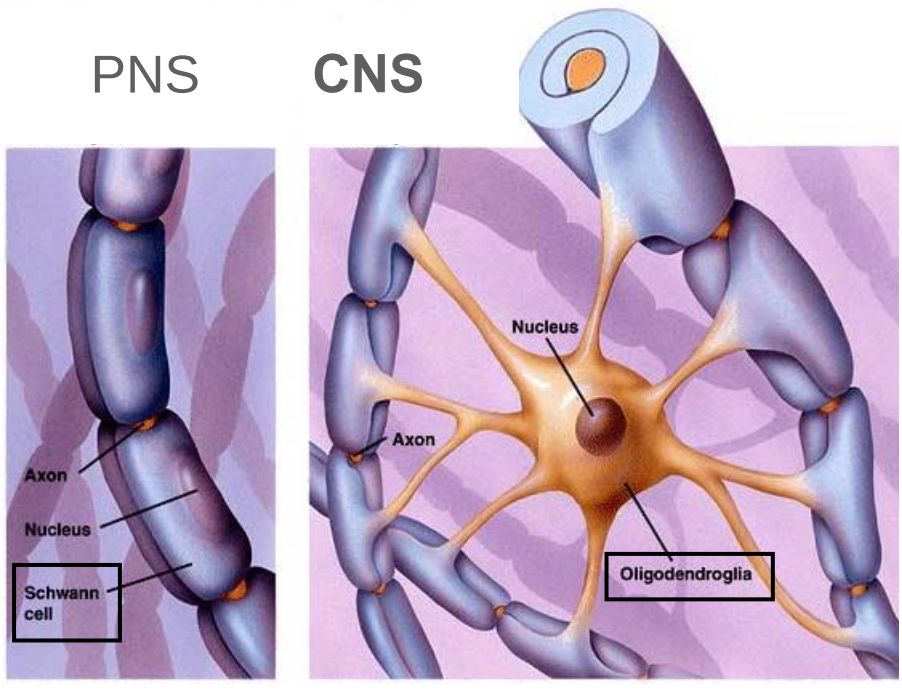
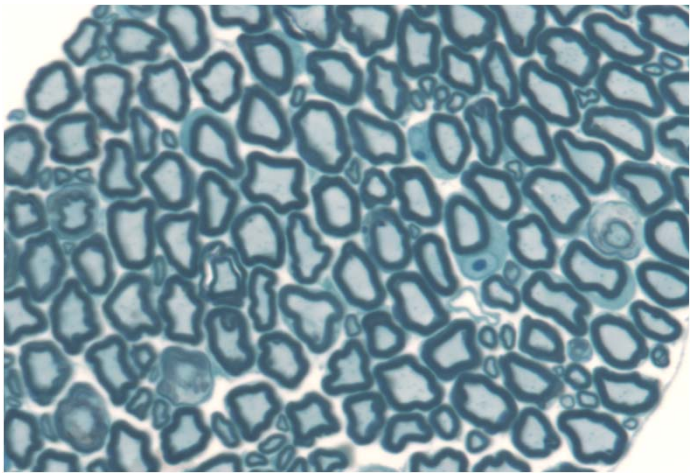
BSc Neuroscience: Module 1

