Neural Stem Cells and Neural Progenitors

Nov. 11 2019

Altman J.: the first evidence for new detate granule cells in postnatal rat hip
(1965)

Cori Cepko: discovered multipotency of neural progenitors in retina (1987)

Sally Temple: described neural progenitors and stem cells (1989)

Brent Reynolds and Samuel Weiss: generation of neurons from isolated neu
cells (1992)

Fred Gage: discovered the human brain produces new nerve cells in adulth

Hongjun Song: revealed self-renewing and multipotent adult neural stem ce
(2011)

Neural stem cells

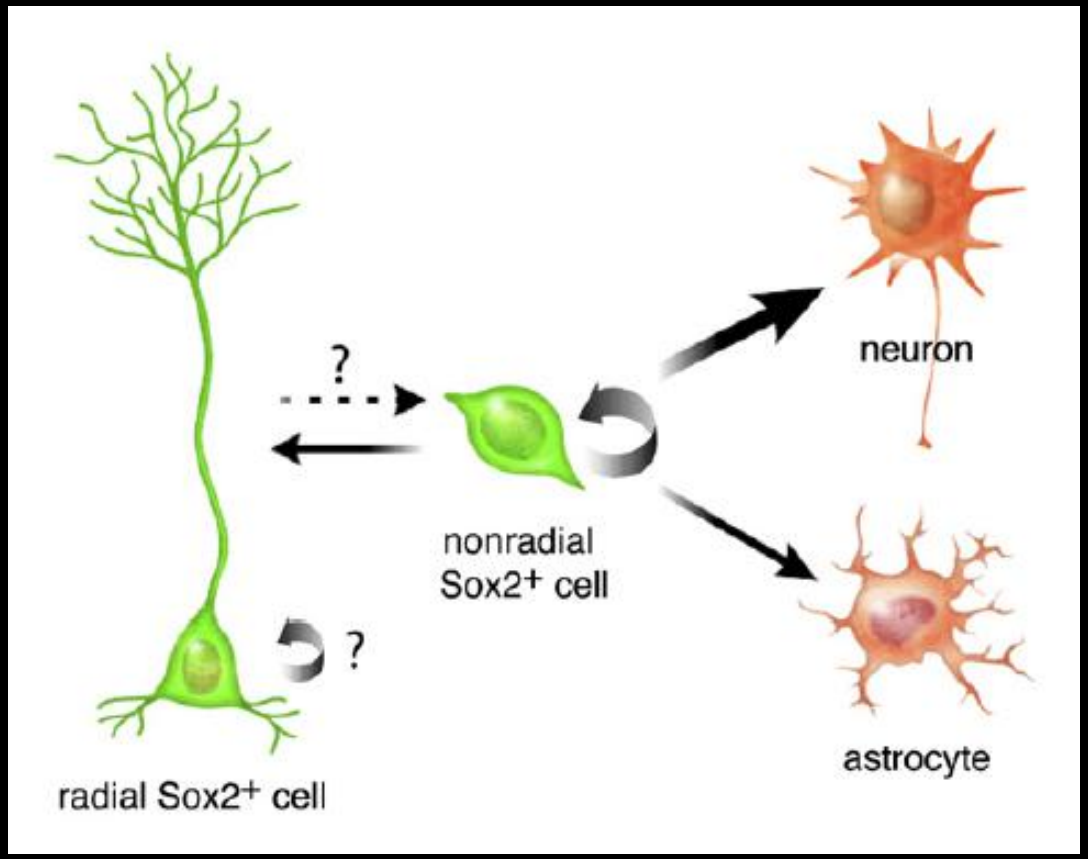
Embryonic Neural Stem Cells
Post-embryonic Neural Stem Cells

Neuroepithelial Stem Cells

Radial Glial Cells (Gli, GFAP, GLAST, Nestin)

Non-radial Glial Cells (Sox2)

Non-radial Glial Cells

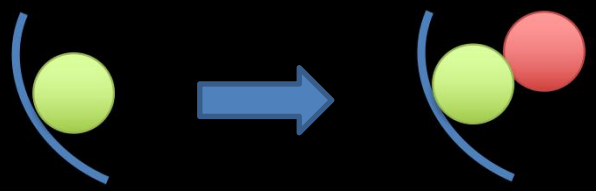


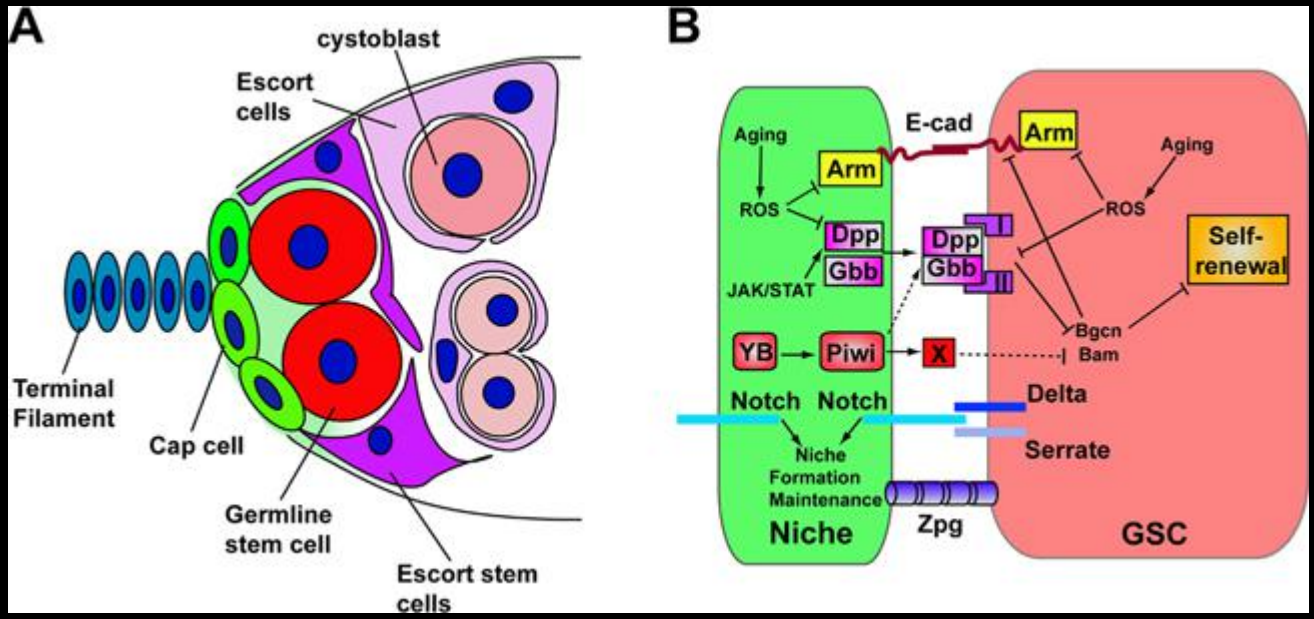
Suh et al., 2012, Cell Stem Cells

Neural stem cells are self-renewing and multipotent cells that generate the main phenotypes of the nervous system.

Self-renewing and Multipotent?

