Sleep

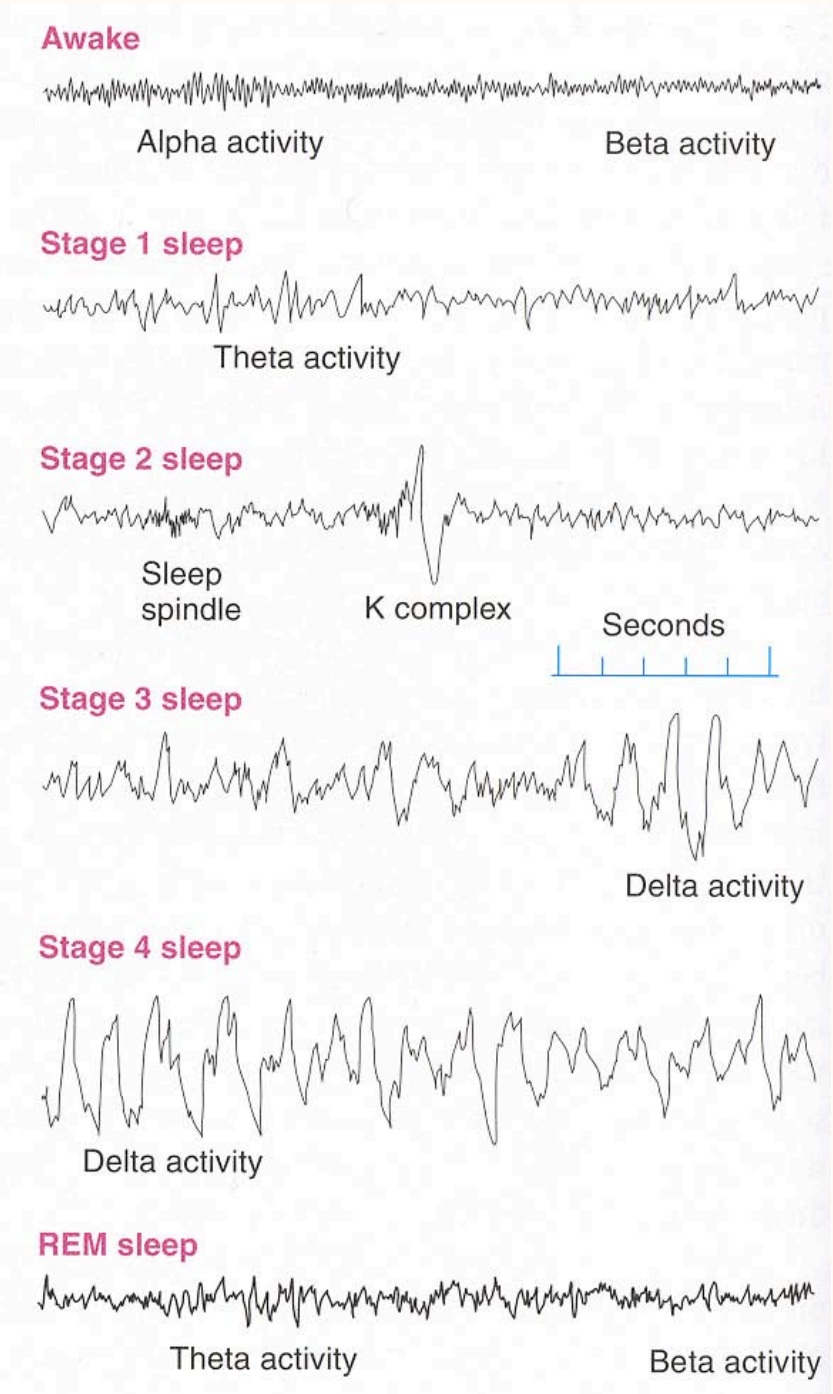
MY FINAL EXAM
is
MAY 27th at 08:30
CLH C & D

Carlson Ch 9


CLASSIC

Stages of sleep

- Awake – alpha activity, regular, medium frequency 8-12 Hz (more prevalent with eyes closed); beta activity, irregular, low amplitude 13-30 Hz
- Stage 1 sleep – theta activity 3.5-7.5 Hz – transition
- Stage 2 sleep – irregular, periods of theta, sleep spindles (short bursts at 12-14 Hz – maintenance of sleep), K-complexes (≈1 per minute)
- Stage 3 sleep – high amplitude delta >3.5 Hz
- Stage 4 sleep – 50% delta activity
- Stages 3 & 4 sleep - slow wave sleep

