

Sleep for Dreamers



Naomi Bock, MD, MS

SLEEP

What

How

Why

**IF YOU SLEEP
THROUGH THIS
PRESENTATION
YOU CAN STILL
LEARN
SOMETHING**

True

False

**IF YOU SLEEP
THROUGH THIS
PRESENTATION
YOU CAN
STILL LEARN
SOMETHING**

False

**DURING
SLEEP THE
BRAIN AND
BODY SHUT
DOWN**

True

False

**DURING
SLEEP THE
BRAIN AND
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DOWN**

False

SLEEP IS ENHANCED BY ALL BUT

- Exercise at any time
- Sleeping in on weekends
- Going to bed at the same time every night
- Avoiding naps

SLEEP IS ENHANCED BY ALL BUT

- Exercise at any time
- ~~Sleeping in on weekends~~
- Going to bed at the same time every night
- Avoiding naps

**DREAMING
ONLY
OCCURS
DURING
REM SLEEP**

True

False

**DREAMING
ONLY
OCCURS
DURING
REM SLEEP**

False

WHICH STATE OF
UNCONSCIOUS-
NESS
IS MOST EASILY
REVERSED?

Coma

Sleep

General Anesthesia

Hibernation

WHICH STATE OF
UNCONSCIOUS-
NESS
IS MOST EASILY
REVERSED?

Sleep

WHAT

- Sleep is a natural ACTIVE state of rest
- Altered state of consciousness
 - Less responsive to our surroundings than when awake
 - Brain activity is different



WHAT HAPPENS DURING SLEEP

- Brain

- Reviewing & organizing new information
- Regulating emotions
- Practicing new skills
- Thus, learning & memory

- Body

- Clearing toxins from cerebrospinal fluid
- Releasing appropriate hormones
- Repairing damaged tissue & maintaining healthy tissue

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MEMORY

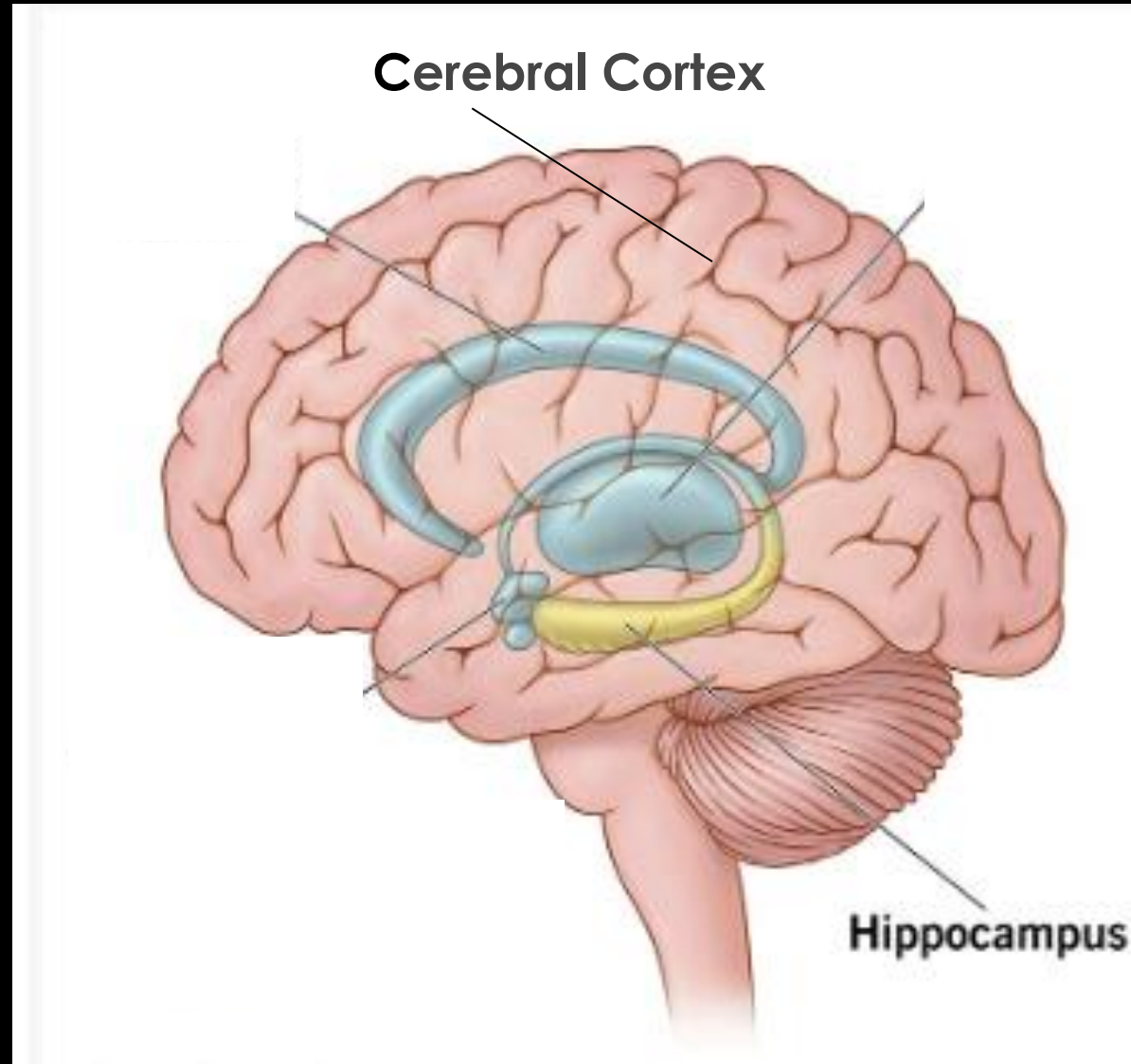
- Brain processes and stores information to use later
- Memories are physical
- Remembering involves strengthening connections between neurons (brain cells)
- A lot of this happens during sleep

MEMORY TYPES

- Long term
 - Near permanent, near infinite storage
 - EXPLICIT = facts, events, visual imagery
 - PROCEDURAL = skills including motor , visuospatial , cognitive (information)
- Short term
 - Seconds to minutes, small storage area
- Sensory
 - Sight, sound, feel etc.
 - < 3 seconds, then either processed or forgotten; serves as buffer to massive sensory exposure

