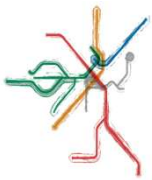
Neuronal Networks

- **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)

Boston

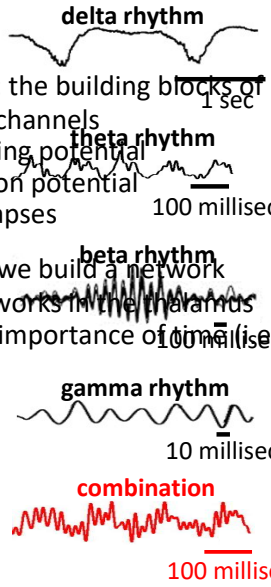


London

DC

Neuronal Networks

Brain Rhythms



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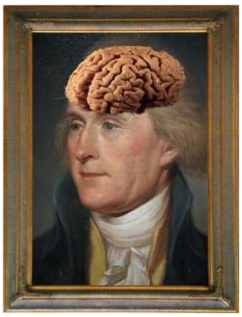
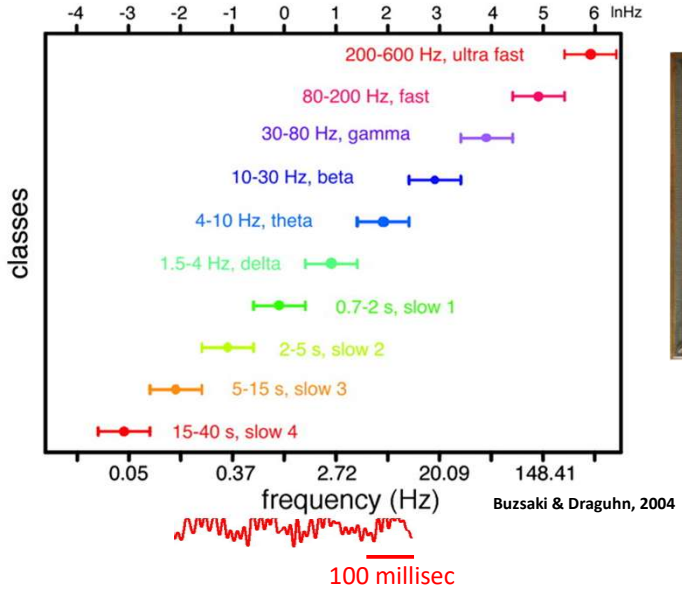
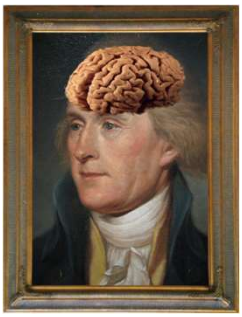


Neuronal Networks

Brain Rhythms

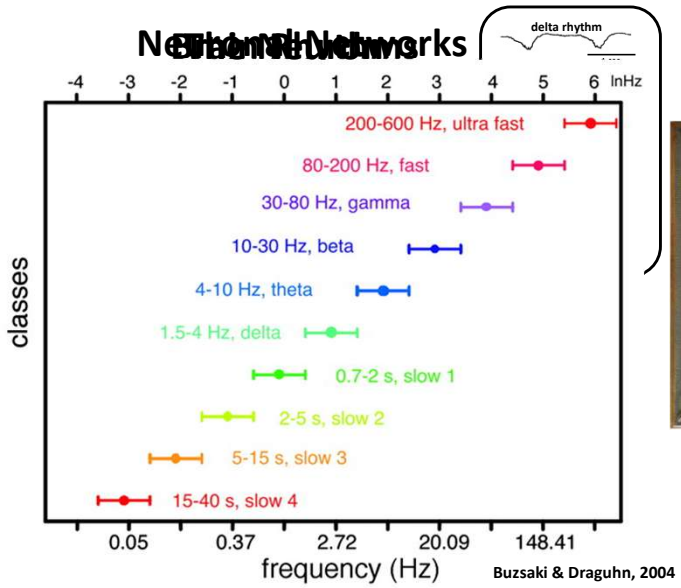


Buzsaki & Draguhn, 2004



100 millisec

Neuronal Networks



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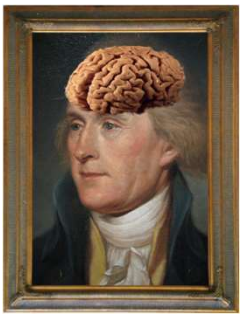
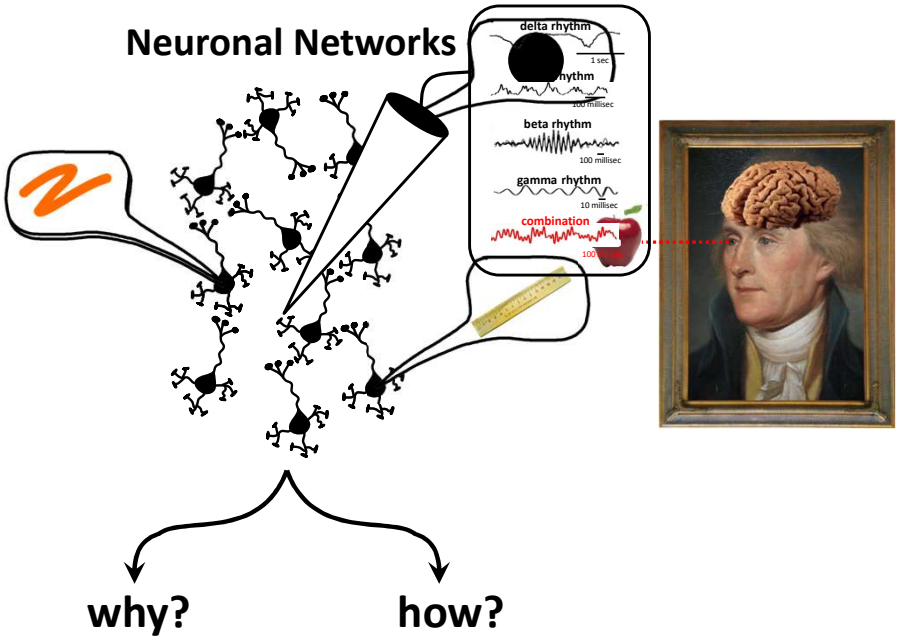


why? **how?**

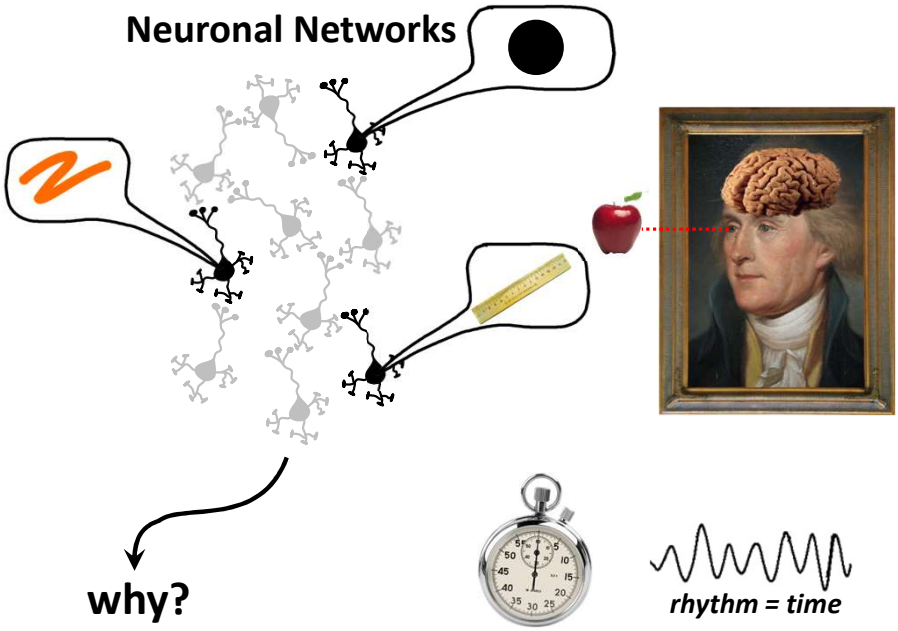
Neuronal Networks



why?

how?

