Chap. 7. Sleep

Arousal

Constant dialogue with the outside world
Different levels of arousal
    sleep, arousal, and higher arousal
Measuring arousal states
    1875 Richard Caton: electrical activity in the animal brains
    1929 Hans Berger: electrical current in the human brain

Electroencephalography

electrical potentials amplified from scalp

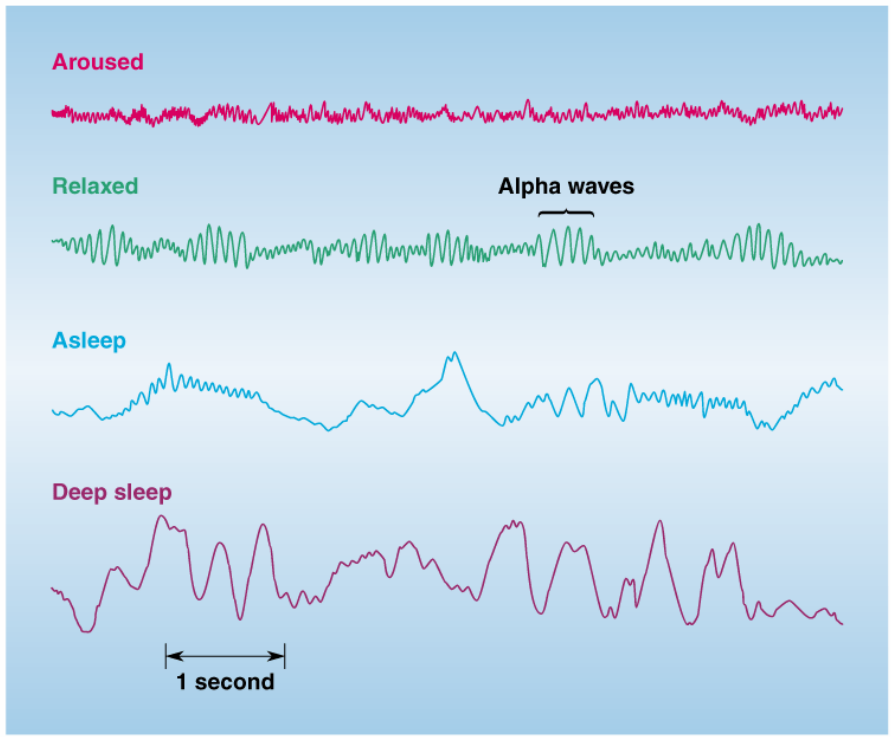
-high temporal resolution

-low spatial resolution

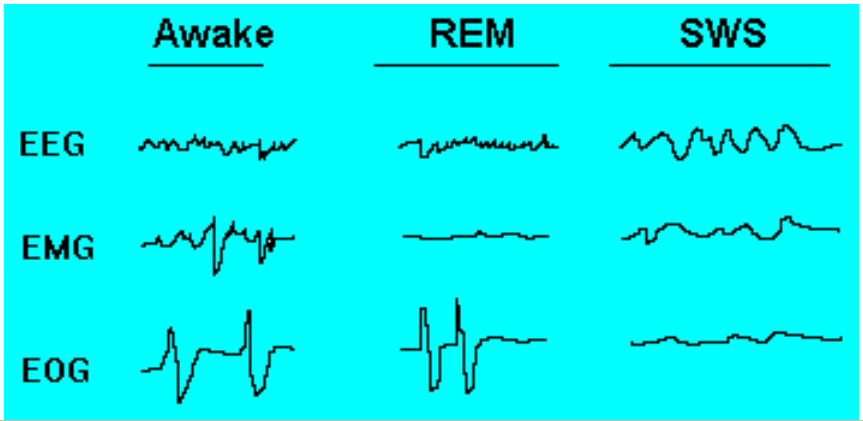
-cortical tissue only