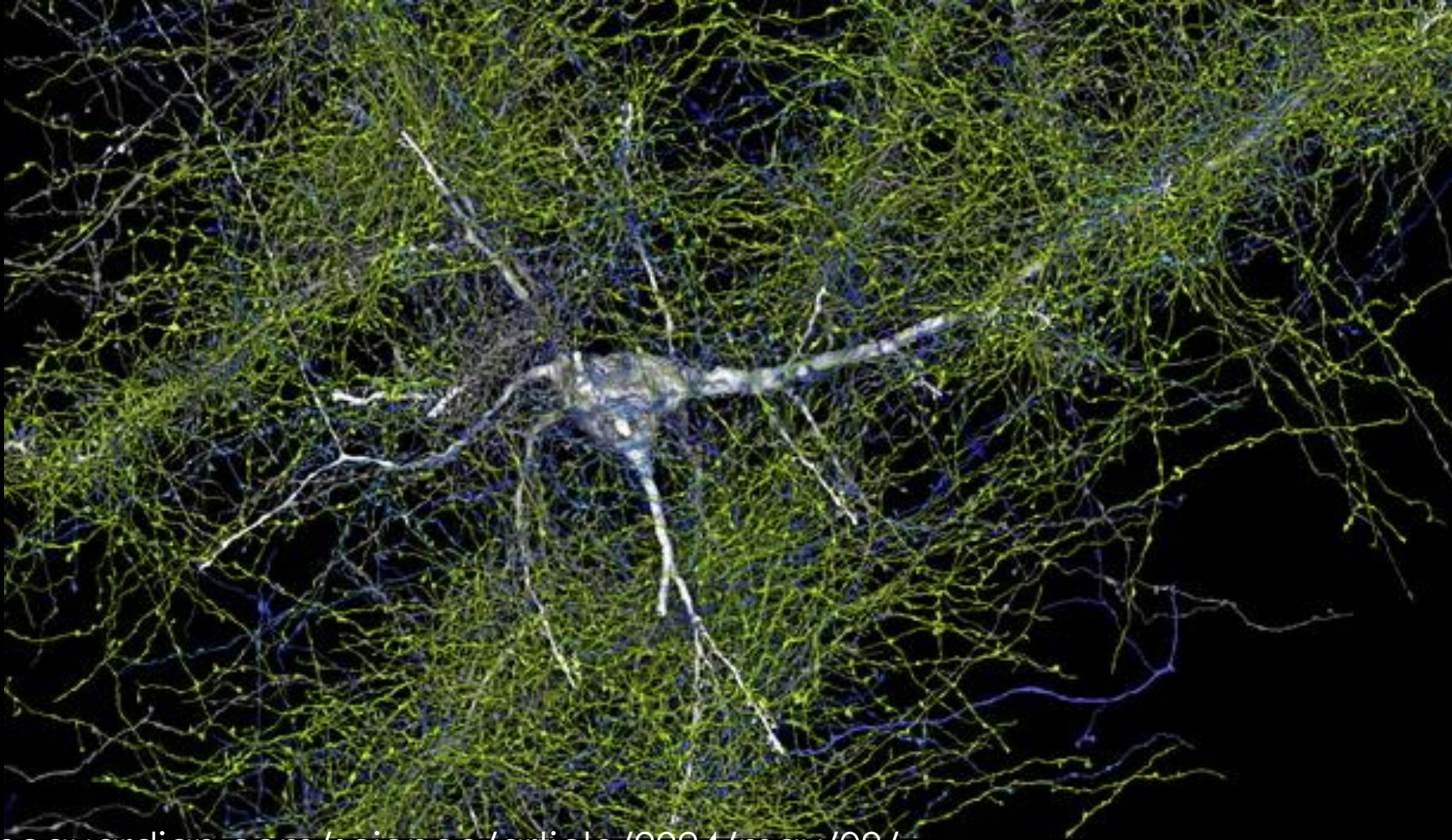
BRAIN

19



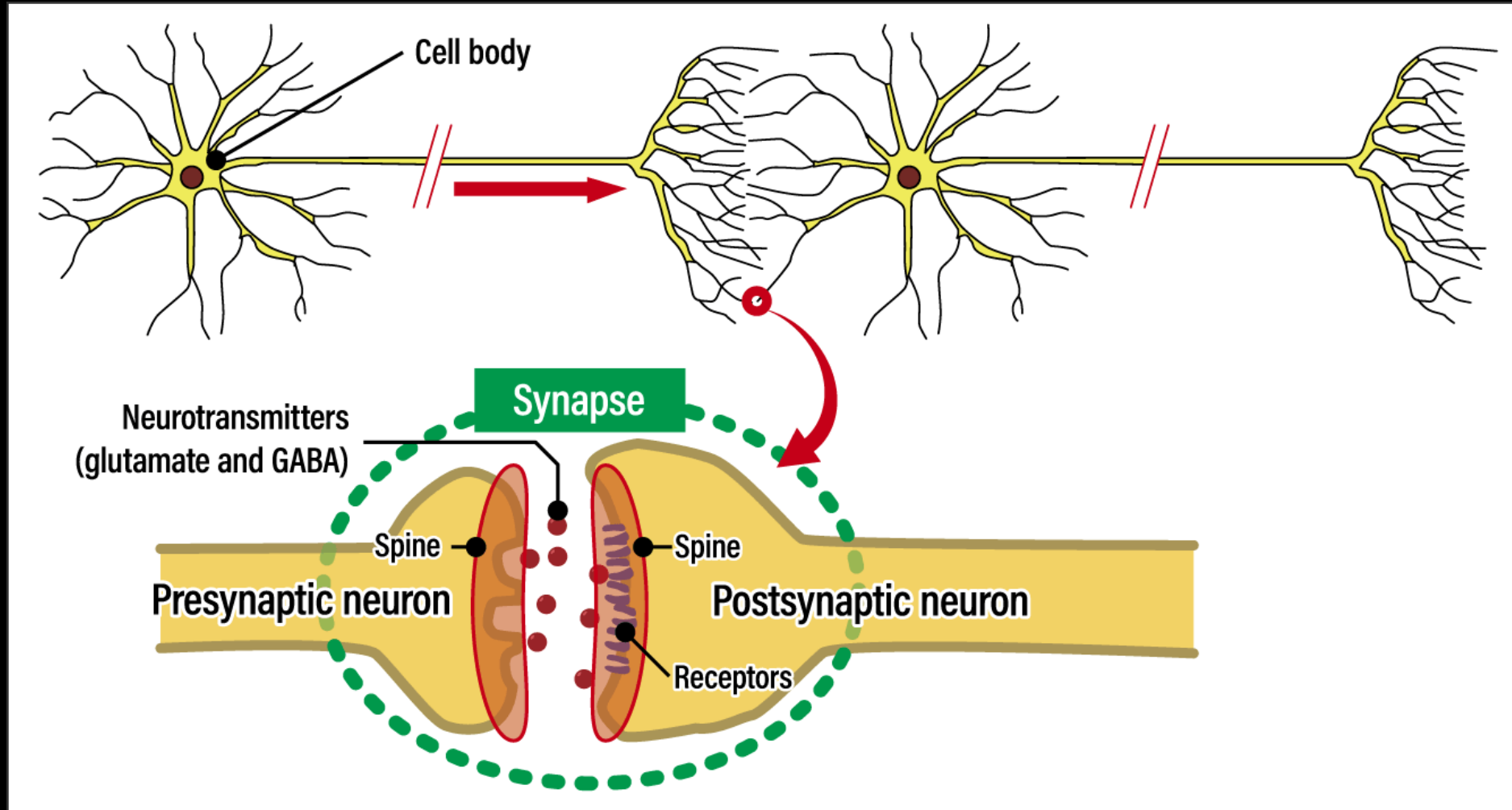
SINGLE NEURON WITH ~5600 NERVE FIBERS CONNECTED TO IT

20



MEMORY FORMATION IN BRAIN CELLS

21

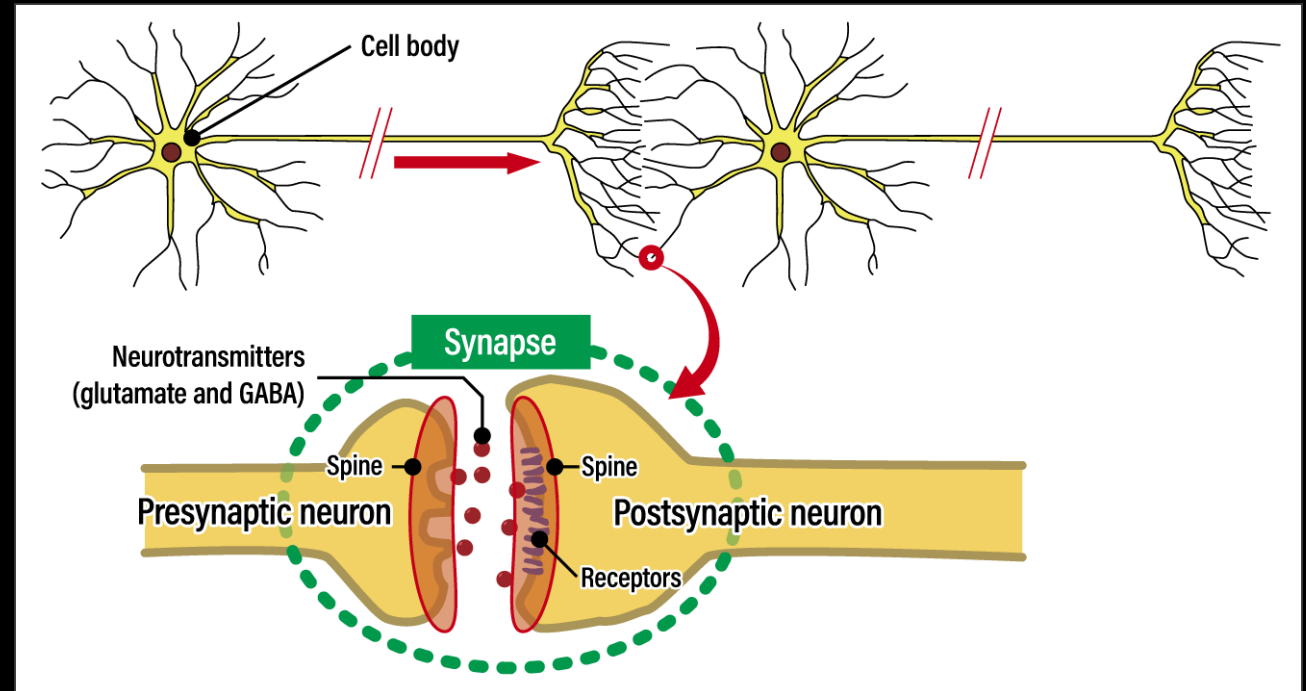


STEPS IN MEMORY FORMATION

- Encoding
- Consolidating
- Storage
- Retrieval

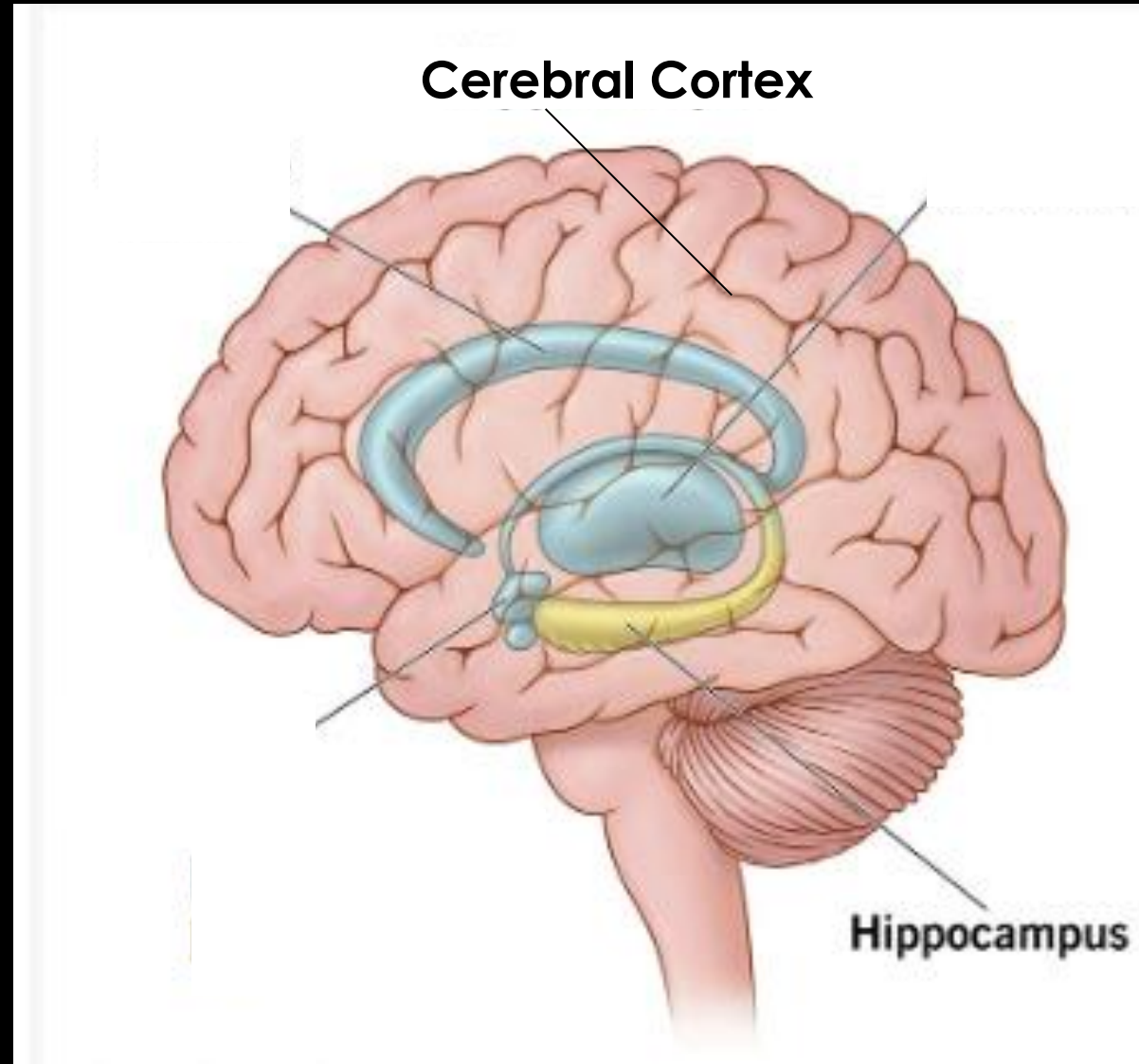
STEPS IN MEMORY FORMATION

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SLEEP

How

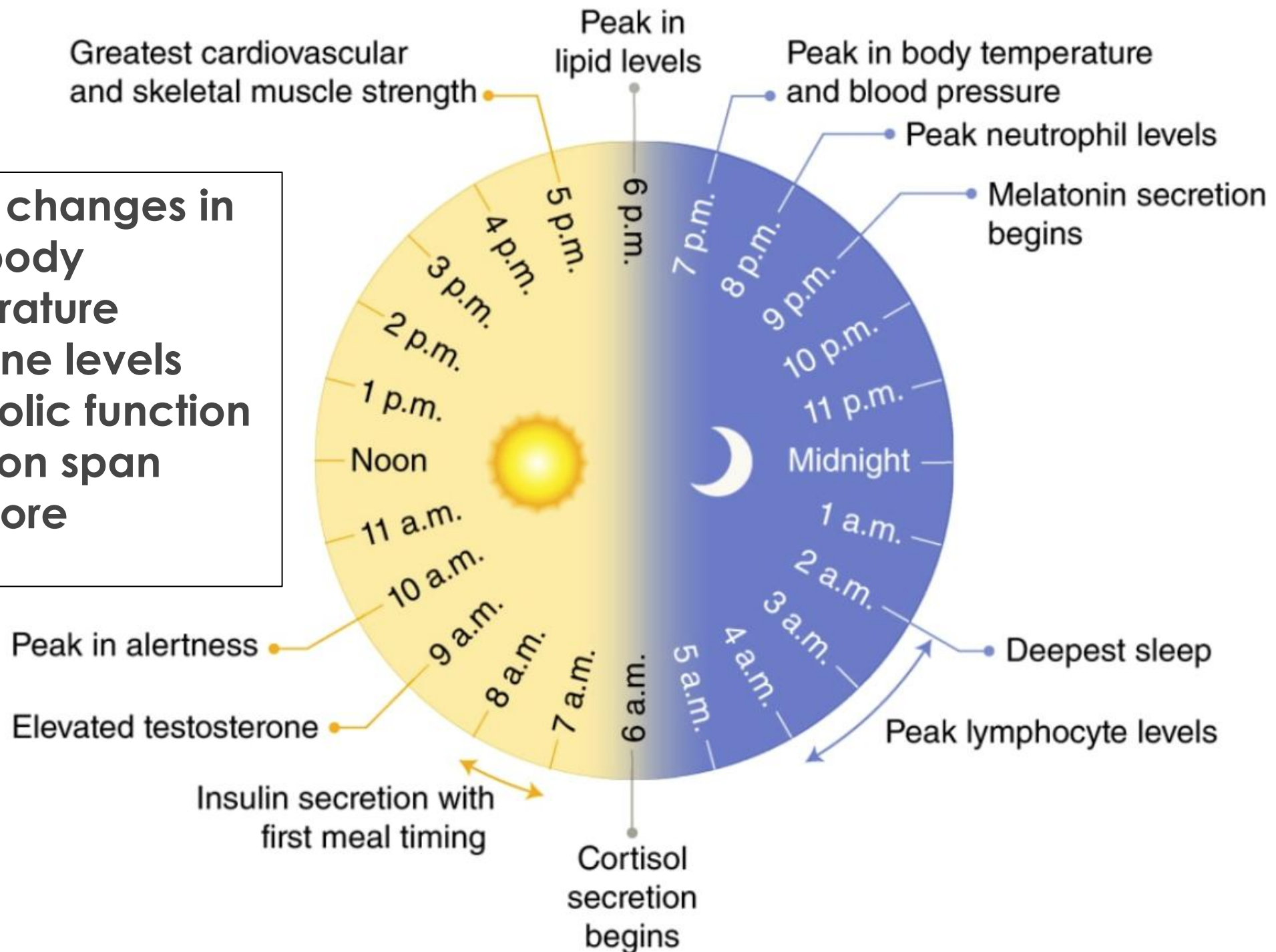
- Whole organism involvement
- Brain in control via internal clock

CIRCADIAN RHYTHM