Schwann cells

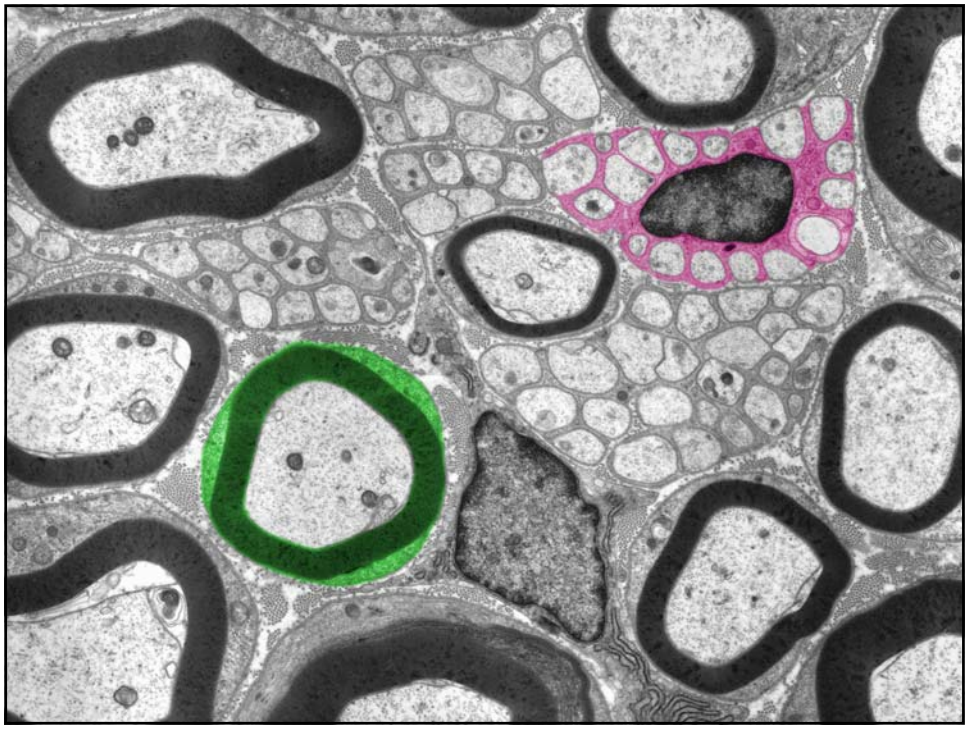
Prof R. Reynolds 2012



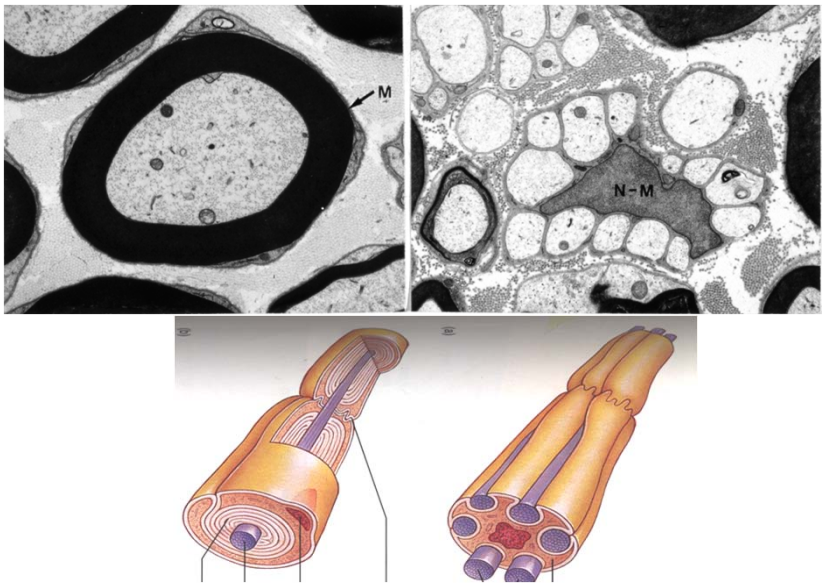
Schwann cells – myelin producing cells of the PNS



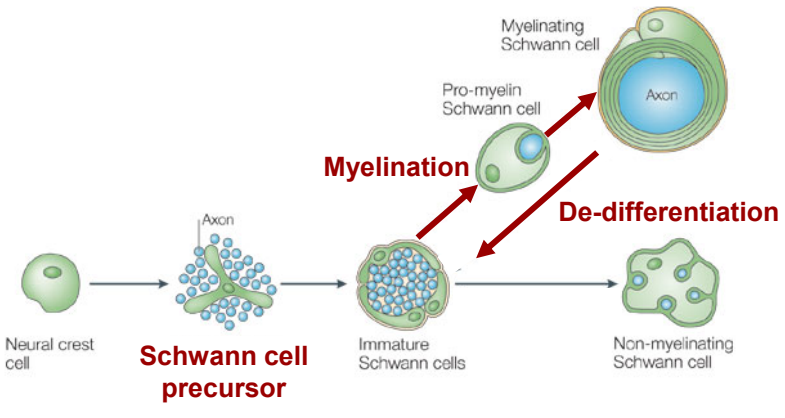
Myelinating schwann cells have a 1:1 relationship with an axon segment, whereas oligodendrocytes produce multiple myelin sheaths



