

Adult neurogenesis

Created by Abcam in collaboration with Gerd Kempermann*

Adult neurogenesis is the production of new neurons in the adult brain. In many species (e.g. fish and birds) it is a common process, but in mammals it is an exception. Mammalian adult neurogenesis takes place primarily in two regions: the SVZ/olfactory bulb system and the hippocampus (as well as the striatum and the hypothalamus in some species). It is a highly complex, polygenic process that

recapitulates aspects of brain development in the otherwise non-neurogenic adult brain, and originates from local precursor cells that reside in defined neurogenic niches. In the hippocampus, adult neurogenesis is regulated by behavior and activity. Finally, adult neurogenesis contributes to specific types of plasticity in the different regions, with regeneration not being its primary purpose.

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Neurogenesis in the adult olfactory bulb

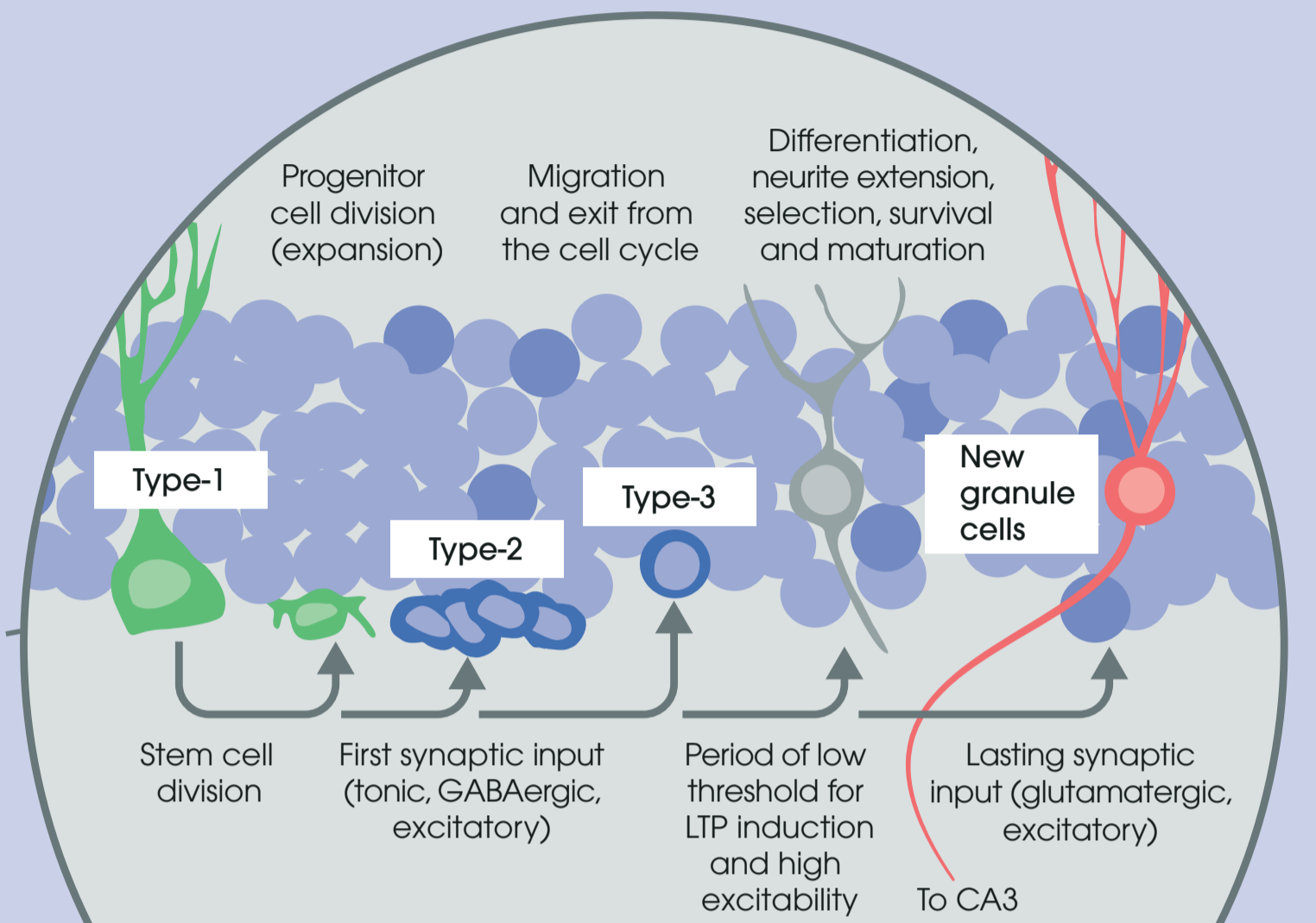
Adult neurogenesis in the striatum

Normally in humans and rabbits and very limited after ischemia in mice and rats.

Adult neurogenesis in the neocortex

Occurs in mammals only during prolonged postnatal generation of Layer VI neurons, and limited post-ischemic neurogenesis (Layer I).