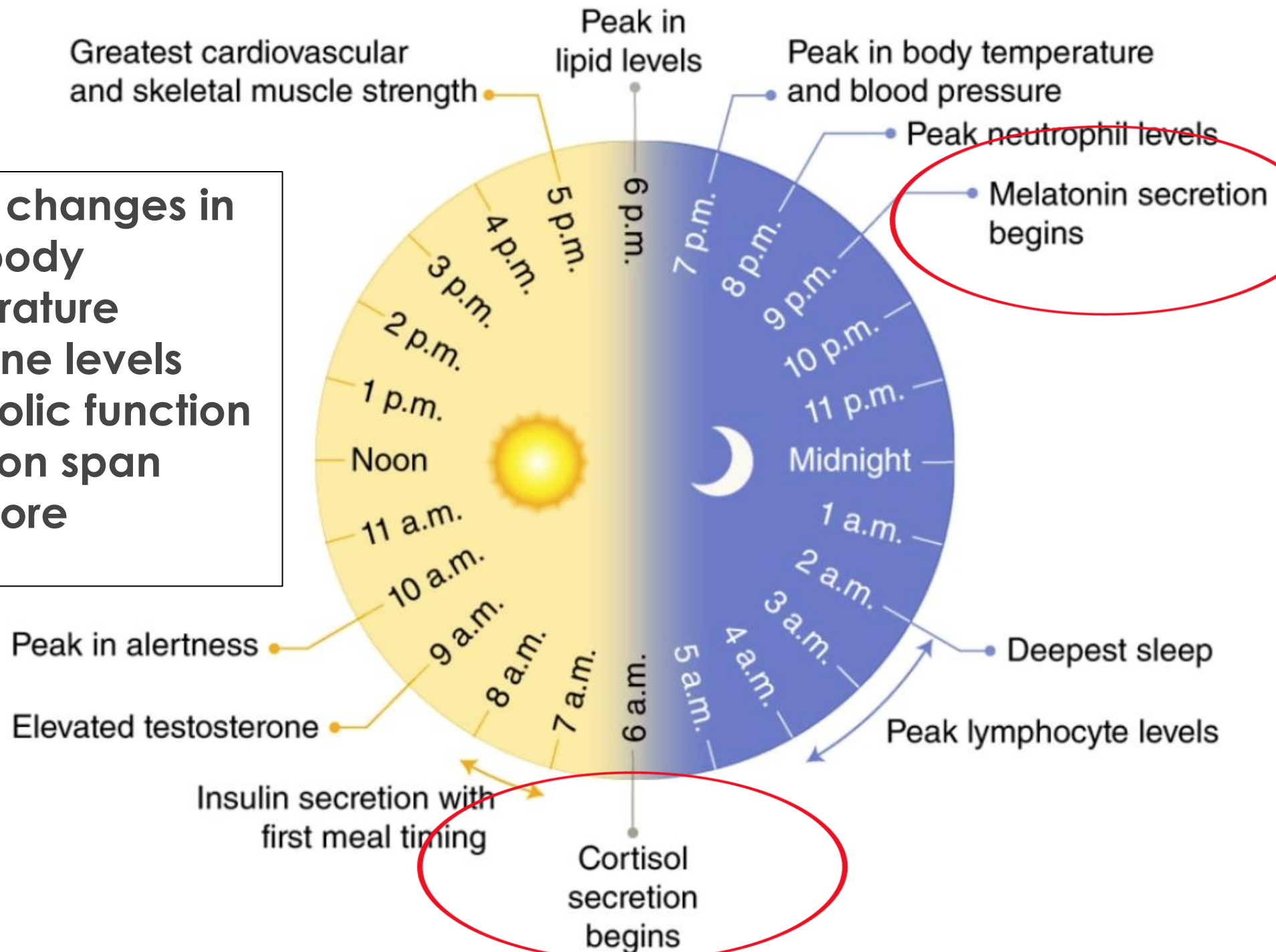
“ABOUT A DAY”

- Body's internal clock
- Brain - wake & sleep
- Endocrine system – cortisol related to energy expenditure versus resting
- Digestive system – insulin secretion, protein creation matches timing of meals
- Muscle strength

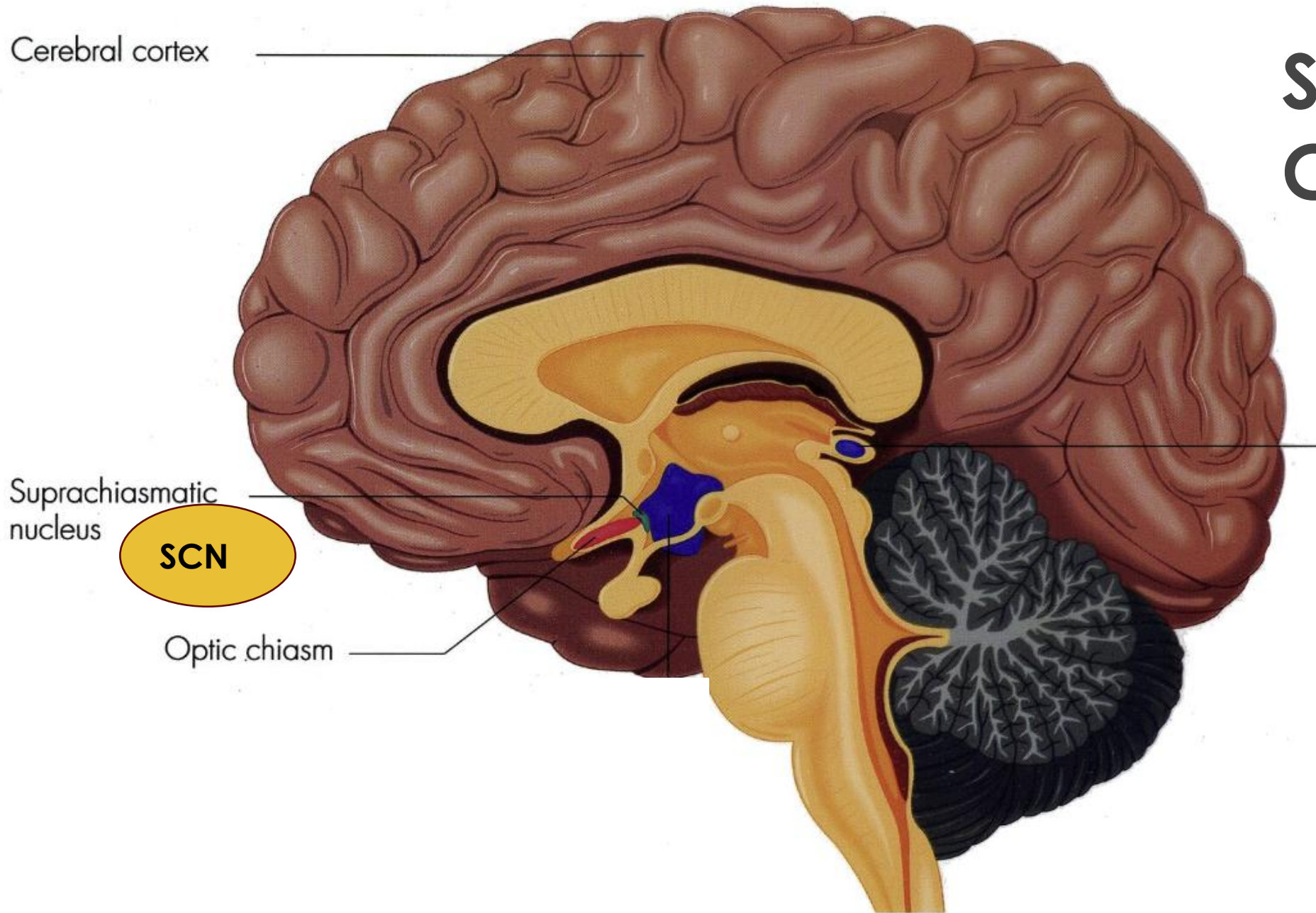
- Cyclical changes in**
- Core body temperature
 - Hormone levels
 - Metabolic function
 - Attention span
 - And more



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- Core body temperature
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 - And more



SCN Is In Charge!



