

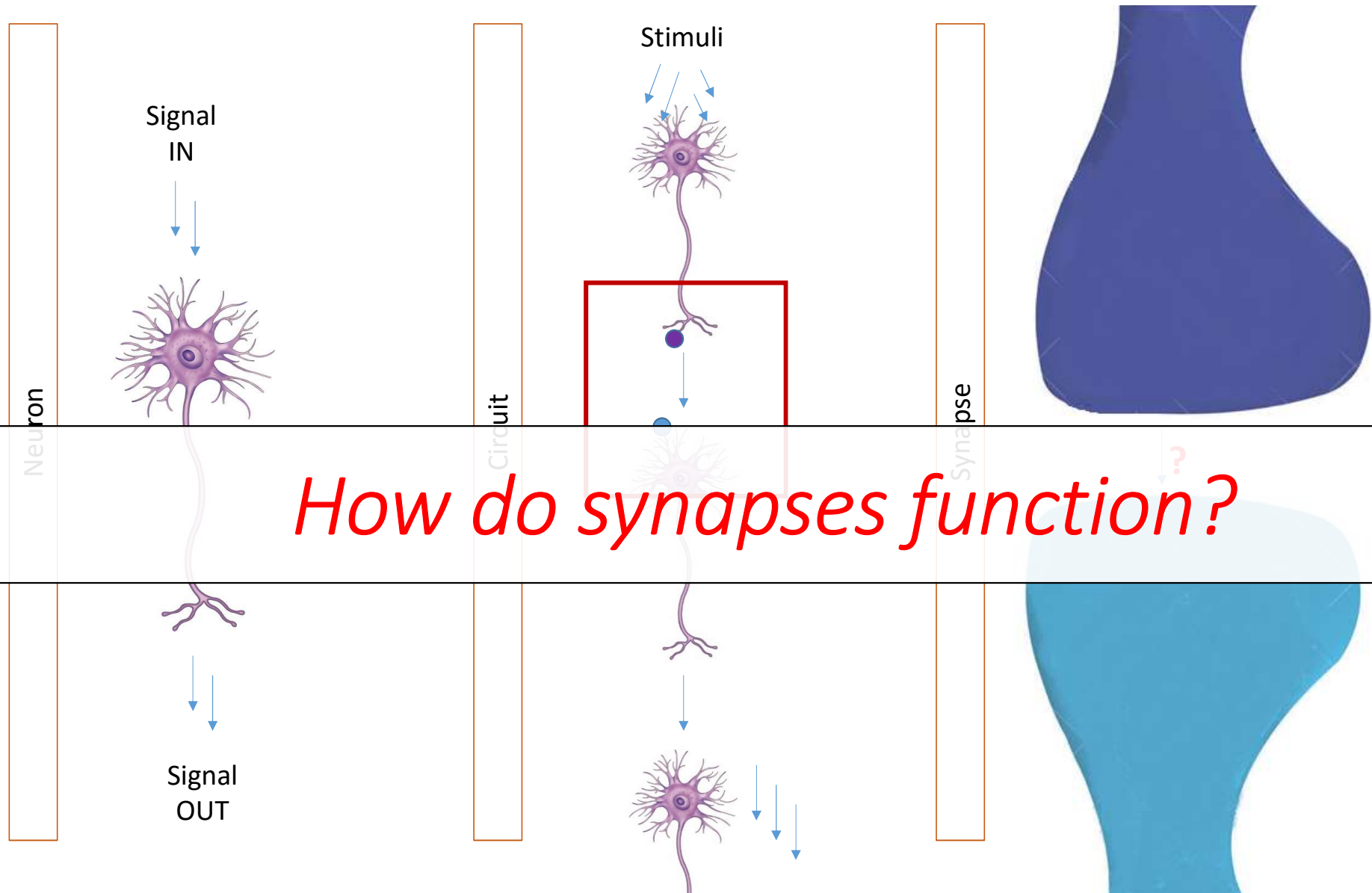
Glia: not just brain “glue”

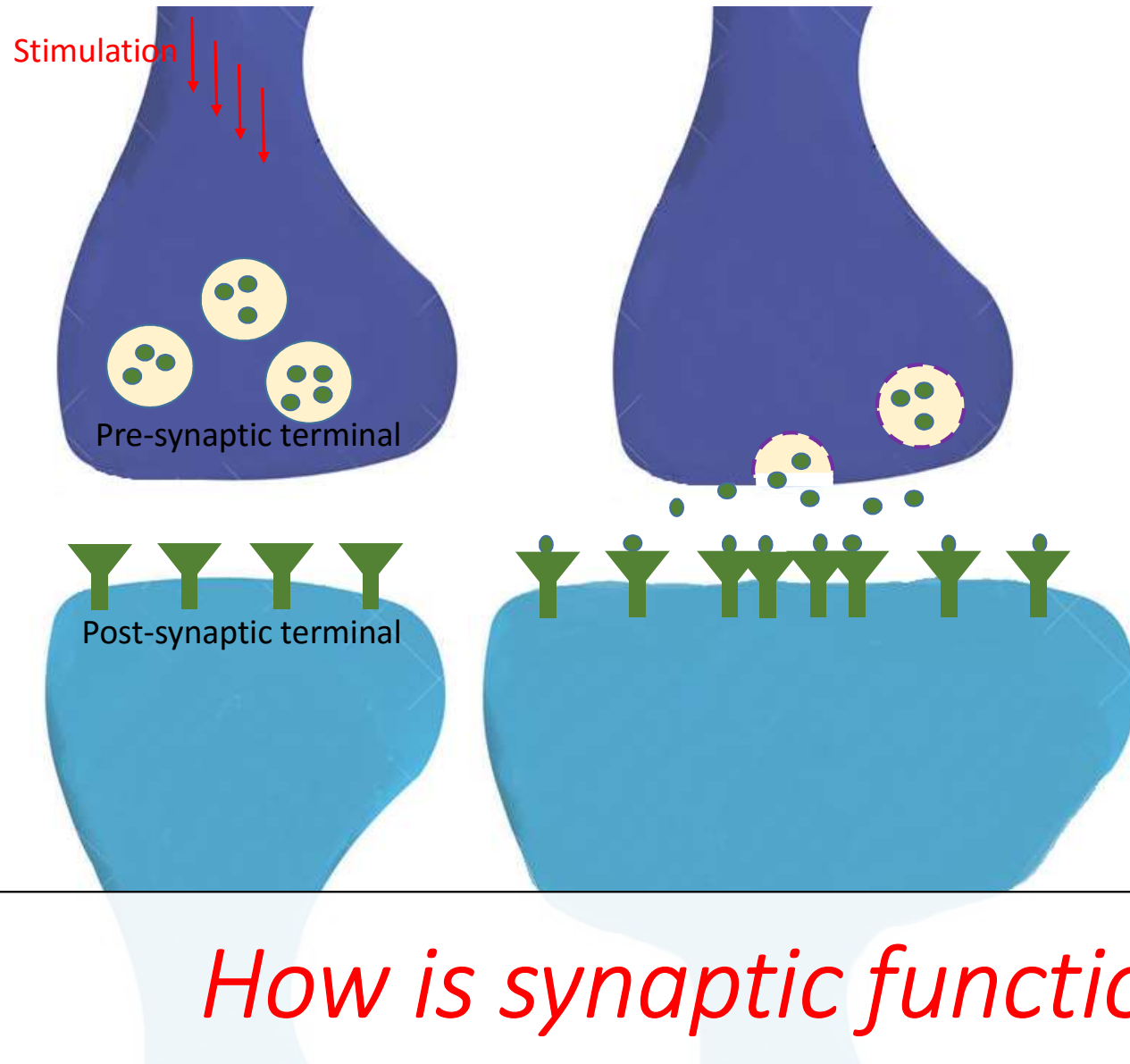
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Stony Brook University





