BRAIN WAVES

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Physiology

A fully functioning brain can generate as much as 10 watts of electrical power

Electrical activity emanating from the brain is displayed in the form of brainwaves.

Learning Objectives

- Describe the Electroencephalogram.
- Describe the Brain Waves.
- Describe the changes in in EEG at different stages of wakefulness and Sleep.
- Describe Psychotic behavior, Manic depressive Psychoses, Schizophrenia and Alzheimer's disease.

The Electroencephalogram

- Electrical recordings from surface of brain or even from outer surface of head show continuous electrical activity in brain

- Undulations in recorded electrical potentials are **Brain Waves** & entire record is **Electroencephalogram** and **Electroencephalograph** is instrument

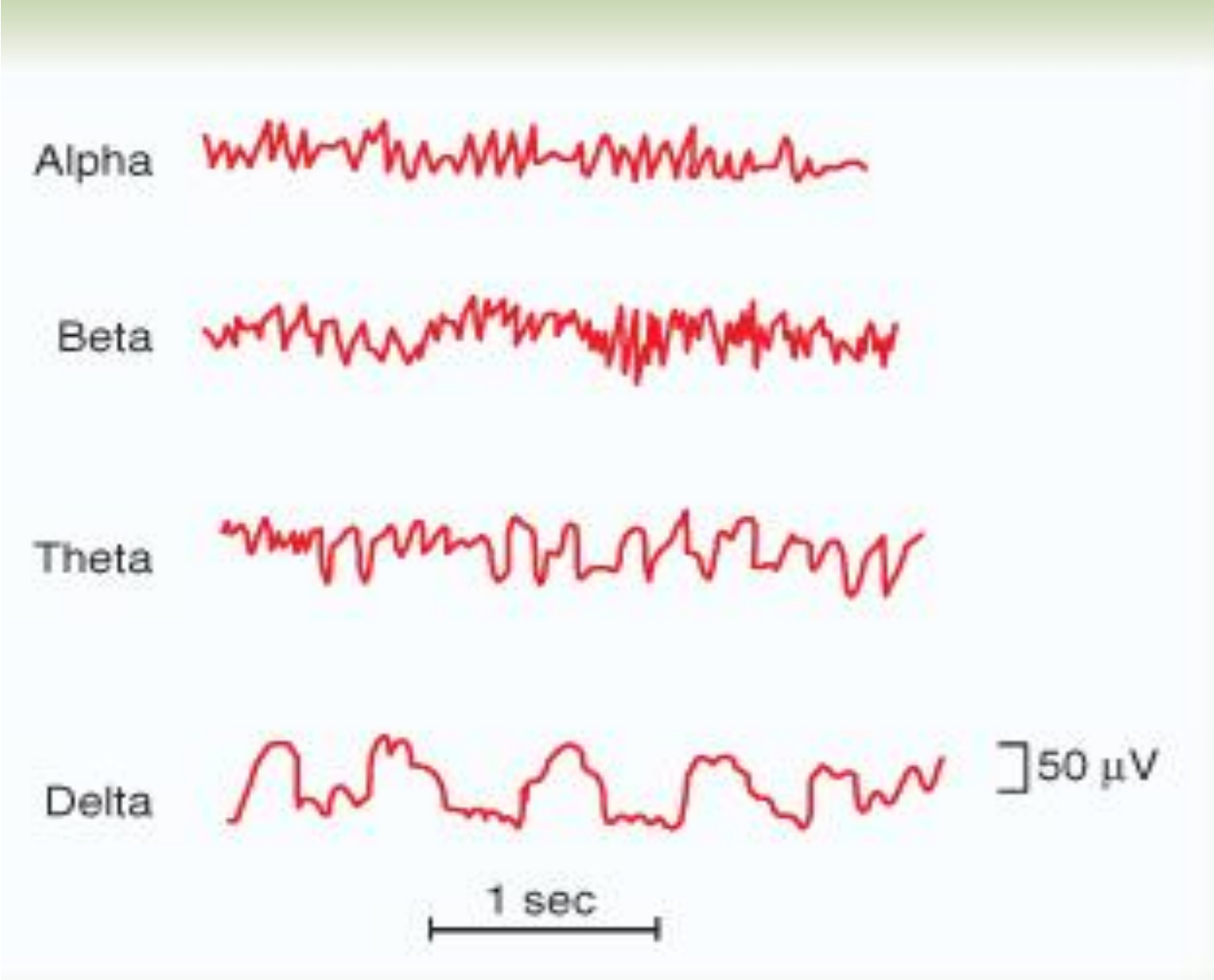
- Vary with state, sleep, wakefulness, Epilepsy

