SLEEP: WHAT IS IT AND WHY DO WE NEED IT ?

Richard Goodstein DO FCCP FACOI

Medical Director , James B. Haggin Memorial Sleep Lab.

WHAT IS SLEEP ?

DEFINITION OF SLEEP

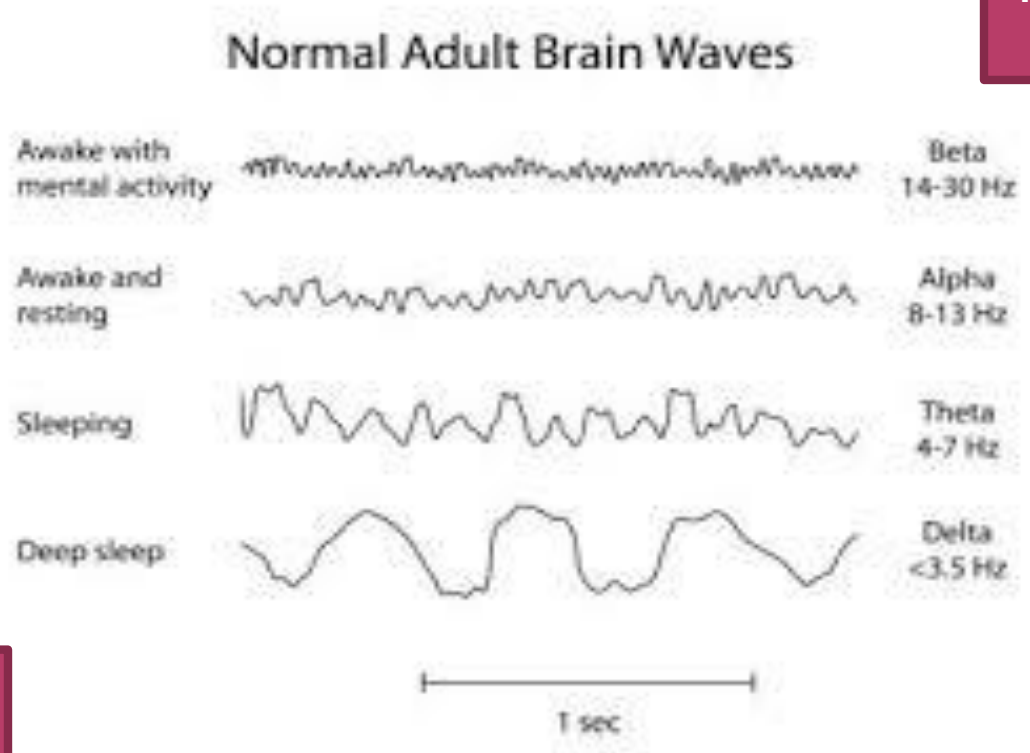
- Reversible cyclic physiologic dissociation from environment
- Characterized by physiologic and neurologic stage specific features
- Age specific variants of norm
- Restorative
- Normative physiologic function sleep dependent
- Universal across time and species

