





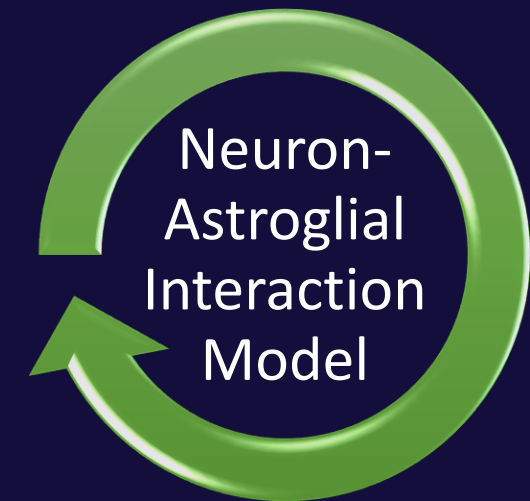
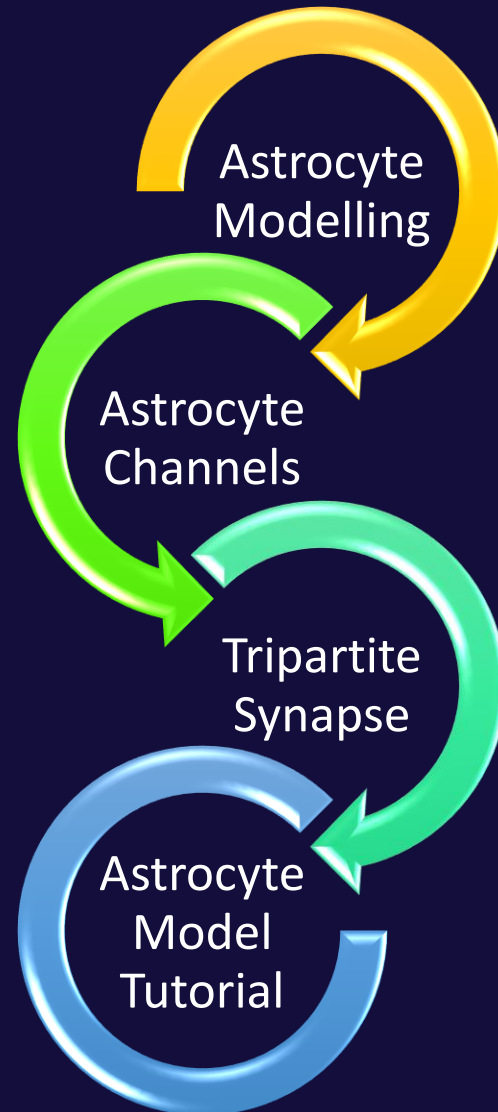
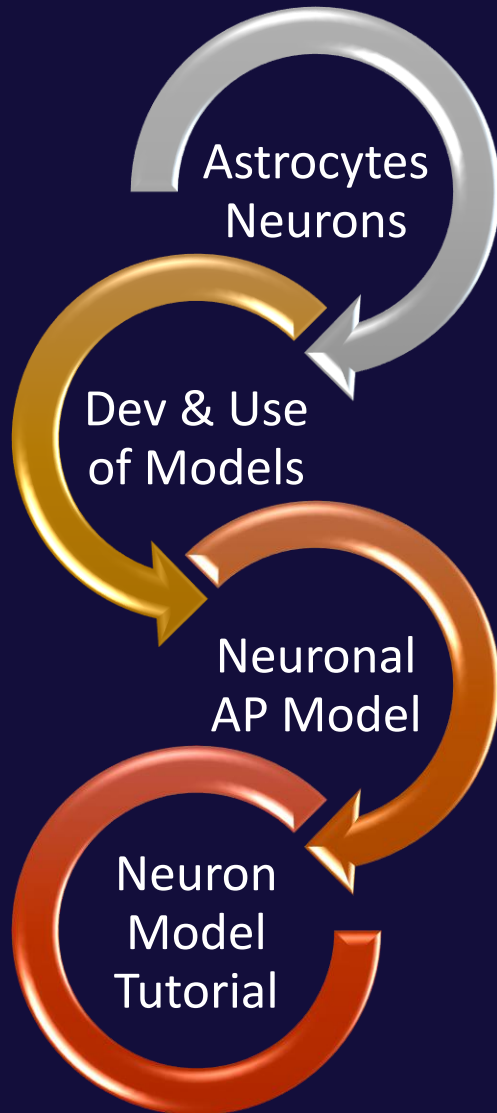
# Ionostasis at the Tripartite Synapse

