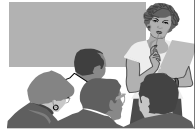


# Sleep

Neil B. Kavey, MD  
Columbia Presbyterian Medical Center

**No longer think of  
sleep as an isolated  
block  
of time at the end of  
the day.**



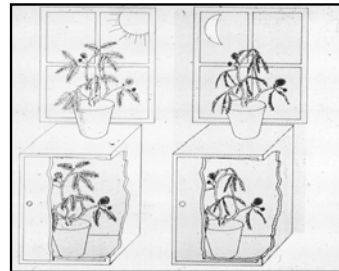
**Sleep is not just the  
absence of wakefulness,**

**It is an active  
physiologic process.**

**SLEEP IS PART OF A 24  
HOUR CYCLE OF SLEEPING  
AND WAKING BEHAVIOR.**

## **Circadian**

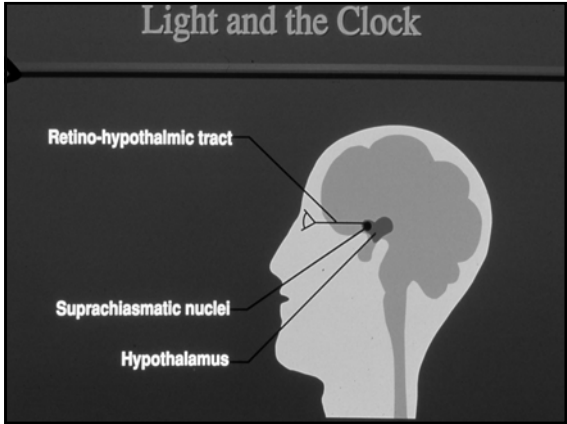
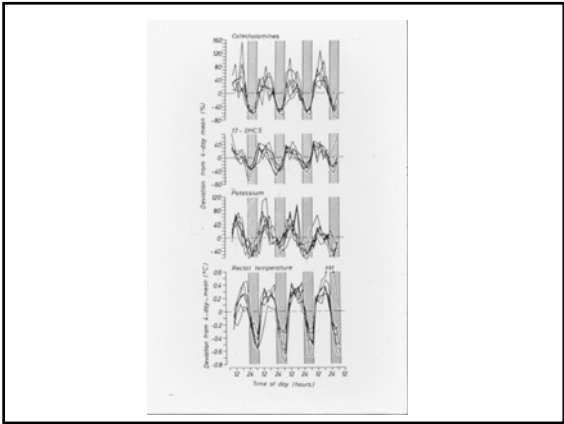
**From the latin *circa*  
(about) + *dies* (day)**



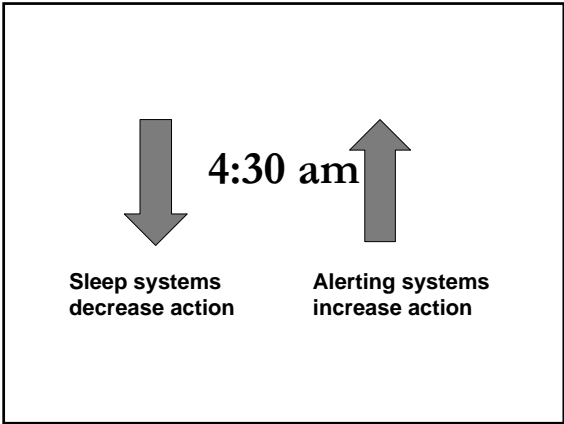
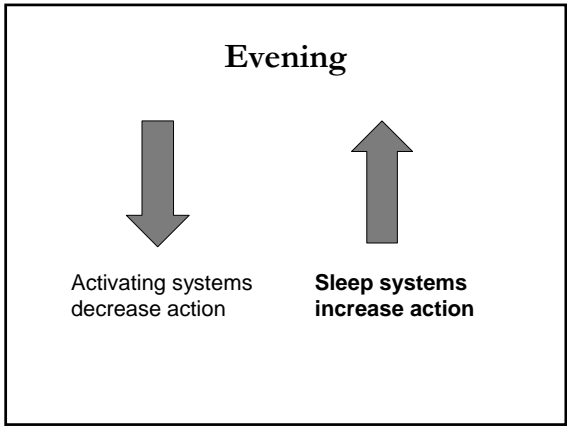
*The first demonstration of a circadian rhythm by Jean  
Jacques d'Ortous de Mairan in 1729*

