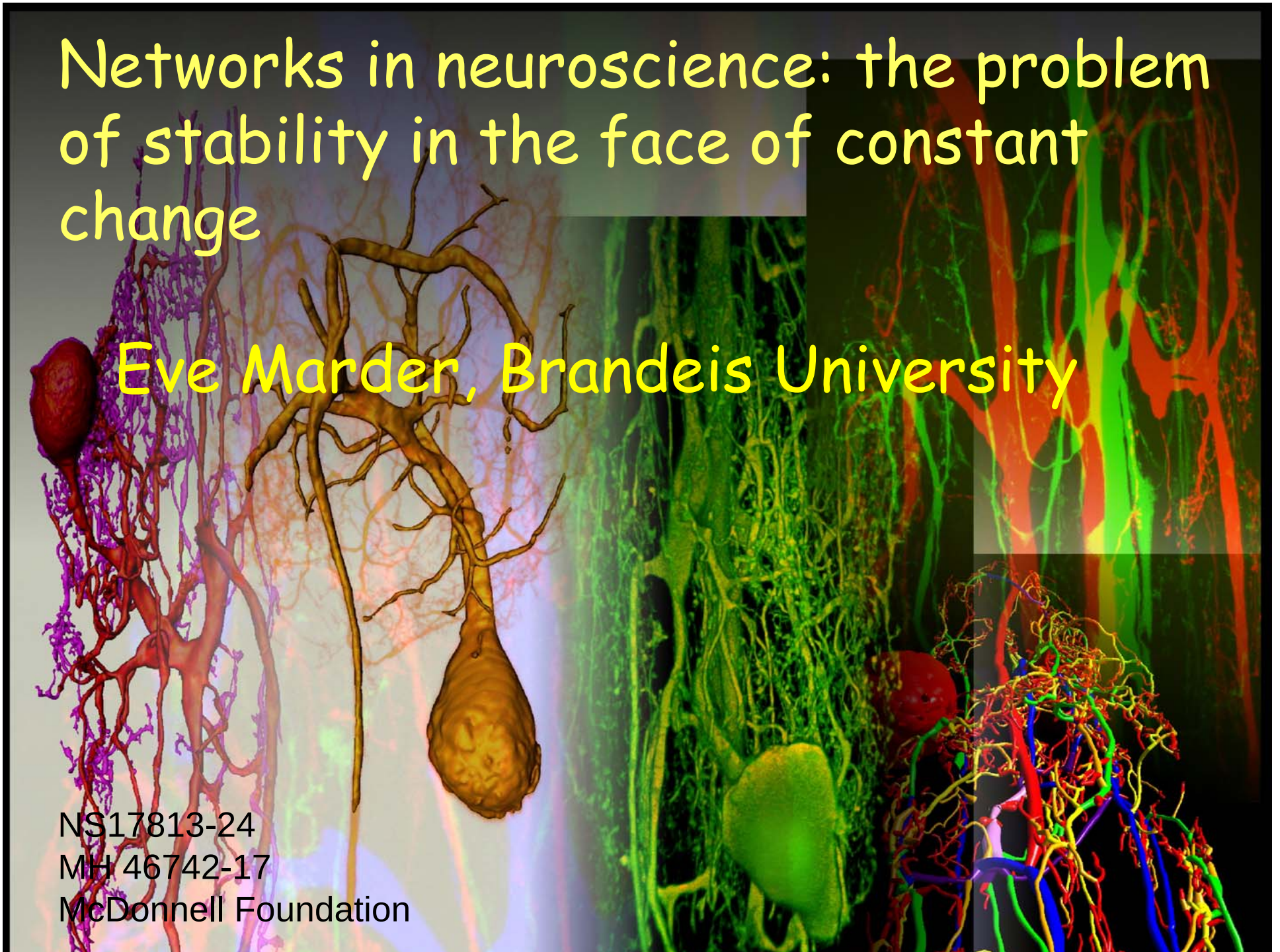


# Networks in neuroscience: the problem of stability in the face of constant change

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# Networks in neuroscience

- Every individual neuron contains complex networks of interacting biochemical and molecular processes
- The nervous system consists of networks of networks