Marinus Toman, Liam McDaid & John Wade

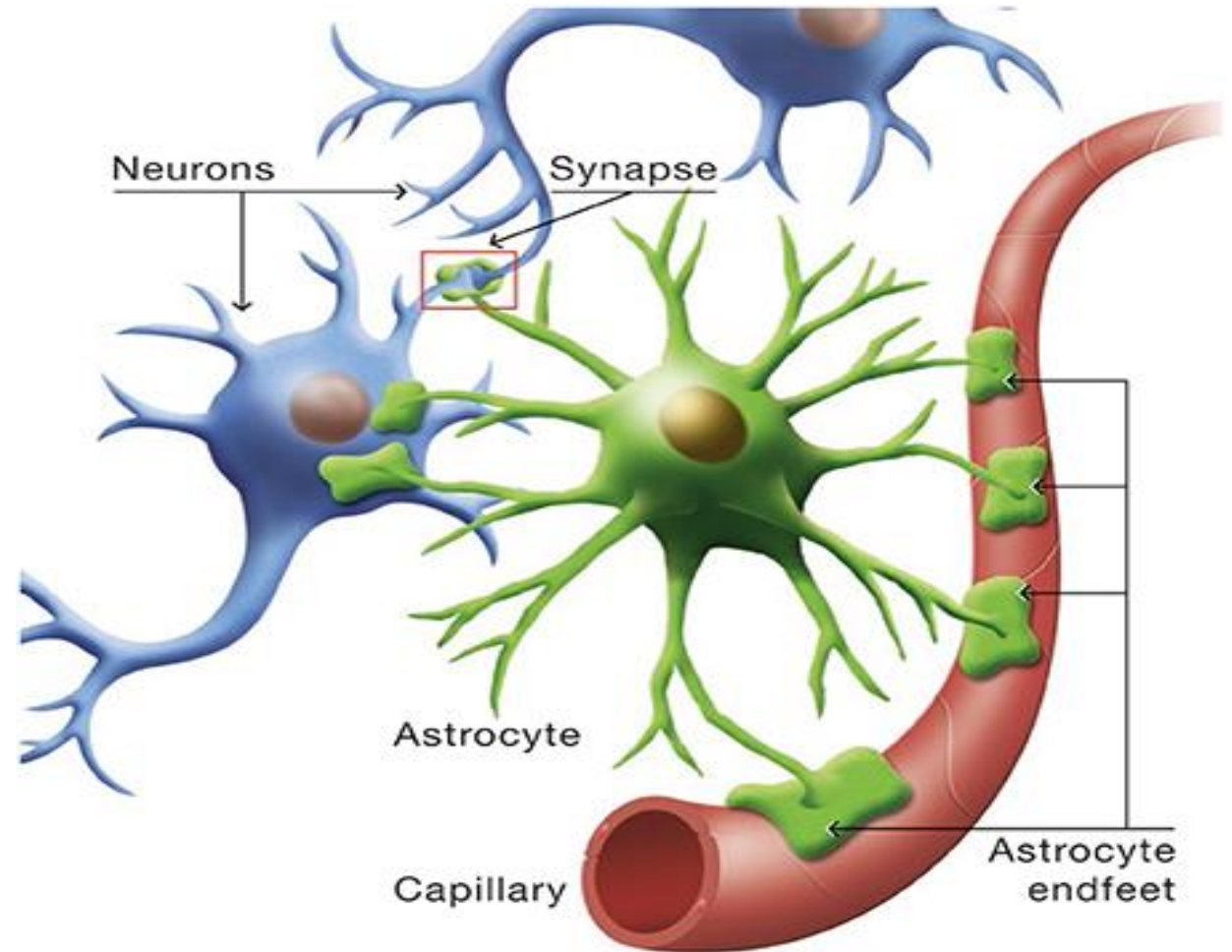
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- Neurons
  - Carry brain's electrical signals
- Astrocytes
  - Support cells - various roles
- Neuro-Astro Interactions
  - Synapse
  - Astrocyte signalling

