Neuroscience *Dr Naeem Iqbal*

The aim of this module is to give a better understanding of working of the brain to the practitioner based on scientific research. This will enable the practitioners to identify client's problems and relate it to the initial consultation.

It will also help to understand the underlying mechanisms and how trance can regulate them.

Finally the practitioners will be able to answer any questions in more depth commonly asked by the clients.

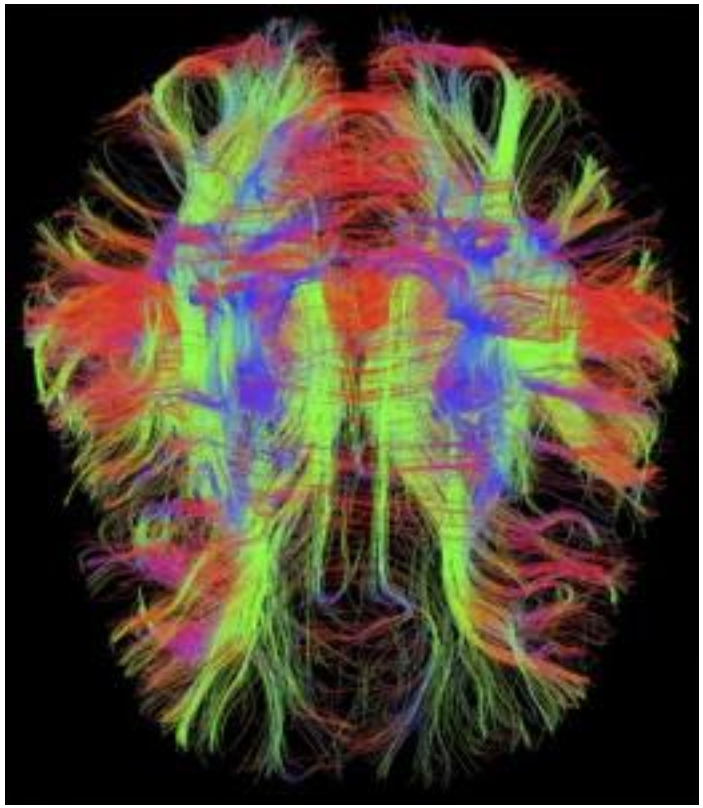
The Brain

- Weighing 1500g, over 10 billion neurones (100000000000), making 1000000000000000 connections. Brain functions as one integrated whole with every single neurone making up to 20,000 connections with other neurones.

- •Although the brain has many components, they all function together in an integrated way.