# Neuroscientists attempt to:

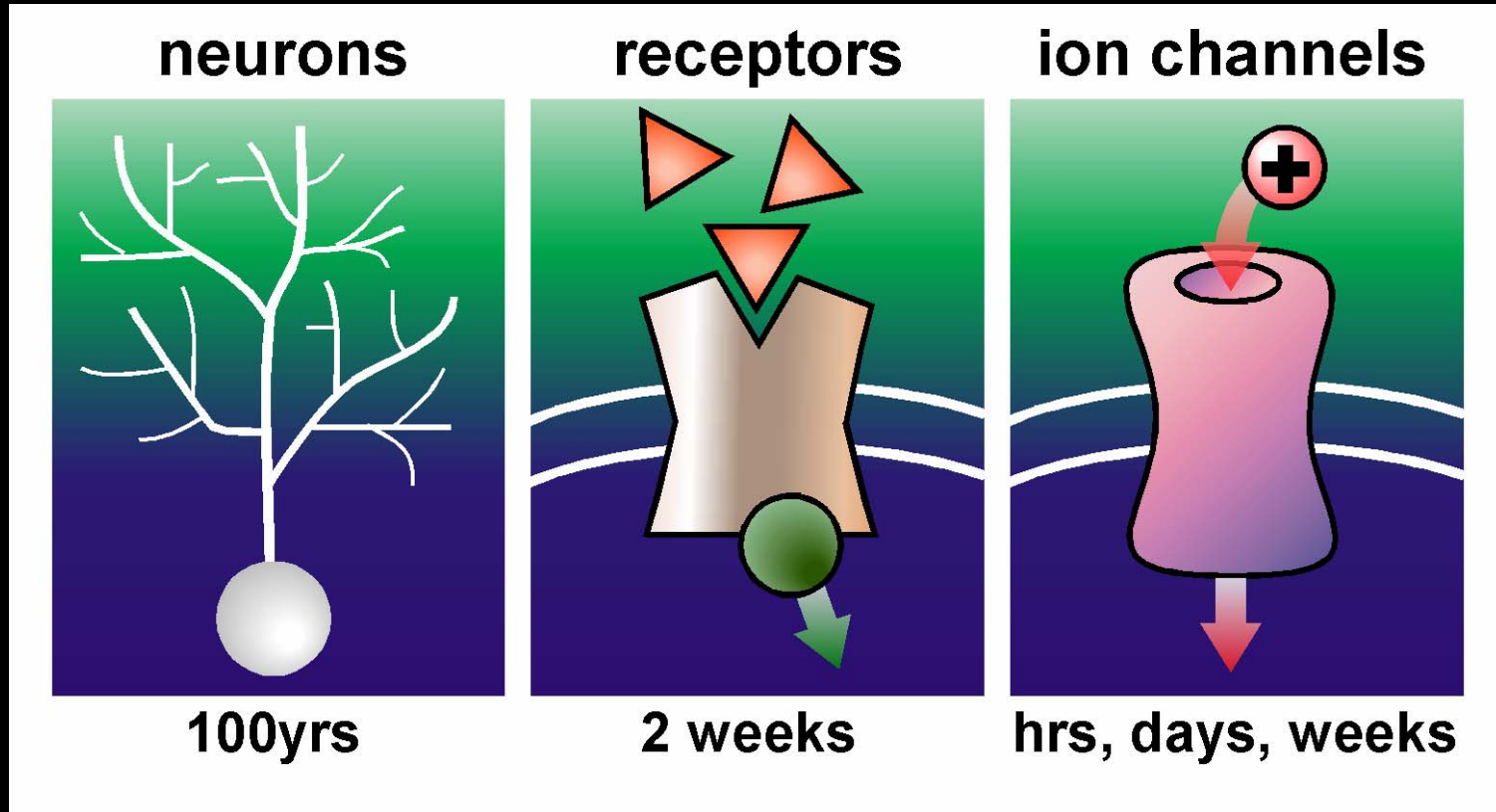
- Determine how functions are localized in neuronal circuits
- Determine the properties of the synaptic wiring and excitability of individual neurons that constitute a network
- Explain how network performance arises from the interactions of the components

The nervous system  
maintains stable network  
function while allowing the  
incorporation of new knowledge  
that modifies network  
structure

Mental illness can be seen as a failure of the normal processes that maintain network stability

- An ongoing balance between plasticity mechanisms that are required for development and learning (LTP, LTD, etc), and homeostatic mechanisms (synaptic scaling) that stabilize neuronal and network performance.