Myelinating and non-myelinating Schwann cells in peripheral nerve

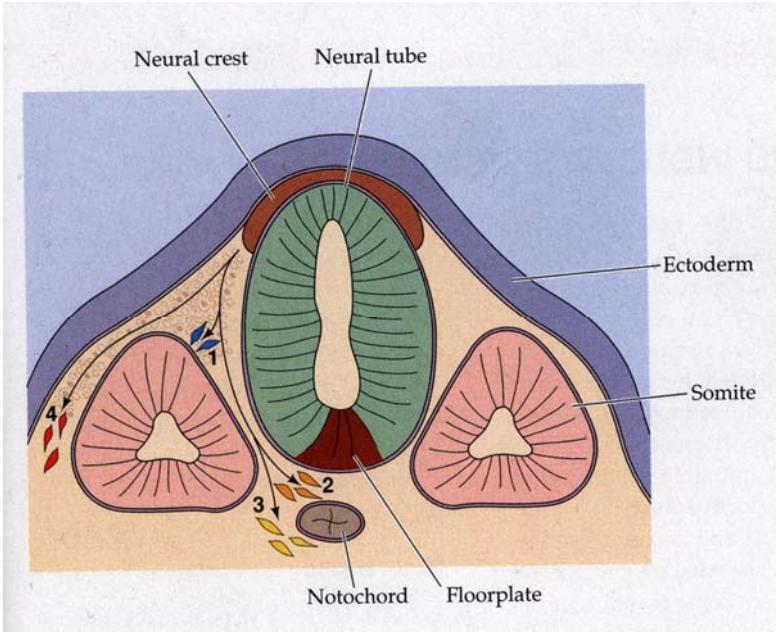


THE SCHWANN CELL LINEAGE IN RODENT SPINAL NERVES

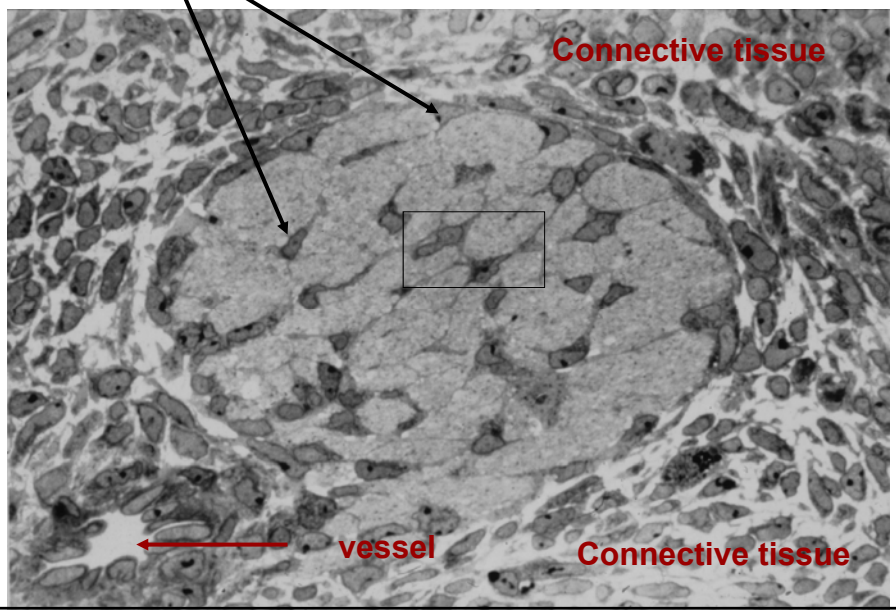


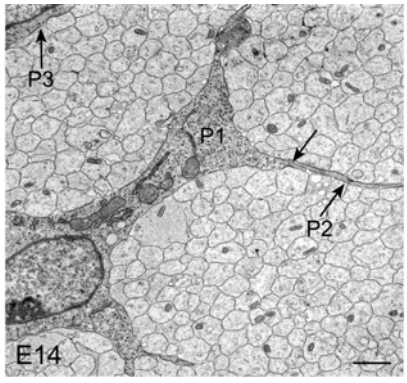
Jessen and Mirsky, Nature Reviews | Neuroscience

Schwann cells originate in the neural crest

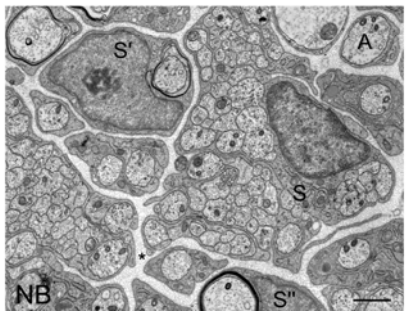


Schwann Cell Precursors in E 12/14 rat sciatic nerve (transverse section)