Brain Activity during Sleep

(Sleep Architecture)

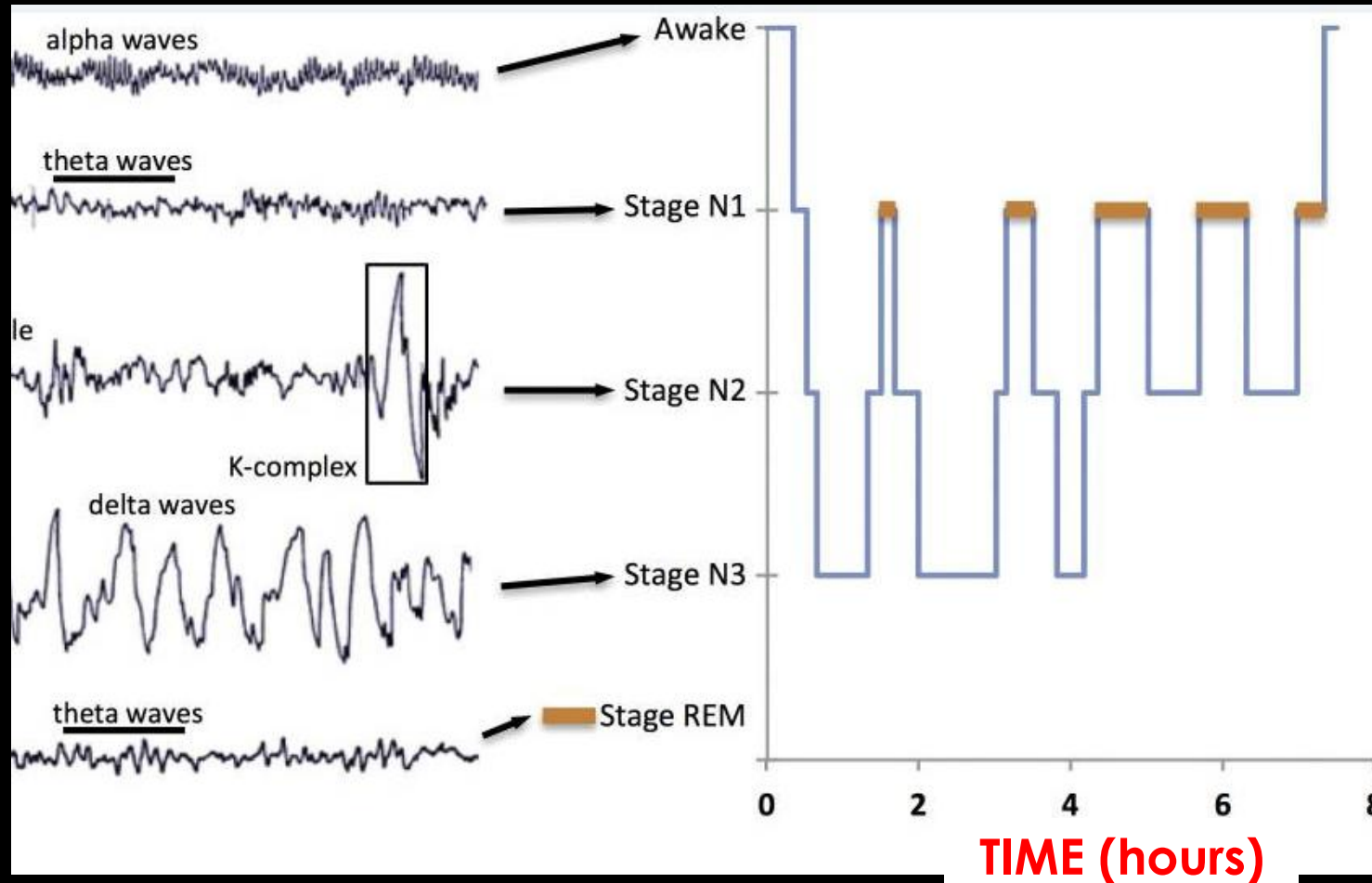


- Predictable patterns
- REM and NREM
- ~Four stages
- Cycles through ~every 90 minutes



EEG FEATURES OF SLEEP/WAKE STAGES (LEFT) & TYPICAL TIME PATTERNS OF HEALTHY SLEEP IN AN ADULT (RIGHT)

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DESCRIPTION OF STAGES OF HEALTHY SLEEP IN AN ADULT

- Stage 1 “Restful wake” – lightest sleep, may not feel like we’re asleep. ~5%
- Stage 2 “Light sleep” but “heavy lifting” – consolidating new learning & memories, ~50%
- Stage 3 “Deep sleep” – rest and restoration, ~20%
- Stage 4 “REM sleep” - major muscles deactivated but brain very active, going through memories, making sense of emotions, ~25%

*We wake 10-16 times per night, mostly don’t remember unless get up to go to bathroom etc.

Experience Sampling in Wakefulness and Sleep

37

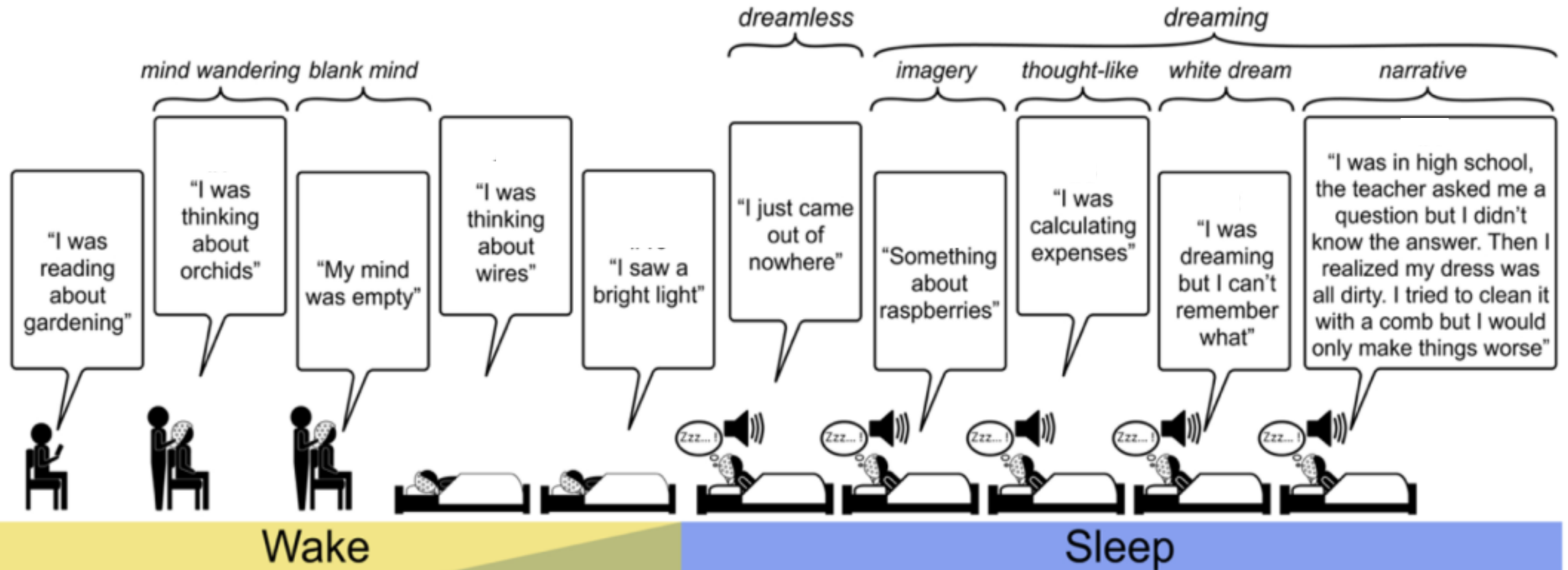
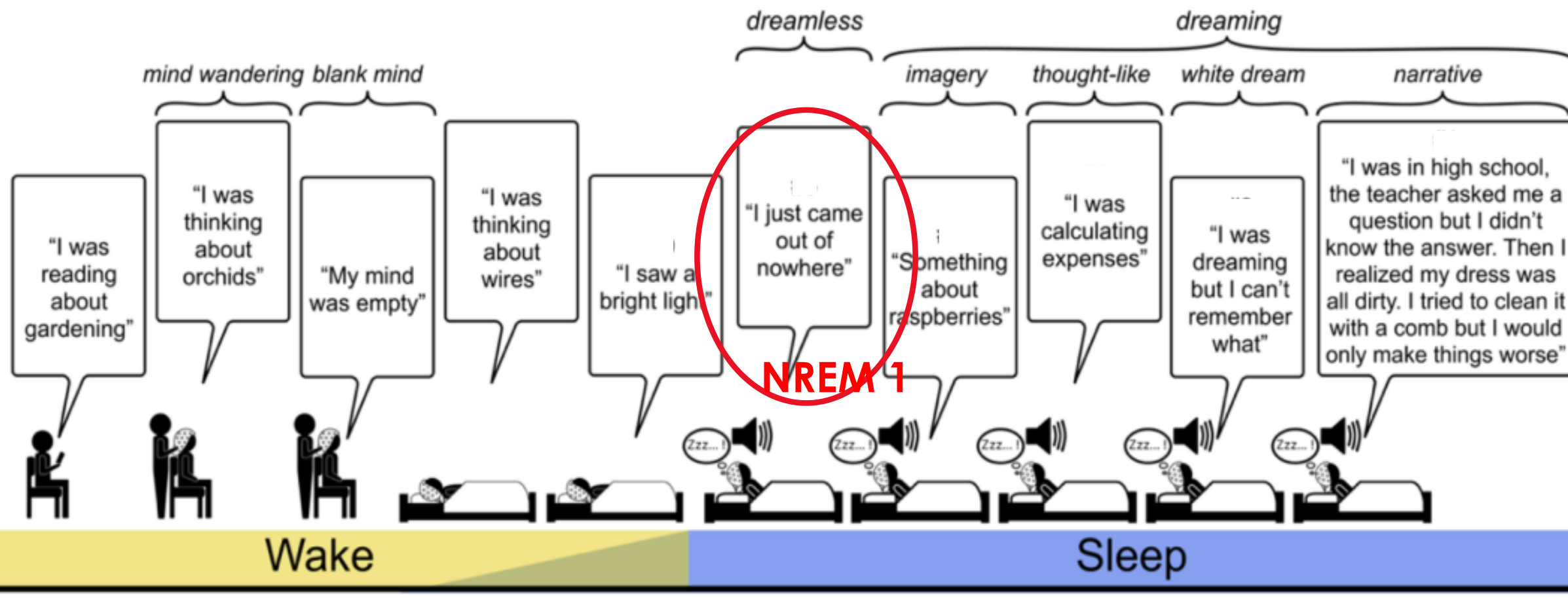


Image: Tononi G, Boly M, Cirelli C. 2024. Consciousness and sleep. *Neuron*.112(10):1568-1594.

