

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

**"MASTERING OTHERS IS STRENGTH;  
MASTERING YOURSELF IS TRUE POWER."**

**- LAO TZU**



# Reticular Formation

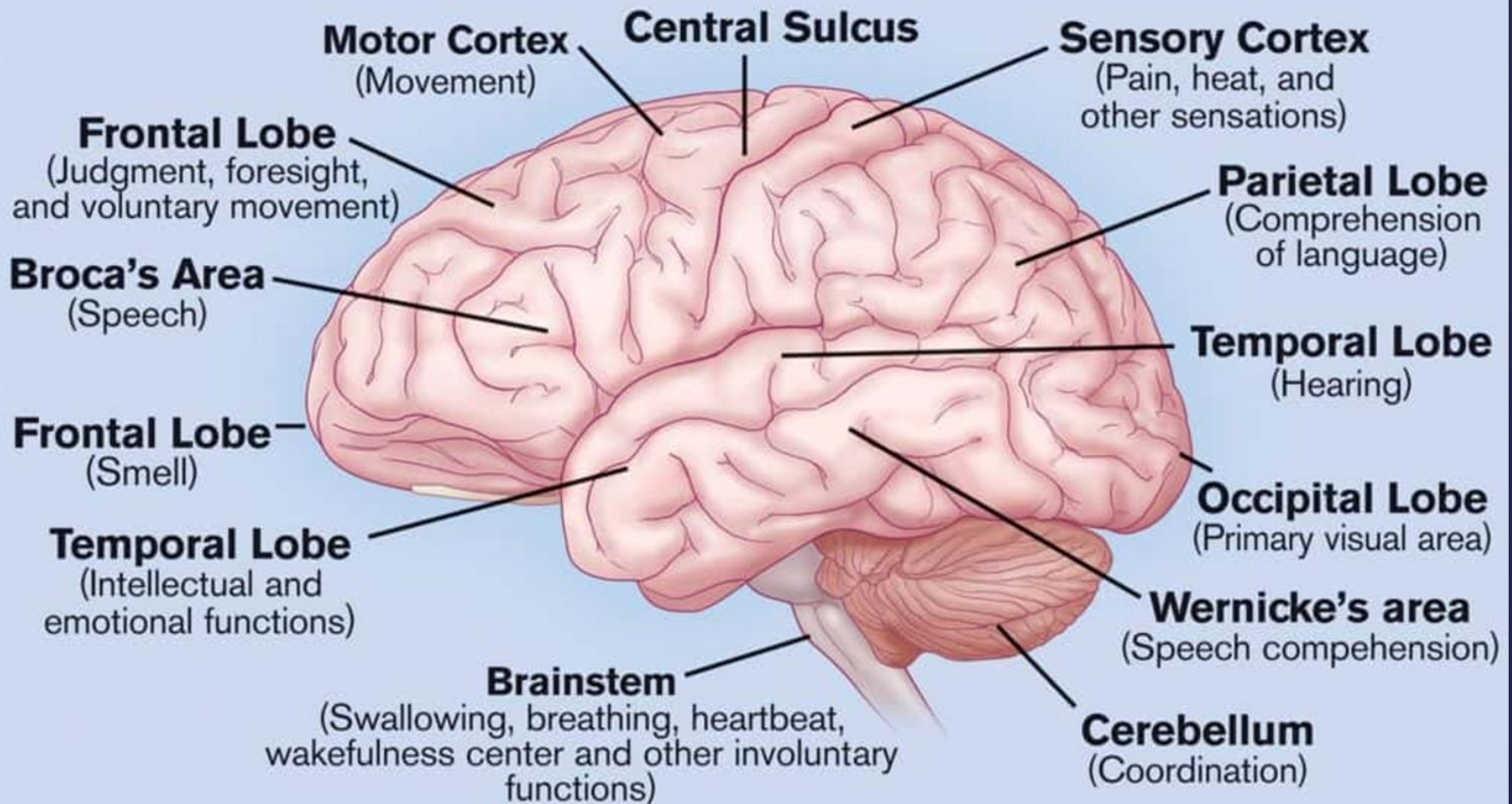
Dr Zubia Shah

# Learning Objectives

- Enumerate the involuntary functions of brain
- Describe Bulboreticular facilitatory area.
- Explain continuous stimulation from lower brain by four neurohormonal systems.