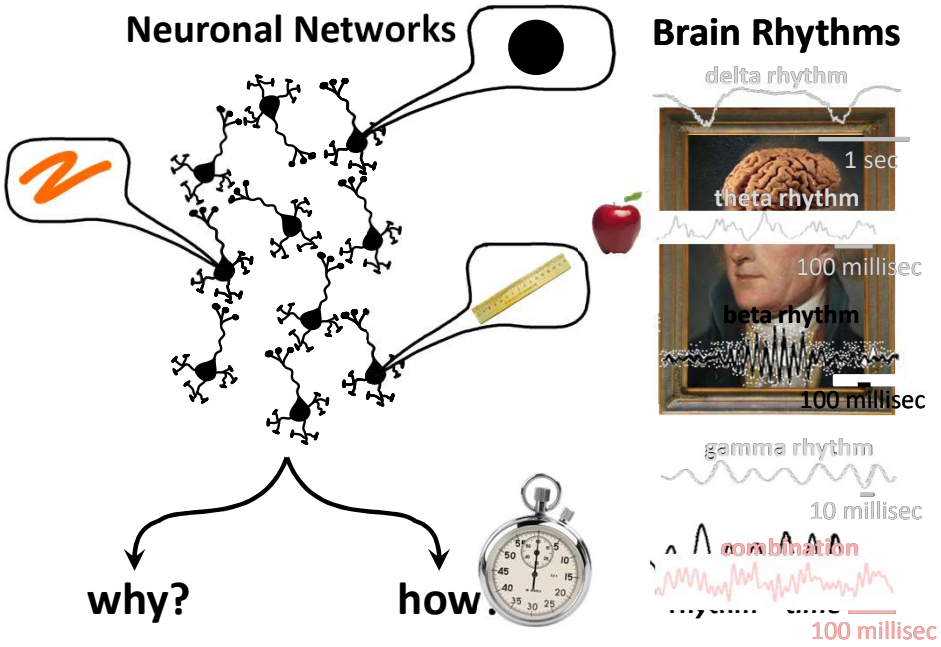
Neuronal Networks



why?

rhythm = time

Neuronal Networks

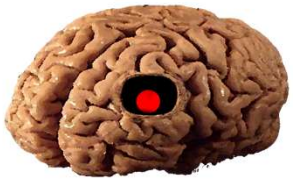


Neuronal Networks

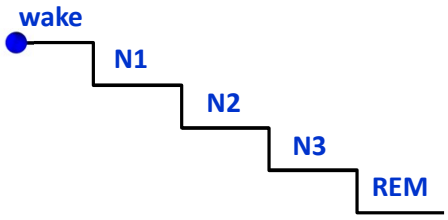
Neuronal Networks

Brain

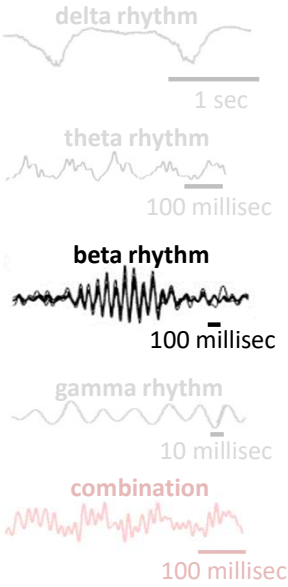
thalamus



Sleep Stages



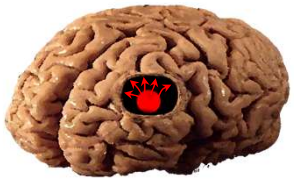
Brain Rhythms



Neuronal Networks

Brain

thalamus



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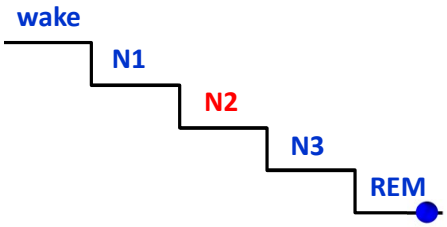

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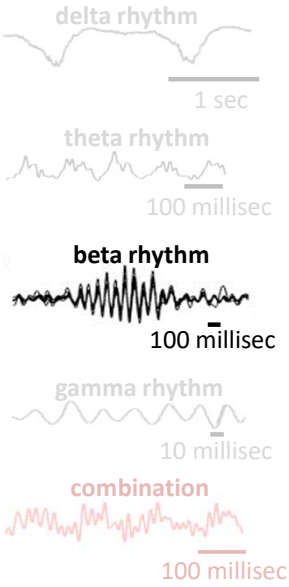
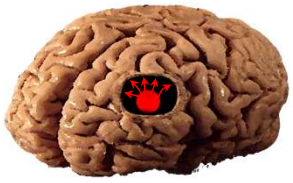


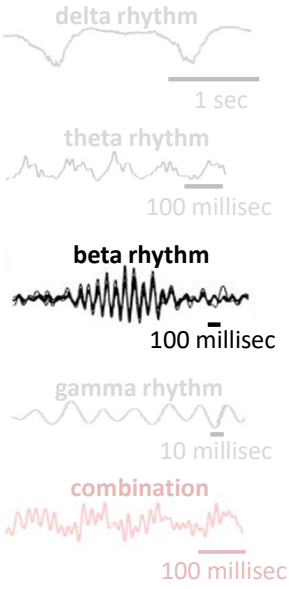
Neuronal Networks

Brain

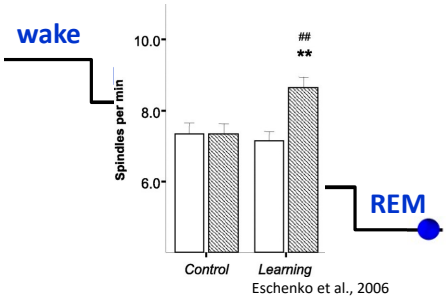
thalamus



Brain Rhythms



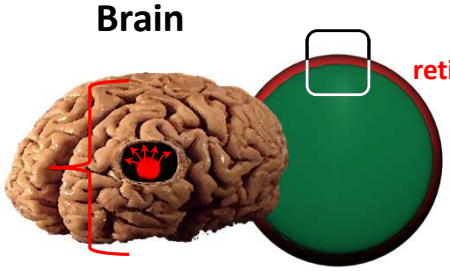
Sleep Spindles



Eschenko et al., 2006

Neuronal Networks

Brain

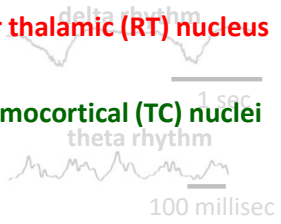


thalamus

reticular thalamic (RT) nucleus

thalamocortical (TC) nuclei

Brain Rhythms



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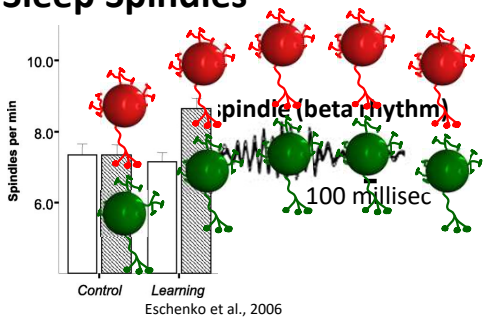