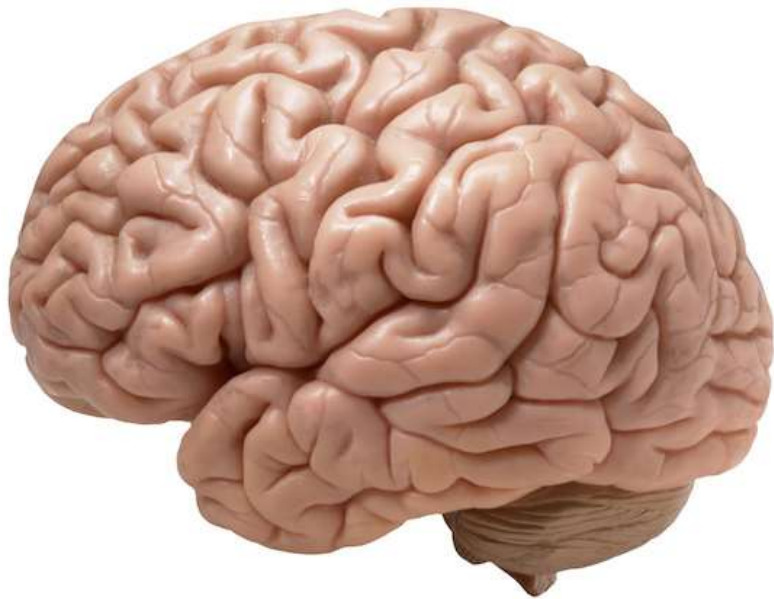
Neuronal function requires
short and *long* term processes:

In the *short* term (ms to s):

- Key proteins are activated
- Local signals will respond to stimuli
- Signal cascades will get activated
- Factors will turn on gene expression
- Neurotransmitter release and uptake
- “Reset” of the system

In the *long* term (min to hr):

- New proteins and structures will be made
- Increase in
 - The physical size and structure of the terminal
 - The density of receptors at the terminal
 - Response speed and sensitivity



Brains are
not made up
of just
neurons

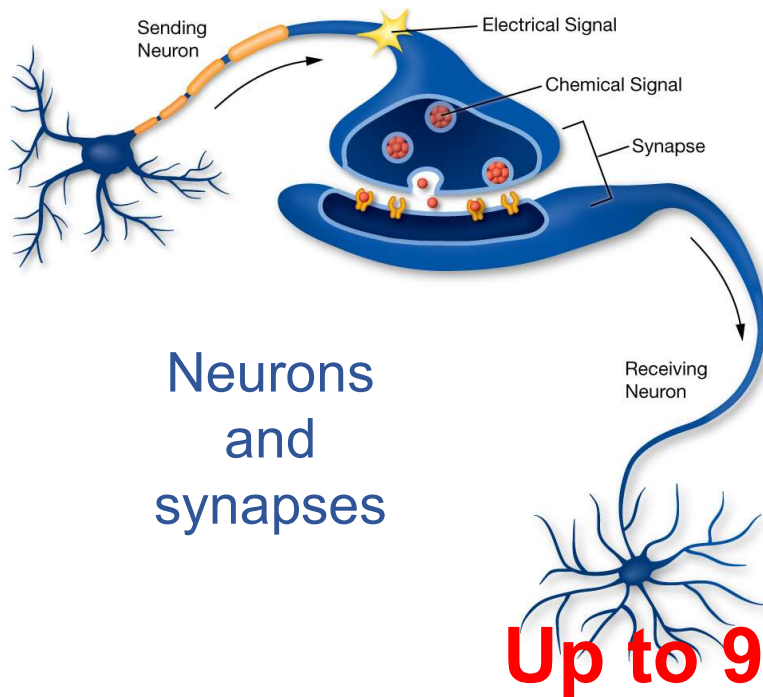
Just like



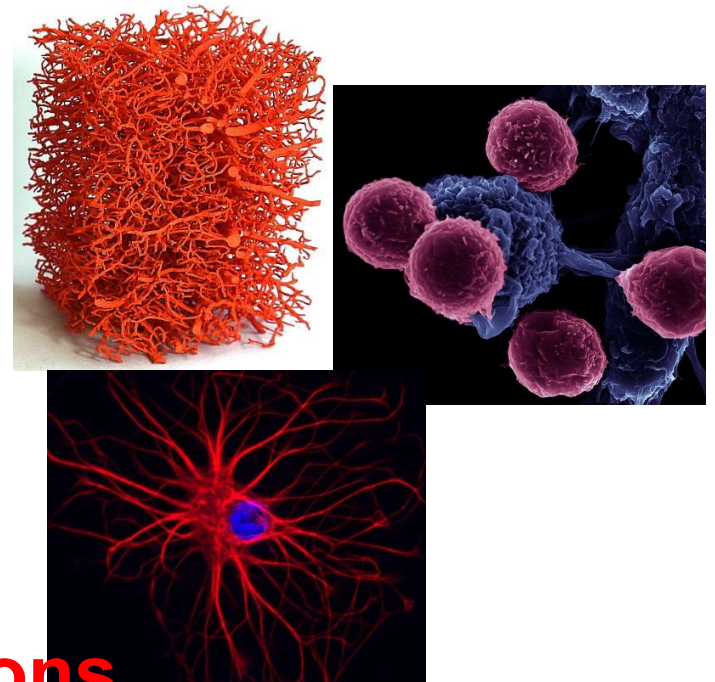
Cars are **not** just engines

Well, what are brains,
then?

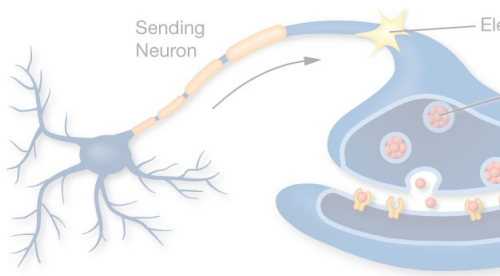
Brain: A conglomerate of many different types of cells, working together to perform our cognitive functions.



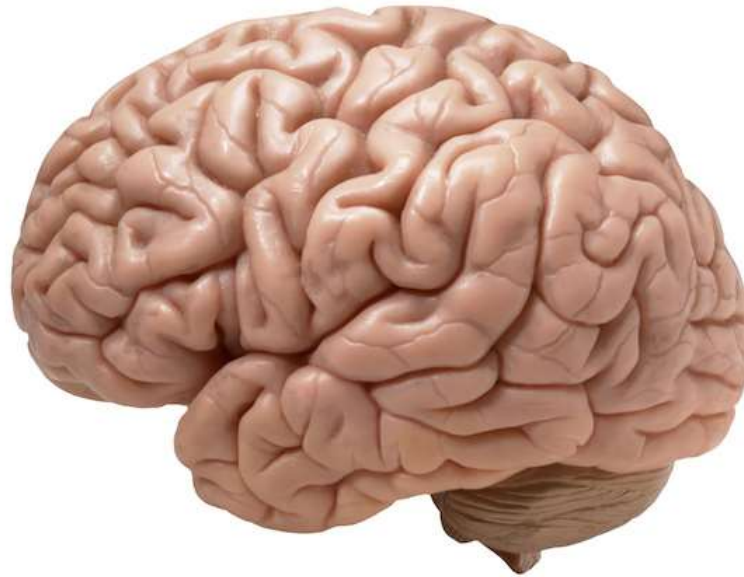
Blood vessels
Immune cells
Glial cells
Stem cells
Etc.



