

# Sleep & Consciousness



## Awareness:

### Physiological Awareness:

- Conscious - wakeful and aware
- Semi-conscious - drowsy or inebriated
- Unconscious - deep sleep, sedation, coma

### Awareness is a product of:

- Alertness - enables us to **perceive**
- Attention - enables us to **focus**

### Brain activity can be measured:

- fMRI - functional magnetic resonance
- EEG - electroencephalogram

### Awareness is processed through:

Parallel processing - attending to multiple stimuli simultaneously

Feature detection - the automatic process by which the nervous system attunes to some stimuli more thoroughly than others

Feature detectors - groups of neurons in the brain that are dedicated to perceiving specific types of stimuli.

Fusiform face area - located in the **fusiform gyrus in the temporal lobe**

### Gamma 31-100 Hz

Poorly understood. More pronounced with heightened focus and among lifelong meditators.

### Beta 16-30 Hz

Normal waking consciousness

### Alpha 8-15 Hz

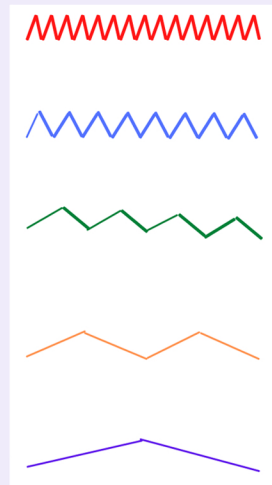
Correlated with resting and relaxation.

### Theta 4-7 Hz

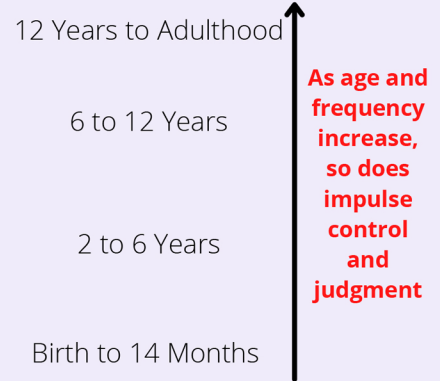
Drowsiness, hypnosis, some forms of meditation, light sleep

### Delta 0.1-3 Hz

Deep sleep



### Human Brain Waves by Age



Good  
Boy  
At  
The  
Dentist

**Remember: 1 Hertz = 1 cycle per second**

## Sleep:

### Sleep Cycles:

90-110 minutes in adults. About 3-4 cycles/night

| <b>N stands for Non-REM</b> | Sleep Stages:               | Characteristics  | Dominant Brain Wave | Duration  |
|-----------------------------|-----------------------------|--|---------------------|---|
| →                           | Stage 1 (N1)<br>light sleep | <u>hypnotic jerks</u> - involuntary twitches<br><u>hypnagogia</u> - Lifelike hallucinations that often involve floating or falling   | Theta               | 5-10 minutes                                      |
| ←                           | Stage 2 (N2)                | <u>Sleep spindles</u> - electrical activity from thalamus filters sensory input and consolidates memories<br><u>k-complexes</u> - generated in the cortex suppresses arousal and consolidates memories | Theta               | Usually occurs 2x/cycle<br>Most of our sleep time |
|                             | Stage 3 (N3)<br>deep sleep  | <u>Slow-wave sleep (SWS)</u><br>Most important for repair and recuperation   | Delta               | Most occurs during first half of night            |
|                             | REM<br>dreaming             | <u>Paradoxical sleep</u> - brain waves similar to being awake<br>Most dreaming occurs during REM   | ---                 | Most occurs during second half of night           |



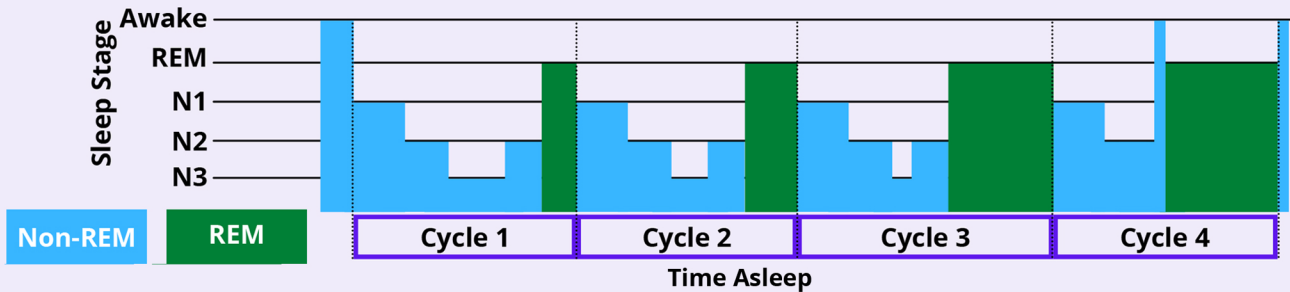
# Sequence:

First Cycle: N1 ⇒ **N2** ⇒ N3 ⇒ N2 ⇒ REM.

Subsequent cycles don't always have N3.

- Ex: N1 ⇒ N2 ⇒ N3 ⇒ N2 ⇒ REM
- Ex: N1 ⇒ N2 ⇒ REM

As the night progresses, less N3 and more REM.



| Age (years) | 0-2   | 3-5   | 6-13 | 14-17 | 18-25 | 26-64 | 65+ |
|-------------|-------|-------|------|-------|-------|-------|-----|
| Hours       | 12-17 | 10-13 | 9-11 | 8-10  | 7-10  | 7-9   | 7-8 |

It's just a myth that elders require more sleep

## REM:

Infants spend **50%** of their sleeping time in REM.

By adulthood, it's about **20%** and it stabilizes there.

## N3 (SWS):

**No SWS at birth.**

Lot's of SWS by 12 months

SWS declines at puberty, stabilizes in mid-20s.

Men over the age of 30 have **less SWS** than women.

## Benefits of Sleep

- Memory consolidation occurs in stages **N2, N3**, and **REM**
- Sleep assists mood, energy, creativity, perception, and judgment
- Regulates the immune system, cortisol, appetite
- During sleep, **glial cells shrink in size**, which allows the brain to remove waste more efficiently
- 7-8 hours of sleep on a regular basis has been correlated with longevity

## Circadian Rhythm

- Humans have "internal clocks" set at 24 hour cycles. This daily rhythm:
  - Is located in the **suprachiasmatic nucleus (SCN)** in the hypothalamus
  - Integrates sensory input from the **retina** (daylight)
  - Is mediated by
    - Melatonin from the **pineal gland**
    - Cortisol from the **adrenal glands**
    - Neurotransmitter signaling
- **Artificial lights** can disrupt this clock
  - usually in the direction of extending the clock to 25 hours or more
- Teenagers have different circadian rhythms than adults
  - Teen alertness peaks about **2 hours later** than it does among adults