Brain waves…

- Four categories of these brainwaves, ranging from the most activity to the least activity.
- Intensities range from **0 to 200 microvolts** and frequencies range from **once every few seconds to 80 or more per second**

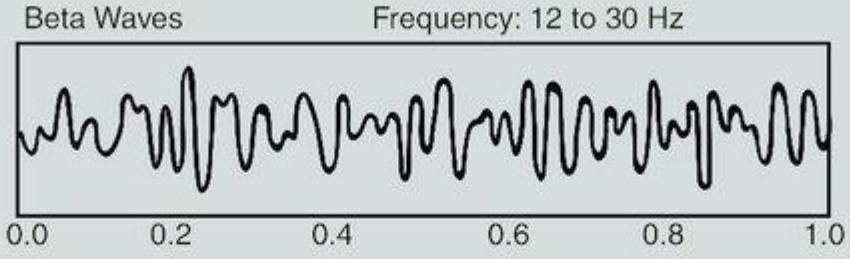
- Waves change markedly between states of **wakefulness, sleep and coma**

Brain Waves in Normal EEG



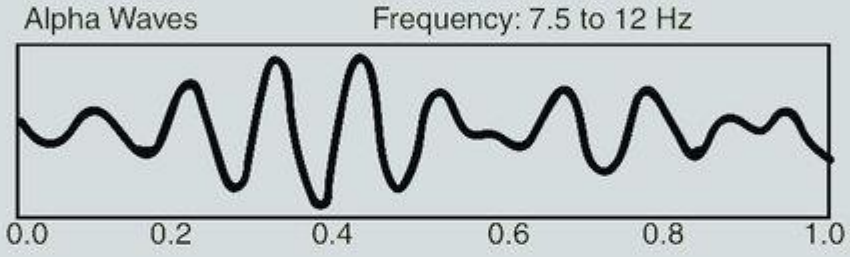
Brain Waves Chart

Beta — **Alert**



14 - 80 cycle /sec

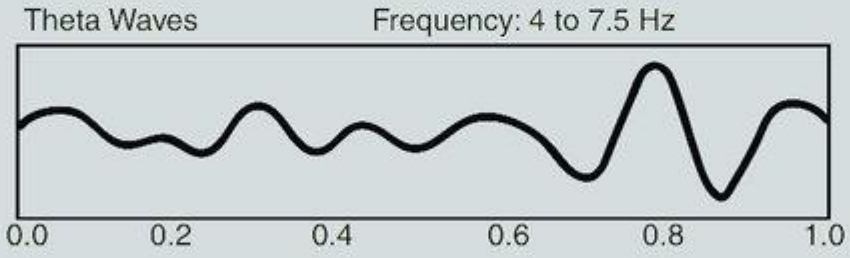
Alpha — **Meditative**



8- 13

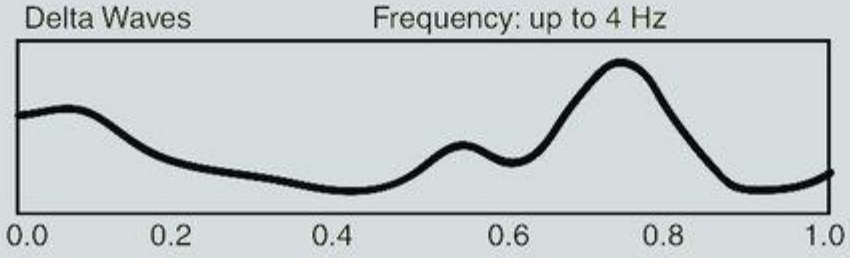
depth of mind

Theta — **Deeply Relaxed**



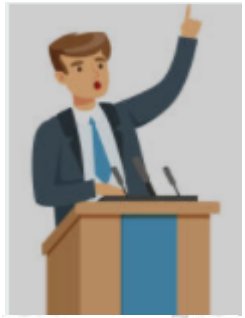
4 - 7

Delta — **Sleeping**



3 - 5

Study and Memorize this diagram, QUIZ is next

