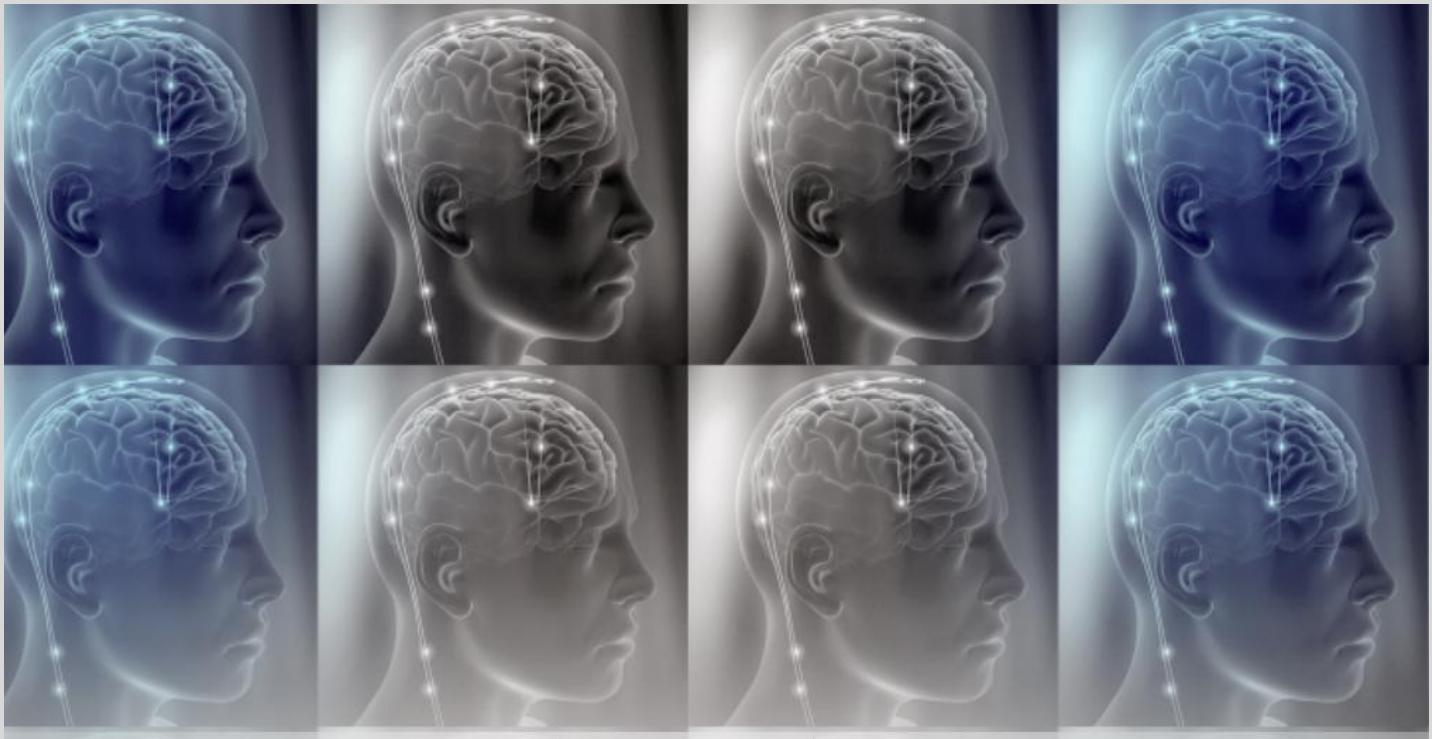

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CNS Central Nervous System

Block

Physiology Team

	Female Side	Male side
Done By:	Yafa Al-shamlan	Tariq Al-otaibi
Revised By:	Nour Al-Khawajah	Mohammed Asiri

CNS Central Nervous System

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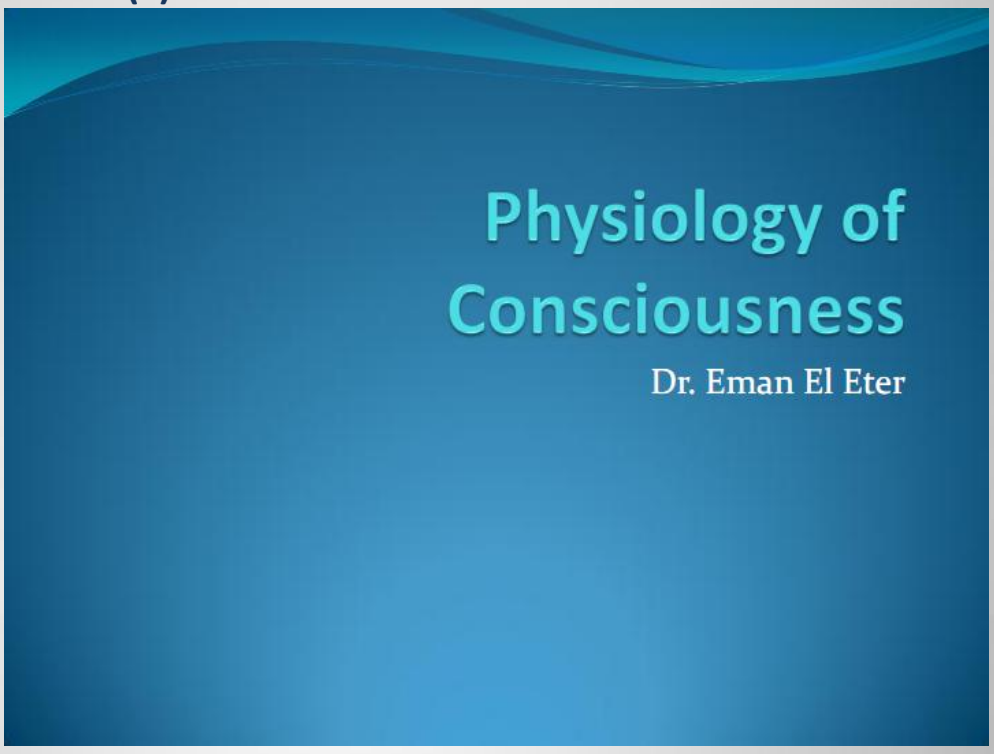

Team Notes :

CNS Central Nervous System

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Objectives

- Levels of consciousness/ definition
- Functional divisions of RF.
- Overview of functions of RF.
- Anatomical components of RAS.
- Connections of RAS.
- Neurotransmitters of RAS.
- Functions of RAS.