Sleep Academic Award

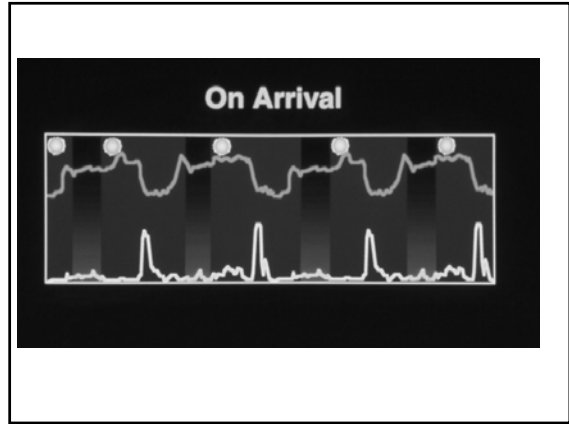
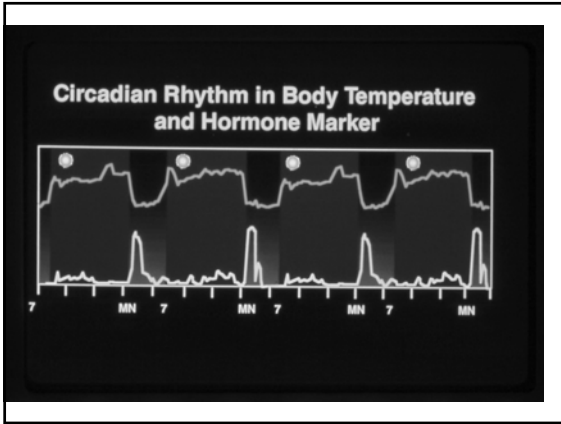
3



**Over a 24 hour period two discrete systems flow one into the other.**



**Our biological clocks are demonstrated in jet lag**



**Neuroanatomical  
Neurophysiological  
Neurochemical  
Studies**

To localize sleep and wakefulness  
Beginning in the 1930's

**3 types of studies to localize sites**

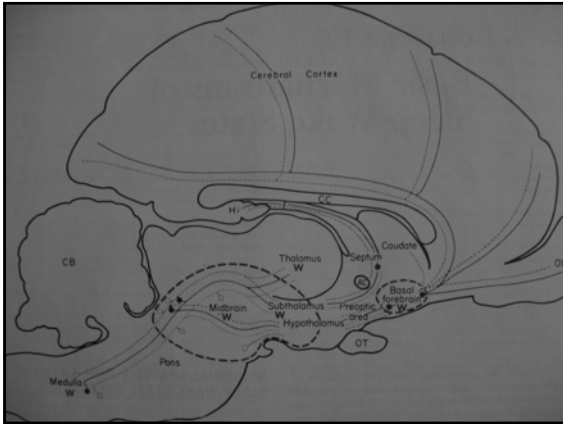
- 1. Transection**
- 2. Stimulation**
- 3. Lesion**

**1940's Moruzzi and Magoun**

1. Electrical stimulation of the brainstem reticular formation, but not the sensory pathways, produced cortical activation consistent with wakefulness
2. Lesions in the same area produced cortical deactivation and slow waves
3. Most effective lesions that produced cortical deactivation were in the midbrain and extending forward into the posterior hypothalamus

This became known as the:

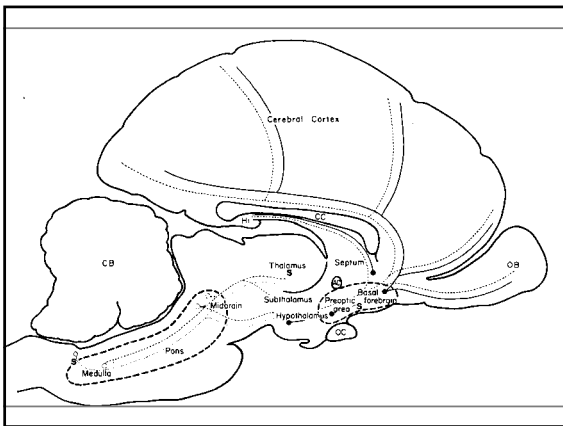
**ASCENDING RETICULAR ACTIVATING SYSTEM**