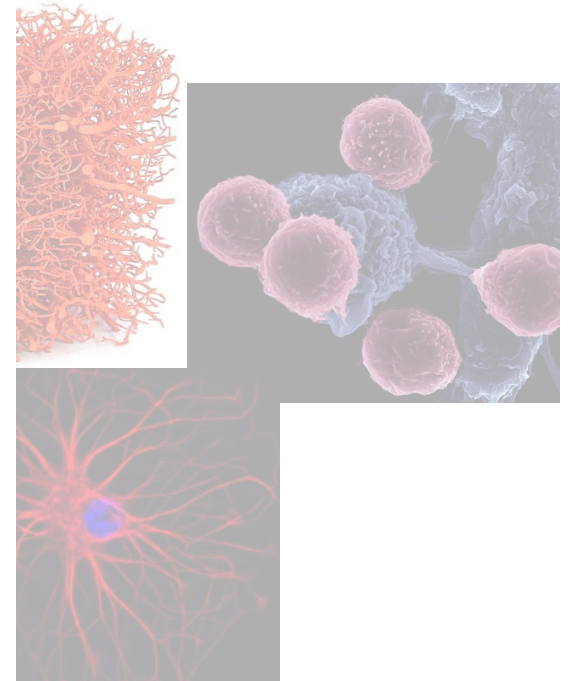
Brain: A conglomerate of many different types of cells, working together to perform our cognitive functions.

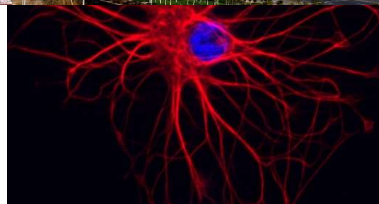
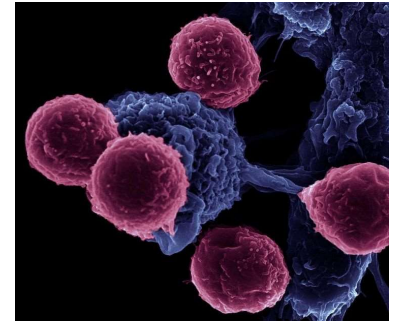
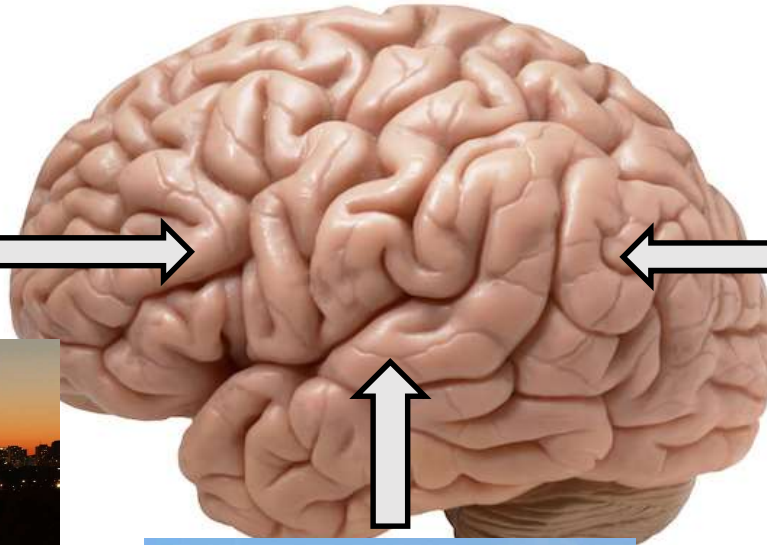


Neurons
and
synapses



Up to 90% NOT neurons





How do all of these
pieces make up such
an efficient “machine”?

The resource highway

A 3D illustration of a blood vessel, showing the internal structure and the flow of red blood cells. The vessel is depicted with a textured, reddish-brown wall. Numerous red blood cells, represented as red, biconcave discs, are shown in motion within the vessel. The title 'The resource highway' is positioned at the top left of the image.

Blood

Oxygen

Nutrients (ex. Glucose)

Immune cells (peripheral)

