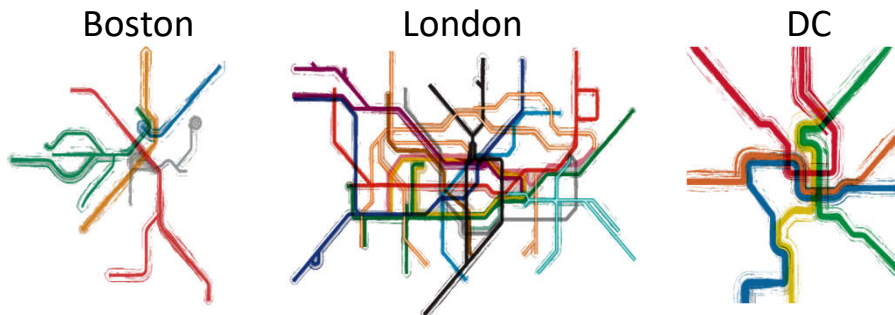
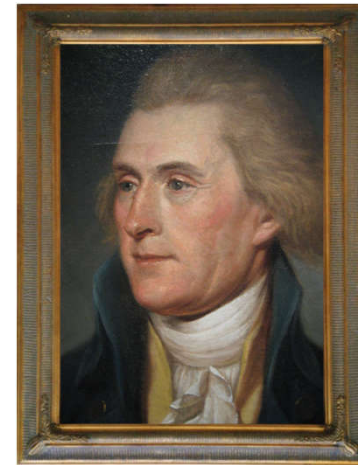


# Neuronal Networks

- **So far:** the building blocks of neurons/networks
  - ion channels
  - resting potential
  - action potential
  - synapses
- **Now:** we build a network
  - networks in the thalamus
  - the importance of time (i.e. brain rhythms)



# Neuronal Networks

## Brain Rhythms



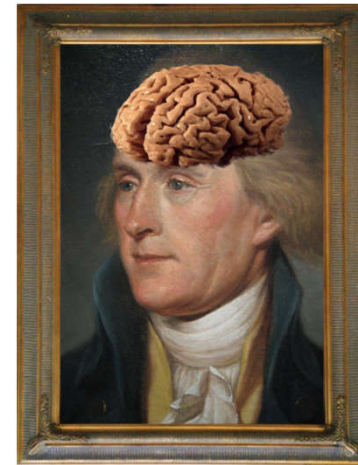
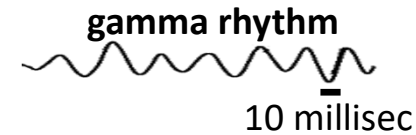
● **So far:** the building blocks of neurons/networks

- ion channels
- resting potential
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- synapses

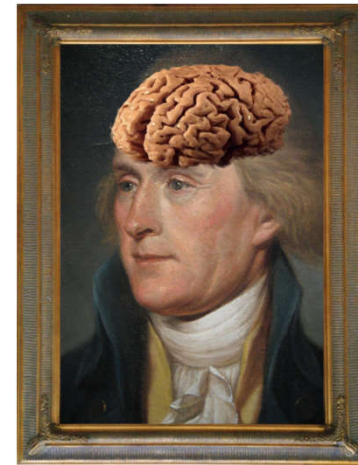
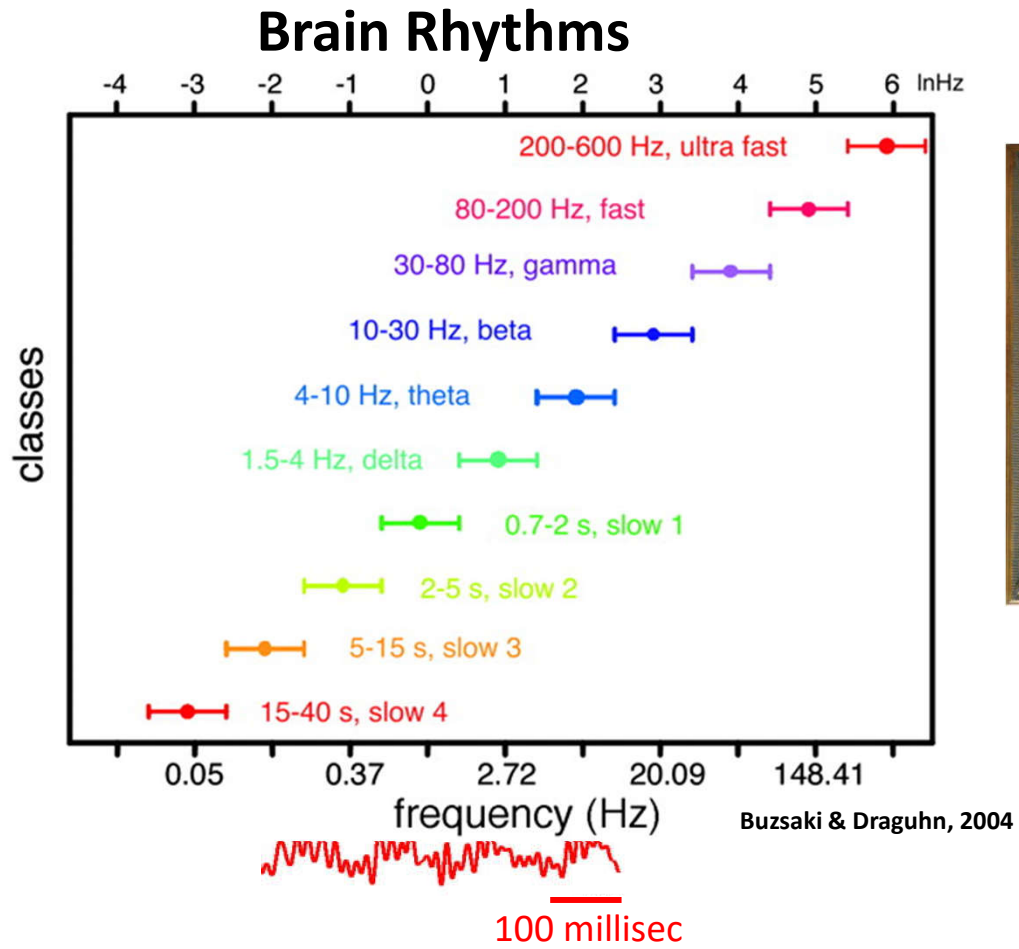


● **Now:** we build a network

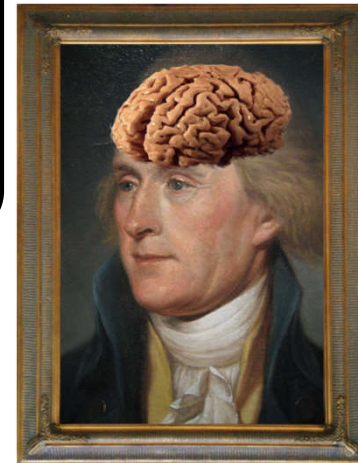
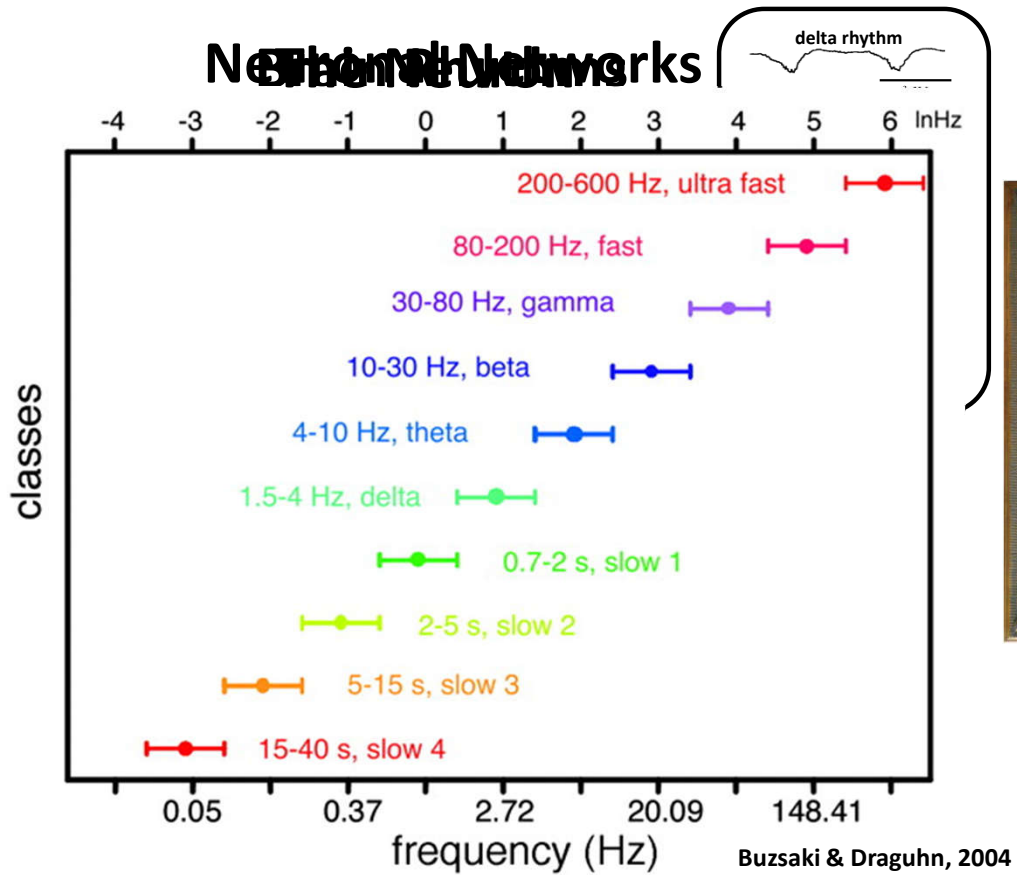
- networks in the thalamus
- the importance of time (i.e. brain rhythms)



# Neuronal Networks



# Neuronal Networks

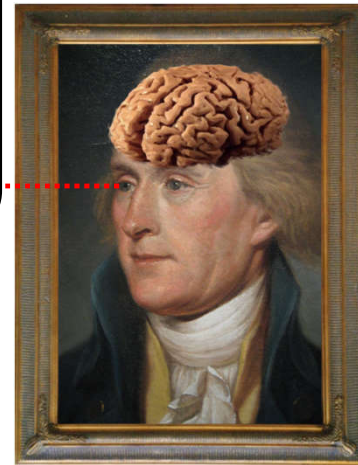
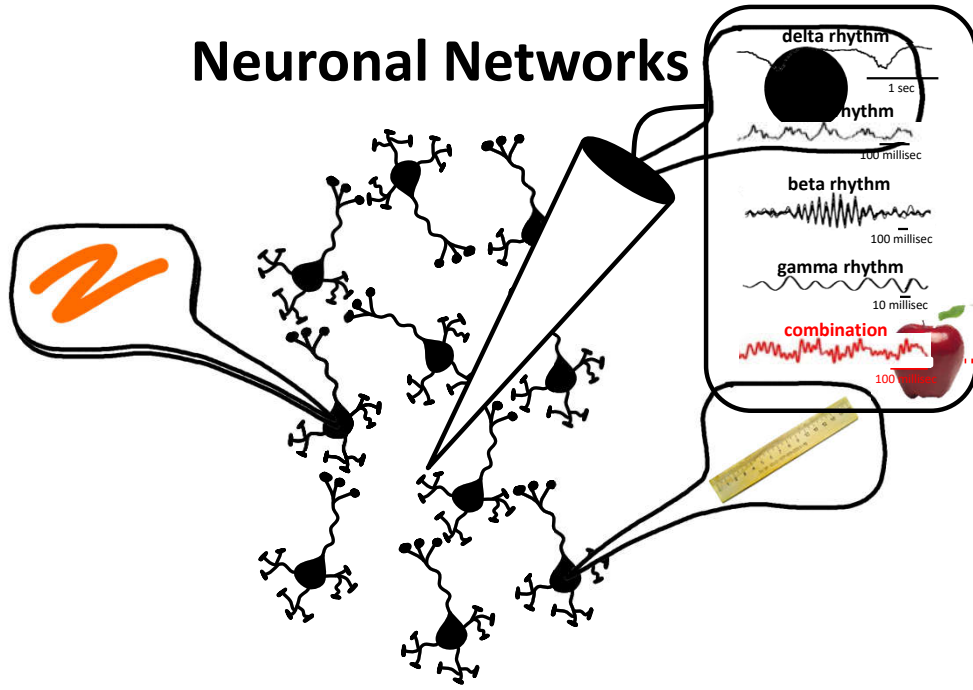


why?

how?

# Neuronal Networks

Neuronal Networks

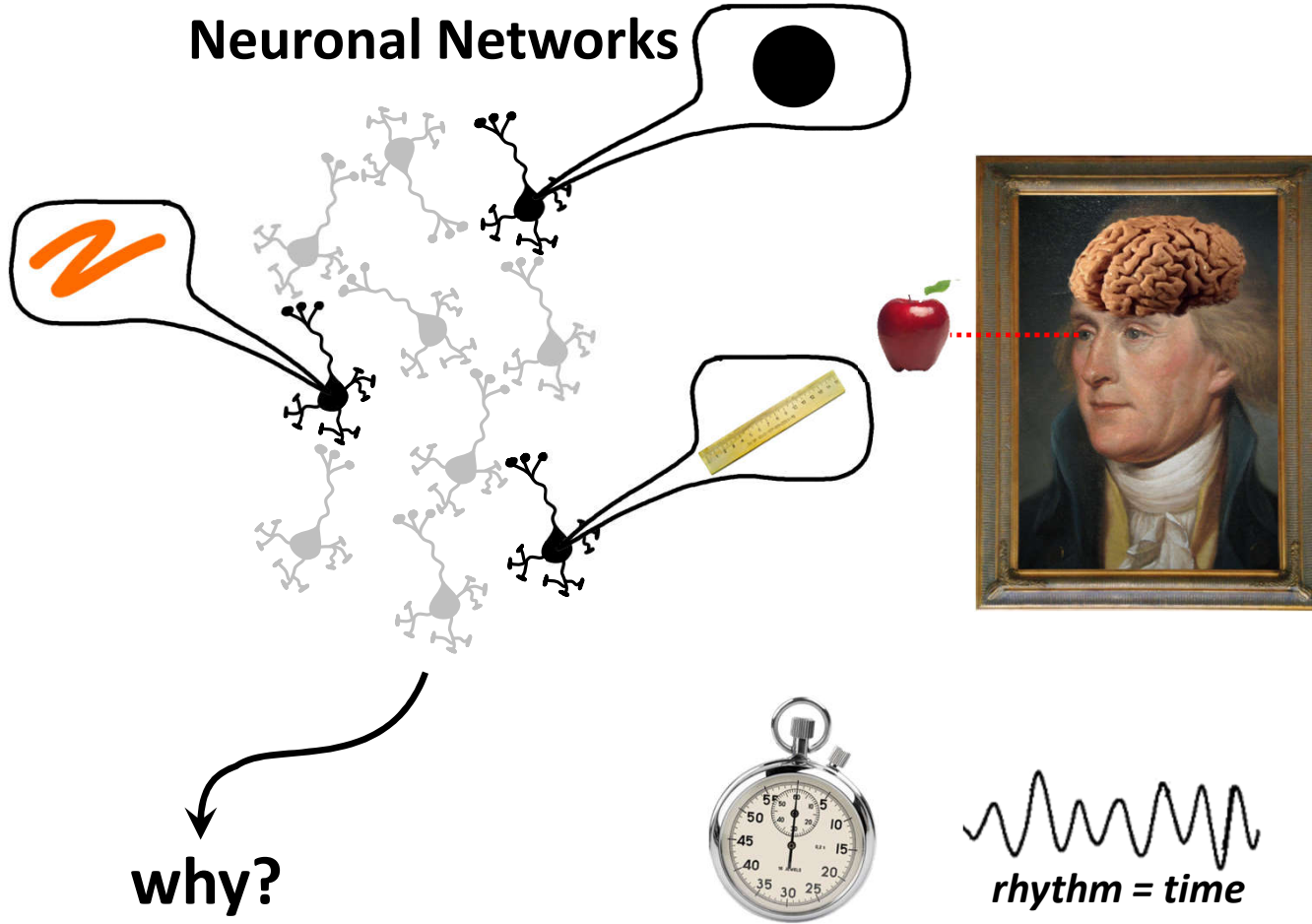


why?