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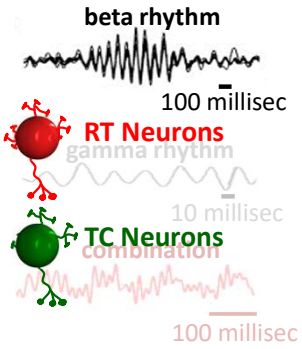
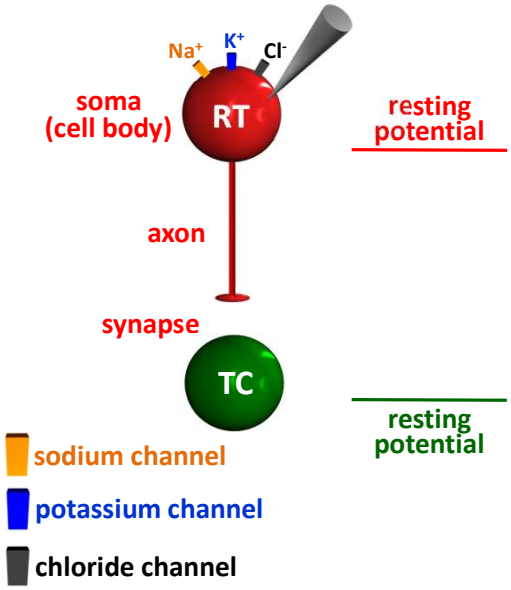


Spindle Circuit



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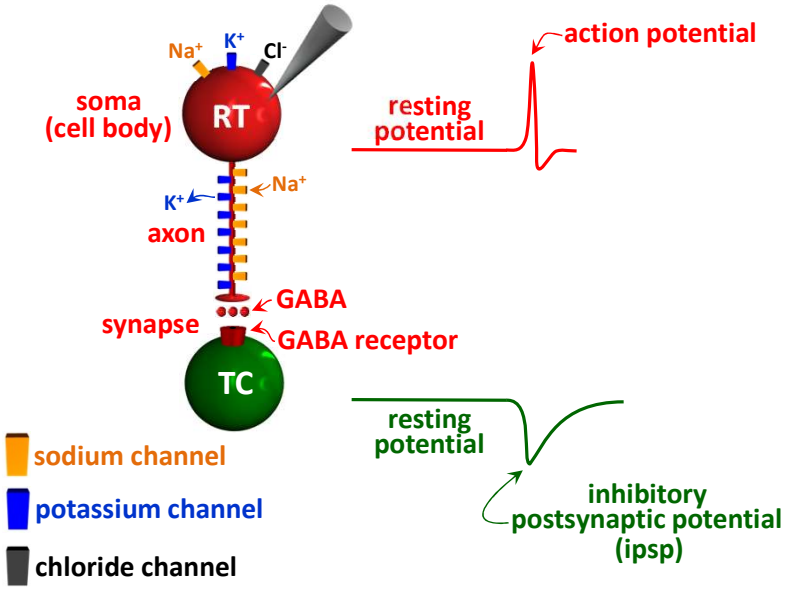

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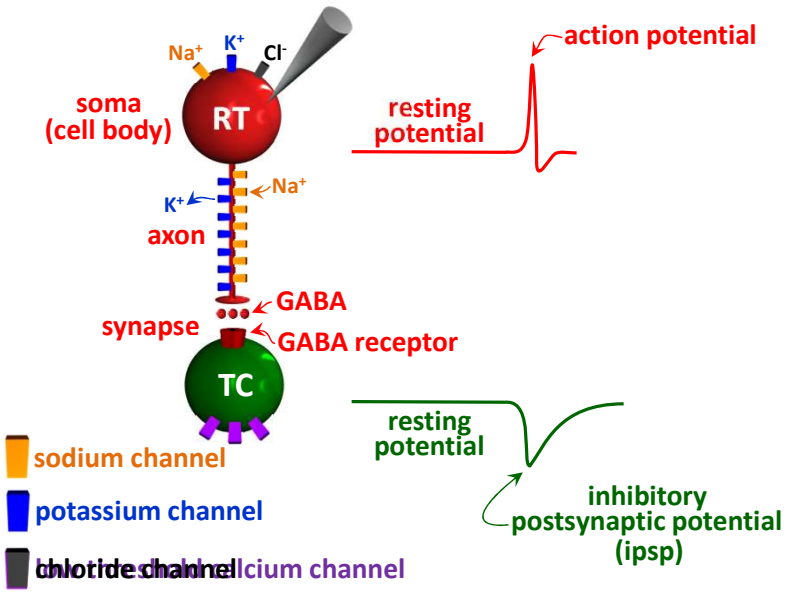

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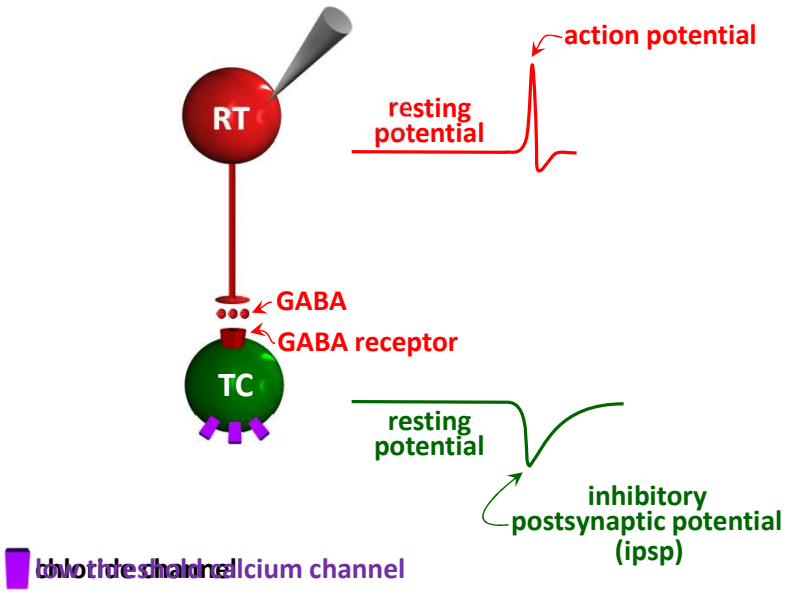
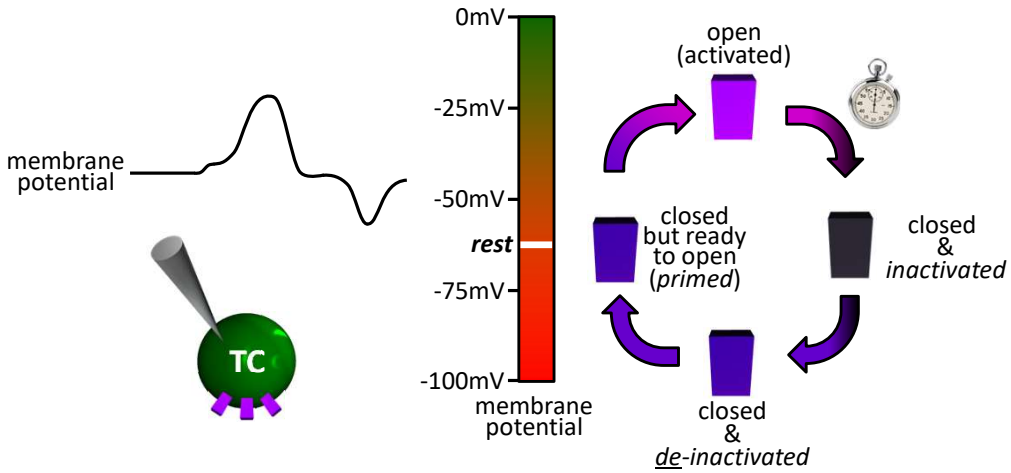


Low Threshold Calcium Channel



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.

