# ****Brain Stem, Reticular Formation, EEG, Sleep, and Reflexes – Exam Summary****

## 📍 ****Learning Objectives****

Identify brain stem nuclei and their functions

Explain the function of the Reticular Formation (RF)

Describe the mechanism of sleep

Explain the withdrawal reflex mechanism

## 🧠 ****1. Brain Stem Overview****

Located between spinal cord and subcortical structures (thalamus, hypothalamus, basal ganglia)

Connected to cerebellum via:

Superior, middle, and inferior cerebellar peduncles

**Contains**:

Ascending/descending tracts

Vital centers (CV, respiratory, etc.)

Reticular formation (RF)

Cranial nerve nuclei (III–XII)

Other functional nuclei

### 🔹 ****Medulla Oblongata****

Contains ascending/descending tracts

**Vital centers**: CV, respiratory, swallowing, vomiting, salivatory

Origin of CN VIII–XII

**Other nuclei**:

Olivatory: regulates muscle tone

Vestibular: posture & equilibrium

Gracile & Cuneate nuclei

### 🔹 ****Pons****

Acts as a **bridge**

Contains:

CN V, VI, VII nuclei

Apneustic & pneumotaxic respiratory centers

**Pontine nucleus** (relay to cerebellum)

### 🔹 ****Midbrain****

Contains sensory/motor tracts

**Important nuclei**:

**Superior colliculi** – visual reflexes

**Inferior colliculi** – auditory reflexes

**Substantia nigra** – motor coordination

**Red nucleus** – with BG & cerebellum for movement

## 🔁 ****2. Reticular Formation (RF)****

### 🔸 Structure

Dense network in medulla, pons, midbrain

Extends from spinal cord to diencephalon

### 🔸 Divisions

#### ****Sensory RF**** (Lateral)

Many small neurons

Gets input from sensory pathways, cortex, cerebellum

Projects to motor RF

#### ****Motor RF**** (Medial)

Large neurons

2 parts:

**Inhibitory RF** (medulla/lower pons): sends lateral reticulospinal tract → ↓ muscle tone

**Excitatory RF** (pons/midbrain): sends:

**Descending tract** → ↑ muscle tone (ventral reticulospinal tract)

**Ascending tract (RAS)** → thalamus → cortex (↑ consciousness)

### 🔸 ****Functions of RF****

Posture & muscle tone

Modifies pain (via raphe magnus)

Facilitates voluntary movements

Controls cortex excitability & sleep

## 🚨 ****3. Reticular Activating System (RAS)****

Ascending branch of excitatory RF

Path: Pons/midbrain → thalamus → cortex

**Function**:

Maintains **wakefulness**

Enhances **conscious sensory perception**

Inhibition of RAS = sleep

## 🧾 ****4. EEG (Electroencephalogram)****

Records brain electrical activity

Used to diagnose **epilepsy**, tumors, brain death

### 🔸 ****Brain Waves****

| **Wave** | **Frequency** | **State** |
| --- | --- | --- |
| **Alpha** | 8–13 Hz | Relaxed wakefulness (parietal/occipital) |
| **Beta** | 14–80 Hz | Mental activity (frontal/parietal) |
| **Theta** | 3–7 Hz | Children, emotional stress, tumors |
| **Delta** | <3.5 Hz | Deep sleep, brain damage in adults |

## 💤 ****5. Sleep****

### 🔸 Definition

Temporary unconsciousness; reversible by stimuli

### 🔸 Sleep Duration

Infants: 18 hrs/day

Adults: 7–9 hrs

Elderly: ~5 hrs

### 🔸 Physiological Changes

↓ BP, ↓ HR, ↓ CO

↓ TV (Tidal Volume), ↓ PVR

↓ Muscle tone, ↓ metabolic rate

### 🔸 Sleep Types

| **Type** | **Features** |
| --- | --- |
| **Non-REM (slow wave)** | No dreams, sleep talking/walking |
| **REM (paradoxical)** | Dreams, beta waves, rapid eye movement |

### 🔸 EEG Patterns in Sleep

| **Sleep Stage** | **EEG Pattern** |
| --- | --- |
| REM | Low amp, high freq (like awake) |
| Non-REM | High amp, low freq (delta) |

### 🔸 Theories of Sleep

**Passive**: RAS becomes fatigued → sleep

**Active**: Sleep center activates → inhibits RAS

## Raphe magnus nucleus releases ****serotonin ………………………………..****

Reflex: Basic functional unit of the nervous system

**Involuntary response** to a stimulus

Mediated through a **reflex arc**

### 🔸 ****Reflex Arc – 5 Components****

**Receptor** – detects stimulus

**Afferent neuron** – transmits sensory input

**Integration center** – spinal cord or brain

**Efferent neuron** – motor output

**Effector organ** – executes response

## 🔹 ****Types of Reflexes (Based on Integration Center)****

| **Site** | **Reflexes** |
| --- | --- |
| **Hypothalamic** | Body temp regulation, water balance |
| **Midbrain (Mesencephalic)** | Pupillary, accommodation, posture |
| **Medullary** | Swallowing, chemoreceptor, baroreceptor |
| **Spinal** | Cutaneous, deep, visceral reflexes |

## 🔹 ****Based on Interneurons****

| **Type** | **Description** | **Example** |
| --- | --- | --- |
| **Monosynaptic** | One synapse (no interneurons) | Stretch reflex |
| **Polysynaptic** | Multiple interneurons | Withdrawal reflex |

## 🔹 ****Spinal Reflexes (Based on Receptor Location)****

**Cutaneous Reflexes**

**Flexion (Withdrawal) Reflex**

Stimulated by **pain**

Afferent → interneurons → motor neurons

Activates **flexors**, inhibits **extensors**

Protects body from harm

**Crossed Extensor Reflex**

Follows withdrawal reflex (~0.2–0.5 sec delay)

**Opposite limb extends** to support body

Helps maintain balance

**Plantar Reflex**

Stimulus: Stroking sole (lateral side)

**Normal**: Plantar flexion of toes (S1 center)

**Babinski sign**: Dorsiflexion + fanning (UMNL in adults, normal in infants)

**Deep Reflexes (Stretch / Tendon Jerks)**

Receptor: **Muscle spindle**

Triggered by tapping a tendon → rapid contraction

| **Reflex Type** | **Spinal Center** | **How to Elicit** |
| --- | --- | --- |
| **Biceps jerk** | C5–C6 | Tap thumb over biceps tendon → elbow flexion |
| **Triceps jerk** | C6–C7 | Tap triceps tendon → elbow extension |
| **Knee jerk** | L2–L4 | Tap patellar tendon → knee extension |
| **Ankle jerk** | S1–S2 | Tap Achilles tendon → plantar flexion |

**Visceral Reflexes**

Control internal organ function

Examples:

**Micturition reflex** (urination)

**Defecation reflex**