<u>Voluntary actions</u>	<u>Differences</u>	<u>Involuntary actions</u>
Not Automatic - with awareness	Type of response	Automatic - without awareness
Cerebrum	Part of the brain controls the actions	Medulla oblongata
Receptor → Spinal cord → Cerebrum → Spinal cord → Effectors	Nervous pathway	Receptor → Spinal cord → Medulla oblongata → Spinal cord → Effectors
Slow	Speed	Fast
Speaking, hearing writing, walking and etc	Example of actions	Heartbeat, peristalsis respiration and etc

# Functions of Brain



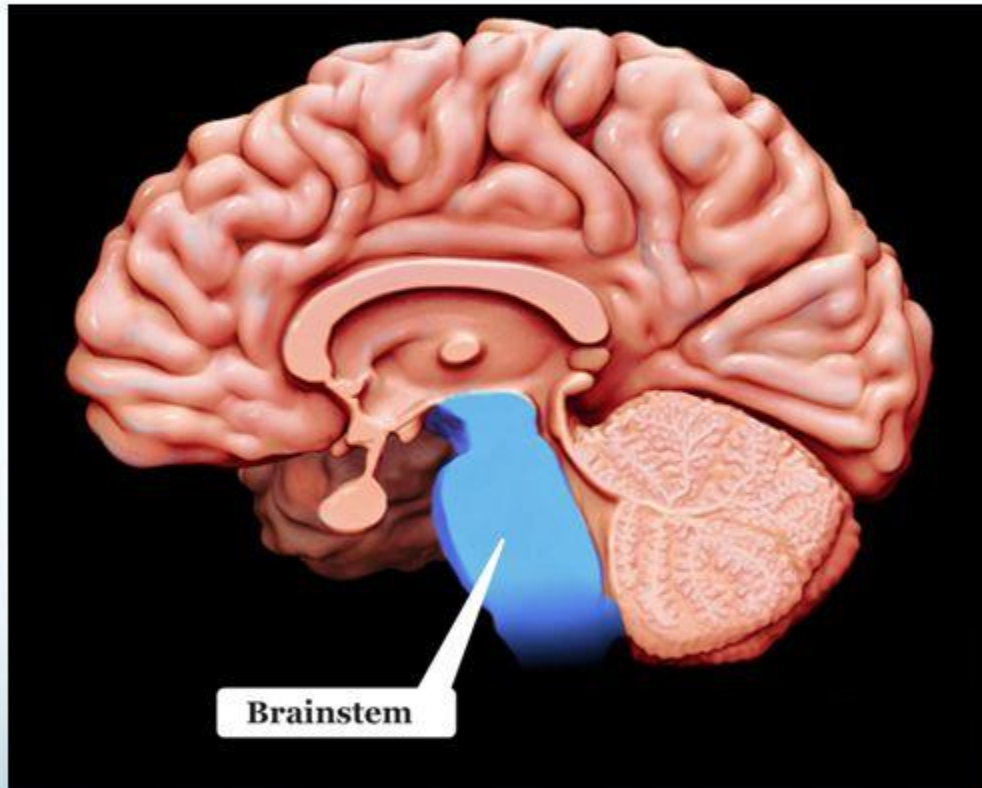
# Involuntary Brain Functions

Involuntary functions include

- Regulating heartbeat,
- breathing,
- blood pressure,
- swallowing,
- reflexes
- and blinking..