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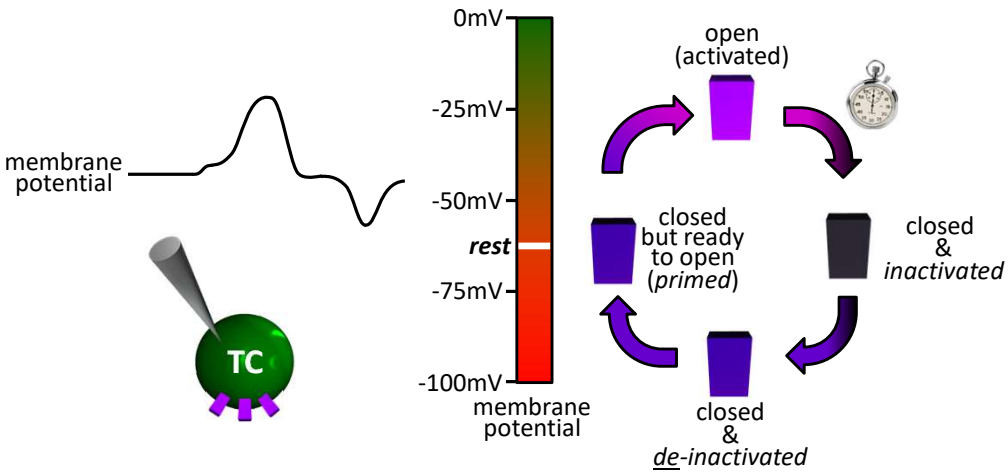

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Which Statement is True?

A. A de-inactivated L-T Ca^{2+} channel is open.

B. If depolarized, an inactivated L-T Ca^{2+} channel will open.

C. Hyperpolarization de-inactivates L-T Ca^{2+} channels.

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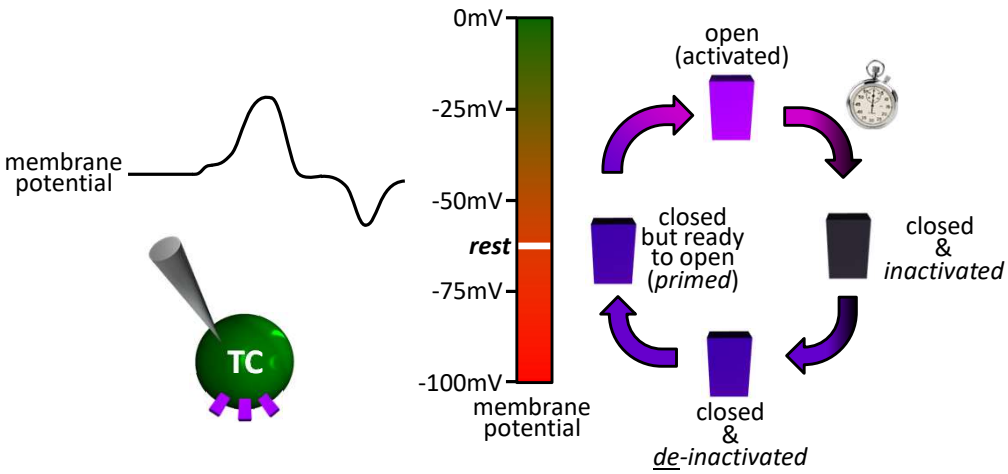

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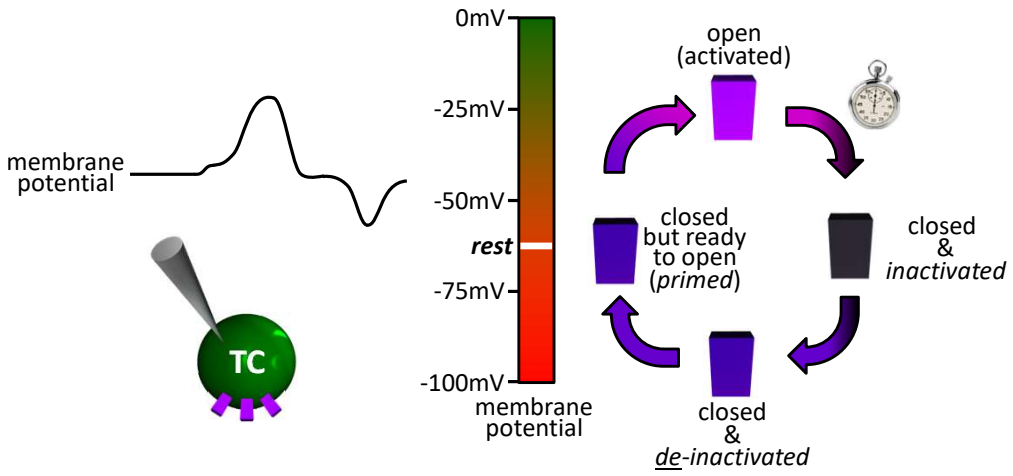
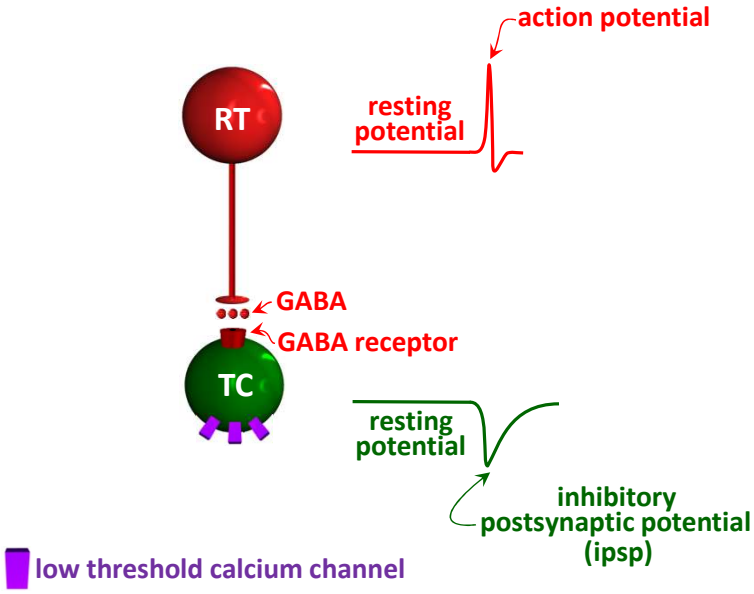


(brain.how)

Spindle Circuit



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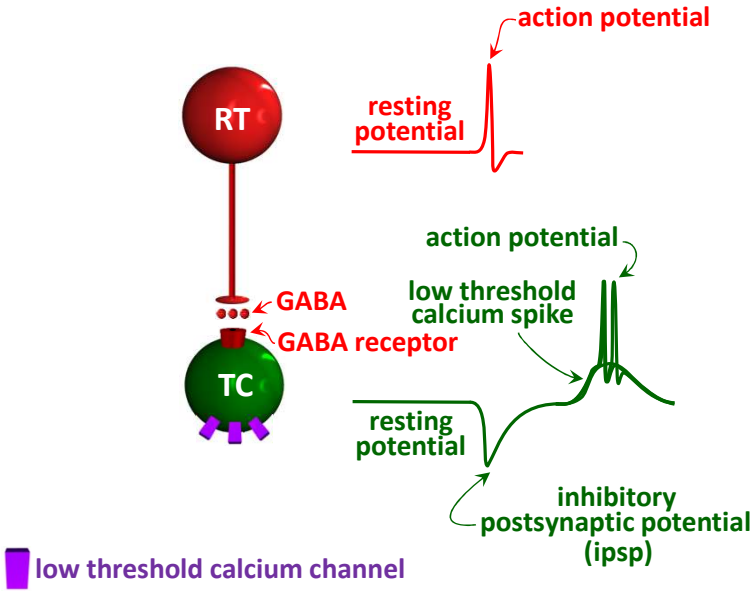