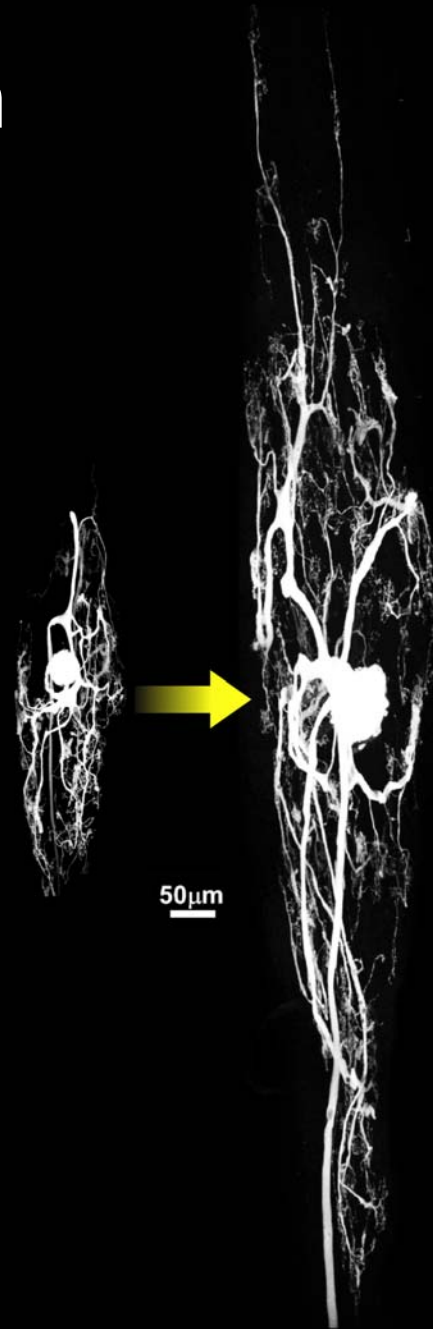
-The components of functional circuits are not static, but are constantly turning over rapidly during the lifetime of a neuron



-How is function maintained while the nervous system is constantly rebuilding itself?