- Neuronal network

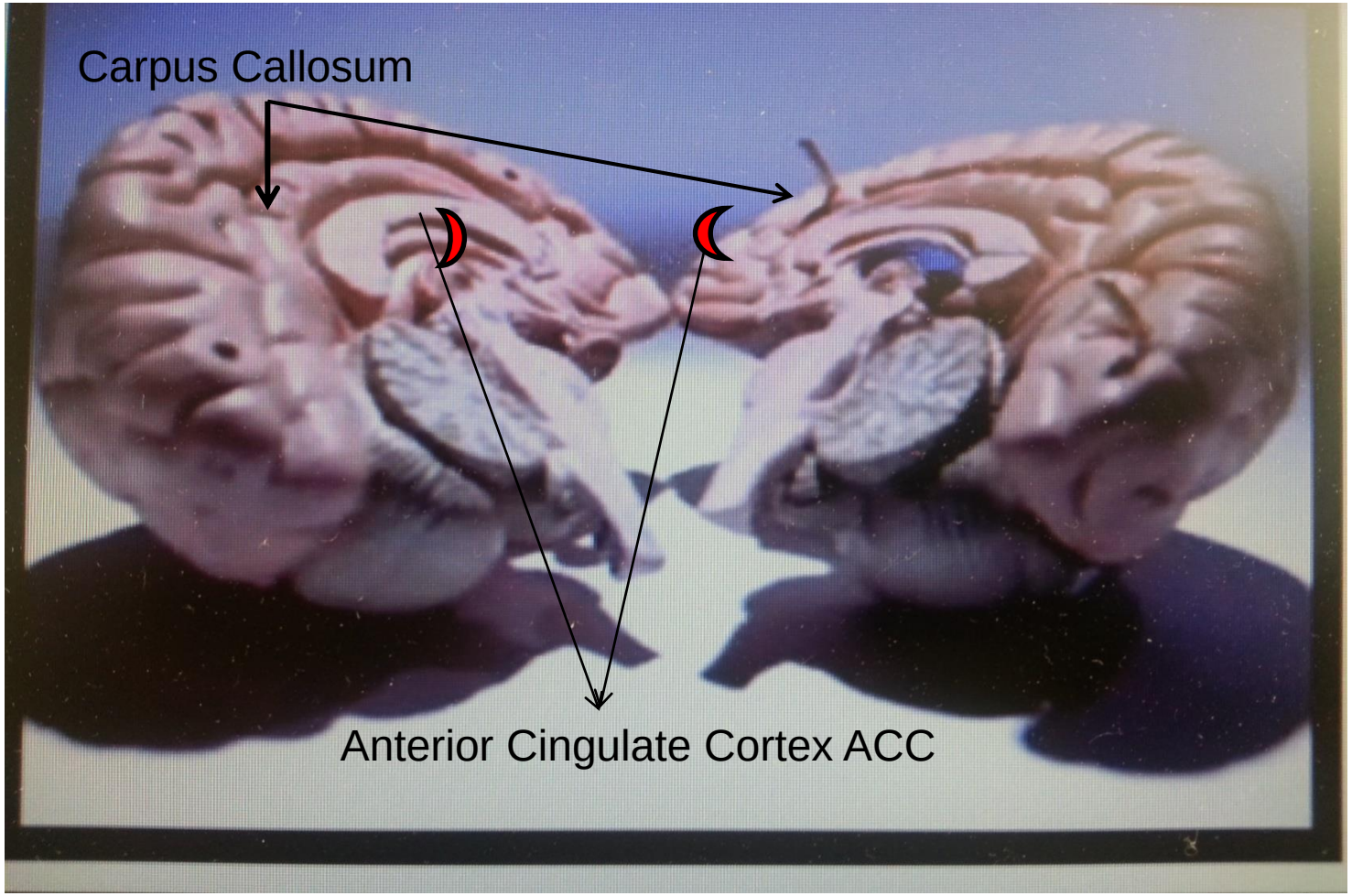
White brain matter



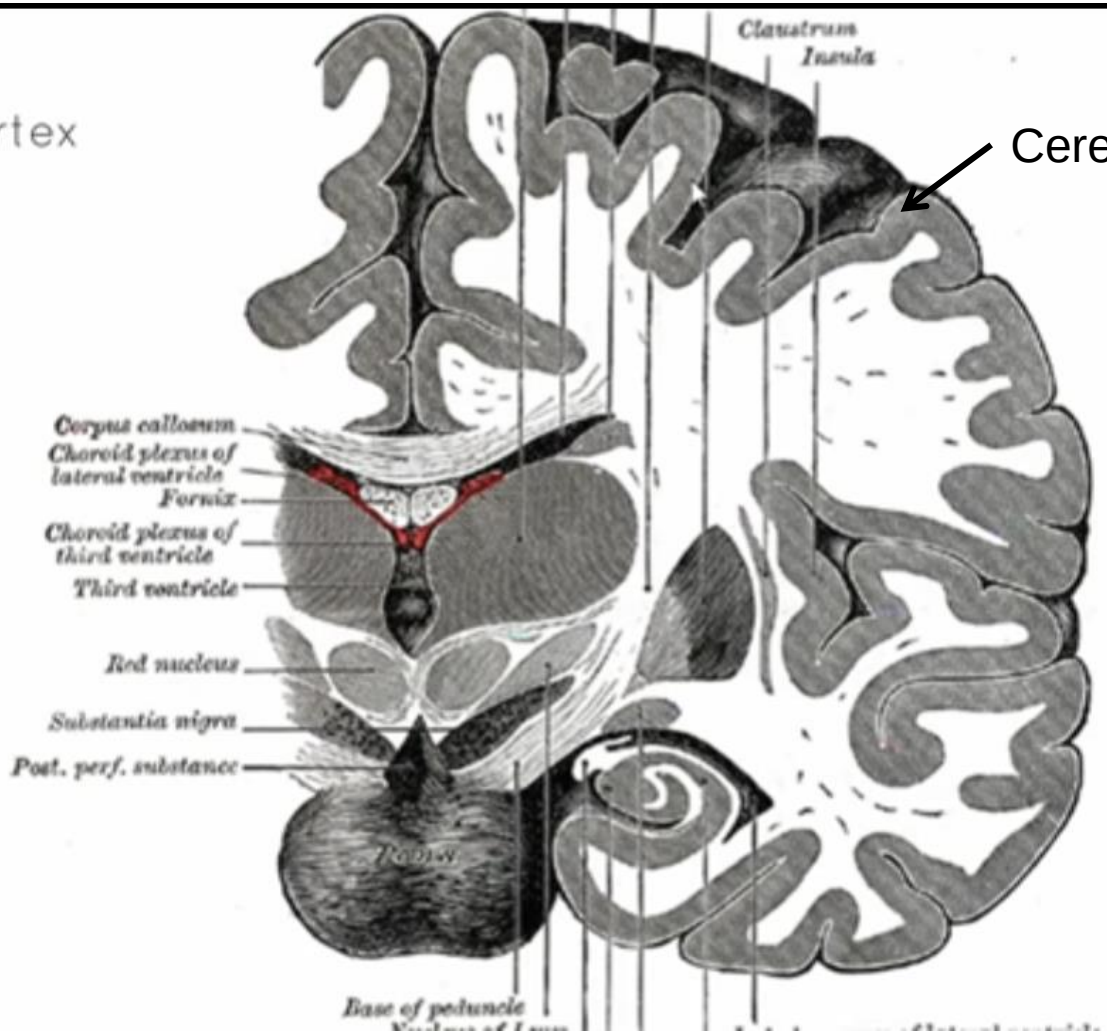
Cerebral Hemisphere and Cerebral Cortex. *(Conscious or Intellectual Brain)*

- The brain comprises two halves called left and right Cerebral Hemispheres, together known as Cerebrum. They are connected at the middle by bundle of fibres called Corpus Callosum which integrates the activity of the right and left brain. The thin outer layer of the cerebral hemispheres is the Cerebral Cortex and is made up of grey matter while the inner part constitutes white matter. Corpus callosum is covered by grey matter called cingulate gyrus.

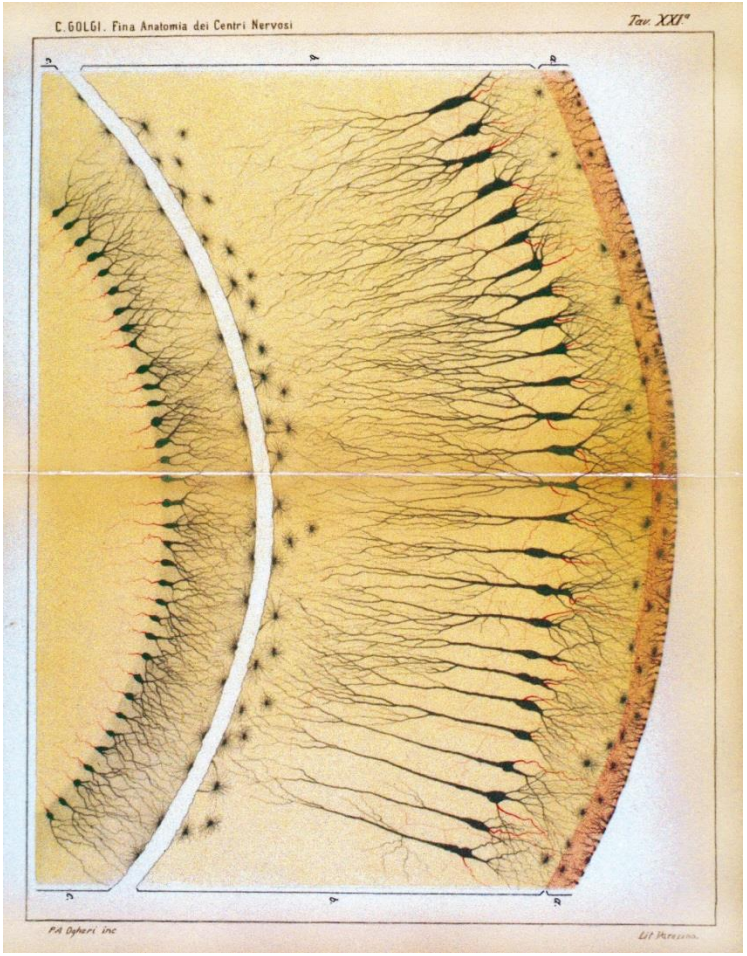
- Different areas of cerebral cortex perform different functions. The motor area controls voluntary movements, the sensory area receives information from the receptors in the skin. Most of the nerve fibres from each side cross over to the opposite side in the lower part of brain hence right side of body is controlled by left brain and vice versa. In a right handed person. The right side of brain is better at functions like spatial abilities, simple language comprehension, non verbal ideation, awareness to environment and is capable of logical choice. The left brain is associated with speech, writing, main language comprehension and calculation.