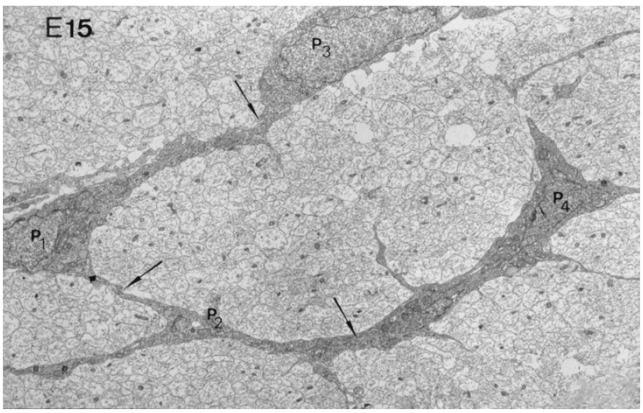




Precursors

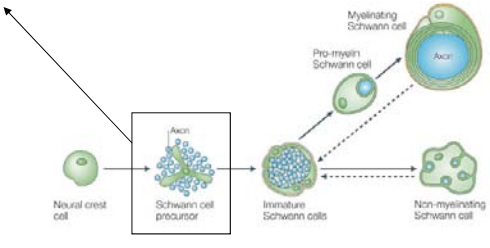


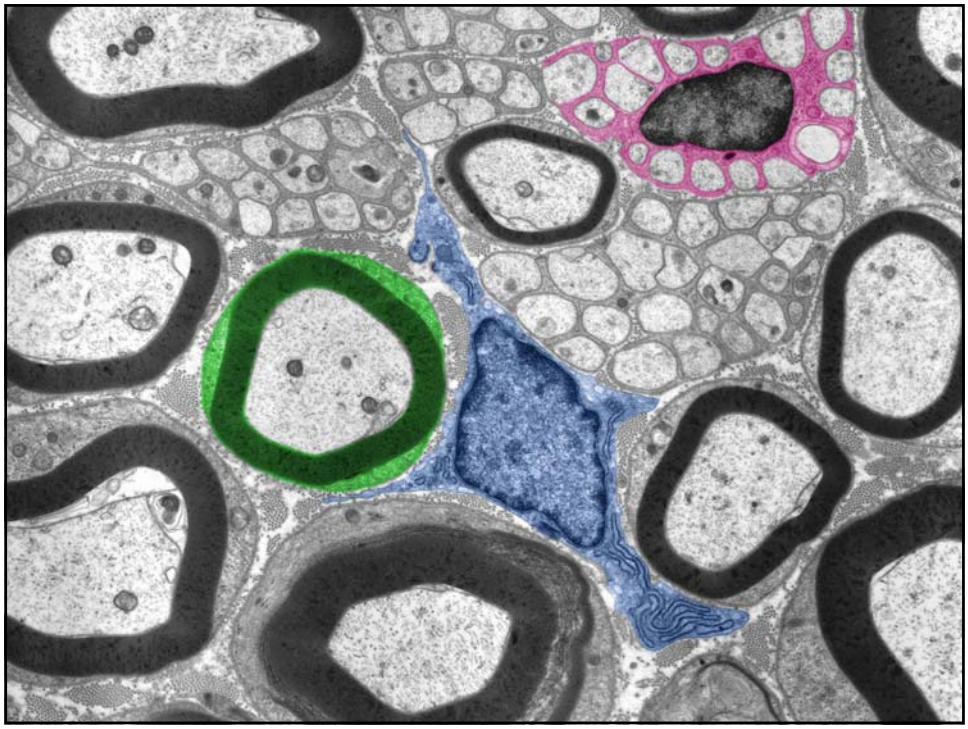
Schwann cells



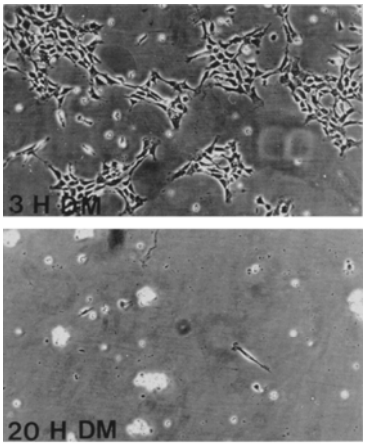
Embryo day 15 rat sciatic nerve

What is the function of SCPs ?

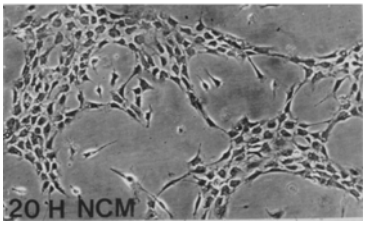




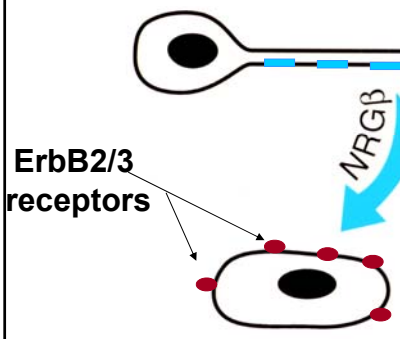
Schwann cell precursors
die under normal culture conditions



Schwann cell precursors are rescued by neurone-conditioned medium



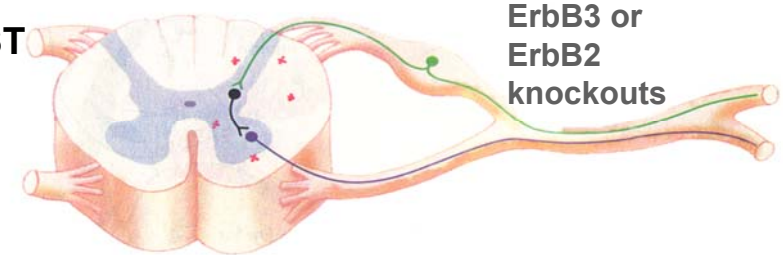
Neuregulin 1 β is an indispensable survival signal for Schwann cell precursors