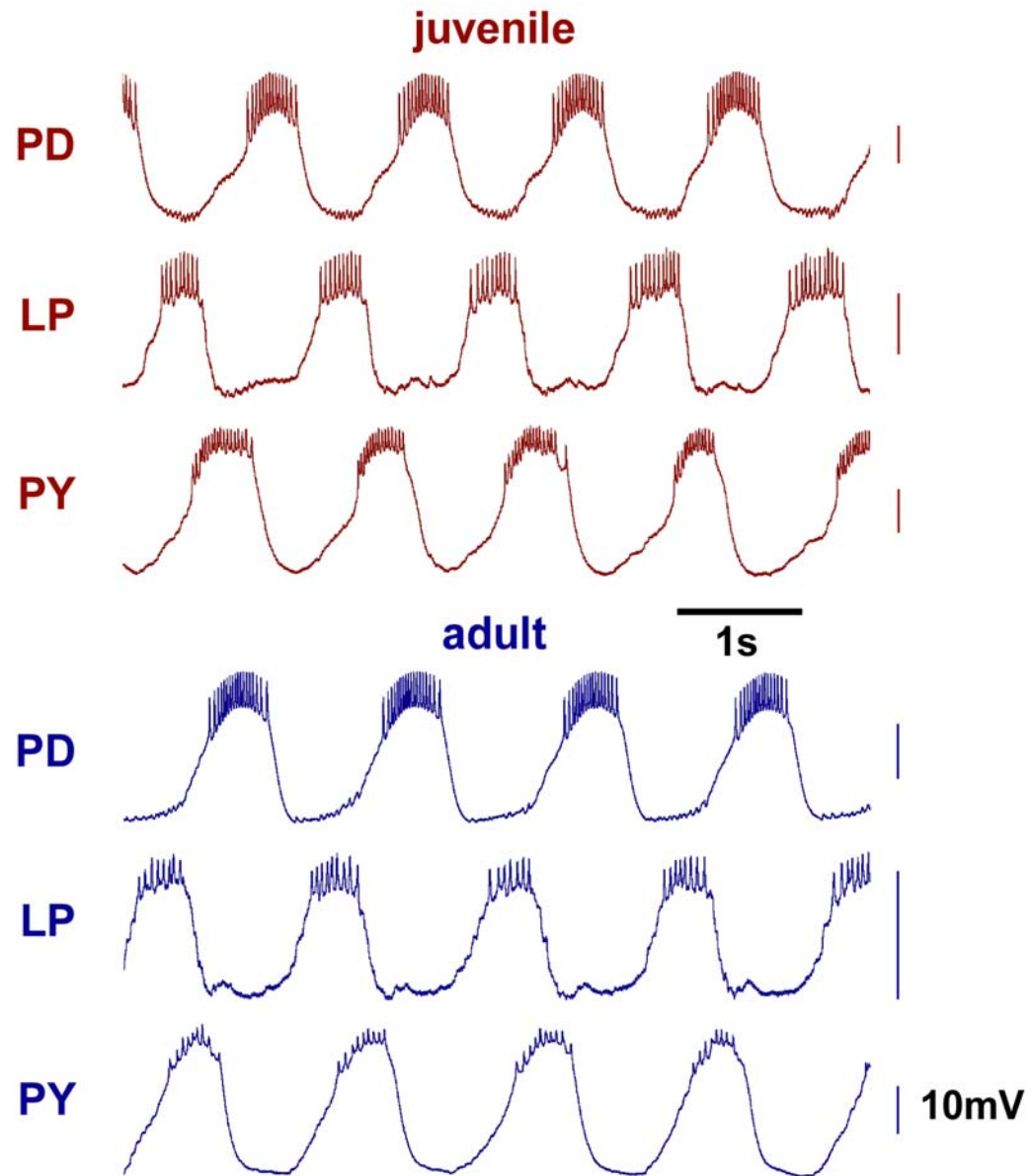
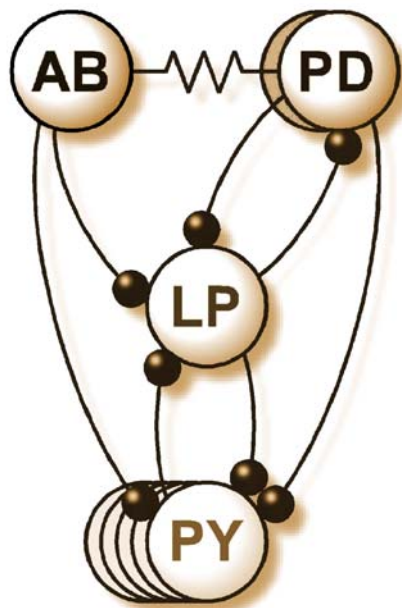


# STG neuron growth



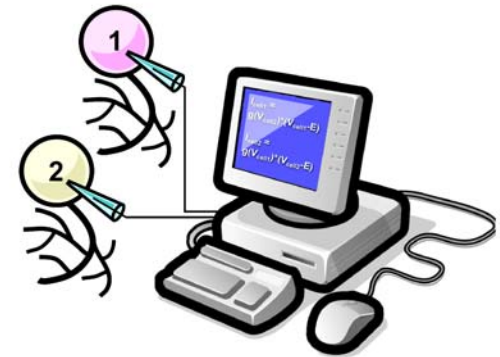
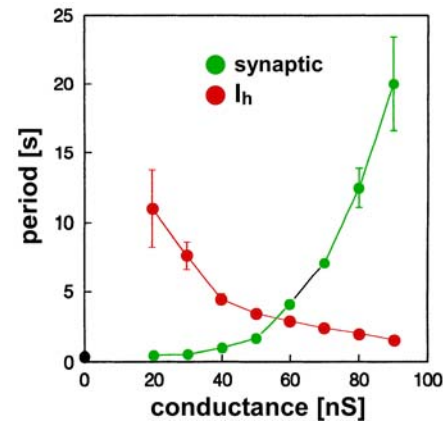
PD, Alexa 568 hydrazide