SLEEP IS HETEROGENOUS

- Non-REM : Stage I
  Stage II
  Stage III
- REM

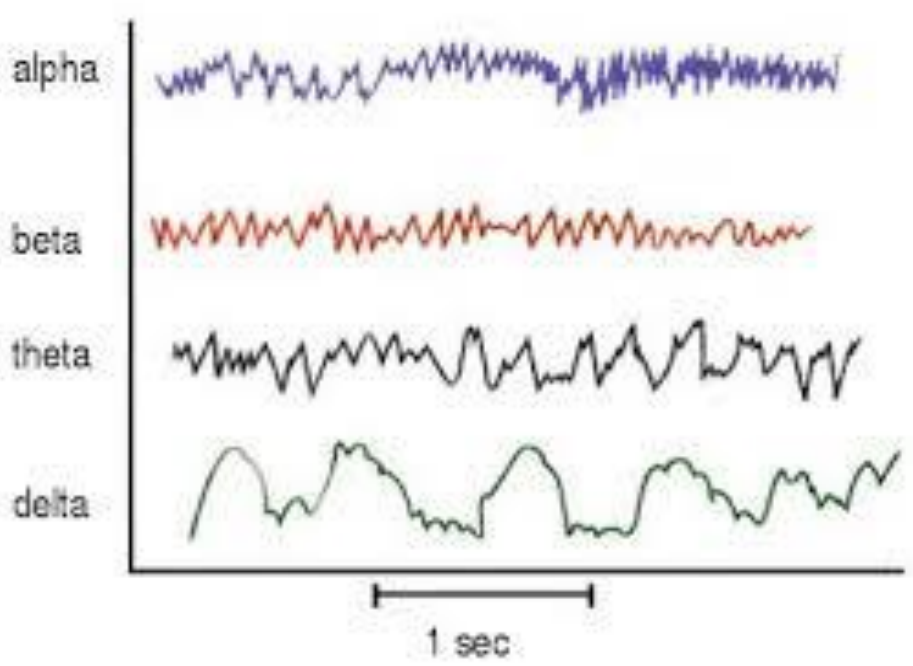
EEG DEFINES SLEEP AND SLEEP STAGES

DECREASING FREQUENCY



DECREASING VOLTAGE

WAVEFORMS OF SLEEP

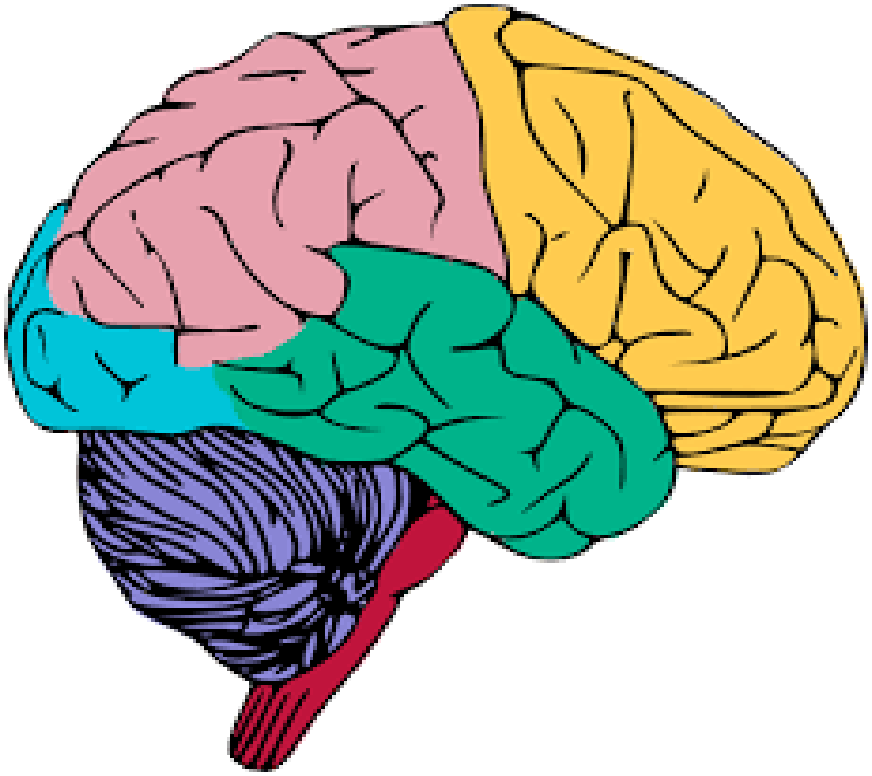


PARIETO-OCCIPITAL

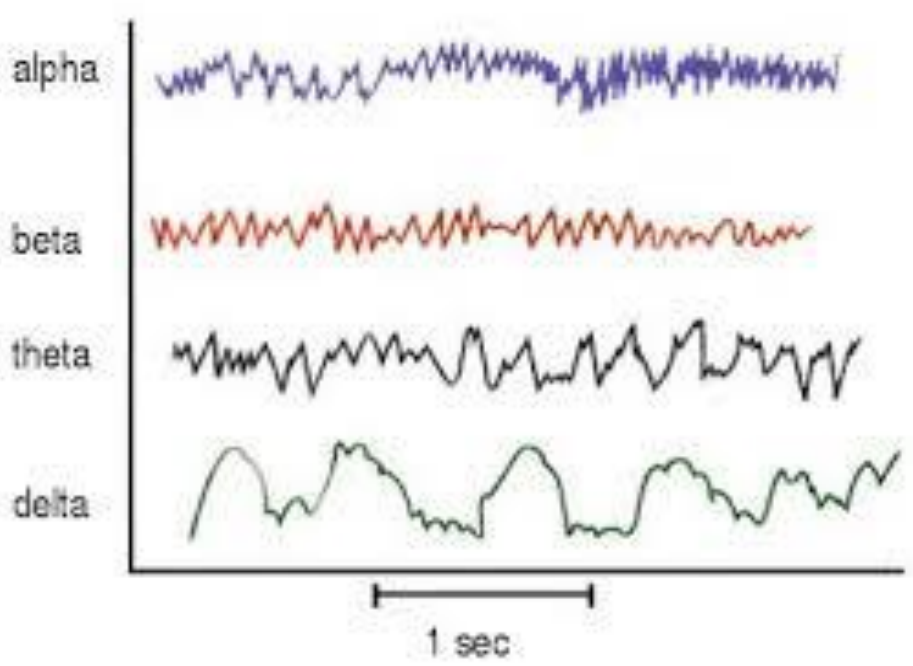
FRONTO-CENTRAL

CENTRAL OR TEMPORAL

DIFFERENT WAVEFORMS DIFFERENT NEUROANATOMY



WAVEFORMS OF SLEEP



PARIETO-OCCIPITAL

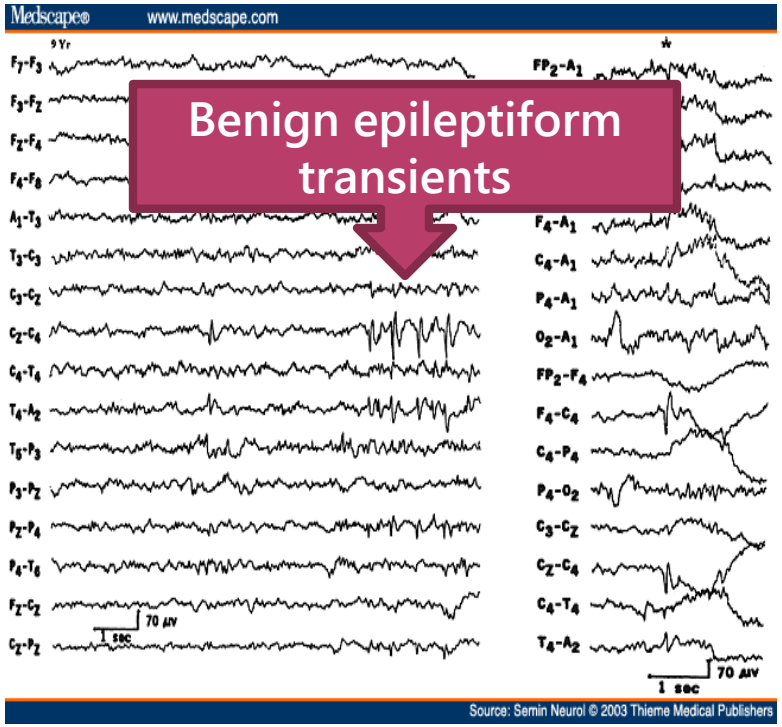
FRONTO-CENTRAL

CENTRAL OR TEMPORAL

WAVEFORMS

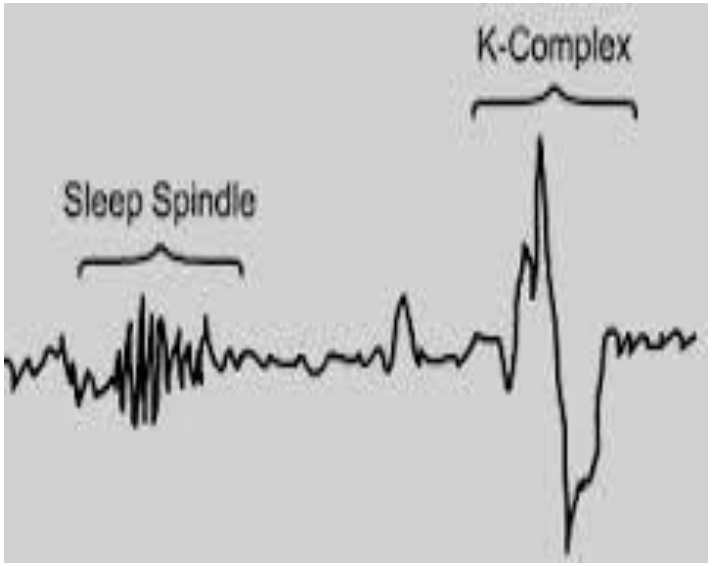
- Specific cortical activity
- Specific Arousal Thresholds