Team Notes :

CNS Central Nervous System

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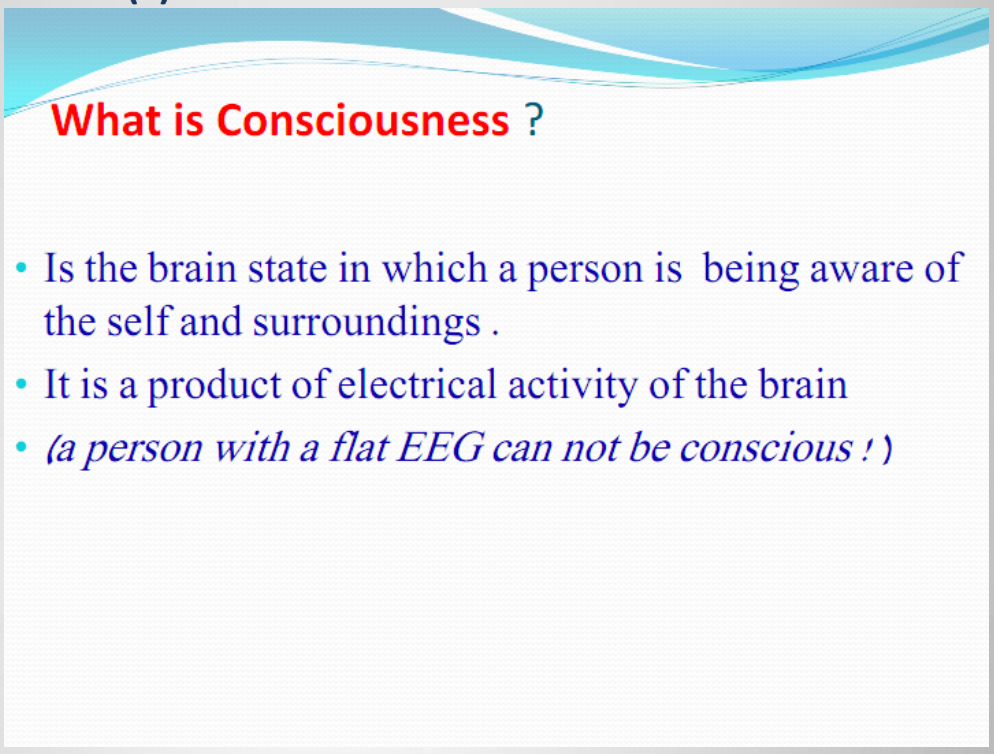

Team Notes :

EEG is electrical reading of brain activity if EEG reading is flat; it indicates that the brain is no longer functioning.

CNS Central Nervous System

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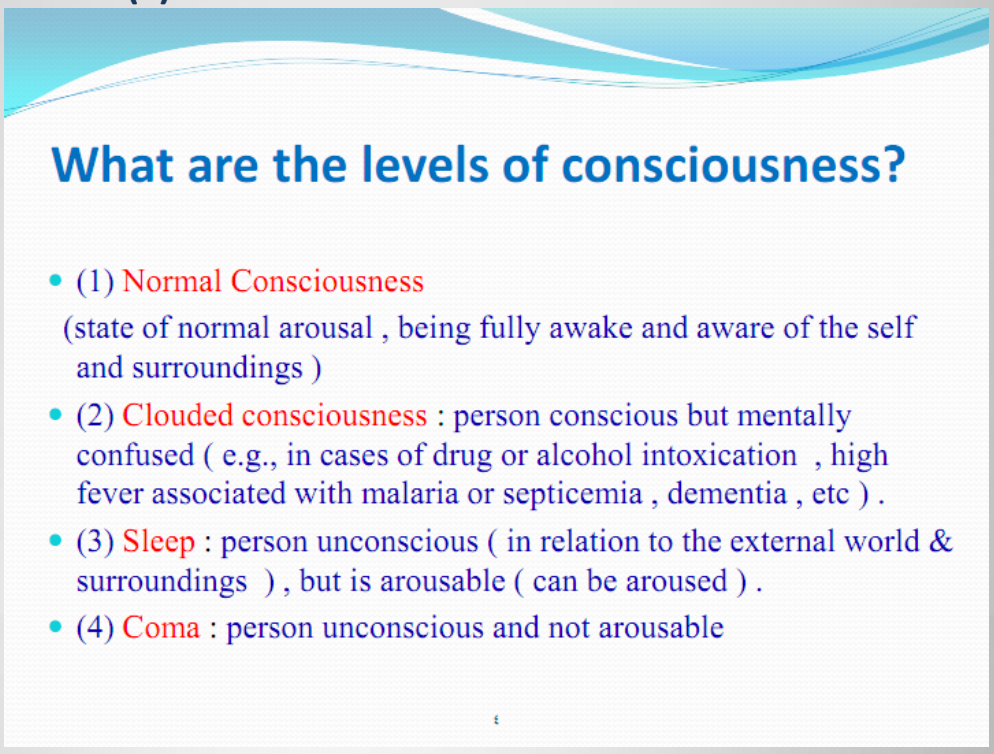

Team Notes :

Some sources add (normal consciousness) → "and being able to respond to stimuli

Clouded consciousness= drowsiness

Deep sleep has higher arousal threshold than light sleep

(But, still arousable)

Stimuli: can be, sound, light, temperature, pain

(They alarm the CNS)