## Pyloric neuron waveforms do not change during growth



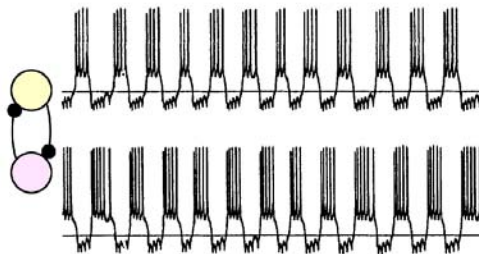
- How tightly tuned do the parameters that govern synaptic strength and intrinsic properties need to be for “good enough” network behavior?
- Understanding the rules that allow compensation in neuronal and network function

Changing either  
intrinsic or synaptic  
conductances can  
alter network function

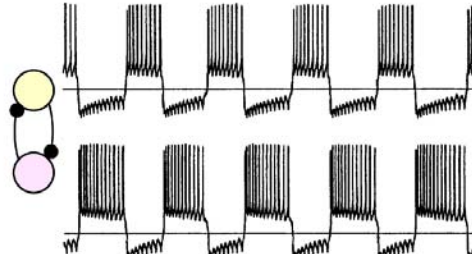


synaptic conductance

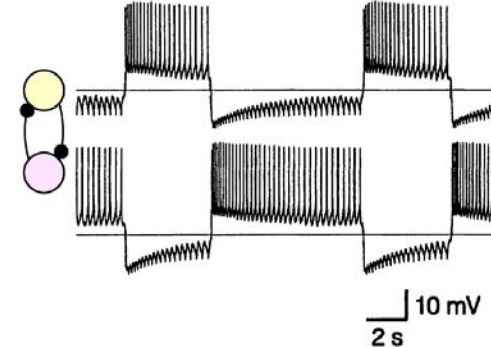
50nS



60nS