Neuregulin 1 is also:
- a mitogen
- lineage progression signal

CONTROL

TEST



What this tells us about SCPs → Neuregulin is a key survival factor

What this tells us about neurons → Peripheral nerves form, even in the absence of glial cells

An unexpected observation: **80% of sensory & motor neurones eventually die, if glial cells are removed**

CONTROL

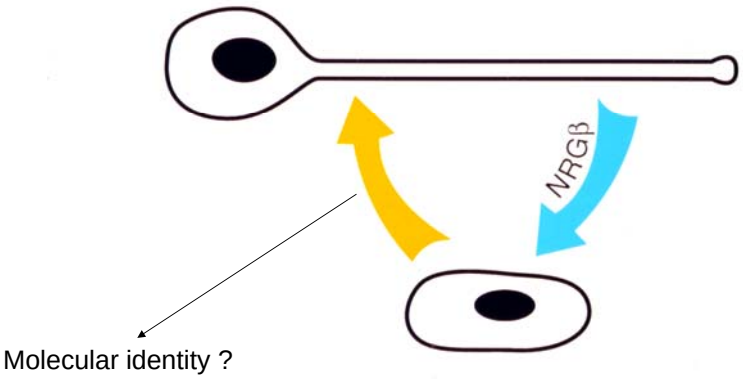
Normal E18

TEST

Knockout E 18:

Glial cells control neuronal survival

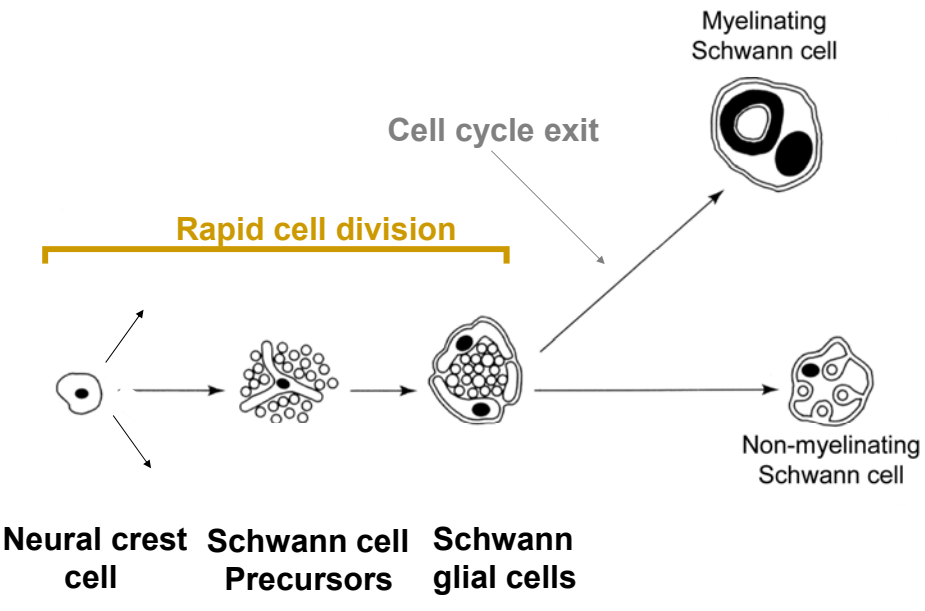
Neurones and Schwann cell precursors rescue each other during development