CNS Central Nervous System

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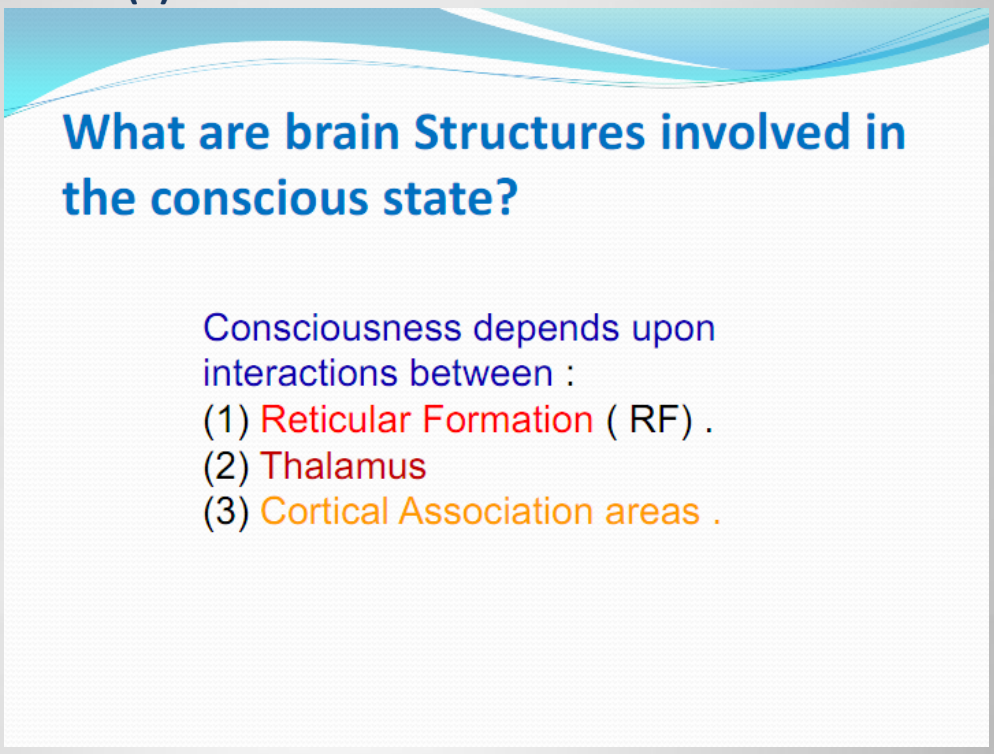

Team Notes :

Reticular Activating System=

Bulboreticular Facilitatory Area + Thalamus

Excitatory signal originates from large numbers of small neurons spread throughout the brain stem reticular excitatory area, most of these pass to the thalamus, through small, slowly conducting fibers that synapse mainly in the intralaminar nuclei of the thalamus and in the reticular nuclei over the surface of the thalamus. From here, additional small fibers are distributed everywhere in the cerebral cortex. The excitatory effect caused by this system of fibers can build up progressively for many seconds to a minute or more, which suggests that its signals are especially important for controlling longer-term background

CNS central Nervous System

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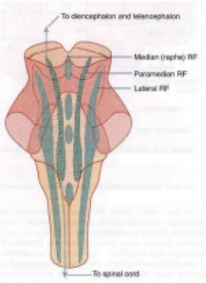
Reticular formation

- This regulates many vital functions including the sleep/awake cycle. It is a polysynaptic network located in the pons, midbrain and upper medulla and is poorly differentiated. It consists of 3 parts:
- **Lateral Reticular Formation**
  - Has small neurones
  - Receives information from ascending tracts for touch and pain.
  - Receives vestibular information from median vestibular nerve.
  - Receives auditory information from superior olivary nucleus.
  - Visual information from superior colliculus.
  - Olfactory information via medial forebrain bundle



Team Notes :

Vestibular information: about balance

Olfactory information: smelling

CNS central Nervous System

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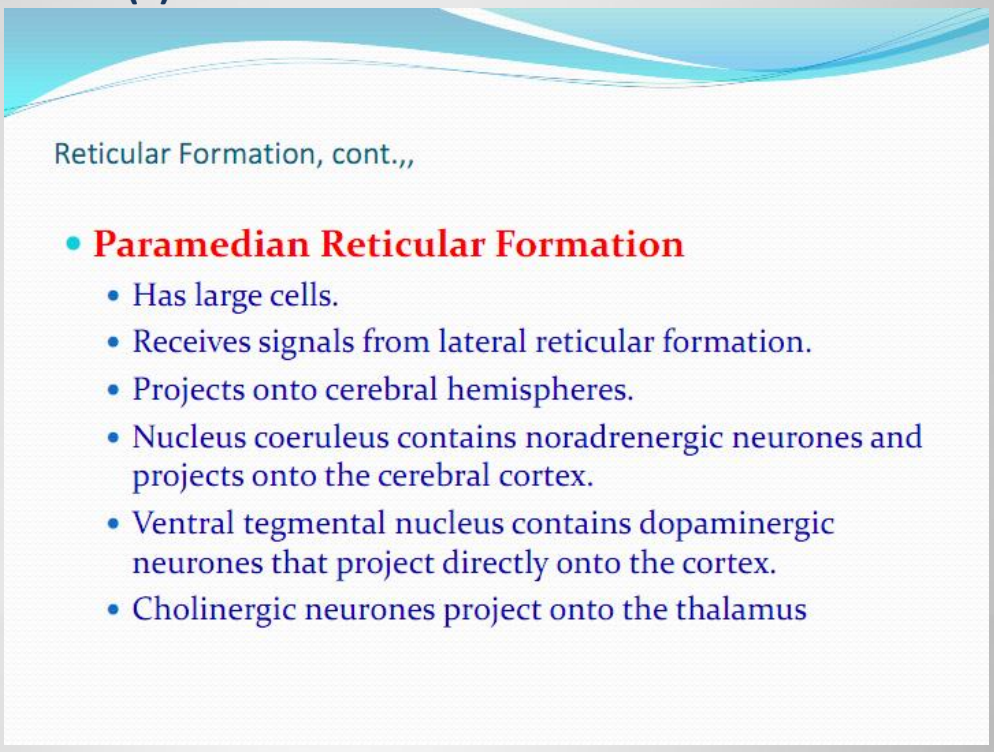

Team Notes :

PRF: receives impulses from lateral reticular formation and sends them to cerebral hemispheres

Thalamus is the intermediate stage between PRF and cortex

CNS Central Nervous System

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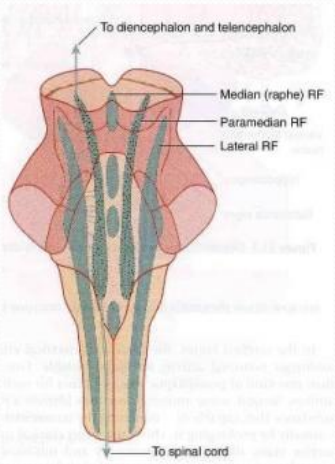
Reticular formation, cont.,,

- **Raphe nuclei (Median RF)**
  - In the midline of the reticular formation
  - Contain serotonergic projections to the brain and spinal cord.