The same types of studies showed that:

Stimulation of certain areas of the brainstem such as the medullary reticular formation (Nucleus of the solitary tract) produced cortical synchronization (sleep)

Lesions of these specific regions produced cortical activation (wakefulness)



**Most recently the HYPOTHALAMUS has emerged as an area of great importance for both sleep and wakefulness**

This next slightly different schematic of the cat brain shows the sites of study by Jouvet and colleagues

REM sleep promoters – cholinergic neurons of the roof of the pons – REM ON

Laterodorsal tegmentum (LDT)

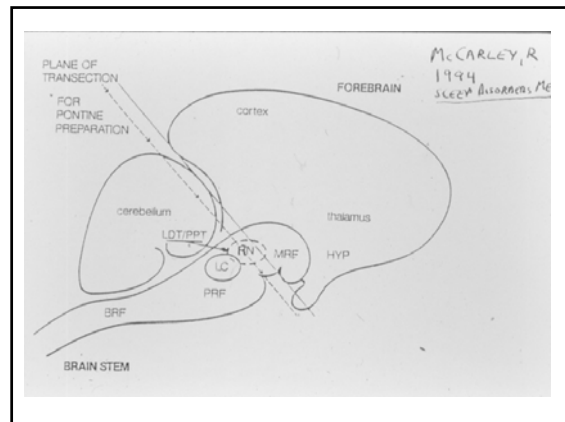
Pedunculopontine Tegmentum (PPT)

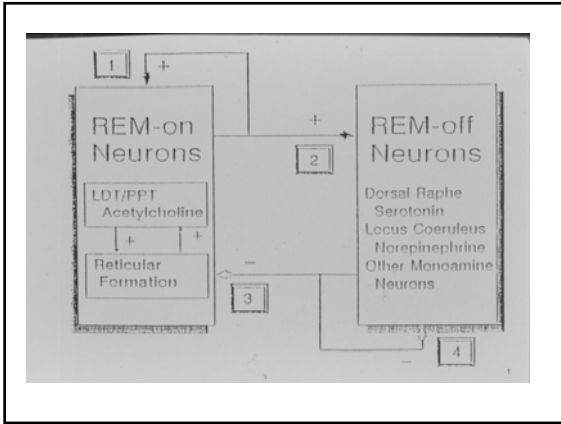
REM sleep suppressors – monoaminergic neurons

REM OFF

Locus Ceruleus (noradrenergic)

Raphe Nucleus (serotonergic)





### Neurochemical regulation of awake and sleep and REM and Non-REM

- Adrenergic
- Cholinergic
- Serotonergic
- Glutamatergic
- Dopaminergic

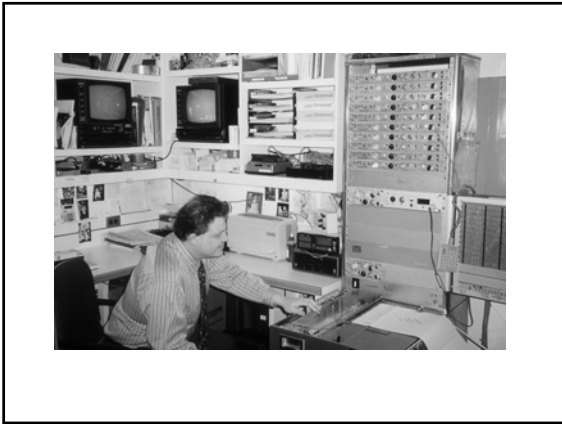
GABA (gamma-aminobutyric acid) – mainly inhibitory – hypothalamus, basal forebrain and thalamus