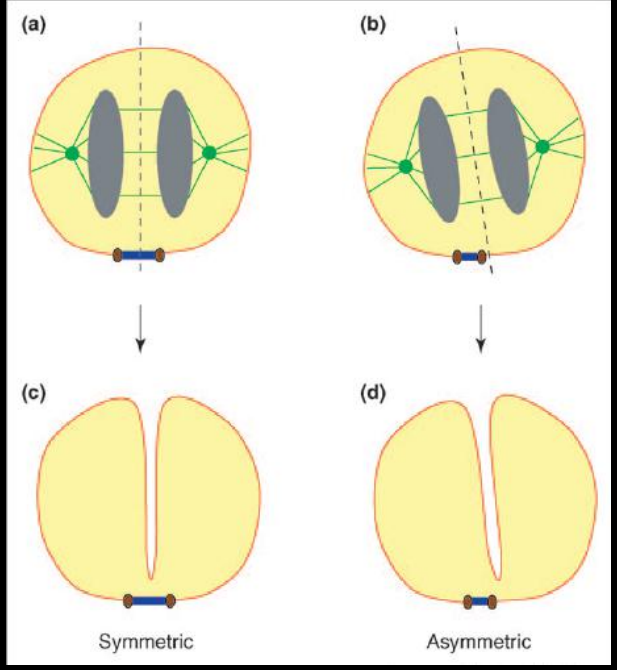
Classic Asymmetrical Cell Division

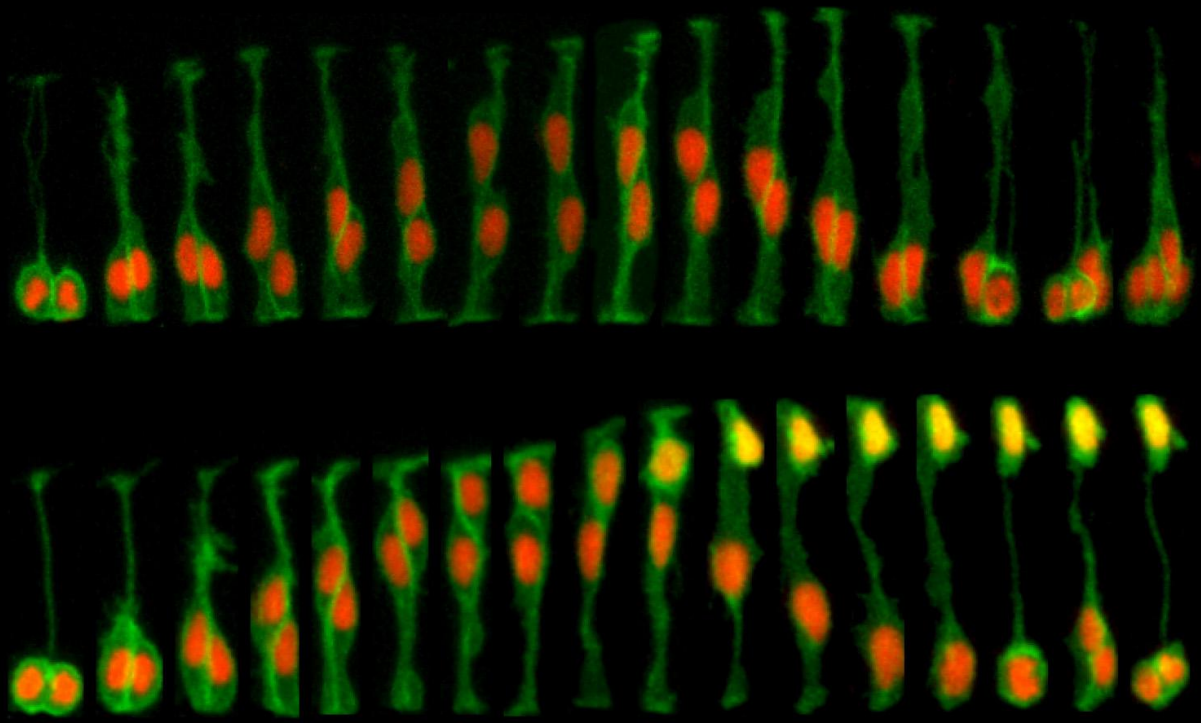




GSC niche in the drosophila ovary

Xie and Spradling, 2000


(a)
(b)
(c)
(d)
Symmetric
Asymmetric

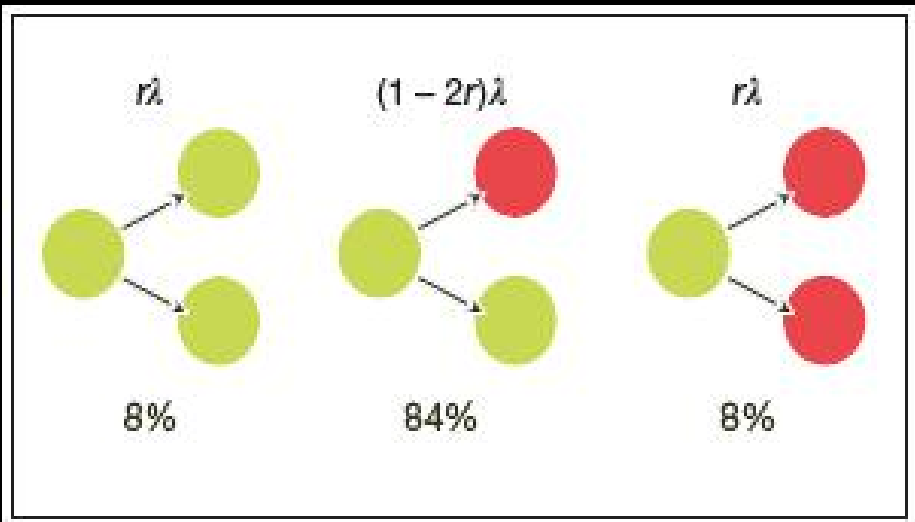


Vol 446|8 March 2007|doi:10.1038/nature05574 nature

LETTERS

A single type of progenitor cell maintains normal epidermis

Elizabeth Clayton[1], David P. Doupé[1], Allon M. Klein[2], Douglas J. Winton[3], Benjamin D. Simons[2] & Philip H. Jones[1]



Cell

Intestinal Crypt Homeostasis Results from Neutral Competition between Symmetrically Dividing Lgr5 Stem Cells

Hugo J. Snippert,[1] Laurens G. van der Flier,[1] Toshiro Sato,[1] Johan H. van Es,[1] Maaike van den Born,[1] Carla Kroon-Veenboer,[1] Nick Barker,[1] Allon M. Klein,[2,3] Jacco van Rheenen,[1] Benjamin D. Simons,[3] and Hans Clevers[1,*]
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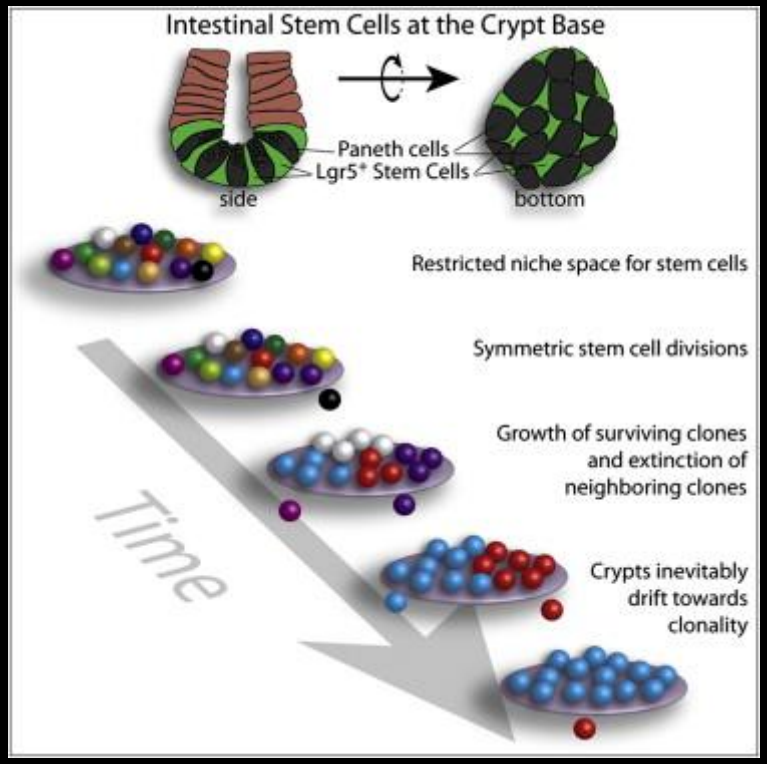
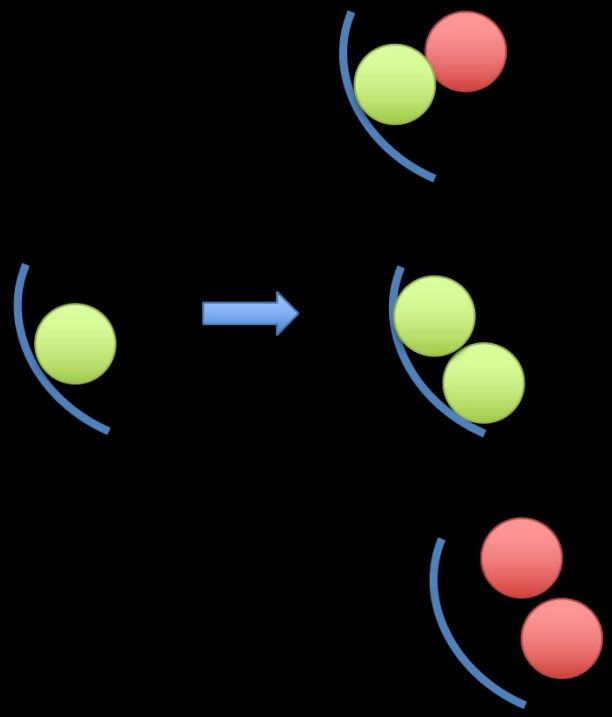
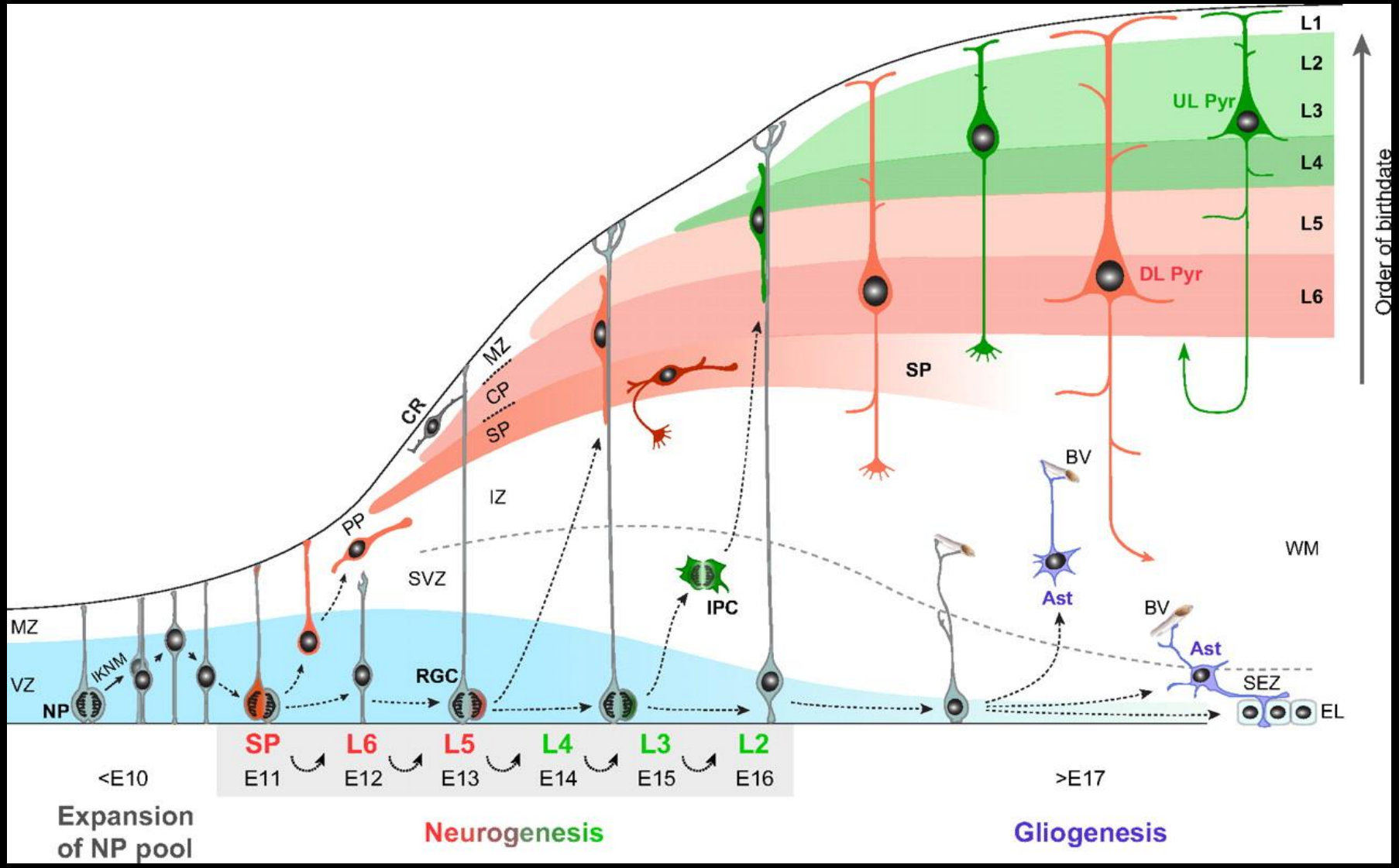
DOI 10.1016/j.cell.2010.09.016