Team Notes :

MRF sends upward and downward pathways to spinal cord

MRF is responsible for pain control

CNS Central Nervous System

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What are the Functions of reticular formation?

- 1. Somatic motor control (Reticulospinal tracts)
- 2. Cardiovascular control - The reticular formation includes the cardiac and vasomotor centers of the medulla oblongata.
- 3. Pain modulation - The reticular formation is one means by which pain signals from the lower body reach the cerebral cortex. It is also the origin of the descending analgesic pathways. The nerve fibers in these pathways act in the spinal cord to block the transmission of some pain signals to the brain.

Team Notes :

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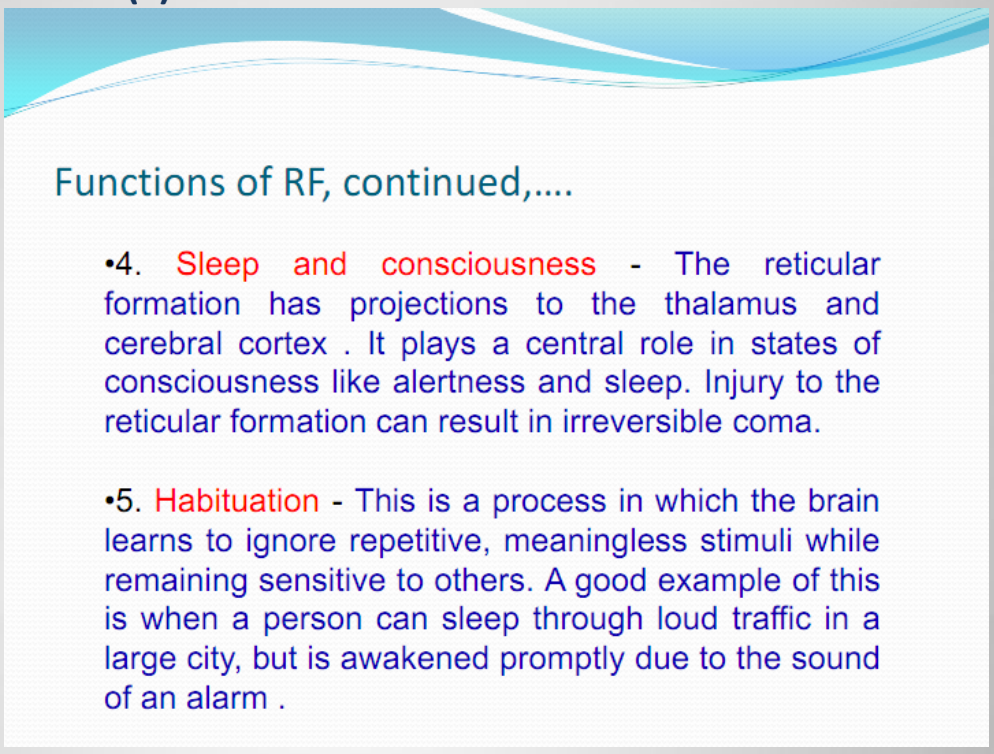

Team Notes :

Habituation: not all stimuli reach brain after a period of time

E.g., when you are sitting & listening to a lecture and there are other noises, at first you will be disturbed but after a while then you ignore them.

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Thalamus:

The thalamus is contained in the mid-part of the diencephalon and is split up into a number of different nuclei which perform 3 main tasks:

- Cholinergic projections excite the individual thalamic relay nuclei which lead to activation of the cerebral cortex.
- Cholinergic projections to the **intralaminar nuclei**, which in turn project to all areas of the cortex .
- Cholinergic projections to reticular nuclei to regulate flow of information through other thalamic nuclei to the cortex.
- Tuberomammillary nucleus in the hypothalamus projects to the cortex and is involved in maintaining the awake state.

The cholinergic projections to the thalamus stimulates the cerebral cortex.

Team Notes :

Intralaminar thalamic nucleus is concerned with consciousness.

Cholinergic neurons in CNS are excitatory

These projections can modulate signals or send them directly to cortex

Cholinergic projections to reticular nuclei control and modulate all impulses from reticular formation (RF) going to the brain