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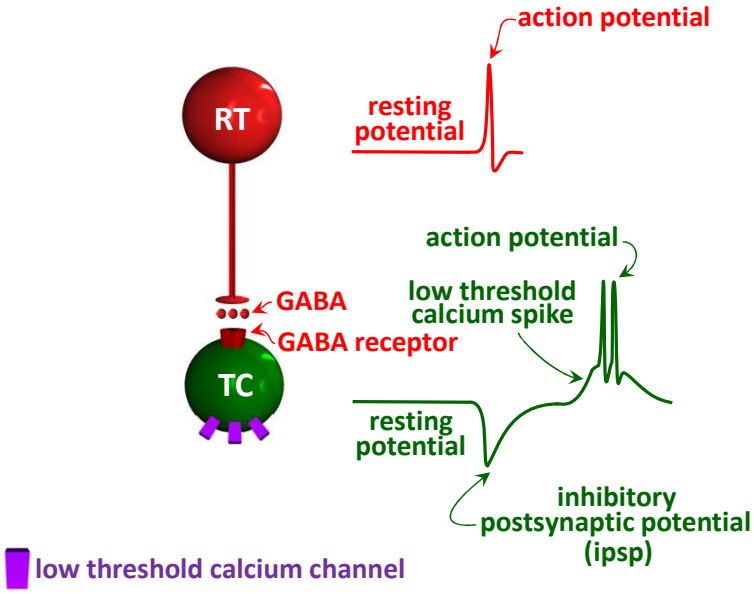

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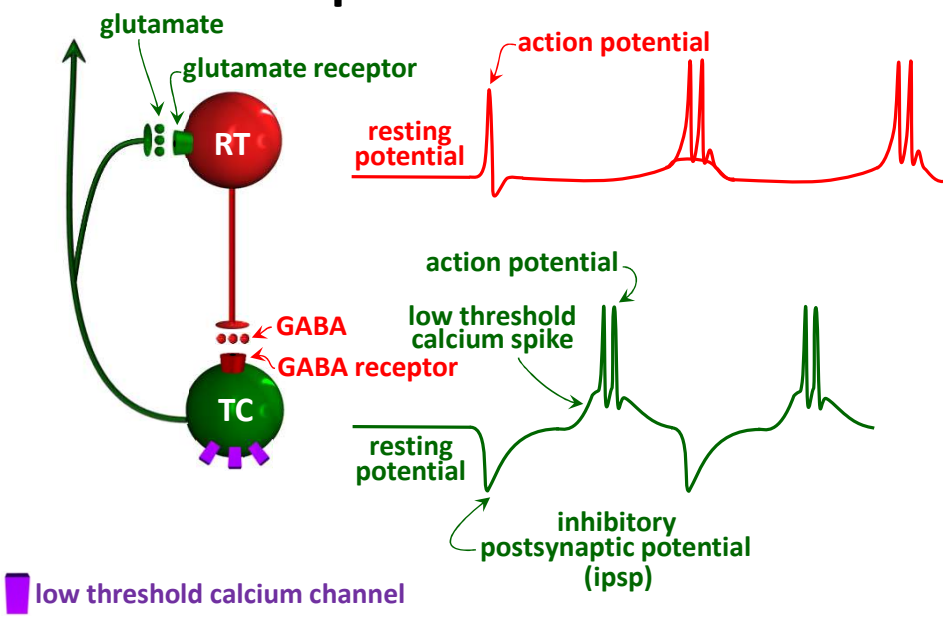

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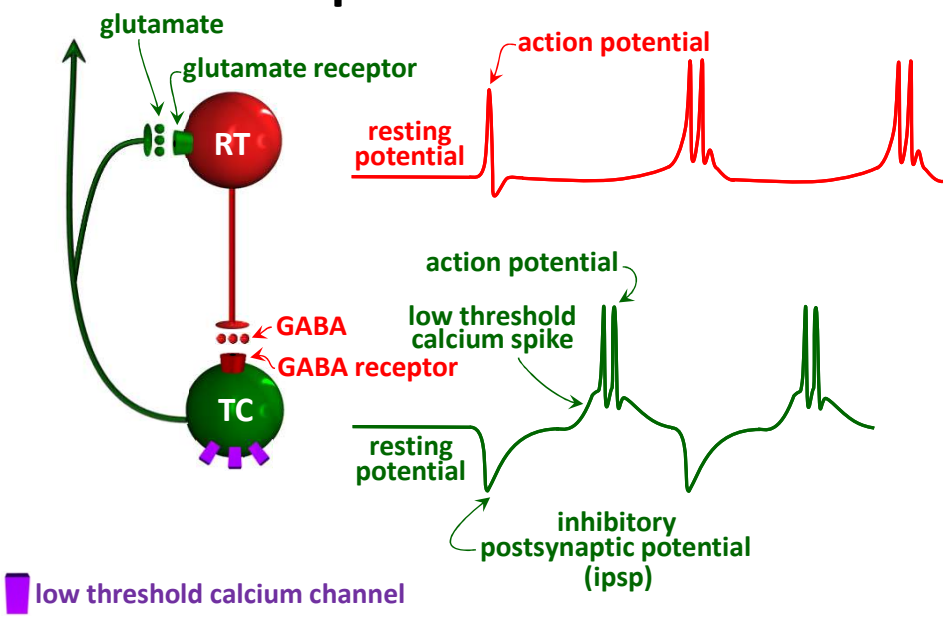


Which statement is the *most* true?:

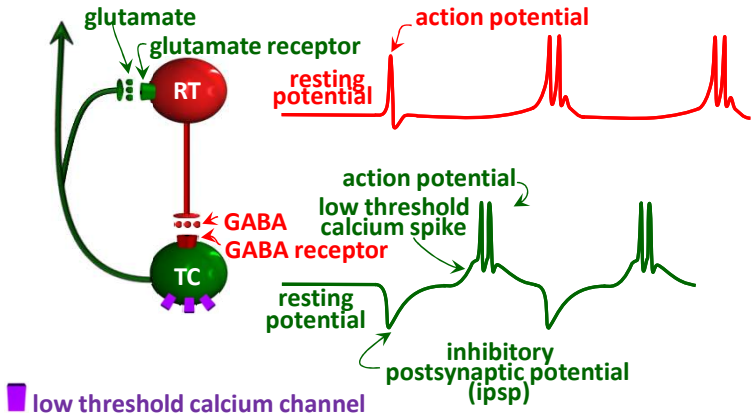
A. Neurons can turn on in response to excitation.