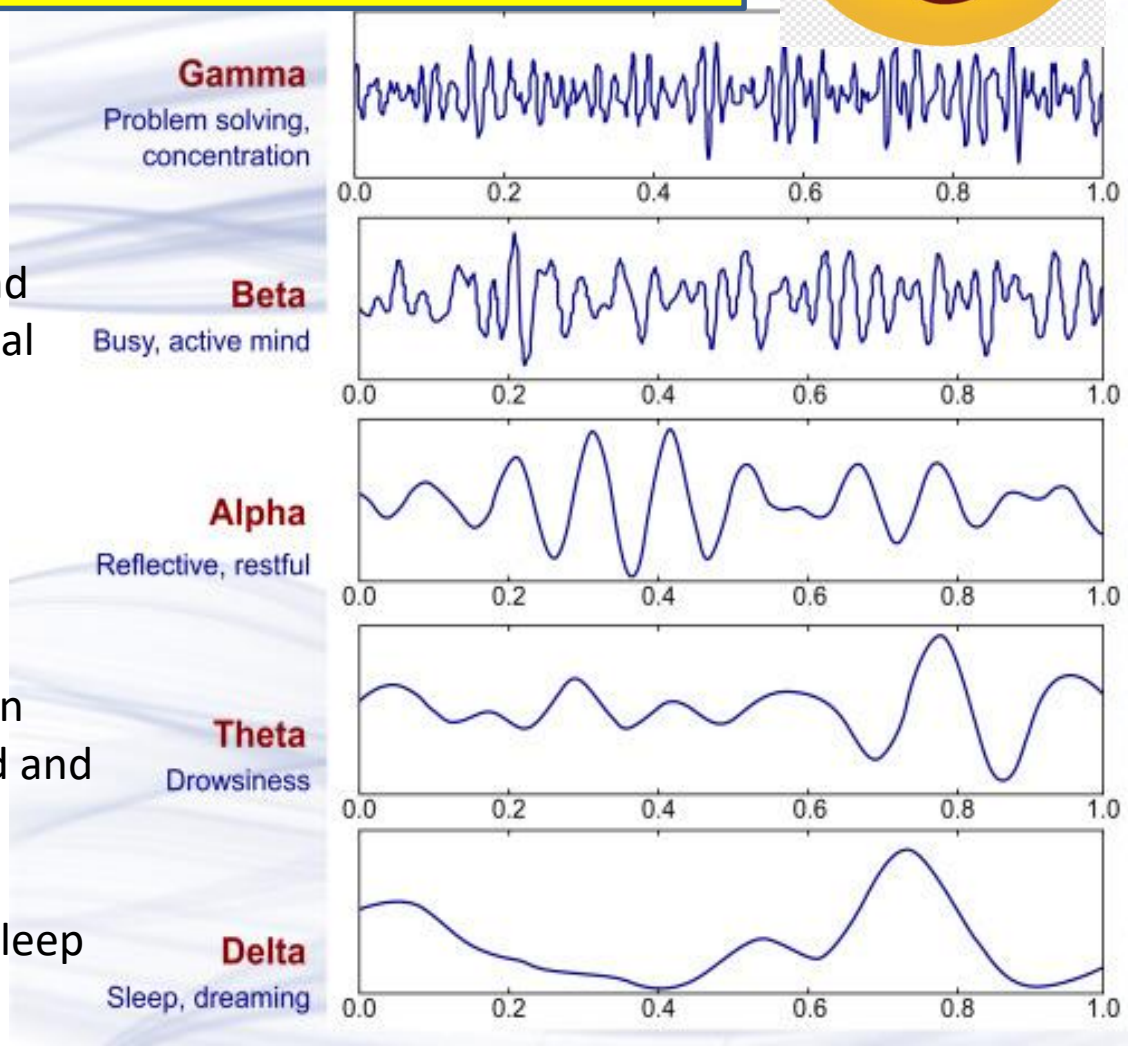


Brain is aroused/alert and actively engaged in mental activities

Non alert , relax

Normally in Children, in adults when frustrated and disappointed

Deep sleep



QUIZ TIME

Function	Wave
A person in act show host whe	
A person who h A person who t one who takes	
Occur in children . Individuals who Can occur in the It is a state wher disengage from t It is typically a ve	
Deep dreamless	

- When we go to bed and **read** for a few minutes before attempting sleep, we are likely to be in low **beta**.
- When we put the book down, turn off the lights and **close our eyes**, our brainwaves will descend from beta, to **alpha**,
- to theta and finally, when we **fall asleep**, to **delta**

