NOT AT NIGHT, BUT DURING LESSONS

SLEEP

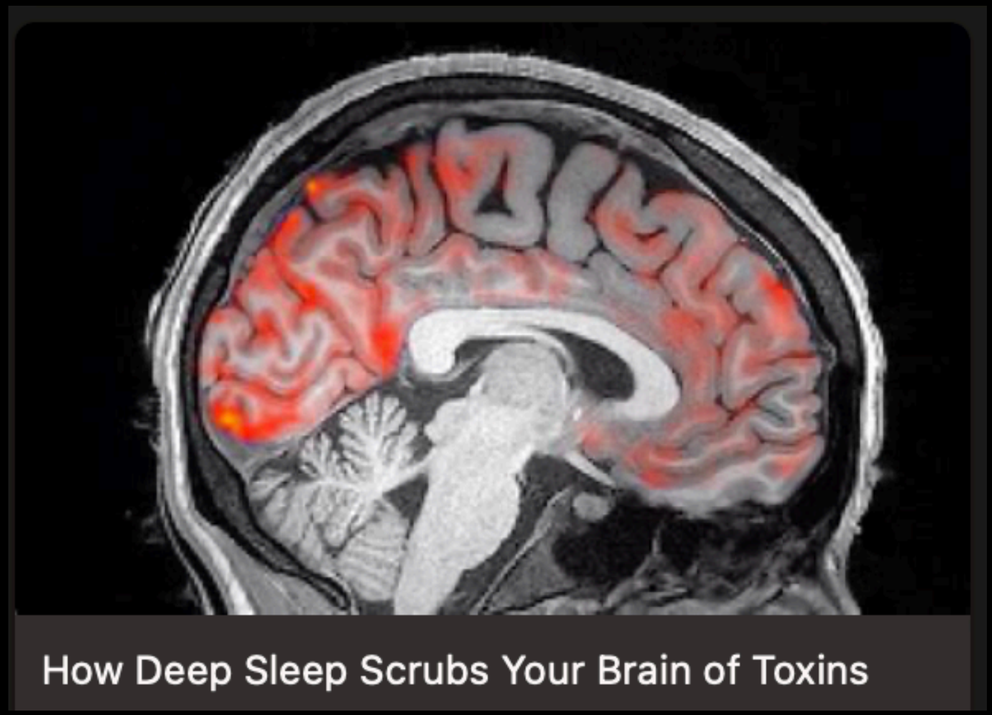
Jim Zhao 20231030

FACTS ABOUT SLEEPING

- In 1/3 of our lives, we SLEEP.
- Sleep loss can have as great impact on performance as drinking alcohol. (probably drunk)

SLEEP BRINGS US...

- Maintain brain health
- Store energy
- Consolidate memory
- Remove metabolic waste
- Repair cells
- Synaptic pruning
- Etc.



way that sleep is good for us: it triggers rhythmic waves of blood and cerebrospinal fluid (CSF) that appear to function much like a washing machine's rinse cycle, which may help to clear the brain of toxic waste on a regular basis.

https://www.bilibili.com/video/BV1w7411w7DJ/?spm_id_from=333.337.search-card.all.click&vd_source=1fec0e5796c965e5fbf5fb3a1843c520

LACK OF SLEEP BRINGS US...

Increasing risk of

- diabetes
- cardiovascular disease, heart attacks, and stroke
- depression
- high blood pressure, obesity
- infection

如果大鼠睡眠被剥夺10天以上就开始出现死亡，20天之内几乎全部死亡。

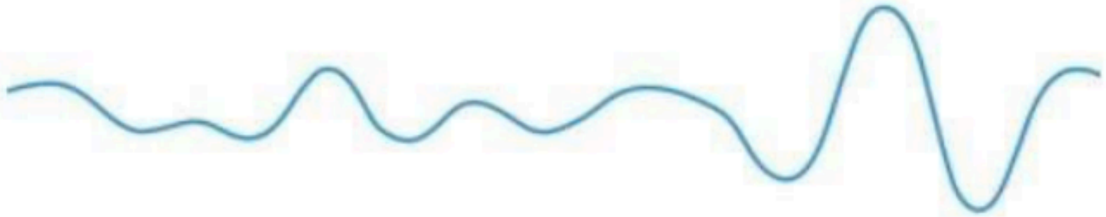
BRAIN WAVES (DETECTED BY EEG)

