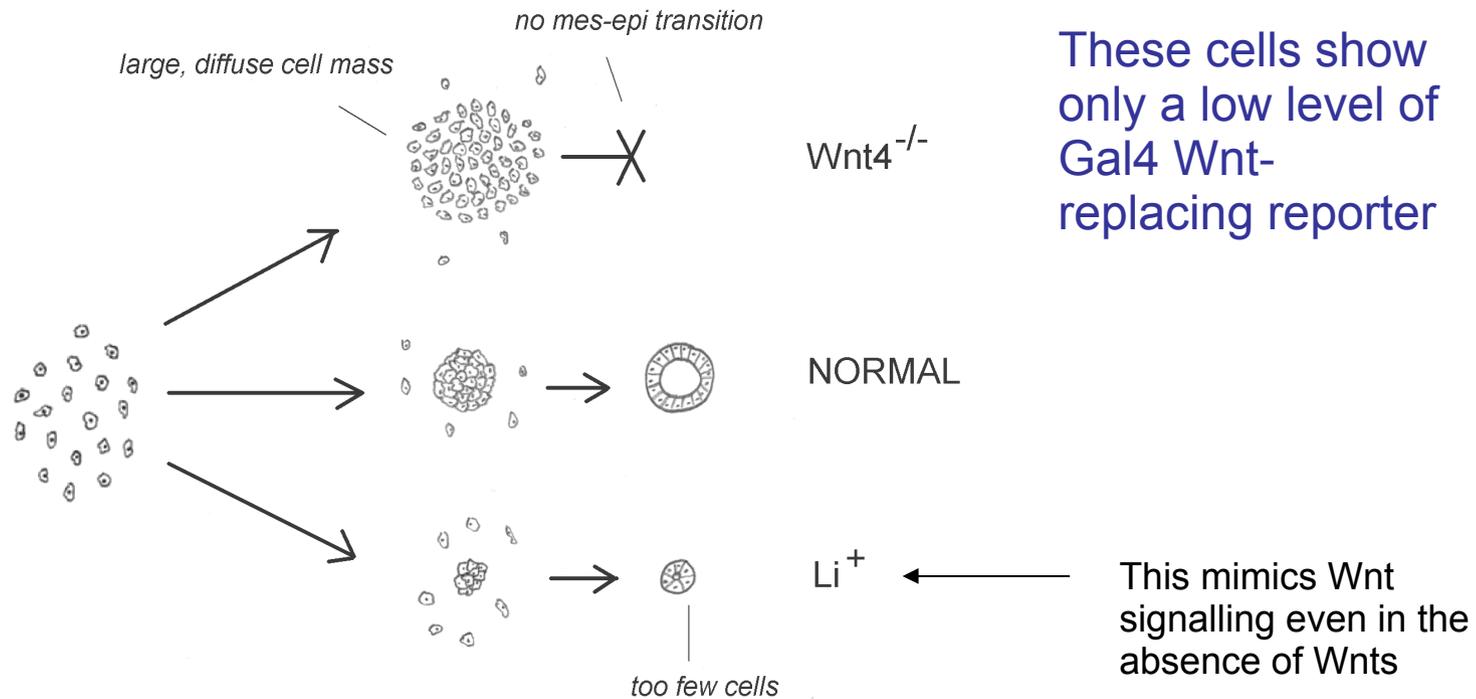
Ref: Davies JA (2005) *Mechanisms of morphogenesis*