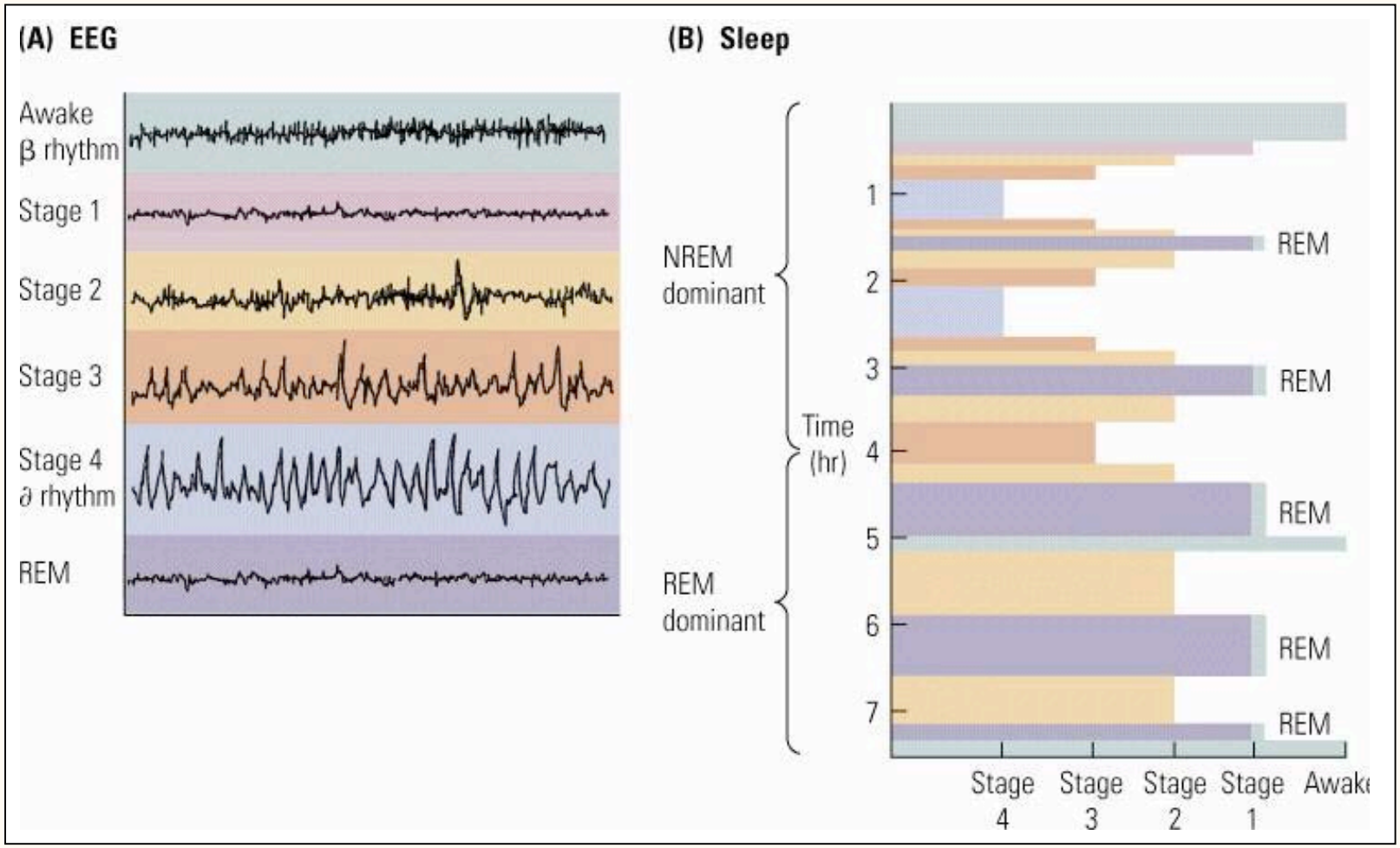


REM sleep

- desynchronized EEG, some theta, rapid eye movements
- body largely paralyzed

Sleep stages

- 90 minute cycle between REM and non-REM sleep



Dreaming

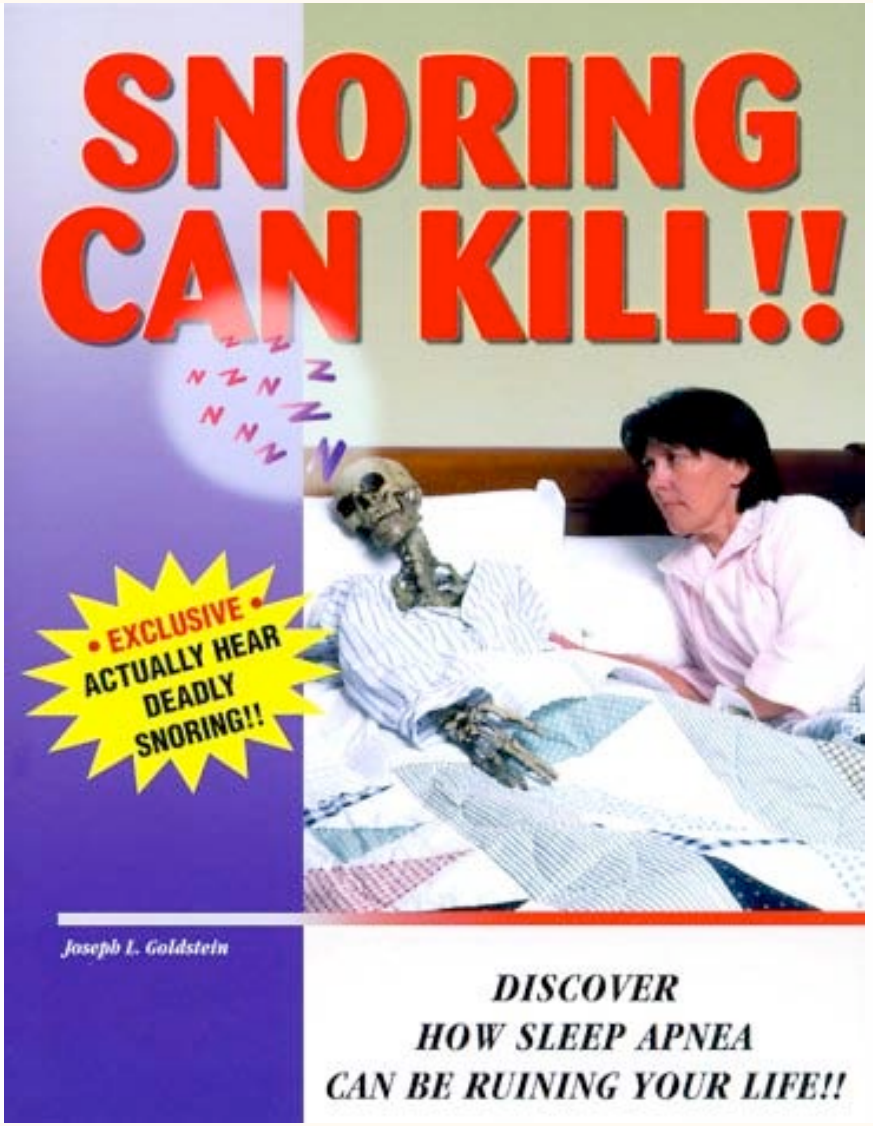
- increased cerebral blood flow to visual cortex and decreased to inferior frontal