Adenosine – in wakefulness accumulates in basal forebrain

Histamine – wake promoting

Hypocretin/Orexin – hypothalamus – wake promoting





**Sleep is not a blank homogeneous state but a complex, cyclical physiologic process**

There are 5 different stages of sleep

Non-REM Sleep      REM Sleep

stage 1

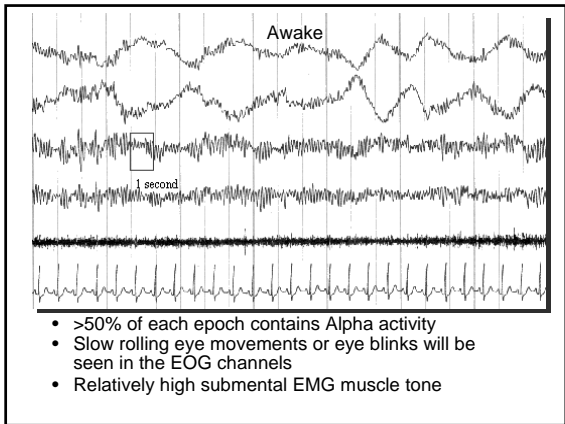
stage 2

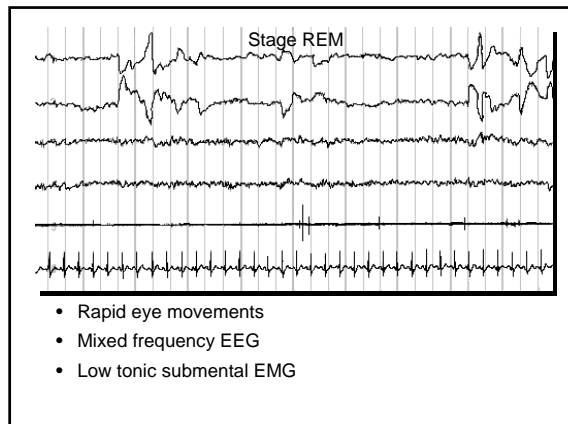
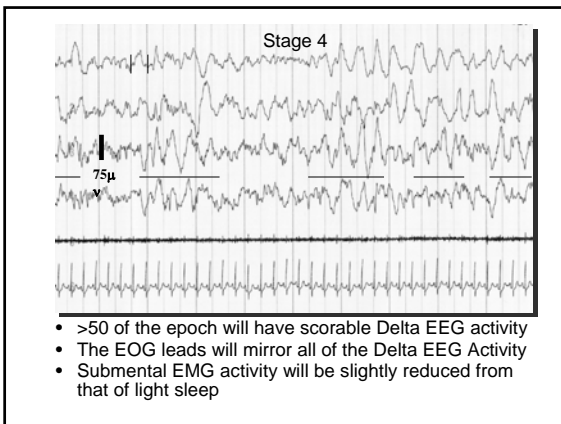
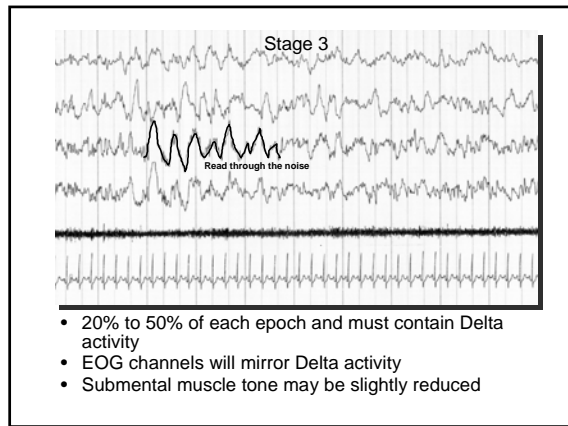
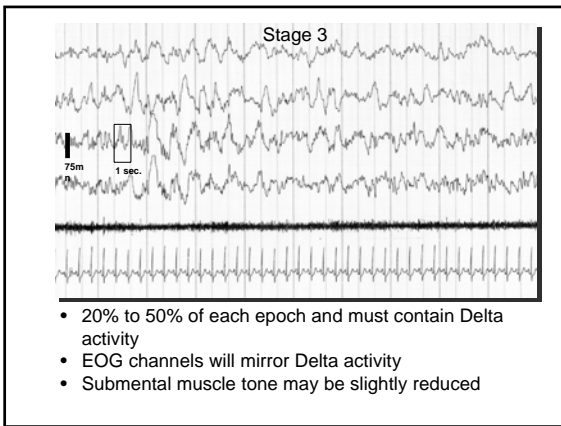
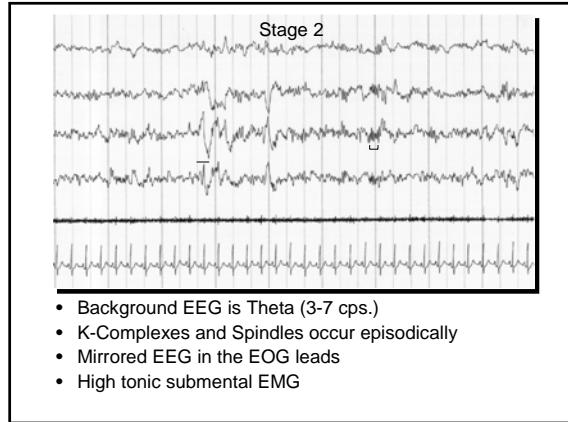
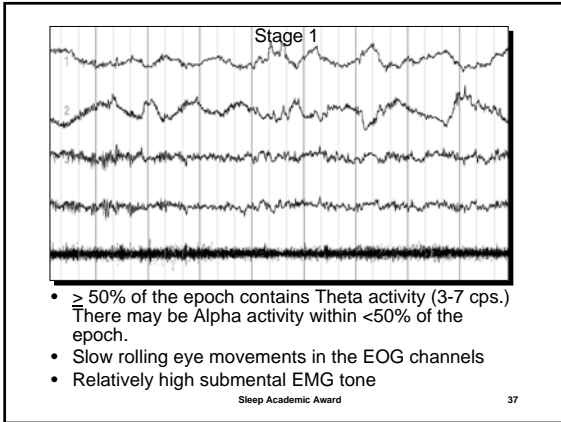
stage 3