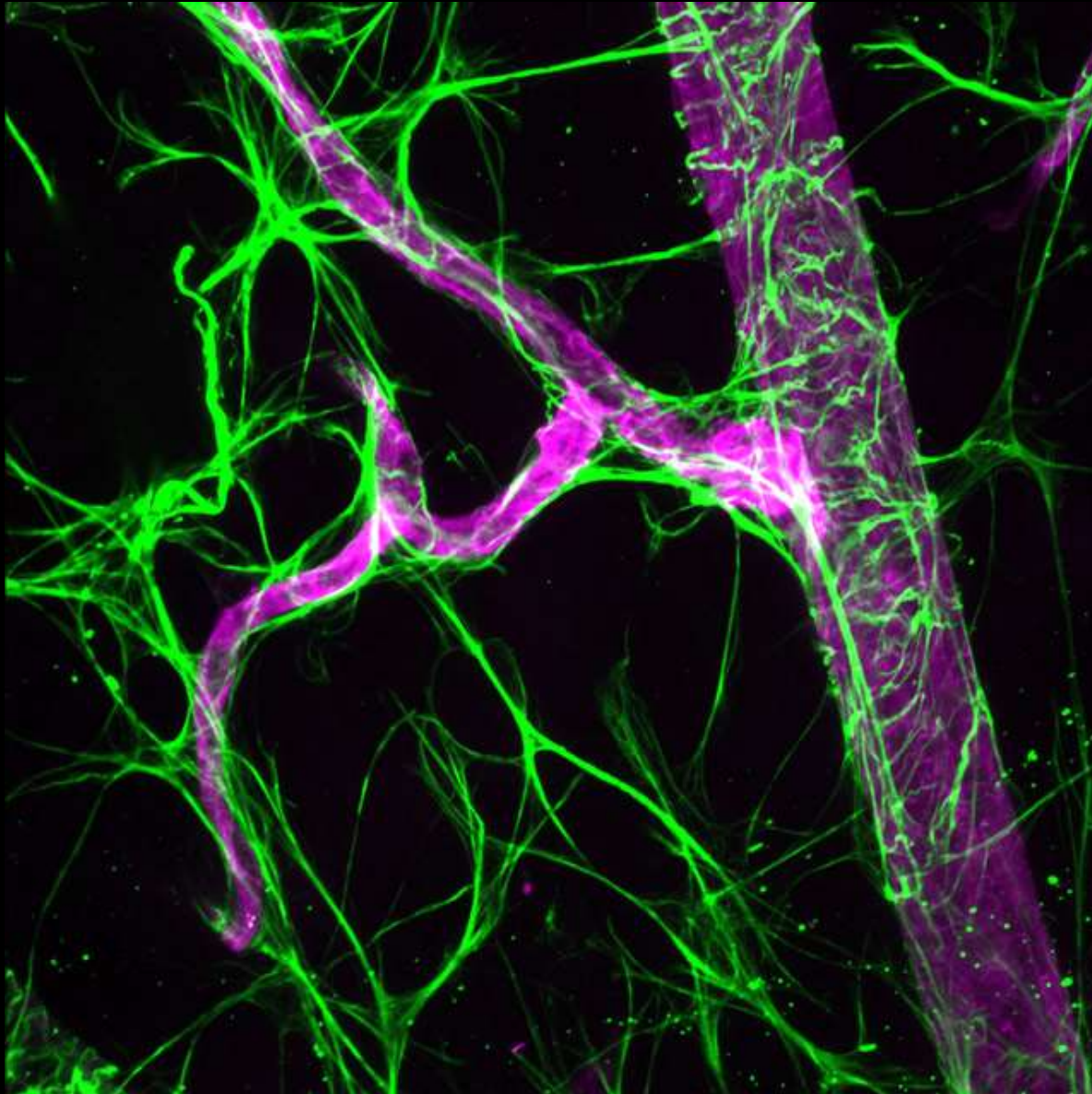
Hormones

Drugs

Toxins

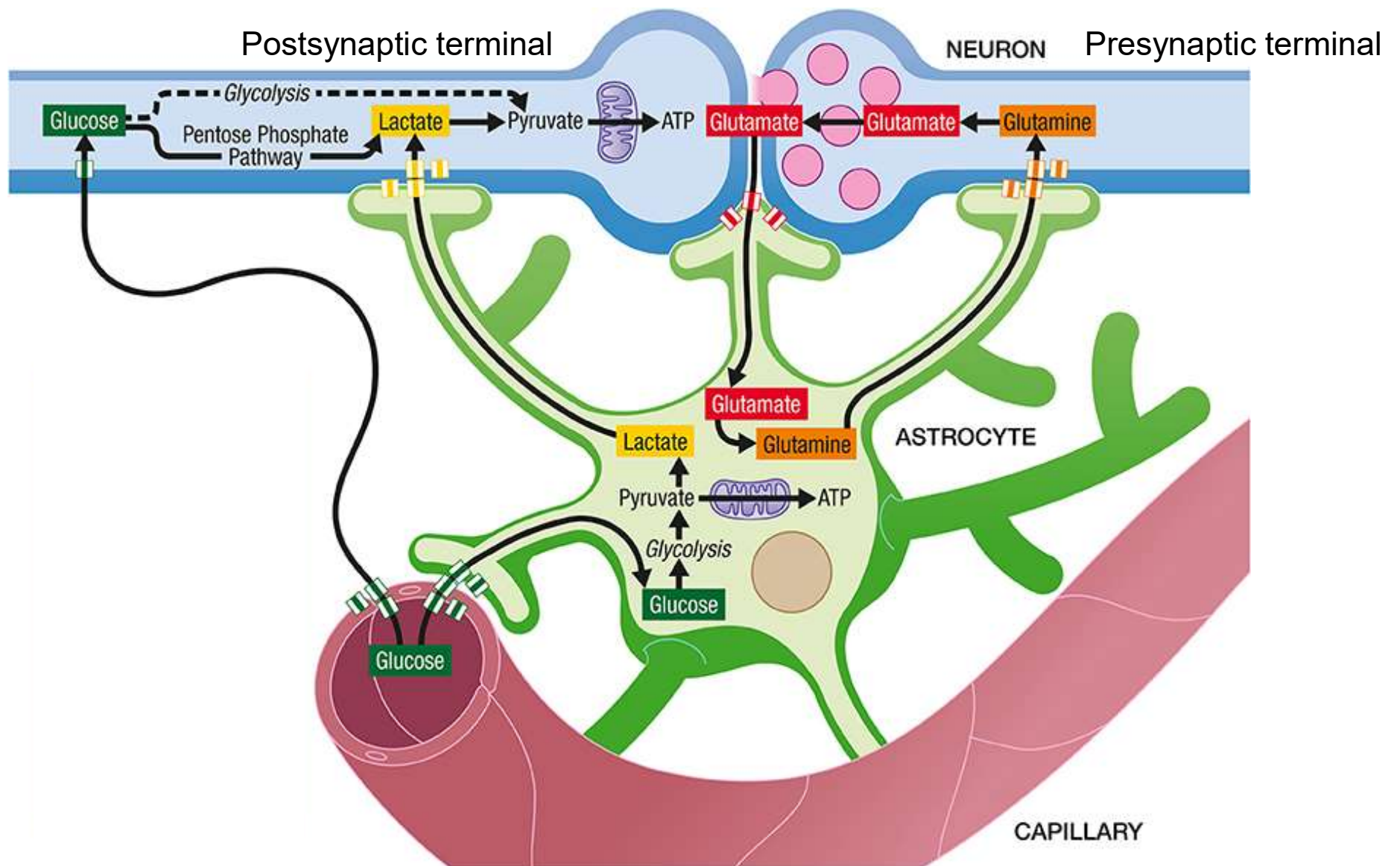
Infectious agents

Cerebral
vessels are
**intimately
associated**
with astroglial
cells

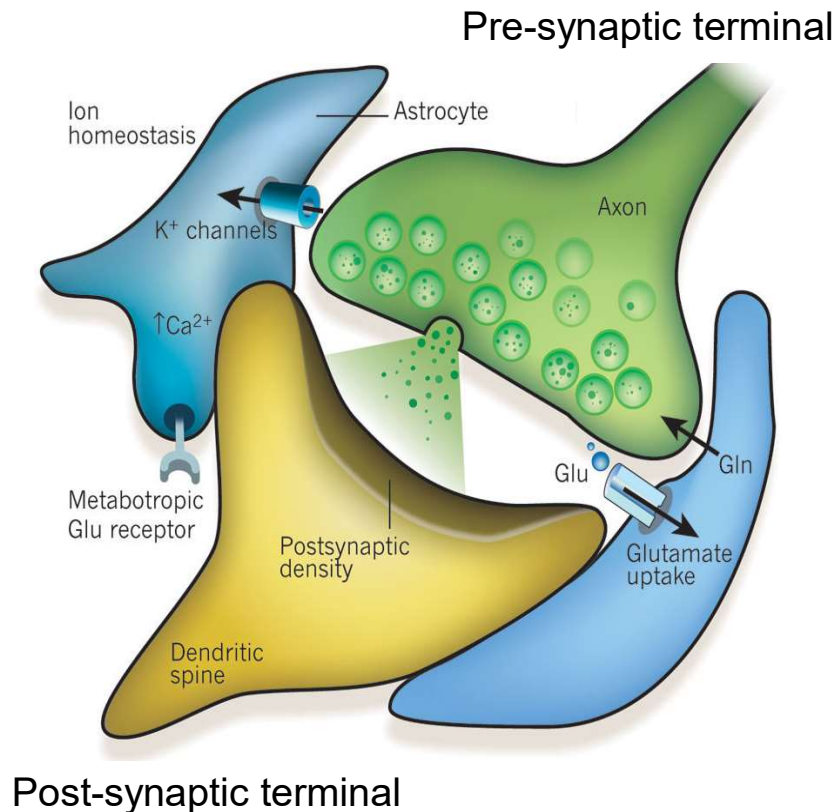


Vessel

Glial cell(s) (astrocytes)