decreased activity (decreased planning, sequencing of events)

increased activity (increased, vivid imagery)

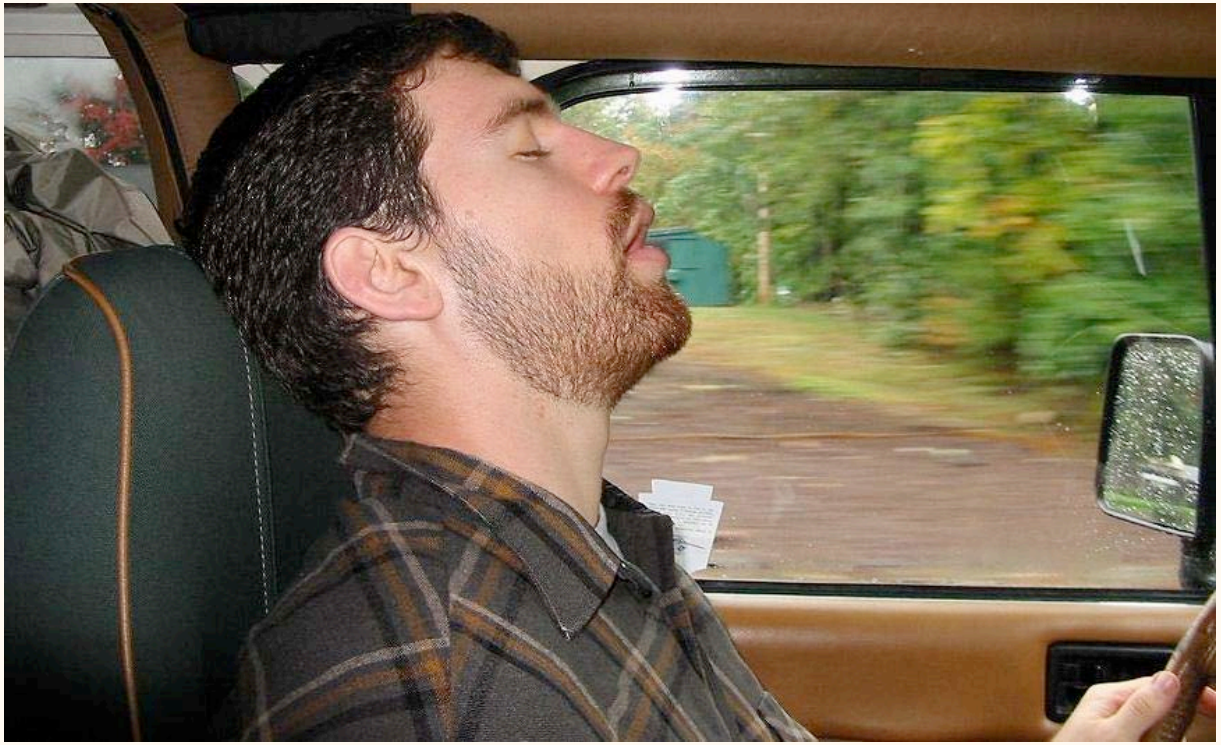
Sleep Disorders - Insomnia

- Margaret Thatcher (and Winston Churchill) slept only a few hours a night! Rainer Goebel = 3hrs
- underlying cause – insomnia is a symptom
- medication can be a curse – sleep medication hangover!
- sleep apnea – difficulty breathing while asleep (people who snore have brief periods of apnea)



Narcolepsy

- sleep attack – at inappropriate times
  (particularly during monotonous or boring conditions)
- ≈ 2 – 5 minutes
- cataplexy – falling to ground – dogs - hypocretin deficiency
- sleep paralysis and hypnagogic hallucinations – alien abduction?