stage 4

**DISTRIBUTION OF SLEEP STAGES**

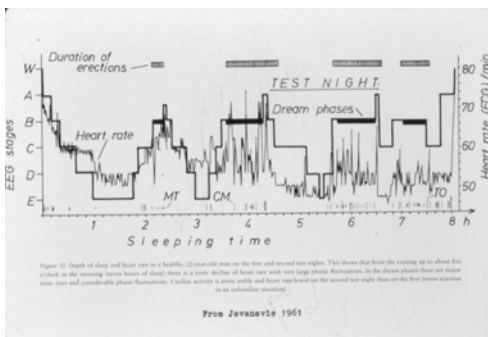
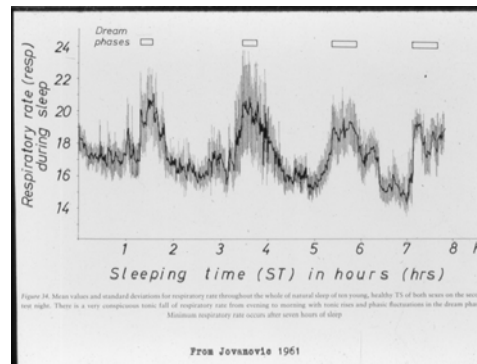
<u>NREM</u>	<u>75%</u>	<u>REM</u>	<u>25%</u>
STAGE 1	5%		
STAGE 2	45%		
STAGE 3	12%		
STAGE 4	13%		





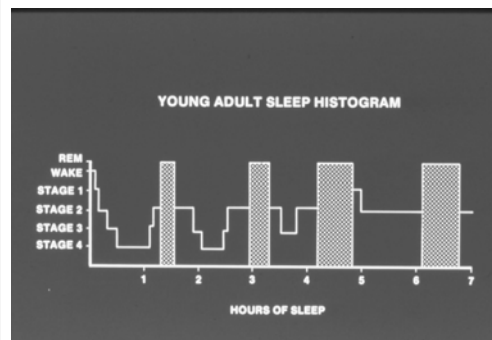
## REM Sleep

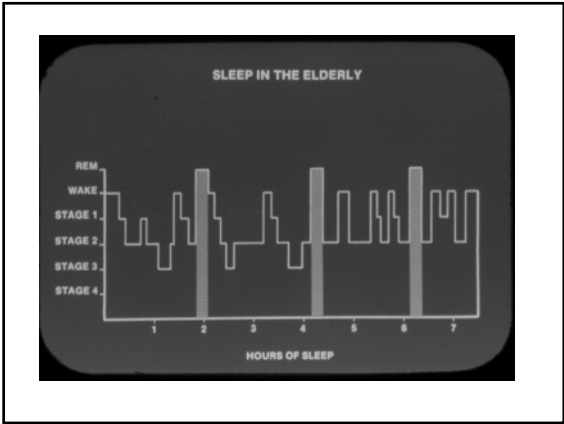
- Characteristic EEG
- Variable heart and respiratory rates
- Muscle paralysis
- REM's