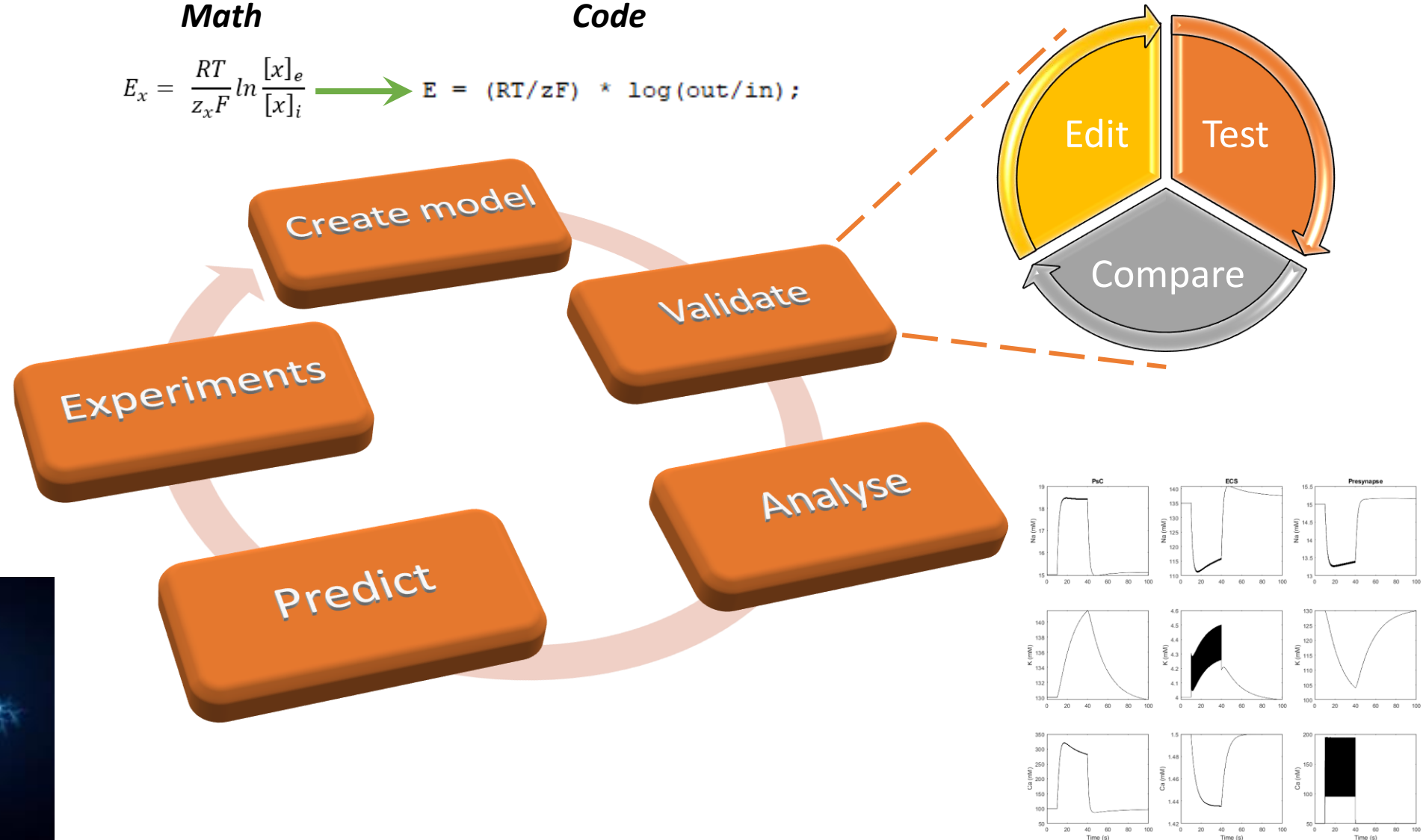


# Development and Use of Model

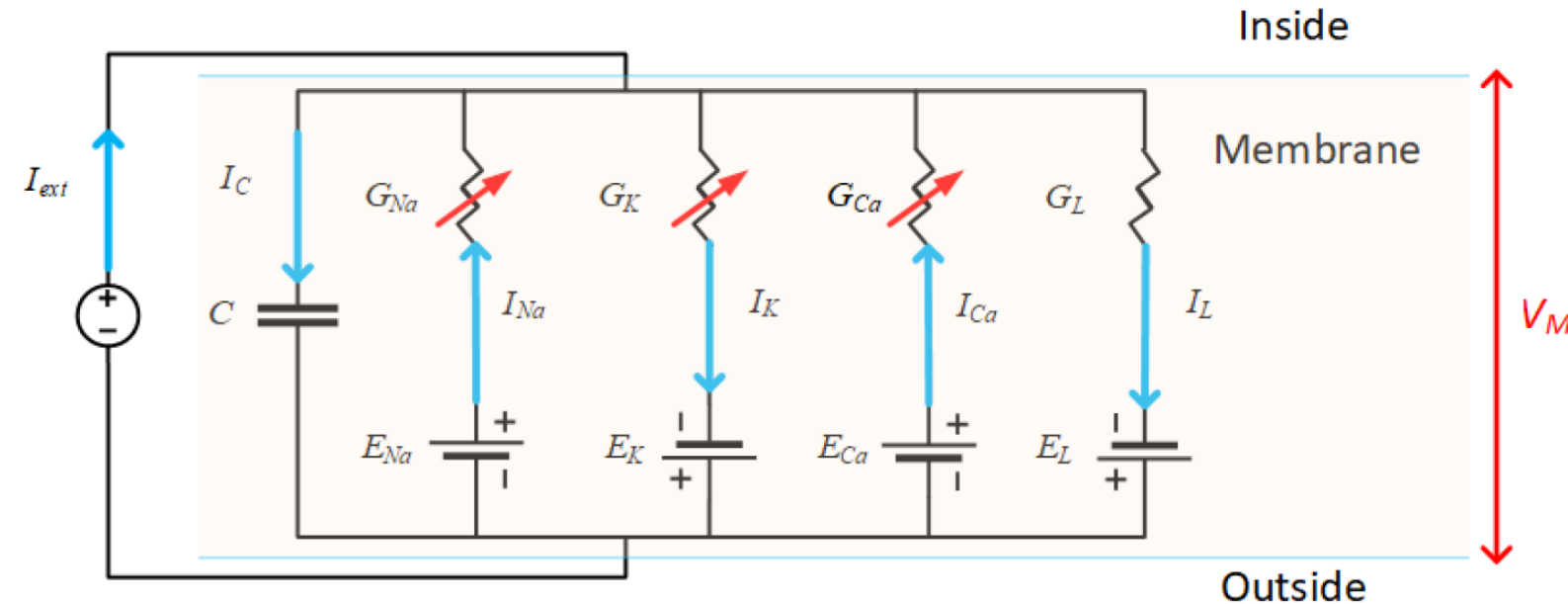
**Math**

**Code**

$$E_x = \frac{RT}{z_x F} \ln \frac{[x]_e}{[x]_i} \longrightarrow E = (RT/zF) * \log(\text{out/in});$$