REM sleep behaviour disorder

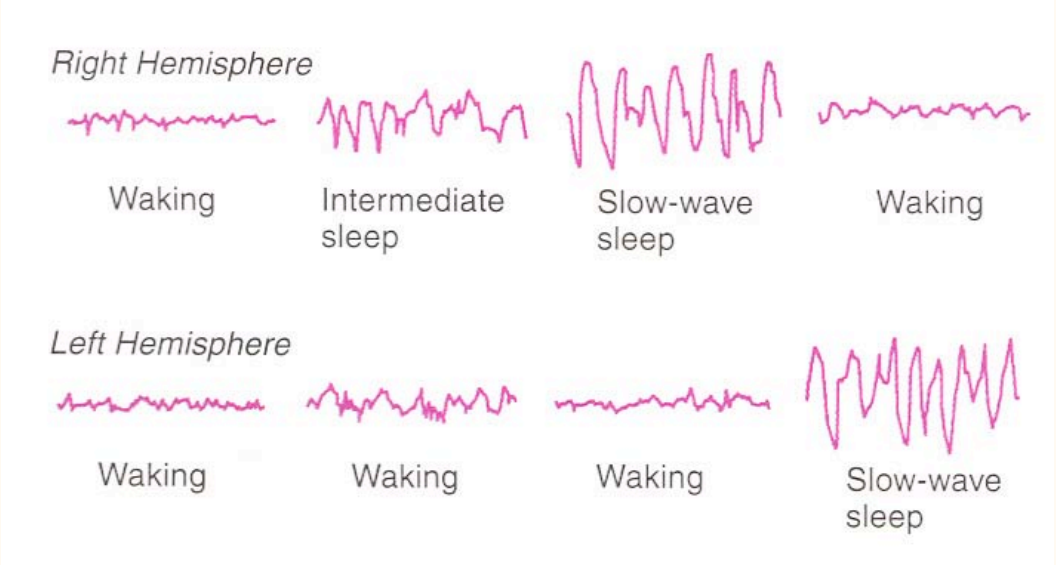
- acting out!
- can be quite dangerous – males dreaming their wives are being attacked will hit out at the attacker – sometimes hitting their wives!
- women do it too…
- failure to inhibit movement during REM

Slow-wave sleep

- usually during stage 4 sleep
- nocturnal enuresis – bedwetting
- somnambulism – sleep walking – different than REM sleep acting out
- pavor nocturnis – night terrors
- usually evident in childhood – resolve naturally

Why do we sleep?

- brain rest? why do cats need so much?
- only warm-blooded vertebrates exhibit REM
- necessary for survival? – Indus Dolphin. Deal with swift currents (sleep 7 hours a day but in 4 to 60s intervals)
- bottlenose dolphin & porpoise sleep one hemisphere at a time! presumably to keep one hemisphere alert

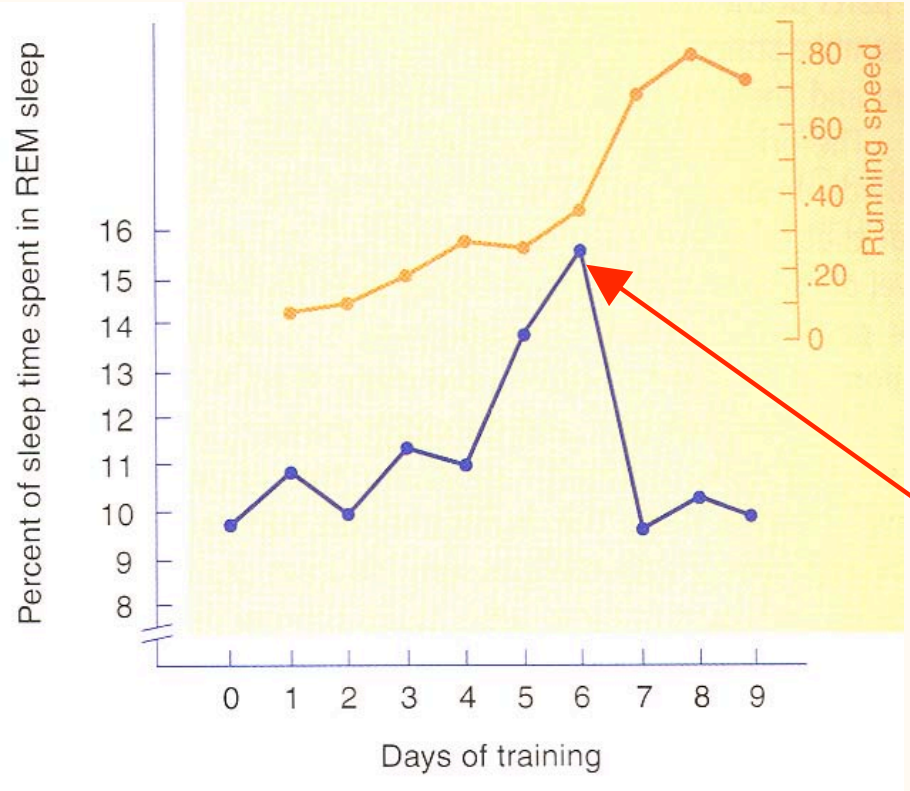


Sleep Deprivation

- similar to the effects of alcohol on cognition – decreased attention, speed of processing
- stage 4 and REM sleep most important
- no compelling relationship between amount of daily exercise and amount of sleep
- more mental activity does lead to greater levels of delta in specific brain regions

REM

- perhaps slow wave sleep is restorative but REM sleep is important for development (higher portion of REM during stages of development)
- consolidation OR clean up?