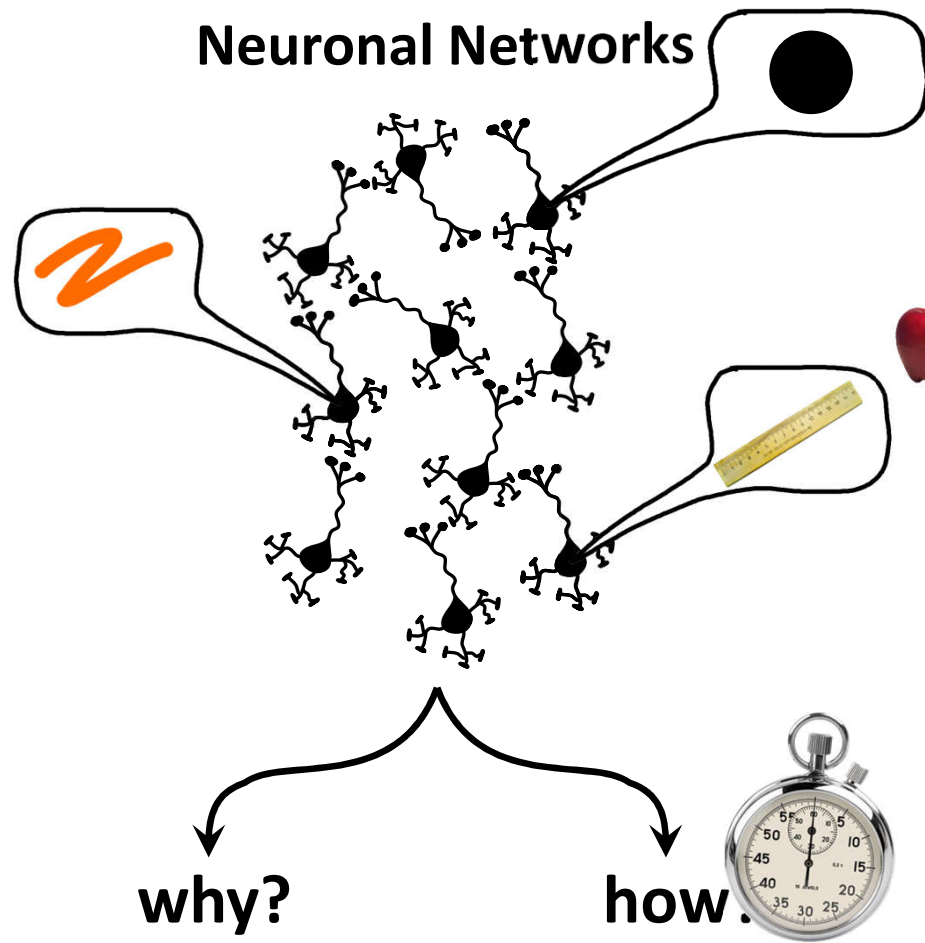
how?