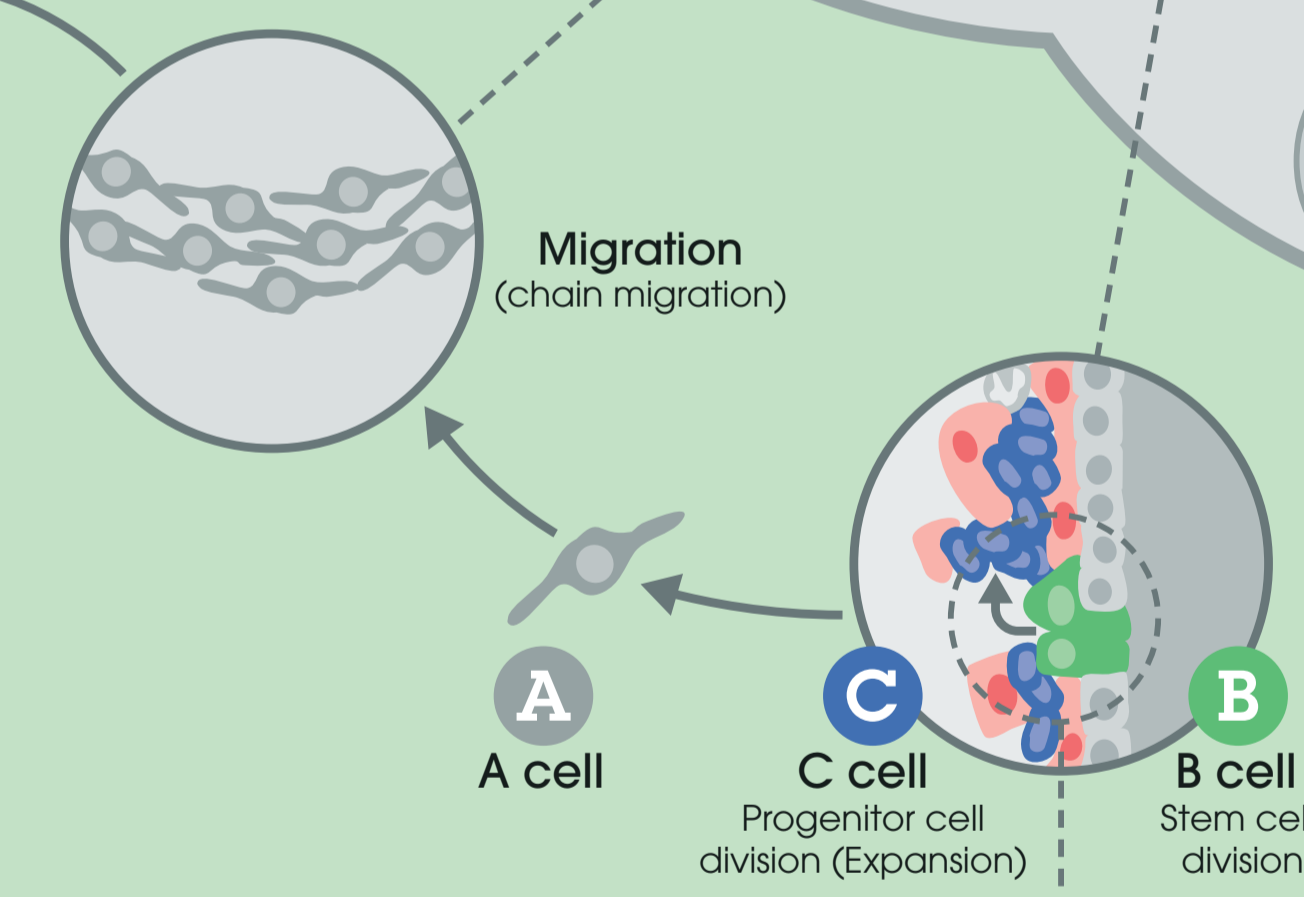
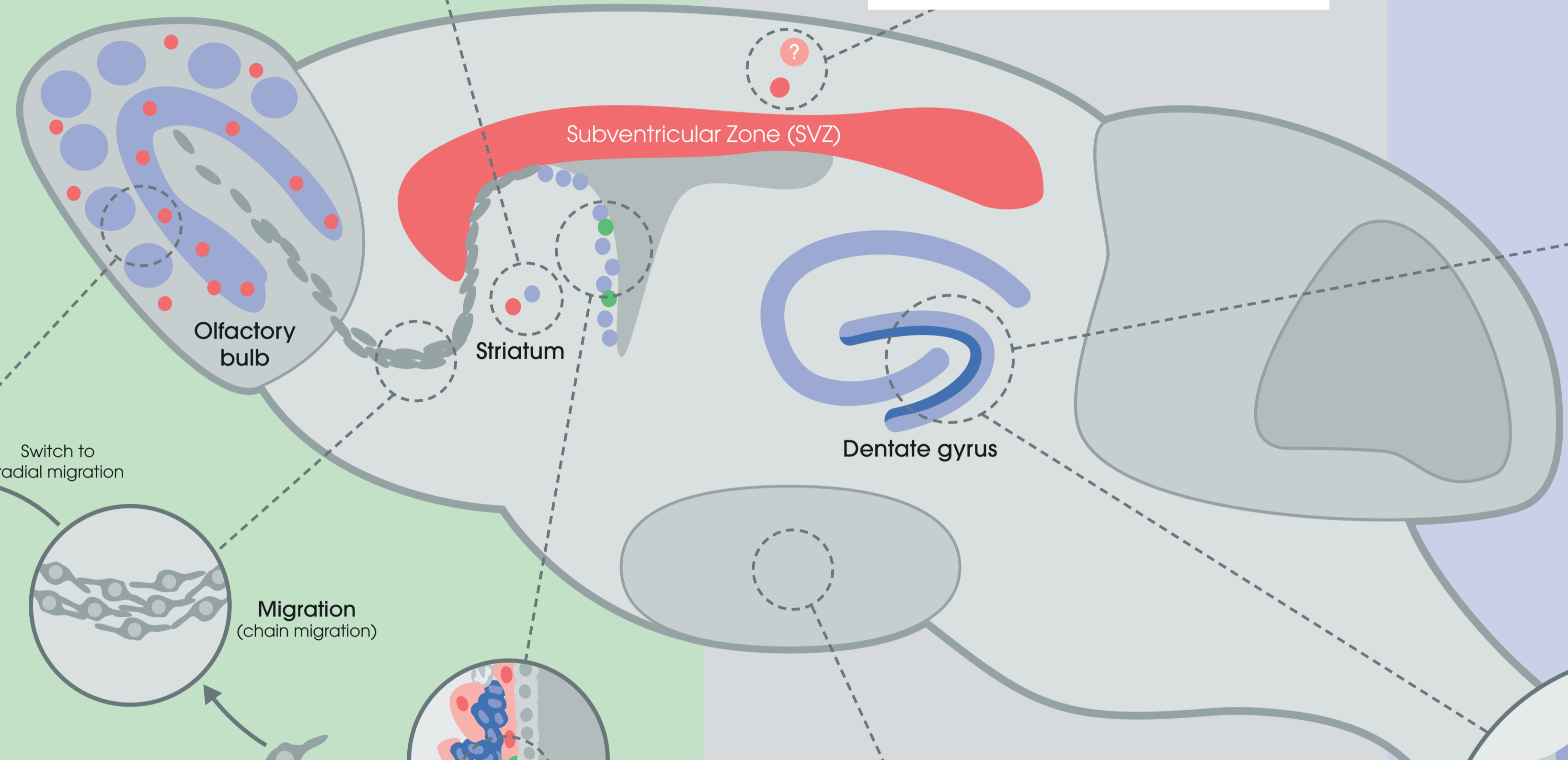
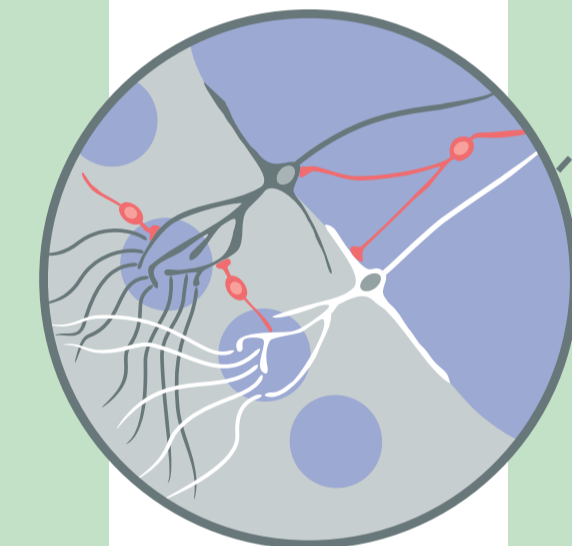
Neurogenesis in the adult hippocampus