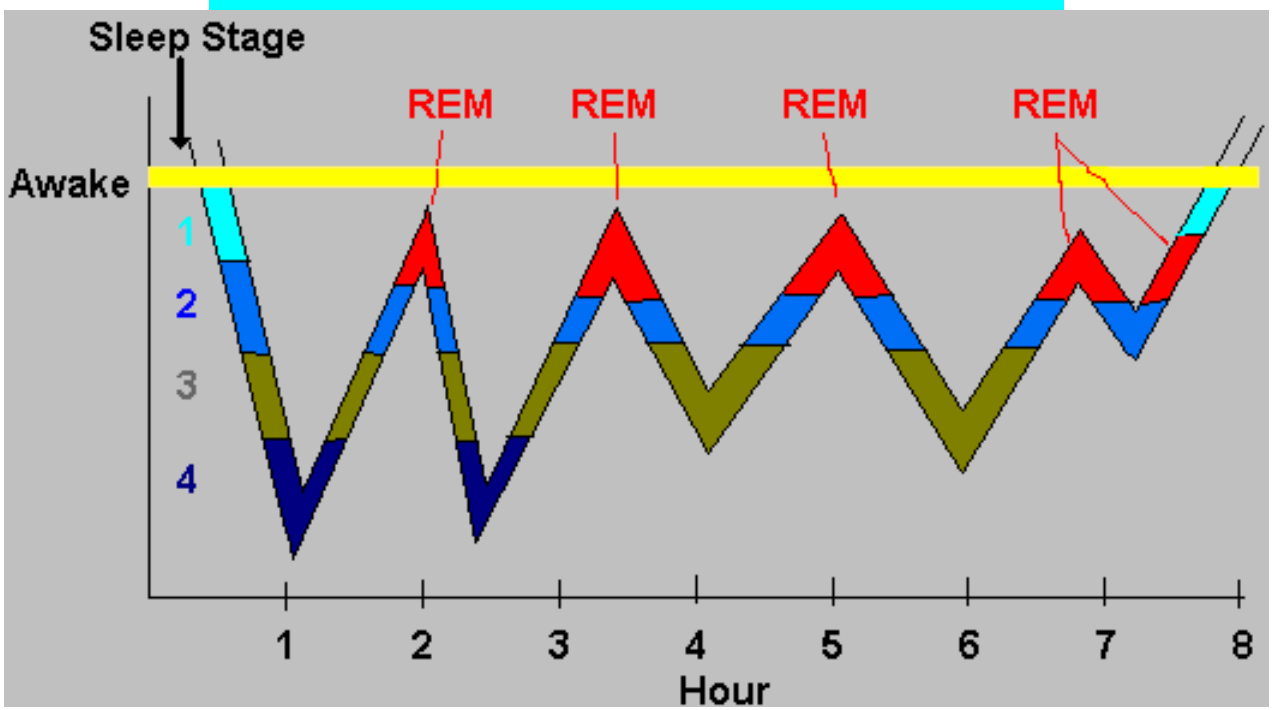
Electroencephalograghy (EEG) recording

► Typical EEGs



Sleep





http://www.univ.trieste.it/~brain/NeuroBiol/Neuroscienze%20per%20tutti/sleep.html

Why sleep?

Repair and Restoration Theory

sleep enables the body and brain to repair itself after working hard all day

going without sleep causes people to be irritable, dizzy, and to have hallucinations and impaired concentration
sleep-deprived rats' bodies work harder
BUT, how much we sleep does not depend on how much we worked that day