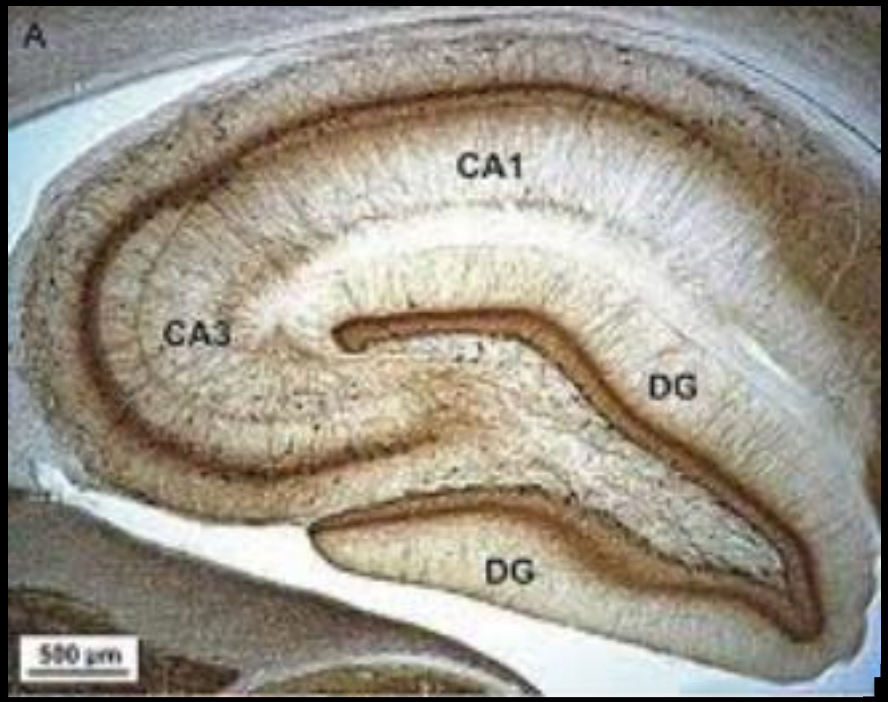


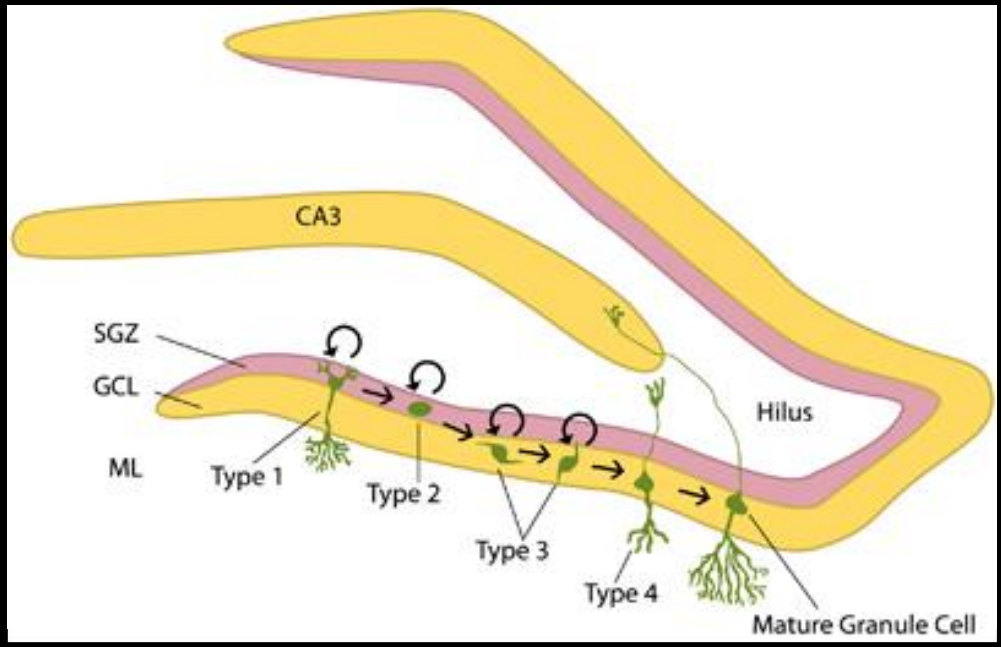
Neurogenic niches

Embryonic Ventricular Zone



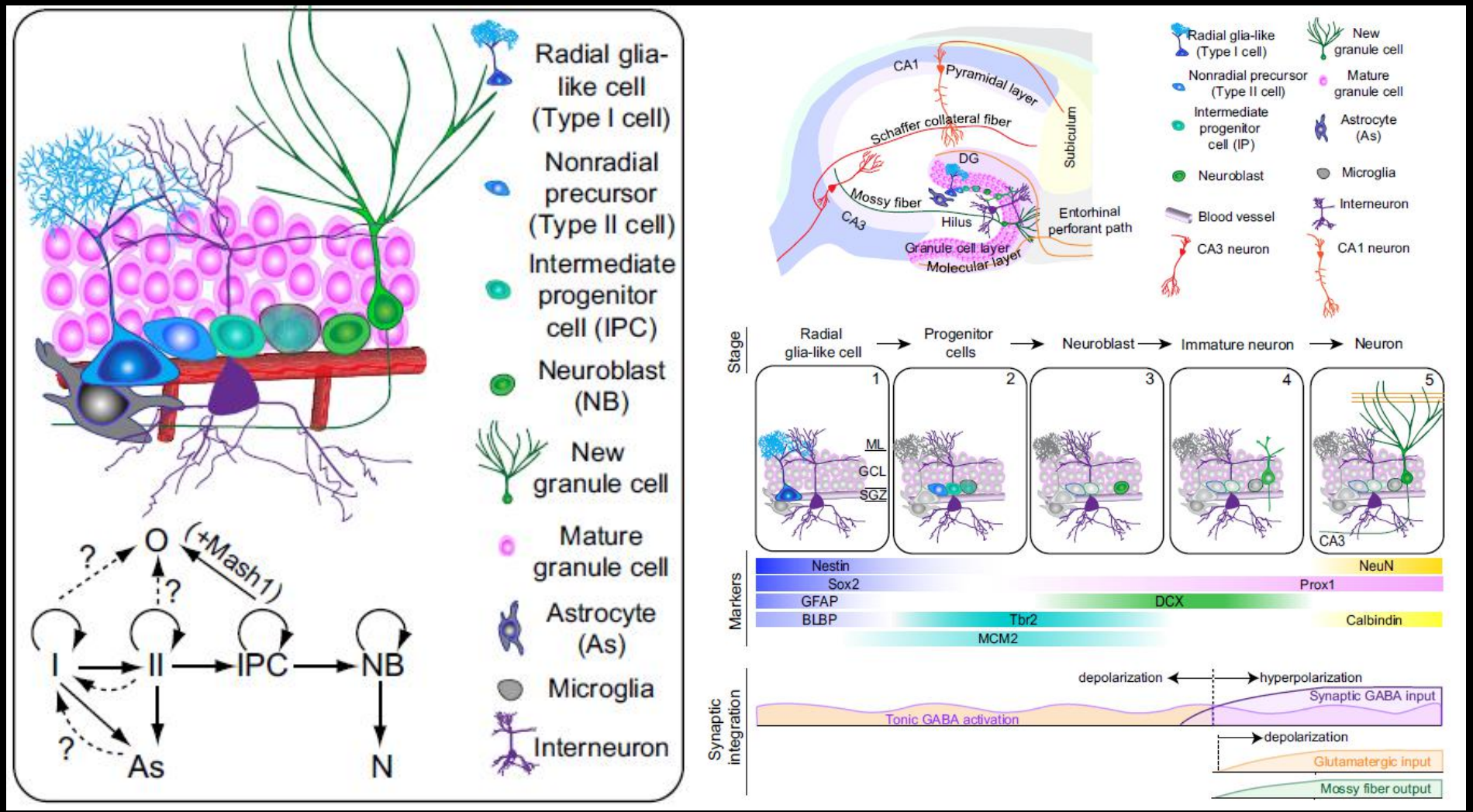
Subgranule zone of dentate gyrus



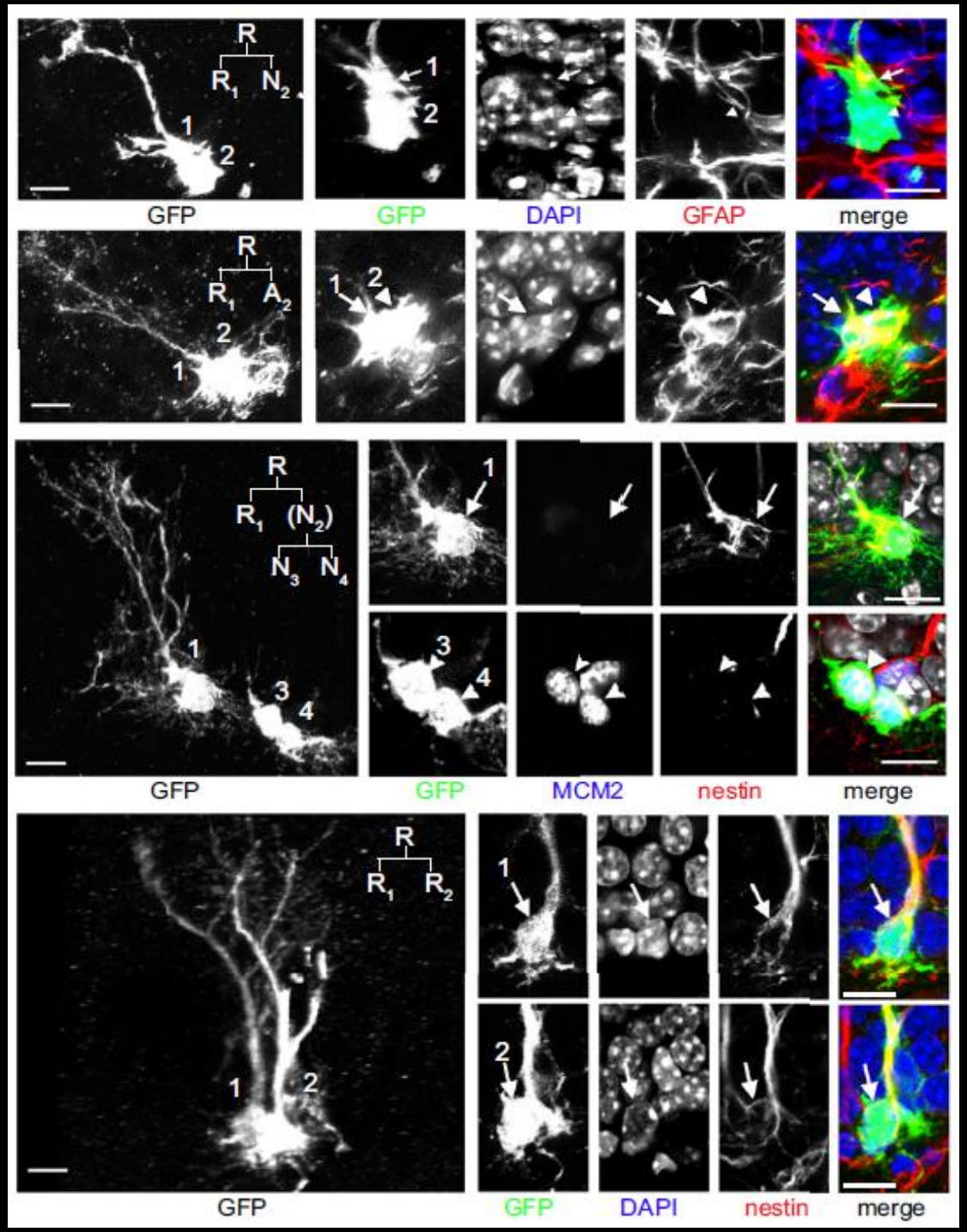


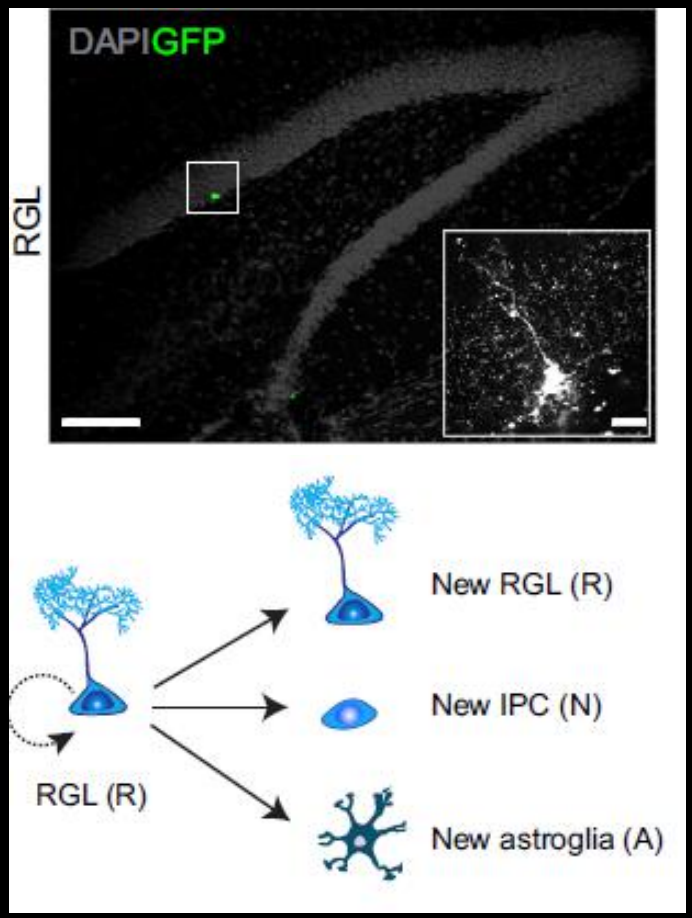
Bonaguidi et al., 2011, Cell

NSCs in hippocampus



Bonaguidi et al., 2011, Cell

