

# Sleep

## Sleep

- Sleep is **defined as unconsciousness** from **which a person** can be **aroused by sensory** or **other stimuli**.
  - It's a **reversible stage**
- It is to be **distinguished from coma, which is unconsciousness** from which a **person cannot be aroused**.
- Sleep is **divided** into **two types: rapid eye movement sleep** and **slow wave sleep**.
- **Each night, a person goes through stages** of **these two types of sleep** that **alternate** with each other .
- **REM sleep occurs** in **episodes of 5-30 minutes** that **occupy about 25% of the sleep time** in **young adults**.
  - **REM sleep** is sort of more of an **active sleep** not a restful
  - **each episode normally recurs** about **every 90 minutes**.

## REM (Paradoxical or Desynchronized) Sleep

- This type of sleep is **not so restful**.
  - Called **paradoxical** cause the **brain will still be active**
- When a **person is extremely sleepy**, each **bout of REM sleep** is **short** and **may even be absent**.
- As the **person becomes more rested through** the **night**, the **durations of the REM bouts increase**.

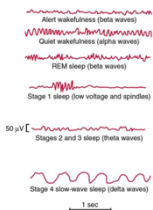
## REM Sleep

- **REM sleep** is a **type of sleep** in which the **brain is quite active**. However, the **person is not fully aware** of the **surroundings**.
- It is an **active form of sleep usually associated** with **dreaming**.
- The **overall brain metabolism** may be **increased** as **much as 20%**.
- The **person is even more difficult** to **arouse by sensory stimuli** than during **deep slow-wave sleep**, and yet **people usually awaken spontaneously** in the **morning during** an **episode of REM sleep**.
- **Muscle tone throughout** the **body** is **exceedingly depressed**, indicating strong **inhibition** of the **spinal muscle control areas**.
- **Despite** the **extreme inhibition** of the **peripheral muscles**, **irregular muscle movements do occur** in **addition** to the **rapid movements of the eyes**.
- **Heart rate** and **respiratory rate usually become irregular**, which is **characteristic** of the **dream state**.

- An electroencephalogram (EEG) shows a **pattern of brain waves similar to those that occur during wakefulness**.
- This **type of sleep is also called paradoxical sleep** because it is a **paradox that a person can still be asleep, despite the presence of marked activity in the brain**.

### Slow wave (NREM) sleep

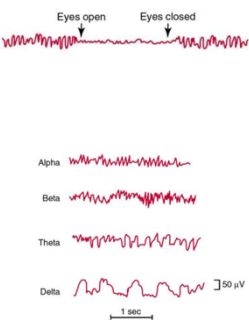
- **Most sleep during each night is of the slow-wave (NREM) variety**, which is the **deep, restful sleep** that the **person experiences during the first hour of sleep after having been awake for many hours**.
- This **sleep is associated with decreases in peripheral vascular tone and many other vegetative functions of the body**.
- For example, 10% to 30% decreases occur in blood pressure, respiratory rate, and basal metabolic rate.
- Although **slow-wave sleep is frequently called "dreamless sleep,"** dreams and **sometimes even nightmares do occur during slow-wave sleep**.
- The **difference between the dreams that occur in slow-wave sleep and those that occur in REM sleep** is that **those of REM sleep are associated with more bodily muscle activity**.
- Also, **the dreams of slow-wave sleep are usually not remembered because consolidation of the dreams in memory does not occur**.



- In the **slow wave sleep** we have **different stages**
  - **Stage 1 is characterized by spikes or spindles of alpha like waves and then a larger stage of decreased voltage or activity**
  - **Stage 2 and 3 and 4 we can see a decrease in the frequency of the waves and in stage 4 you can see typical delta waves in deep sleep**
- **Sleep is not very well understood** there are **so many theories** trying to explain to however none of them yet have explained the whole mechanism of it or the importance of it
- There are **many nuclei that play a major role in sleep** such as the **raphe nuclei** the **reticular formation nuclei, nucleus tractus solitarius and nuclei in the hypothalamus**, plus **many neurotransmitters** may play a role in sleep