# Neuron Action Potential Model



## Changing Membrane Potential

$$C \frac{dV_m}{dt} = -(I_{Na} + I_K + I_{Ca} + I_L + I_{ext})$$

## Ion Channel Currents

$$I_{Na} = G_{Na} m^3 h (V_m - E_{Na})$$

$$I_K = G_K n^4 (V_m - E_K)$$

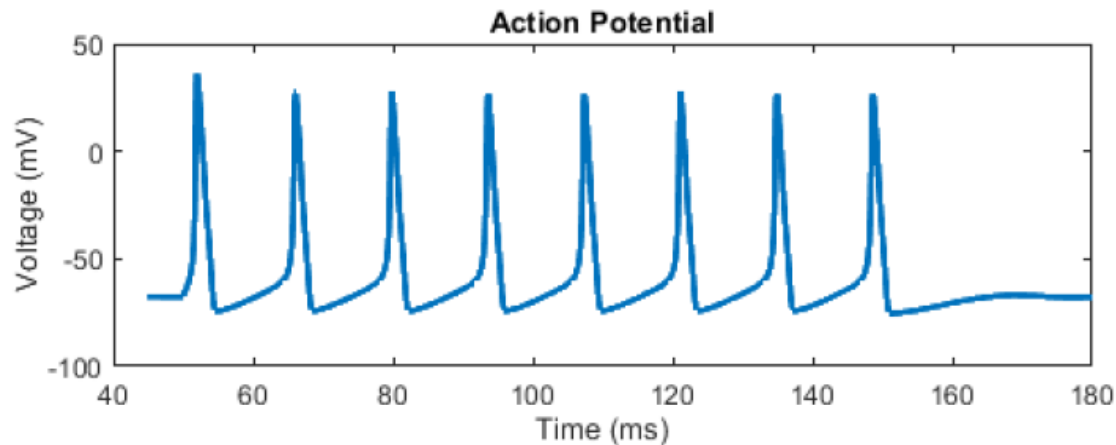
$$I_L = G_L (V_m - E_L)$$

$$I_{Ca} = G_{Ca} s^3 (V_m - E_{Ca})$$

## Ion Channel Gating Kinetics

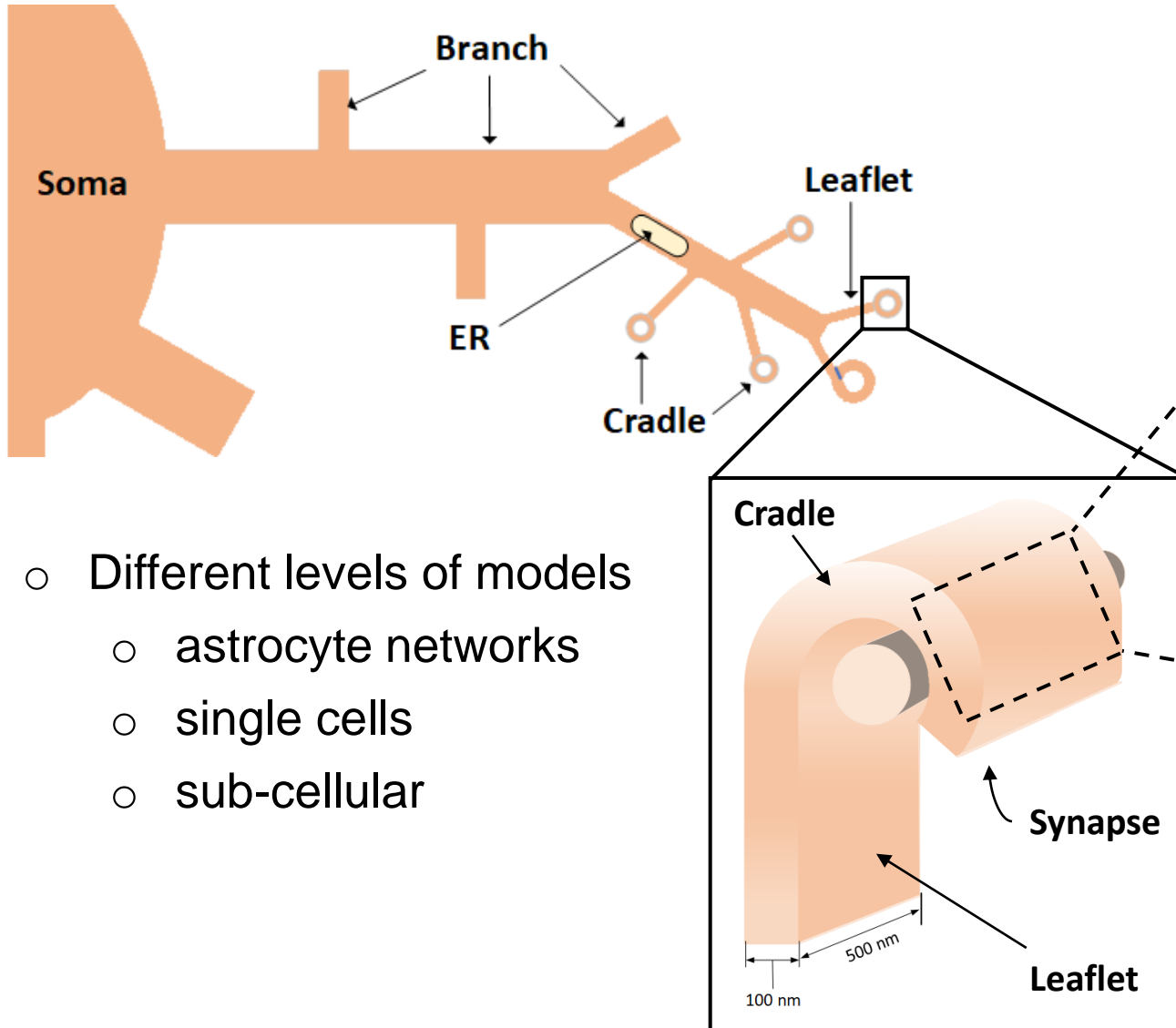
$$\frac{dx}{dt} = \alpha_x (1 - x) - \beta_x x$$