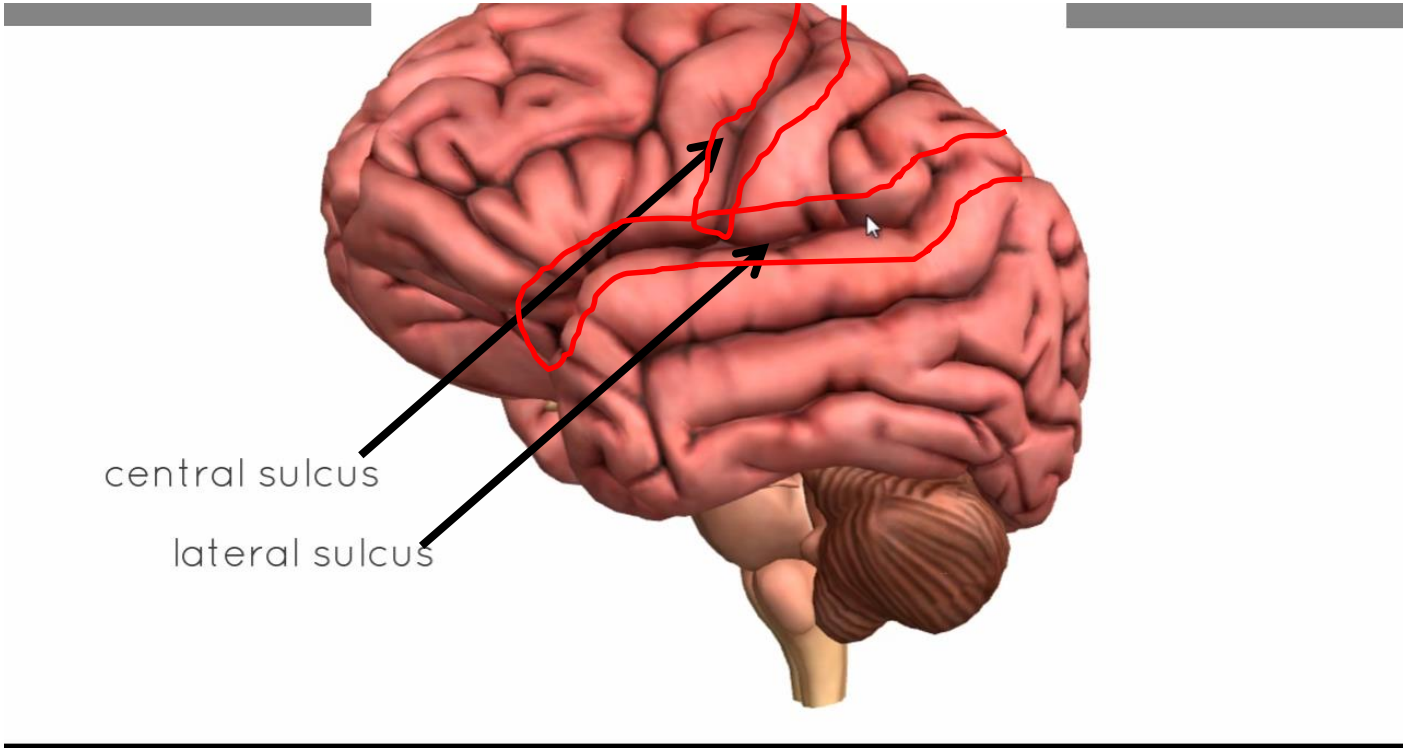

Carpus Callosum
Anterior Cingulate Cortex ACC

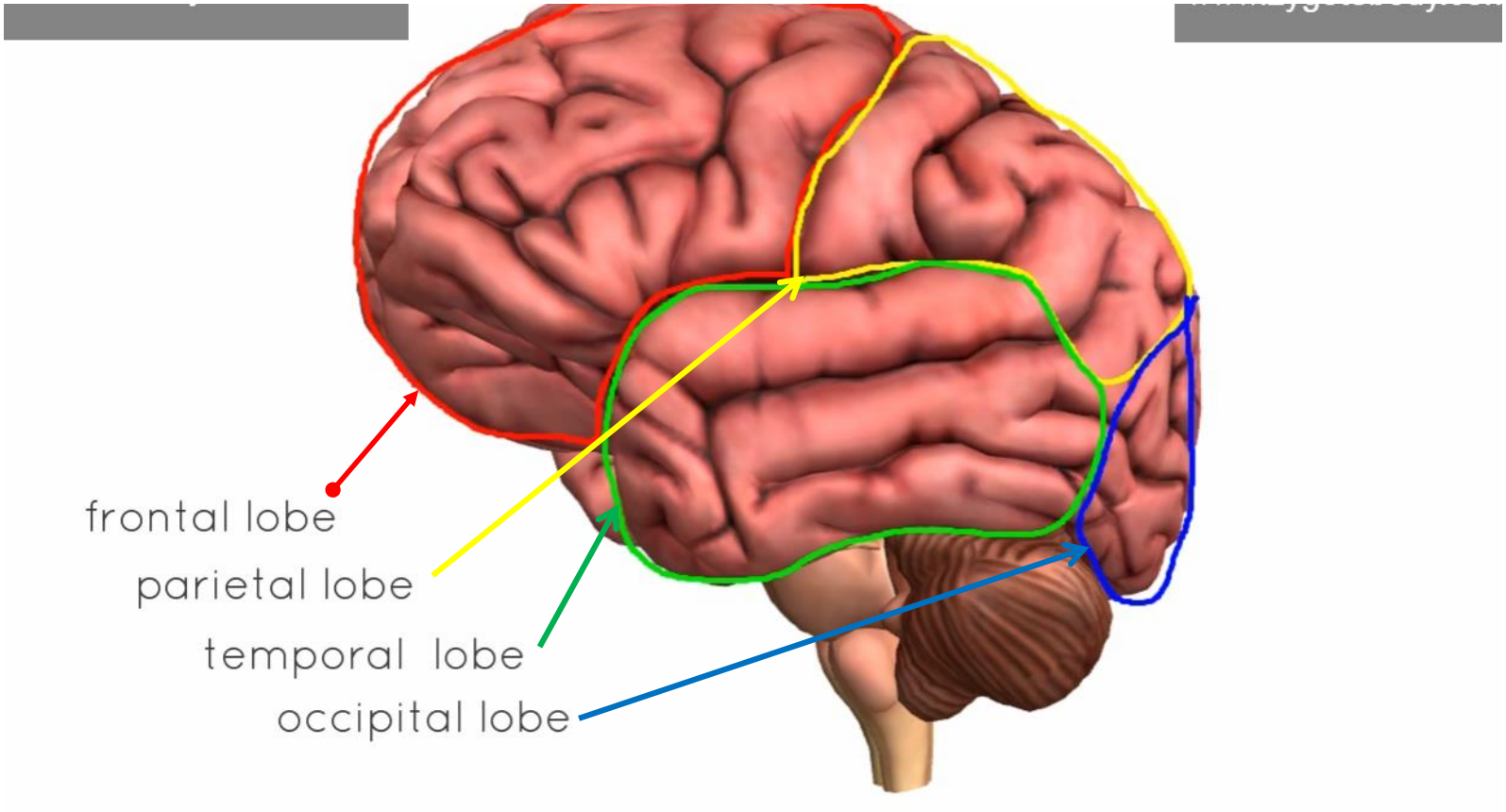
cerebral cortex



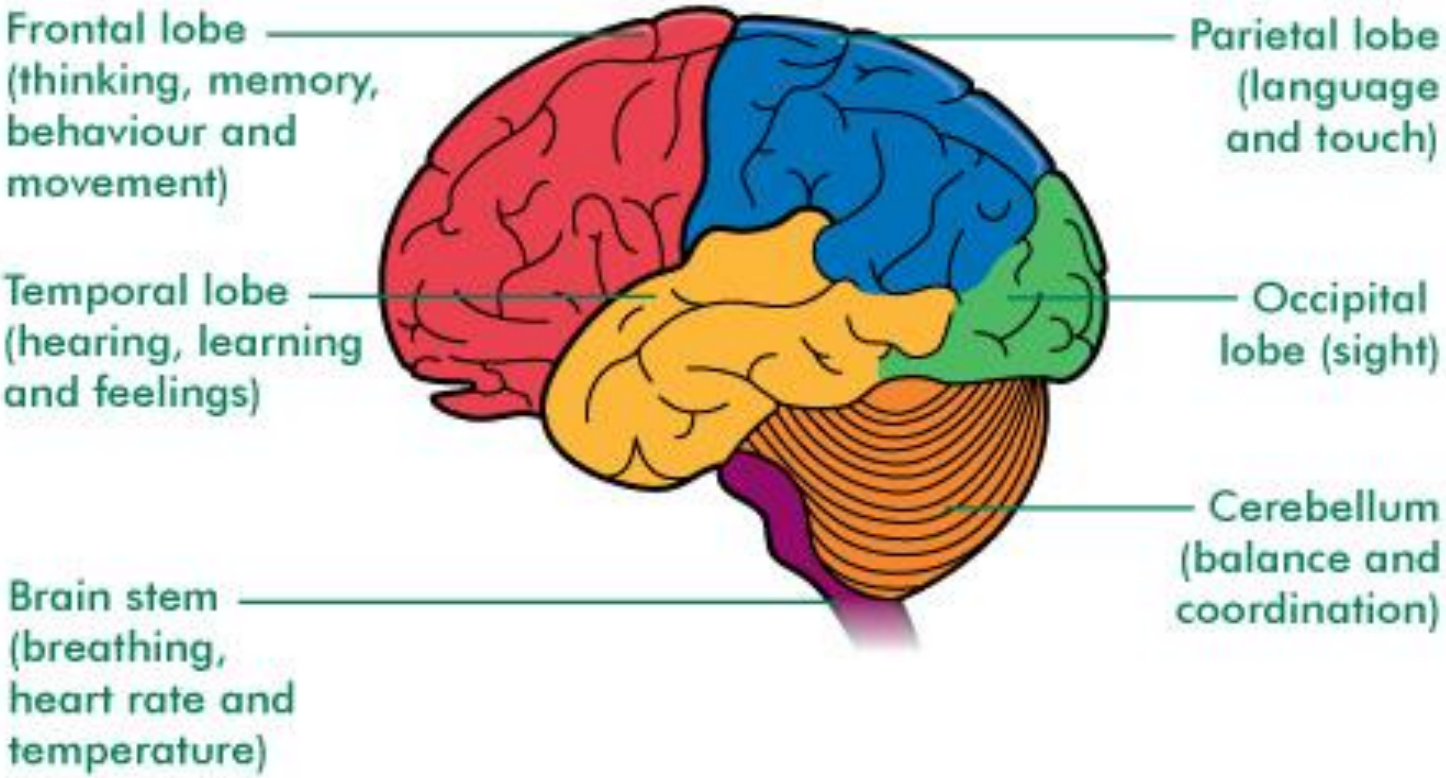
Cereberal Cortex




central sulcus
lateral sulcus


frontal lobe
parietal lobe
temporal lobe
occipital lobe

Lobes of Brain



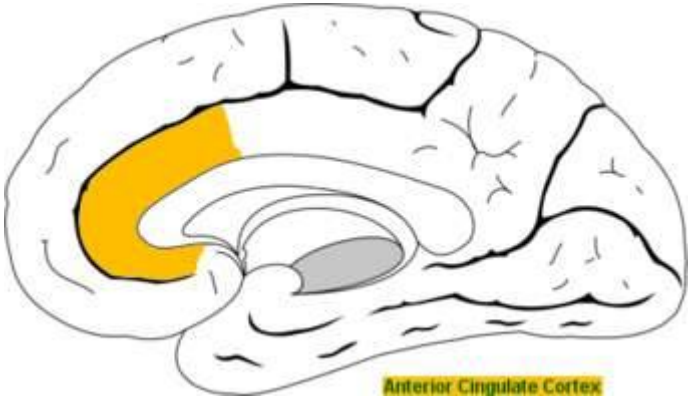
Anterior Cingulate Cortex ACC