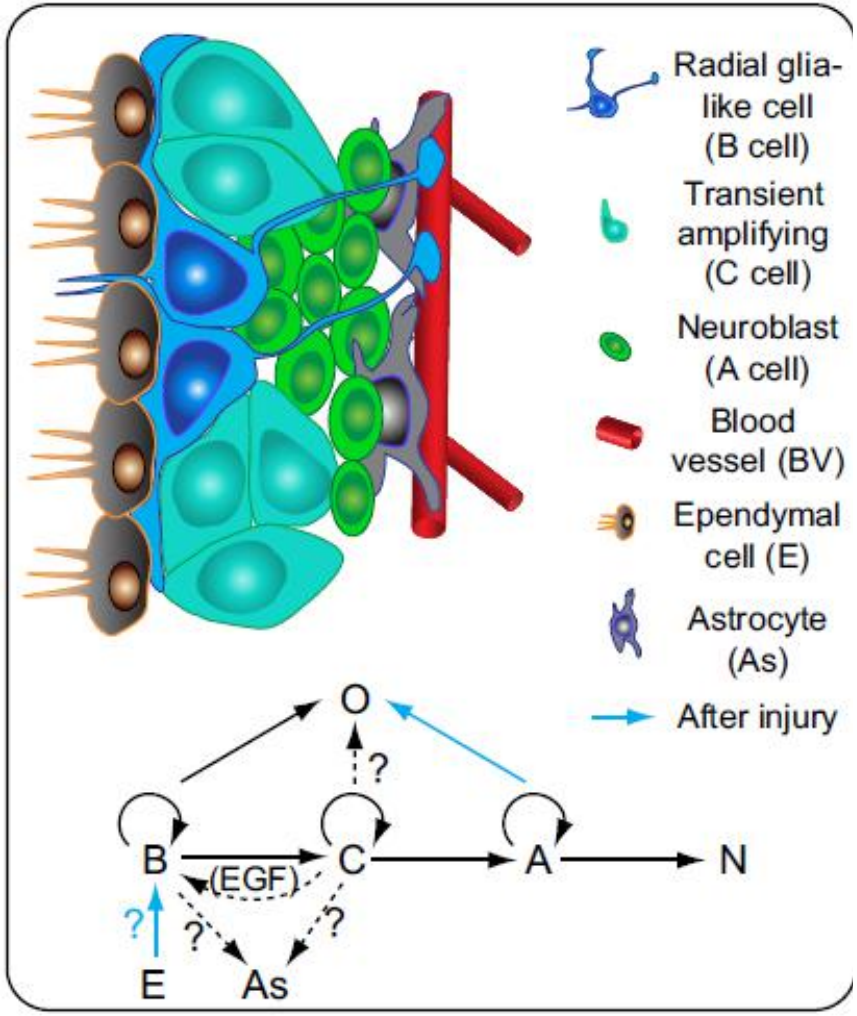


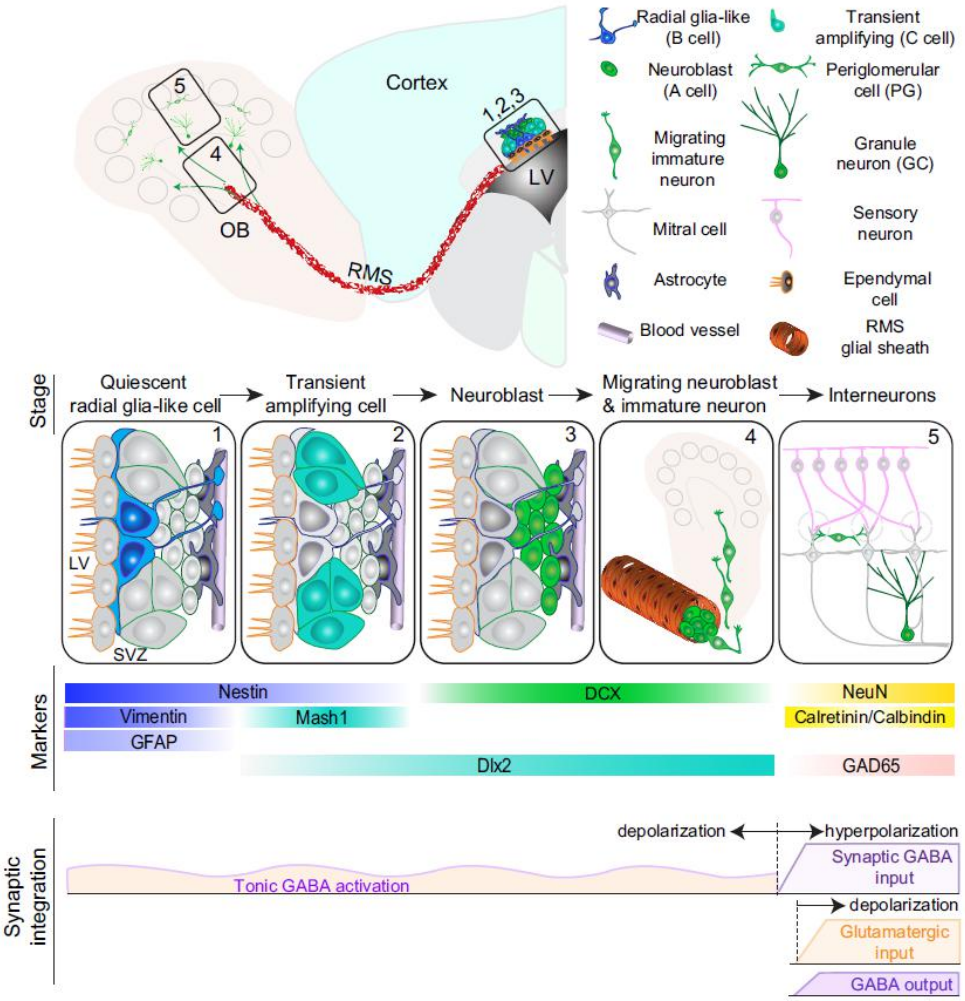


Nestin-CreER
Z/EG

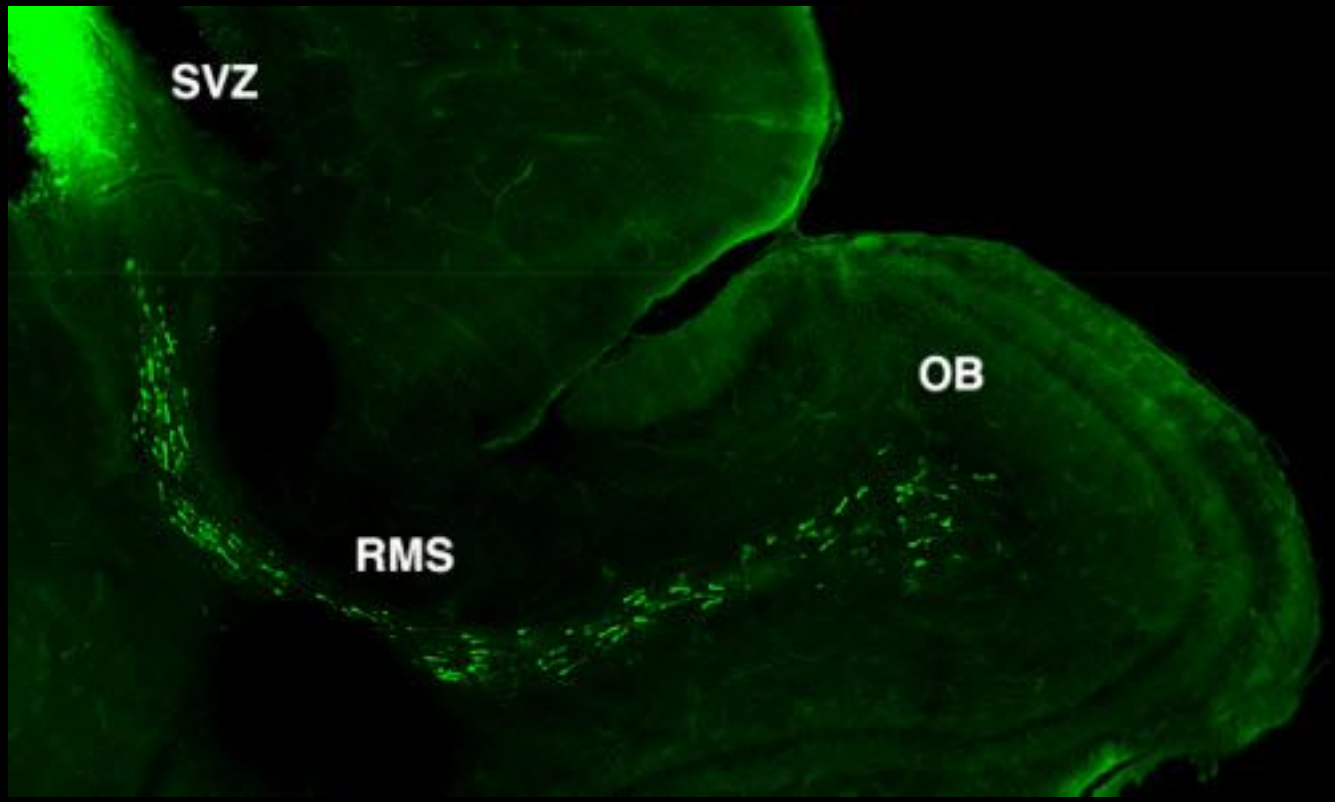
Bonaguidi et al., 2011, Cell

NSCs in the Subventricular Zone





Neurogenesis in Olfactory Bulb



Neurogenesis in Human Brain

Cell

Neurogenesis in the Striatum of the Adult Human Brain