# Neuronal Networks

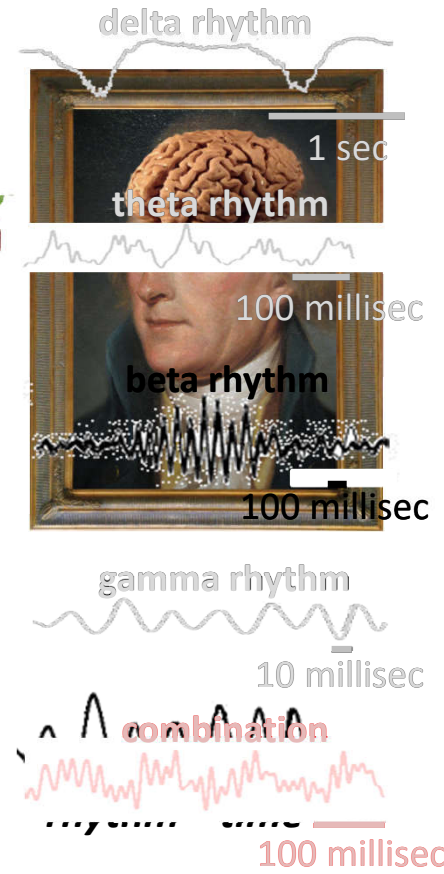
Neuronal Networks



# Neuronal Networks



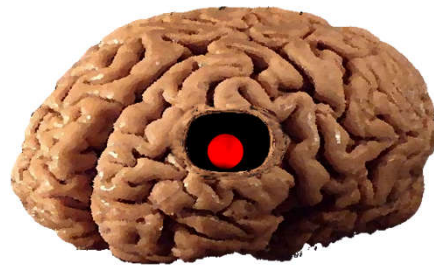
## Brain Rhythms



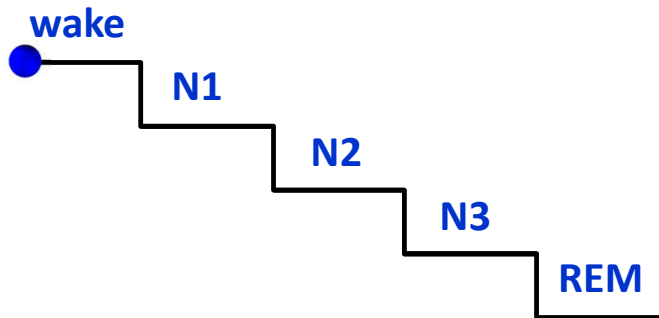
# Neuronal Networks

## Brain Networks

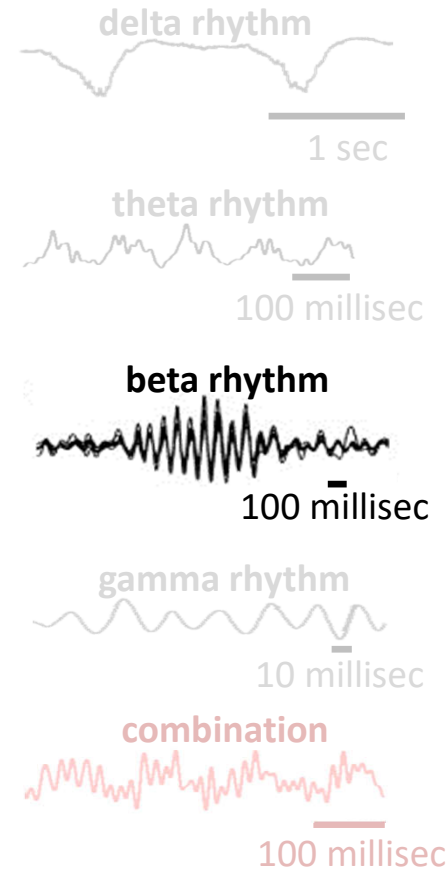
thalamus



## Sleep Stages



## Brain Rhythms

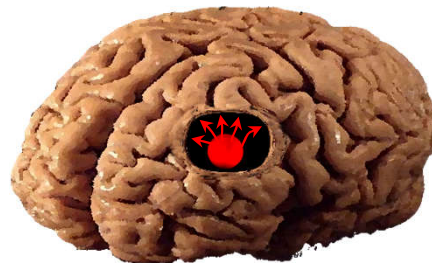




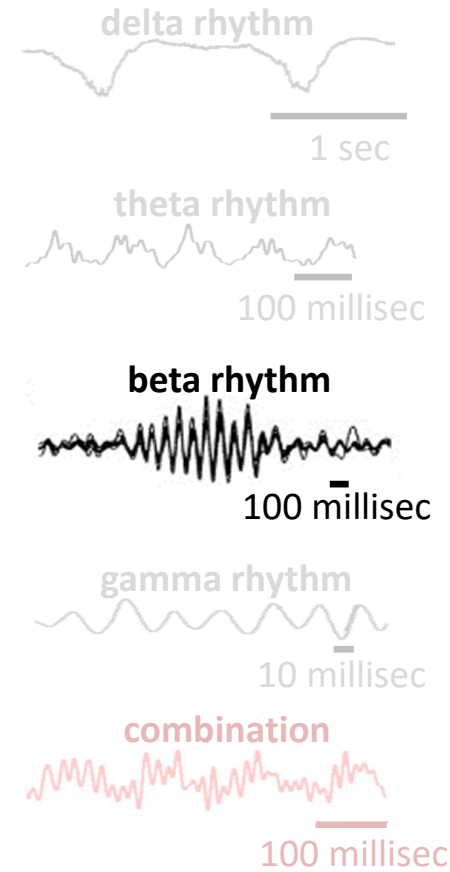
# Neuronal Networks

## Brain

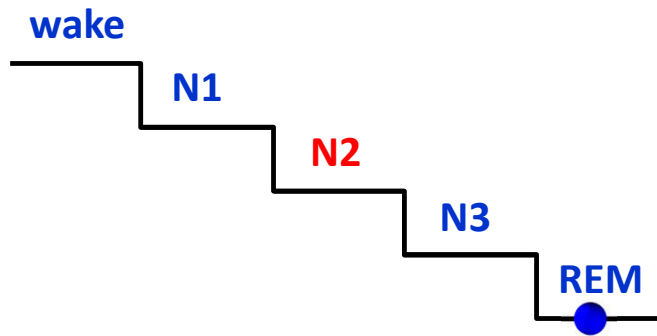
thalamus



## Brain Rhythms



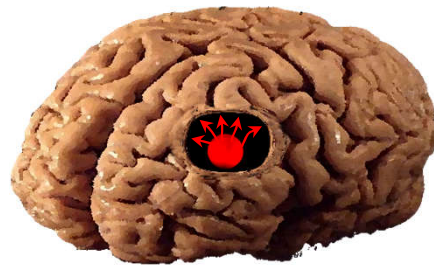
## Sleep Stages



# Neuronal Networks

## Brain

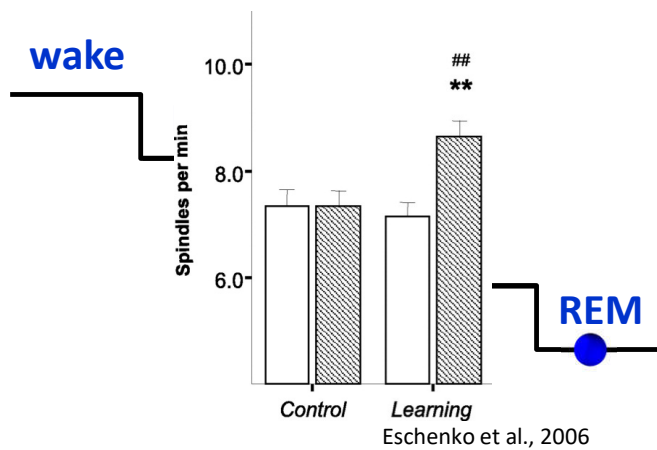
thalamus



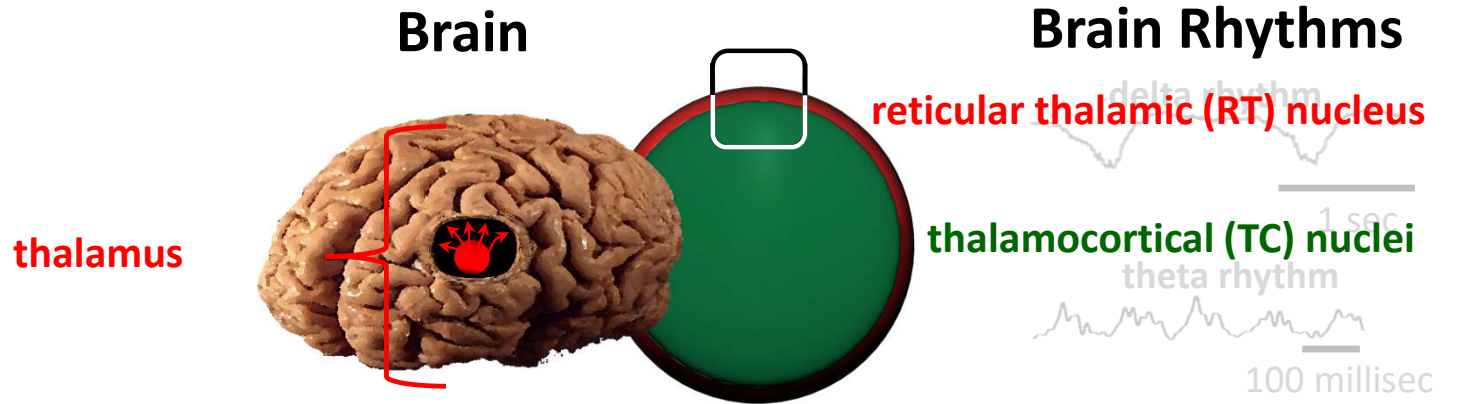
## Brain Rhythms



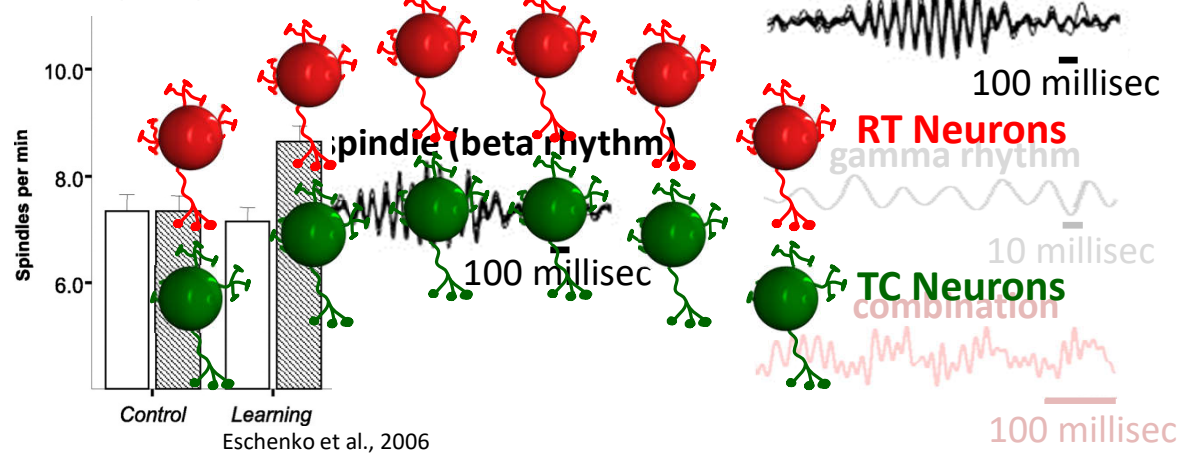
## Sleep Spindles



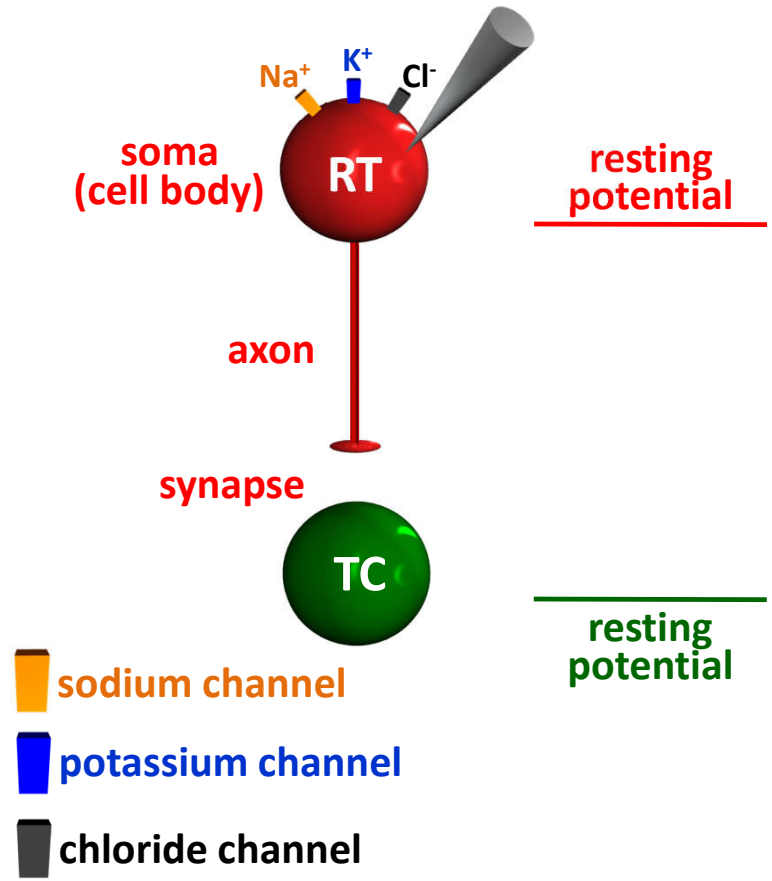
# Neuronal Networks



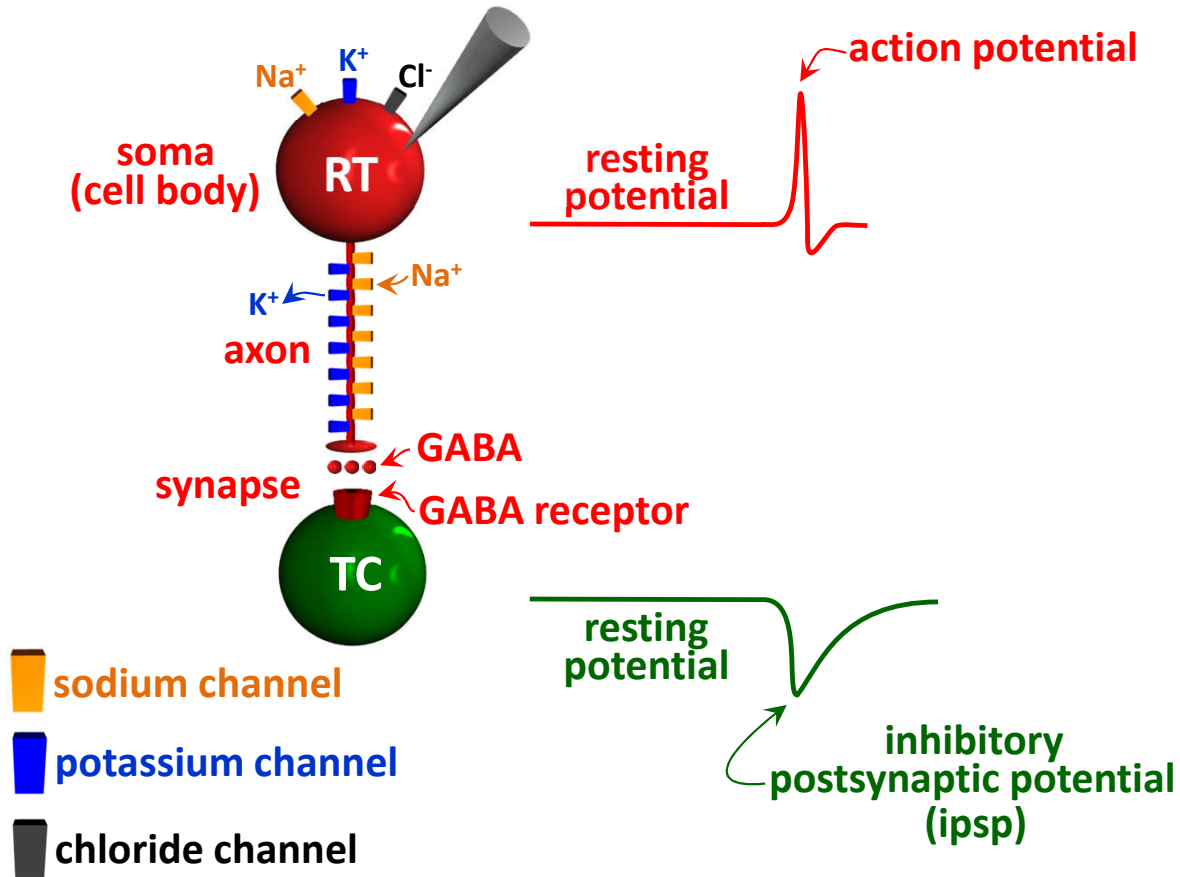
## Sleep Spindles



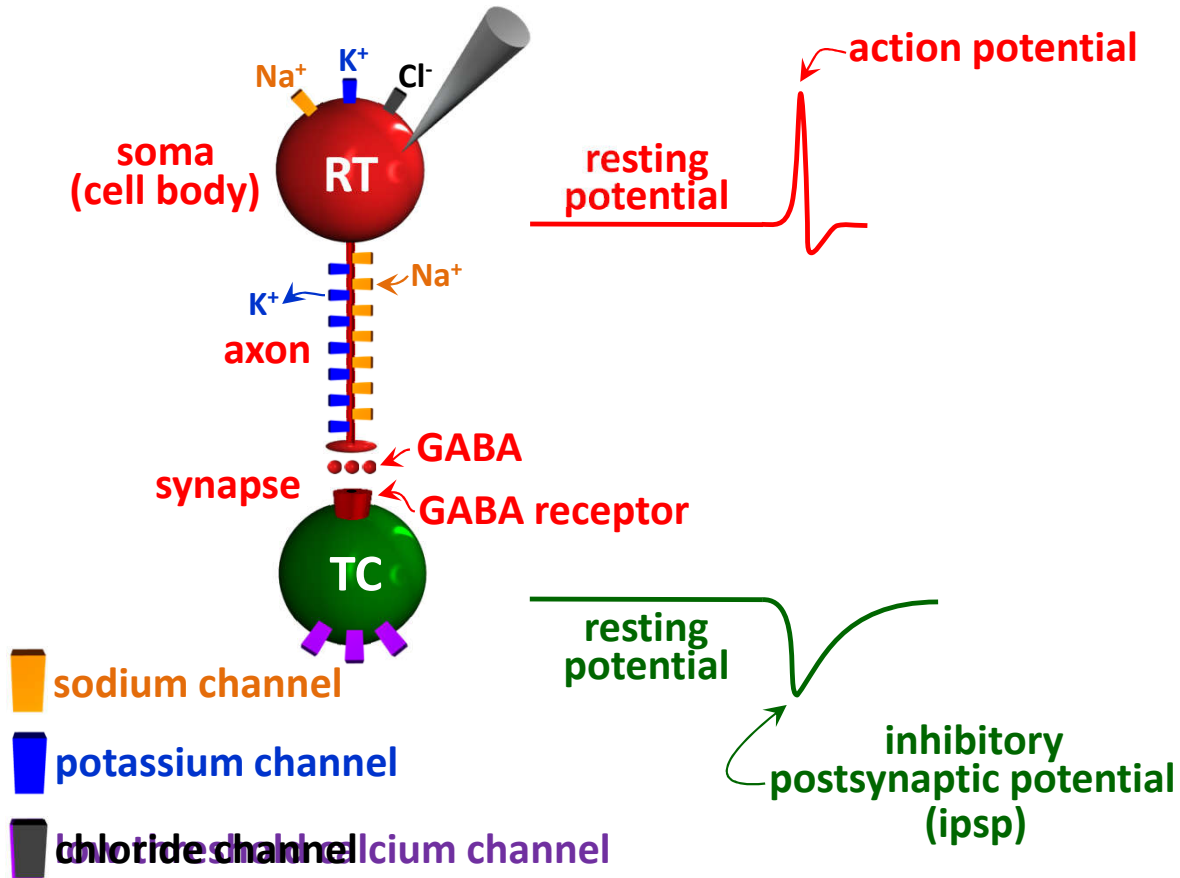
# Spindle Circuit



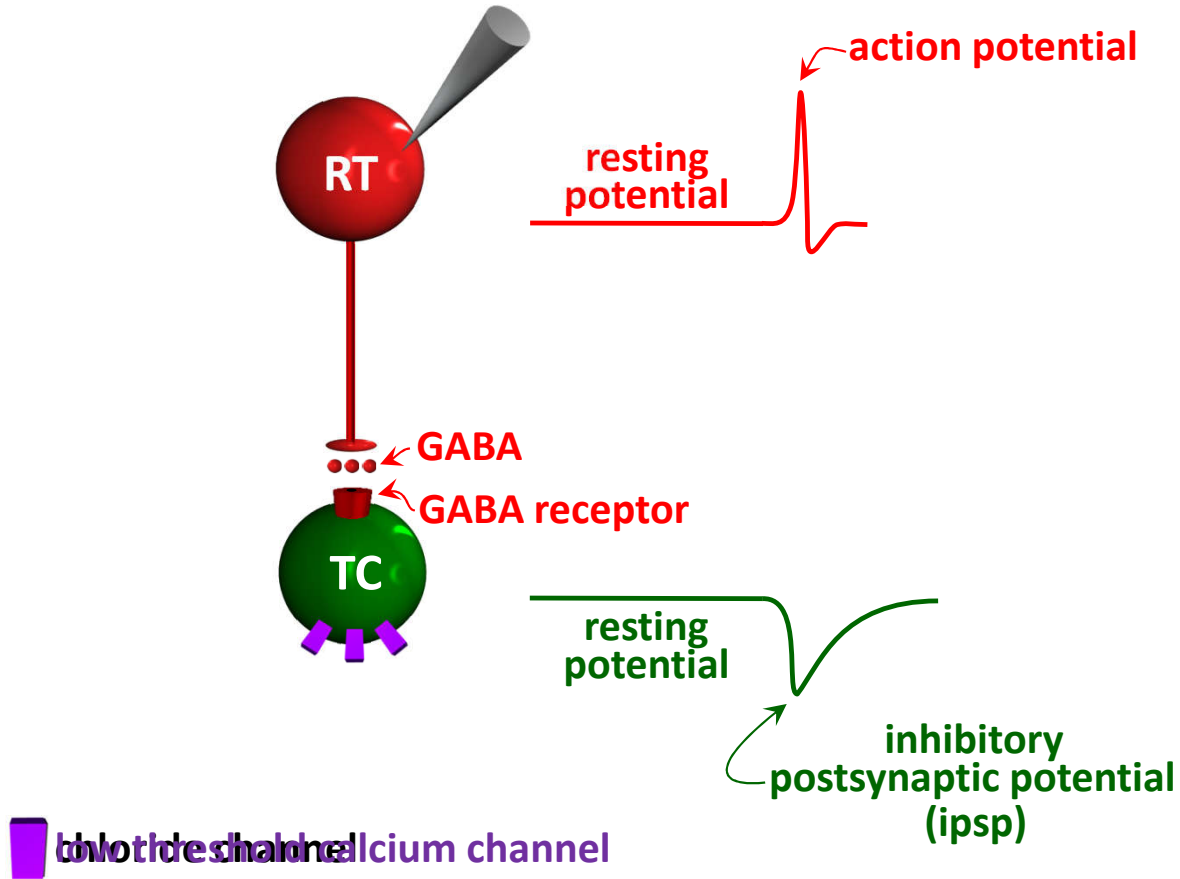
# Spindle Circuit



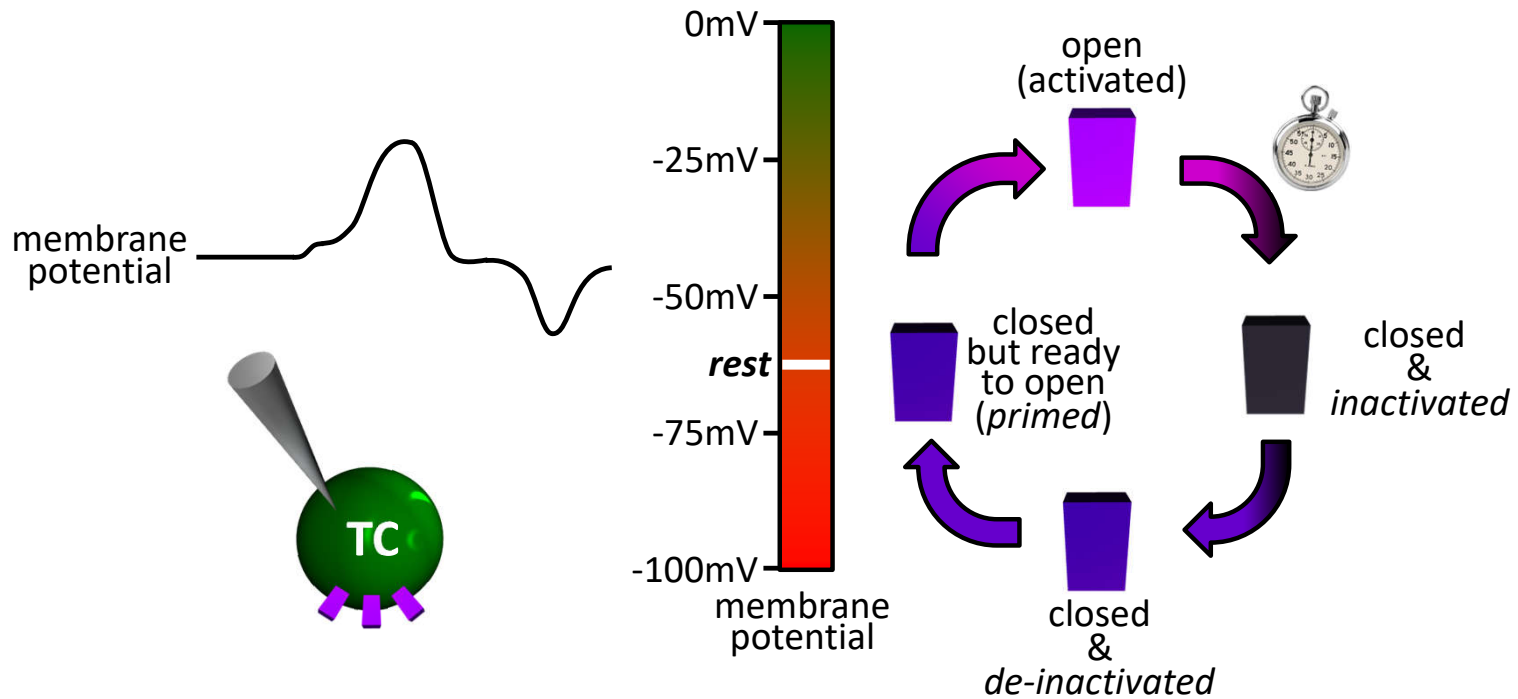
# Spindle Circuit



# Spindle Circuit



# Low Threshold Calcium Channel



 low threshold calcium channel