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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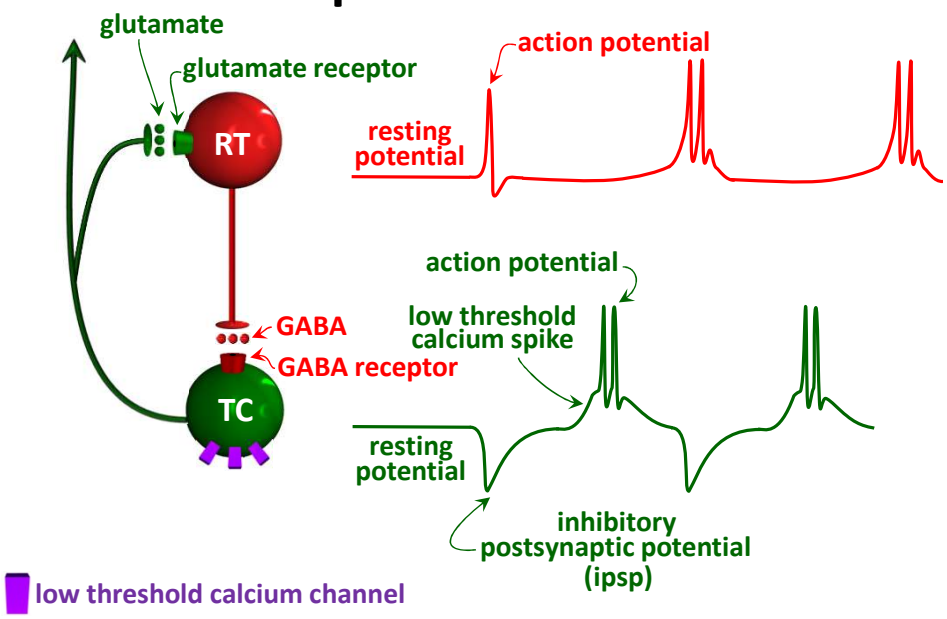
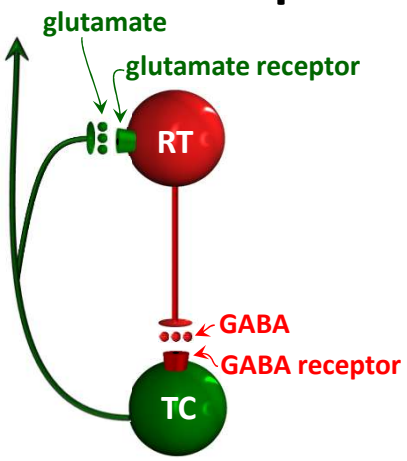
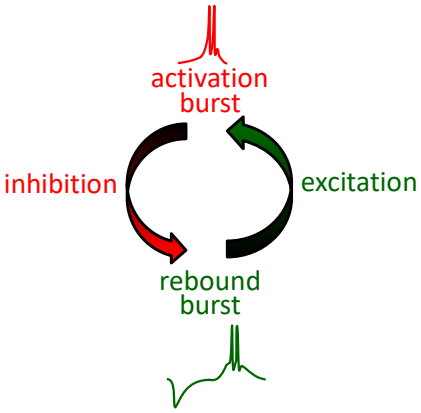


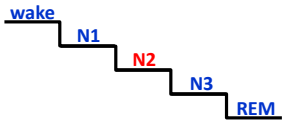
Spindle Circuit



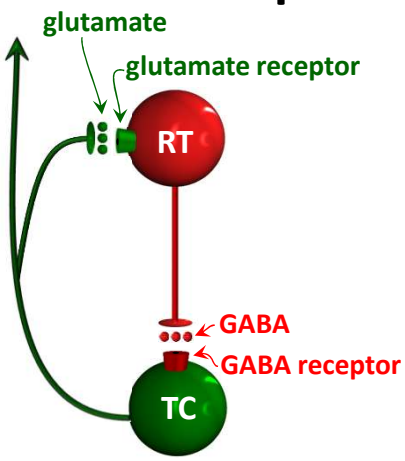


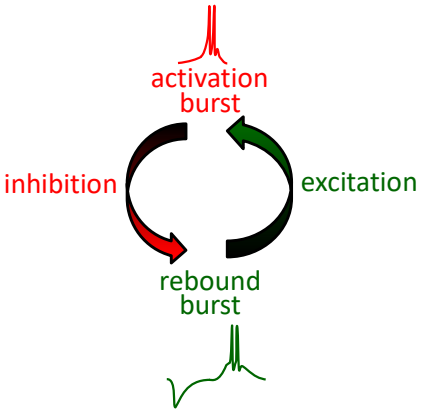
Sleep Spindle

Sleep



Spindle Circuit





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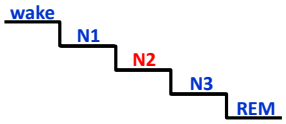

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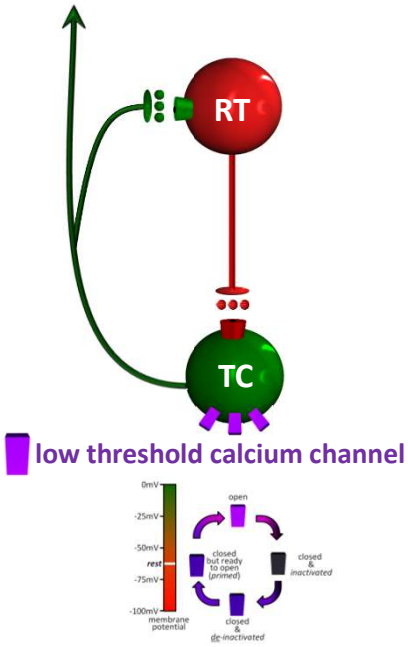
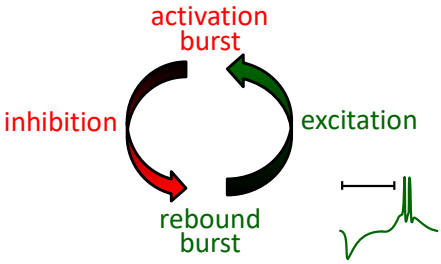
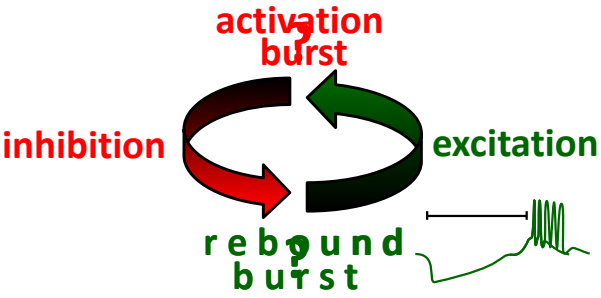
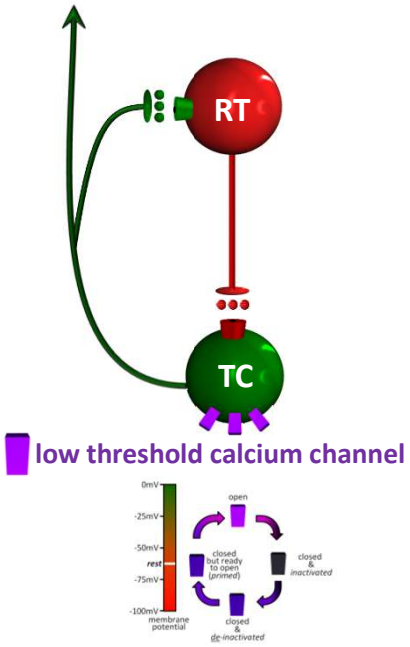
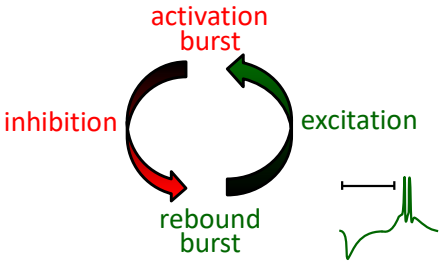