<https://www.ncbi.nlm.nih.gov/books/NBK20367/#:~:text=For%20instance%2C%20the%20human%20brain,to%20each%20type%20of%20task.>

# Brain Stem



- Located at the base of the brain, the brainstem is composed of the **midbrain**, the **pons** and the **medulla**. It regulates basic involuntary functions necessary for survival such as:
  - Breathing
  - Heart rate
  - Blood pressure
  - Swallowing
- It also plays a role in alertness and sensation



# Reticular Formation

- System of motor and sensory fibres and nerve cells forming the central core of brainstem
- Extends from superior part of **spinal cord**
  - ◎ **diencephalon**

# Definition

Diffused mass of neurons and nerve fibers forming an ill-defined reticulum (network) in the central portion of the brainstem

# Connections

Connects

- **hypothalamus,**
- **basal ganglia,**
- **cerebellum and**
- **cerebrum**

with fibres in all major ascending and descending tracts

# Reticular Activating System

- a component of the reticular formation located throughout the brainstem.
- modulate between slow sleep and fast sleep rhythms ☺
- the nuclei that form the RAS play a significant role in coordinating both the sleep-wake cycle and wakefulness.
- responsible for attention, arousal, modulation of muscle tone, and the ability to focus

<https://www.ncbi.nlm.nih.gov/books/NBK549835>

# Descending Reticular System

- Regulation of heart rate
- Blood pressure
- Respiration
- Muscle tone
- and control many Autonomic motor functions

# Ascending Reticular System

**Activating influence** on Cerebral Cortex

- In a sleeping animal electrical stimulation will show a typical pattern of arousal