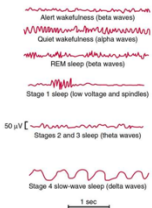
### Brain waves

- **Electrical recordings from the outer surface of the head demonstrate that there is continuous electrical activity in the brain**.
- **Both the intensity and the patterns of this electrical activity are determined by the level of excitation of different parts of the brain**.
- In **healthy people, most waves in the EEG can be classified as alpha, beta, theta, and delta waves**.
  - **Alpha waves are mainly present during a wake, restful state of celebration, once there is deep sleep they would disappear, and any specific mental**



**activities** especially to do with the **occipital lobe** like **opening the eyes**, these **alpha waves** will be **converted** to **beta waves** which are **lower voltage waves**

- **Beta waves reflect specific mental activities**
- **Theta waves** are **present** in **children** and also in **people with strong emotional stress like frustration** and **disappointment**
- **Delta waves** are **seen** in **deep sleep** or **serious brain disorders** or in **infancy**
- The **discharge** of a **single neuron** or **single nerve fiber** in the **brain** can **never be recorded from the surface of the head**.
- Instead, **many thousands** or **even millions of neurons** or fibers **must fire synchronously** for **the potentials from the individual neurons** or **fibers to summate enough** to be **recorded through the skull**.
  - From the picture above you can see that when the **eyes were closed** the **electrical activity** can be **seen in the form of alpha waves** however when they **opened** there was an **increase in the electrical activity** but in an **asynchronous fashion** so this **asynchronization would nullify each other** that's why the **recorded electrical activity shows** more of a **delta wave type**. And then as soon as the eyes closed again you can see that the alpha waves returned
  - So again the **electrical activity recording reflected** the **degree of synchronization NOT** the **total degree of activity** of the **neurons**
- Thus, the **intensity** of the **brain waves from the scalp** is **determined mainly by** the **numbers of neurons** and **fibers that fire in synchrony with one another**, **not by** the **total level of electrical activity** in the **brain**.
- In **fact, strong nonsynchronous nerve signals often nullify one another** in the **recorded brain waves** because of **opposing polarities**.



## Alpha waves

- **Alpha waves** are **rhythmical waves** that **occur at frequencies between 8 and 13 cycles/sec** and are **found** in the **EEGs of almost all healthy adults** when they are **awake** and in a **quiet, resting state** of **cerebration**.
- **These waves occur most intensely** in the **occipital region** but **can also be recorded from** the **parietal** and **frontal regions** of the **scalp**.
- Their **voltage** is **usually about 50 microvolts**.
- **During deep sleep**, the **alpha waves disappear**.
- **alpha waves** are **thought to result from spontaneous feedback oscillation** in this diffuse **thalamocortical system**, possibly including the **reticular activating system** in the **brain stem** as well.

## Beta waves

- When the **awake person's attention** is **directed to some specific type of mental activity**, the **alpha waves** are **replaced by asynchronous, higher frequency but lower voltage** beta waves.
- Beta waves **occur at frequencies greater than 14 cycles/sec** and as **high as 80 cycles/sec**.
- They are **recorded mainly from the parietal and frontal regions during specific activation of these parts of the brain**.

## Theta waves

- Theta waves have **frequencies between four and 7 cycles/sec**.
- They **occur normally** in the **parietal and temporal regions in children**, but they also occur **during emotional stress** in **some adults, particularly during disappointment and frustration**.
- Theta waves **also occur in many brain disorders, often in degenerative brain states**.

## Delta waves

- Delta waves **include all the waves of the EEG with frequencies less than 3.5 cycles/sec**, and they **often have voltages two to four times greater than most other types of brain waves**.
- They **occur in very deep sleep, in infancy, and in persons with serious organic brain disease**.
- Therefore, delta waves **can occur strictly in the cortex independent of activities in lower regions of the brain**.
- **some synchronizing mechanism can occur in the cortical neuronal system by itself—mainly independent of lower structures in the brain—to cause the delta waves**.
- Delta waves **also occur during deep slow-wave sleep**, which **suggests that the cortex then is mainly released from the activating influences of the thalamus and other lower centers**.