- Specific metabolic and autonomic functions

N1 SLEEP



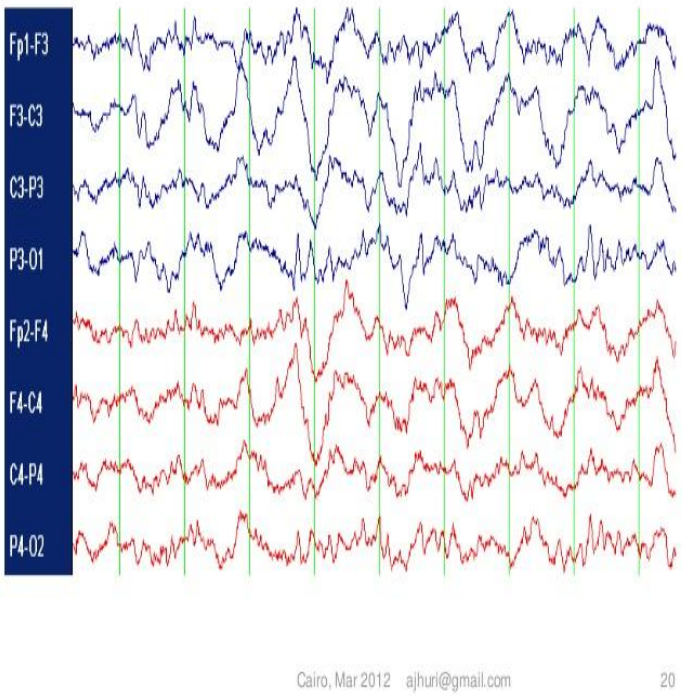
- Transition from awake to sleep
- As Alpha decreases …theta , beta and vertex waves.
- Slow rolling eye movement
- ~ 5% of sleep

N2 SLEEP



- K complex >0.5 sec
- Associated with Sleep Spindles
- Begin to see Delta waves < 50%.
- ~50% of sleep

N3 SLEEP

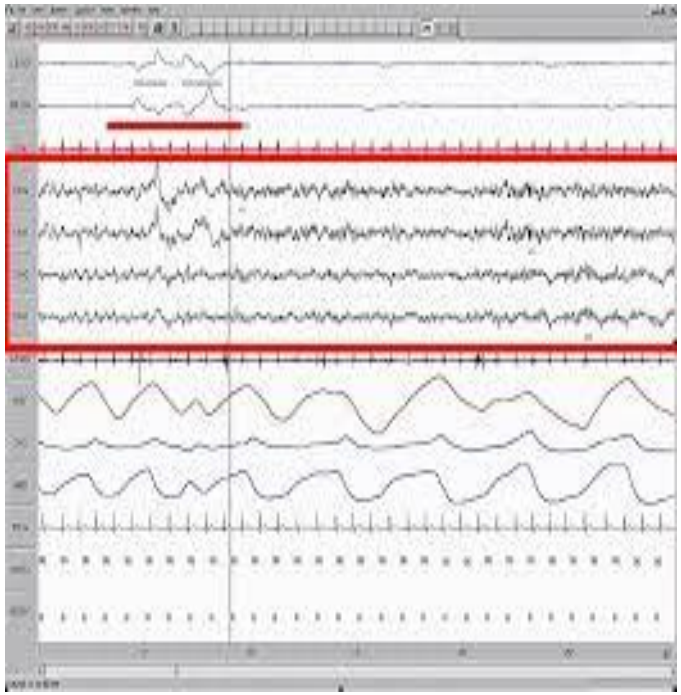


- Delta waves > 50%
- 20% of Sleep
- Memory consolidation
- Slow Wave Sleep
- ~ 10% of dreams but more realistic

N3 SLEEP

- Memory consolidation
- Somatrophic axis
- Decreases with age. Females> Males (Sign of Aging).