So

**Reticular Activating System or  
Bulboreticular facilitatory Area**

- Controls level of **Consciousness** and produces **Alert State**

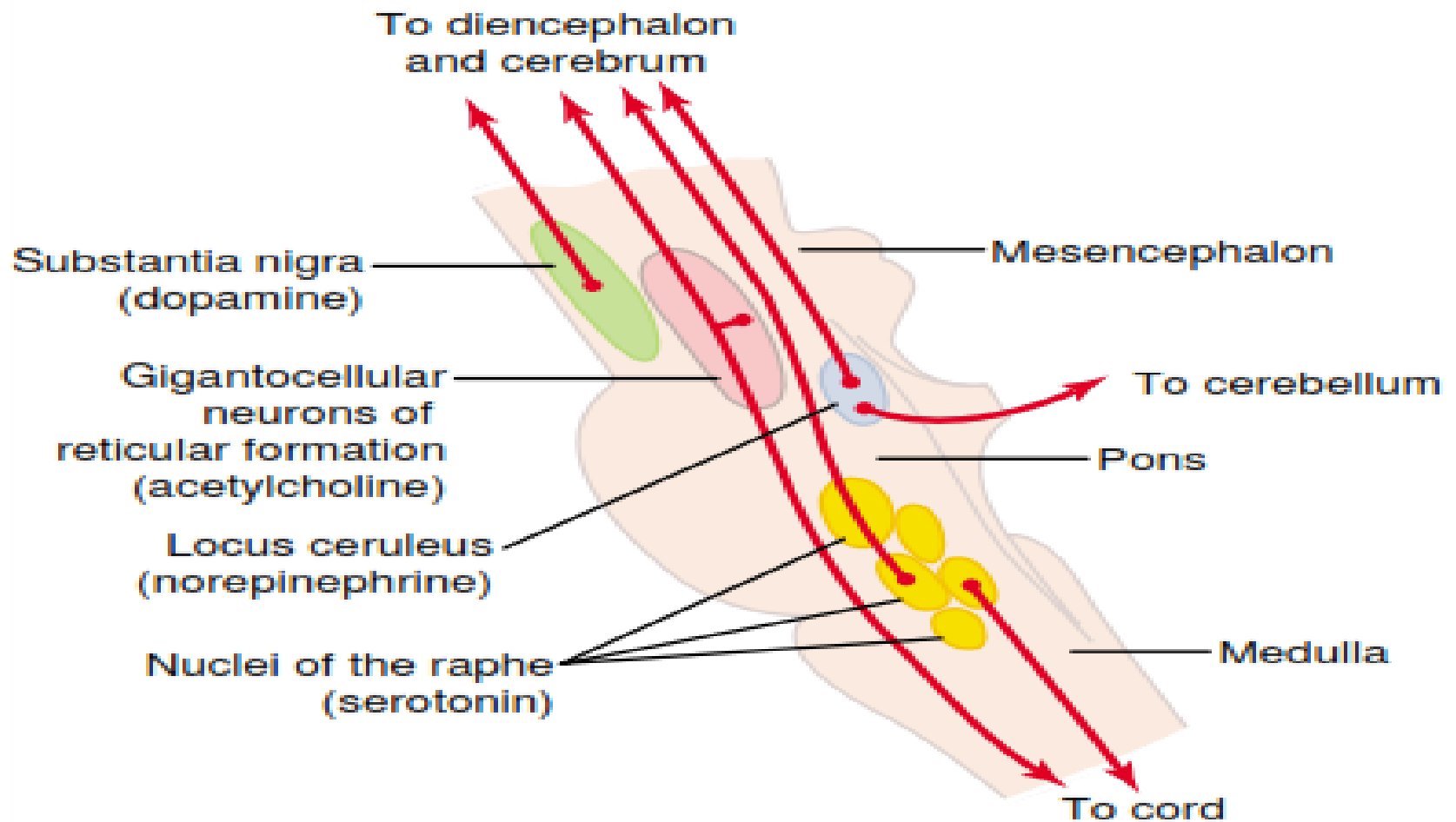
# Neurotransmitters

# Neurotransmitters in Reticular Formation

(SAND)

1. Serotonin (Raphe Nuclei)
2. Acetyl Choline (Gigantocellular Neurons)
3. Noradrenaline (Locus Coeruleus) and
4. Dopamine (Substantia Nigra)





**Figure 58-3**

Multiple centers in the brain stem, the neurons of which secrete different transmitter substances (specified in parentheses). These neurons send control signals upward into the diencephalon and cerebrum and downward into the spinal cord.

# Reticular Formation

Can be roughly divided into 3 longitudinal zones

- **Midline** - Raphe Nuclei
- **Medial Zone** - Long ascending and descending projections
- **Lateral Zone** - Cranial nerve nuclei

# Characteristics of RAS

diffuse aggregations of cells

- **Magnocellular zone**

- Large cells in medial 2/3

- serve as the effector regions (give rise to the efferent projections) and receive afferents fibers

- **Parvocellular zone**

- Small cells found laterally

- receive afferent fibers from both neighboring regions of the brainstem as well as from distant structures