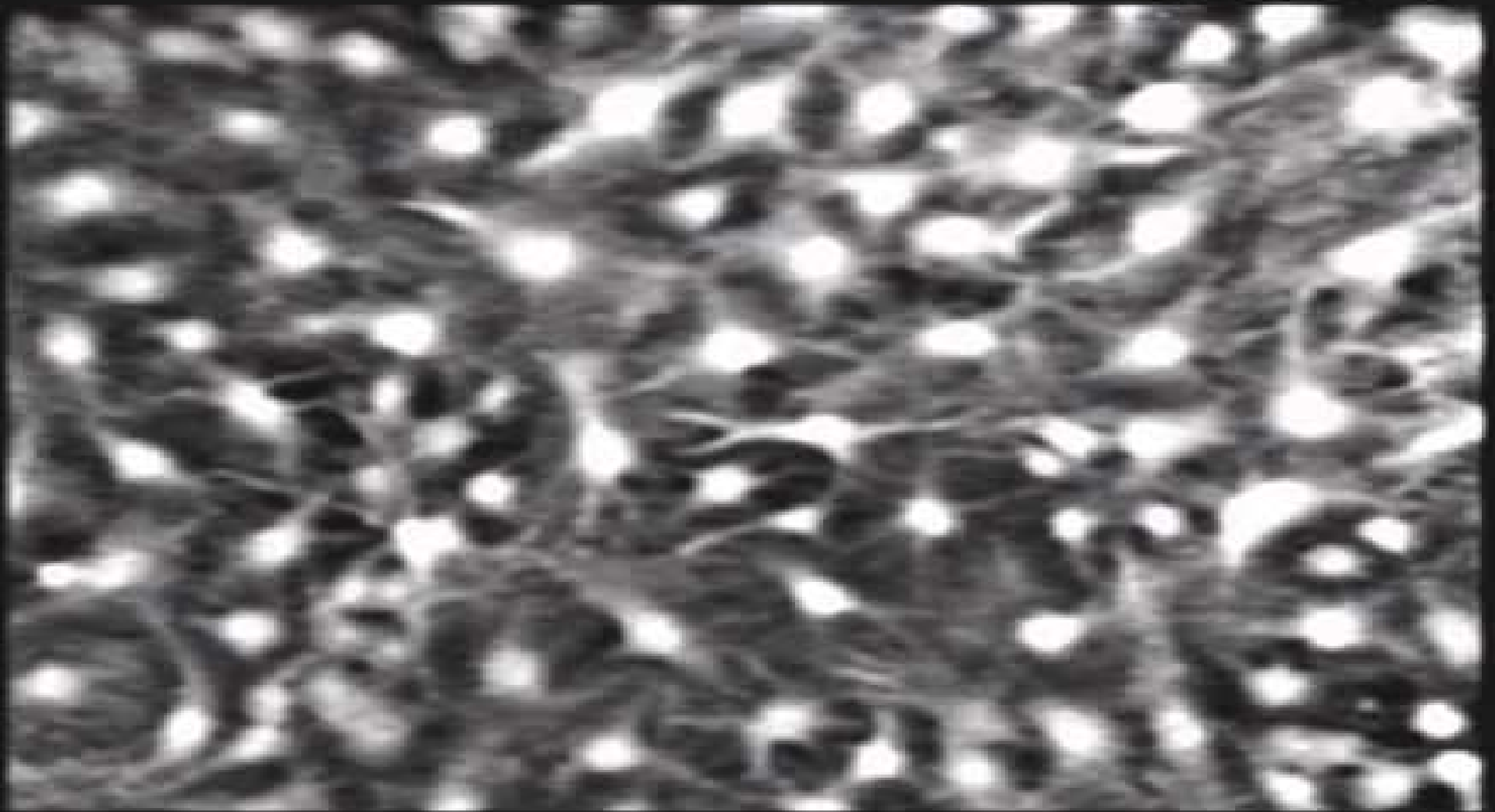


Astrocytes support synaptic function in many ways



- **Provide sources of energy for neurons**
- Secrete hormones to support overall neuronal health
- Control ions and neuronal excitability by:
 - Buffering potassium
 - Regulating extracellular pH
 - Recycling neurotransmitters (Ex. glutamate, GABA)
 - Supplying building blocks for neurotransmitters
 - Releasing 'gliotransmitters'
 - Expressing contact-mediated factors that influence synapse maturation

0262

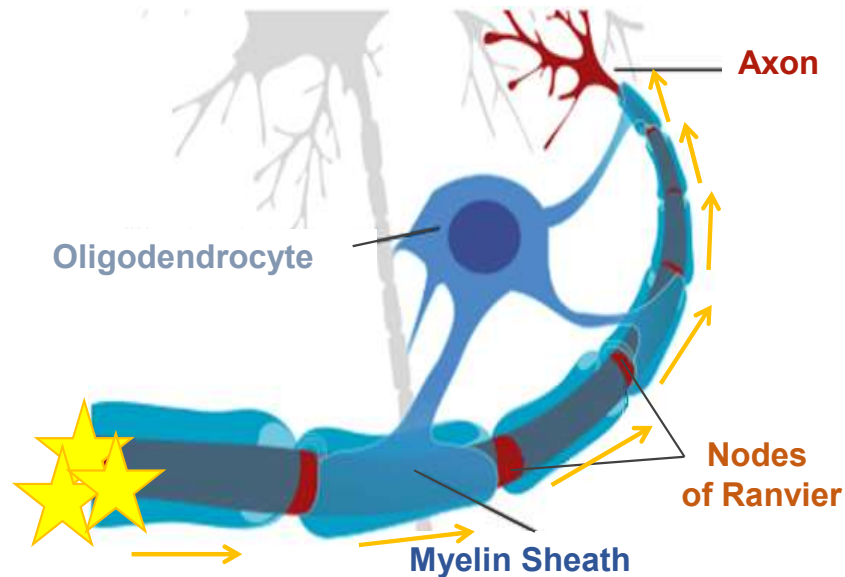


Are astrocytes the only
glial cell type?

No.

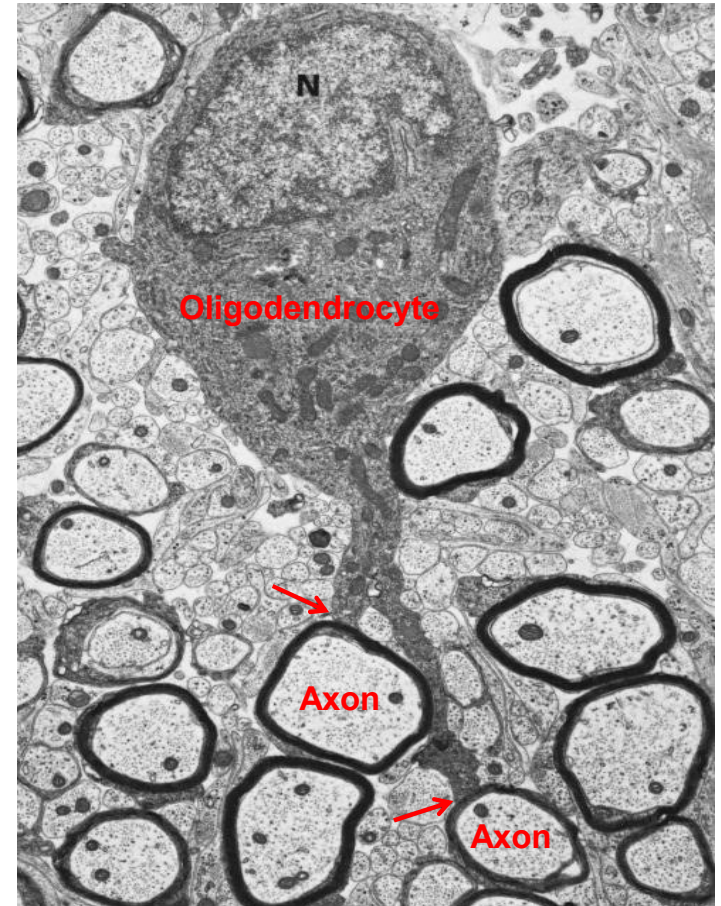
Oligodendrocytes myelinate & support the CNS

Oligodendrocytes extend “processes” that contact axons and wrap around them to form a myelin sheath