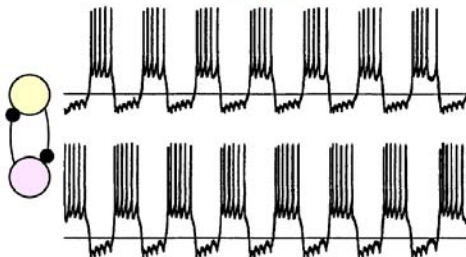


80nS

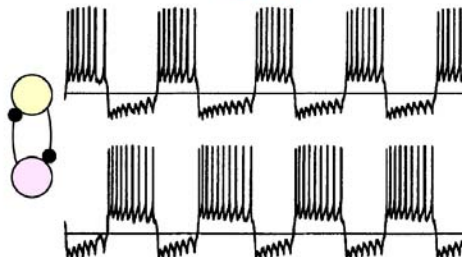


$I_h$  conductance

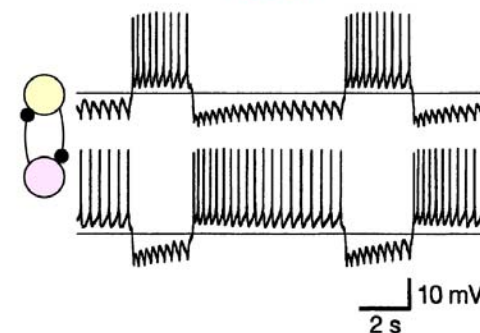
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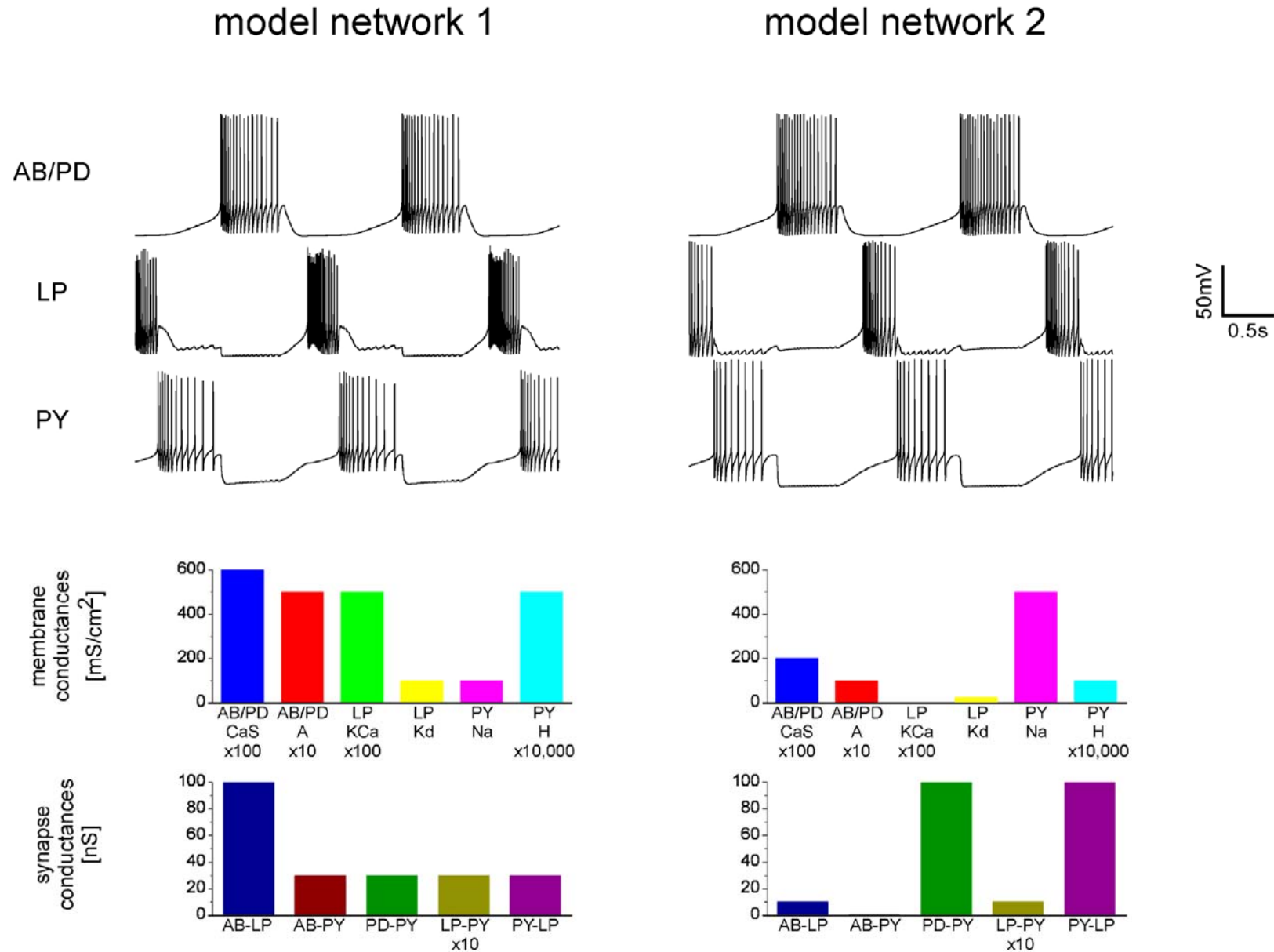


30nS



Sharp et al, 1996

# Similar network activity; disparate circuit parameters



- Biological systems do not have redundant functions but many overlapping processes that can provide smooth transitions between multiple sets of underlying mechanisms to promote stable function yet allow plastic change.