Origin of brain waves

- **When a number of neurons fire synchronously**
- **Alpha**

I. Cortical and thalamic neurons when fire synchronously connection

II. Reticular activating system and thalamic connections

- **Delta**

Independently in cerebral cortex

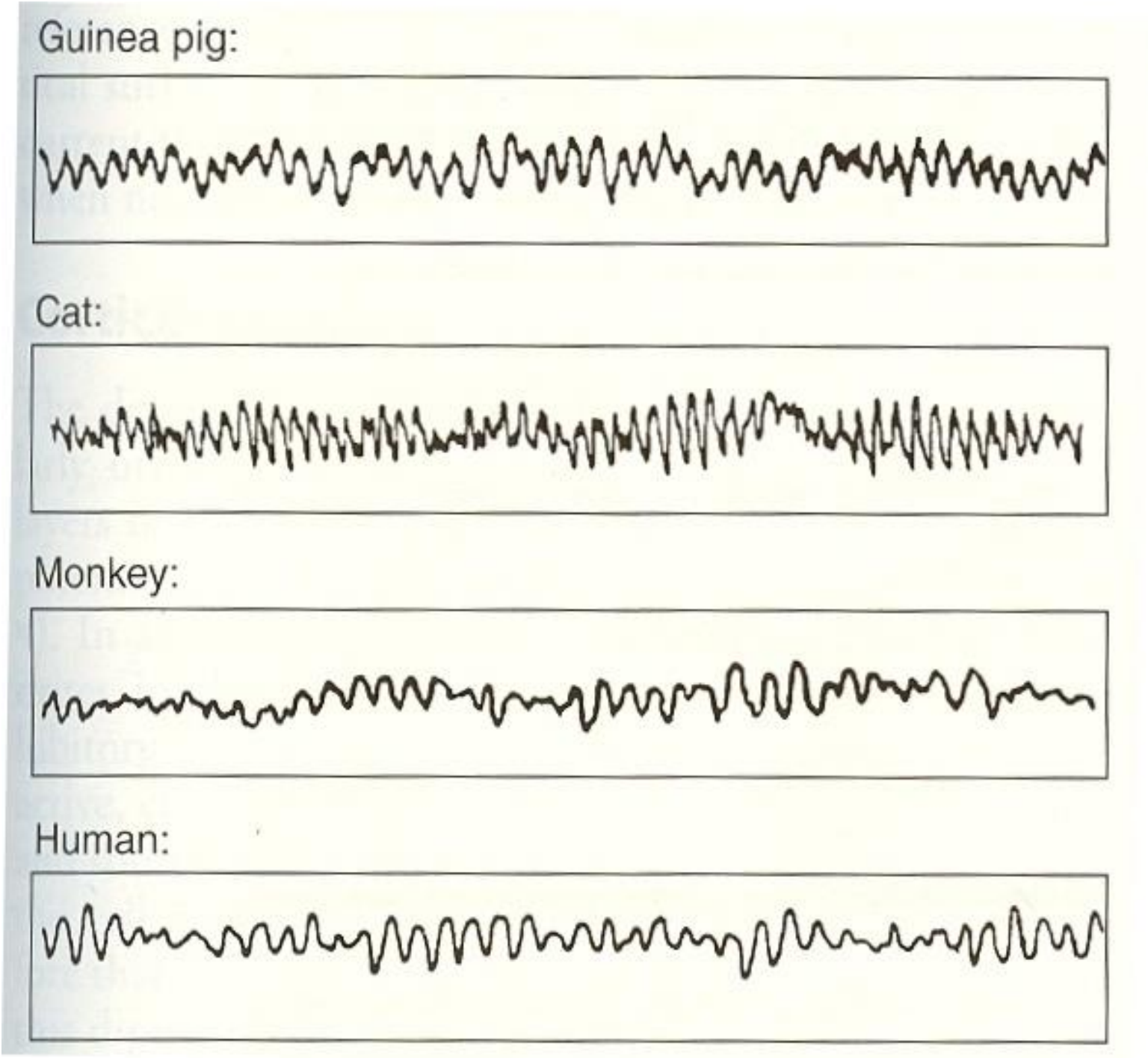
Rhythms of EEG (Waves)

Alpha Rhythm

In normal adults

- Awake ,at rest ,mind wandering
- Drowsiness, light sleep or narcosis with eyes closed
- Regular (synchronous)
- Most marked in occipital area
- 8 – 13 Hz , amplitude of 50 microvolts
- Disappear during deep sleep

Alpha rhythm in different species



Rhythms of EEG (Waves)

Beta Rhythm

- Higher frequency (14 – 80 HZ)
- Lower amplitude (5- 10 volts)
- Recorded from parietal and frontal regions during activation of these parts of brain

1. Extra activation of CNS (alert wakefulness, REM sleep)
2. Tension , fear

Brain waves...