- The Cingulate Cortex is the collar formed around the carpus callosum the frontal part is called the anterior cingulate cortex.

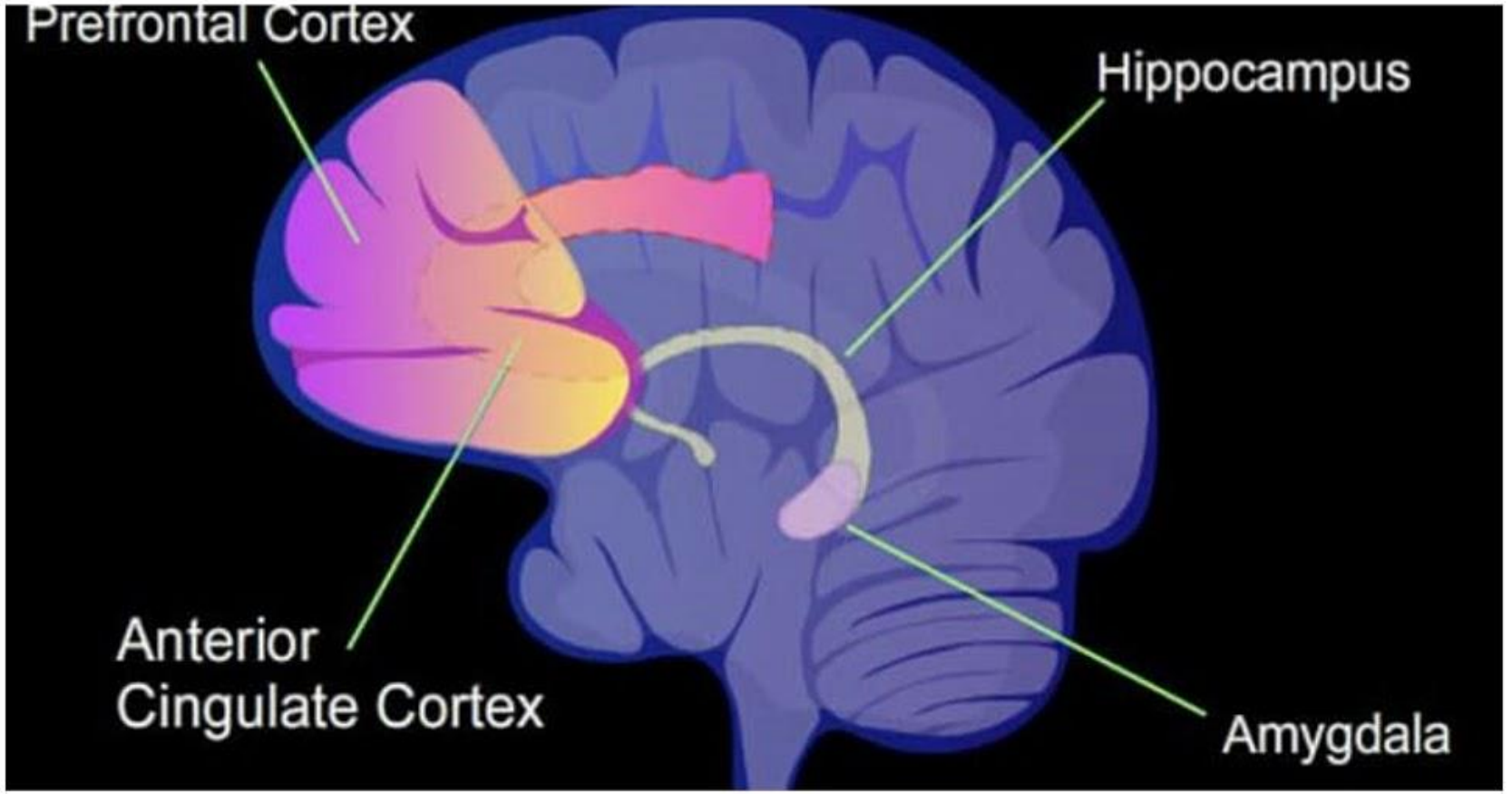
- Anterior cingulate cortex has an important role in focused problem-solving and emotional self control. These functions are central to intelligent behaviour. The functioning of anterior cingulate cortex varies between anxiety and focused problem solving. This is consistent with the common experience that focusing on a solution relieves anxiety.