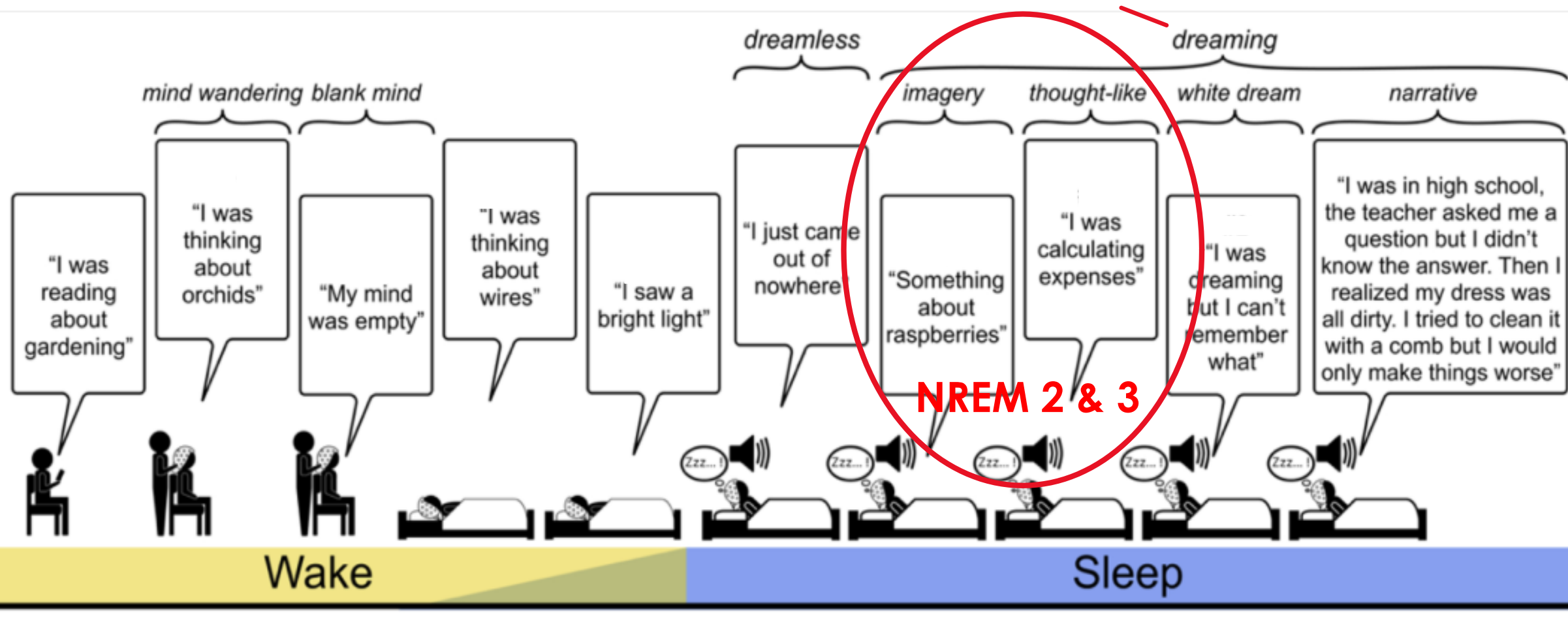
Experience Sampling in Wakefulness and Sleep

38



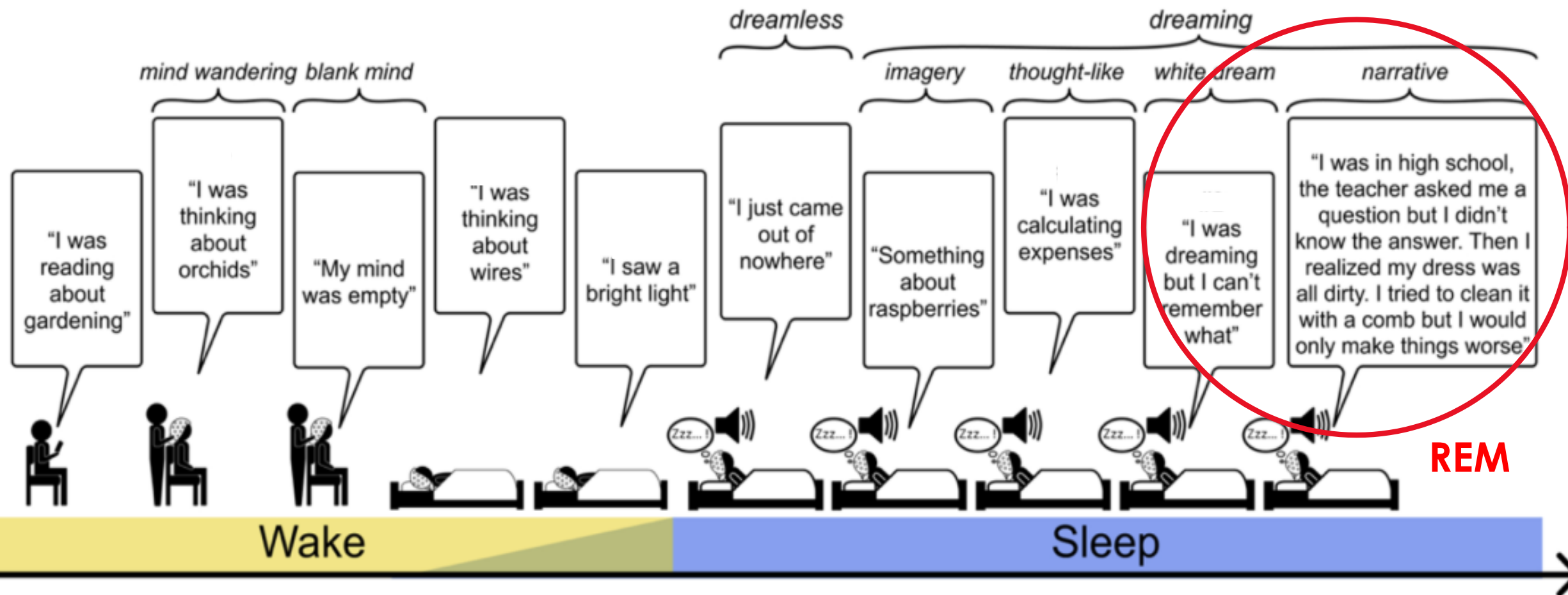
Experience Sampling in Wakefulness and Sleep

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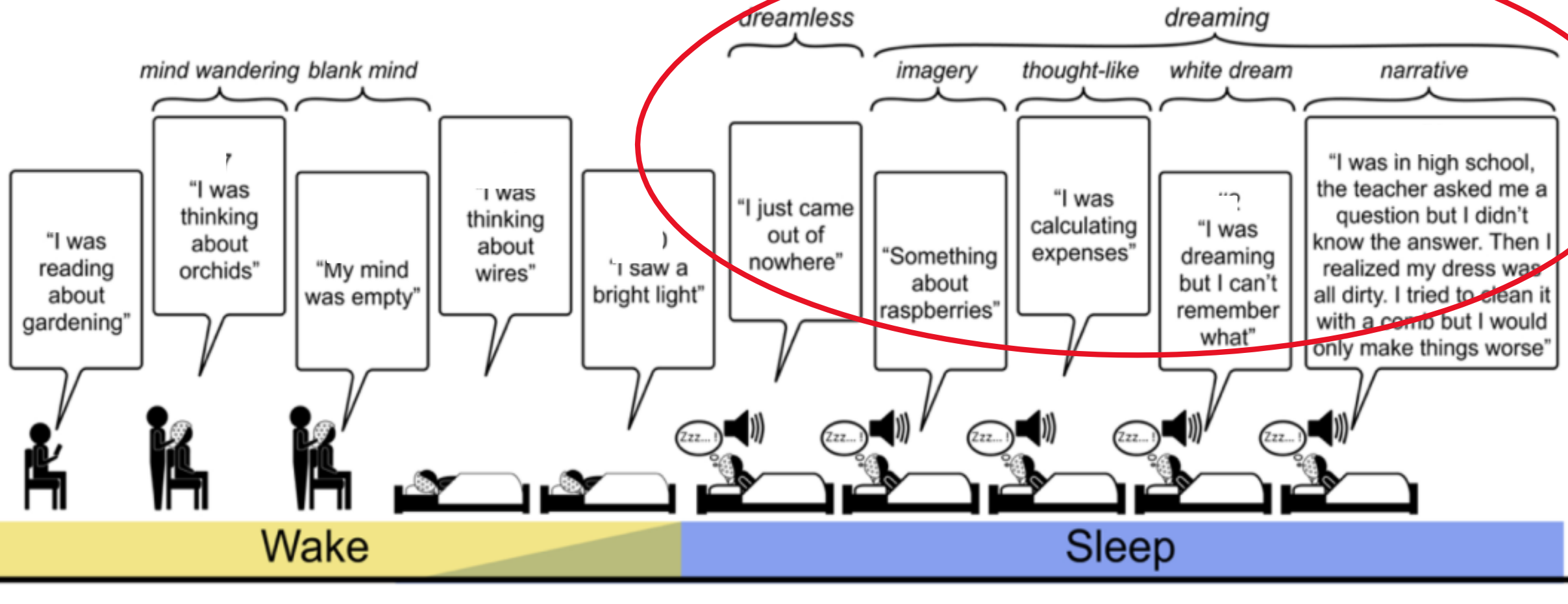


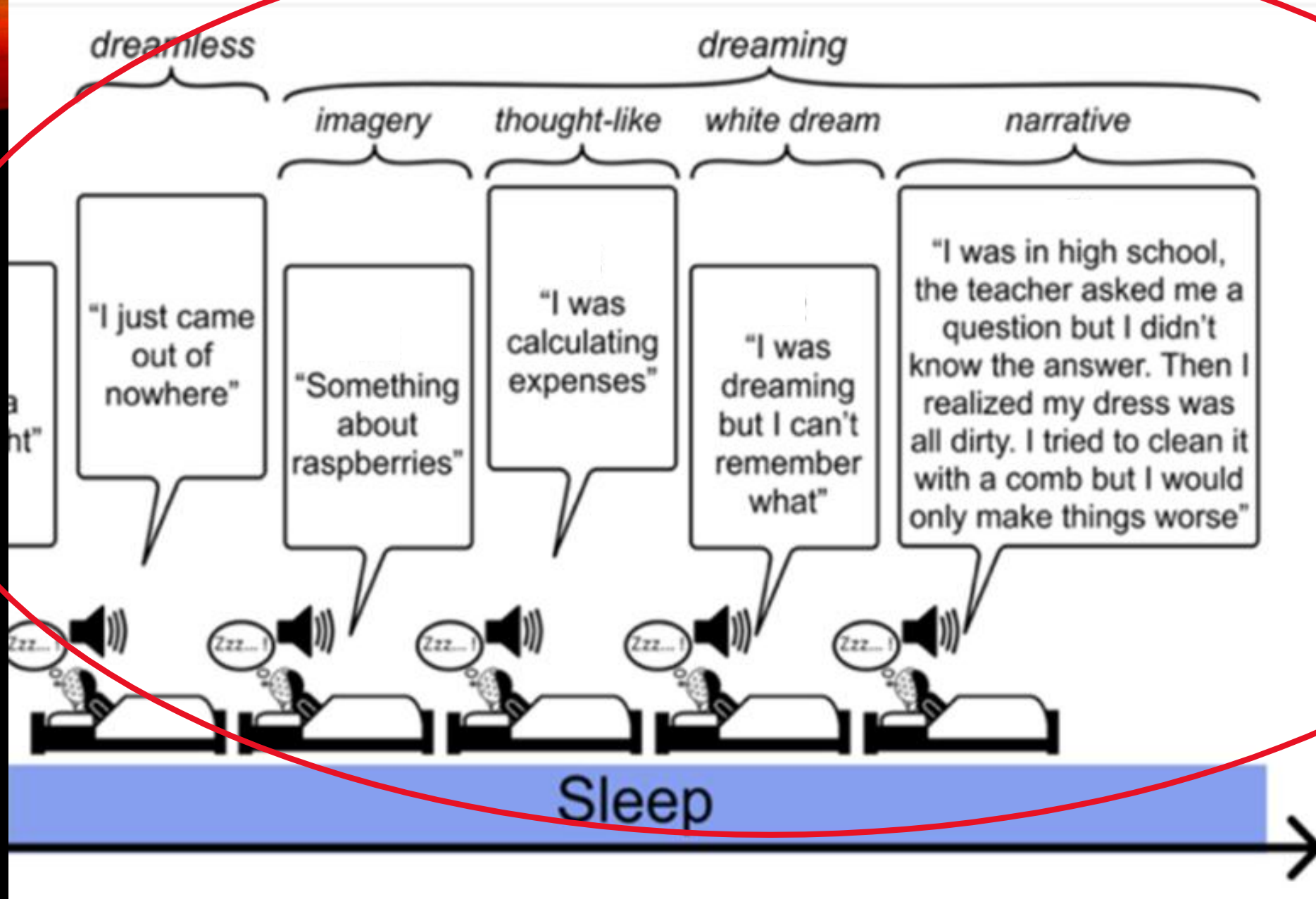
Experience Sampling in Wakefulness and Sleep