REM SLEEP



- REM
- Motor reduction or absence (hypotonia or atonia)
- Low voltage high frequency waves

REM SLEEP

- Cardiopulmonary Variability
- Paradoxical Sleep
- Cyclic ; ultradian
- Dreams …90% . Vivid and bizarre.
- 20-25% of sleep

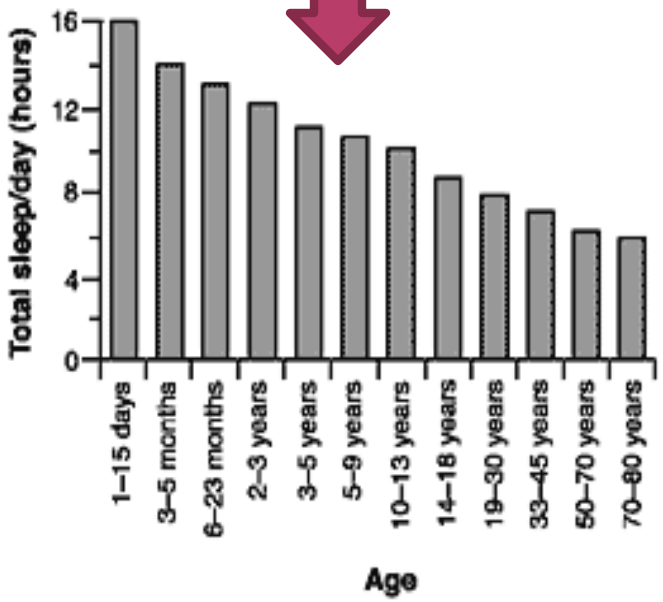
REM SLEEP

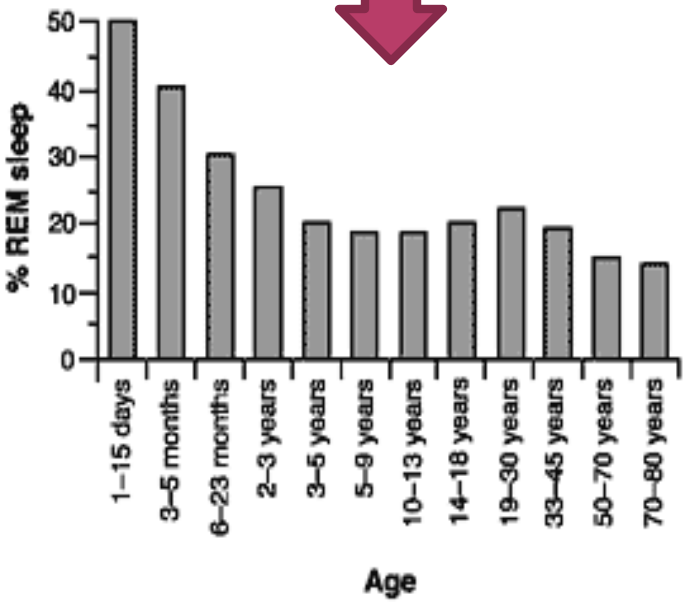
- Mood
- Memory
- Neuronal development especially in infants