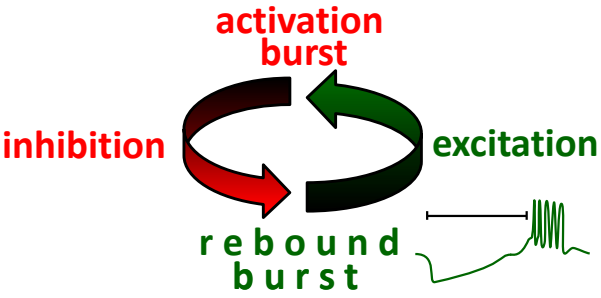




Spindle Circuit







Prolonged inhibition of thalamocortical (TC) neurons will cause:

A. Weaker TC firing activity *during* the inhibition.

B. Weaker TC firing activity *after* the inhibition.

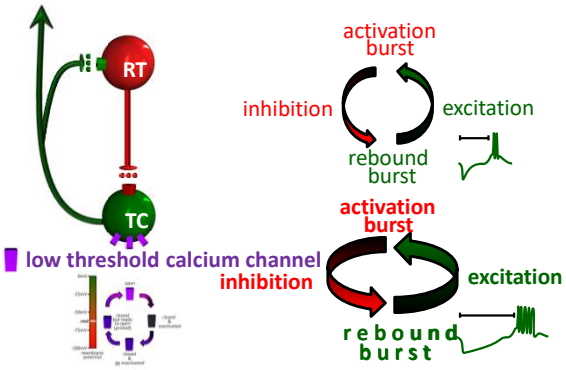
C. Stronger TC firing *during* the inhibition.

D. Stronger TC firing *after* the inhibition.

E. A & B.

F. A & D.

Spindle Circuit



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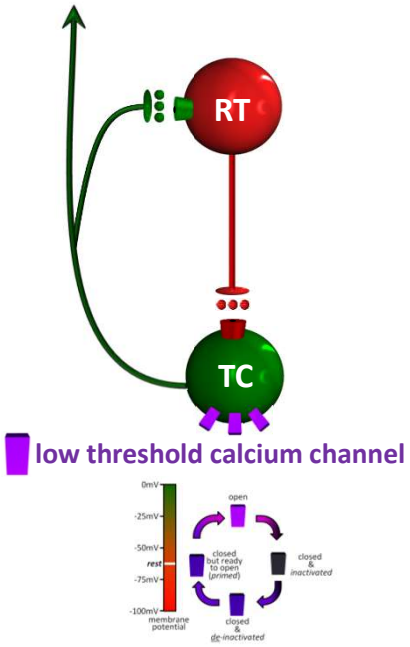
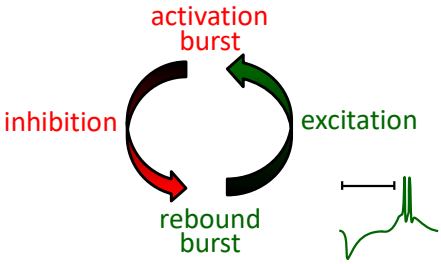
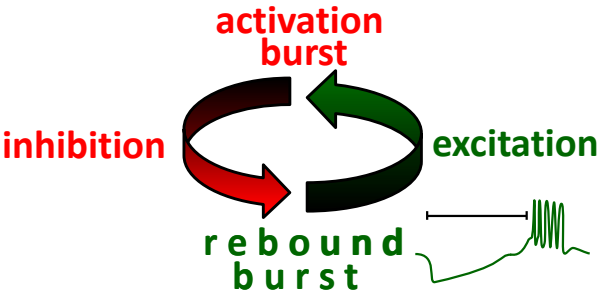
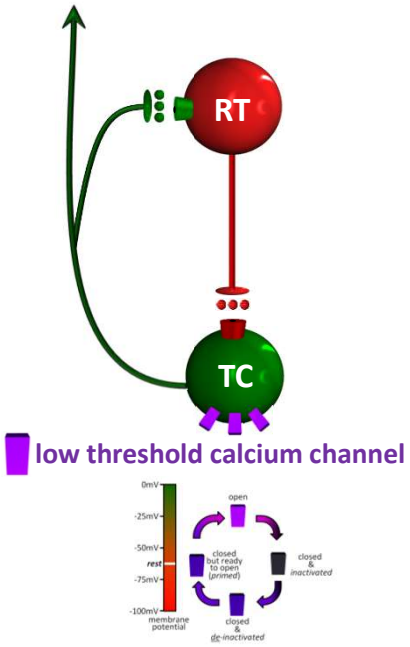
Spindle Circuit