	ALPHA WAVE	BETA WAVE	THETA WAVE	DELTA WAVE	GAMMA WAVE
WHEN	Relaxed Eye closed	Fully awake Sensory input Concentrate on task	Meditation	Deep sleep	Excited or anxious Have new, complex thoughts
FREQUENCY (Hz)	8-12	12-30	4-8	1.5-4	30-80

δ Delta waves

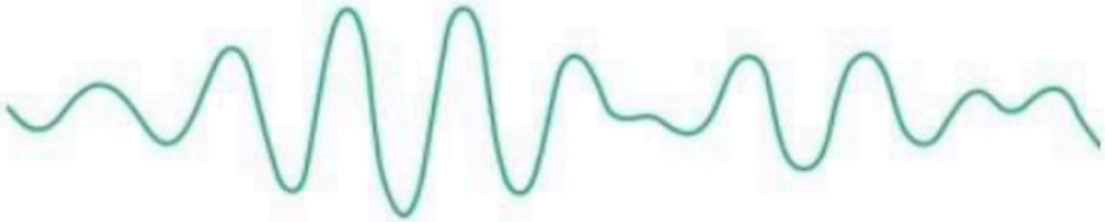
1.5 - 4 Hz

θ Theta waves



4 - 8 Hz

α Alpha waves



8 - 12 Hz

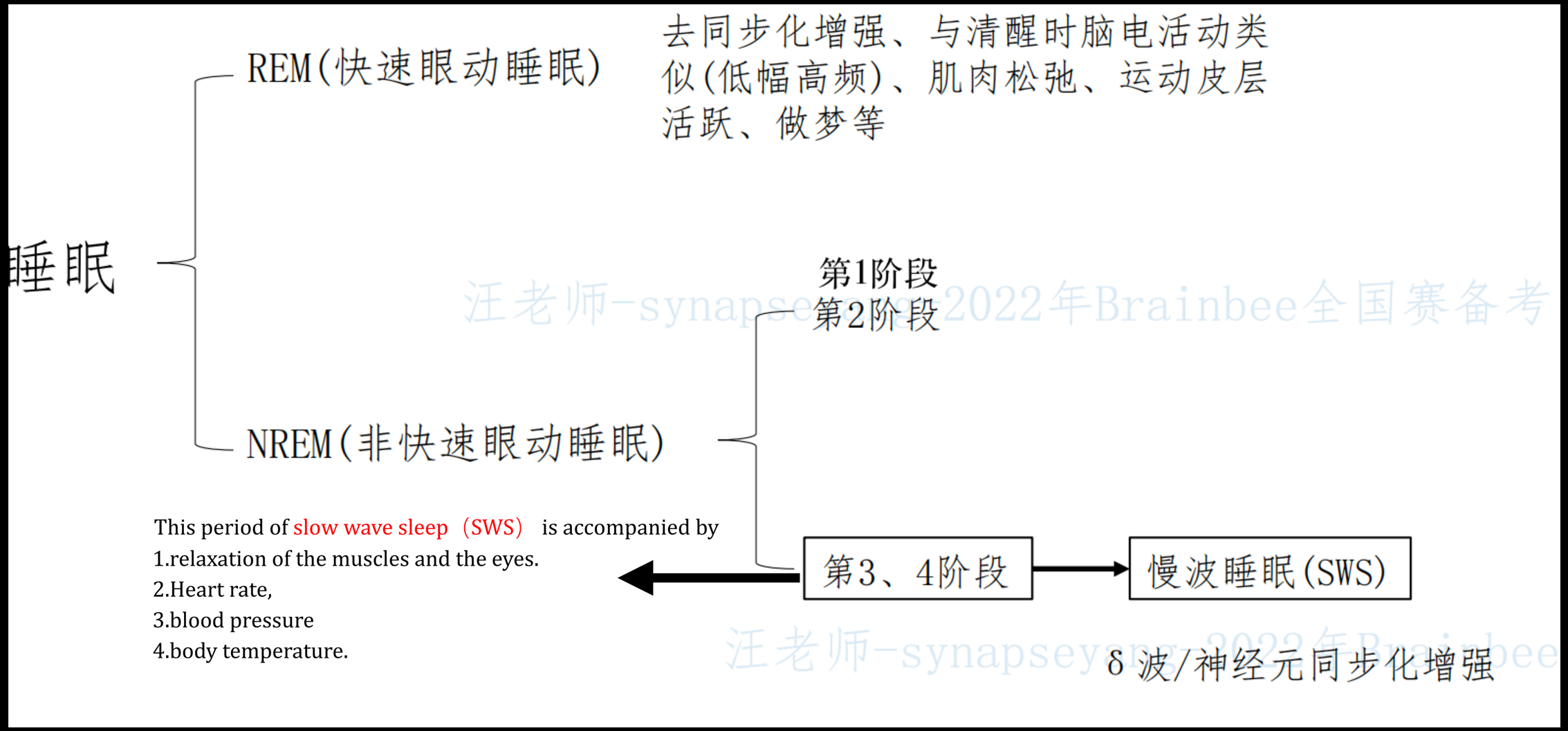