Theta Waves

Frequency → **4 to 7 Hz**

Seen in

a) Children

b) stage 2 and 3 sleep

c) Emotional Stress especially frustration and disappointment in adults

d) Brain disorders and degenerative brain states

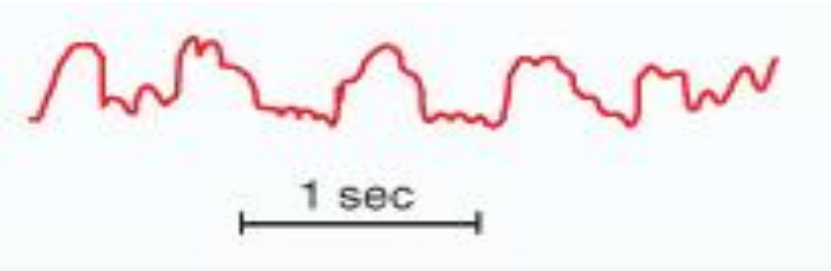
Rhythms of EEG (Waves)

Delta Rhythm

- Large amplitude 20-200 microvolts (2 to 4 times greater than most types of brain waves)
- Regular
- Frequencies less than 3.5 HZ

1. Very deep Sleep (stage 4 sleep)
2. Infancy
3. Serious organic brain disease

Rhythms of EEG (Waves)



Delta Waves

- Highest voltage
- Lowest frequency (< 4/sec)
- Very deep sleep
- Infancy
- Serious organic brain disease

Rhythms of EEG (Waves)

Gamma Oscillation

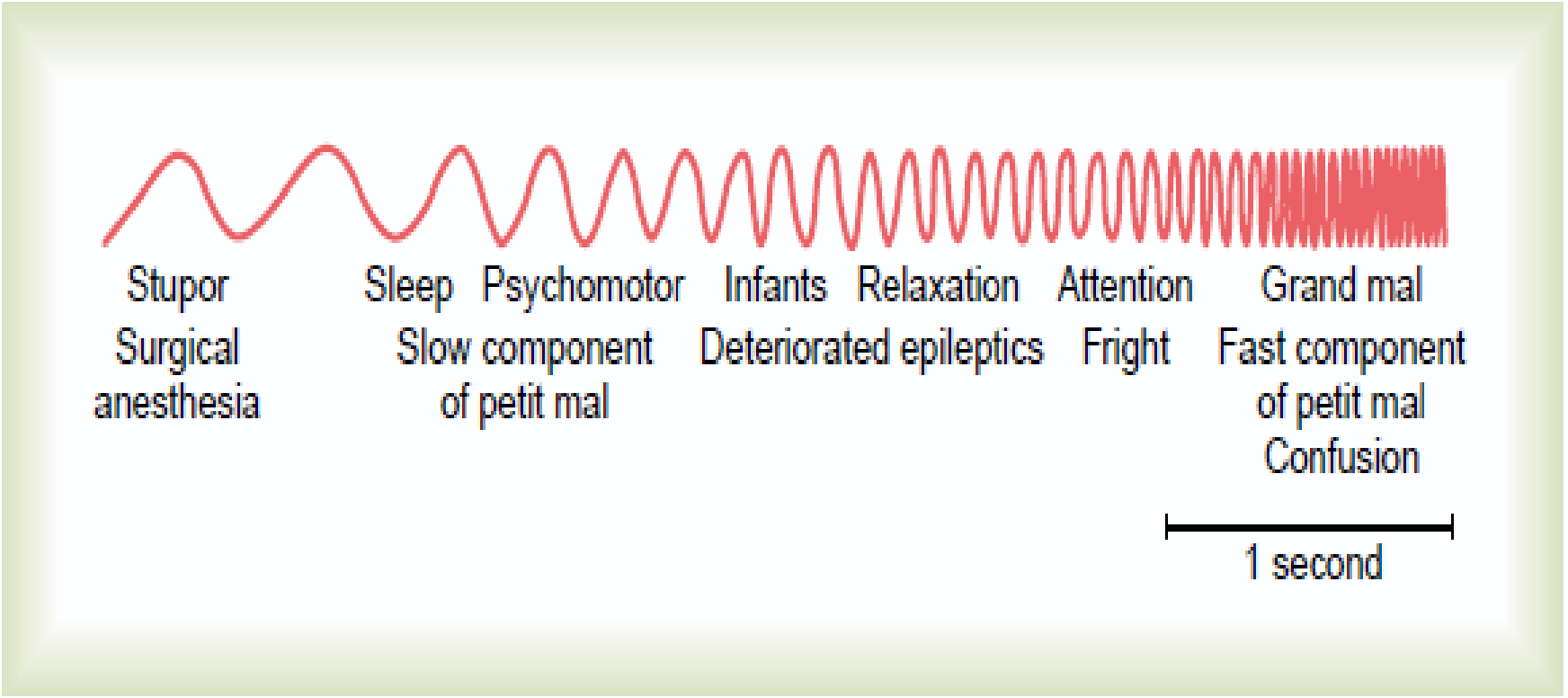
- Highest frequency (30 – 80 HZ)
- Focusing attention on something
- Picture yourself deeply immersed in a complex project or fascinated by a lecture from a noted subject matter expert. You're alert and highly focused.
- people with learning difficulties or impaired mental processing may not produce as many gamma waves.