- This forms one of the basis of hypnotherapy as during trance the mind is focused on solutions through relaxation and metaphors hence the anxiety starts alleviating.

Interior cingulate cortex



Important Structures with reference to Solution focused hypnotherapy



Primitive Brain(contd)

- **Brain Stem**
- The brain stem comprises; midbrain, pons, reticular formation and medulla oblongata.
- The midbrain controls cranial reflex activities like blinking, ducking, and pupillary reflex. It integrates incoming messages and has connections with visual and auditory perception.
- Pons is a bridge between the higher brain and spinal cord. It also has some role in control of breathing.
- A small area of the pons is called locus coeruleus which is associated with anxiety and mood disorders.

Primitive Brain (cont'd)

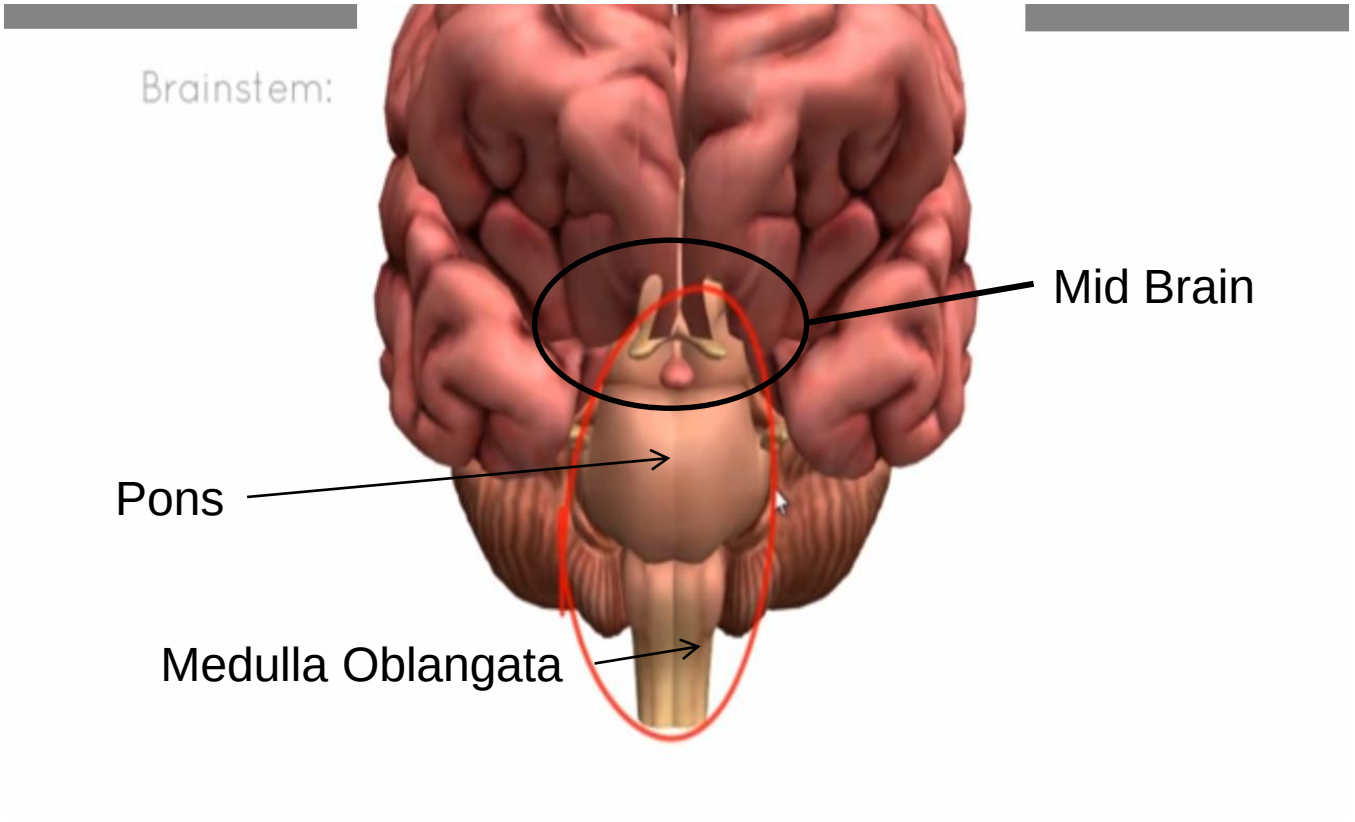
- **Medulla oblongata:**
- The medulla oblongata is the lower portion of the brainstem. It relays nerve signals between brain and spinal cord and deals with autonomic functions such as respiration (via dorsal respiratory group and ventral respiratory group, blood pressure, heart rate, swallowing, vomiting, defecation.

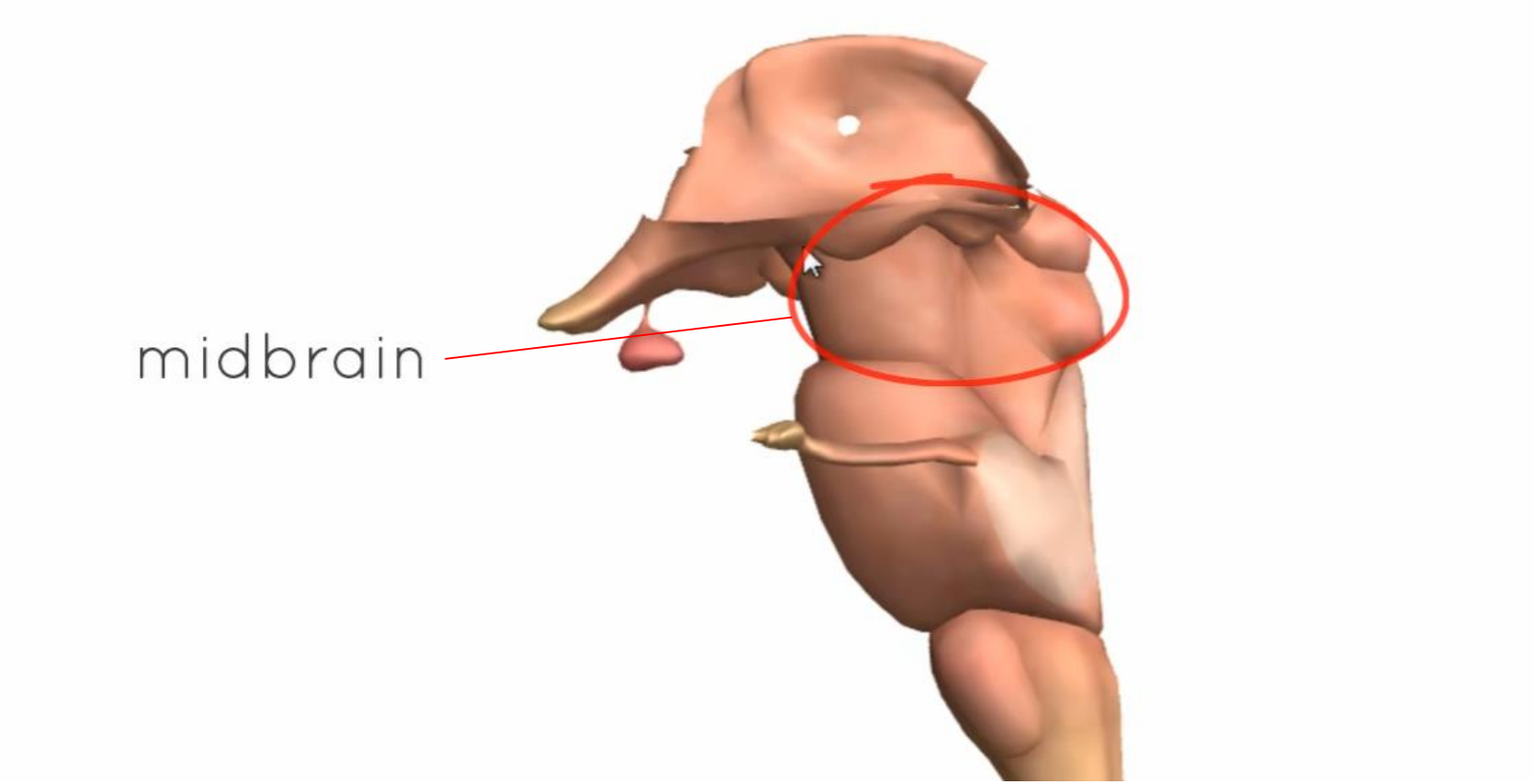
- Most of the fibres cross over the pons and medulla to the opposite side hence the left brain control the right side of body and vice versa.