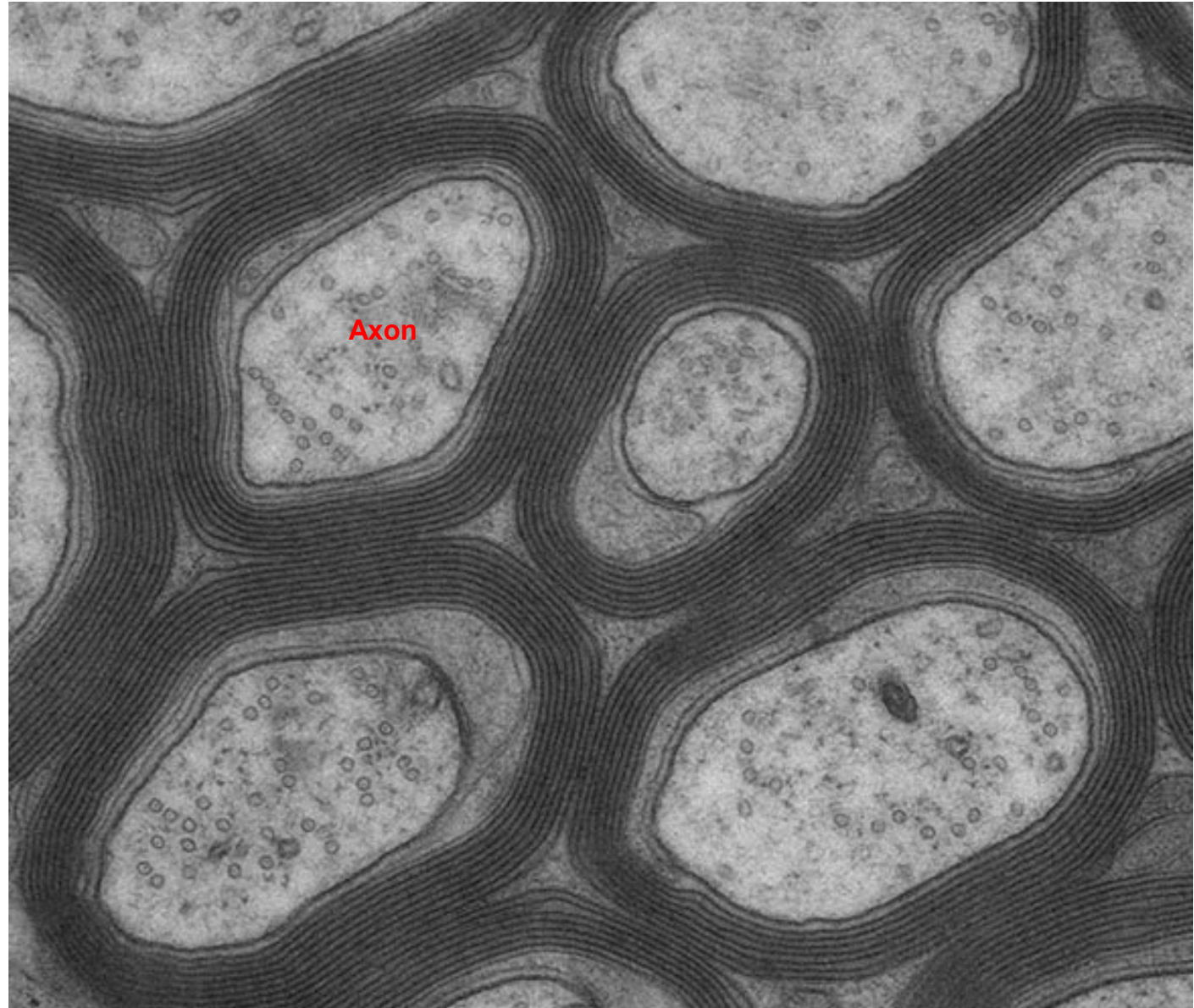
The myelin sheaths provide:

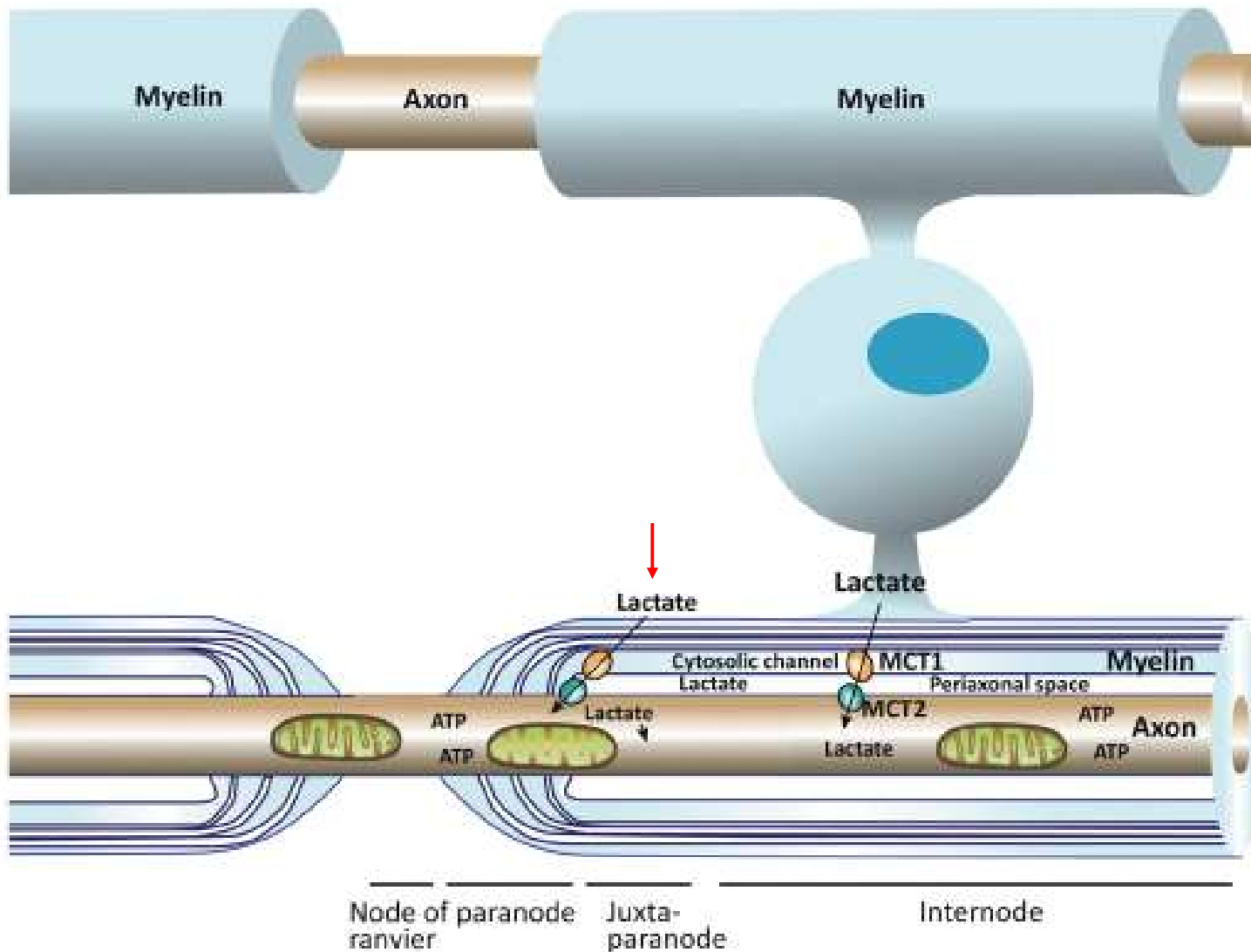
- Fast, **saltatory conduction** of nerve transmission
 - Signal fidelity over long distances
 - Maintenance of neuronal viability
 - Architectural and structural support