REM SLEEP OVER THE LIFE SPAN

Sleep declines over time

REM Declines over time and cycles become longer



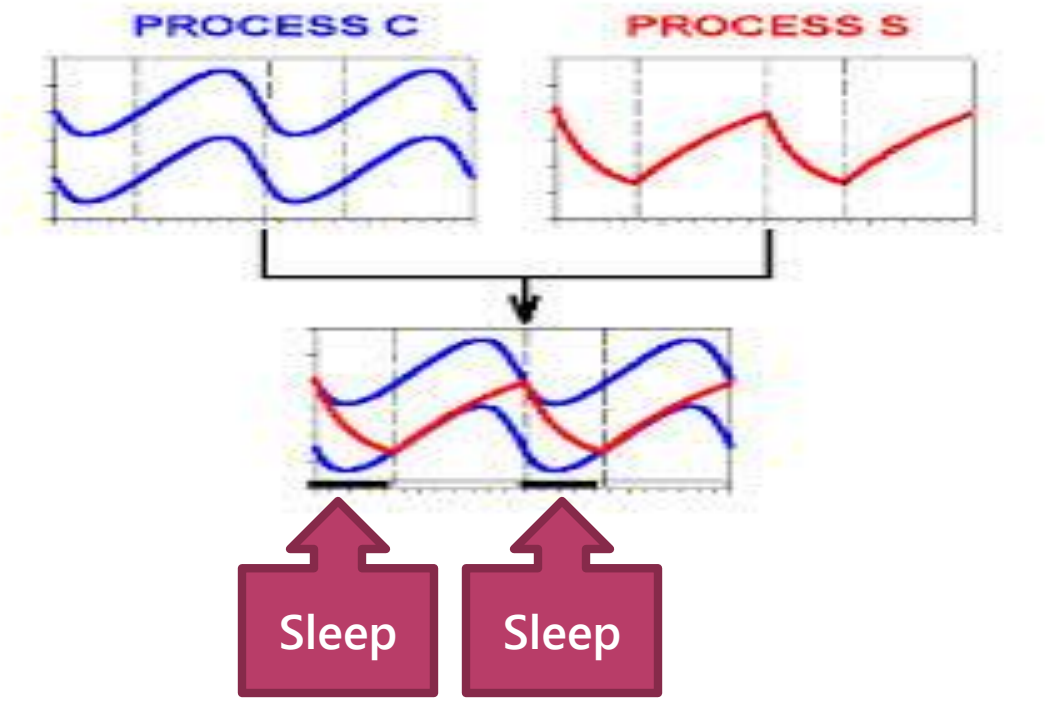


Data from Roffwarg, H.P., J.N. Muzic, and W.C. Dement. 1966. Ontogenetic development of the human sleep-dream cycle. *Science*, 152: 604–619.

REM OVER TIME

- Newborn + infants….50%
- Puberty….40%
- Adult….25%
- Elderly ….declines

WHAT MAKES US SLEEP ?



TWO PROCESS SLEEP-WAKE CYCLE

- PROCESS S…WAKE DEPENDENT
- PROCESS C…WAKE INDEPENDENT

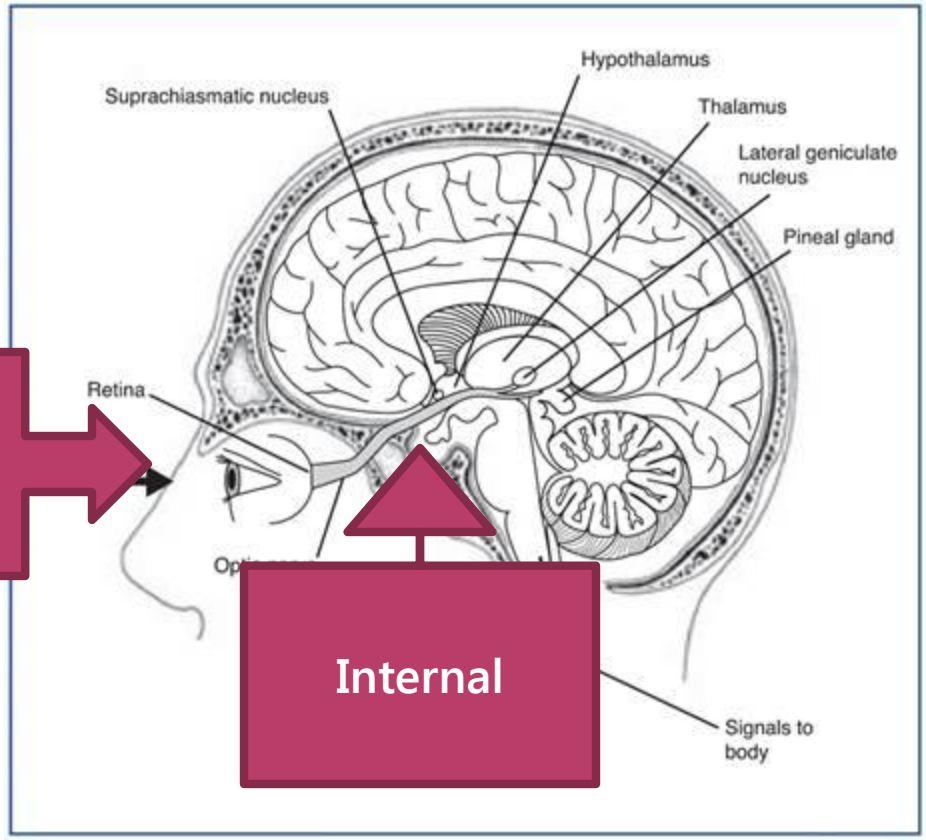
PROCESS S

- Sleep onset based on level of wakefulness and activity
- As Sleep progresses level of wakefulness should increase

TWO PROCESS SLEEP-WAKE CYCLE

- PROCESS S…WAKE DEPENDENT
- PROCESS C…WAKE INDEPENDENT

PROCESS C (CIRCADIAN)



External

" Zeitgebers"