β Beta waves

12 - 30 Hz

γ Gamma waves

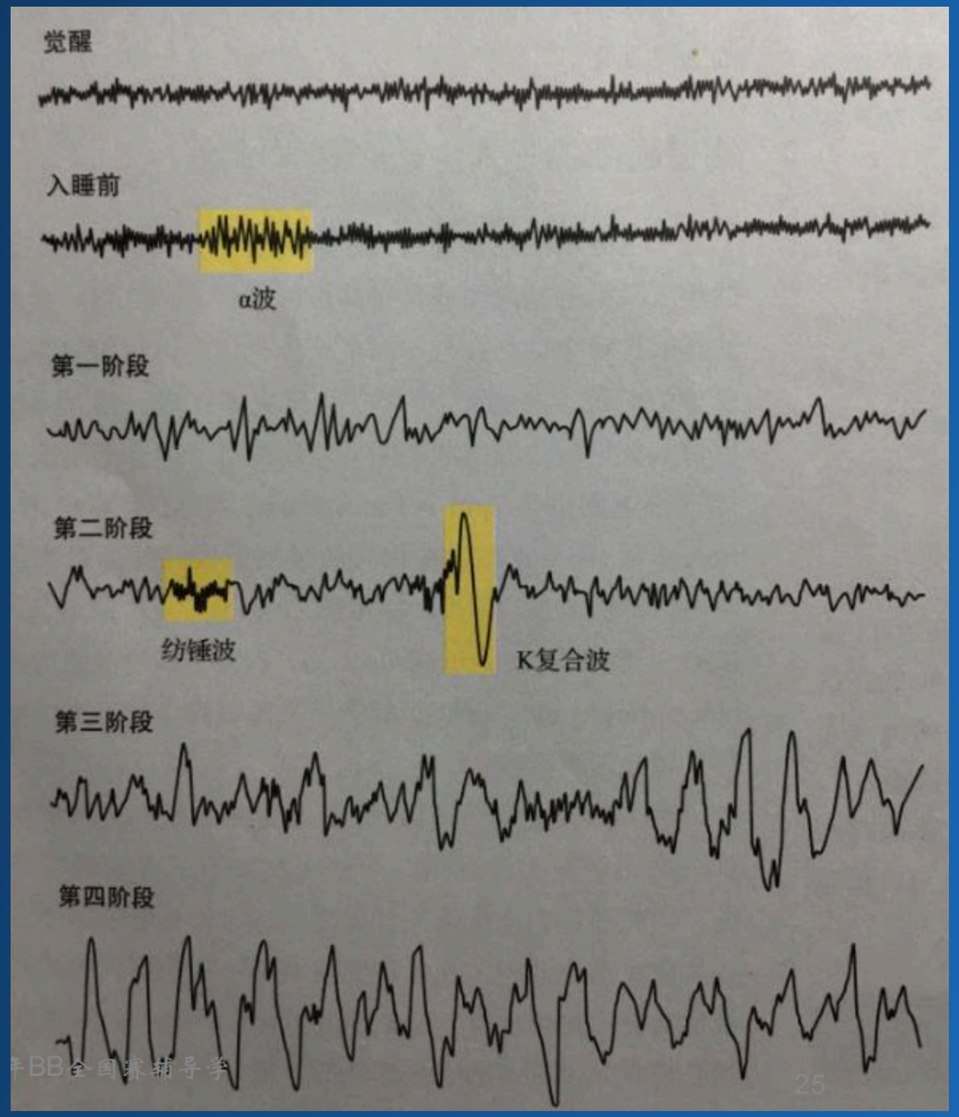
30 - 80 Hz

SLEEP STAGE


睡眠
REM(快速眼动睡眠)
去同步化增强、与清醒时脑电活动类似(低幅高频)、肌肉松弛、运动皮层活跃、做梦等
NREM(非快速眼动睡眠)
第1阶段
第2阶段
第3、4阶段
慢波睡眠(SWS)
δ波/神经元同步化增强
This period of slow wave sleep（SWS） is accompanied by
1.relaxation of the muscles and the eyes.
2.Heart rate,
3.blood pressure
4.body temperature.