Siegel, GJ et al., Basic Neurochem. 1999

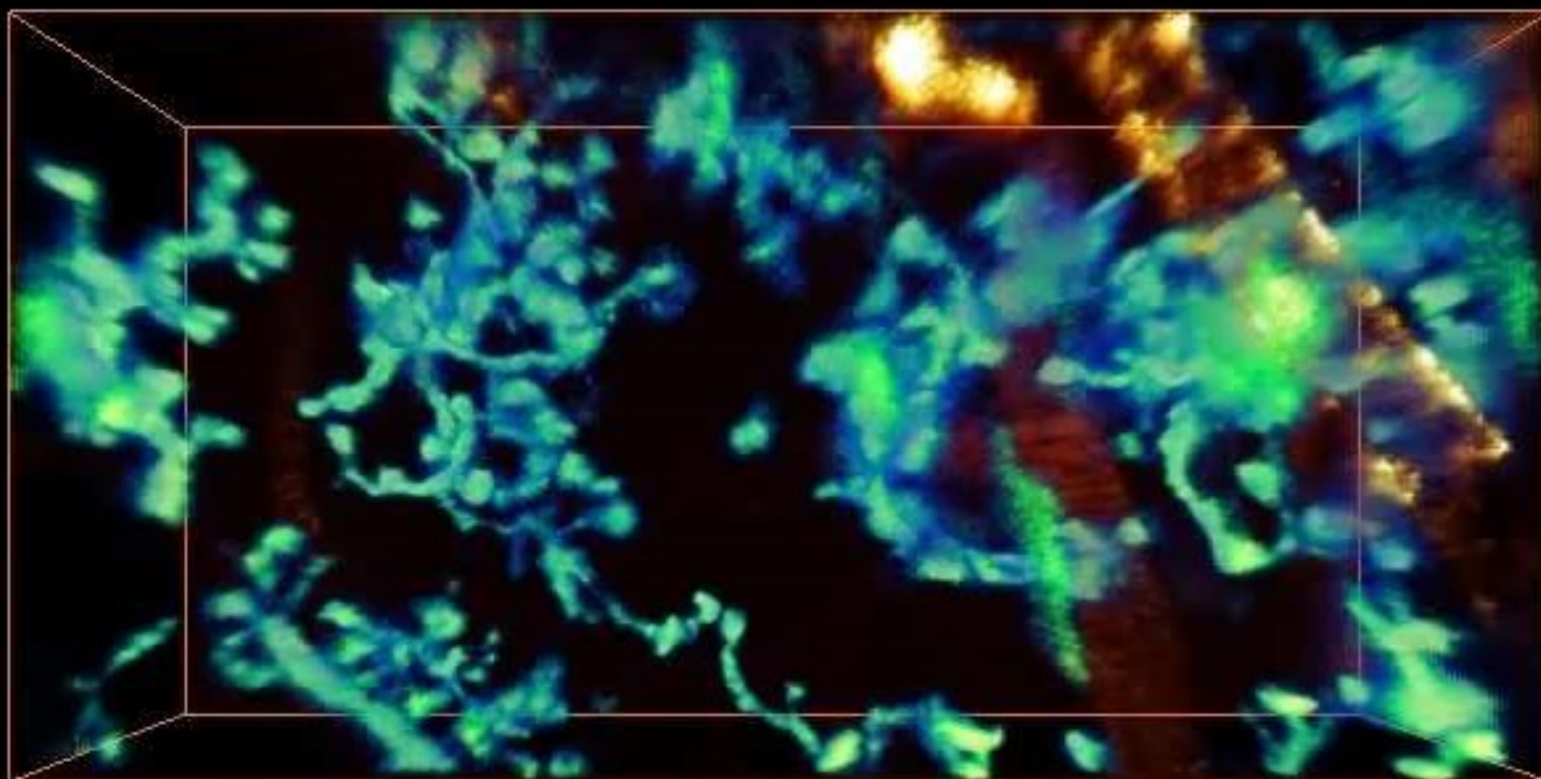
Is the function of these perfectly formed layers only to insulate and increase/protect conduction?





- “Feed” neurons **energy** metabolites to maintain axon efficient
- Secrete hormones, growth factors, and **MANY** factors that influence neuronal health

How is the system kept
“in-check”?

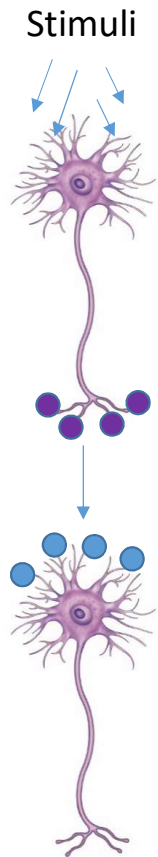


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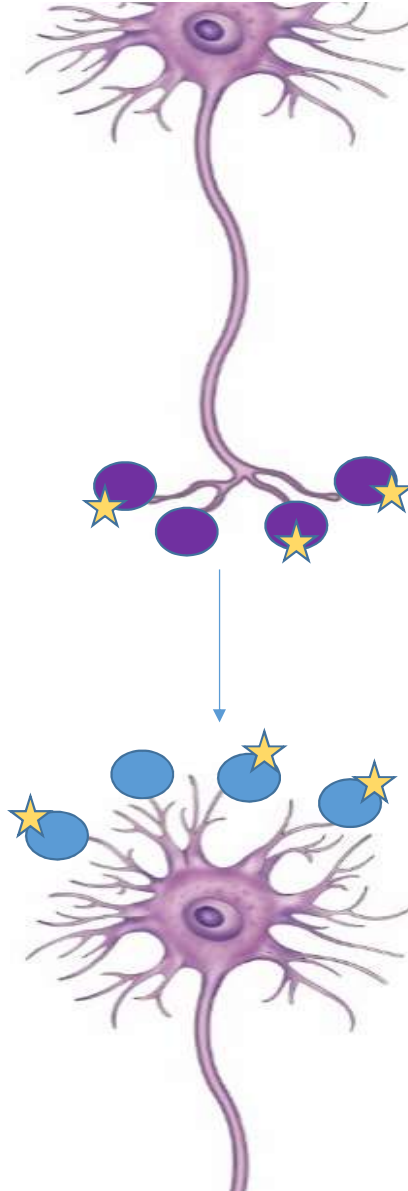
Time = 0.00 sec

“Pruning”