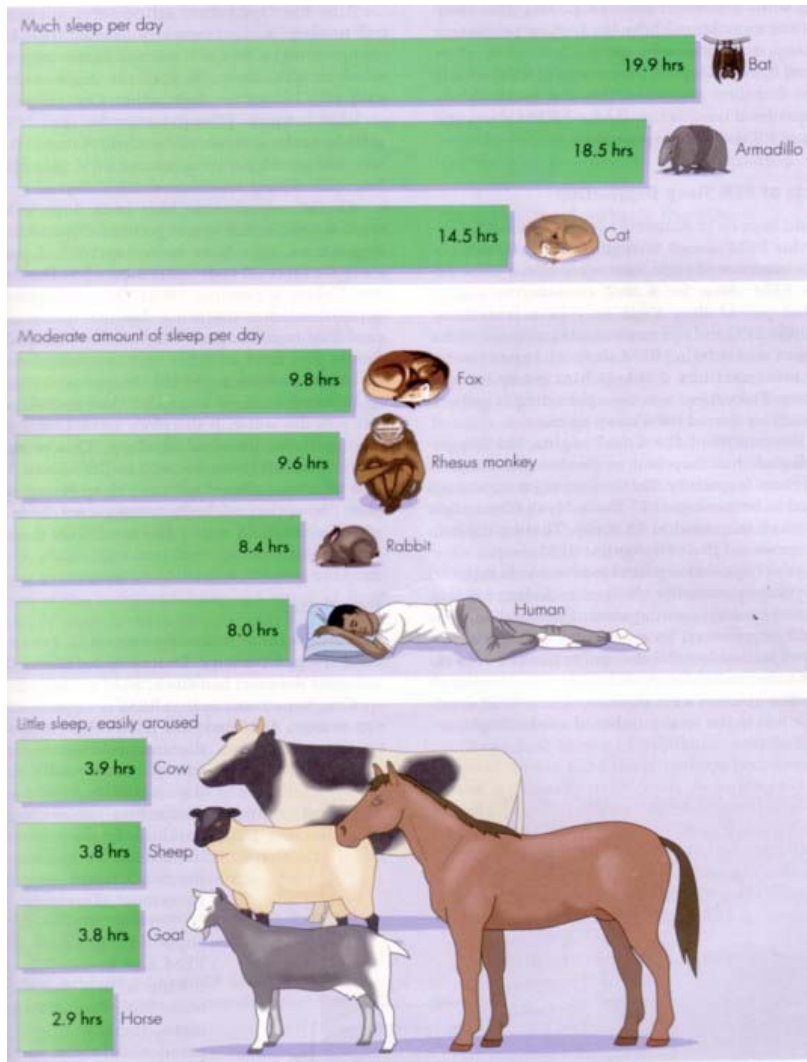
Evolutionary Theory

- we evolved to sleep so that we would conserve energy when we were least efficient

- during sleep body temperature decreases

- predicts that species will sleep different amounts depending on how much they must look for food and watch for predators

www.psy.fsu.edu/undergrad.prog/hull/Sleep.ppt



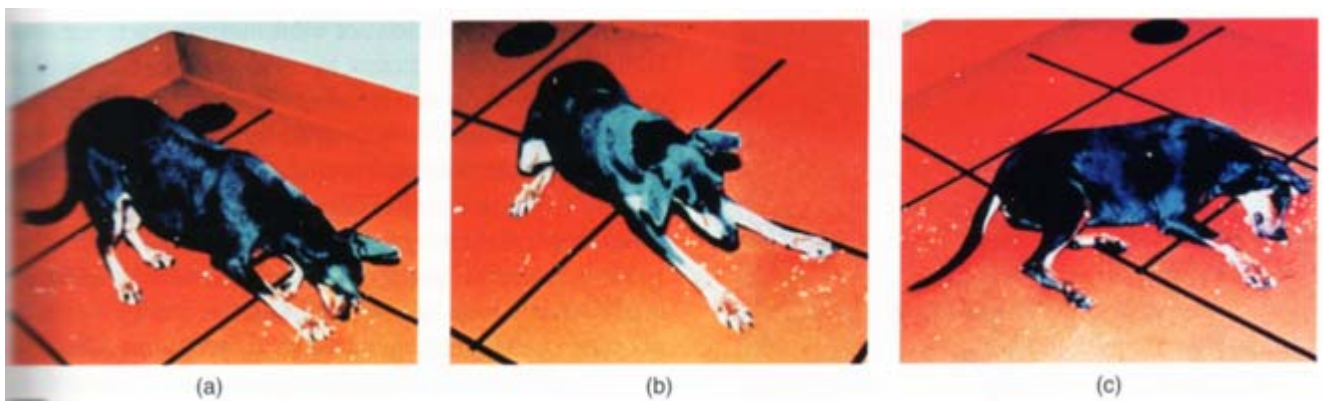
Sleep Disorders

Insomnia

- habitual sleeplessness
- possible causes: excessive noise, stress, drugs, medications, pain, uncomfortable temperature, sleep apnea, periodic limb movement disorder
- three forms: onset, maintenance, termination

Narcolepsy (기면발작) (cataplexy 탈력발작)

- Frequent, unexpected periods of sleepiness during the day
- affects about 1 in 1000 people
- symptoms: extreme daytime sleepiness, cataplexy, sleep paralysis, hypnagogic hallucinations
- involvement of orexin



Sleep Disorders

Night Terrors

- experience of intense anxiety from which a person awakens screaming in terror
- occur during nonREM sleep
- more common in children

Sleep Walking

- occurs mostly in children
- runs in families
- expressed early in the night during stage 3 and 4 sleep

Dreaming during REM sleep
Why do we dream?