Hypothalamus: is important in arousal

CNS Central Nervous System Block

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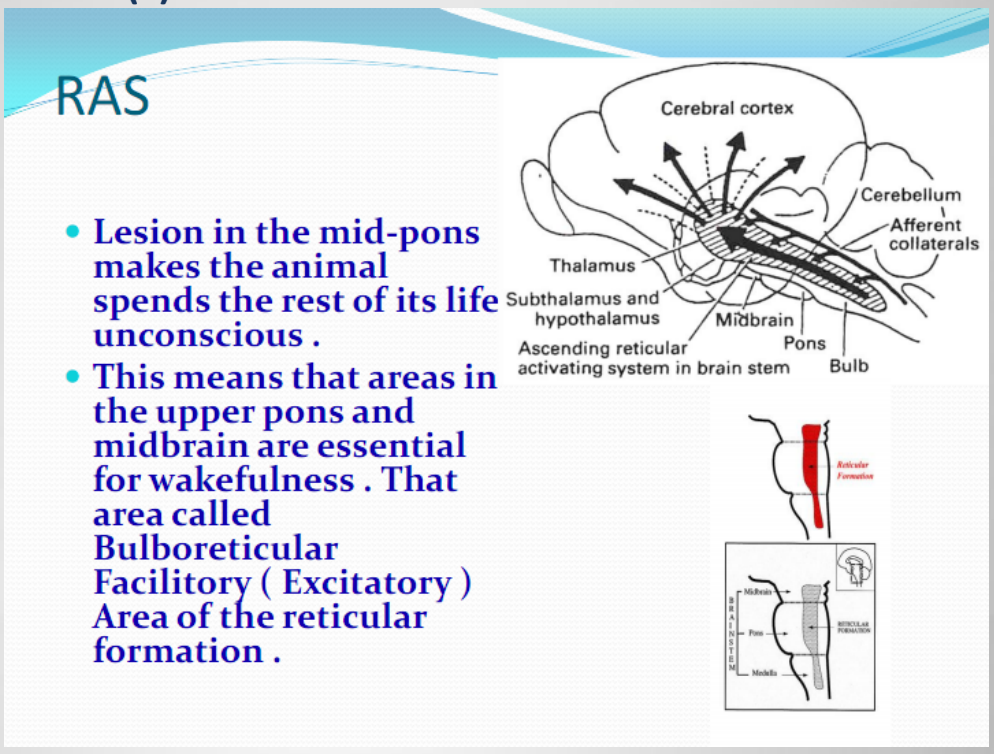

Team Notes :

RAS= reticular activating system

RAS collects parts of RF & specific nuclei of the thalamus and other parts in hypothalamus and tegmentum

Unconscious= in coma, no impulses going to the brain

Bulboreticular (in upper pons)

The Bulboreticular Facilitory (Excitatory) Area sends excitatory signals into Thalamus. As a result, the thalamus excites almost all areas of the cortex

The RAS is the system, which keeps our cortex awake and conscious

CNS Central Nervous System

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Anatomical components of RAS

- The RAS is composed of several neuronal circuits connecting the brainstem to the cortex . These pathways originate in the upper brainstem reticular core and project through synaptic relays in the rostral intralaminar and thalamic nuclei to the cerebral cortex. As a result, individuals with bilateral lesions of thalamic intralaminar nuclei are lethargic or somnolent.
- ***Several areas traditionally included in the RAS are***:
- Midbrain Reticular Formation.
- Mesencephalic Nucleus (mesencephalon)
- Thalamic Intralaminar nucleus
- Dorsal Hypothalamus.
- Tegmentum.

Team Notes :

CNS Central Nervous System

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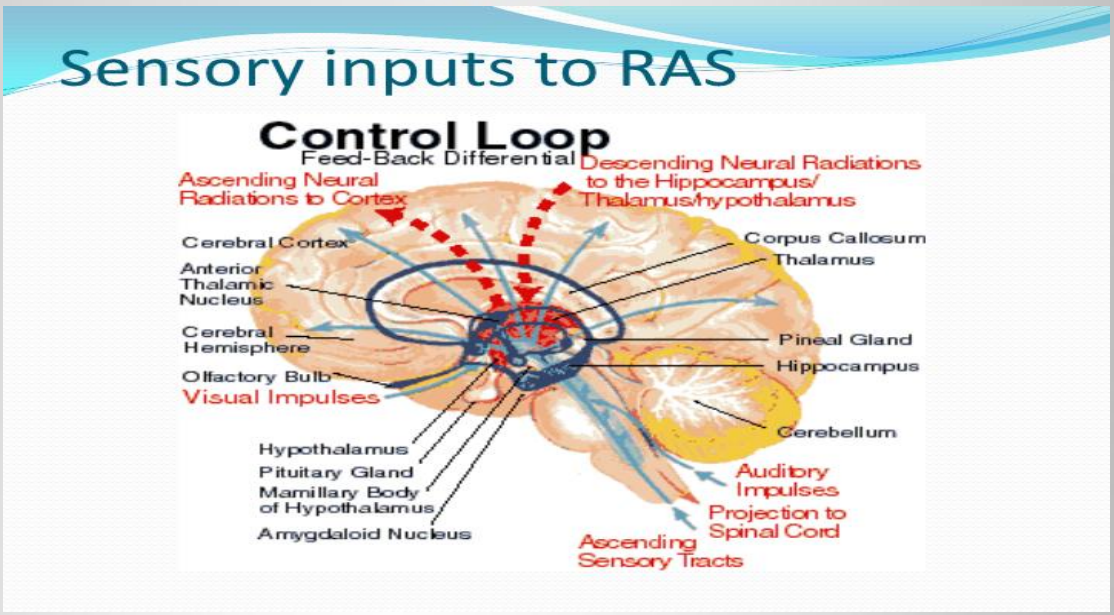

Ascending neural radiation is from hippocampus and thalamic pathways These pathways filter the impulses (differentiate the important impulses from the non-important) and send them to neural radiation then to cortex then a reaction happens.

Team Notes :

- **The awakening action of the RAS is mediated by fibers secreting Acetylcholine (Ach) and Norepinephe (NE)**
- **The RAS provides the main drive that maintains effective cortical excitability level, & interruption of this ascending pathway (e.g., by a tumor) causes the subject to go into unremitting coma lasting for the remainder of life.**
- **The level of consciousness is largely influenced by :**

(1) Peripheral sensory inputs

(2) Thalamocortical sectors .