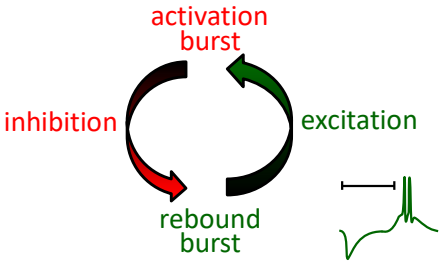


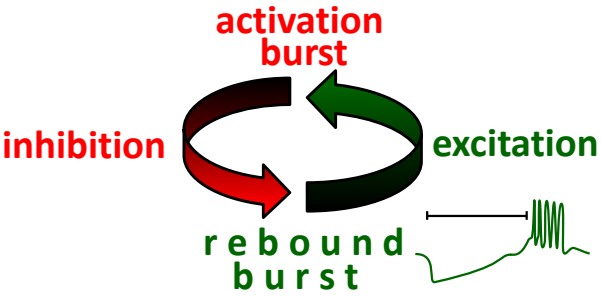




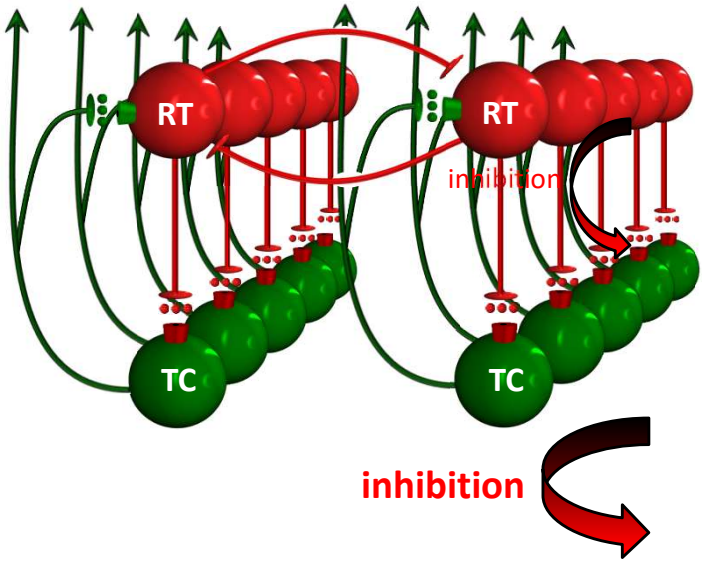
Spindle Circuit



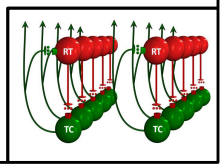




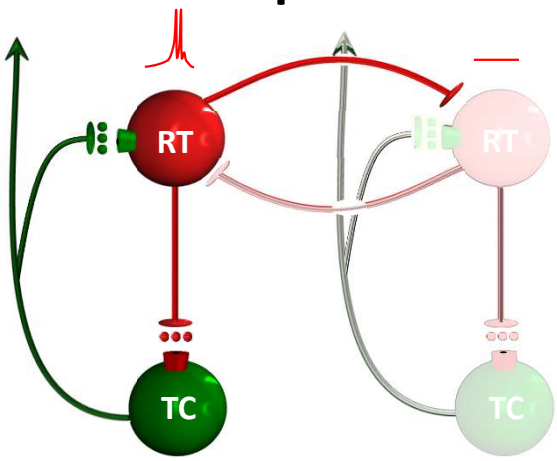
Spindle Circuit



inhibition



Spindle Circuit



Network

activation burst

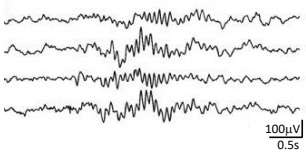
inhibition ⟲ excitation

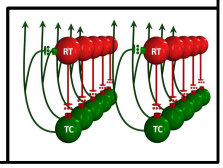
rebound burst

Sleep Spindle

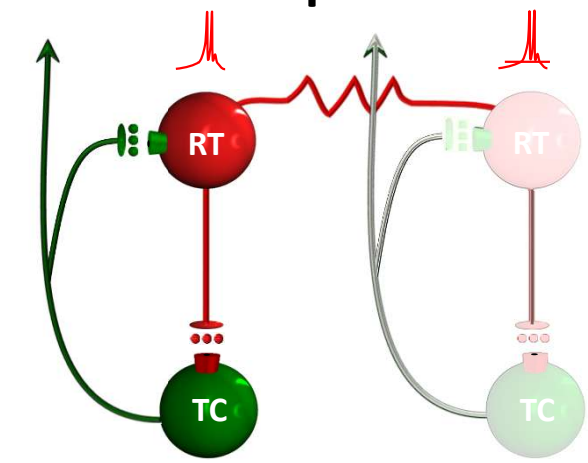
100 millisec

Sleep Spindle

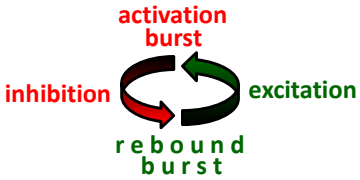




Spindle Circuit



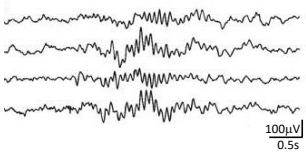
Network



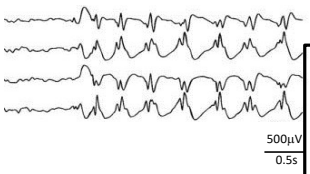
Sleep Spindle

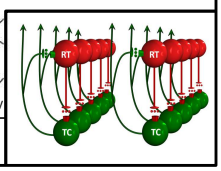
100 millisec

Sleep Spindle

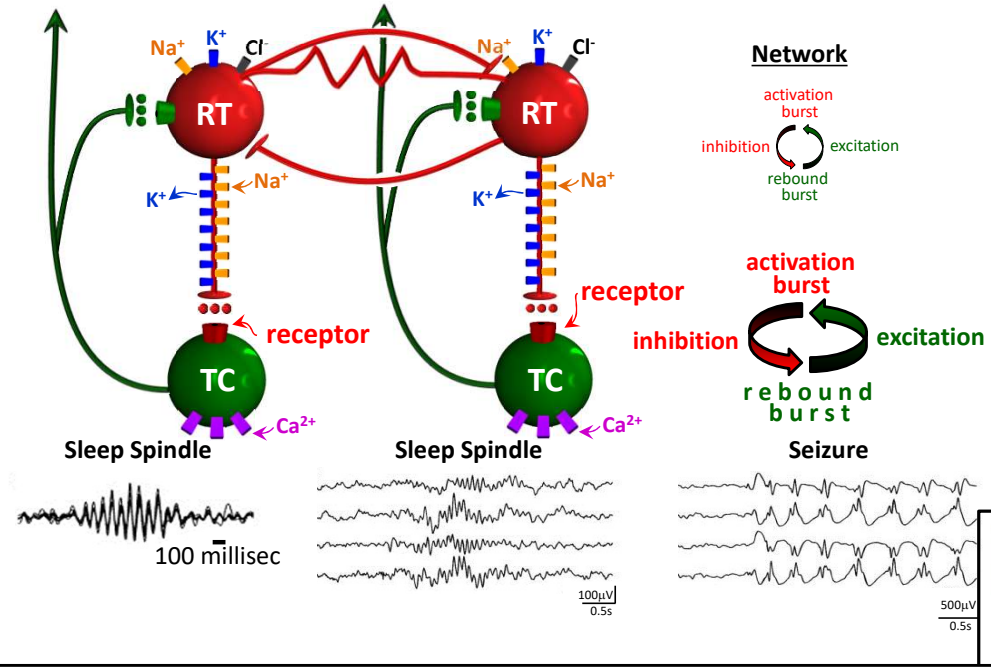


Seizure

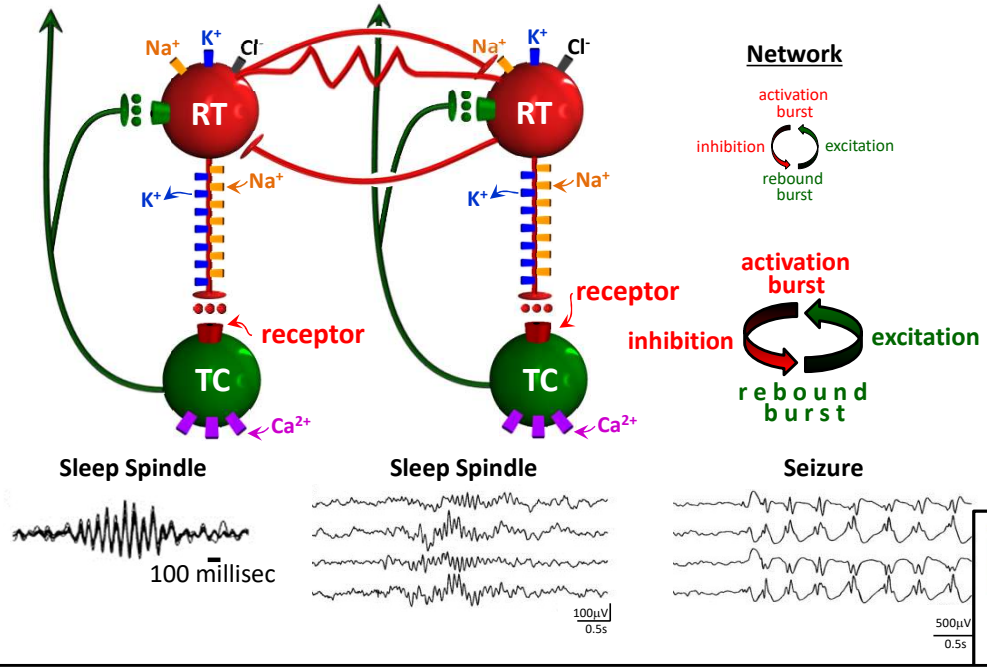




Spindle Circuit



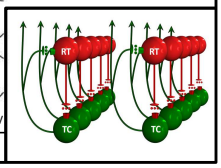
Spindle Circuit



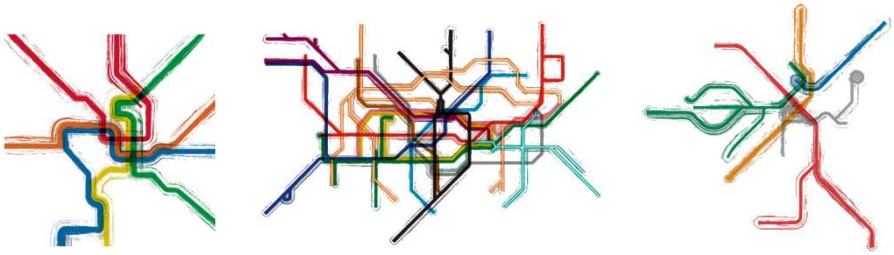
Sleep Spindle

Sleep Spindle

Seizure



Which one is Boston?:



Neuronal Networks: Summary