40



WHICH OF THESE HAVE YOU EXPERIENCED⁴¹





INSOMNIA

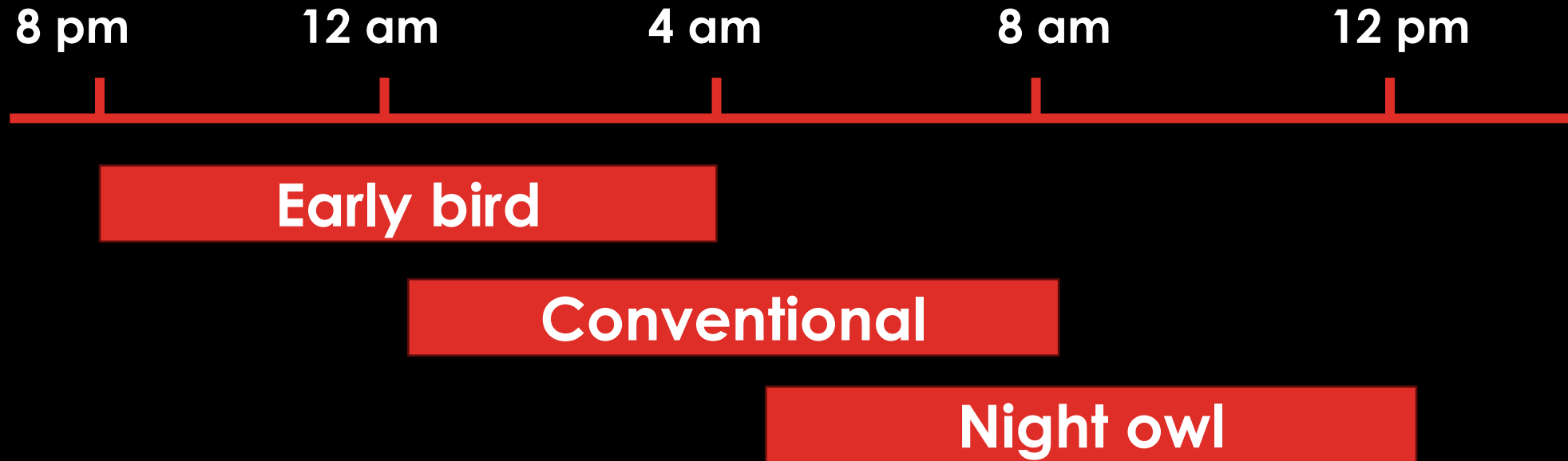
- A common sleep disorder
- Characterized by persistent difficulty
 - falling asleep*
 - staying asleep*
 - waking up too early*
- Leading to poor sleep quality
- Daytime impairment like fatigue, irritability, poor concentration
- Despite having sufficient opportunity for sleep

* Not specific number of hours or time of night; in “the eye of the beholder”

CHRONOTYPES

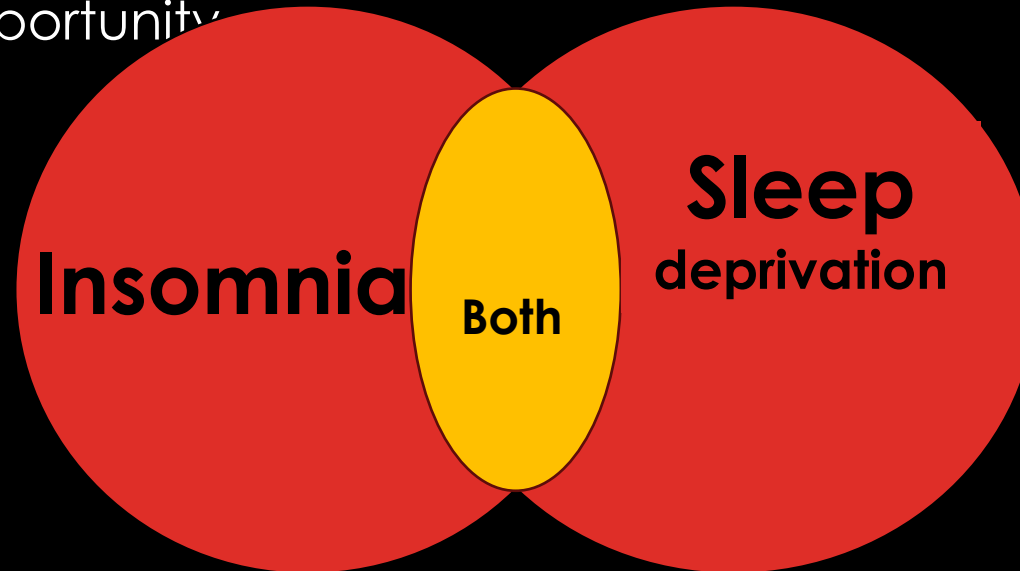
- Natural preferences of the body for wakefulness and sleep
- Influenced by genetics and driven by circadian rhythm
- Affect sleep as well as performance and activity throughout the day
- Adapting to one's natural chronotype can improve sleep quality, energy, and mood

CHRONOTYPES



INSOMNIA AND SLEEP DEPRIVATION ARE NOT THE SAME

- Has enough opportunity to sleep
- No obvious external sleep disruptors

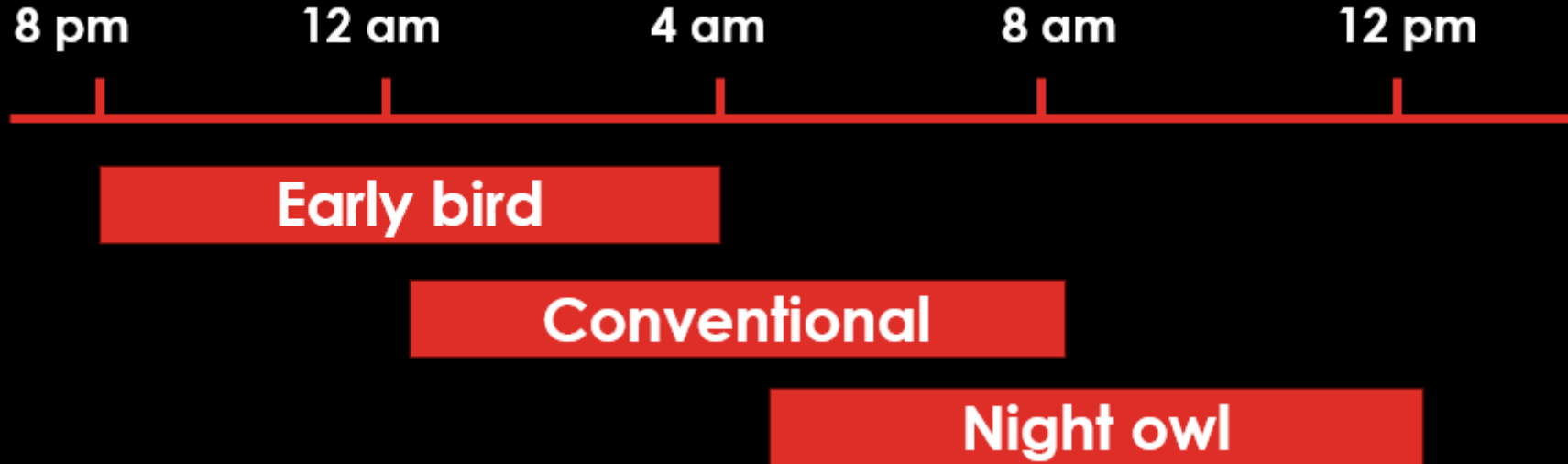


- Pulling all-nighters
- Not having enough time to sleep due to family/work obligations
- Significant disruptions from the environment (eg newborn)

WHAT IS YOUR CHRONOTYPE?

HOW IS YOUR SLEEP QUALITY?

WHAT IS YOUR CHRONOTYPE?



HOW IS YOUR SLEEP QUALITY?

FALLING ASLEEP

STAYING ASLEEP

WAKING UP IN THE MORNING



Tired

Worn out, depleted,
exhausted, bored, low
energy



Sleepy

Close to falling asleep,
eyes drooping, head
nodding



Tired

Worn out, depleted,
exhausted, bored, low
energy

Cure: stretch, walk, tea



Sleepy

Close to falling asleep,
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Cure: go to sleep



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Sleepy

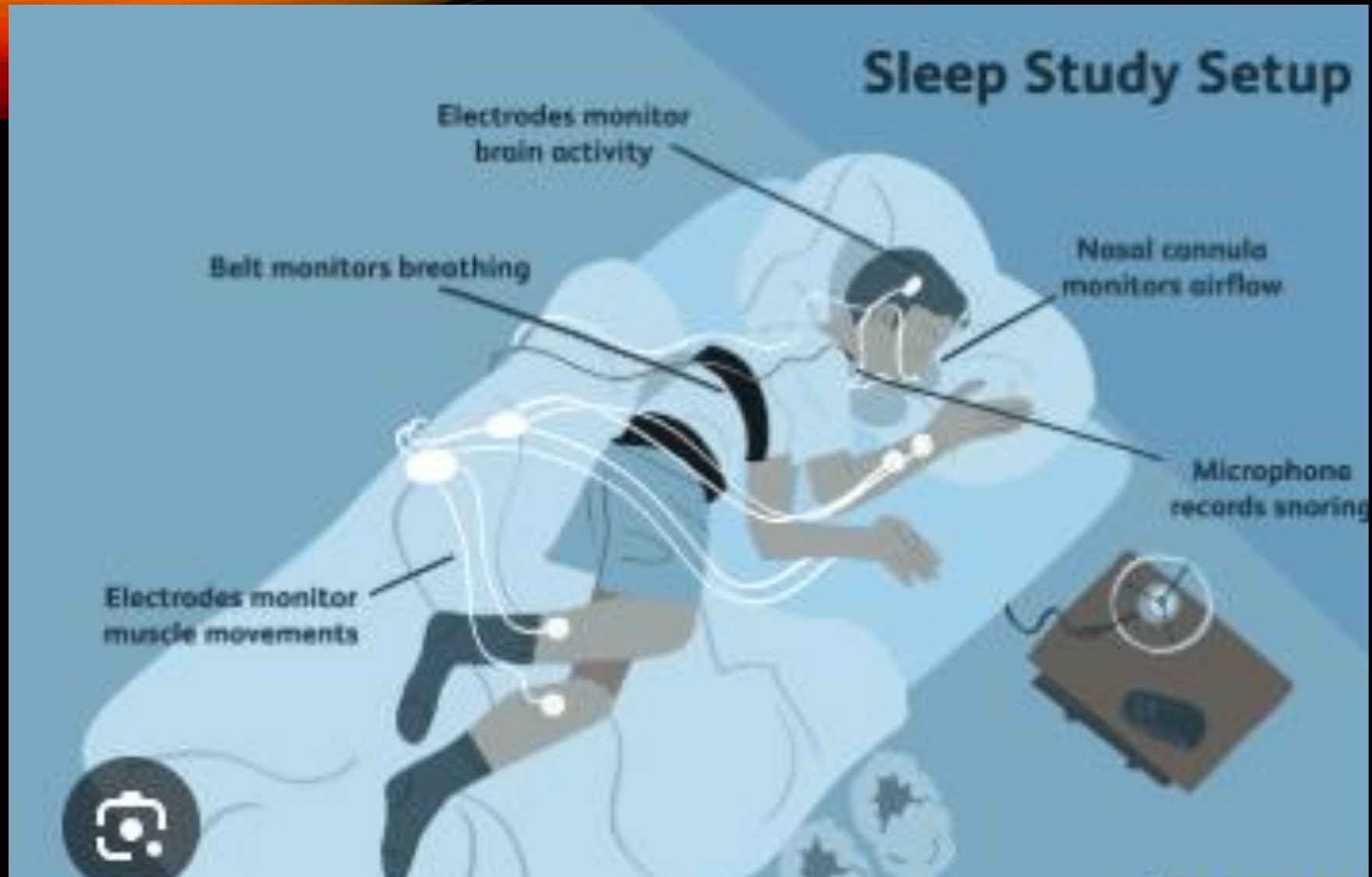
Close to falling asleep,
eyes drooping, head
nodding

Cure: go to sleep

Can you tell when you are tired from when you are sleepy?