Precursor cell stages	New neuron
GFAP	
BLBP	
Nestin, Sox2	
DCX, PSA-NCAM	Calretinin, Tuc4
	Calbindin
	NeuN

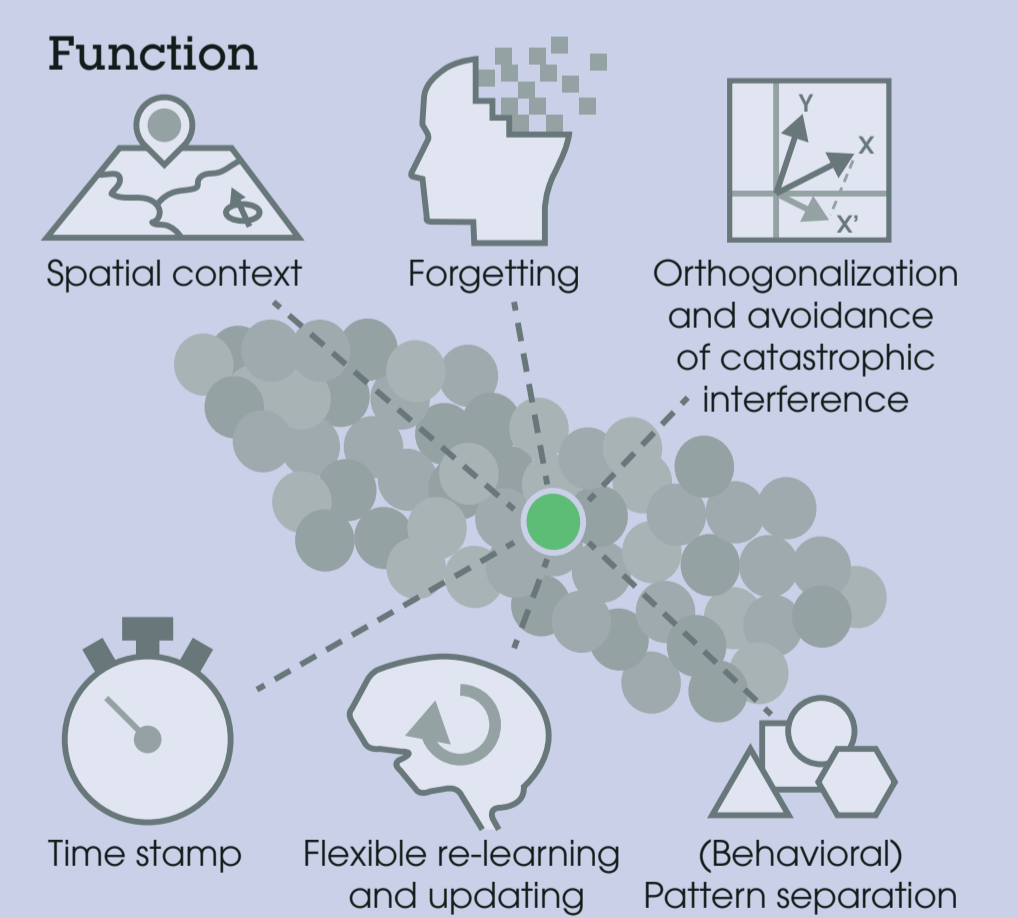
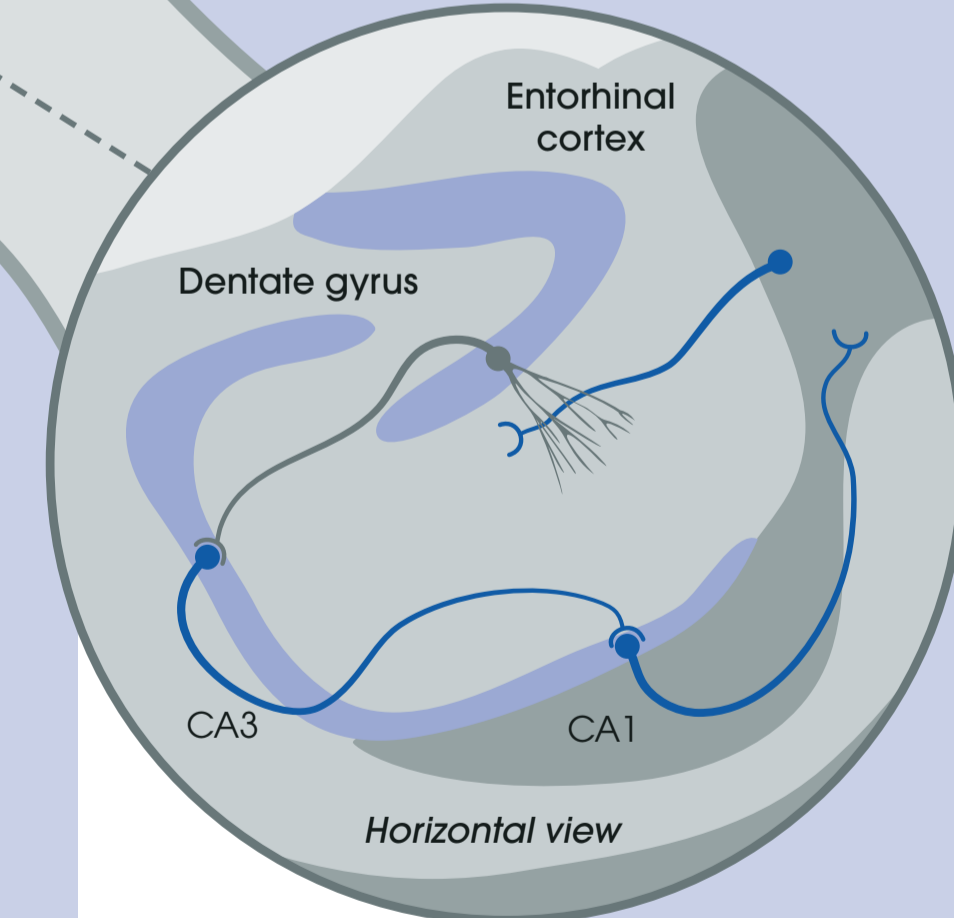