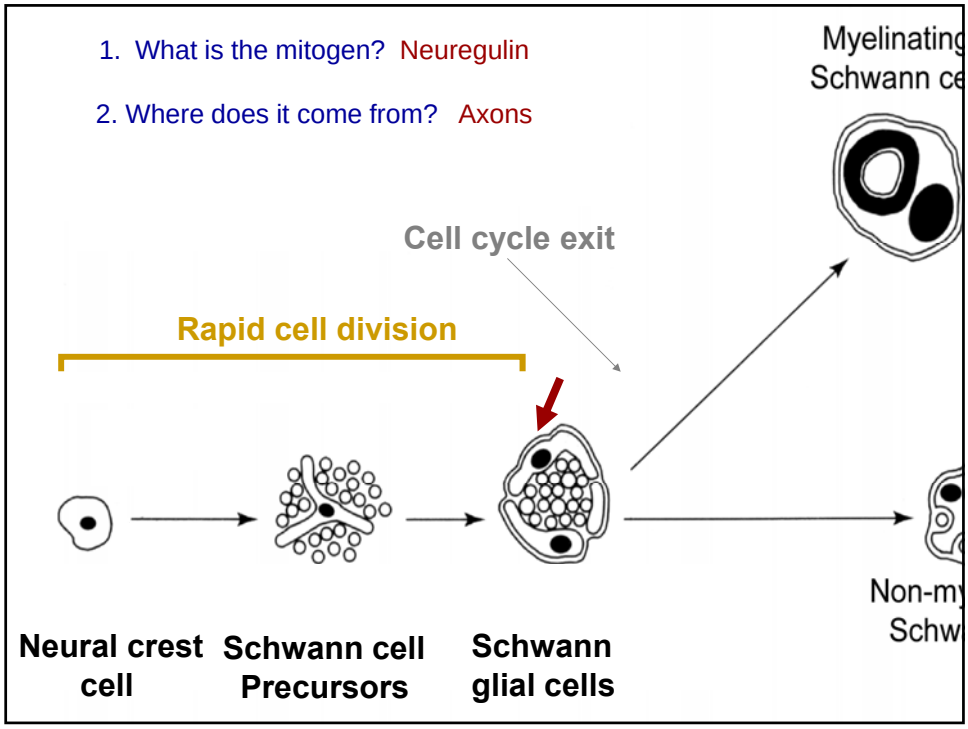


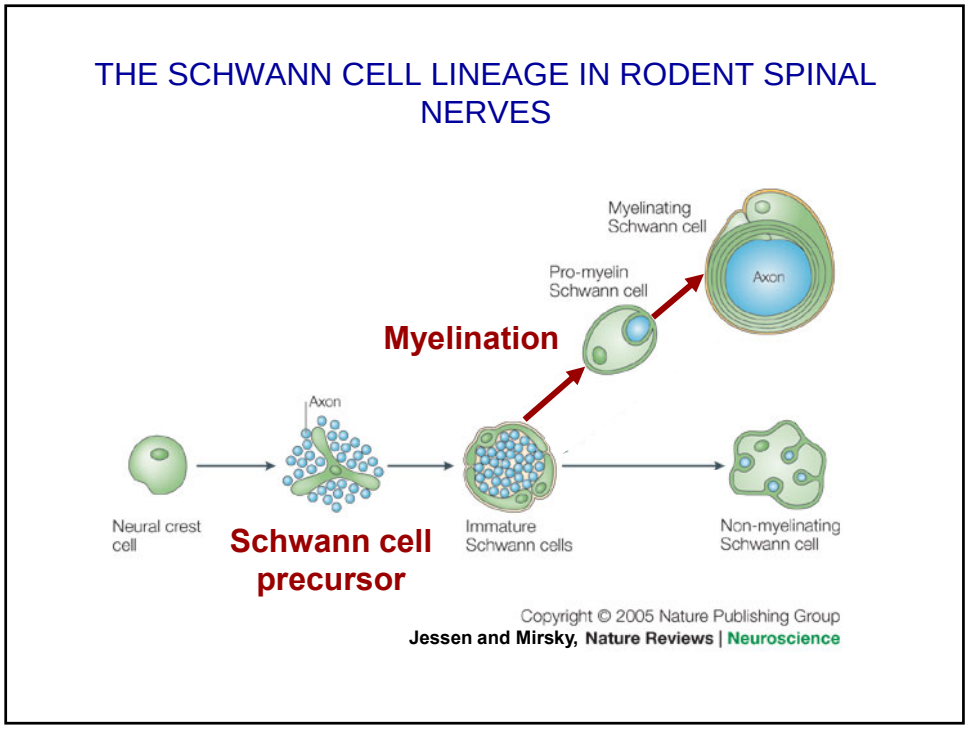
Schwann cells are generated between E15 and E17

in nerves of the rat hind limb

PROLIFERATION




1. What is the mitogen? Neuregulin
2. Where does it come from? Axons
Myelinating
Schwann ce
Cell cycle exit
Rapid cell division
Non-my
Schw
Neural crest cell
Schwann cell Precursors
Schwann glial cells