TYPES OF INSOMNIA

- Acute
 - Short term, often triggered by stress, travel, life events
- Chronic
 - Long-lasting, occurring at least 3 nights/week for 3+ months
 - Can be due to other medical or psychological conditions, or as a primary disorder



PRIMARY SLEEP DISORDERS

- Sleep apnea
- Restless leg syndrome
- Narcolepsy



Patient dreaming of being treated by the god Asclepius (right) behind whom stands Hygea; to left, members of the patient's family

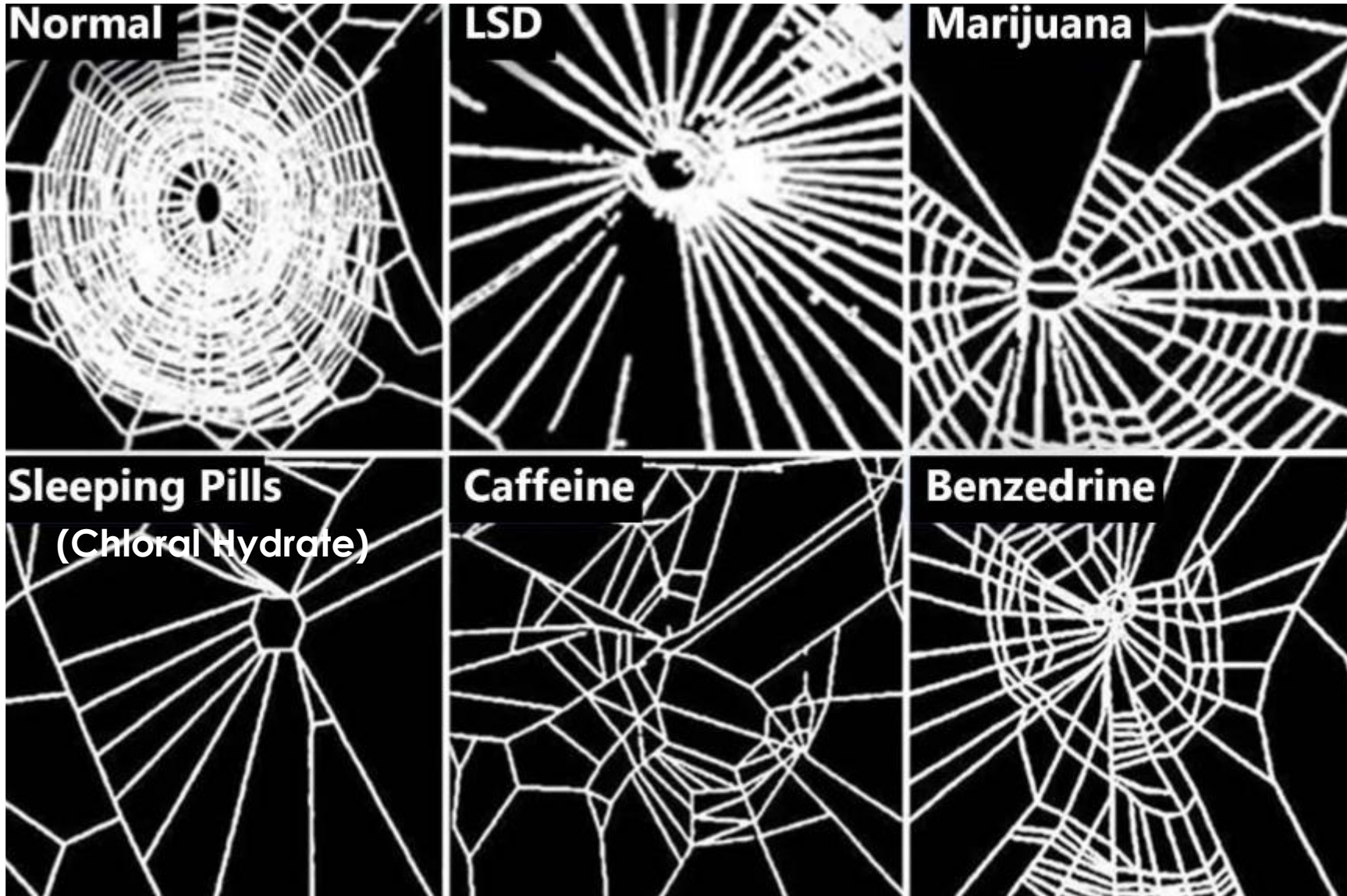
UNDERLYING MEDICAL & MENTAL HEALTH CONDITIONS ASSOCIATED WITH SLEEP DISORDERS

- Chronic pain
- Cancer
- Diabetes
- Heart disease
- Asthma
- Gastroesophageal reflux disease (GERD)
- Overactive thyroid
- Parkinson's disease
- Alzheimer's disease
- Depression and/or anxiety
- AND the drugs we take for them

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- **AND the drugs we take for them**

NASA: How Drugs Given to Spiders Affected Their Webs



A NASA study from 1995 shows just how different drugs affect the spiders' ability to make webs.

MEDICATIONS KNOWN TO CAUSE INSOMNIA

- **Decongestants:** Medications containing pseudoephedrine or phenylephrine
- **Beta-blockers:** Often used for high blood pressure or heart conditions
- **Steroids:** Medications like prednisone, often used for inflammation, can cause restlessness
- **Antidepressants:** Specifically SSRIs and tricyclic antidepressants
- **Asthma medicines:** Beta-agonists and theophylline can cause a jittery, waking effect
- **Alzheimer's medication:** Cholinesterase inhibitors like donepezil (Aricept)
- **Smoking Cessation aids:** Nicotine patches or varenicline (Chantix)
- **Diuretics:** Taken for high blood pressure, can cause frequent waking to use the bathroom

MEDICATION EFFECTS ON DREAM RECALL FREQUENCY

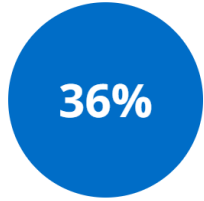
60

- **Alcohol, Benzodiazepines, Barbiturates**
 - Decreased REM 1st part of night, then REM pressure to catch up can lead to nightmares
- **Anti-depressants - SSRIs, SNRIs**
 - May cause abnormal dreams and realistic nightmares
 - Less time in REM sleep
 - **Perception of less dreaming:** Once quality of sleep or mental health symptoms improve, may have less dream recall
- **Blood pressure and heart medications like statins, beta-blockers**
 - Most associated with increase in vivid dreams and nightmares



Lack of Sleep Leads to Greater Risk

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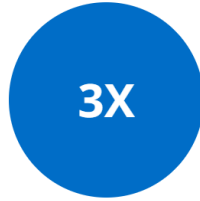
Increased Risk for Colorectal Cancer