Play around?
Any benefit?

compensation of REM sleep

REM sleep decrease during childhood

consolidation or resolving of experiences: but fetus also dream

A type of consciousness resulting from a less vigorous dialogue between brain regions

underdeveloped brain

prevailing chemicals in the brain: schizophrenic

failure of processing large amounts of sensory input during asleep

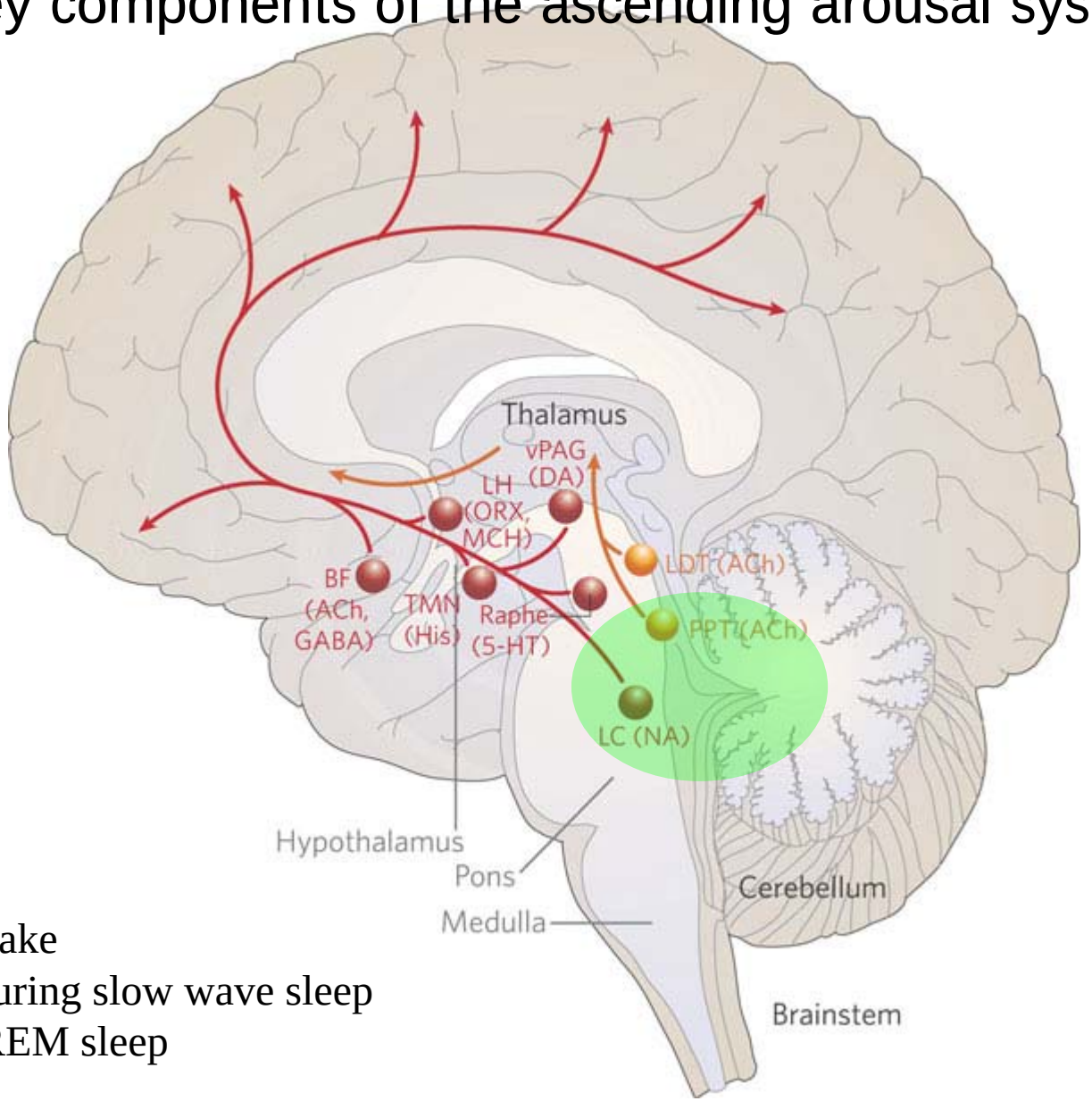
high protein synthesis during sleep

Regulation of sleep

in nonhuman animals: pineal gland is important for sleeping, melatonin secretion

in human controlled by a variety of factors

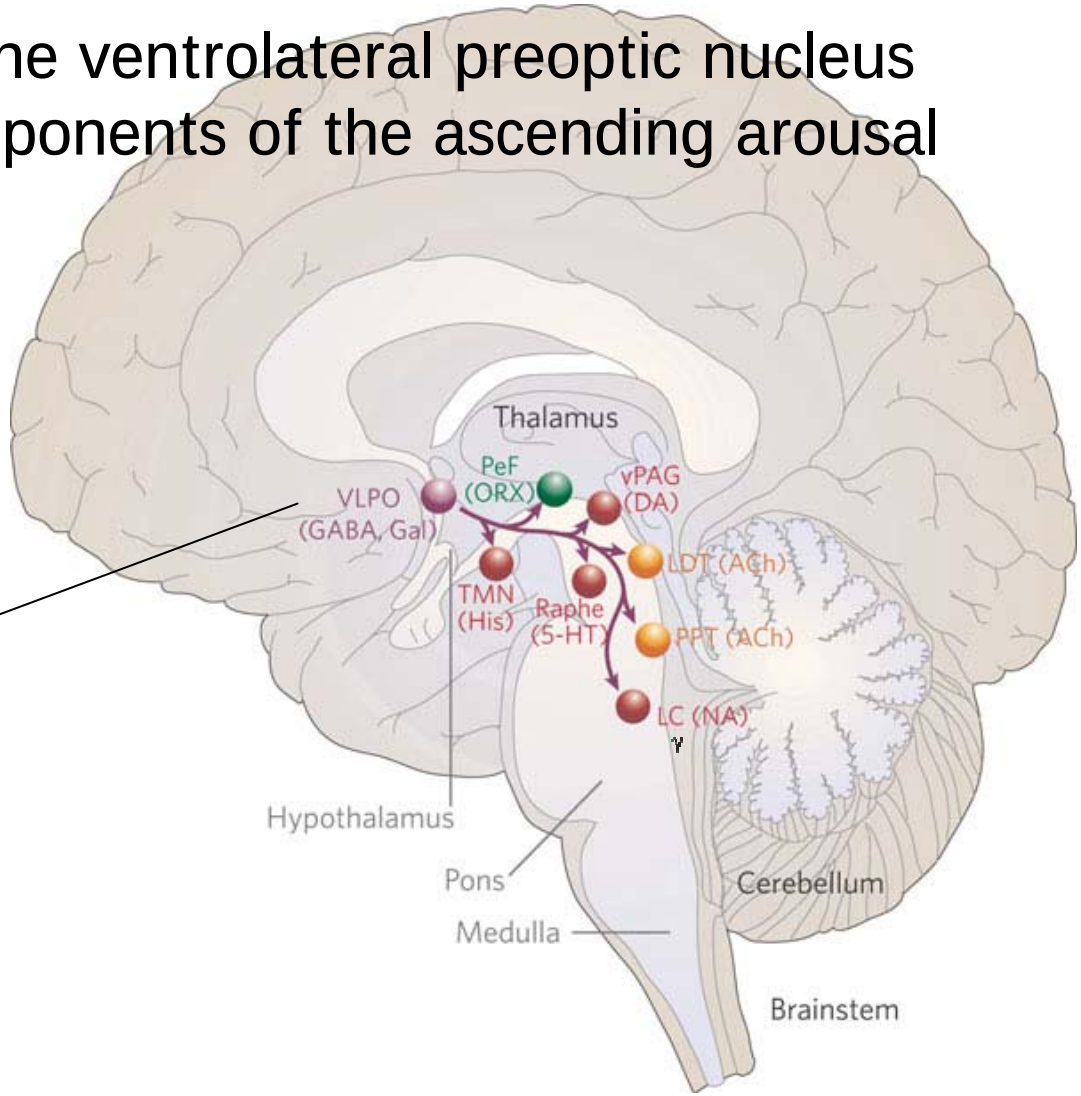
Some key components of the ascending arousal system