- **Reticular formation (RF):**
- It is cluster of neurones, embedded within the whole length of brain stem. The upper part of the RF is called the reticular activating system and is involved in states of alertness and waking. During sleep its activity is diminished.

- **Cerebellum:**
- It smooth's and coordinates fine muscle movements, regulates muscle tone and controls balance.

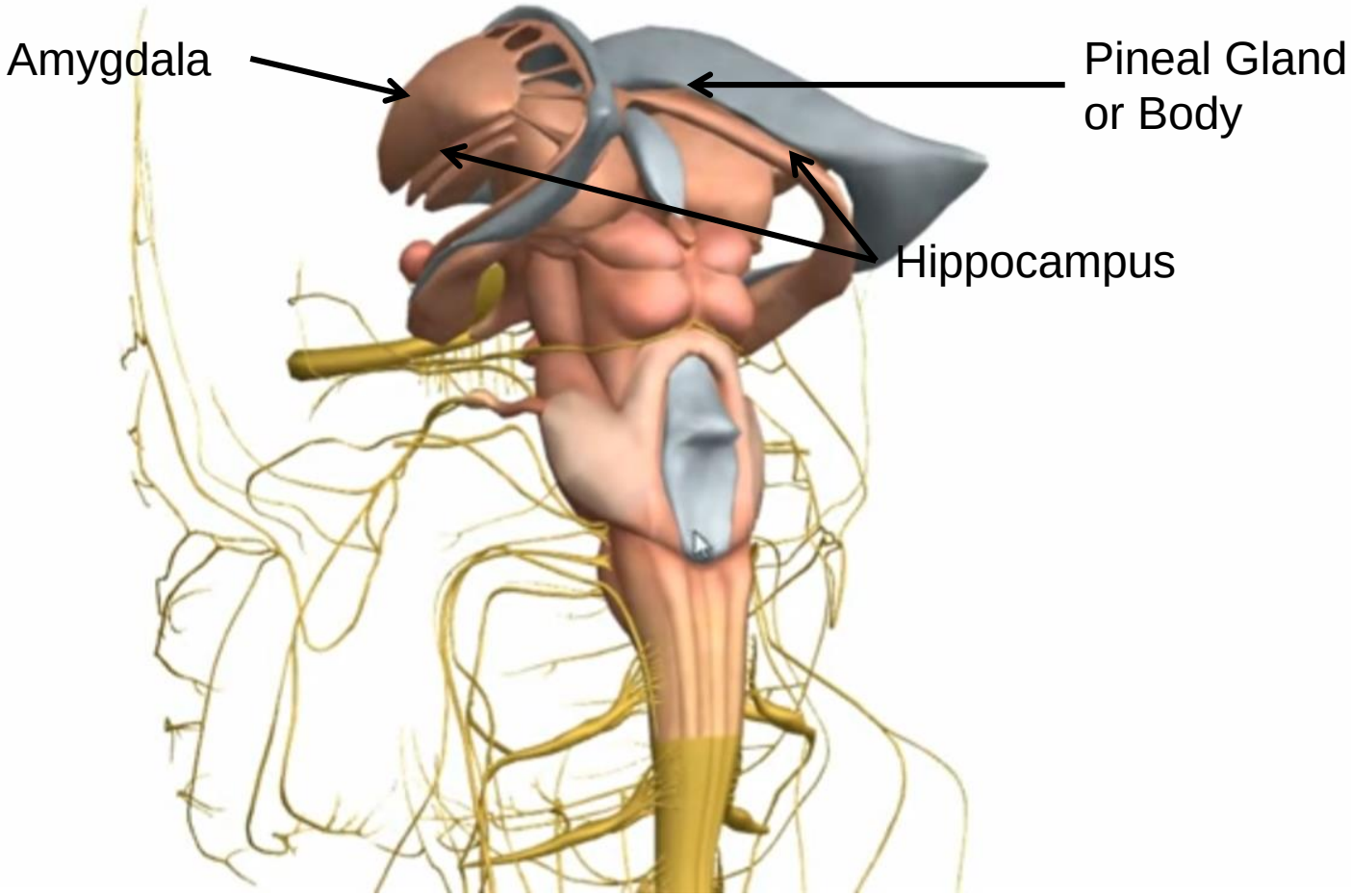
Brain Stem



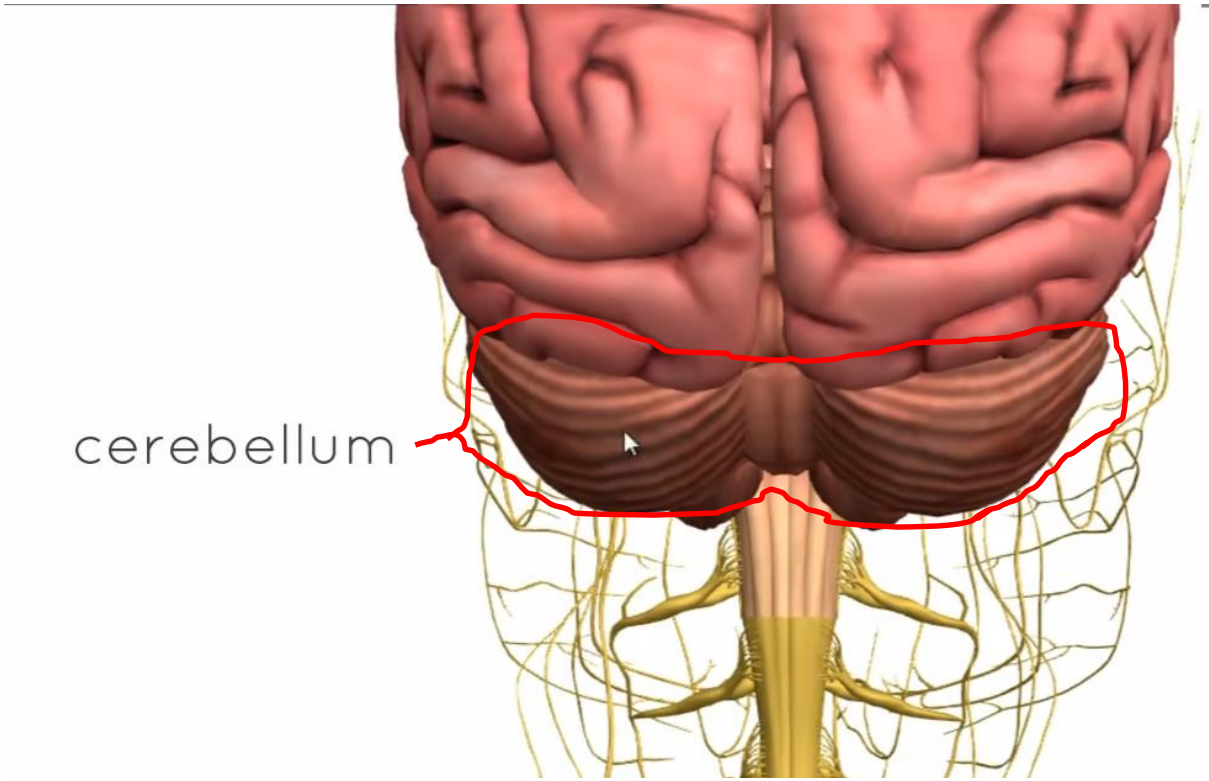


Nuclei for respiration, heart rate and for most of cranial nerves are situated in Mid Brain

Pineal Gland:
Looks like a pine cone but is size of a pea. Lies deep within the brain. It secrets a hormone called Melatonin involved in initiation of sleep.



Cerebellum controls coordination, balance and muscle tone



Primitive Brain

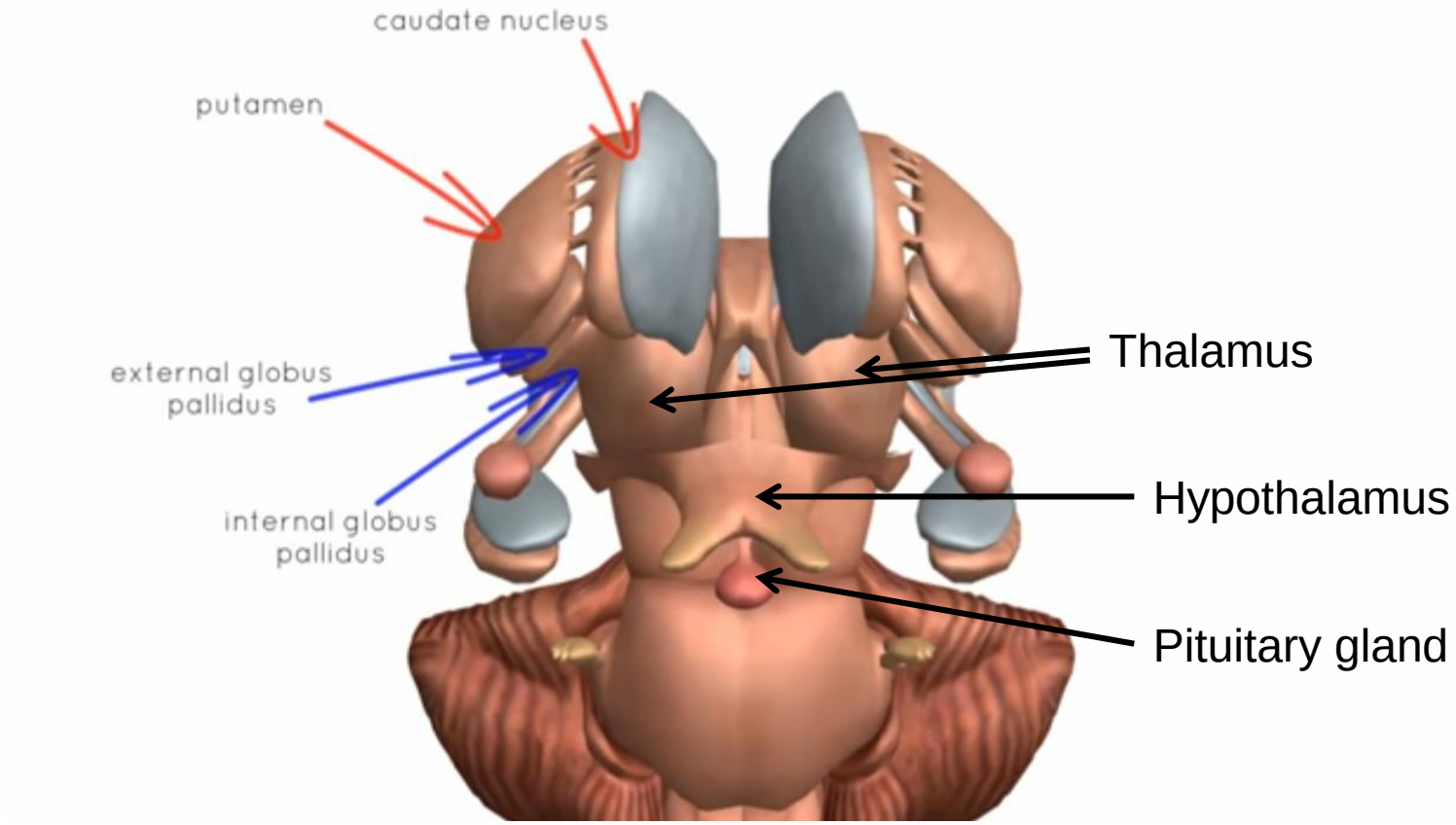
- **Basal Ganglia: striatum or caudate-putamen and globus pallidus**
- It is located deep the cerebral hemisphere. It is made up of grey matter. It controls the muscle movements. All the impulses coming from the motor area are relayed through it. Also known to have a role in time keeping.

- **Thalamus:**
- It relays all the sensory information to sensory areas of cortex. Plays role in sleep-wake cycle.

- **Hypothalamus:**
- Is a group of tiny areas deep within the cerebral hemisphere. It is hugely important as it integrates the mind and body. It is a physiological link to expression of emotions like rage, sexual behaviour, pleasure and fear.

- It controls the autonomic nervous system. Also, controls temperature regulation, eating and homeostasis (balance of fluids). It also produces hormones, some of which control anterior pituitary gland and influences functions of some other components of brain as well e.g. Pineal gland.

BASAL GANGLIA



Primitive Brain (cont'd)

- **Limbic System:**
- Limbic system is involved in emotion, instinct memory and the integration of autonomic functions with conscious awareness. It includes subcortical structures such as the amygdala, hippocampus, hypothalamus and basal forebrain, as well as cortical areas such as the hippocampal, anterior cingulate cortices. It has a complex system of nerve connections.