$$x \in \{m, h, n\}$$

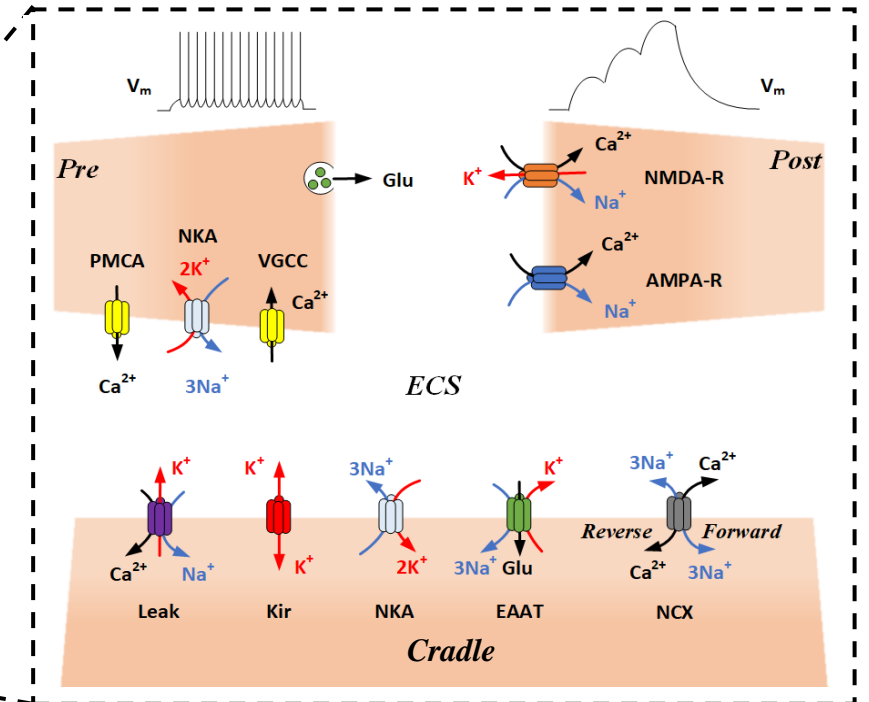


Hodgkin-Huxley Neuron Action Potential Model:  
Solving HH model with the MATLAB ODE solver

# Astrocyte Modelling



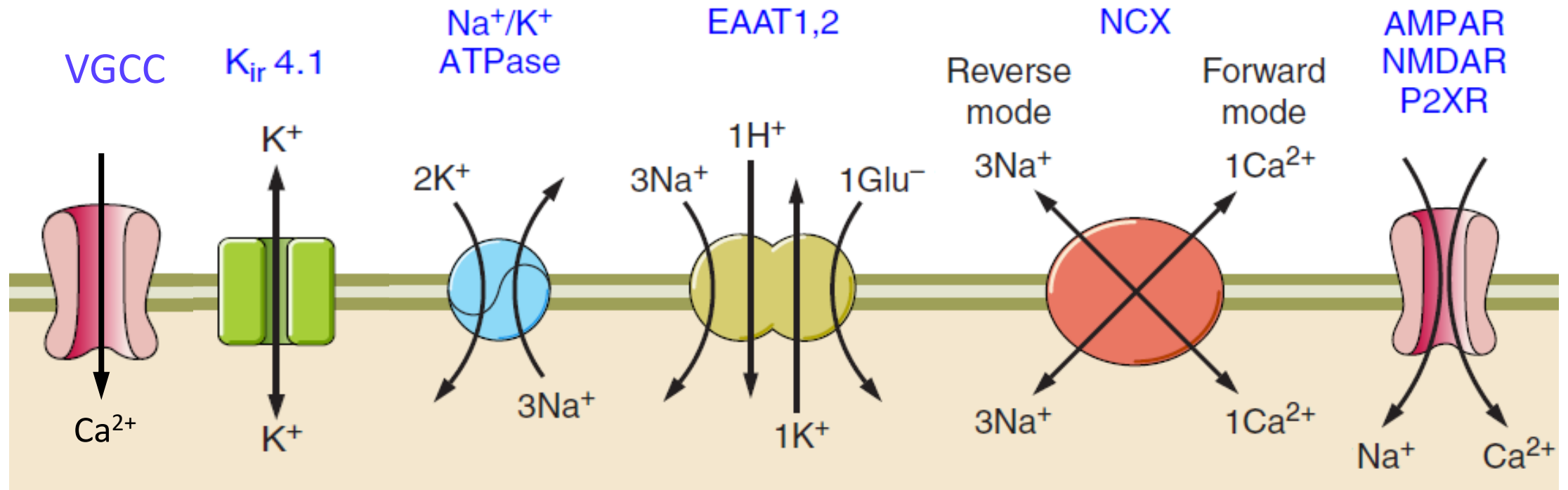
- Different levels of models
  - astrocyte networks
  - single cells
  - sub-cellular