- Video

## Sleep architecture

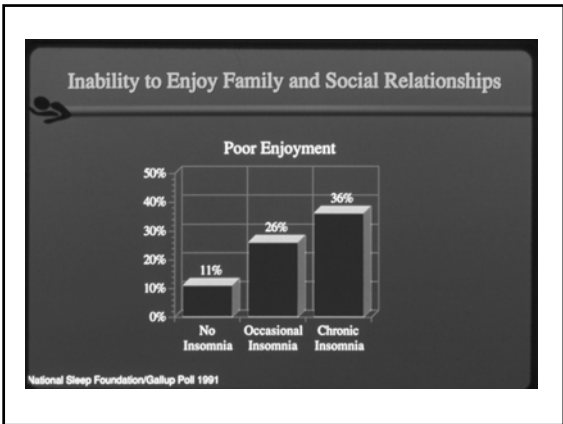
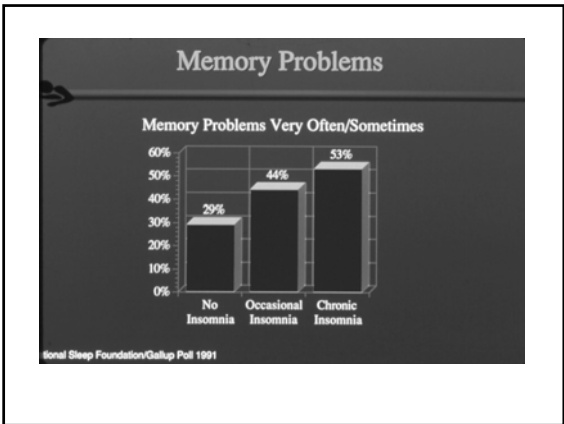
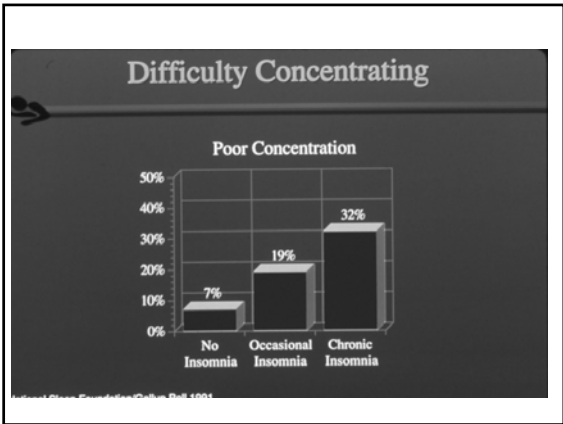


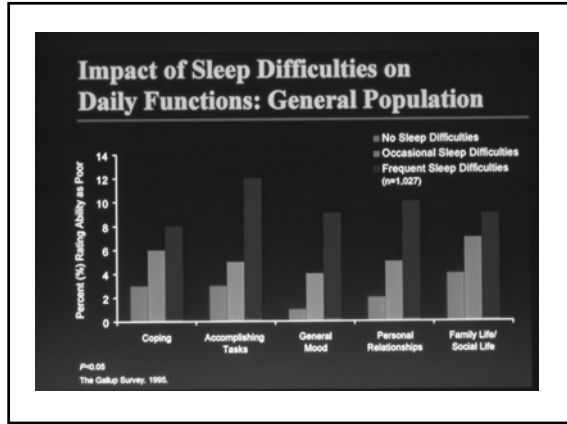
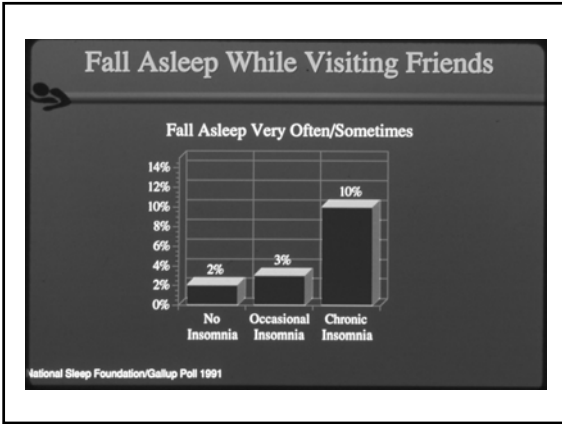