- The EEG of a 12-year-old girl with stage II subacute sclerosing pan encephalitis (SSPE), who had also suffered from a non-progressive mental retardation of unknown etiology since early childhood, revealed periodic generalized stereotyped **fast wave bursts** synchronous with **myoclonic jerks**.

Brain Activity

Quiet wakefulness	:	Alpha waves
Alert wakefulness	:	Beta waves
Focusing attention	:	Gamma waves
Sleep (2&3)	:	Theta waves
Deep sleep(4)	:	Delta waves

Effect of Varying Degrees of Cerebral Activity on Basic Rhythm of EEG



Psychotic Behaviour and Dementia

- **Role of Specific Neurotransmitter Systems**

many of these conditions result from decreased function of neurons that secrete a specific neurotransmitter

Parkinson's Disease , there is loss of neurons in substantia nigra that secrete **dopamine** in caudate nucleus and putamen

Huntington's Disease loss of **GABA** and **Acetylcholine** secreting neurons → abnormal motor patterns and Dementia

Draw a table like this one and fill it as you go through the coming slides

	Depression	Manic depressive psychosis	Schizophrenia	Alzheimer's diseases
Symptoms/ clinical features				
Pathology				
Treatment				

Depression And Manic Depressive Psychoses

Depression

- **Symptoms** are grief, unhappiness, despair, misery, loss of appetite, sex drive and insomnia
- ↓formation of **norepinephrine** or **serotonin** or both
- Drugs blocking these 2 like **Reserpine** → depression
- **70%** Can be treated by drugs that ↑ effects of norepinephrine and serotonin like MAO Inhibitors and Tricyclic Antidepressants

Manic Depressive Psychosis

- Some patients alternate between **depression** and **mania (bipolar)**

- **Excess** of norepinephrine and serotonin → mania and drugs that decrease these like **lithium compounds** are used for treatment

Schizophrenia

Schizophrenia

- Many types
- Commonly patient hears voices and has **delusions of grandeur**, **intense fear** or other types of feelings that are unreal

- **Highly paranoid** (**thinking and feeling like you are being threatened in some way, even if there is no evidence, or very little evidence, that you are)**

- **Incoherent speech**, **dissociation of ideas**, abnormal thought sequences and are often withdrawn with **abnormal posture** and rigidity

Symptoms of Schizophrenia

Schizophrenia...

Causes of Schizophrenia

1. Excess DOPAMINE

- Patients with Parkinson's on L Dopa develop schizophrenic like symptoms
- **Chlorpromazine, Haloperidol** decrease dopamine and treat schizophrenia

