Glia:
not just brain “glue”

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How do synapses function?
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

How is synaptic function regulated?
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.

Neurons and synapses

Blood vessels
Immune cells
Glial cells
Stem cells
Etc.

Up to 90% NOT neurons
Brain: A conglomerate of many different types of cells, working together to perform our cognitive functions.

Up to 90% NOT neurons
How do all of these pieces make up such an efficient “machine”?
The resource highway

- Blood
- Oxygen
- Nutrients (ex. Glucose)
- Immune cells (peripheral)
- Hormones
- Drugs
- Toxins
- Infectious agents
Cerebral vessels are intimately associated with astroglial cells.
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
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”? 
“Pruning”

Stimuli

Tagging

Recognition & degradation
Microglia clean, build and maintain the CNS
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Some helpful references:

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  http://neuroscience.uth.tmc.edu/s4/chapter11.html
  http://www.nature.com/nrn/journal/v7/n1/full/nrn1824.html

• Astrocytes:
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Pruning:

NG2 Glia form synapses with Neurons:
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