# Consequences of Sleep Deprivation

give hints as to the function of sleep

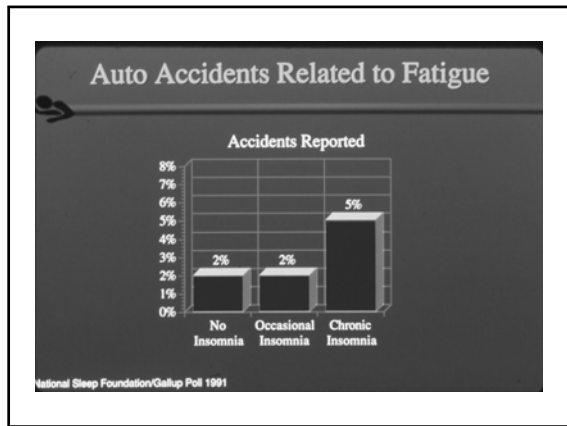
- ## Consequences of Sleep Deprivation
- A. Cognitive changes
  - B. Emotional/Personality changes
  - C. Physical performance decrements





Sense of Humor  
in Sleep Deprivation

■ **Gone**



- E. Physical Changes in Body**
1. **Thyroid function**
  2. **Glucose metabolism**  
**Insulin response**
  3. **Stress hormone elevation**
  4. **Decreased immune function**
  5. **Increased cardiac risk**

- REM Deprivation**
- REM pressure
  - REM rebound

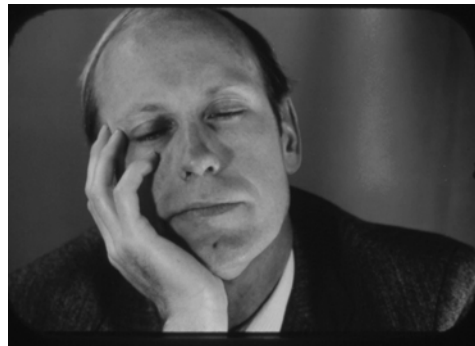
**We are not aware of the extent to which our functioning is compromised by sleep deprivation. (U of PA study)**

## **Sleep Disorders**

**The insomnias**



**The hypersomnias**



- Parasomnias
- Sleepwalking (Somnambulism)
  - Sleep Terror (Pavor Nocturnus, Incubus)
  - Enuresis
  - Dream Anxiety Attacks
  - Bruxism
  - Abnormal Swallowing
  - Cardiovascular Symptoms
  - Gastroesophageal Reflux
  - Jactatio Capitis Nocturna
  - Cluster Headaches and Chronic Paroxysmal Hemicrania

## Disorders of the biological clock

## THE NARCOLEPSY SYNDROME

- ### NARCOLEPSY TETRAD
- 1) EXCESSIVE DAYTIME SLEEPINESS
  - 2) CATAPLEXY
  - 3) SLEEP PARALYSIS
  - 4) HYPNAGOGIC HALLUCINATIONS

EXCESSIVE DAYTIME SLEEPINESS IS USUALLY, BUT NOT ALWAYS, THE MOST PROMINENT AND TROUBLESOME COMPONENT OF THE TETRAD

CATAPLEXY IS A BRIEF (SECONDS TO MINUTES) EPISODE OF MUSCLE WEAKNESS AND/OR PARALYSIS. WHEN ATTACK IS OVER, PATIENT IS COMPLETELY NORMAL

**NARCOLEPSY TETRAD**

- 1) EXCESSIVE DAYTIME SLEEPINESS
- 2) CATAPLEXY
- 3) SLEEP PARALYSIS
- 4) HYPNAGOGIC HALLUCINATIONS

**Snoring  
and  
Sleep Apnea**

Video

**Sleep walking -  
Somnambulism**

**Sleep terrors**

Video

**REM sleep  
behavior disorder**