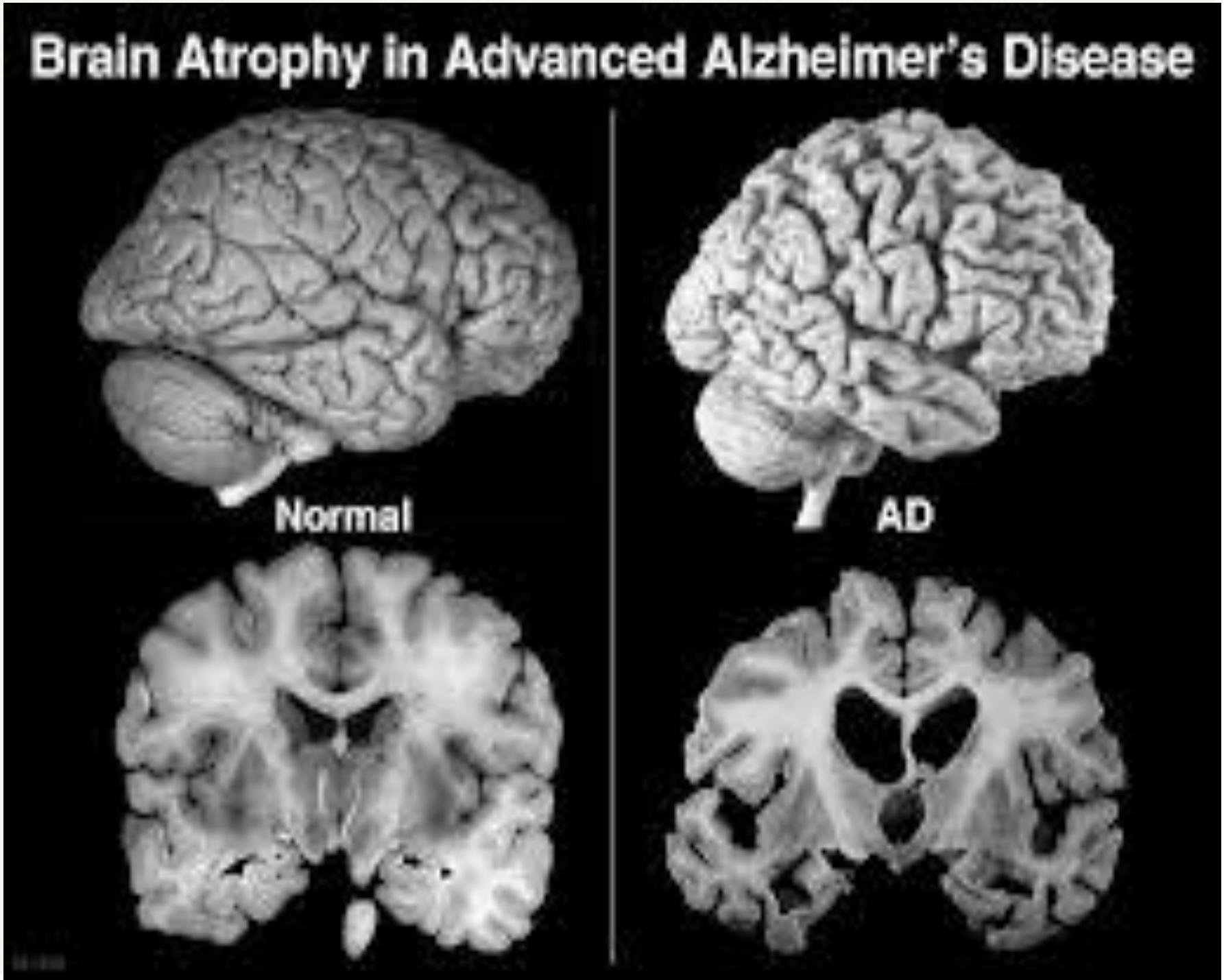
2. Involvement of Prefrontal Area

3. Hippocampus is reduced in size in dominant hemisphere

Alzheimer’s Disease

Alzheimer's Disease

- **Premature brain aging**
- **Begins in mid adult life** → **extreme loss of mental powers**
- Loss of neurons in **limbic pathway for memory**
- **Progressive and fatal neurodegenerative** disorder
- Most **common** type of dementia in elderly in USA