Aurélie Ernst,[1] Kanar Alkass,[1,2] Samuel Bernard,[3] Mehran Salehpour,[4] Shira Perl,[5] John Tisdale,[5] Göran Possnert,[4] Henrik Druid,[2] and Jonas Frisén[1,*]
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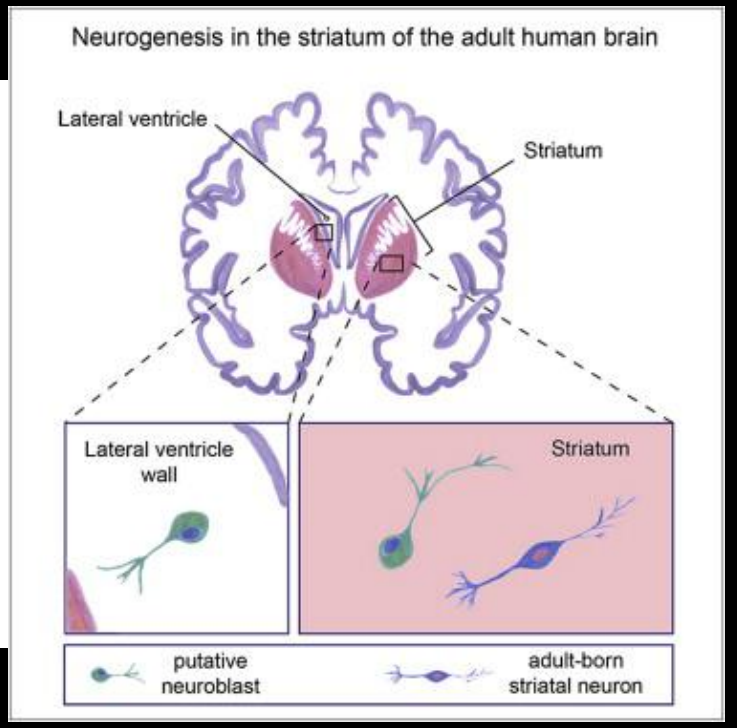
*Correspondence: jonas.frisen@ki.se
http://dx.doi.org/10.1016/j.cell.2014.01.044



Neural stem cell is a cellular function?