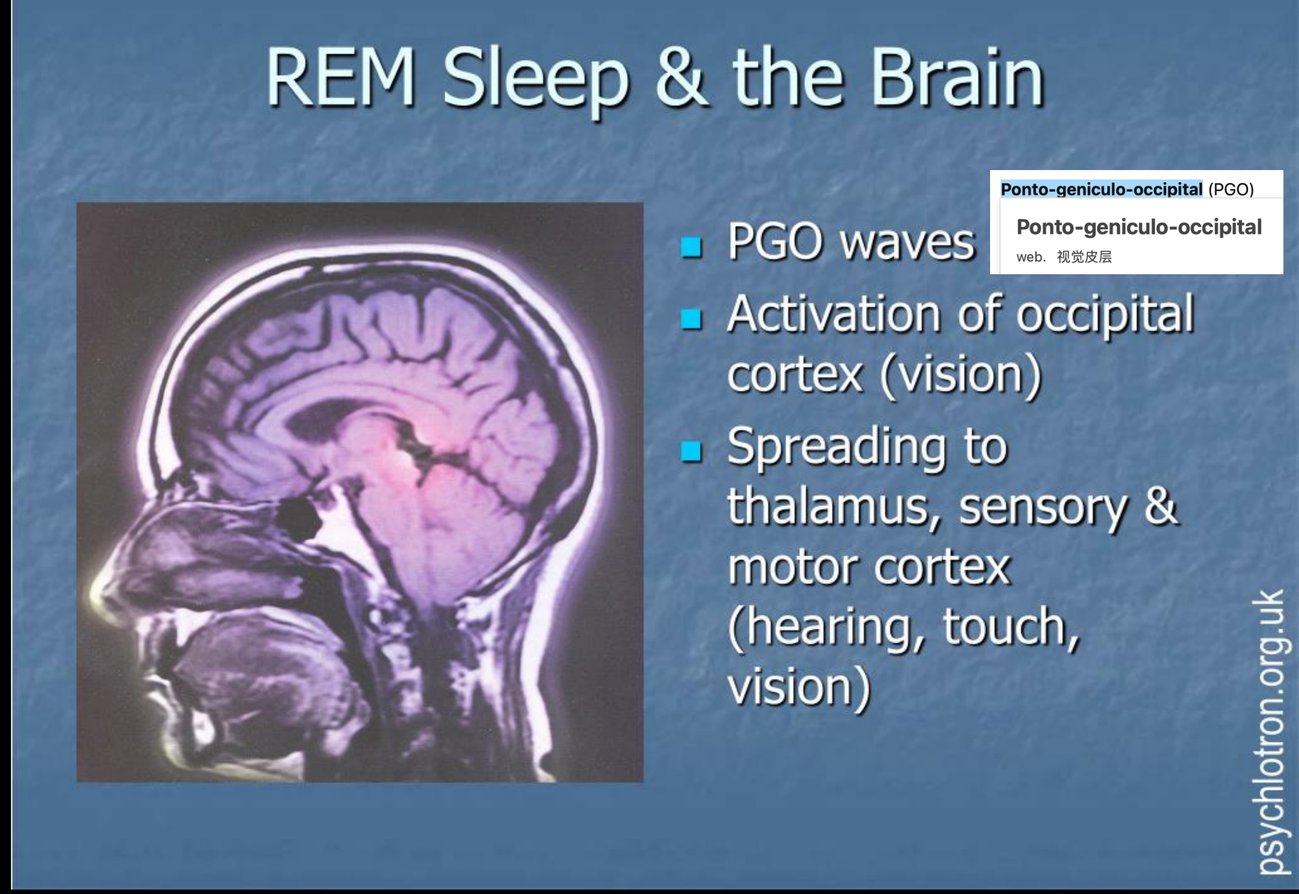
EEG (ELECTROENCEPHALOGRAM) OF NREM

- Stage 1: low amplitude, high frequency, similar but relatively slower than awake
- Stage 2: higher amplitude than stage 1 sleeping, occasional K-complex and sleep-spindle wave
- Stage 3: characterised by sporadic delta wave, also the largest, slowest wave
- Stage 4: mainly delta wave



REM SLEEPING

- Rapid eye movement