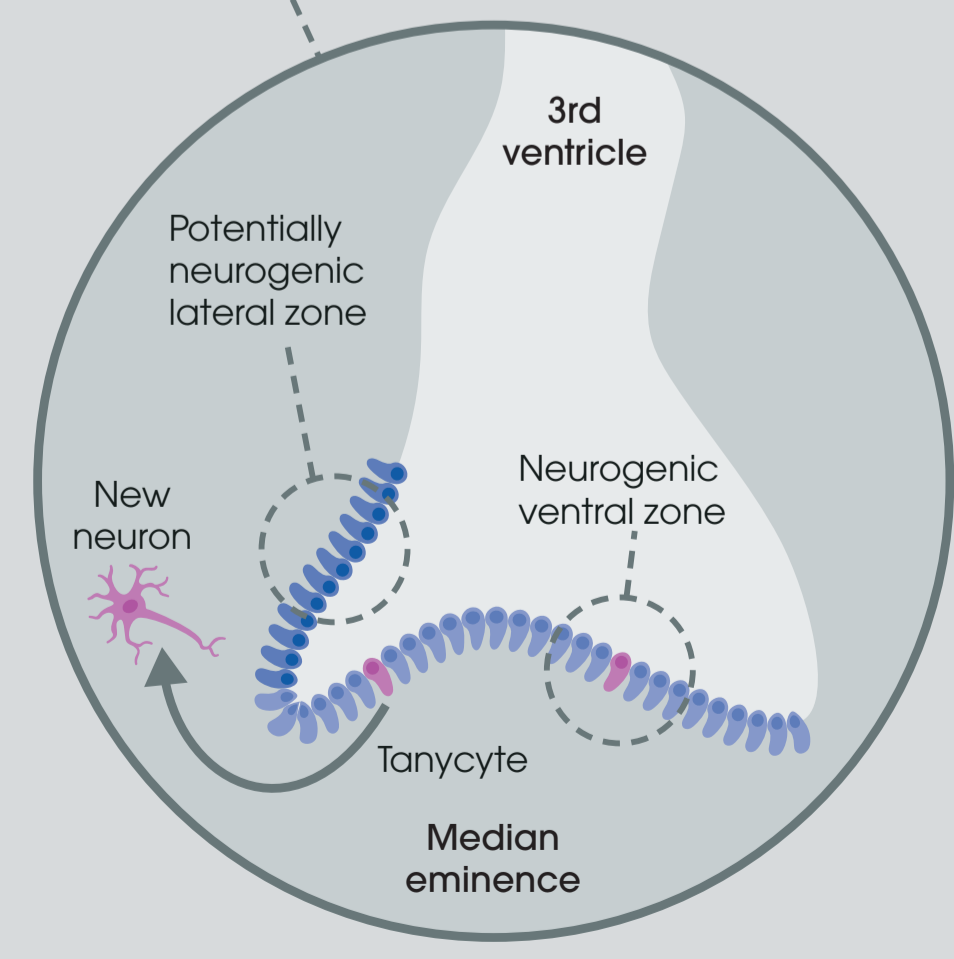
Simplified sequence of marker expression