36% increased in risk for colorectal cancer



Impacted Immunity

Less active immunity protectors called natural killer cells



Increased Risk for Type 2 Diabetes

Nearly 3X increased risk for developing type 2 diabetes



48%

48% increased risk of developing heart disease



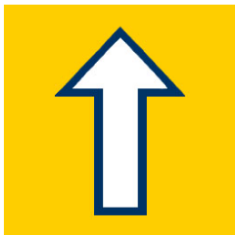
Higher Blood Pressure

Increased risk of high blood pressure



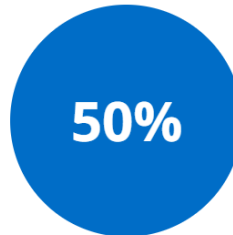
3X

3X more likely to catch a cold



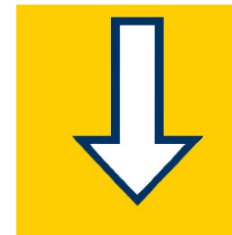
Feeling Hungrier

Higher levels of the hunger hormone ghrelin



Higher Risk for Obesity

50% higher risk for obesity if you get less than 5 hours of sleep nightly



Less Appetite Control

Lower levels of the appetite-control hormone leptin

BRAIN

- Depression
- Irritability
- Anxiety
- Forgetfulness
- Fuzzy thinking



33% Increase in Dementia Risk

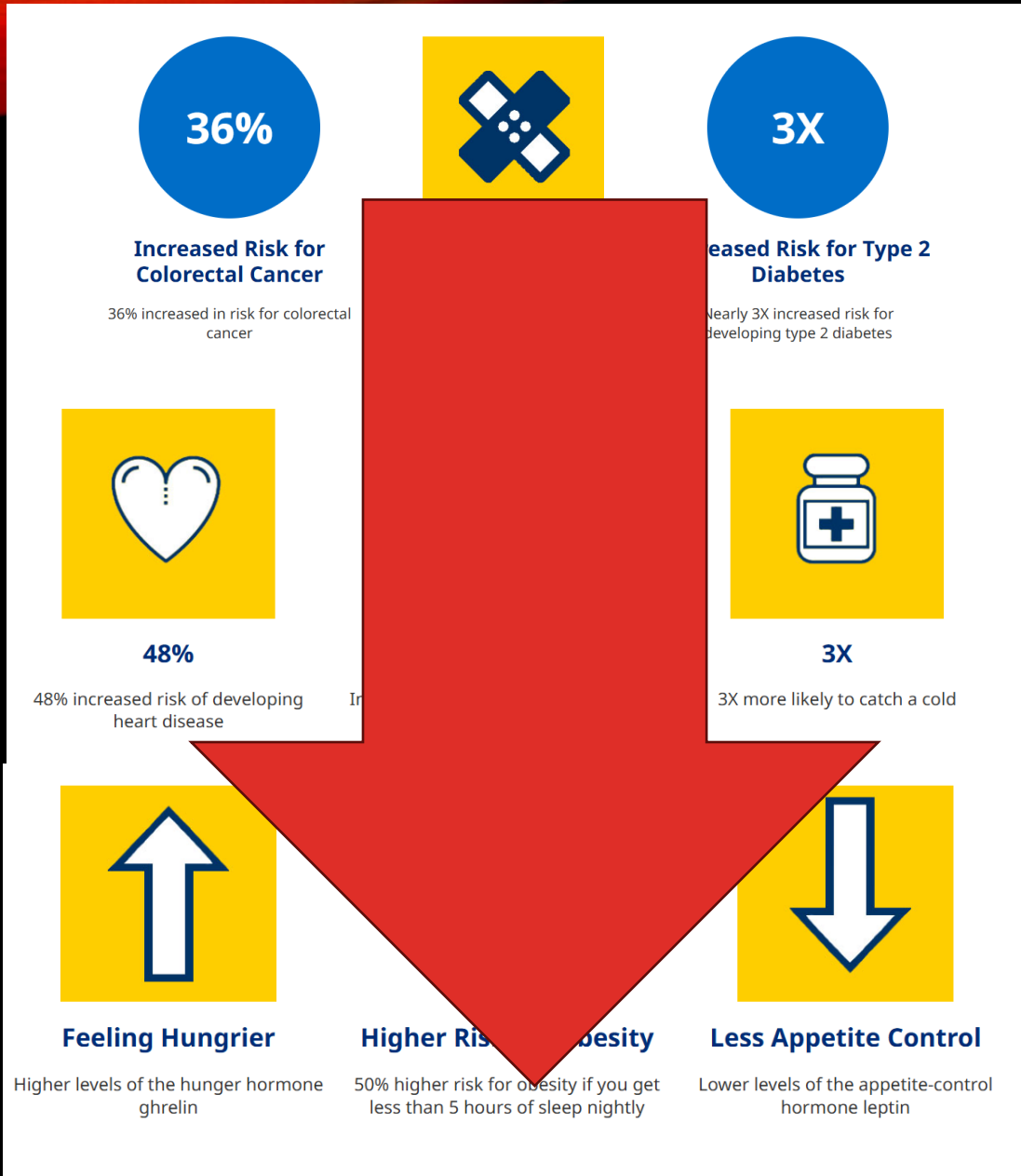


Sleep Deprivation Can Age Your Brain 3-5 Years

Source: John Hopkins Medicine

Quality Sleep Leads to Decreased Risk

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BRAIN

- Depression
- Irritability
- Anxiety
- Forgetfulness
- Fuzzy thinking

A large red arrow points downwards, indicating a decrease in risk. The infographic is divided into three columns by this arrow. The left column shows a 3X more likely chance to catch a cold. The middle column shows a 3X more likely chance to catch a cold. The right column shows a 3X more likely chance to catch a cold. Icons include a bandage, a heart, a pill bottle, and arrows.

Health Outcome	Risk Increase
3X more likely to catch a cold	3X
3X more likely to catch a cold	3X
3X more likely to catch a cold	3X

Source: John Hopkins Medicine

AGING AND SLEEP



- Circadian pacemaker (SCN) degeneration & decrease in melatonin secretion
 - Less consistent sleep-wake cycle
 - Changes in chronotype – more toward early bird
- Likely that most sleep problems due to
 - All the medical and psychiatric conditions mentioned, and meds used to treat them

SLEEP DIFFERENCES IN WOMEN & MEN

- Conclusion: Not major differences for the most part
- Most differences likely due to gender, eg social roles, caregiving, work schedules, stress, health behaviors
- Some biological differences, especially related to reproductive physiology

SLEEP IN WOMEN

- Menstrual cycle
 - Premenstrual syndrome associated with insomnia or hypersomnia
 - Post-ovulation phase associated with poorer sleep quality
- Pregnancy
 - 1st trimester – increased sleep
 - 3rd trimester – reduced REM sleep, restless leg syndrome, frequent waking
- Menopause
 - Insomnia, night sweats, hot flashes
- Post menopause
 - Increased risk sleep apnea
 - Overall better subjective sleep

SLEEP

Why

WHAT HAPPENS DURING SLEEP

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- Thus, memory & learning

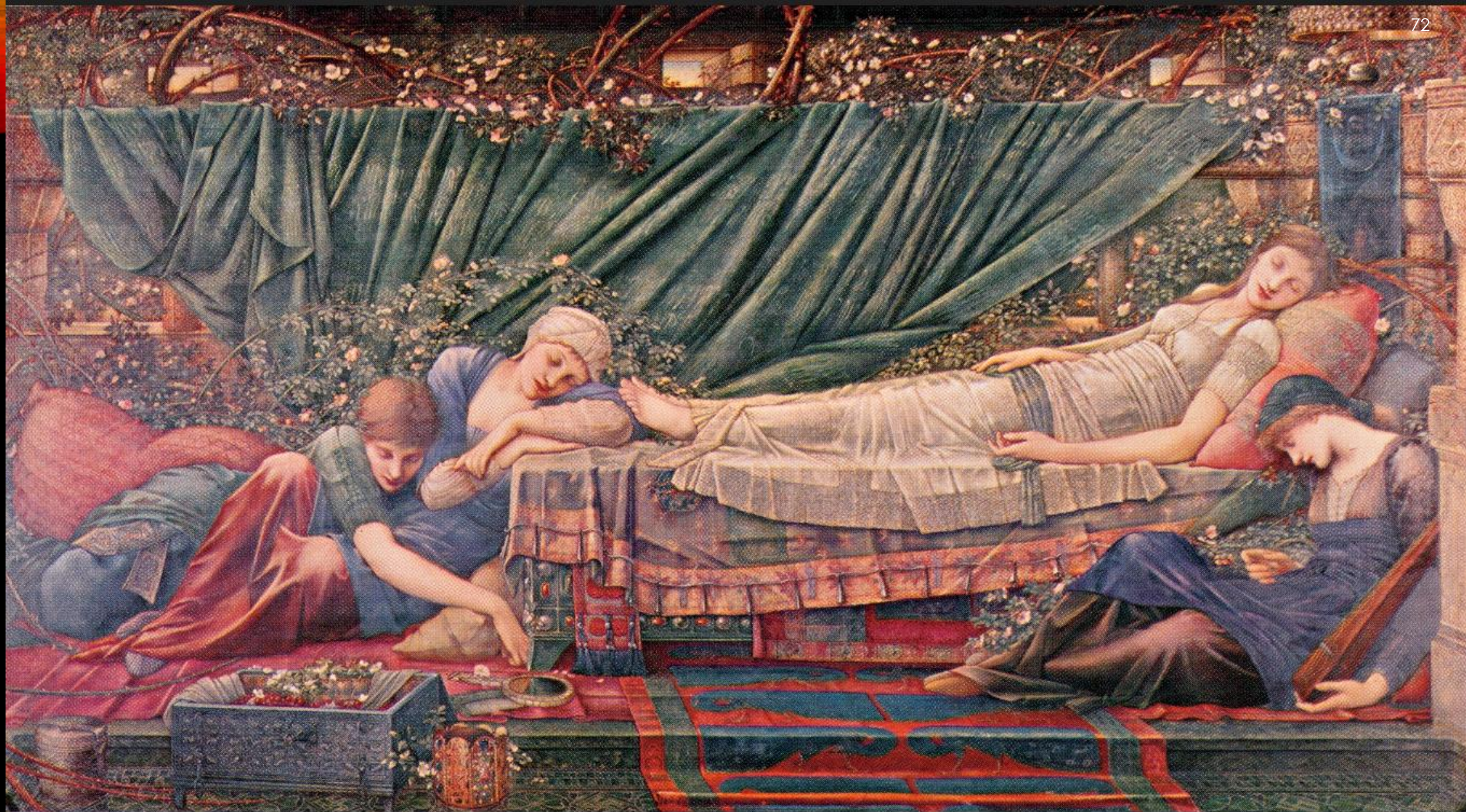
- Body

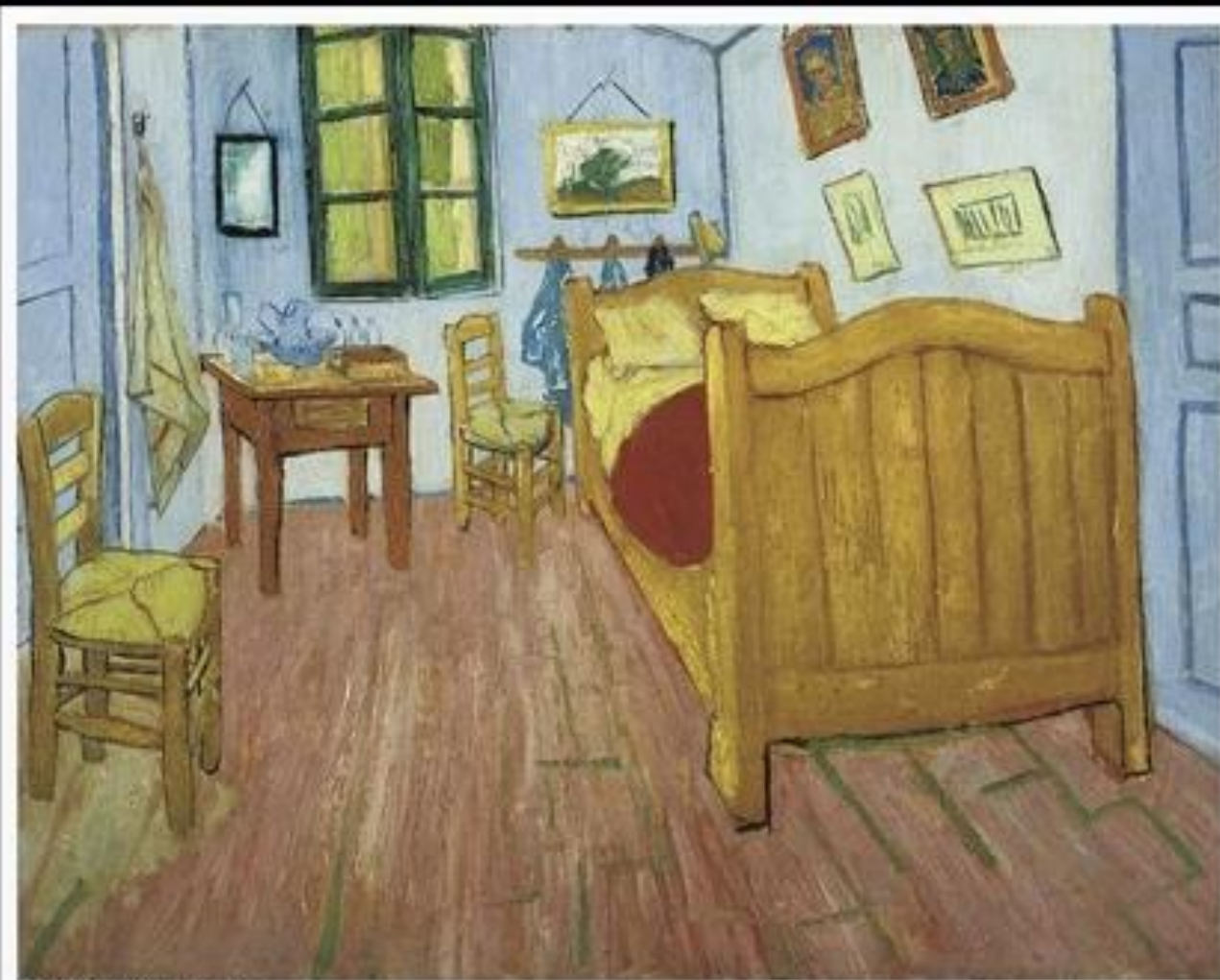
- Clearing toxins from cerebrospinal fluid
- Releasing appropriate hormones
- Repairing damaged tissue & maintaining healthy tissue

- No scientific consensus on why
- All animals sleep
- Intuitively organism that stayed awake would be more productive & less vulnerable to predators
- Why evolved this way

EVOLUTIONARY THEORY

- We're on a planet with recurring change in environment: Day & Night
- Need to adapt to survive in both
- Evolution favored animals that change physiology each day/night cycle





J.M.W. Turner, The Bedroom, 1840 (oil on canvas)

THANK YOU!