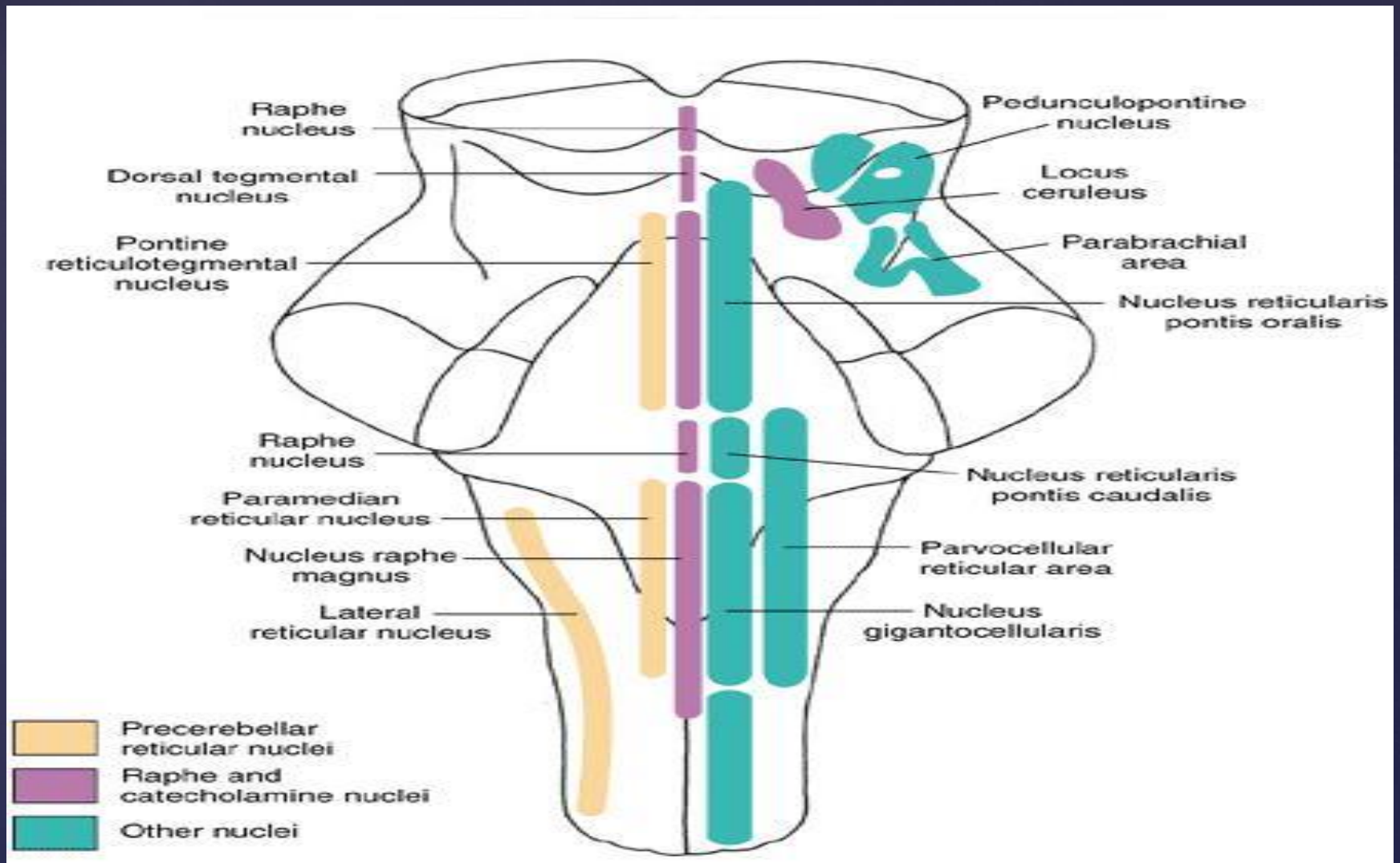


Figure. The positions of the magnocellular and parvocellular regions of the reticular formation.