- Same modelling techniques as neurons
  - channels/transporters in a membrane
  - astrocytes typically have different channels than neurons

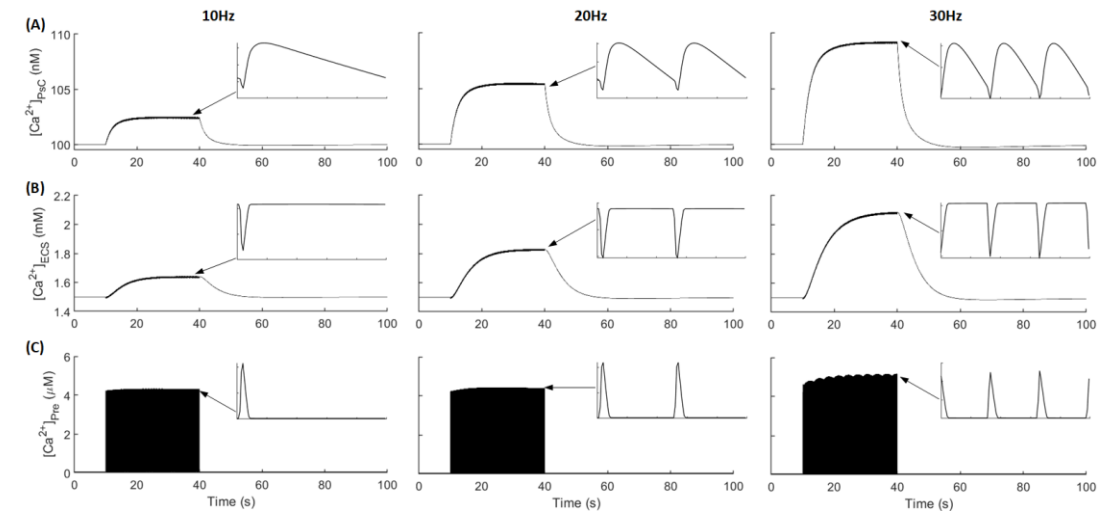
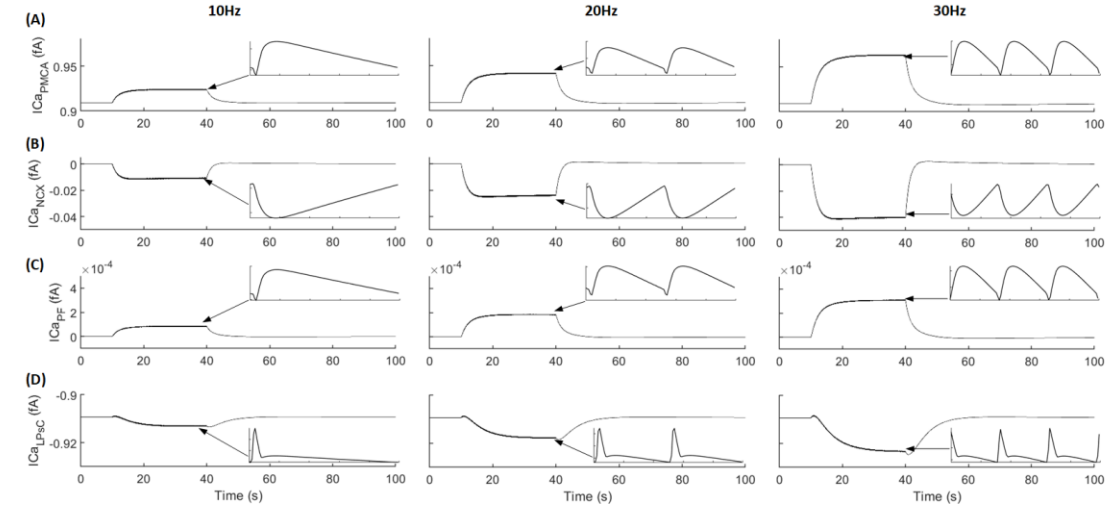
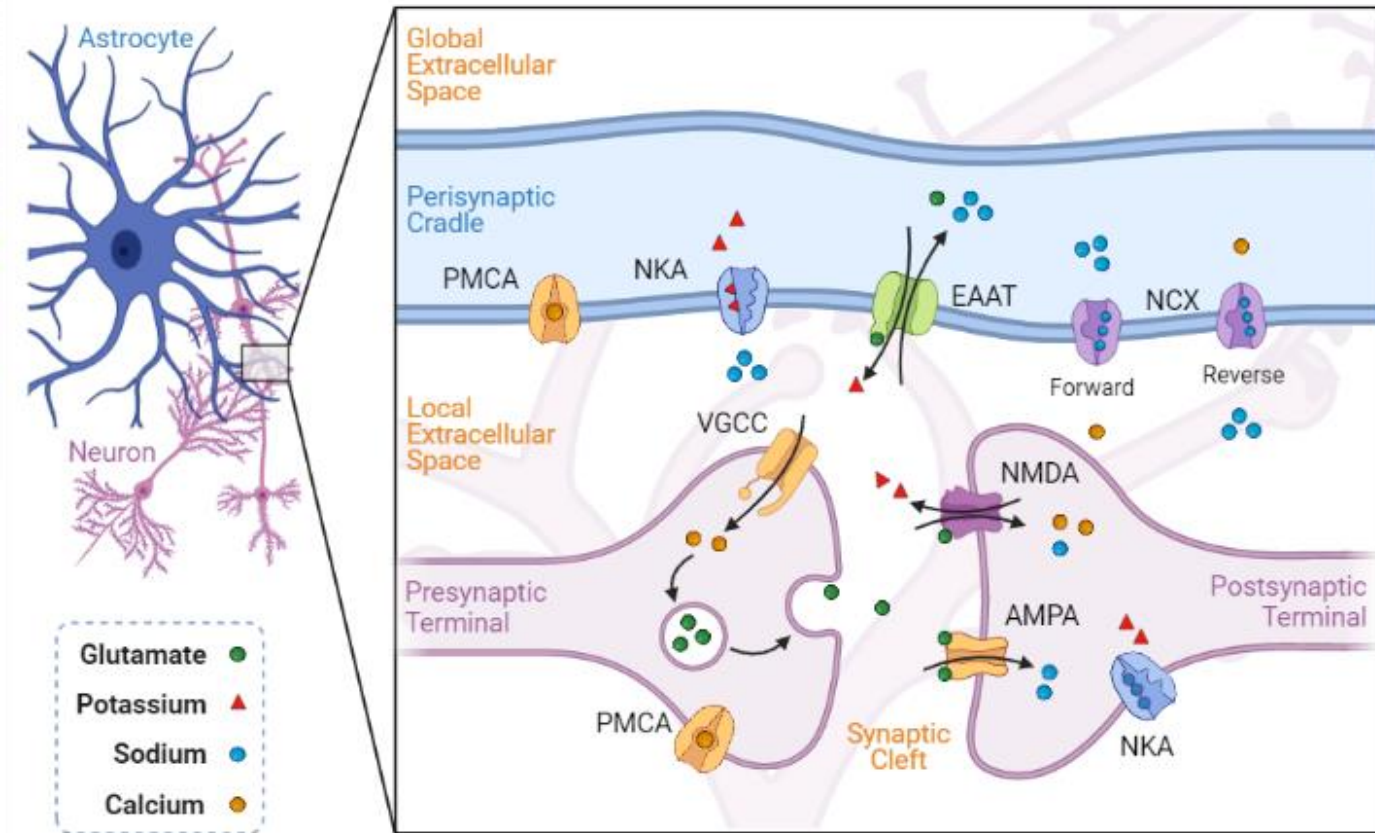


# Receptors / Channels



Reference: Verkhratsky A, Nedergaard M. Physiology of Astroglia. *Physiol Rev* 98: 239–389, 2018. doi:10.1152/physrev.00042.2016.

# Ionostasis at the Tripartite Synapse



Astrocyte Homeostasis Model:  
Solving model with Euler's method

# Conclusion