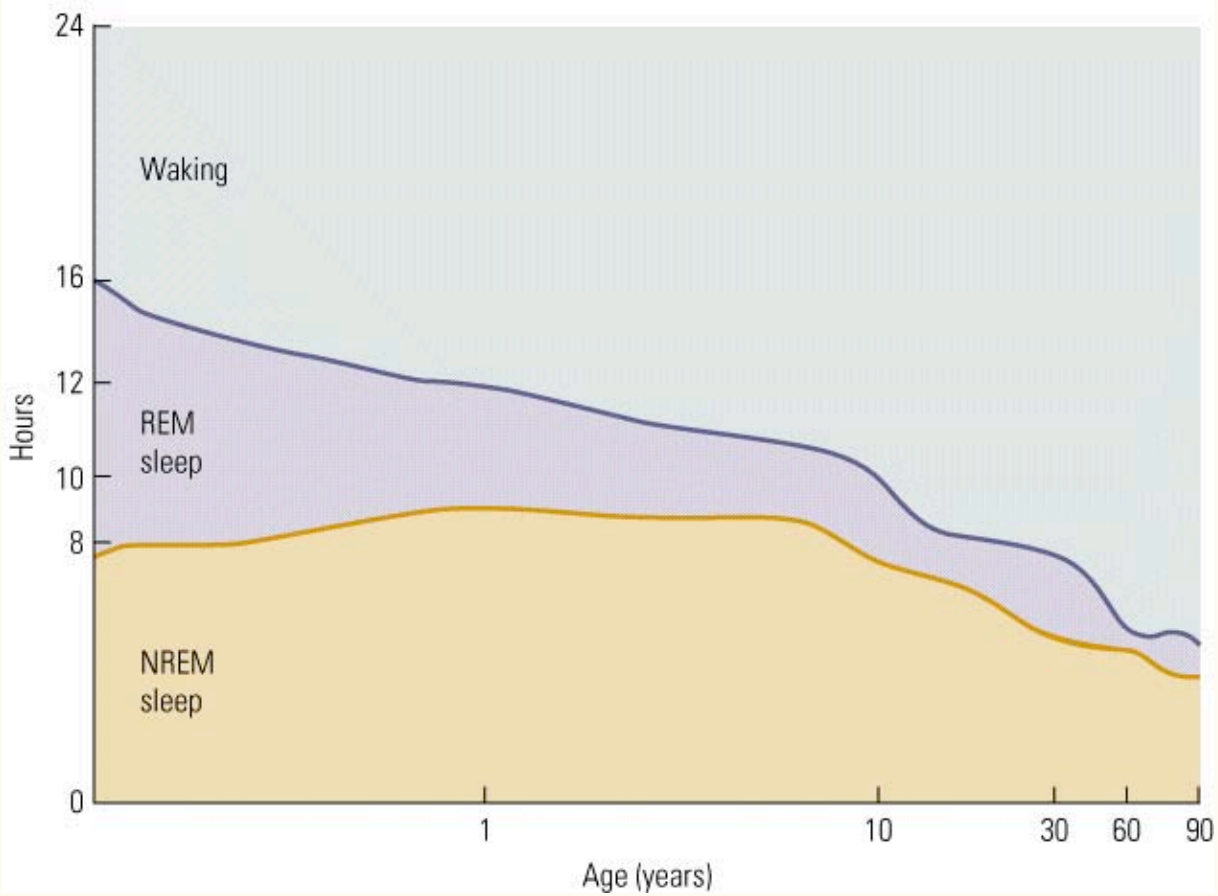


REM sleep increases during exam time! Don't deprive yourself!

Largest increase in REM sleep associated with largest increase in performance

Sleep over the life span

- in general we require less sleep as we get older
- the proportion of REM sleep needed also decreases



Physiological Mechanisms

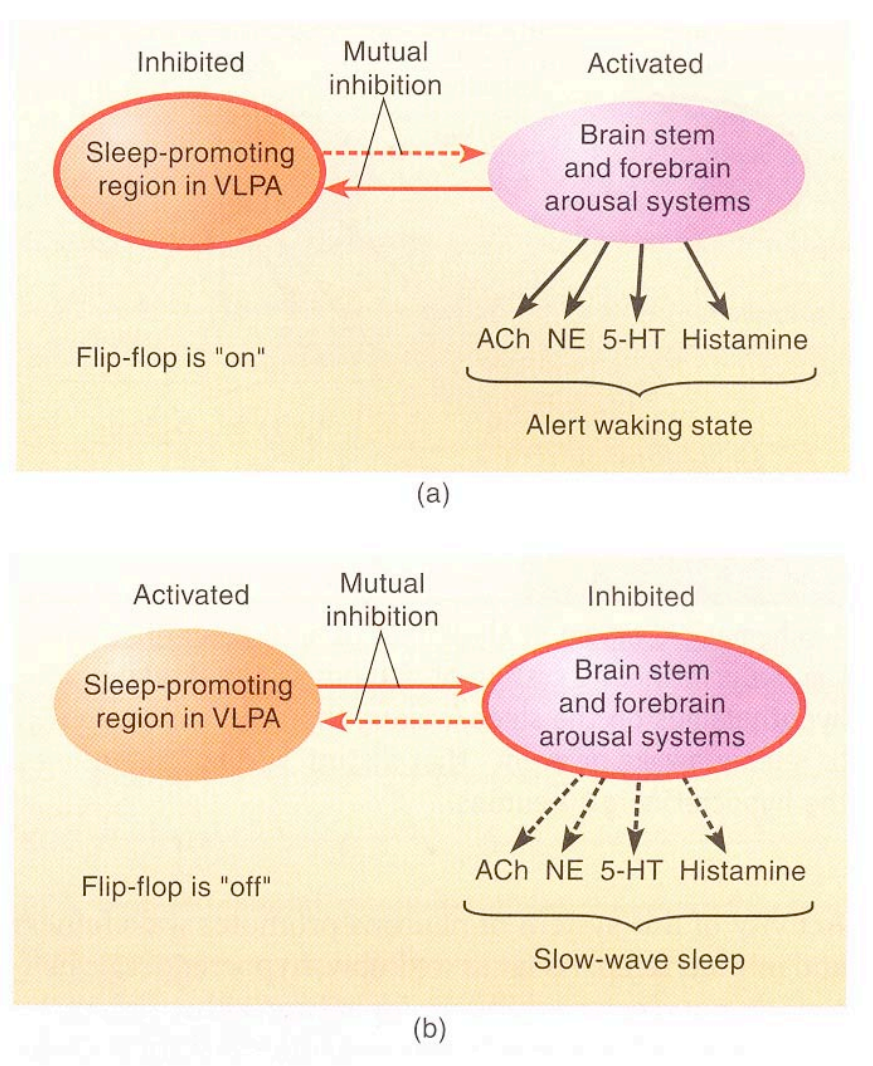
- benzodiazepines? Used as a treatment for REM sleep disorders
- adenosine?
  - plays a role in regulating sleep
- extra glucose in the system (produced by astrocytes) metabolism of glucose increases levels of adenosine
  - Disinhibits sleep-promoting neurons