- opens with depolarization
- inactivated state *cannot* open
- de-inactivates (aka *primes*) with hyperpolarization

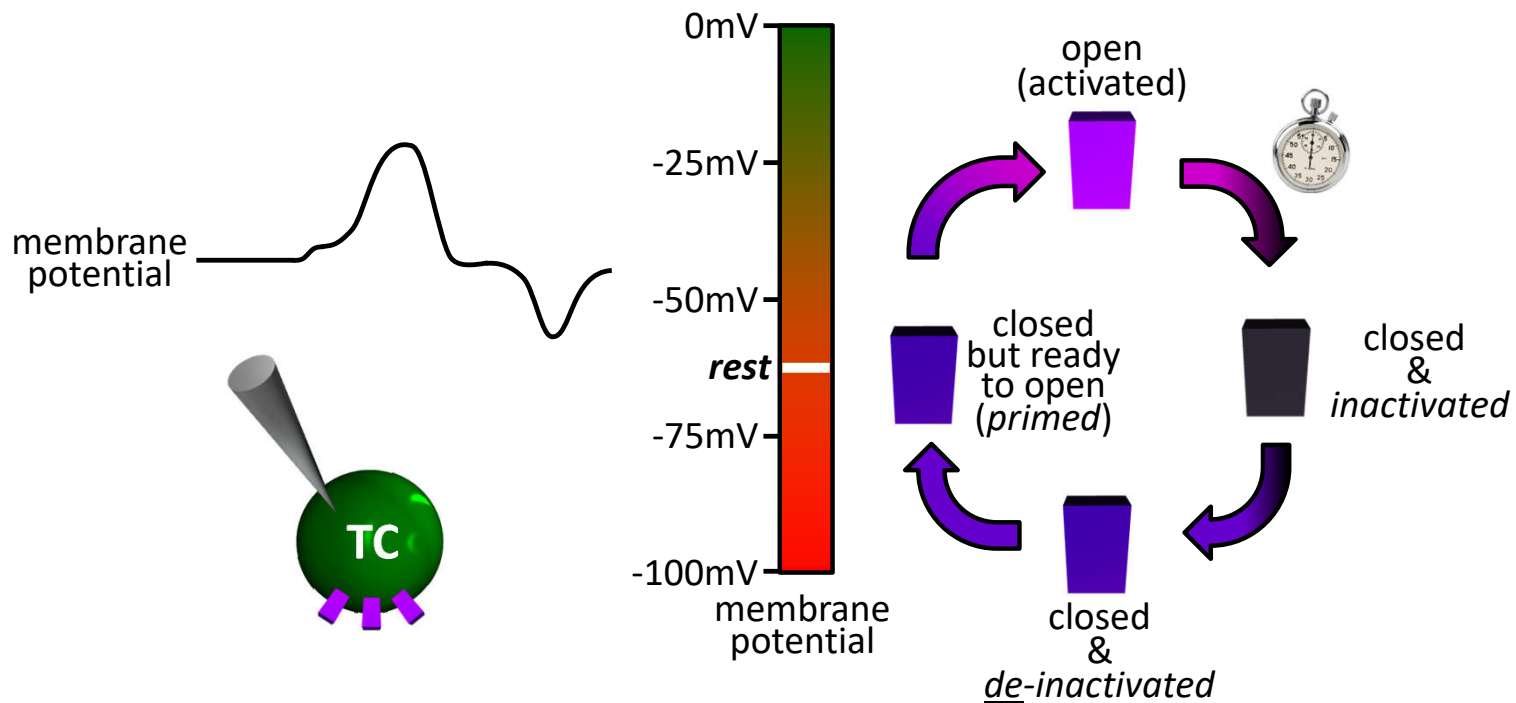




## Low Threshold Calcium Channels are called Low Threshold because:

- A.** They are primarily expressed in lower vertebrates.
- B.** Hyperpolarization lowers their threshold for activation.
- C.** They are activated at relatively hyperpolarized membrane potentials.
- D.** They easily get angry.

# Low Threshold Calcium Channel



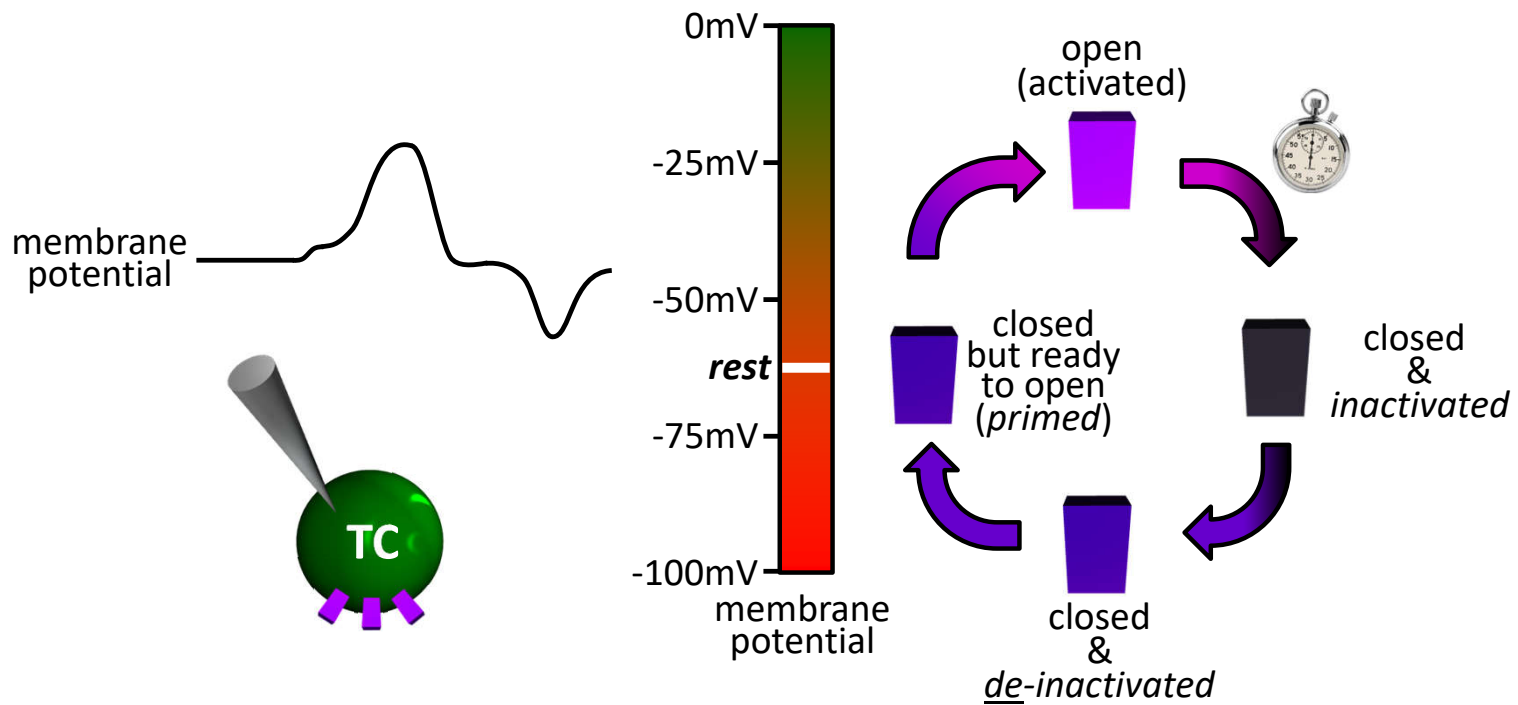
Low Threshold Calcium Channels are called Low Threshold because:

- A. They are primarily expressed in lower vertebrates.
- B. Hyperpolarization lowers their threshold for activation.
- C. They are activated at relatively hyperpolarized membrane potentials.**
- D. They get angry easily.

# Which Statement is True?

- A.** A de-inactivated L-T  $\text{Ca}^{2+}$  channel is open.
- B.** If depolarized, an inactivated L-T  $\text{Ca}^{2+}$  channel will open.
- C.** Hyperpolarization de-inactivates L-T  $\text{Ca}^{2+}$  channels.
- D.** Hyperpolarization opens L-T  $\text{Ca}^{2+}$  channels.