Evidence for quorum sensing: the kidney



Ref: Davies JA (2005) *Mechanisms of morphogenesis*

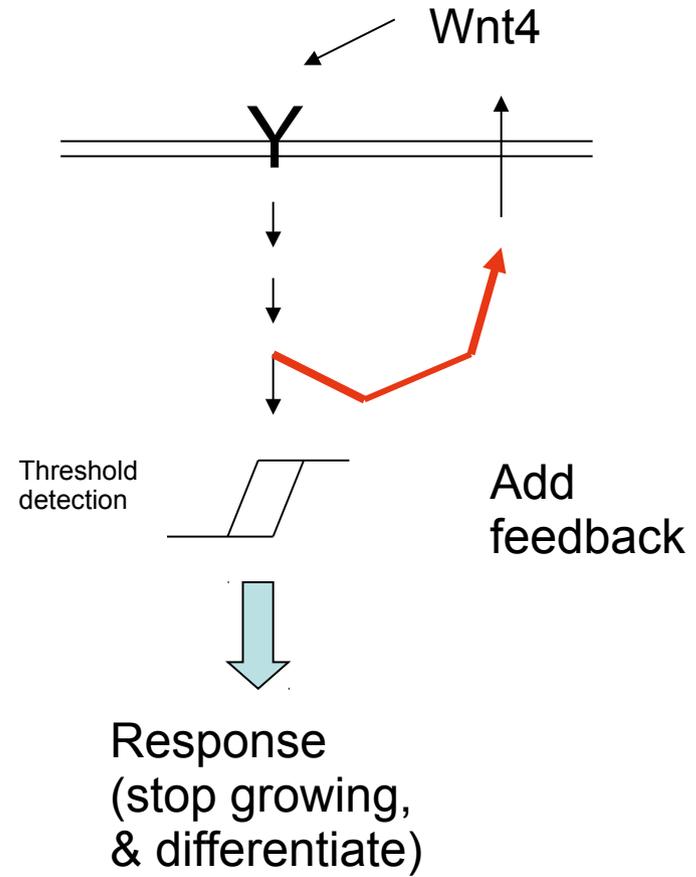
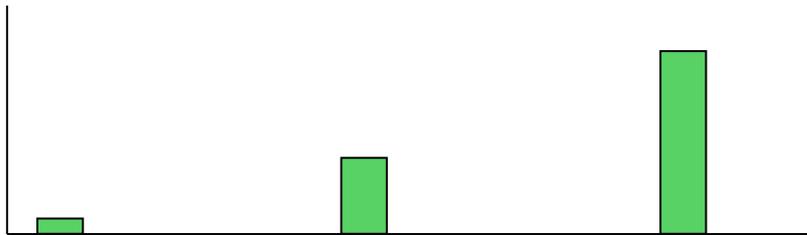
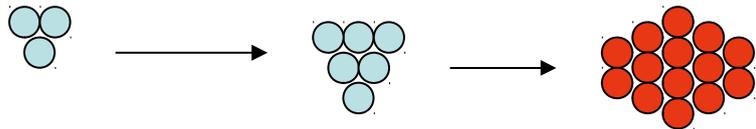
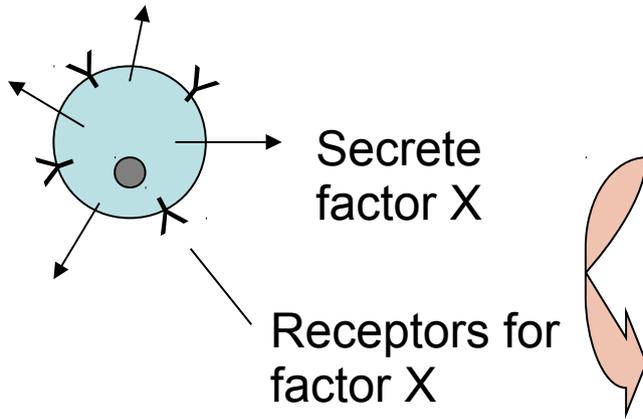
Evidence for quorum sensing: the kidney



Ref: Davies JA (2005) *Mechanisms of morphogenesis*

Kidney model

Paracrine signalling:

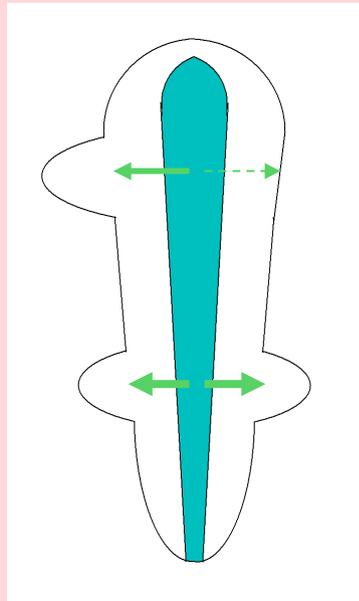
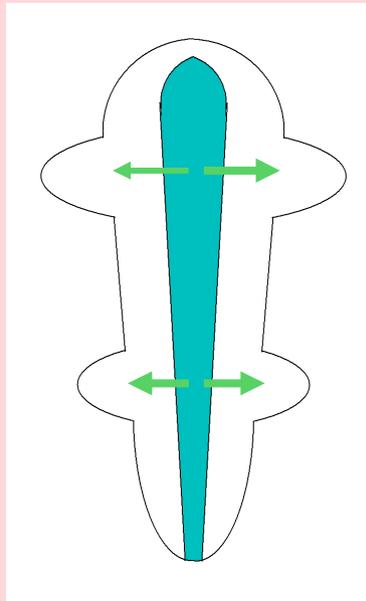


"Are we big enough for that other tissue?"

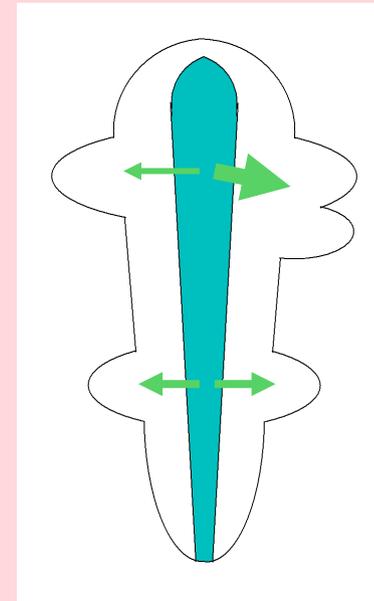
- The trophic theory

Innervation of chick limbs:

Hamburger V (1934) J Exp Zool 68: 449-494; Hamburger V (1939) Physiol Zool 12: 268-284