Arousal

- arousal – level of alertness (a continuum)
- ACh – agonists increase EEG signs of arousal; antagonists decrease EEG signs
- Norepinephrine – catecholamine agonists (e.g., speed) increase arousal via noradrenergic system in the locus coeruleus
- Seratonin (5-HT) – increases relate to locomotion and cortical arousal – facilitating ongoing behaviours
- Histamine – direct effect on cortex, indirect affect via ACh induced changes

Sleep / wake cycles

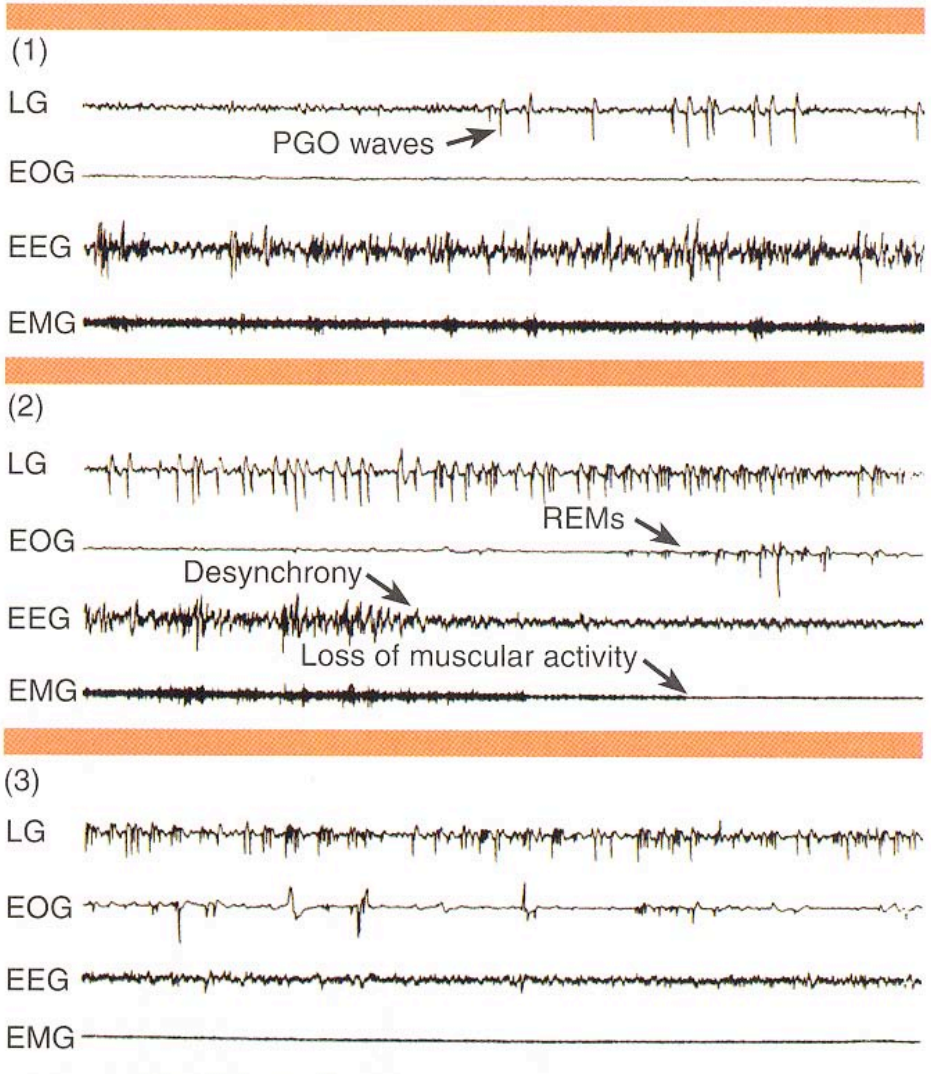
- ventrolateral preoptic area (VLPA: anterior to hypothalamus)



- Areas are reciprocally connected by inhibitory GABAergic neurons.