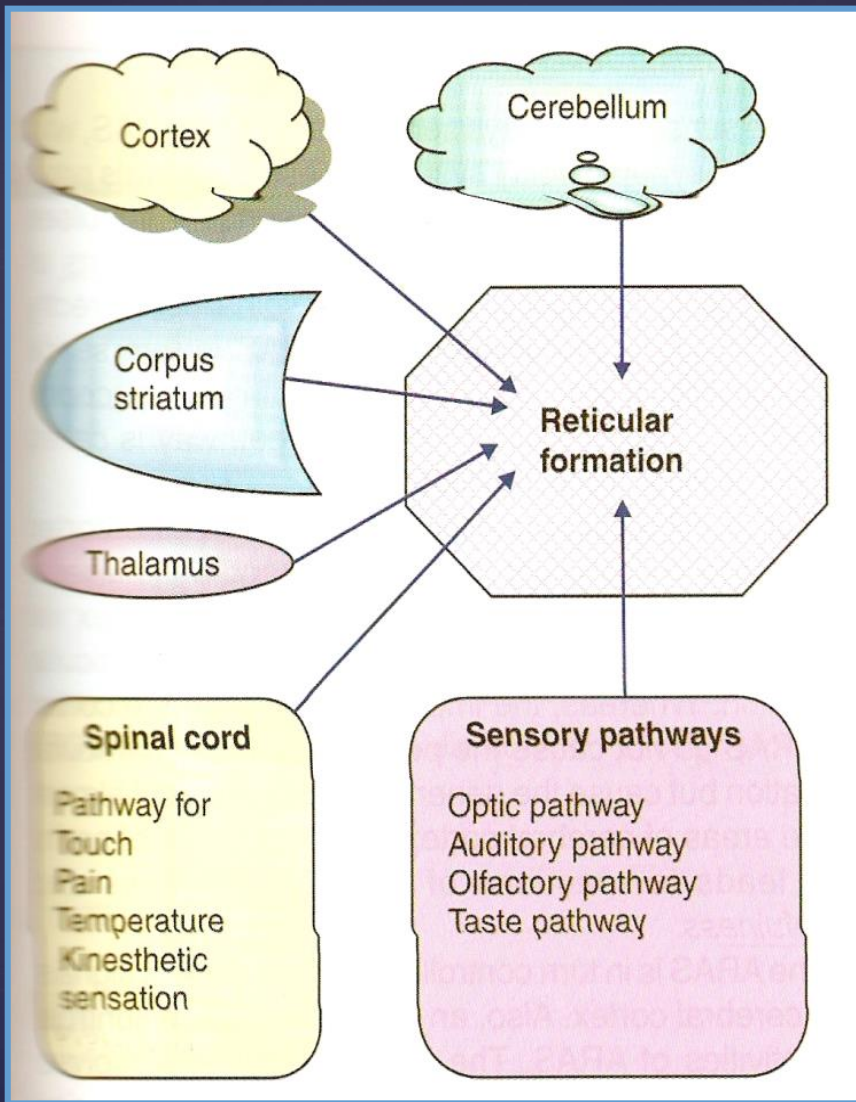


Fig. 1 -Afferent connections of reticular formation

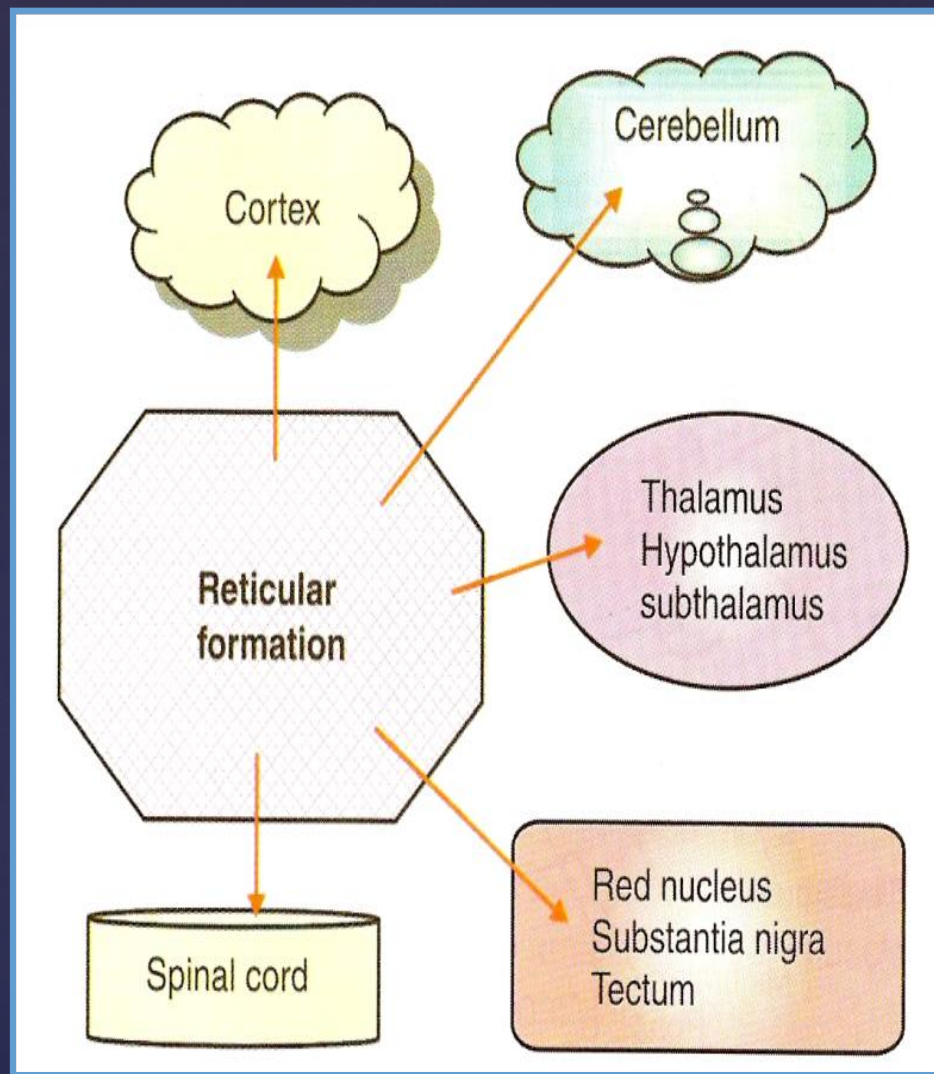


Fig. 2 – Efferent connections of reticular formation

# Connections of Reticular Formation

# Current Concept Reticular Formation

1. **Arousal Or Alerting System For Cerebral Cortex**
1. **Maintaining Consciousness**

# Effect Of Drugs

Depression © decreases alertness and induces sleep (**Barbiturates**)

Stimulates Cerebrum © alertness and wakefulness (**Amphetamines**)

# Functions of Reticular Formation

1. Motor activities and some spinal reflexes
2. Control of respiration, blood pressure and heart rate
3. Activates cerebral cortex to a state of wakefulness
4. If stops working ☹ unconsciousness (coma)
5. Filters incoming Sensory impulses
6. Monitors all bodily activities
7. Auditory and vestibular impulse from ear exerts a powerful effect along with descending part of RAS



# Neurohormonal Systems Brain

1. **The Locus Coeruleus And Norepinephrine System**
2. **The Substantia Nigra And Dopamine System**
3. **The Raphe Nuclei And Serotonin System**
4. **The Gigantocellular Neurons of Reticular Excitatory Area And Acetylcholine System**