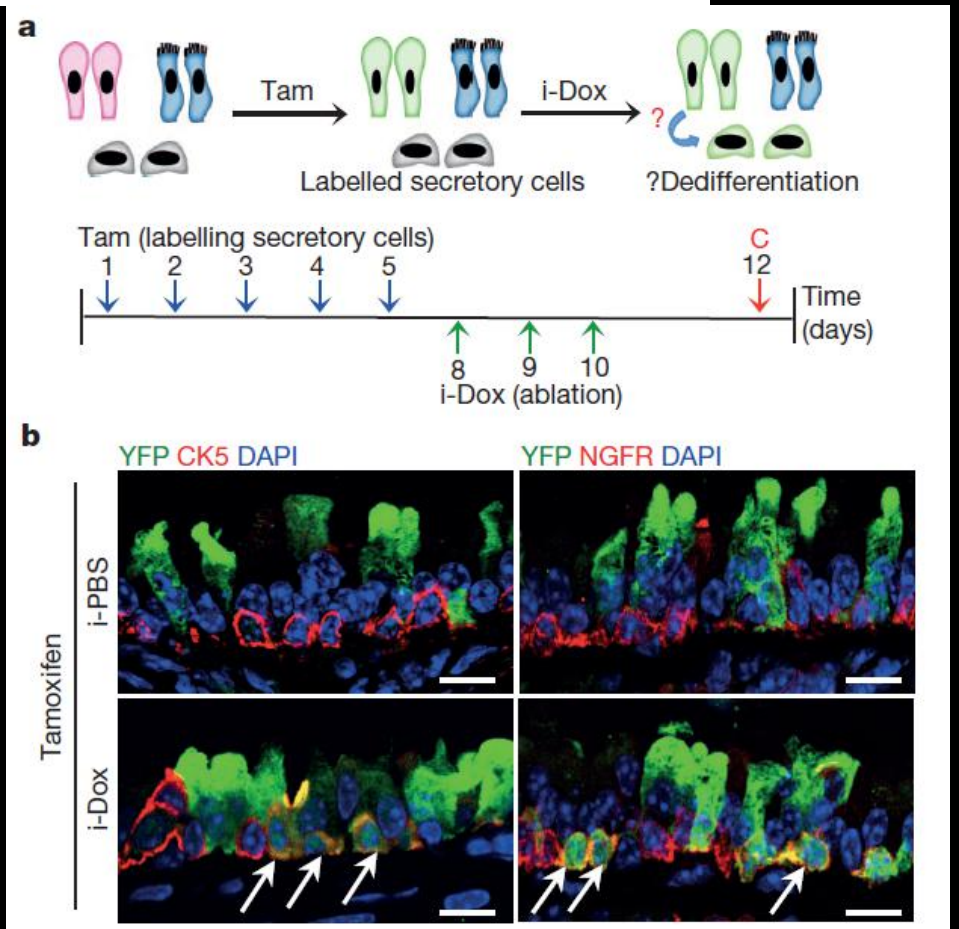
ARTICLE

doi:10.1038/nature12777

Dedifferentiation of committed epithelial cells into stem cells *in vivo*

Purushothama Rao Tata[1,2,3,4], Hongmei Mou[1,2,3,4], Ana Pardo-Saganta[1,2,3,4], Rui Zhao[1,2,3,4], Mythili Prabhu[1,2,3,4], Brandon M. Law[1,2,3,4], Vladimir Vinarsky[1,2,3,4], Josalyn L. Cho[3,5], Sylvie Breton[6], Amar Sahay[1,4,7], Benjamin D. Medoff[3,5] & Jayaraj Rajagopal[1,2,3,4]

Scgb1a1-creER/LSL-YFP::CK5-rtTA-tet(O)-DTA

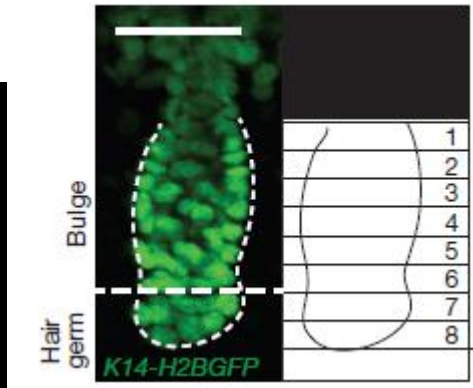


ARTICLE

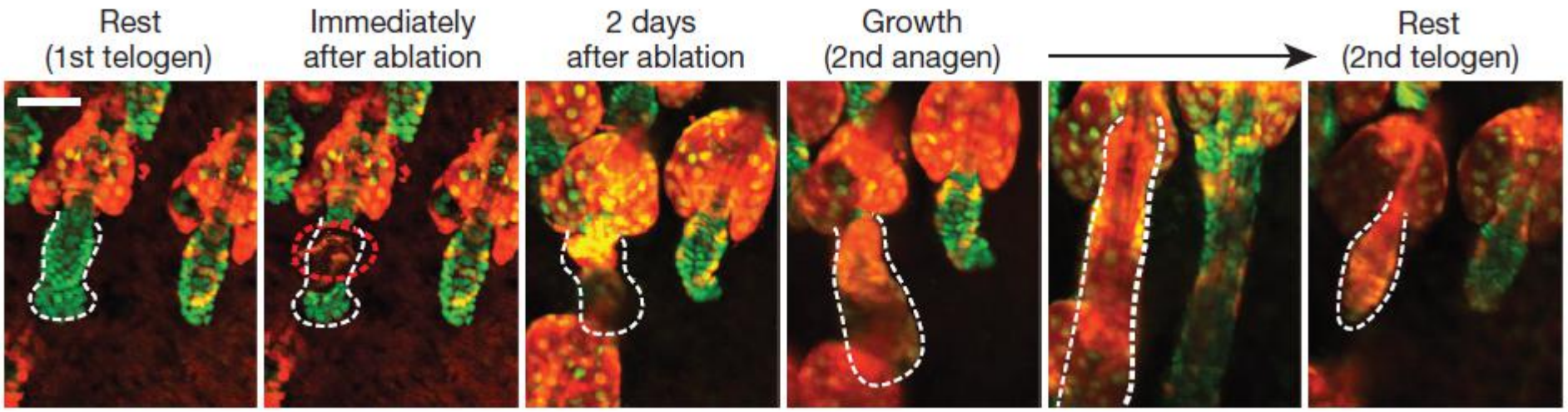
doi:10.1038/nature12602

Spatial organization within a niche as a determinant of stem-cell fate

Panteleimon Rompolas[1], Kailin R. Mesa[1] & Valentina Greco[1]