- Brain wave similar to that when awake: low amplitude, high frequency, significant at motor cortex
- Atonia, paralysis of body muscle
- Only muscles responsible for breathing and eye movement control are still active



Ponto-geniculo-occipital (PGO)

Ponto-geniculo-occipital

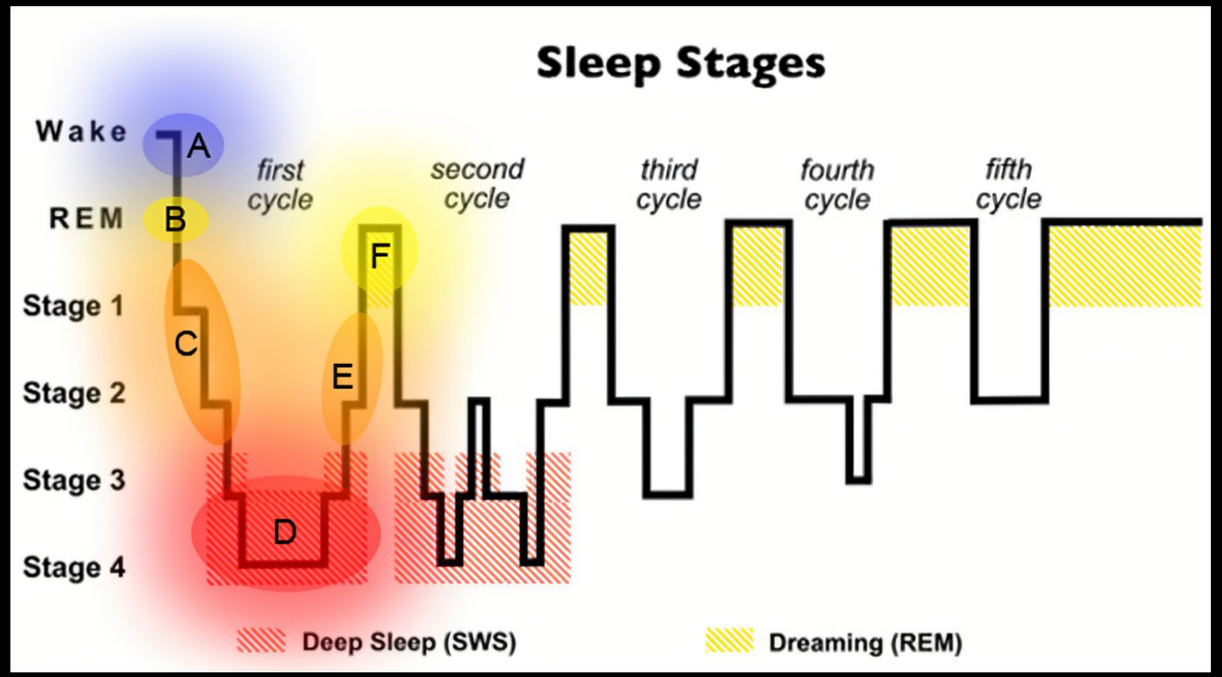
web. 视觉皮层

An individual enters this stage about an hour to an hour and a half after falling asleep.

Heart rate and respiration rate become irregular.