THE SCHWANN CELL LINEAGE IN RODENT SPINAL NERVES
Myelinating Schwann cell
Pro-myelin Schwann cell
Axon
Myelination
Axon
Neural crest cell
Schwann cell precursor
Immature Schwann cells
Non-myelinating Schwann cell
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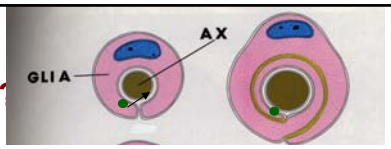
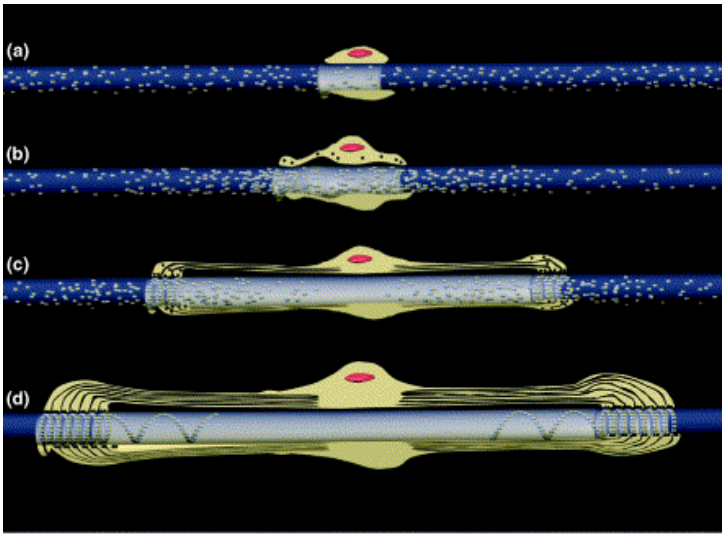
Jessen and Mirsky, Nature Reviews | Neuroscience

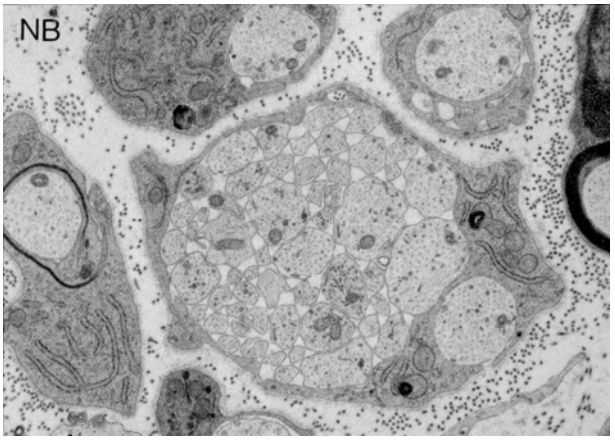
Myelin wrapping – how does it really happen?



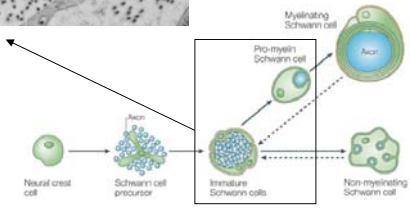


Current Opinion in Neurobiology

Myelination



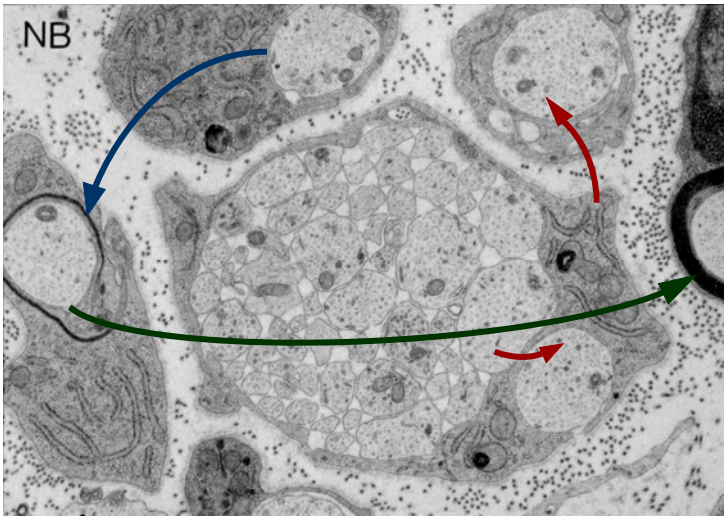
The sciatic nerve at birth



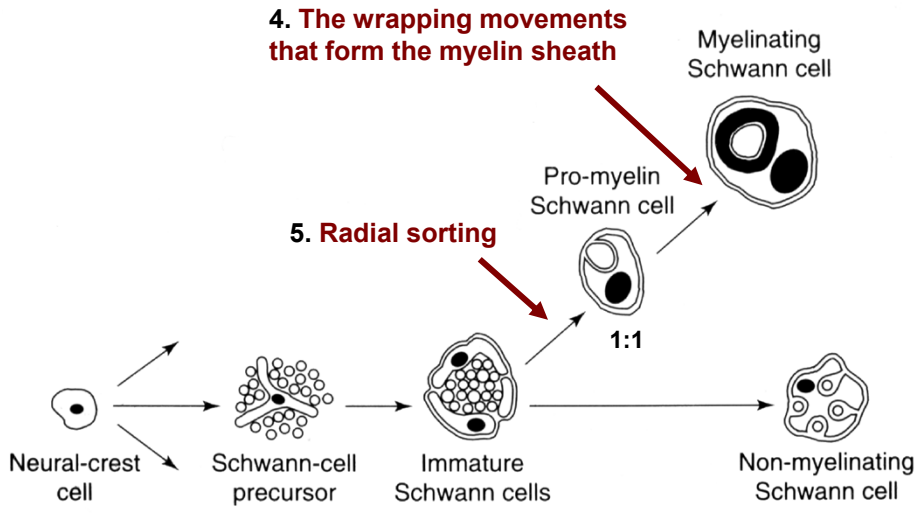
Radial sorting (formation of 1:1 relationship)