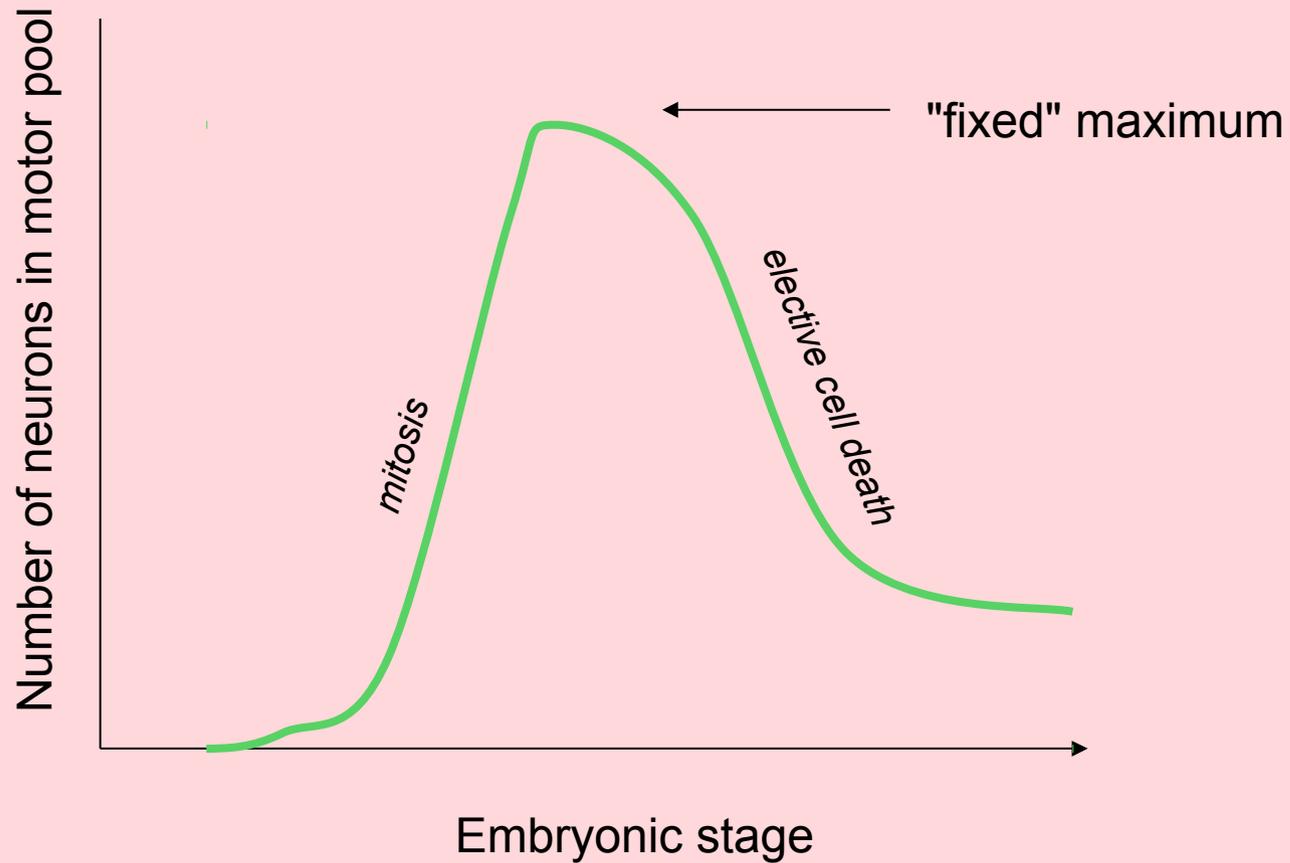


Fewer neurons
when target field
is reduced

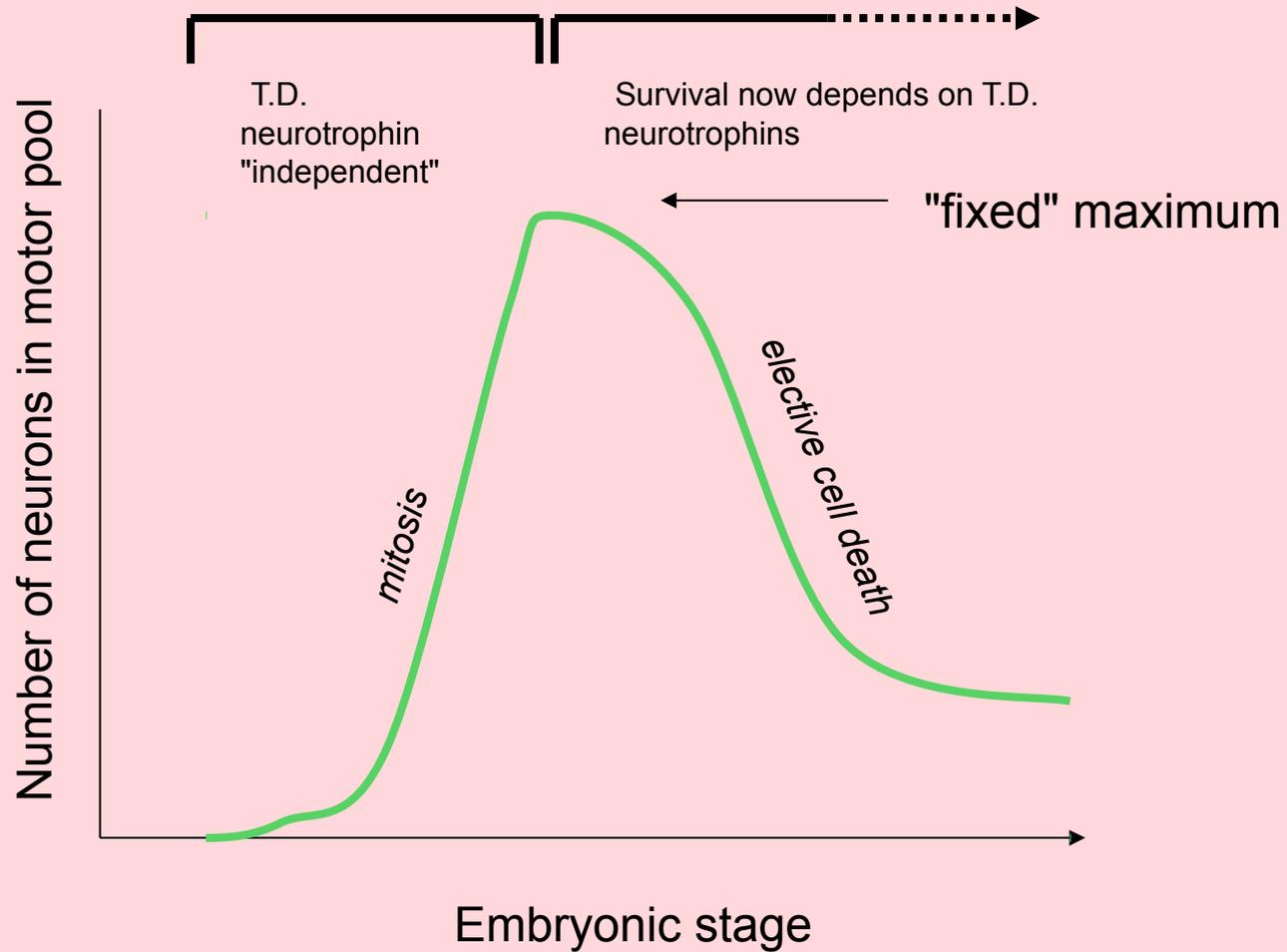


More neurons
when target field
is increased

Time course of neuronal development:



Time course of neuronal development:

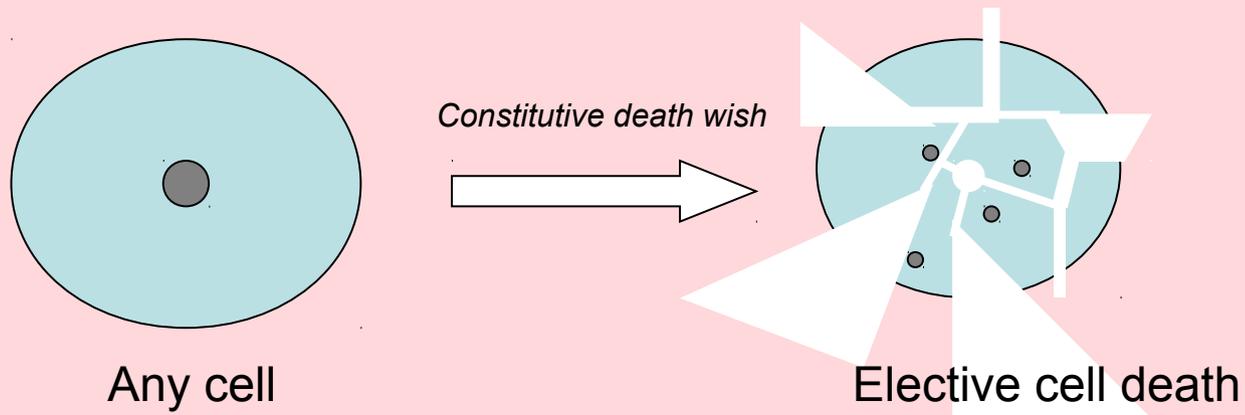


Neurotrophins:

- NGF
- BDNF
- NT-3
- GDNF
- CNTF
- HGF

This is not just a neuronal story...

The Trophic Theory: (Martin Raff)



This is not just a neuronal story...

The Trophic Theory: (Martin Raff)