SLEEP STAGE

- One cycle of sleeping lasts about 90 minutes, with nREM making up of 75-80 minutes and REM making up of 10-15 minutes.
- These cycles of slow wave and REM sleep alternate, with the slow wave sleep becoming less deep and the REM periods more prolonged until waking occurs.
- If awakening from SWS, one can only remember fragmented dream, not the full, active dream.
- AS Psychology Dement & Kleitman ⬆️



WAKEFULNESS - THREE MAIN ASPECTS

(1) Maintained by the brain's arousal systems - many are in the upper brainstem, with neurones connecting with the forebrain 名的脑干网状结构具有唤起维持觉醒的作用。其腹侧上行通路经下丘脑影响前脑功能，背侧上行通路则通过丘脑非特异性投射系统影响大脑皮质的激活。

The neurones use acetylcholine, norepinephrine, serotonin and glutamate to keep us AWAKE.

(2) Orexin-producing neurones in hypothalamus send projections to the brainstem & spinal cord, the thalamus & basal ganglia, as well as the forebrain, amygdala and dopaminergic neurones.

Activated by insulin-induced low blood sugar, increase metabolic rate

(3) Orexin neurones also connect to hypothalamic neurones containing histamine, which contributes to staying awake, too.

SLEEPINESS

- During SWS

  Arousal system is suppressed by the ventrolateral preoptic (VLPO) nucleus in the hypothalamus.

  Cells of VLPO release inhibitory neurotransmitters - galatin and GABA.

- During REM

  Norepinephrine level remains low while acetylcholine level stays high, activating thalamus and neocortex.

  Forebrain excitation without external sensory stimuli produces dream.

BALANCE OF ACH AND NOR-EPI OF BRAIN STATES

	Awaken	SWS	REM
Ach Level	High	Low	High
Nor-Epi Level	High	Low	Low

SLEEP-WAKE CYCLE

- Circadian system + homeostatic system drive your body to crave sleep.
- The two systems are separate and act independently.

CIRCADIAN SYSTEM - PROTEIN AND LIGHT

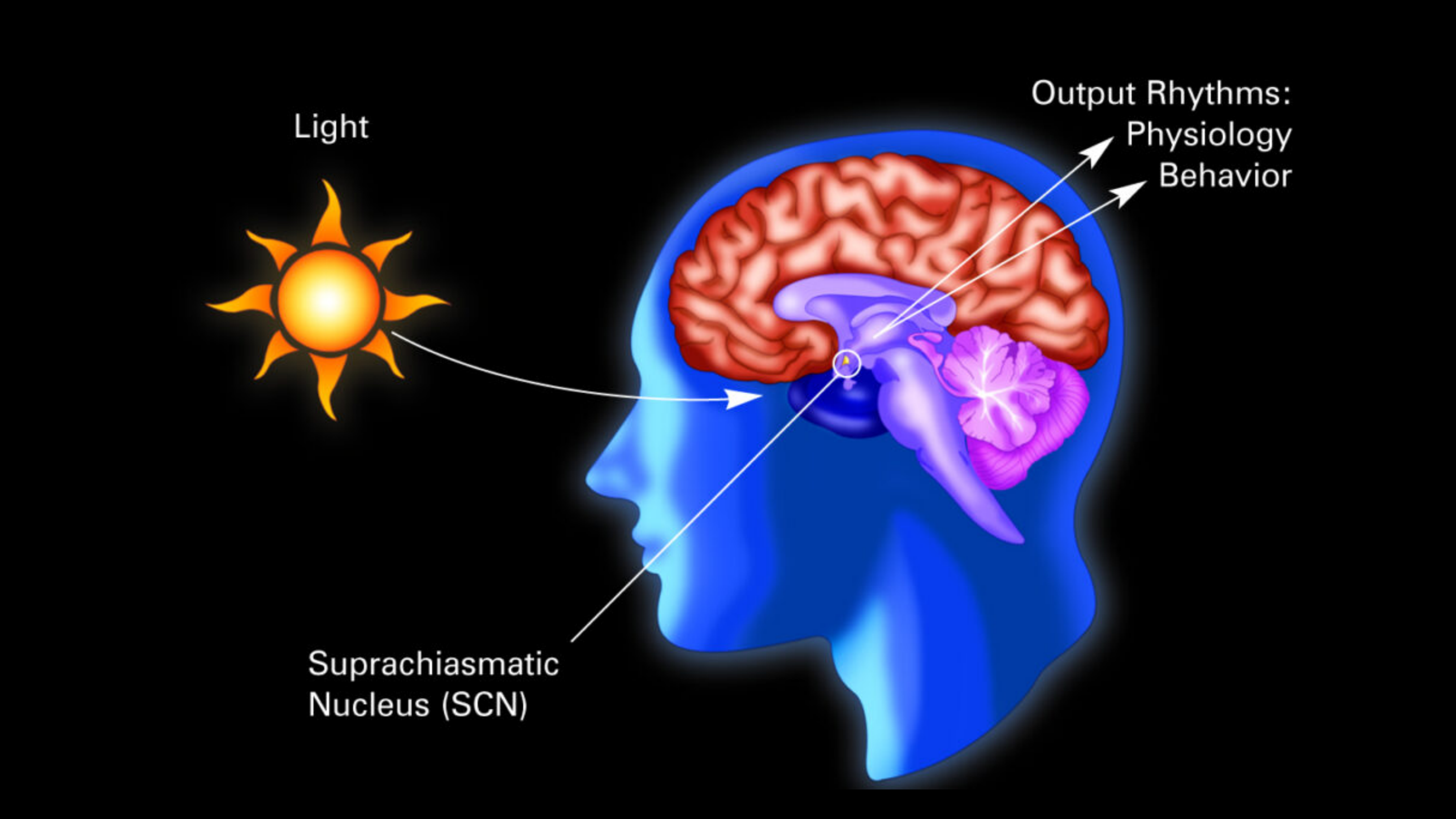
- Regulated by suprachiasmatic nucleus (SCN) (not the only one responsible), a small group of nerve cells in the hypothalamus, mainly for arousal