CNS Central Nervous System

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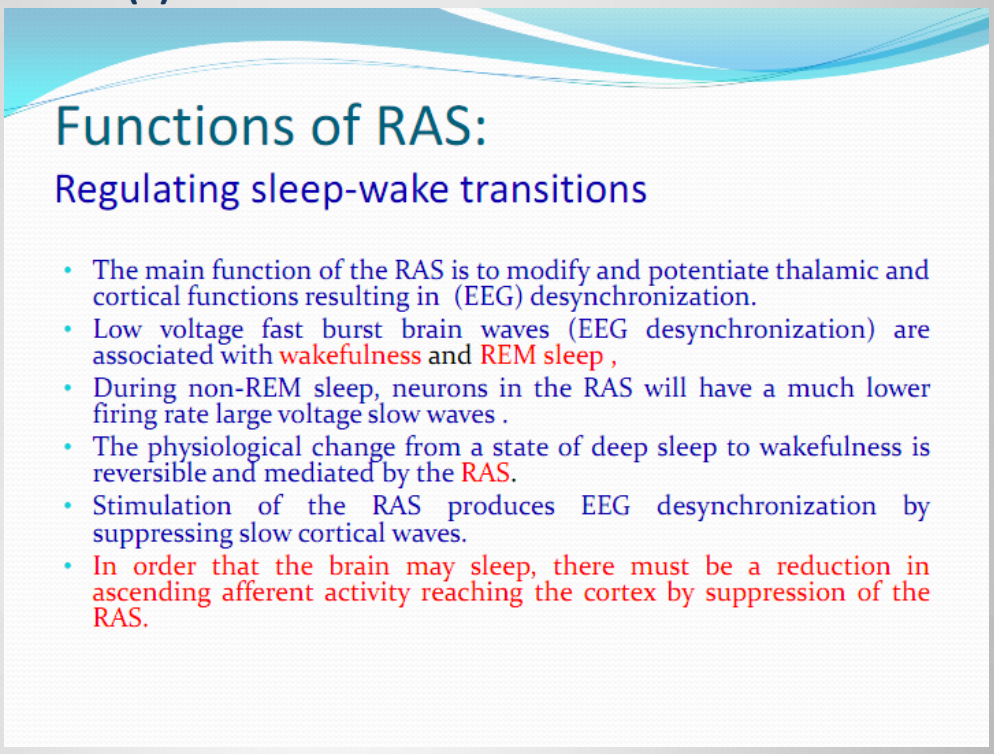

Team Notes :

Desynchronization = changing of sleep waves

RAS is responsible for wave changes during sleep, RAS activity decreases during REM sleep and increase while changing between waves (on & off)

CNS central Nervous System

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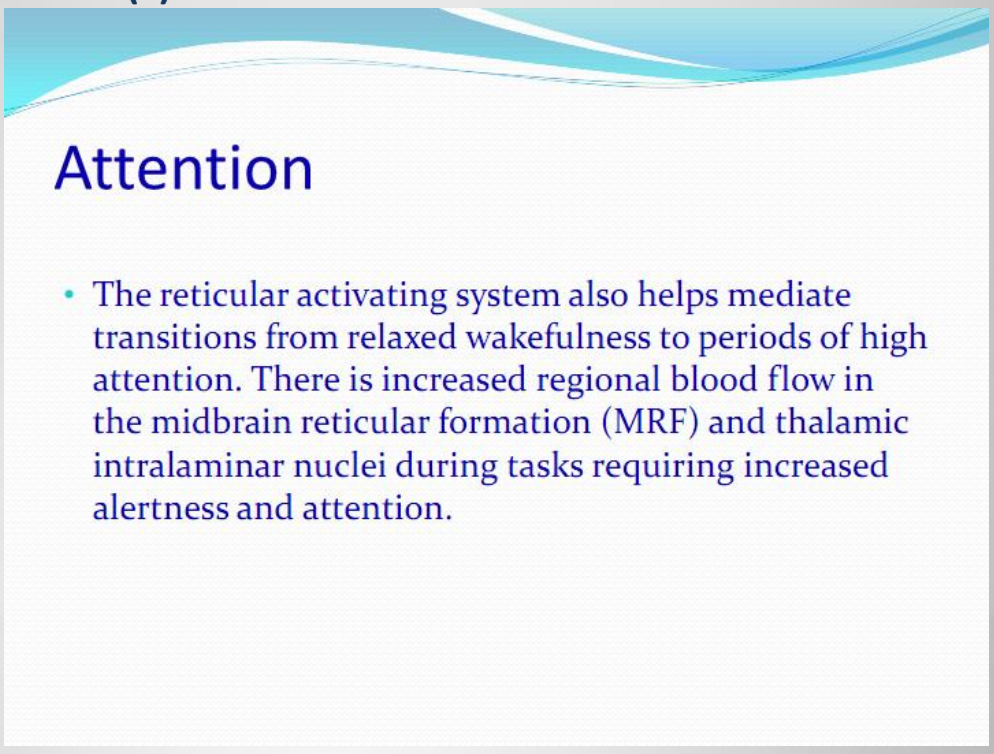

Team Notes :

Attention= concentration

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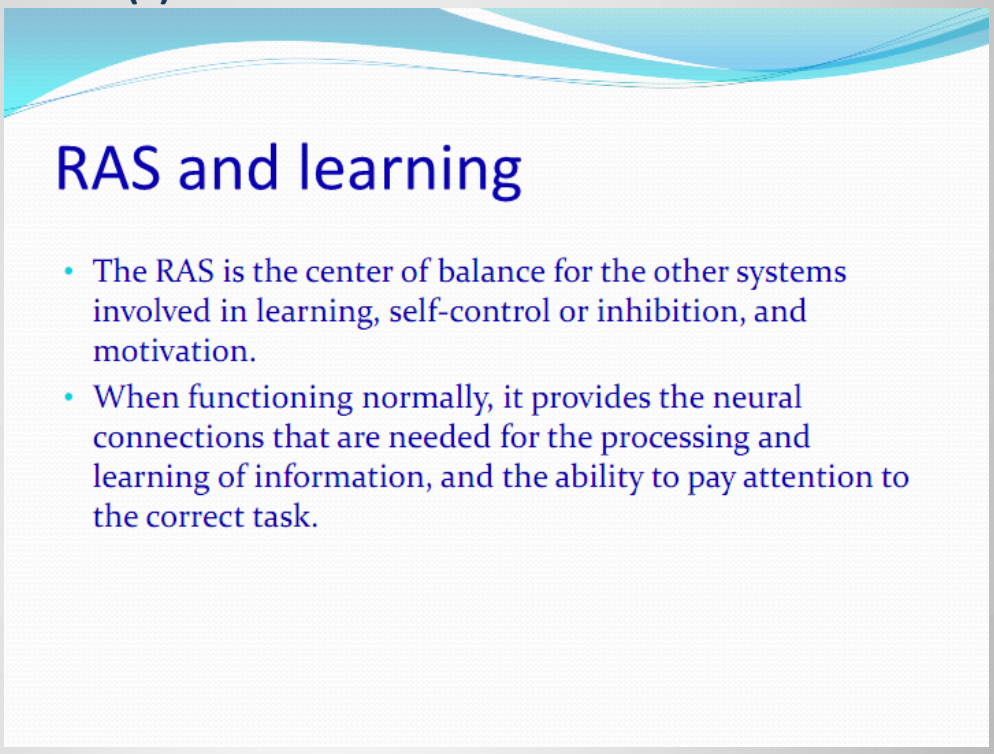