Internal

Genetics , Medication , Disease and Affective Disorders

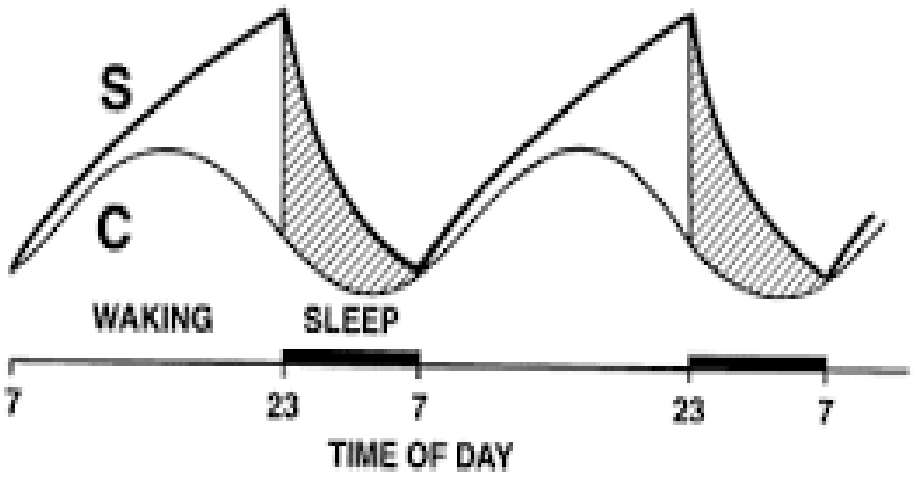
PROCESS C

- SCN…above optic chiasm at base of III Ventricle
- Delays in young
- Advance in elderly
- Affected by visual changes (cataracts)…esp. low frequency wavelengths .

PROCESS C AND AGING

- Amplitude and timing of the cycle decreases with age
- Loss of cortical mass
- Decreased cortical synapses
- Decreased neurotransmitters

SLEEP WAKE CYCLE

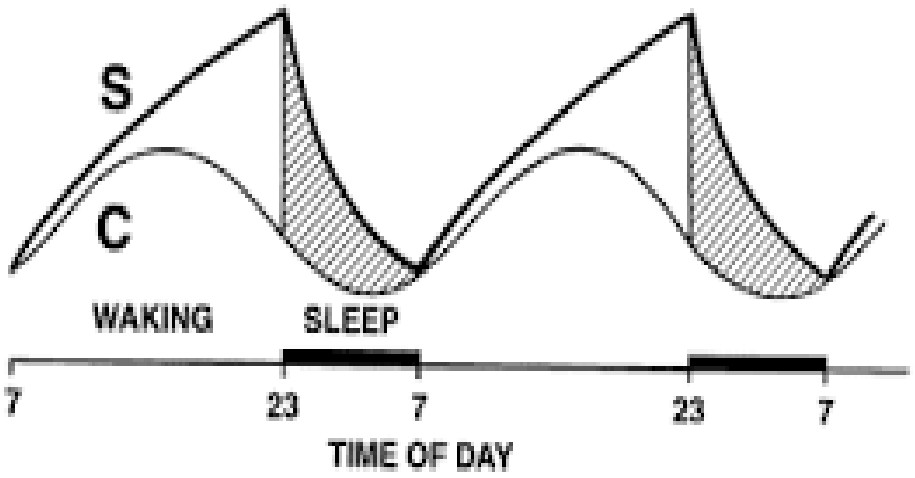


PROCESS C AND AGING

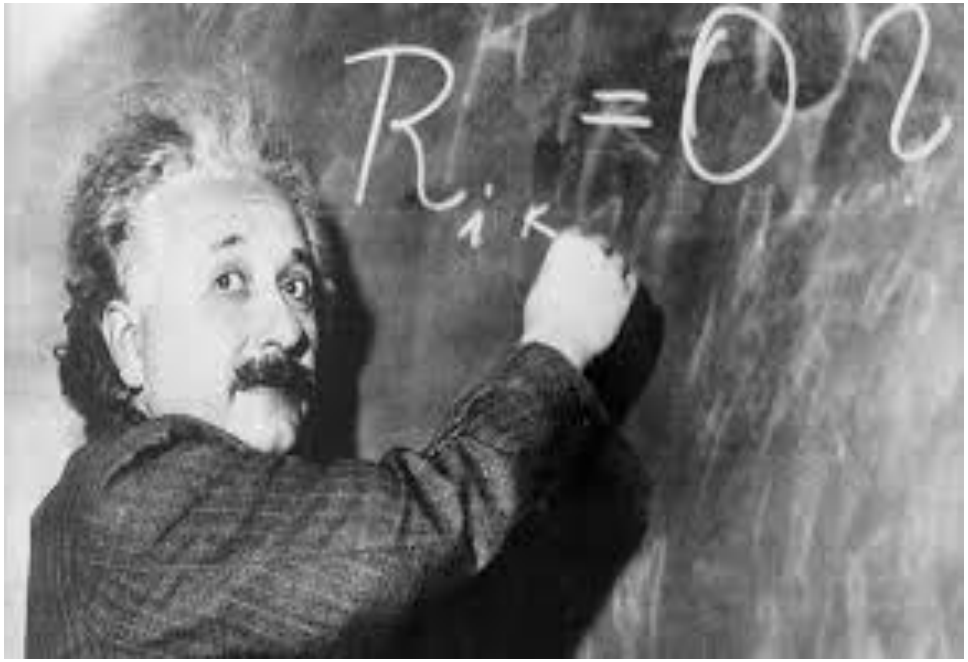
- Amplitude and timing of the cycle decreases with age
- Loss of cortical mass
- Decreased cortical synapses
- Decreased neurotransmitters

BORBELY'S TWO PROCESS SLEEP-WAKE CYCLE (A.BORBELY SECRETS OF SLEEP 1984)