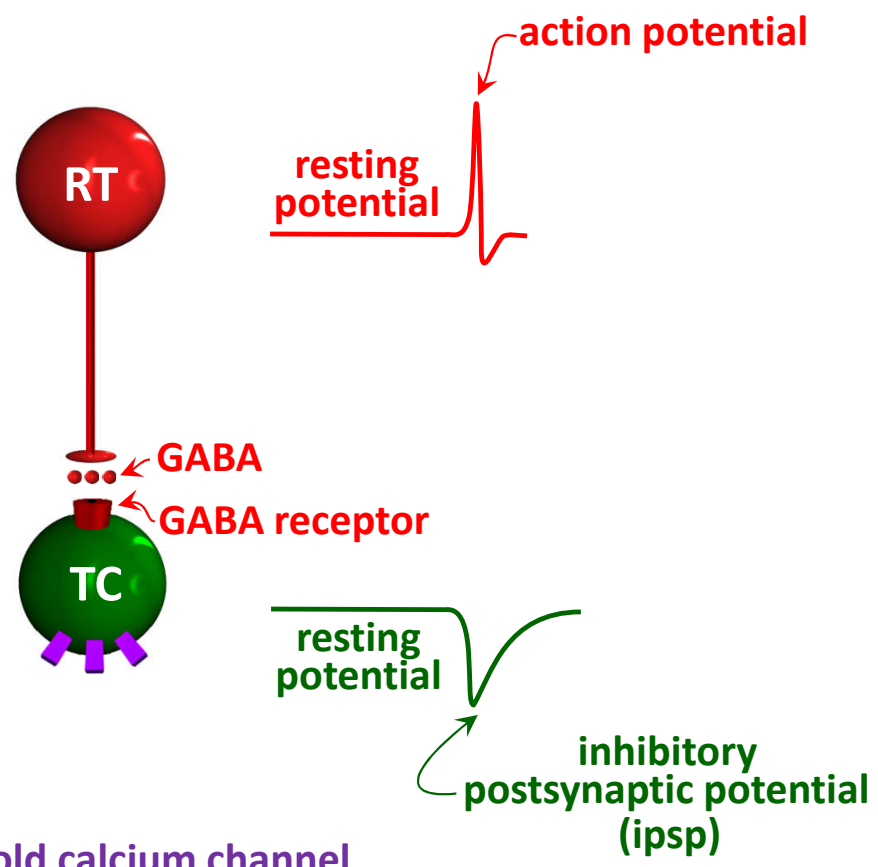
# Low Threshold Calcium Channel



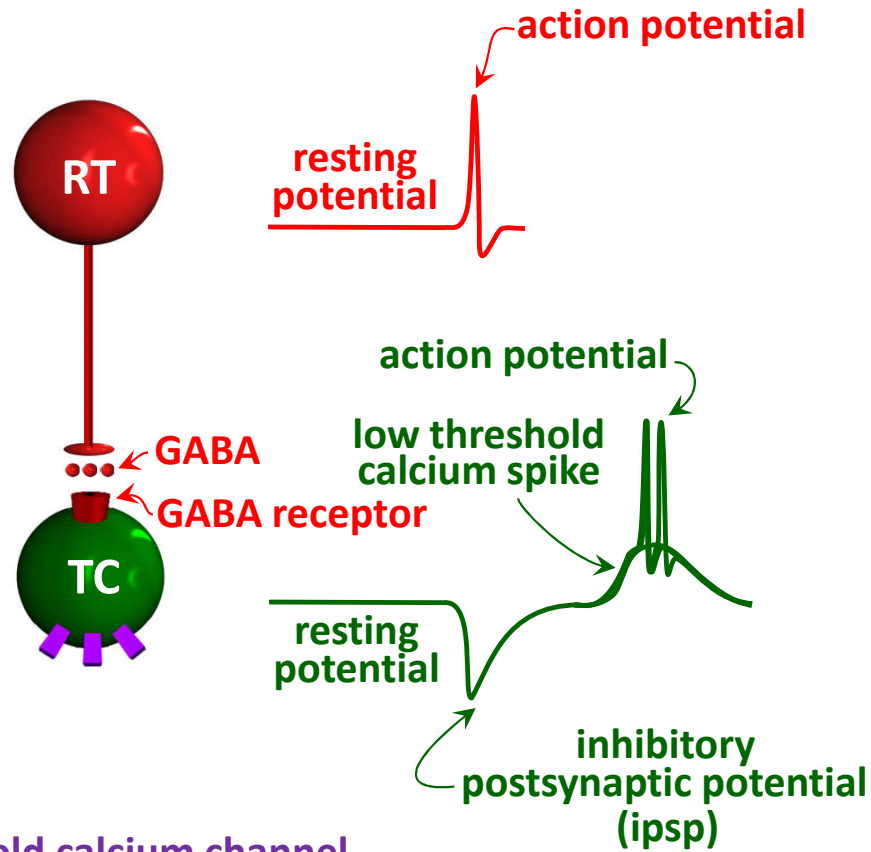
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- A. A de-inactivated L-T Ca<sup>2+</sup> channel is open.
- B. If depolarized, an inactivated L-T Ca<sup>2+</sup> channel will open.
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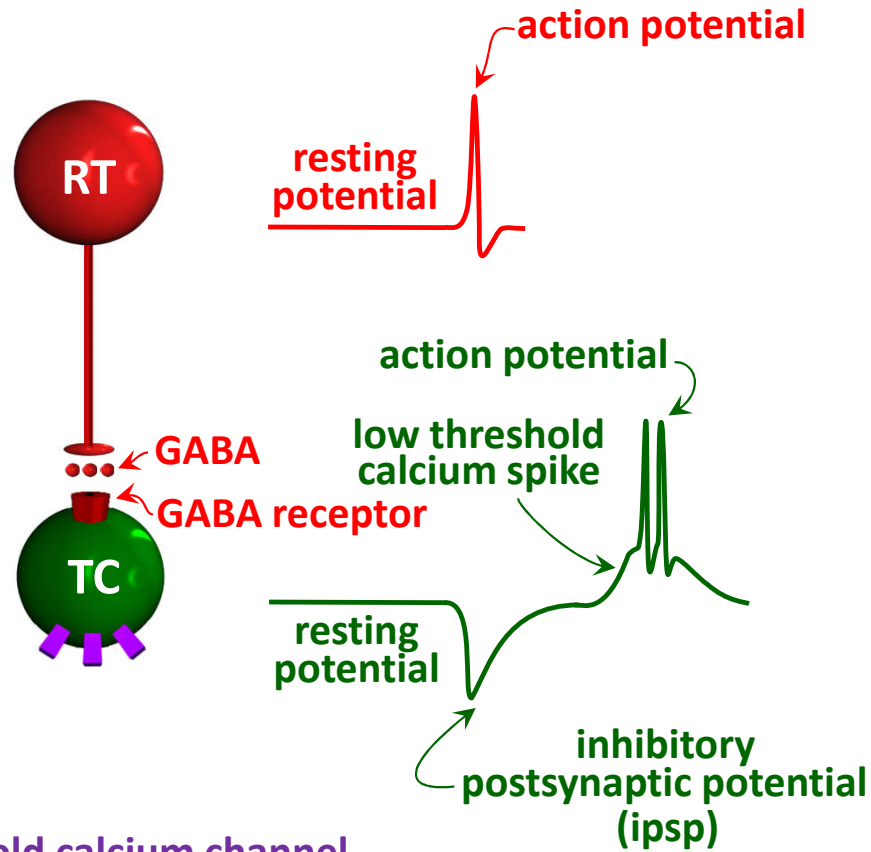
# Spindle Circuit



# Spindle Circuit

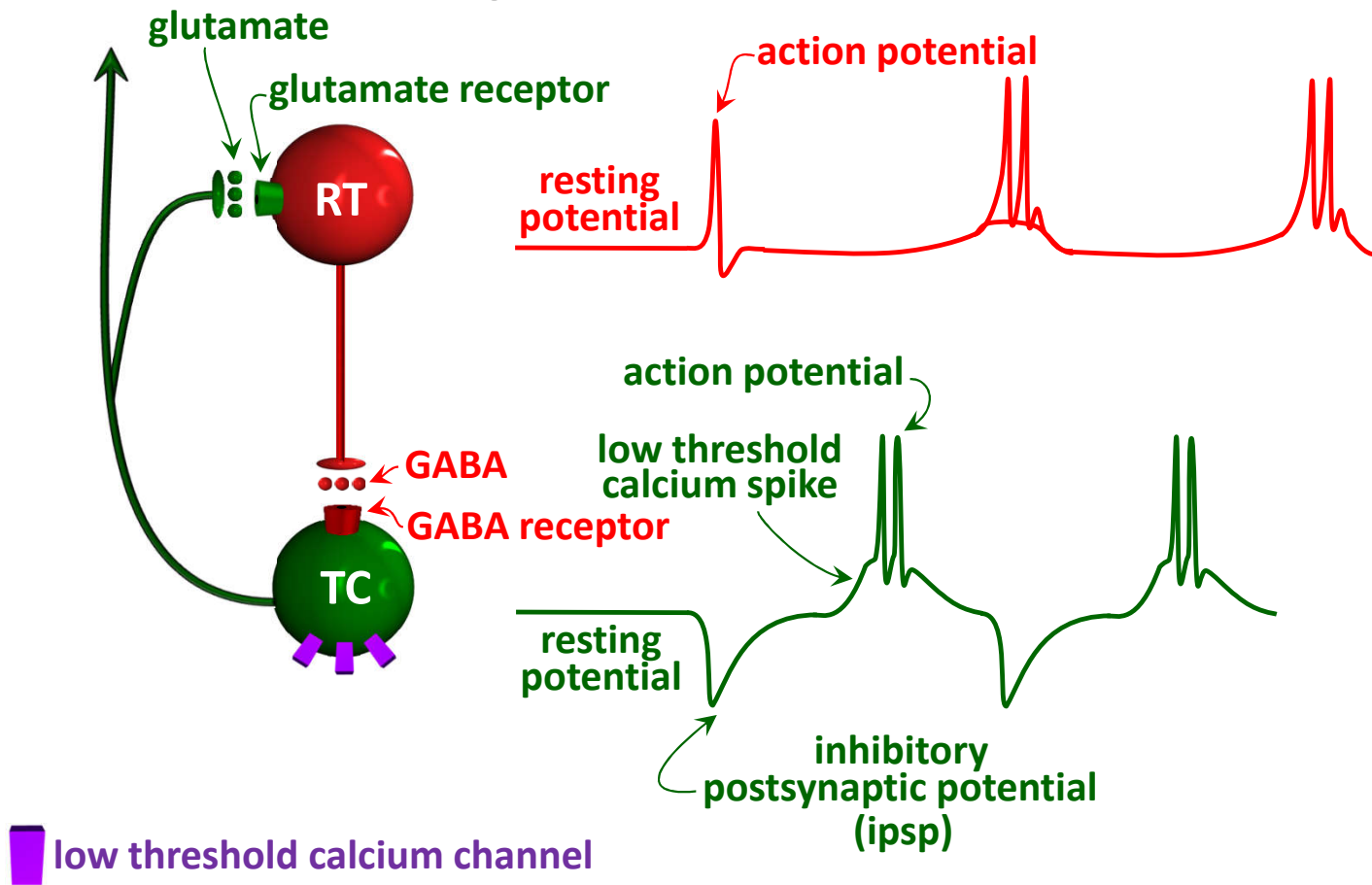


# Spindle Circuit

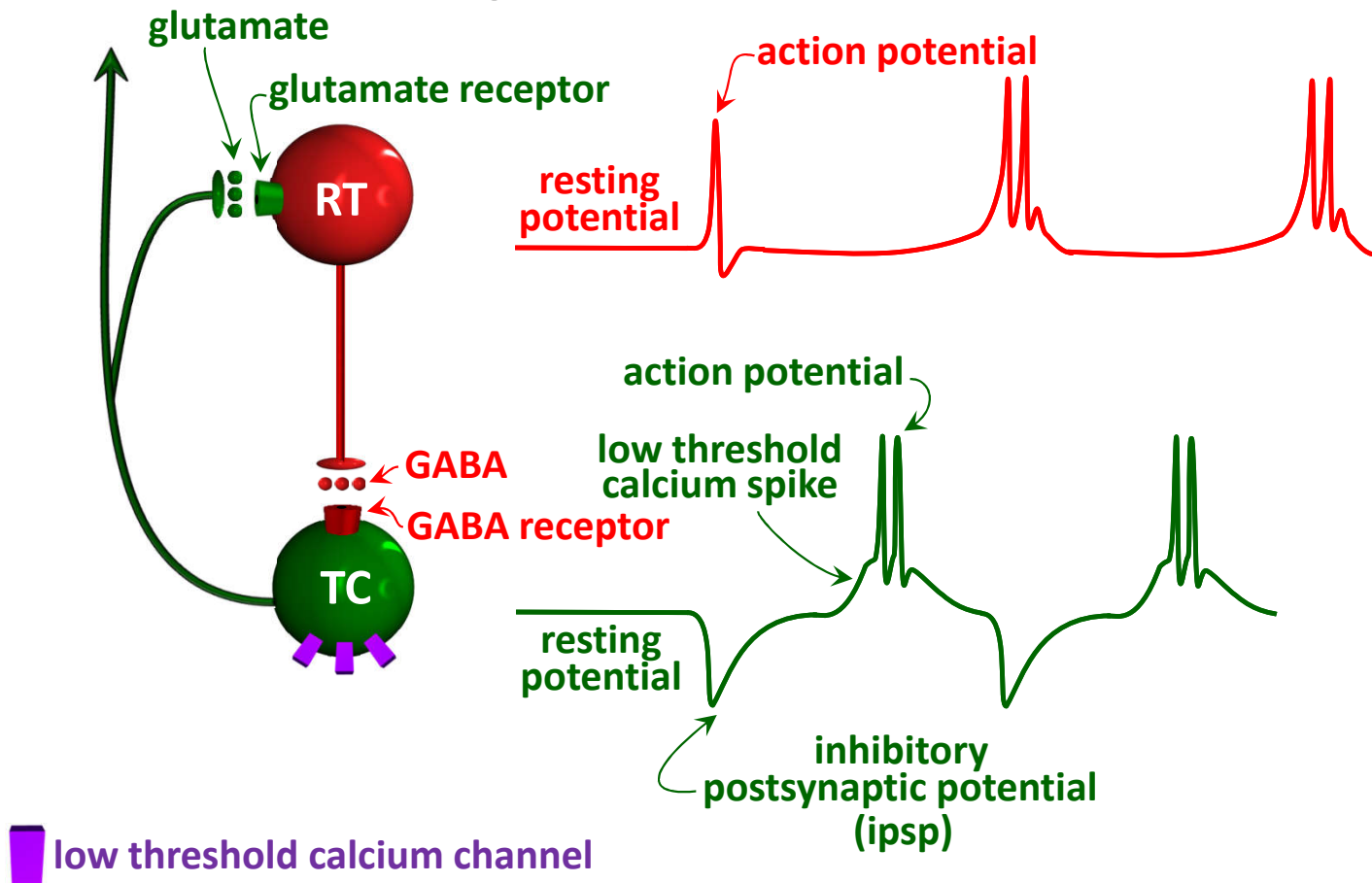




# Spindle Circuit



# Spindle Circuit

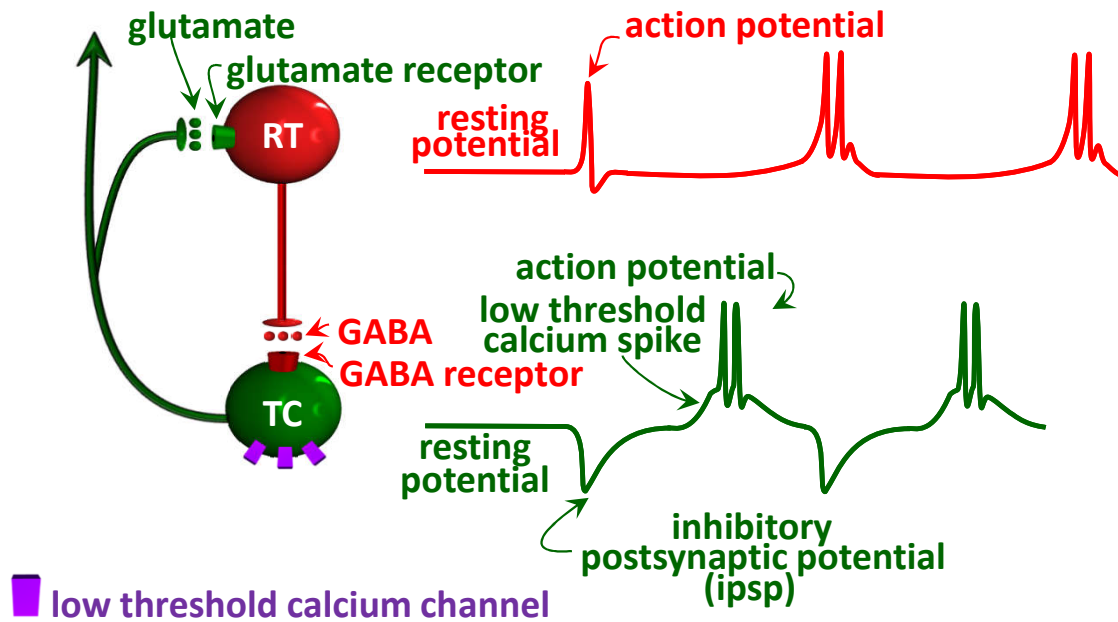




Which statement is the *most* true?:

- A. Neurons can turn on in response to excitation.
- B. Neurons can turn on in response to inhibition.
- C. Both A & B are false.
- D. Both A & B are true.