SCN神经元在夜间往往不活动，黎明时才开始放电。

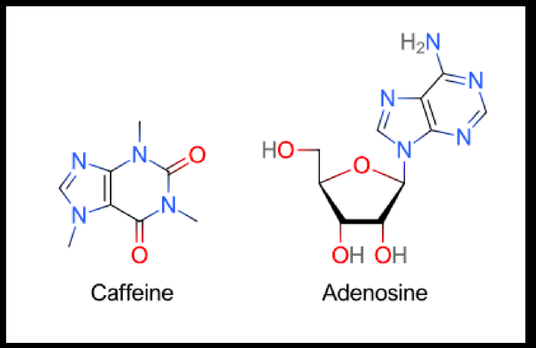
- These cells express proteins, which go through 24-hour biochemical cycle, including activity, sleep, hormone release and other bodily functions.

- SCN also receives input directly from the retina by light, adjusting the rhythm to the outside world's day-night cycle. (When time zone changes)

- SCN sends signals that eventually reach VLPO and orexin neurones, regulating arousal.


Light
Output Rhythms:
Physiology
Behavior
Suprachiasmatic
Nucleus (SCN)

HOMEOSTATIC SYSTEM



- When staying awake longer than usual, adenosine level increases across the brain - from basal forebrain to throughout the cortex.
- Increased adenosine binds to specific receptors on neurones in arousal centres to slow down cellular activity and reduce arousal, increasing slow waves during SWS. Level of adenosine then decreases during sleep.
- Caffeine acts as stimulant by competing with adenosine, binding to adenosine receptors, preventing arousal reduction.

SLEEP DISORDERS

- Insomnia
- Apnea
- REM behaviour disorder
- Narcolepsy

INSOMNIA

✳ Symptoms:

- Difficulty falling asleep initially
- Falling asleep and then awaken partway through the night and cannot fall asleep again

✳ Causes:

- Excessive daytime sleepiness
- Obstructive sleep apnea

✳ Treatments:

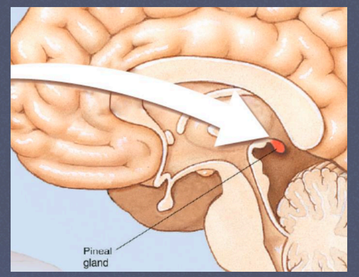
- Sedatives, sedating antidepressant drugs →
- Have melatonin →

available to help, none produces a truly natural and restful sleep state because they tend to **suppress the deeper stages of slow wave sleep**. They also are ***not effective*** in helping people ***stay asleep***.