SLEEP WAKE CYCLE

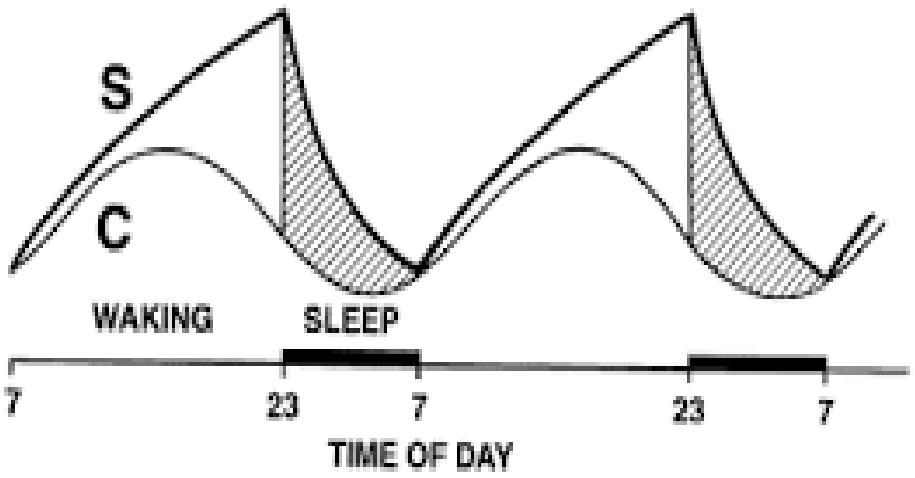


HOW DOES THIS WORK ?