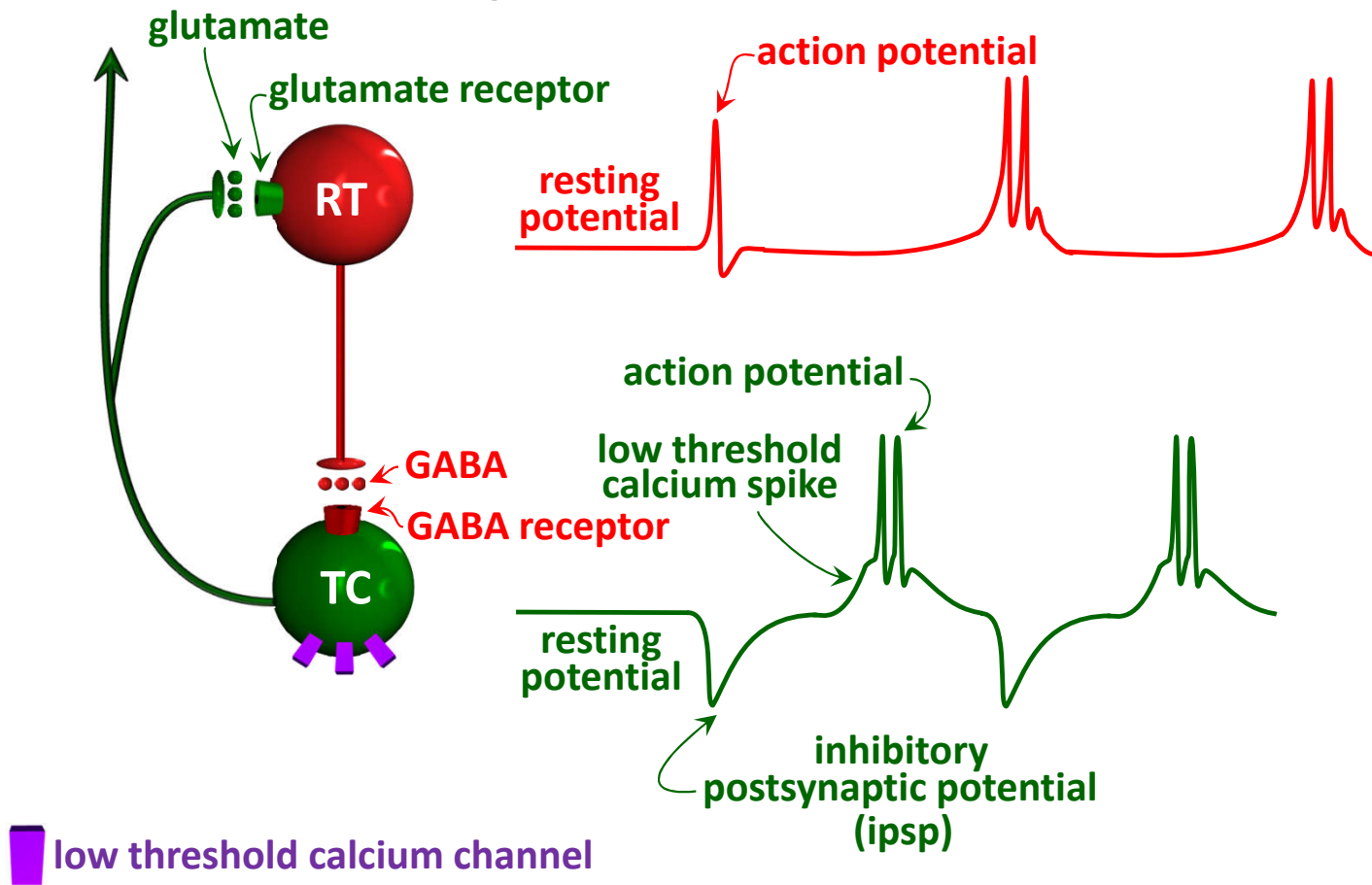
# Spindle Circuit



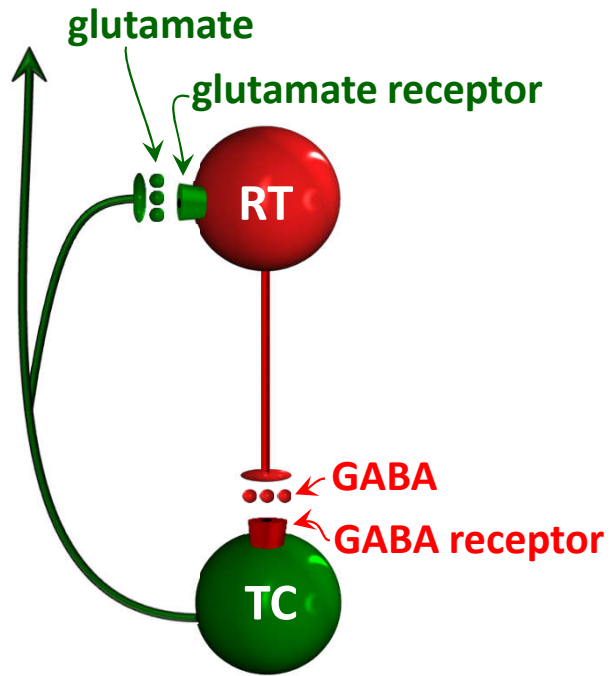
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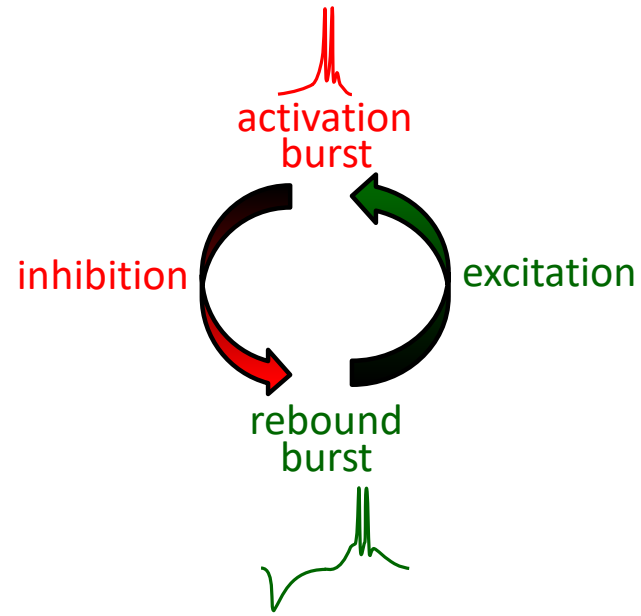
# Spindle Circuit



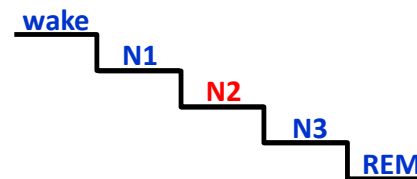
# Spindle Circuit



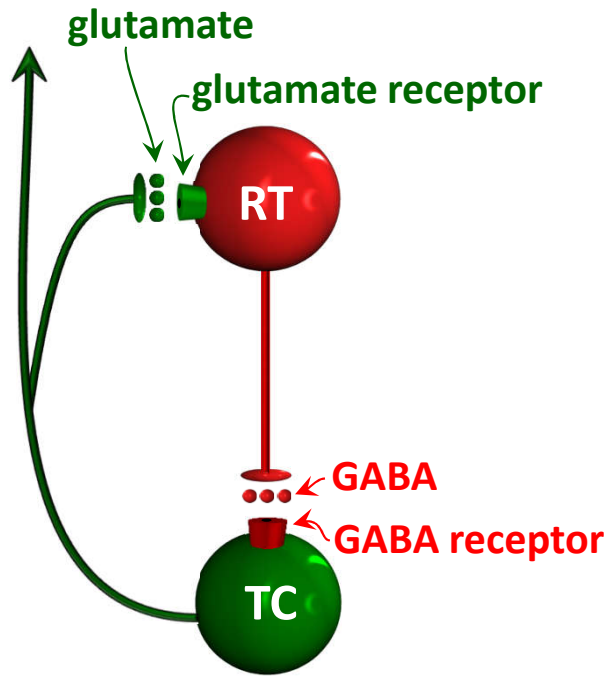
Sleep Spindle



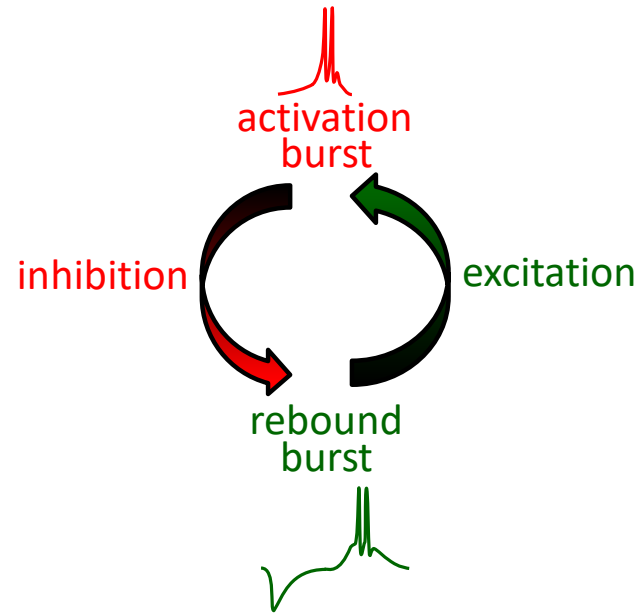
Sleep



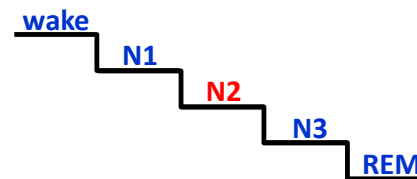
# Spindle Circuit



Sleep Spindle

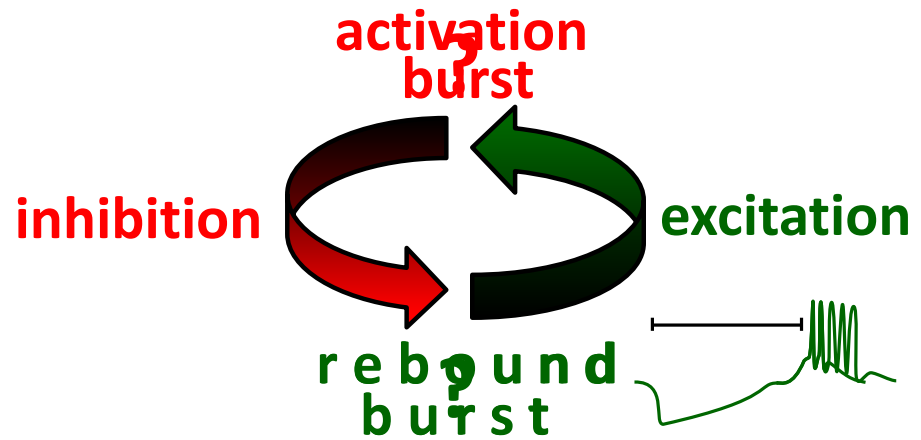
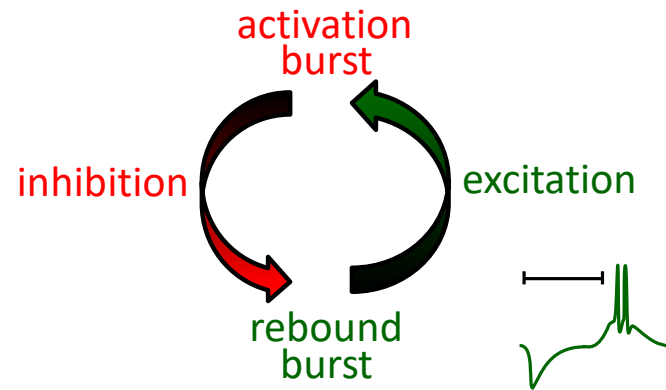
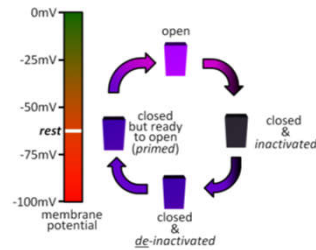
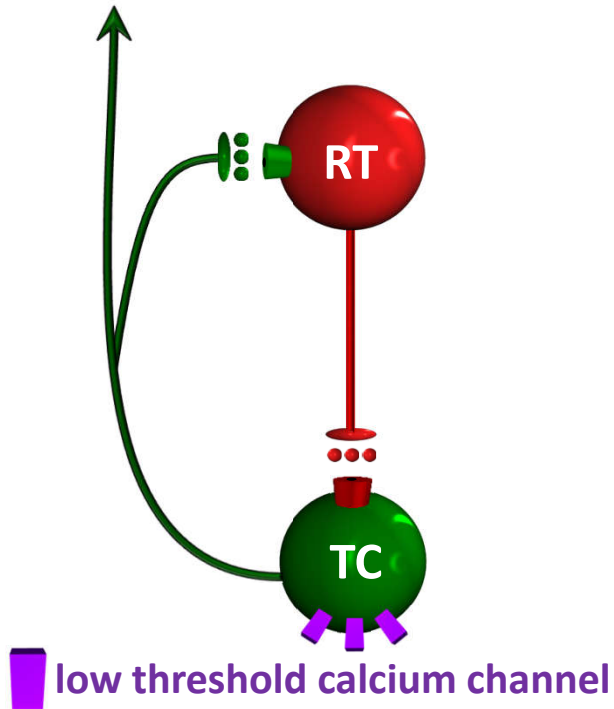


Sleep

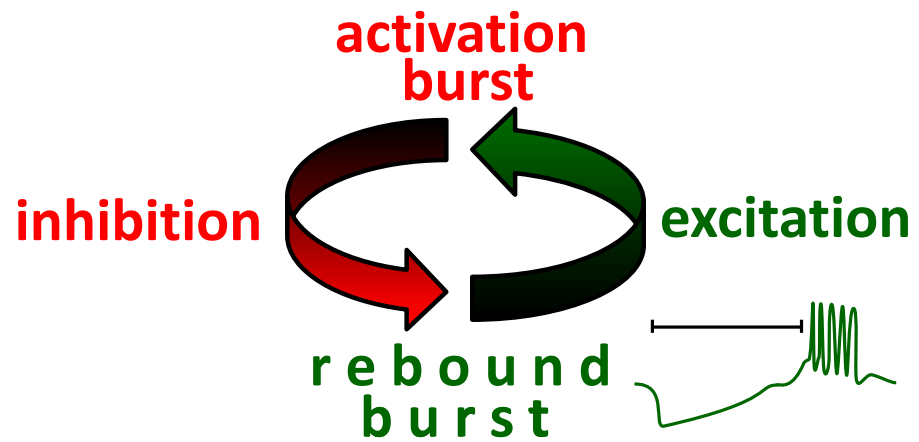
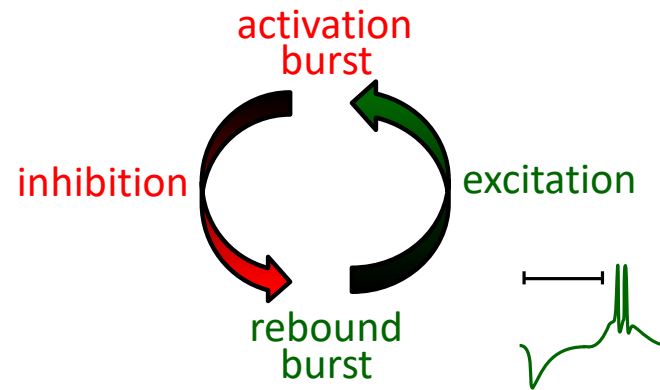
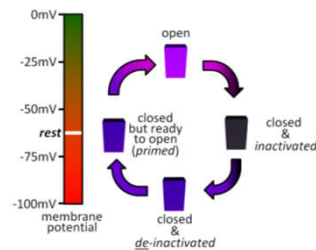
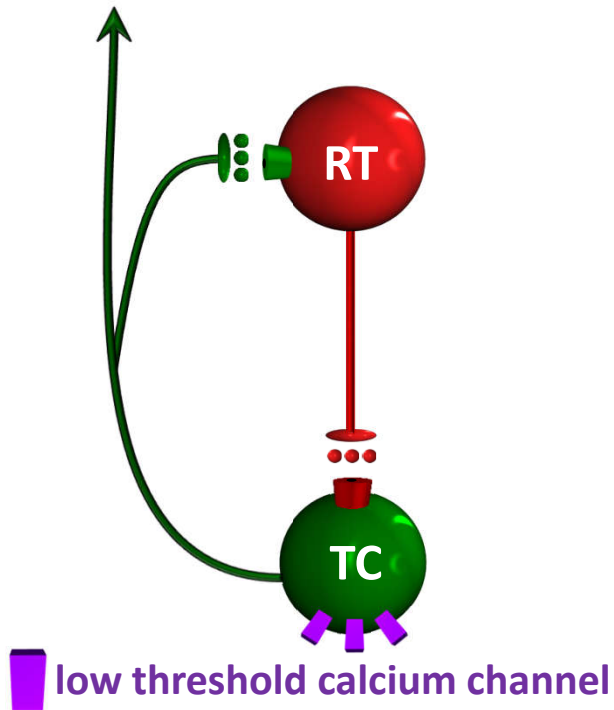