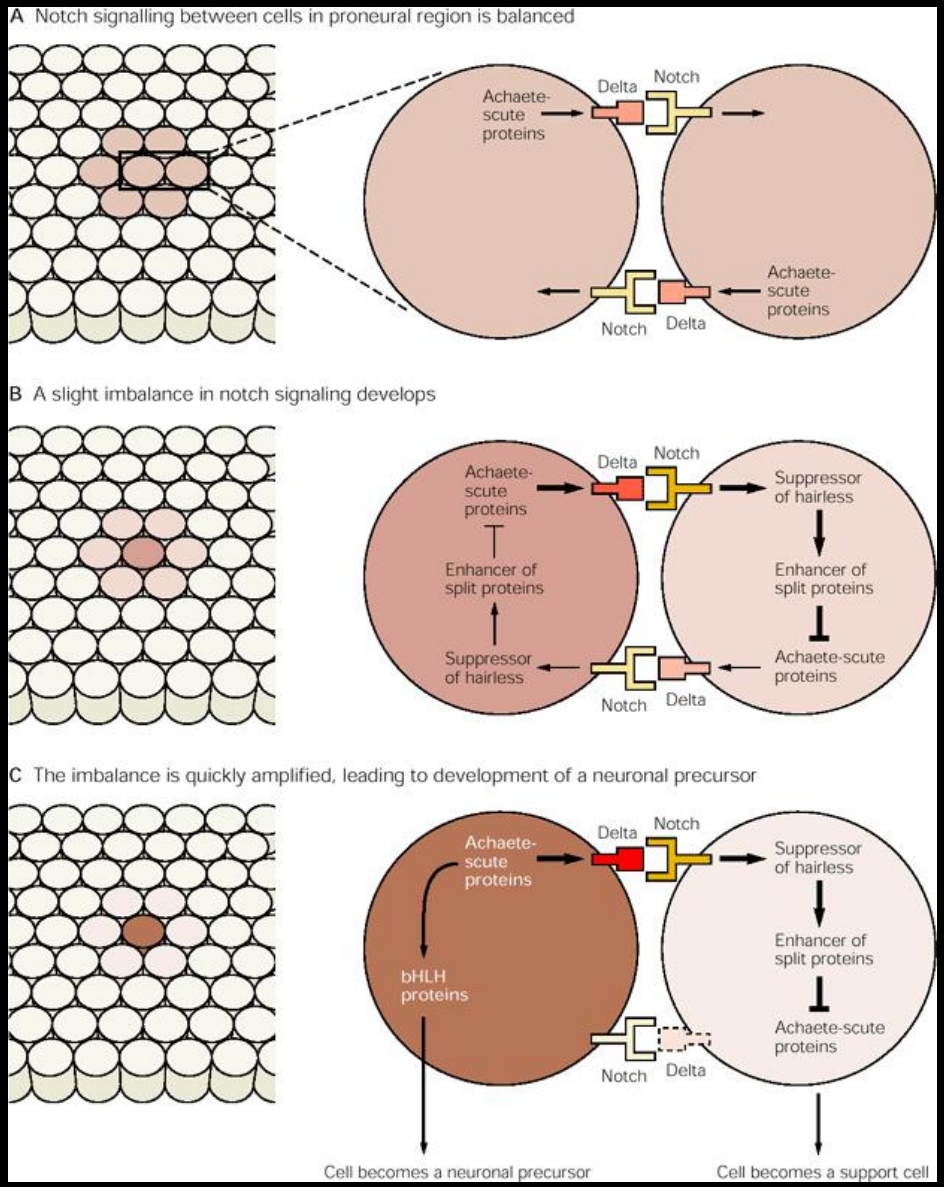
Mouse hair follicle niche



Neuronal differentiation

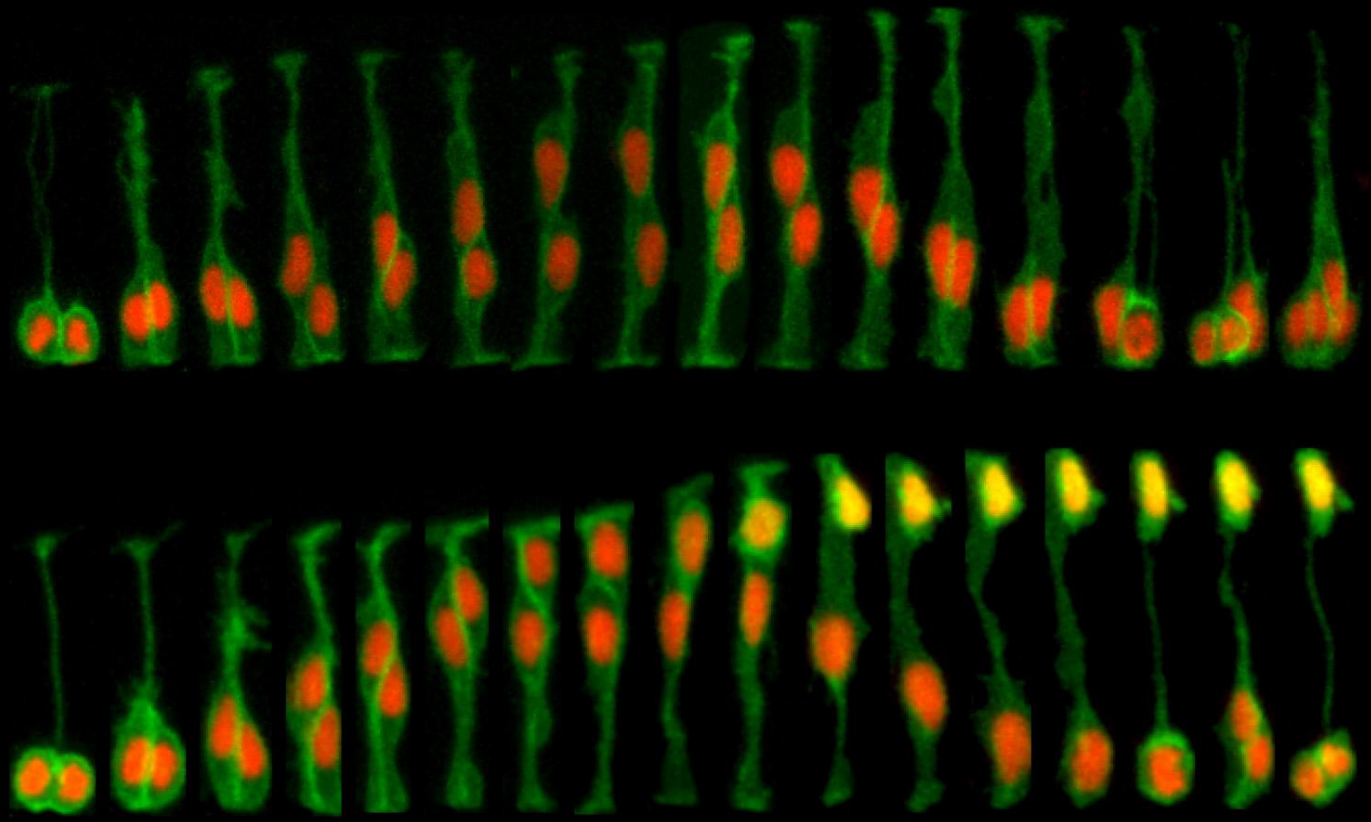
In developmental biology, cellular differentiation is the process by which a less specialized cell becomes a more specialized cell type.

Delta-Notch Signaling



Aguirre et al., 2010, Nature
Androutsellis-Theotokis., 2006, Natu

Interkinetic Nucleus Migration



Cell

Regulation of Neurogenesis by Interkinetic Nuclear Migration through an Apical-Basal Notch Gradient

Filippo Del Bene,[1] Ann M. Wehman,[1] Brian A. Link,[2,*] and Herwig Baier[1,*]
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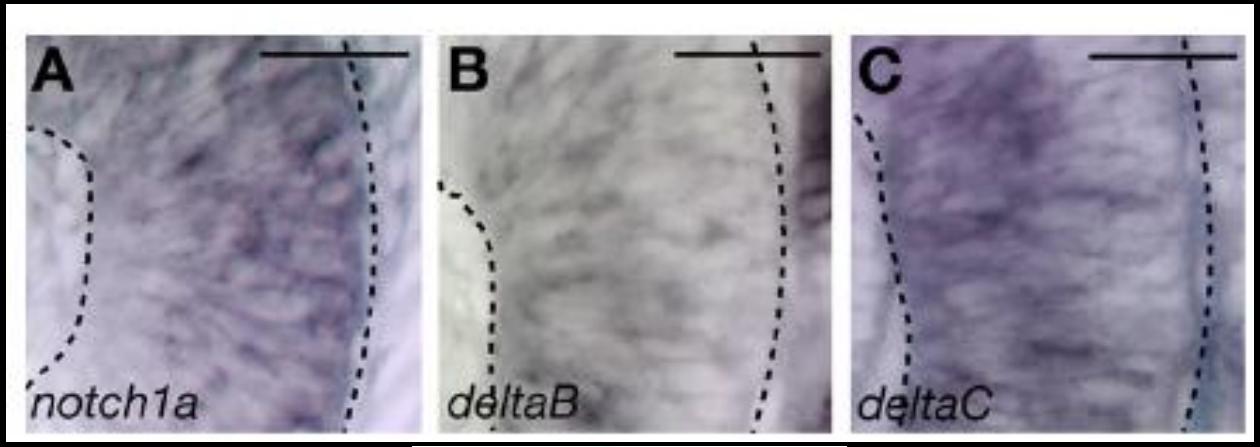
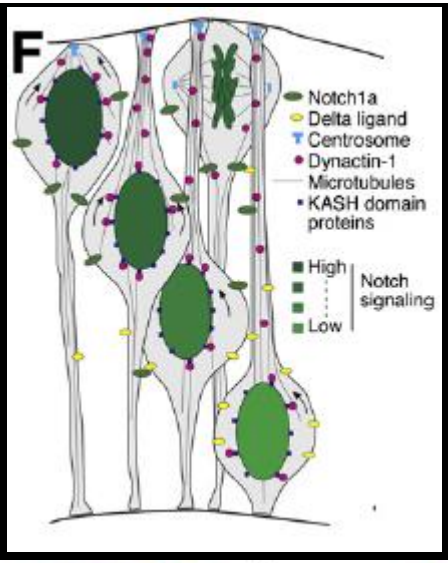
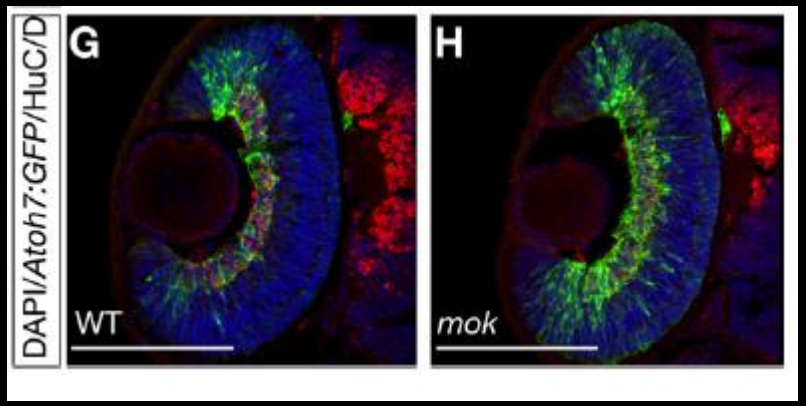
DOI 10.1016/j.cell.2008.07.017

Mok mutant: the motor protein Dynactin-1 is disrupted, INM more rapidly and deeply To the basal side and more slowly to the apical size.