IT'S WORSE THAN ROCKET SCIENCE

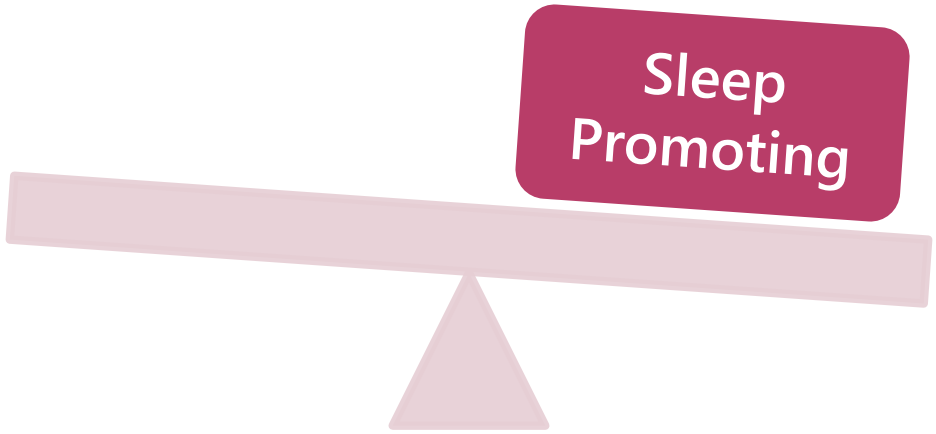
SLEEP WAKE CYCLE



SLEEP

Arousal

Sleep

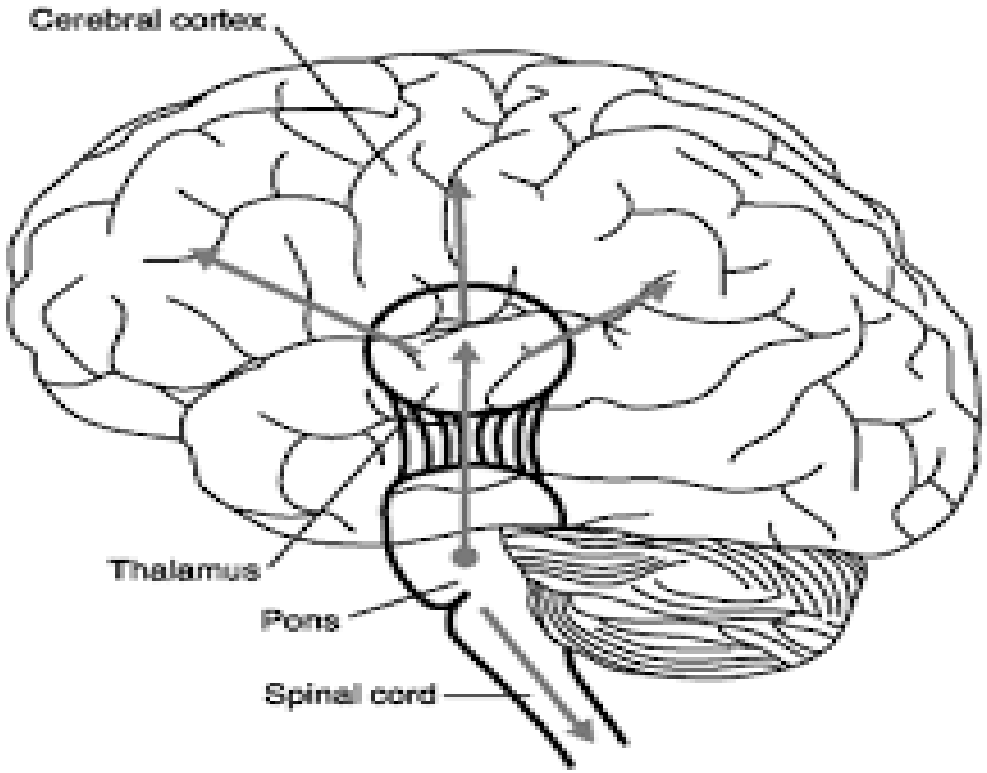


BIOCHEMICAL BASIS OF SLEEP

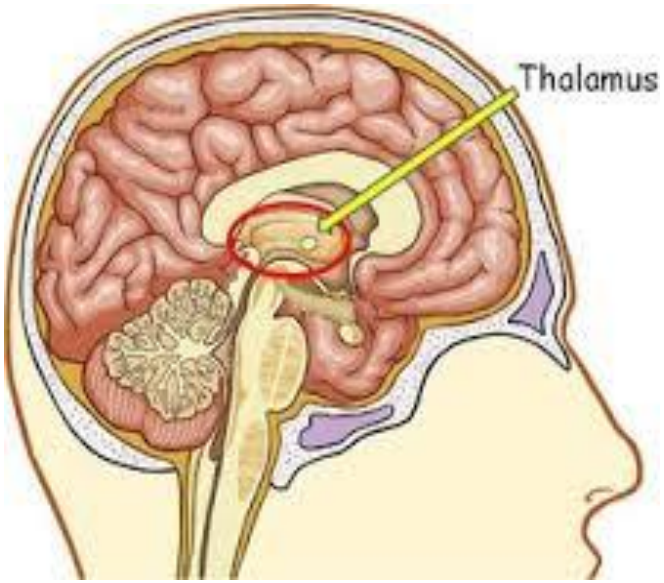
- Acetylcholine
- Adenosine
- GABA
- NE
- Dopamine
- Orexin

SLEEP PROMOTION	AWAKE

NEUROANATOMY OF SLEEP



THALAMUS



- Delta waves and Spindles
- Relay that blocks afferents activity
- Blocks efferents to Pons in REM

BIOCHEMICAL INFORMATION TRANSLATED ELECTRICALLY ACROSS THE BRAIN

WHAT IS SLEEP ?

- A complex anatomically and biochemically interactive process .
- Associated with a reversible withdrawal from external environment
- Goal oriented
- Heterogeneous / Stage Specific
- Cyclic
- Restorative

RESTORATIVE

- Energy Conserving
- Metabolic Function
- Memory Consolidation
- Immunologic Processing
- Regeneration / Repair
- Growth especially in neonate/young
- Well-being

APOTOSIS (CELL DEATH)

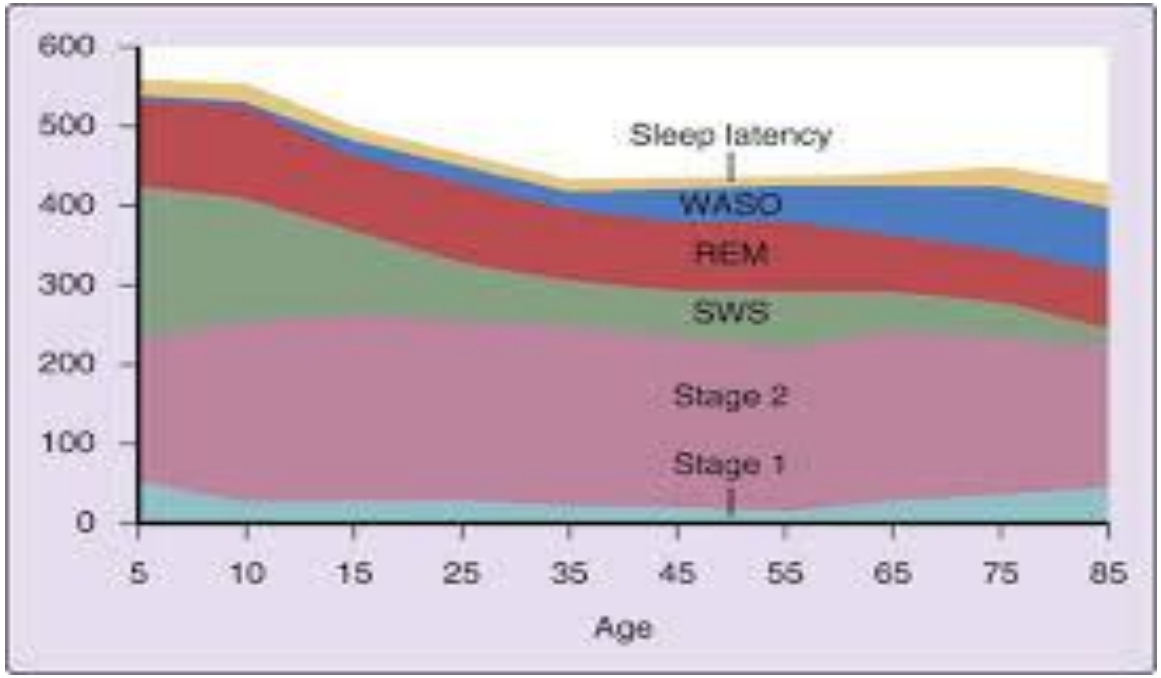
- PROGRAMMED
- INDUCIBLE
- INCREASES IN INFLAMMATORY STATES
- INFLAMMATORY STATES ARE QUANTITATIVELY AND QUALITATIVELY RELATED TO SLEEP

RESTORATIVE

- Energy Conserving
- Metabolic Function
- Memory Consolidation
- Immunologic Processing
- Regeneration / Repair
- Growth especially in neonate/young
- Well-being

WELL BEING ....

AGE AND SLEEP



HOW MUCH DO WE NEED ?

“ I HAVE YET TO SEE ANY PROBLEM HOWEVER COMPLICATED , WHICH, WHEN LOOKED AT THE RIGHT WAY, DID NOT BECOME MORE COMPLICATED.”

PAUL WILLIAM ANDERSON