# Spindle Circuit



# Spindle Circuit

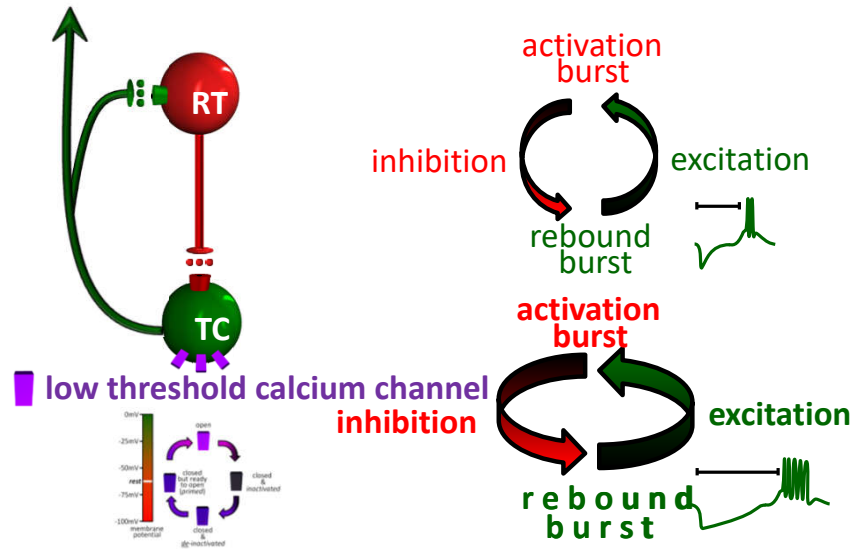




Prolonged inhibition of thalamocortical (TC) neurons will cause:

- A. Weaker TC firing activity *during* the inhibition.
- B. Weaker TC firing activity *after* the inhibition.
- C. Stronger TC firing *during* the inhibition.
- D. Stronger TC firing *after* the inhibition.
- E. A & B.
- F. A & D.

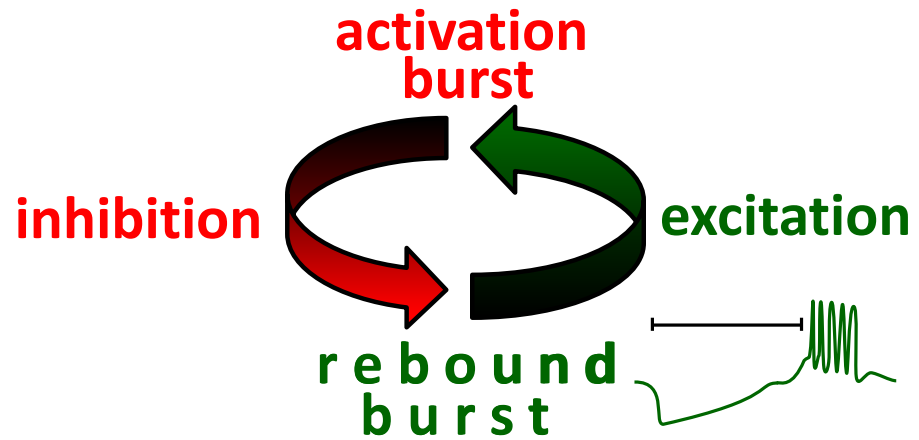
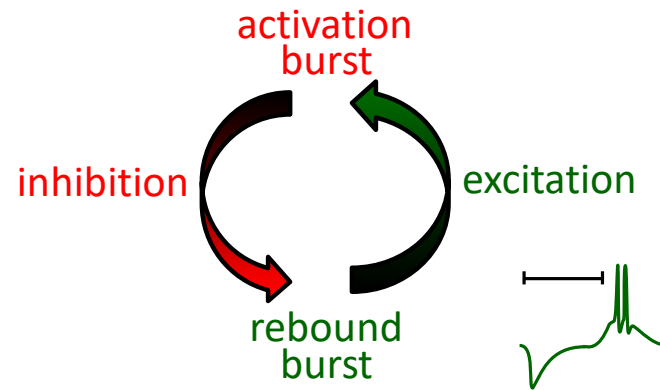
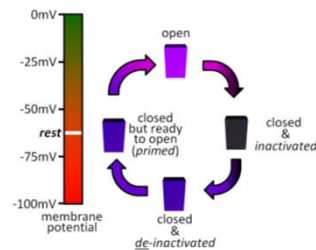
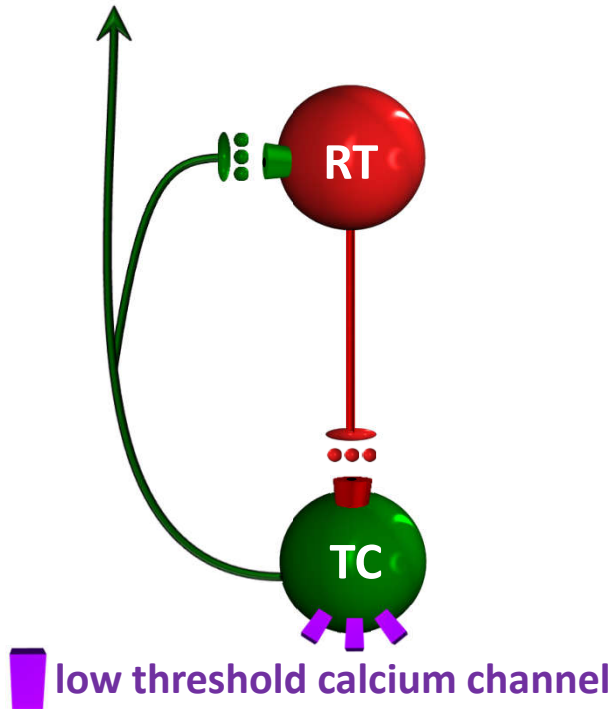
# Spindle Circuit



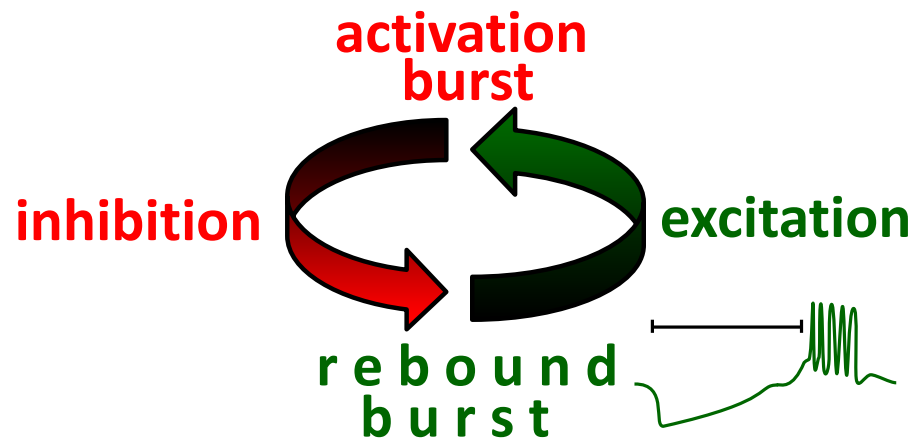
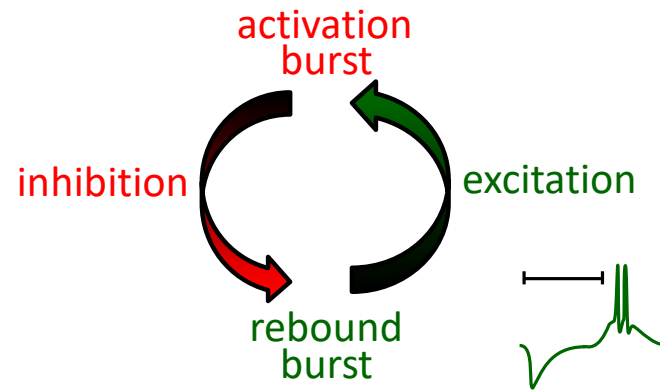
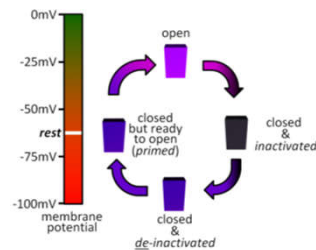
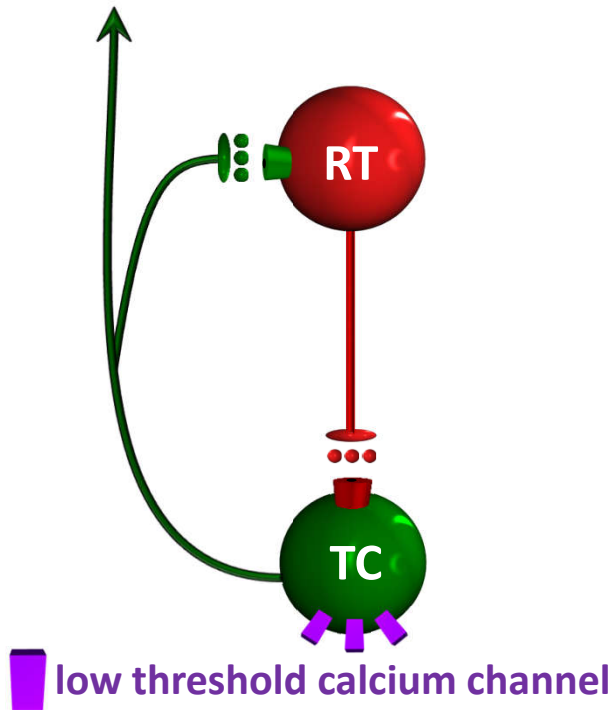
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- D. Stronger TC firing *after* the inhibition.
- E. A & B
- F. A & D**