Team Notes :

Attention and learning are related, e.g. when studying an boring subject you will have difficulty in concentrating, because is restored in your memory that it is boring, and vice versa. So you have to be aroused in order to study

RAS receives information from hippocampus and from the limbic system

CNS Central Nervous System

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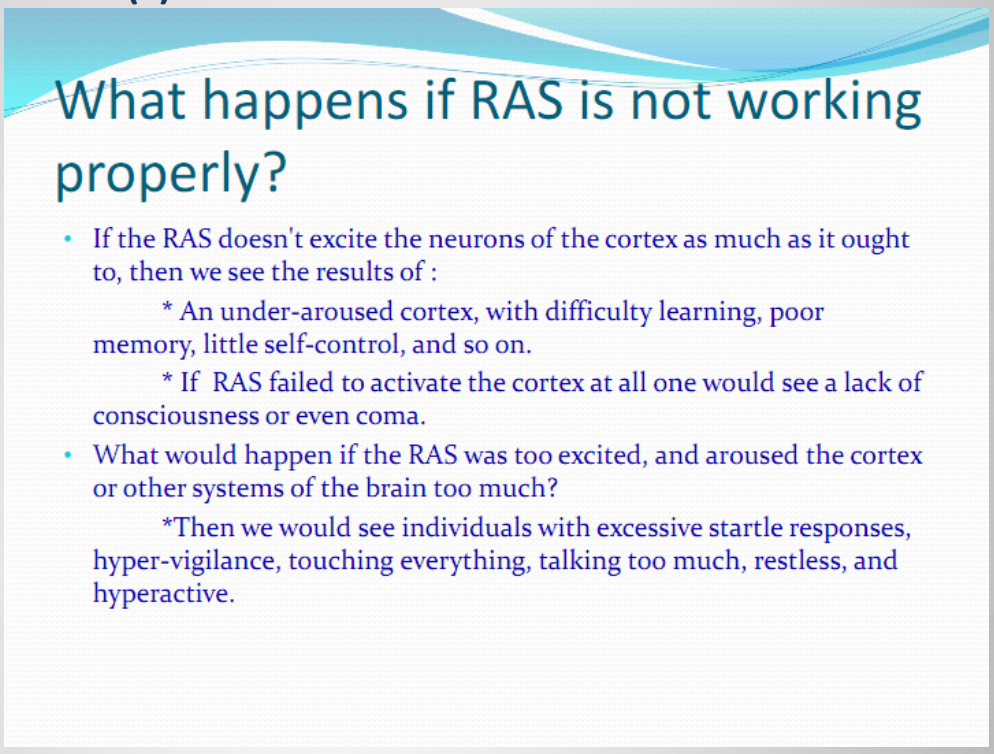

Team Notes :

If RAS is not active properly, it will lead to either:

Drowsiness so no concentration, or over excitation so also no concentration

Hyperactive= like in some children and they suffer from learning difficulties

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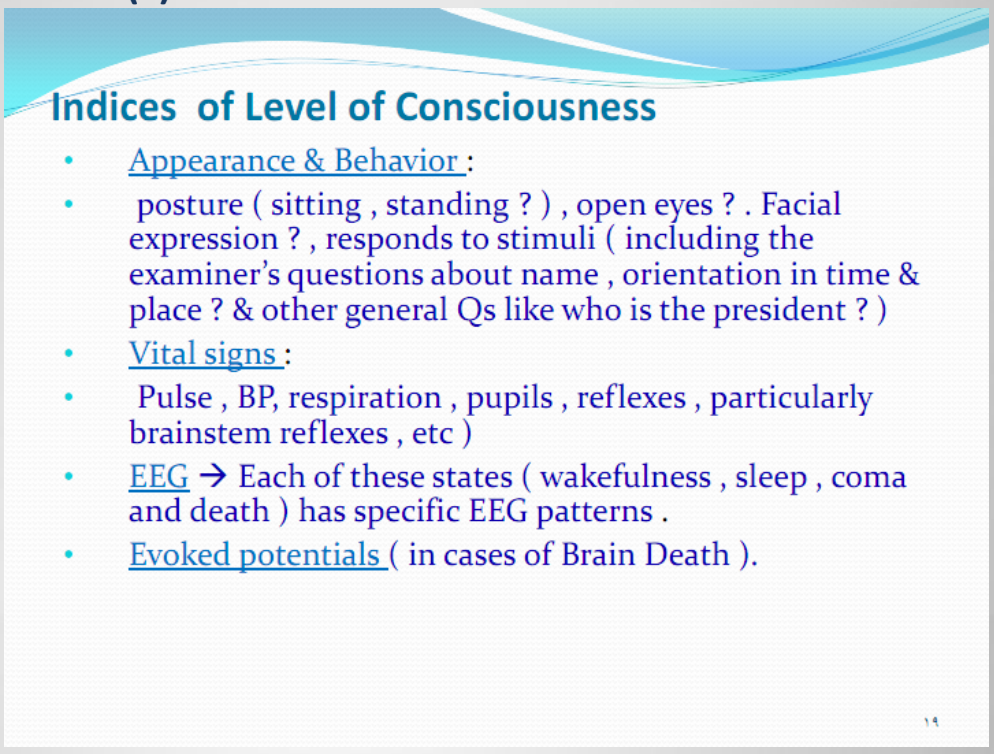

Team Notes :