# The Locus Coeruleus And Norepinephrine System

Small area between pons and mesencephalon

Nerve fibres spread from here to all areas of brain

Norepinephrine is excitatory in most areas of brain  
and inhibitory in some

Role in dreaming ☺ REM sleep

# The Substantia Nigra And Dopamine System

- Substantia nigra lies superiorly in mesencephalon
  - ◎ nerve endings to putamen and caudate nucleus where they secrete Dopamine
- Inhibitory in Basal Ganglia but may be excitatory in other areas of brain

# The Raphe Nuclei And Serotonin System

- Raphe nuclei in midline of pons and medulla
- ◎ Serotonin ◎ suppresses Pain And causes Sleep

# The Gigantocellular Neurons And Acetylcholine System

- Giant Cells in Reticular Excitatory Area of Pons And Mesencephalon
- Acetylcholine is secreted at nerve endings
- Mostly Excitatory Neurotransmitter

# Other Neurotransmitters and Neurohormonal systems in Brain

- Enkephalins,
- GABA,
- Glutamate,
- Vasopressin,
- Adrenocorticotrophic hormones,
- $\alpha$ - Melanocyte stimulating hormone ( $\alpha$ -MSH),  
Neuropeptide Y (NPY),
- epinephrine, histamine, endorphins,  
angiotensin II and neurotensin



**Any Questions**

# References



Guyton & Hall

Sherwood Physiology

Ganong's Physiology



Thank you