Neural control of REM

- cerebral metabolism equivalent to waking state
- PGO (pons, geniculate, occipital) heralds onset
- during waking REM inhibited by 5-HT

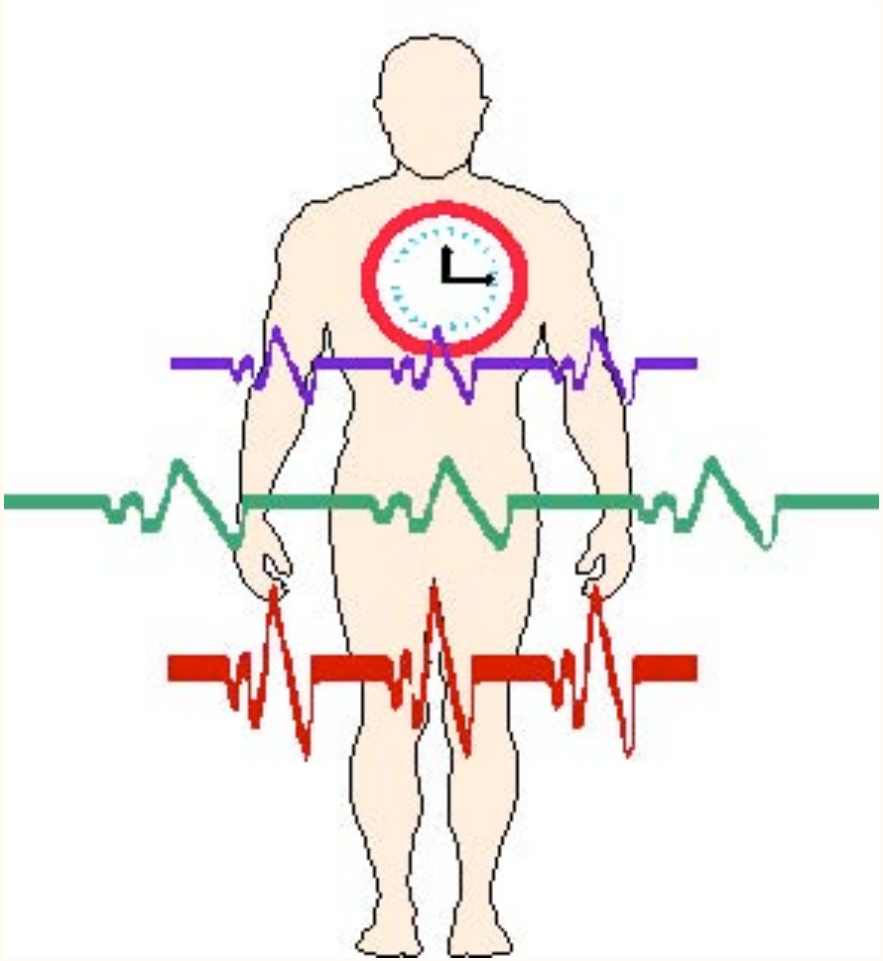


Neural control of REM

- ACh release in the dorsolateral pons
- project to thalamic nuclei – PGO waves arise from LGN connections
- basal forebrain connections produce arousal & cortical desynchrony
- REMs arise from connections with the tectum

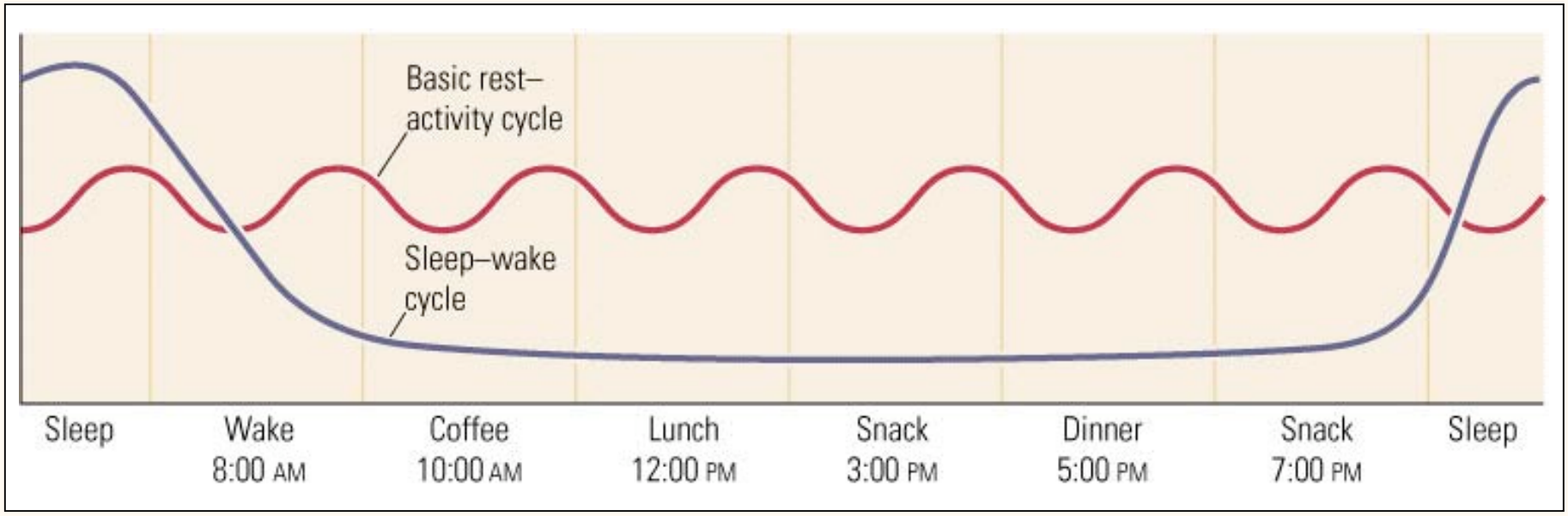
Biological Clocks

- 90 minute REM sleep cycle
- 90 minute activity / rest cycle
- breeding seasons



Biological Clocks

- 90 minute activity / rest cycle
- 24 hour sleep / wake cycle



Biological Clocks

Biological rhythm	Time frame	Example
Circannual	Yearly	Migratory cycles of birds
Infradian	Less than a year	Human menstrual cycle
Circadian	Daily	Sleep / wake cycle
Ultradian	Less than a day	Eating cycles