The level of consciousness is tested in emergencies especially after accidents

If absent reflexes, (coma)

If only delta waves shown in EEG, (coma)

CNS Central Nervous System

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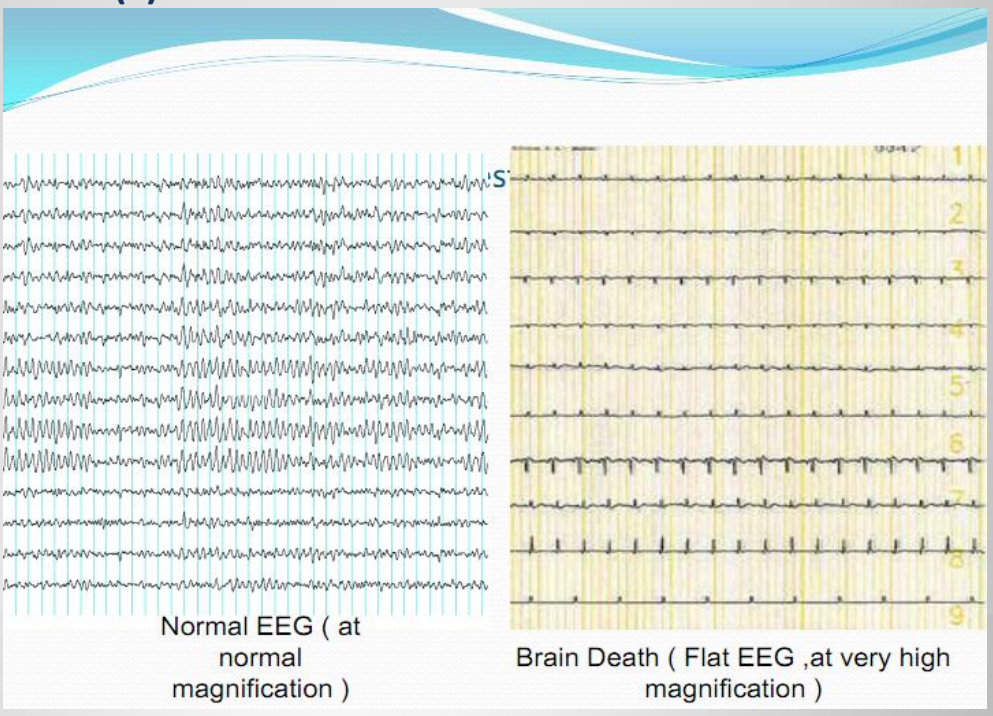

- **Alpha Rhythm :**Observed in awake , relaxed adult humans with eyes closed ,Most prominent in the Parieto-Occipital region , though it is sometimes observed in other locations When attention is focused on something the alpha rhythm becomes replaced by irregular low-voltage activity This phenomenon is known as Alpha Block
- **Beta Waves (a fast rhythm) : lower amplitude than alpha In frontal regions(same as alpha but eyes are open),(noise)**
- **Gamma Waves (a fast activity) : Effect of "Focused Attention or alert Wakefulness , even if eyes are closed : Often seen in a subject who is , on being aroused , focuses his attention on something (a particular object/person/ animal ,etc)..**
- **Theta Waves: in children but in (adults during sleep only), recorded from the Hippocampus in experimental animals.**
- **Delta Waves: In deep sleep and coma, In frontal regions**
  Infants (because there's no myelination

CNS Central Nervous System

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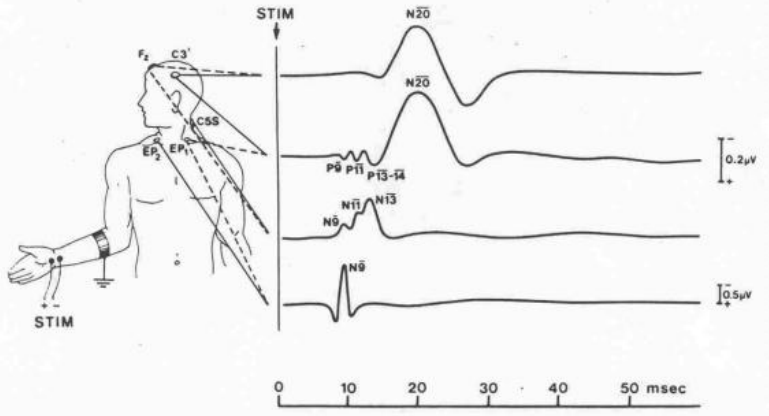
Brain Death Confirmatory Testing with Somatosensory Evoked Potentials

Stimulation of a sense organ can evoke a cortical response that can be recorded by scalp electrode over the primary receiving cortical area for that particular sense .



Team Notes :

Evoked potential: if there is no response at all for stimuli then, brain death

The EEG shows special features in different age groups of normal subjects

Summary

- **The areas in the upper pons and midbrain are essential for wakefulness, and called it the Bulboreticular Facilitory (Excitatory) Area of the reticular formation. (This Bulboreticular Facilitory Area is also called by some scientists The Brainstem Ascending Reticular Activating System)**

- **The level of activity of the Bulboreticular Facilitatory area and , consequently , the level of alertness and arousal is largely determined by the number and type of sensory (afferent) signals that enter the CNS from the periphery .Pain signals , in particular , increase activity in this excitatory area and therefore strongly excite the brain to attention.**
- **<u>Role of Thalamo-Cortical Sectors :</u>**
  Not only do excitatory signals pass to the cerebral cortex from the RAS, but feedback signals also return from the cortex back to the Thalamus (which is part of the RAS).

- **Almost every area of the cerebral cortex connects with its own highly specific area in the thalamus. These functional segments are called Thalamocortical Sectors They are made of → Thalamo-cortical (TC) fibers and feedback Cortico-thalamic (CT) fibers . These neural circuits between the thalamus & cortex are essential for determining the level of consciousness**
- **EEGs of early childhood, late childhood, adolescence, middle age and old age also have some differences.**
- **In cases of coma EEG may be dominated by delta waves**
- **In case brain death the EEG is flat, even at very high magnification**