睡前服用褪黑素可以改善那些缺乏褪黑素的失眠症患者的睡眠。

Damage to the VLPO area causes irreversible insomnia.

Melatonin is synthesised from serotonin by pineal gland.



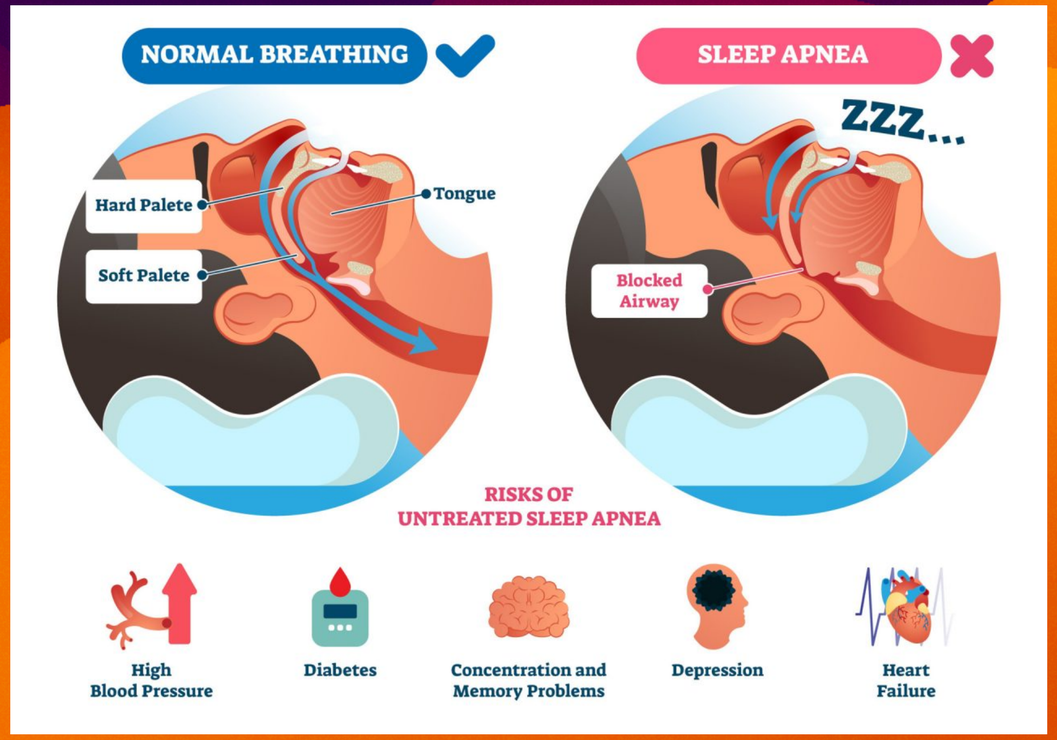
(SLEEP) APNEA

✳ Symptoms:

- High blood pressure, risk of heart attack
- Hard to reach deep stage SWS

✳ Treatments:

- Devices that induce continuous positive airway pressure to keep the airway open
- Losing weight
- Sleep on one's back
- Avoid alcohol or sedative drug



REM SLEEP DISORDER

✳ Common in patients with Parkinson's disease (PD), stroke or dementia

✳ Symptoms:

- Periodic limb intermittent jerks
- Act out dreams by getting up and moving around

✳ Causes:

- Muscles fail to become paralysed during REM sleep.

✳ Treatments:

- Drugs for PD
- A benzodiazepine called clonazepam

NARCOLEPSY

✳ 1/3000 prevalence rate

✳ Symptoms:

- Entering REM stage very quickly even when partially awake, known as hypnogogic hallucination
- Attacks during which they lose muscle tone - attacks of paralysis, known as cataplexy, can be triggered by emotional experiences, even a joke

✳ Causes:

- Loss of nerve cells in the lateral hypothalamus that contain orexin
- The trigger of paralysis remains to be found

✳ Treatments:

- Remains to be developed

HAVE A GOOD SLEEP

THOUGH YOU PROBABLY WOULDN’T