A
notch1a
B
deltaB
C
deltaC

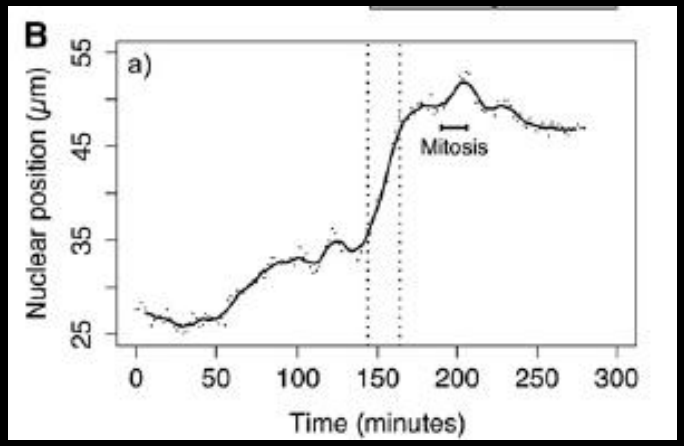

F
Notch1a
Delta ligand
Centrosome
Dynactin-1
Microtubules
KASH domain proteins
High
Low
Notch signaling


DAPI/Atoh7:GFP/HuC/D
G
WT
H
mok

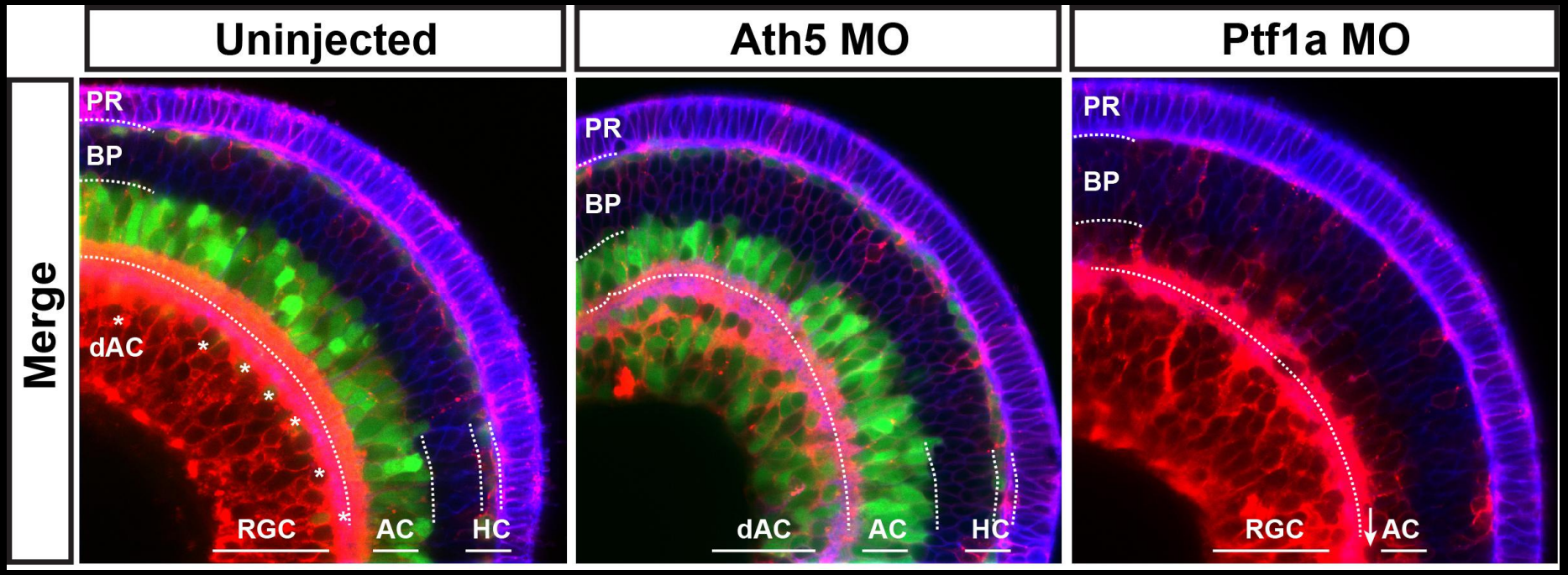
Cell

Actomyosin Is the Main Driver of Interkinetic Nuclear Migration in the Retina

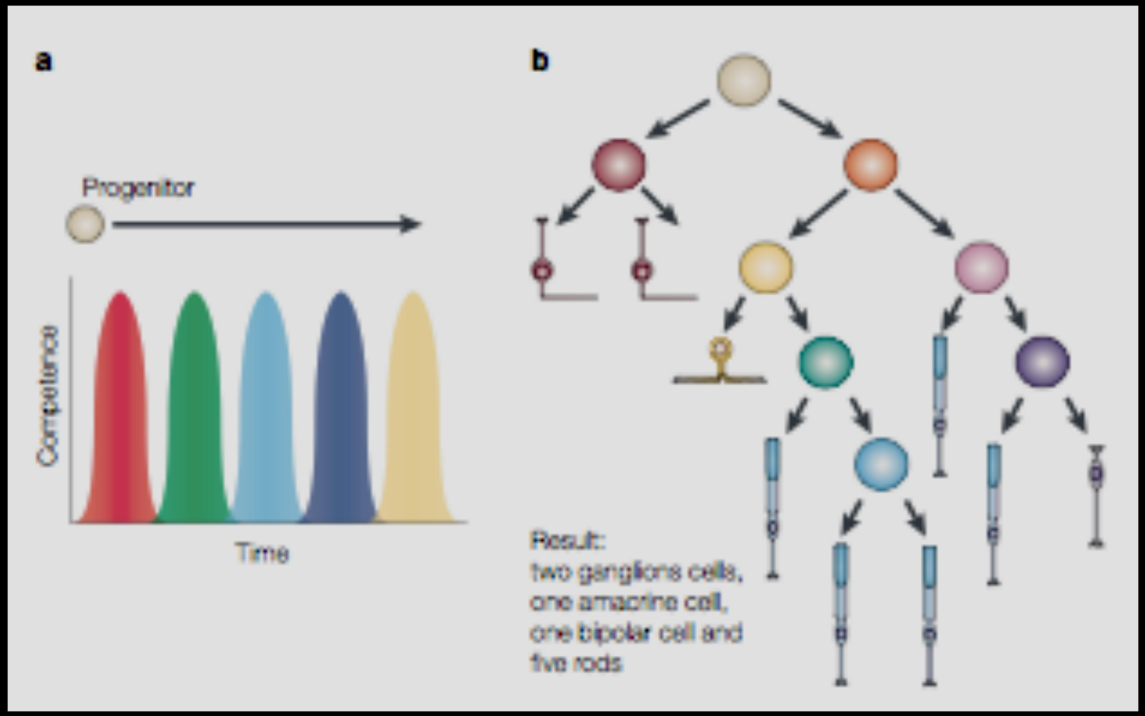
Caren Norden,[1,3] Stephen Young,[1,3] Brian A. Link,[2] and William A. Harris[1,*]
[1]Department of Physiology, Development and Neuroscience, Cambridge University, Downing Street, Cambridge CB2 3DY, UK
[2]Department of Cell Biology, Neurobiology, and Anatomy, Medical College of Wisconsin, 8701 Watertown Plank Road, Milwaukee, WI 53226, USA
[3]These authors contributed equally to this work
*Correspondence: harris@mole.bio.cam.ac.uk
DOI 10.1016/j.cell.2009.06.032



Fate Specification

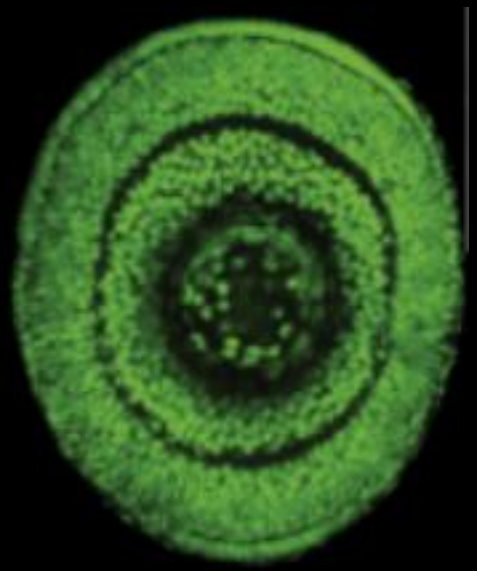


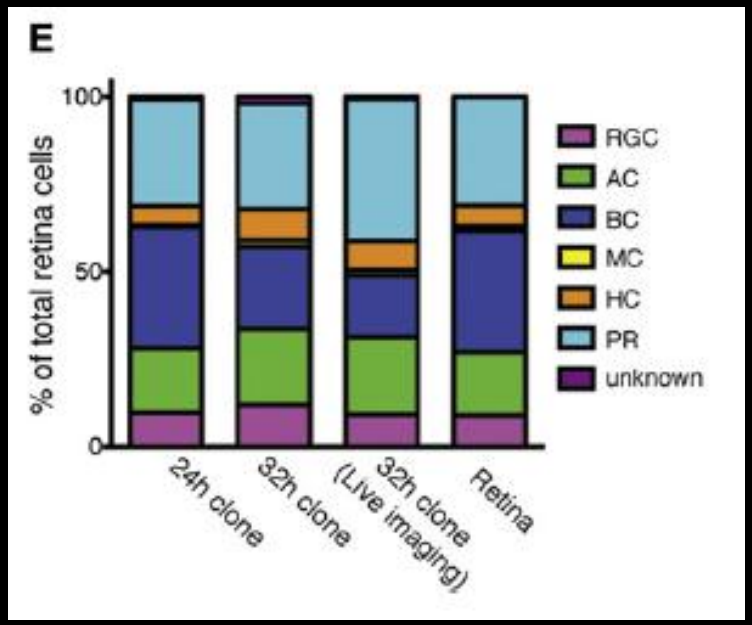
Histogenesis



Competence Model: RPCs pass through a series of competence states, progressively changing their responsiveness to instructive extrinsic cues, which also change over time.

Cell Composition





Outstanding Questions of Adult Neural Stem Cells

- ✓ Whether there exit individual true NSCs or not?
- ✓ What is the heterogeniety of adult NSC properties (Nature vs. Nuture)?
- ✓ What is the lineage relationship of such progenitor heterogeniety?
- ✓ What is the embryonic origin of different neural precursors?
- ✓ What is the multipotency of aNSCs in the physiological condition and upon injury?
- ✓ Why are adult Neural Stem Cells quiescent?

Outstanding Questions of Neural Differentiation

- ✓ What is a neural cell fate?
- ✓ How is a given cell fate specified?
- ✓ How are different cell fates generated sequentially?
- ✓ How are the new-born neurons synapsed together?

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