Brain Atrophy in Advanced Alzheimer's Disease
Normal
AD

Clinical Features of Alzheimer's

1. Memory impairment

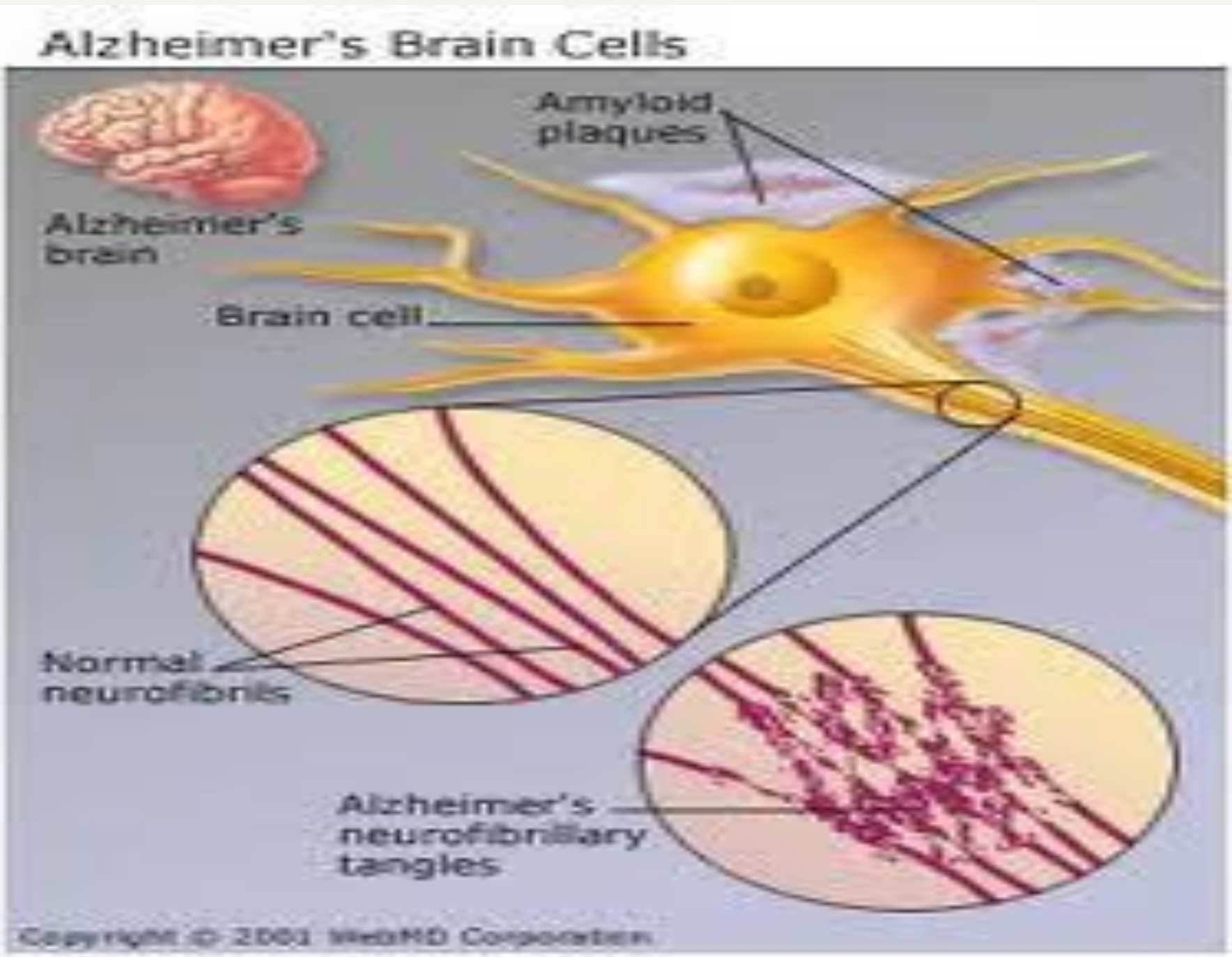
2. Language deterioration

3. Visuospatial deficits

4. Motor , sensory abnormalities, gait disturbances and seizures are uncommon till late phases of disease

Pathology In Alzheimer's Disease

- Accumulation of brain **Beta-Amyloid Peptide**
- Accumulates in **amyloid plaques** ranging in diameter from 10 to several hundred µm widespread in brain
- **Metabolic degenerative diseases** like **hypertension**, **atherosclerosis, diabetes and hyperlipidemia** may play a role in Alzheimer's


Alzheimer's Brain Cells
Amyloid plaques
Alzheimer's brain
Brain cell
Normal neurofibrils
Alzheimer's neurofibrillary tangles
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Role of Beta Amyloid Plaques In Alzheimer's Disease

1. All mutations of Alzheimer's disease **↑Beta amyloid peptide**
2. Down's syndrome patients have **3 copies of gene** for **amyloid precursor protein** and → early alzheimer's
3. Patients with **abnormal gene for apolipoprotein** → ↑ deposition of amyloid protein → AZ
4. Mice with ↑ amyloid protein have **memory deficits**
5. **Antiamyloid antibodies** in AZ patients attenuates the disease

MCQ

- Alpha rhythm in EEG

  a) 20 to 30 waves per second

  b) disappear on opening eyes

  c) replaced by slower, larger waves during REM sleep

  d) associated with deep sleep

  e) most pronounced in frontal region

MCQ

- A patient with REM sleep shows

  a) hyperventilation

  b) Periods of loss of skeletal muscle tone

  c) slow but steady heart rate

  d) high amplitude EEG wave

  e) decreased brain metabolism

MCQ

- Frequency of Alpha waves in EEG
  1. 3 – 5 cycles per second
  2. 4 – 7 cycles per second
  3. 8 – 13 cycles per second
  4. less than 3.5 cycles per second
  5. 50 to 200 cycles per sec

Waves in different states

- Quiet wakefulness
- Alert wakefulness
- Deep sleep
- Sleep
- Focusing attention
- Gamma
- Theta
- Delta
- Beta
- Alpha

Major transmitter acting on substantia nigra

1. Dopamine
2. Acetyl choline
3. Epinephrine
4. Substance P
5. Glycine

Regarding Paradoxical Sleep

1. EEG shows delta waves
2. Brain metabolism is decreased
3. Is NREM Sleep
4. Associated with vivid dreams
5. Relaxing sleep

Parkinson's Disease is due to

a) Loss of Acetylcholine secreting nerve endings
b) Loss of dopaminergic neurons in substantia nigra
c) Excess of dopamine
d) Loss of GABA
e) Loss of norepinephrine

Huntington's Disease is caused by

a) Loss of acetylcholine
b) Loss of dopamine
c) Loss of GABA
d) Loss of norepinephrine
e) Excess of dopamine

Delusions, hallucinations, flat affect, hyperactive behaviour are features of

a) Parkinson's Disease
b) Huntington's Disease
c) Schizophrenia
d) Alzheimer's Disease
e) Depression

All are features of Alzheimer's except

a) Loss of memory
b) Language deterioration
c) Motor and sensory abnormalities
d) Amyloid plaques
e) Old age disease


Thank
you