Fire during wake
Slow down during slow wave sleep
Stop during REM sleep

Nature **437**, 1257-1263 (27 October 2005)

The key projections of the ventrolateral preoptic nucleus (VLPO) to the main components of the ascending arousal system

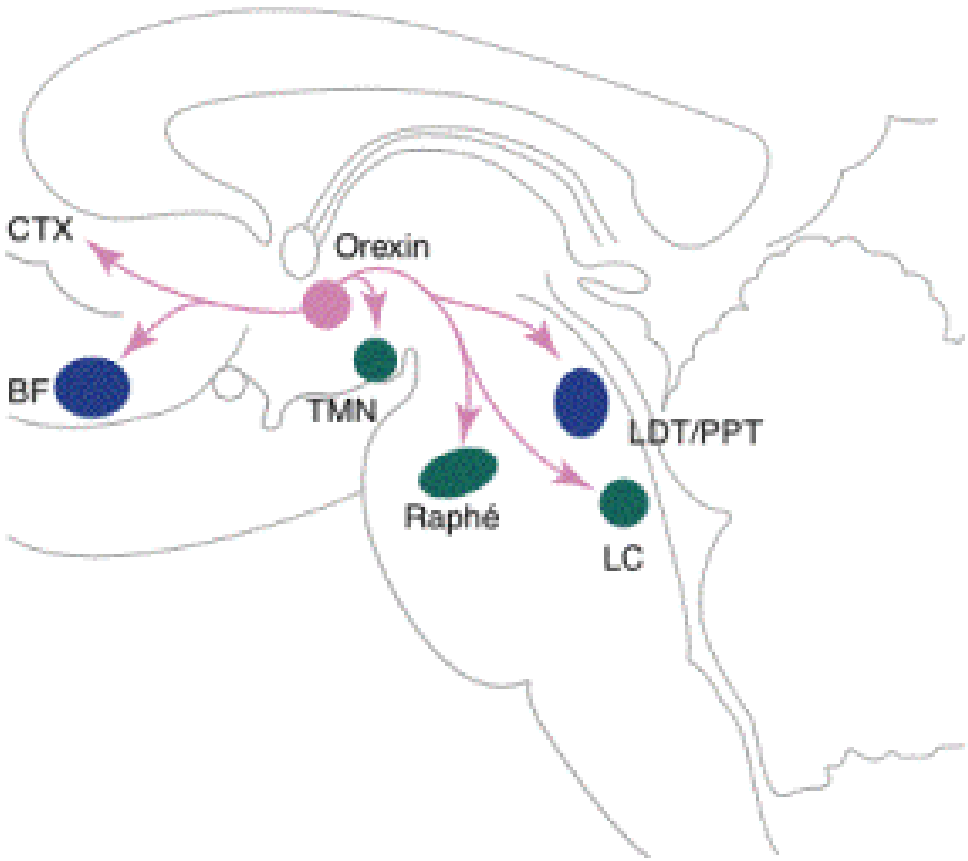


Turn off arousal system, causing sleep
If damaged, irreversible insomnia

It includes the monoaminergic cell groups (red) such as the tuberomammillary nucleus (TMN), the A10 cell group, the raphe cell groups and the locus coeruleus (LC). It also innervates neurons in the lateral hypothalamus (LHA; green), including the perifornical (PeF) orexin (ORX) neurons, and interneurons in the cholinergic (ACh) cell groups (yellow), the pedunculopontine (PPT) and laterodorsal tegmental nuclei (LDT). Note that the VLPO neurons lie within the region outlined by von Economo for the anterior hypothalamic lesion that caused insomnia. 5-HT, serotonin; GABA, -aminobutyric acid; gal, galanin; NA, noradrenaline; His, histamine.

Orexin neuron in hypothalamus promotes wakefulness

- Suppresses REM sleep
- Excitatory signal to the arousal system
- KO mice was narcoleptic
- Abnormal receptor in narcoleptic dogs



Two main signals control our need for sleep and its circuitry

Homeostasis:

ex. Adenosine accumulation during wake: energy depletion

caffeine is an adenosine blocker

sleep debt

Body's circadian clock: the suprachiasmatic nucleus in the hypothalamus