## Epilepsy

- **Seizures are temporary disruptions of brain function caused by uncontrolled excessive neuronal activity**.
  - **Neuronal activities can get excessive and uncontrolled leading to the disruptions of the brain function and if it is temporary we call it seizures**
  - If we **know the cause or the underlying mechanism it can be treatable then the seizures can go away**
    - For example if there is **electrolyte imbalance** and we **correct like if someone is hypoglycemic or caused by drugs or infection**, if you **treat this underlying condition**, then **these kind of seizures will go away**
  - However if these **seizures are recurrent** then we **call it epilepsy**

- **Epilepsy** is a **chronic condition** of **recurrent seizures** that can also vary from nearly **undetectable symptoms** to **periods of vigorous convulsions**.
- Epilepsy is **not a single disease**.
- Its **clinical symptoms** are **heterogeneous** and **reflect multiple underlying pathophysiological mechanisms**.
- **Epileptic seizures** can be **classified into two major types**:
  - (1) **focal seizures** (**partial seizures**) that are **limited** to a **focal area** of **one cerebral hemisphere**.
  - (2) **generalized seizures** that **diffusely involve both hemispheres** of the **cerebral cortex**.

### Focal seizures

- Focal seizures are **often classified** as **simple partial seizures** when there is **no major change** in **consciousness** or as **complex partial seizures** when **consciousness is impaired**.
- Simple partial seizures **may be preceded by** an **aura**.
- **Complex partial seizures** may also begin with an **aura** followed by **impaired consciousness** and **strange repetitive movements**.
- The **time after the seizure**, prior to the **return of normal neurological function**, is called the **postictal period**.

### Generalized seizures

- Generalized epileptic seizures are **characterized** by **diffuse, excessive**, and **uncontrolled neuronal discharges** that at the **outset spread rapidly** and **simultaneously to both cerebral hemispheres** through **interconnections between the thalamus and cortex**.
  - There are **two types of generalized seizures**
    - **1. Generalized tonic-clonic seizures**
    - **2. Absence seizures**

### Generalized tonic-clonic seizures

- Generalized tonic-clonic seizures, **previously called grand mal seizures**, are **characterized** by an **abrupt loss of consciousness** and **extreme neuronal discharges** in **all areas** of the **brain**—the **cerebral cortex**, the **deeper parts** of the **cerebrum**, and **even the brain stem**.
- Also, **discharges transmitted all the way into the spinal cord** sometimes cause **generalized tonic seizures** of the **entire body**, followed toward the **end of the attack** by **alternating tonic** and **spasmodic muscle contractions** called **tonic-clonic seizures**.
- **Often the person bites** or “**swallows**” his or her **tongue** and **may have difficulty breathing**, sometimes to the **extent that cyanosis occurs**.
- Also, **signals transmitted from the brain to the viscera** frequently cause **urination** and **defecation**.
- The **usual generalized tonic-clonic seizure lasts** from **a few seconds** to **3 to 4 minutes**.

- It is **also characterized** by **post-seizure depression** of the **entire nervous system**.
- The **majority of generalized seizures** are **idiopathic**, which **means** that the **cause is unknown**.
- **factors that can increase the excitability of the abnormal "epileptogenic" circuitry enough to precipitate attacks include**
  - (1) **strong emotional stimuli**
  - (2) **alkalosis** caused by **over-breathing**
  - (3) **drugs**
  - (4) **fever**
  - (5) **loud noises** or **flashing lights**.

### Absence seizures

- **Absence seizures, formerly called petit mal seizures, usually begin in childhood or early adolescence**
- **Absence seizures almost certainly involve the thalamocortical brain activating system.**
- They are **usually characterized by 3 to 30 seconds of unconsciousness or diminished consciousness, during which time the person often stares and has twitch-like contractions of muscles, usually in the head region, especially blinking of the eyes; this phase is followed by a rapid return of consciousness and resumption of previous activities.**