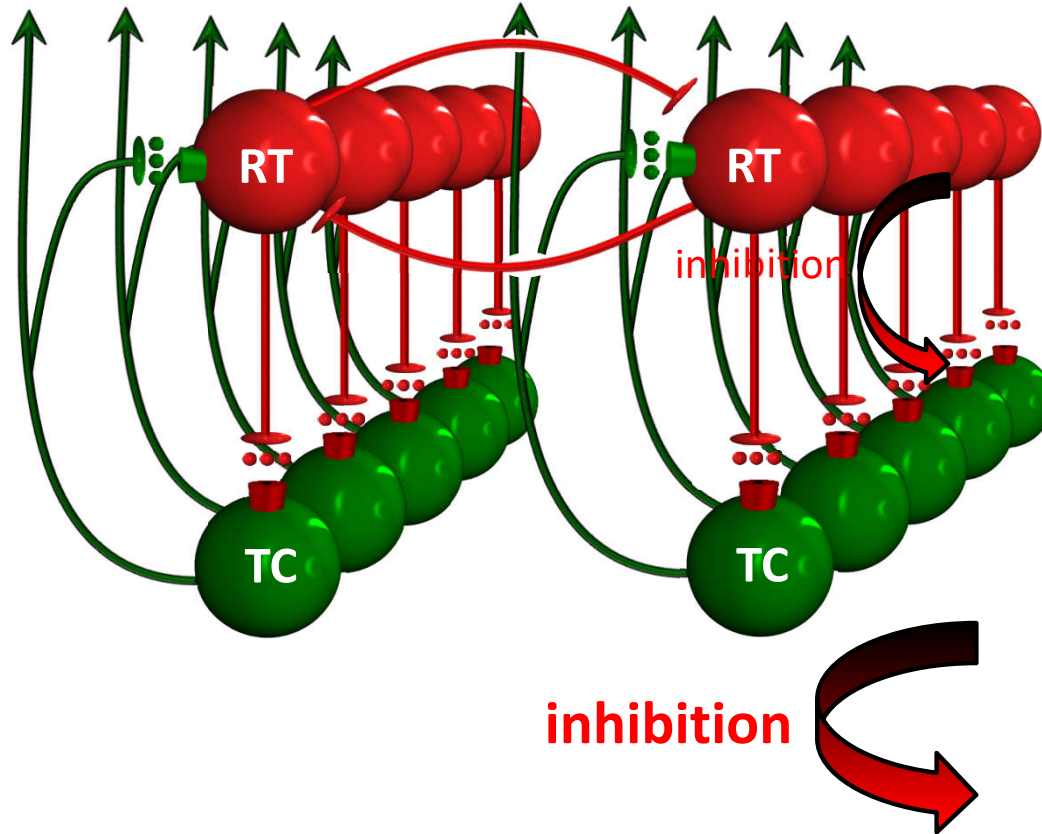
# Spindle Circuit



# Spindle Circuit

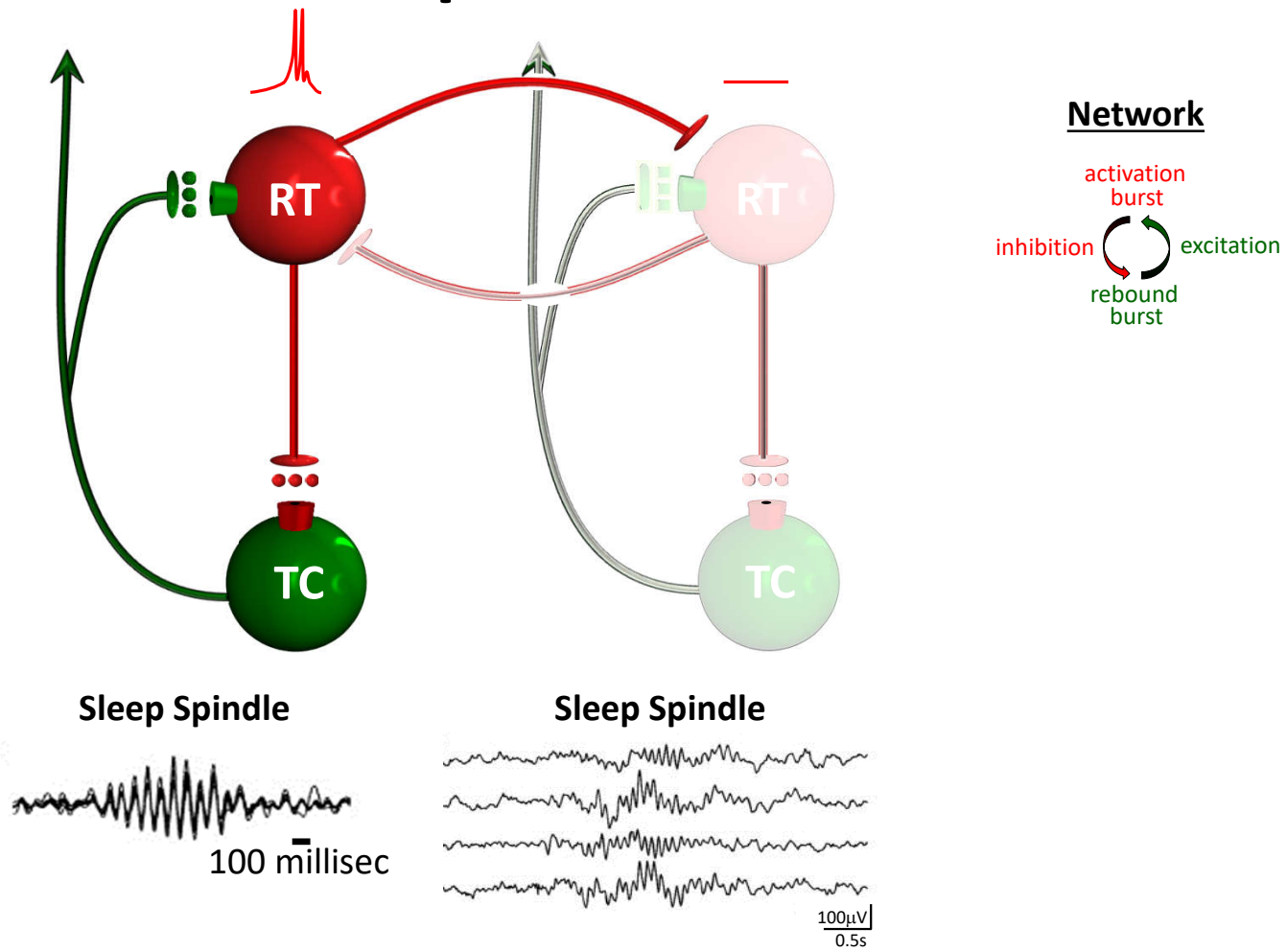


# Spindle Circuit





# Spindle Circuit



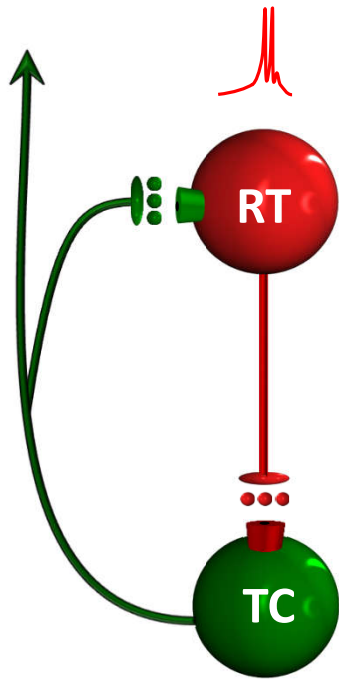
Sleep Spindle

Sleep Spindle

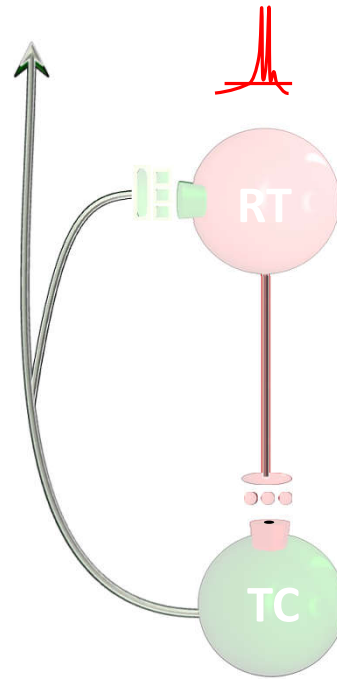
100 millisecond

100μV  
0.5s

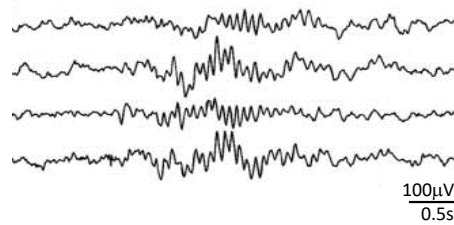
# Spindle Circuit



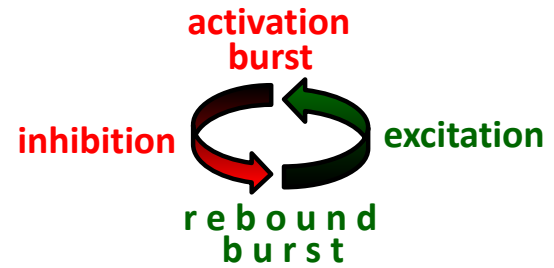
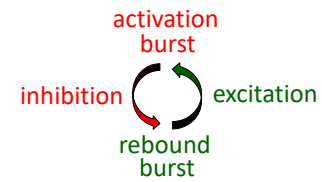
Sleep Spindle



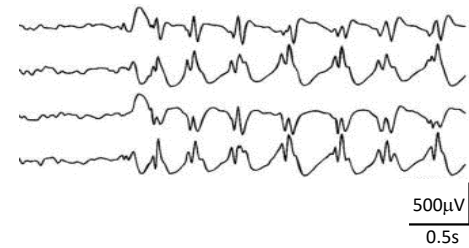
Sleep Spindle



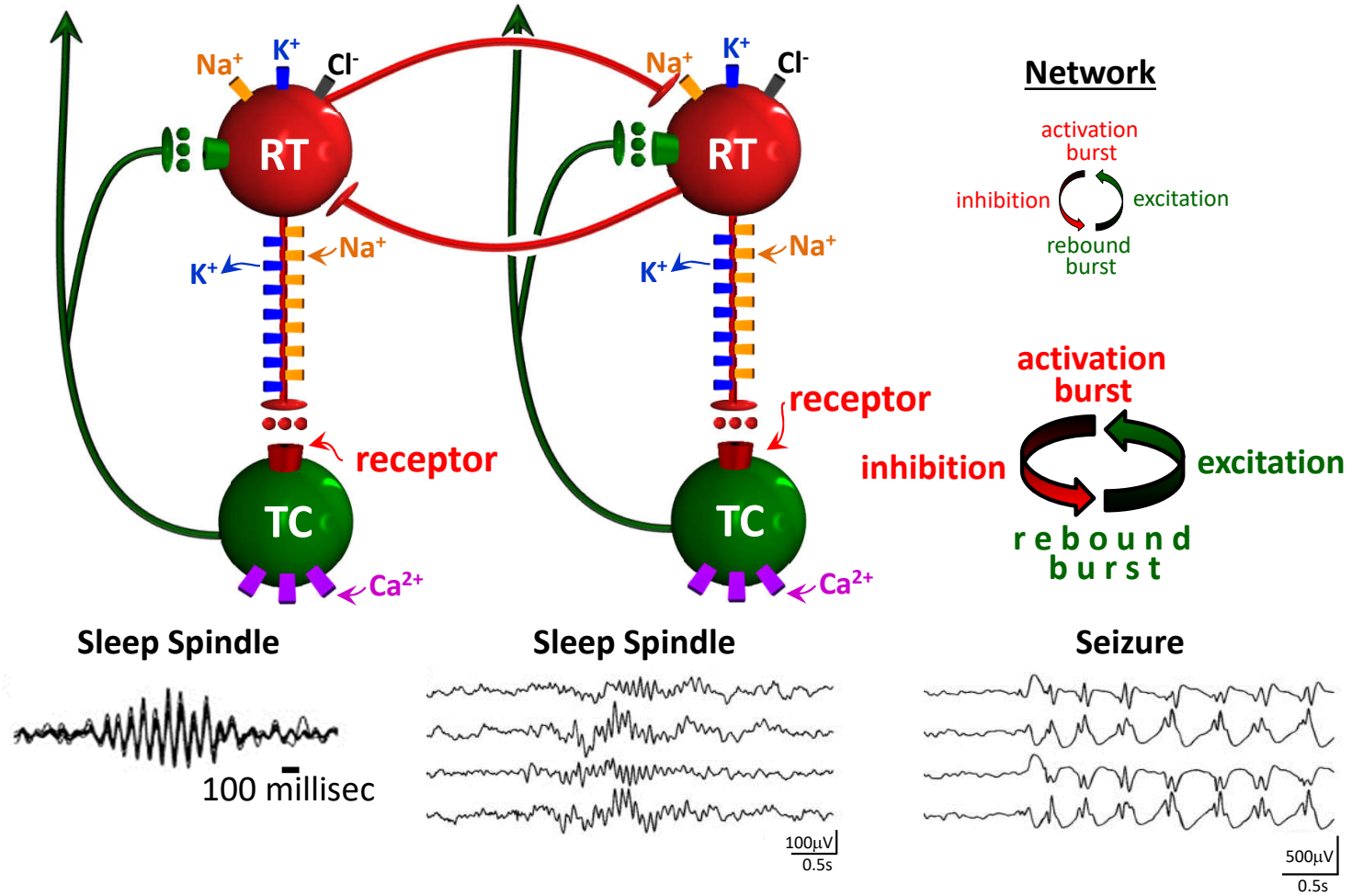
## Network



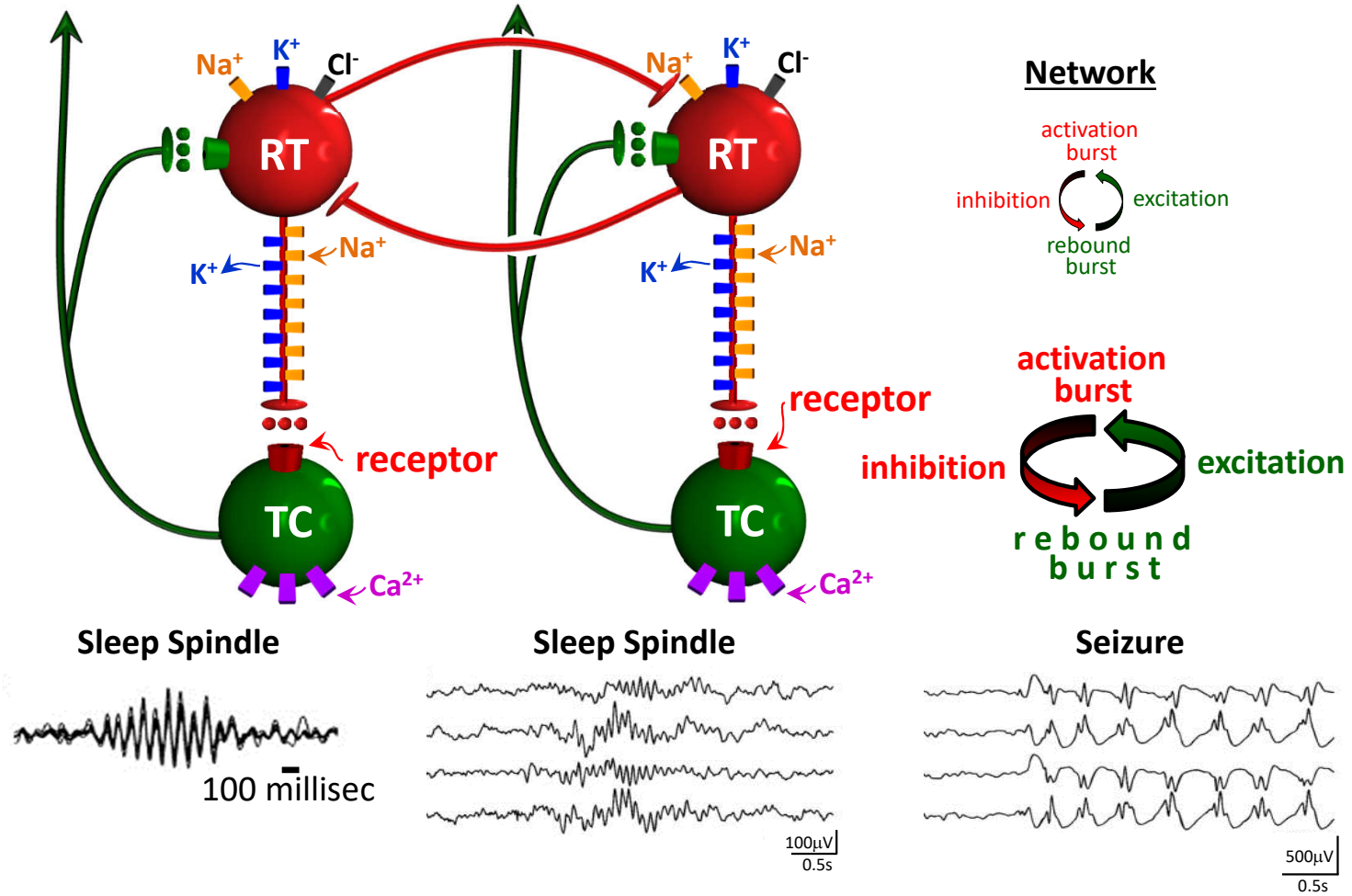
Seizure



# Spindle Circuit

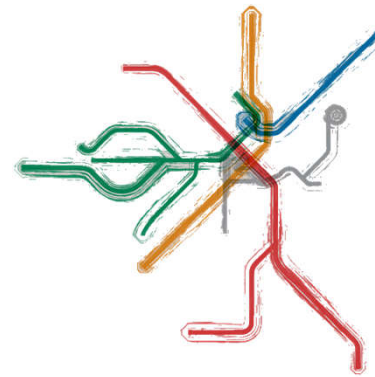
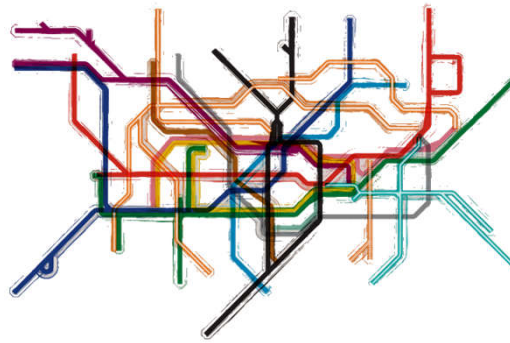


# Spindle Circuit





Which one is Boston?:



# Neuronal Networks: Summary