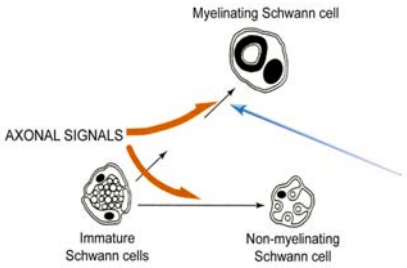
Activation of the myelin programme

Wrapping & myelin sheath formation



THE SCHWANN CELL LINEAGE IN RAT AND MOUSE





ACTIVATION OF THE MYELIN PROGRAMME:

1 Withdrawal from the cell cycle

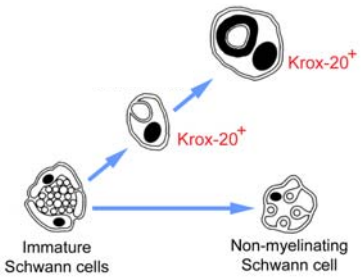
2 Up-regulation of the myelin proteins
(Pzero, MBP and many others)

3 Down-regulation of immature Sch proteins

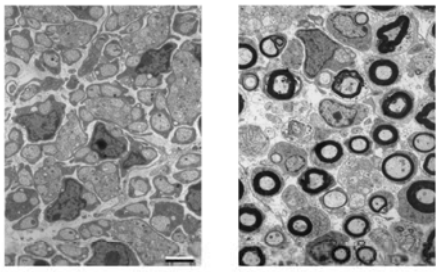
4 Membrane synthesis and wrapping
to form the myelin sheath

The transcription factor Krox-20 :

Selectively expressed in myelinating cells



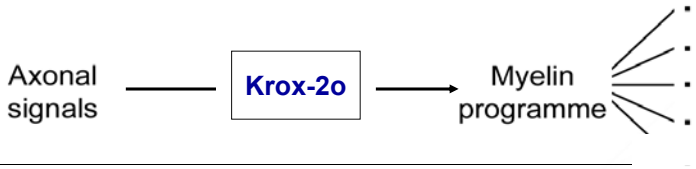
Essential for myelination

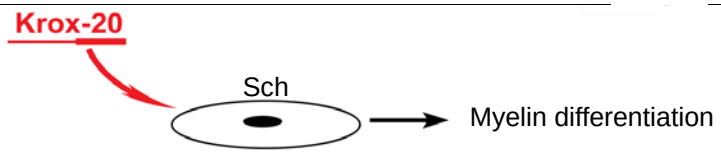


Krox-20$^{-/-}$ wildtype

From Topilko and Meijer 2001

Drives the myelination programme

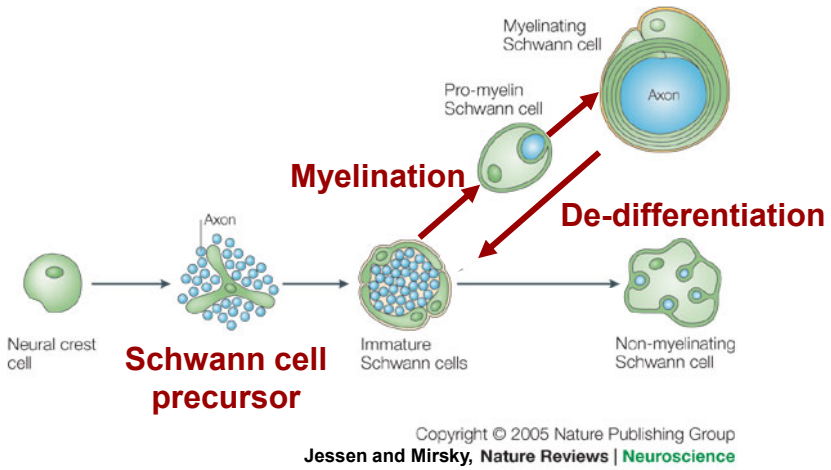




Krox-20 expression is sufficient to activate the myelin programme in isolated Sch in vitro

Krox-20 is a global regulator of myelin differentiation

THE SCHWANN CELL LINEAGE IN RODENT SPINAL NERVES



References

1. *KR Jessen & R Mirsky (2005) The origin and development of glial cells in peripheral nerves. Nat Rev Neuroscience 6:671-682*

2. *KR Jessen & R Mirsky (2008) Negative regulation of myelination. Glia 56:1552-65.*