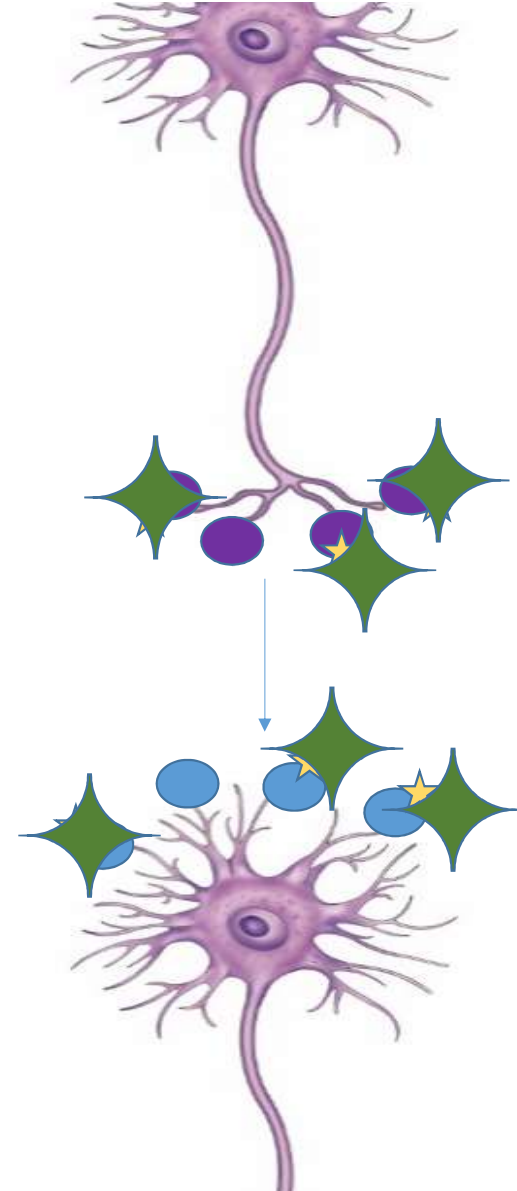
Circuit



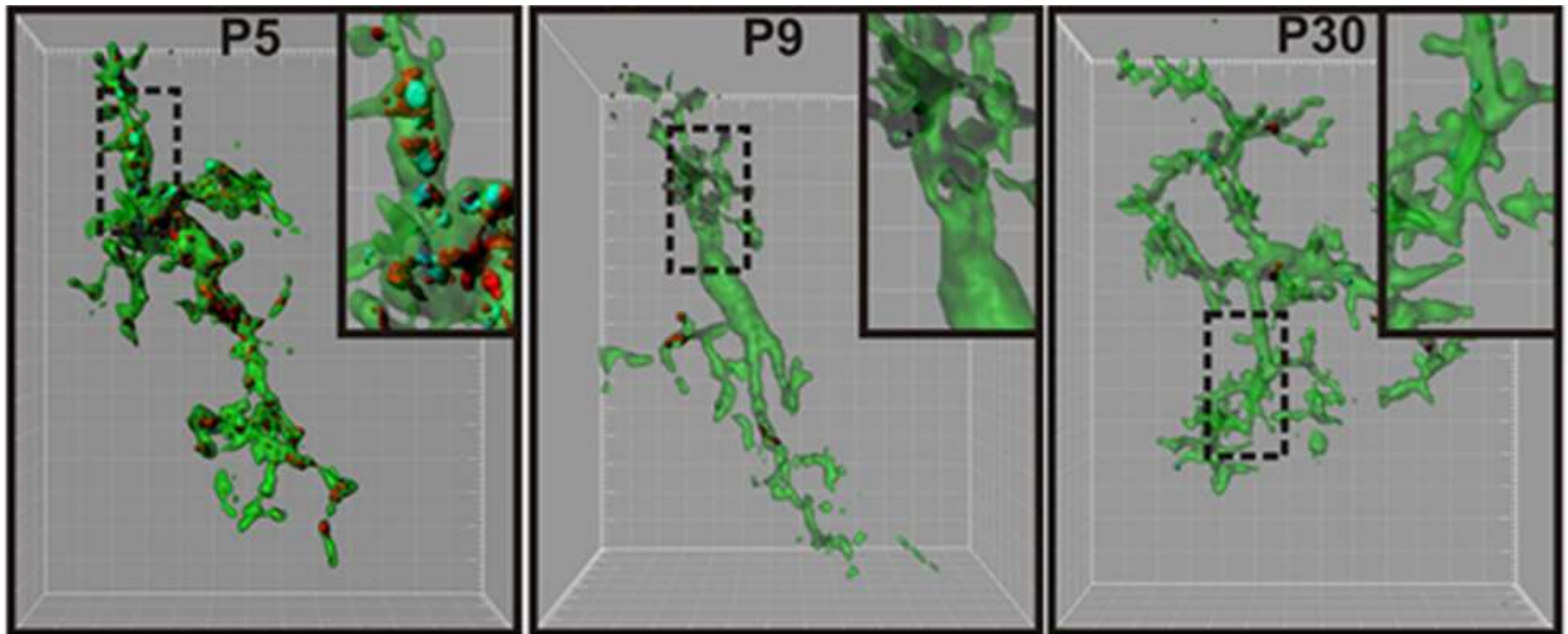
Tagging

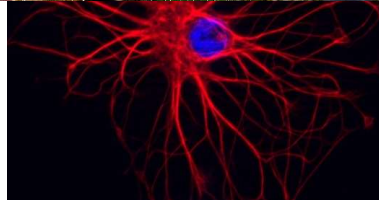
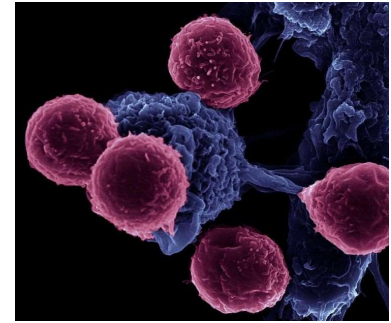
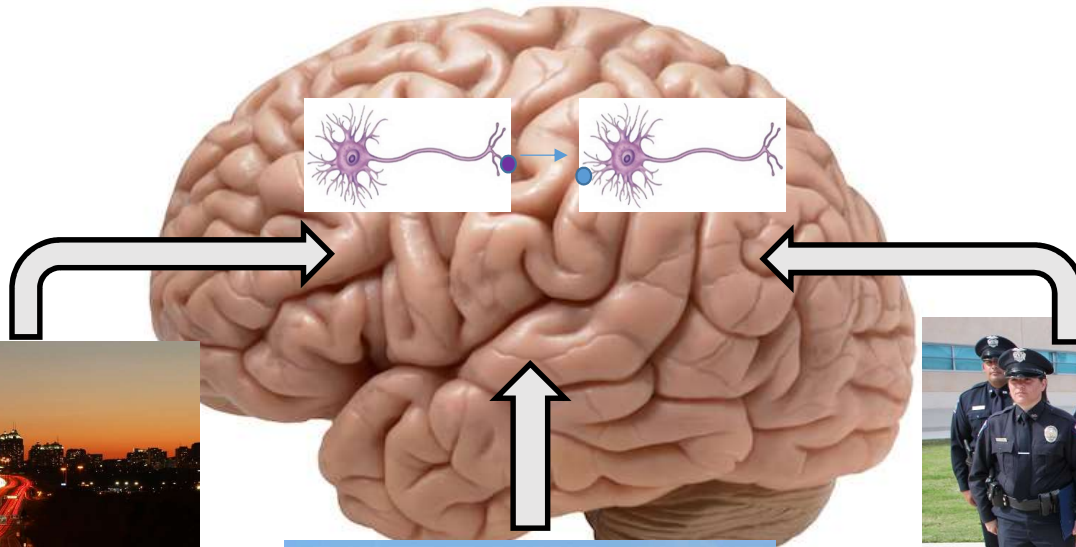


Recognition & degradation



Microglia clean, build and maintain the CNS





Acknowledgements

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The SBU Glia Club

The Society of Hispanic Professional Engineers

Professional (NYC) &

Student (SBU) chapters

Society for Neuroscience

Neuroscience Scholar's
Program

Some helpful references:

- Blood vessels:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3206737/>

<http://neuroscience.uth.tmc.edu/s4/chapter11.html>

<http://www.nature.com/nrn/journal/v7/n1/full/nrn1824.html>

- Astrocytes:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2894949/>

<http://www.nature.com/neuro/journal/v18/n7/full/nn.4043.html>

<http://www.nature.com/nrn/journal/v14/n5/full/nrn3484.html>

<http://www.antanitus.com/>

<http://www.ncbi.nlm.nih.gov/pubmed/25288116>

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Some helpful references:

Tiling:

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Modeling:

Book: Biophysically based Computational Models of Astrocyte ~ Neuron Coupling and their Functional Significance

ISBN: 978-2-88919-178-9

Pruning:

<http://www.ncbi.nlm.nih.gov/pubmed/26745839>

<http://www.ncbi.nlm.nih.gov/pubmed/25463024>

NG2 Glia form synapses with Neurons:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3130155/>

<http://link.springer.com/article/10.1007/s13295-015-0010-2>