Differentiation
 Neurite extension, selection and survival, maturation.
 At least seven types of new interneurons in the granular and periglomerular layer are produced.



Adult neurogenesis in the hypothalamus

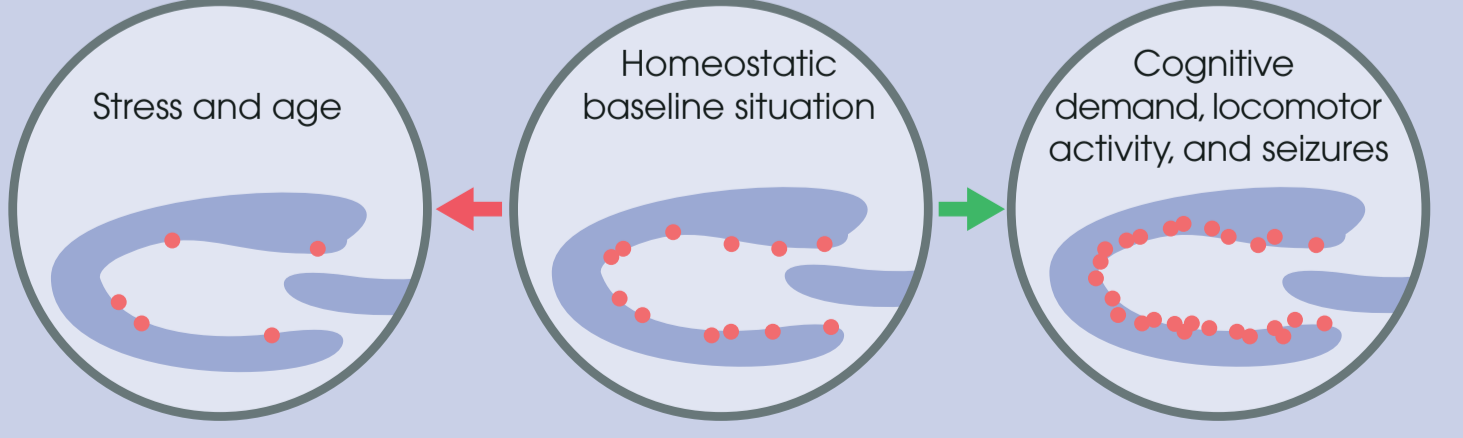
A population of tanycytes in the median eminence of the 3rd ventricle can give rise to new hypothalamic neurons in mice. Additional precursors might arise in the lateral wall of the ventricle.



Connectivity

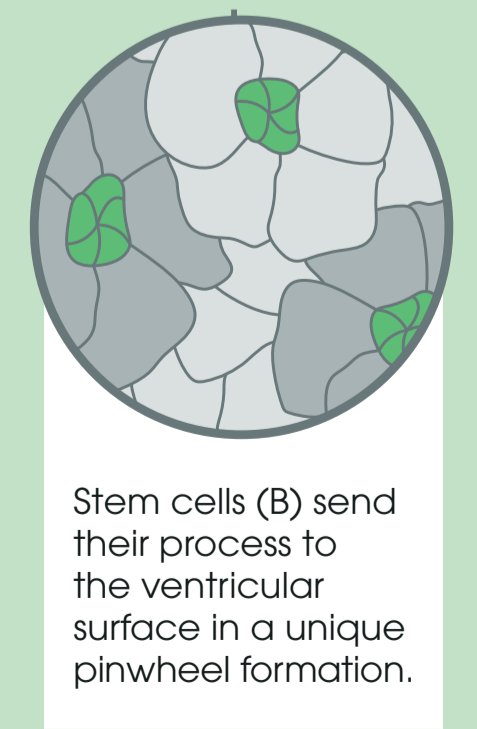
Adult hippocampal neurogenesis adds new excitatory granule cells that link synapses 1 and 2 in the tri-synaptic backbone of hippocampal circuitry.

Regulation



Precursor cell stages	Postmitotic stages
B → C → A	
Neuronal lineage	
GFAP, Sox2	EGFR, Dlx
Nestin, BLBP	DCX, PSA-NCAM, Ascl1
Pax6*, Gsx2*	Calretinin, (TH)
Gli1*, Nkx2.1*	NeuN
*Precursor cells in the SVZ are regionalized: wall areas with specific transcription factor profiles give rise to different types of neurons in the olfactory bulb.	
Oligodendrocytic lineage	
PDGFRα	Olig2
	MBP, O4

Simplified sequence of marker expression



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