Circadian Rhythms

- circadian rhythms – 24 cycles
- passive response to changes in light conditions
- internal clocks
- zeitgeber – a stimulus that resets the internal clock – e.g., light conditions

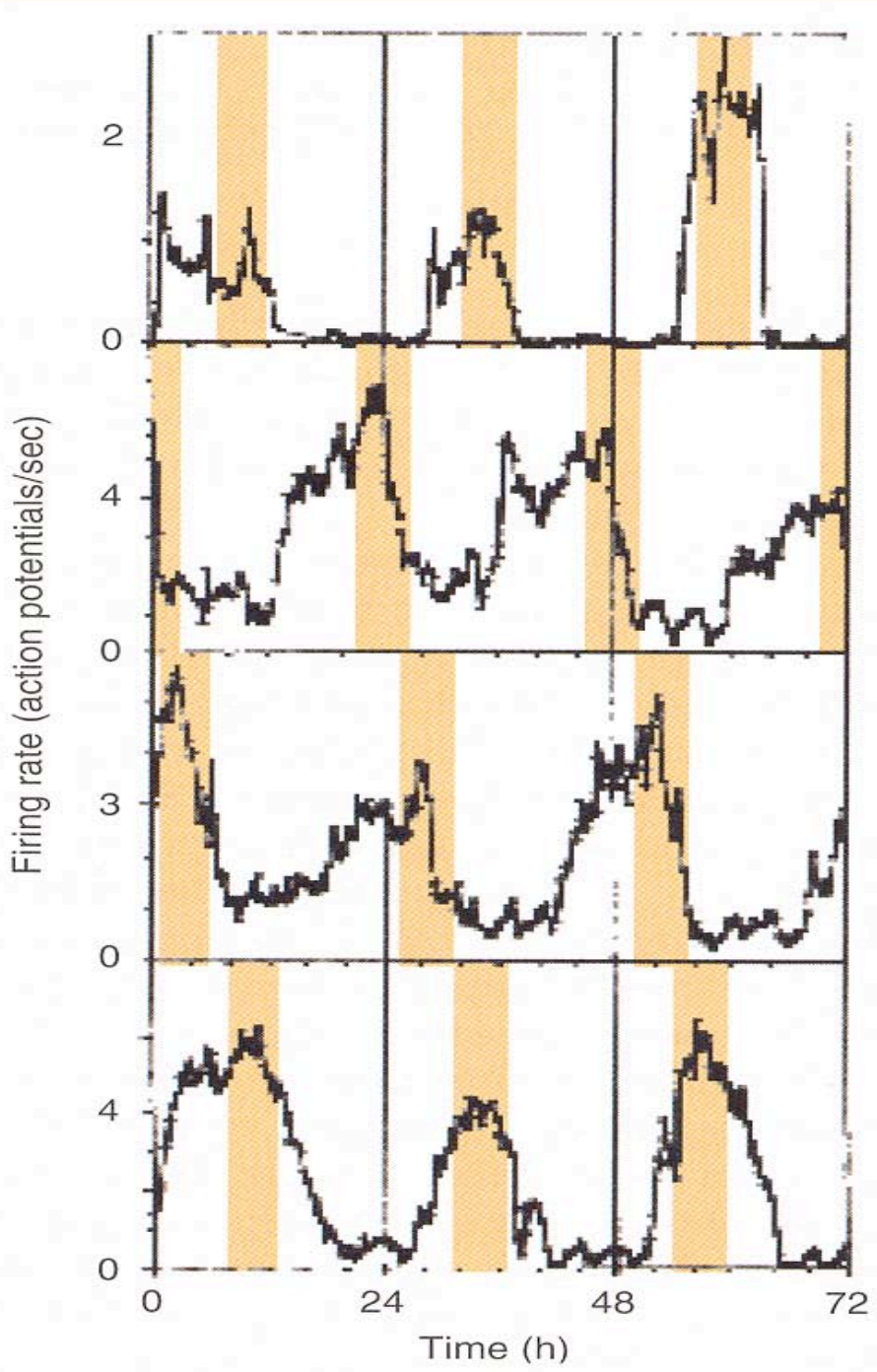
- free running would lead to a 25 hour day!

Circadian rhythms

- suprachaismatic nucleus (SCN) responsible for many rhythms incl. sleep – rhythm disrupted but amount maintained
- direct projections from retina provide the zeitgeber – information re light
- melanopsin – photochemical responsible for maintaining diurnal rhythms

SCN clock

- individual neurons in SCN shows periodicity
- cyclic production of proteins – two loops, once a criterion level is reached in loop 1, loop 2 kicks in to inhibit production



Seasonal rhythms

- breeding rhythms that begin as day lengths increase and end as they begin to decrease
- pineal gland (Descartes thought this was the centre of mental activity – in centre of brain only part without two hemispheres)
- pineal gland secretes melatonin during the night – more produced during long nights of winter signaling the season
- SADS – seasonal affective disorder – a decrease in melatonin levels?

SADS

- light phase of the circadian rhythm may be too short
- expose person to artificial light to prolong the “photoperiod” of the day

Jet lag!

- desynchrony with SCN and external environment
- jet lag is temporary (and the payoff is worth it)
- east to west travel usually easier

Shift Work

- long term maintenance of a shift easier to deal with than flipping between day shift and night shift
- exposure to artificial light at appropriate times of day can help
- bright light can help with SADs too