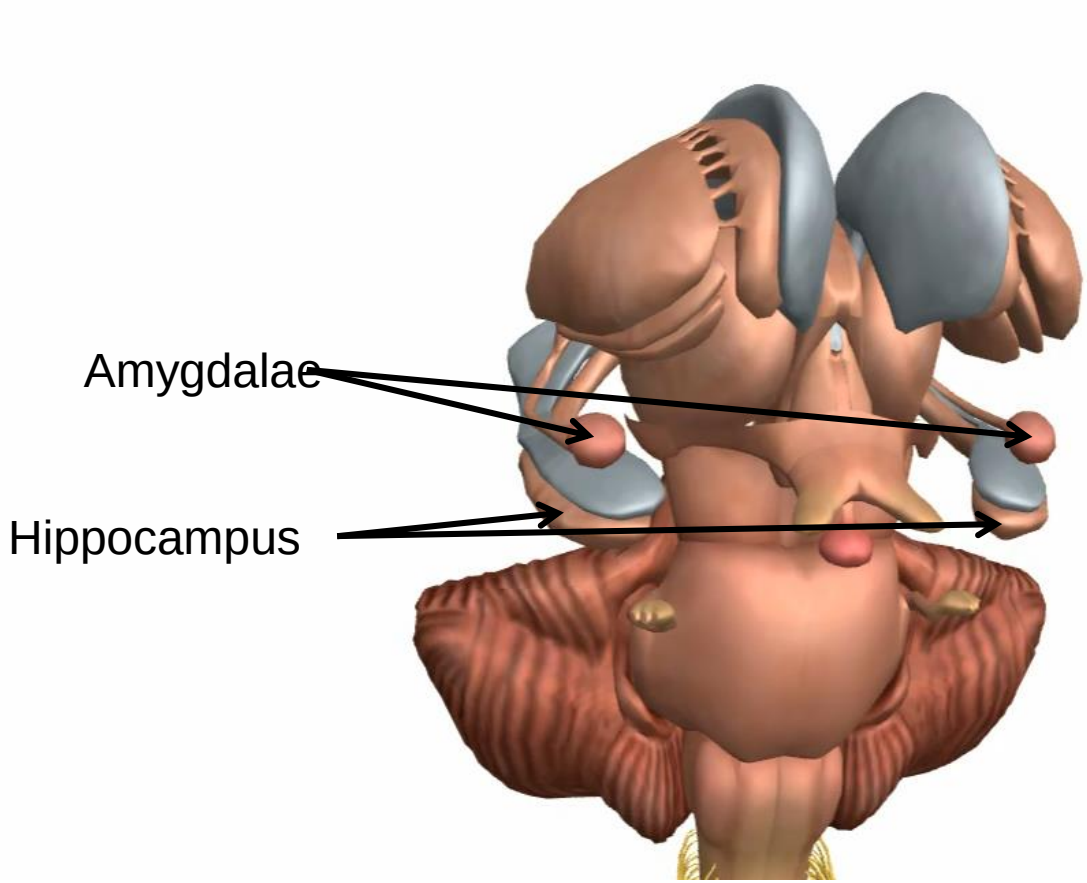
- The limbic system through its connections with ANS(Autonomic nervous System) can override the control of frontal cortex i.e. intellectual brain and produce a primitive response in situations of danger.

Primitive Brain (cont'd)

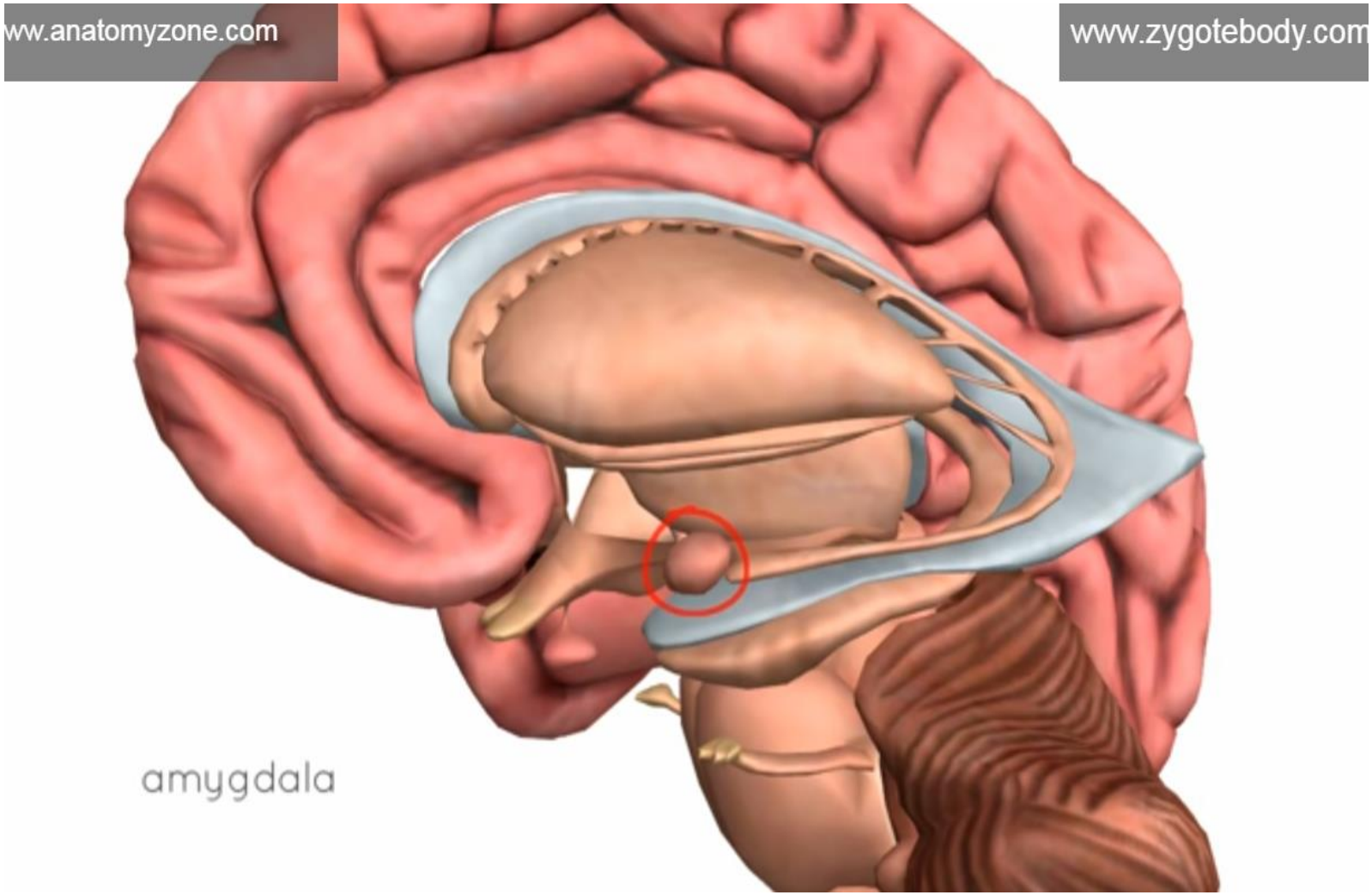
- **Hippocampus:** Hippocampus being an important part of limbic system is involved in negative emotional memory e.g. fear. In the case of an emotional event leaving behind a bad memory, the experience is stored in hippocampus. When the intellectual control is overridden the and brain is operating from the primitive part. The negative memories in this part of brain can be responsible for OCD and other fearful experiences as they are no more counteracted by the frontal cortex i.e. intellectual brain. The hippocampus is also known to be involved in navigation and smell.

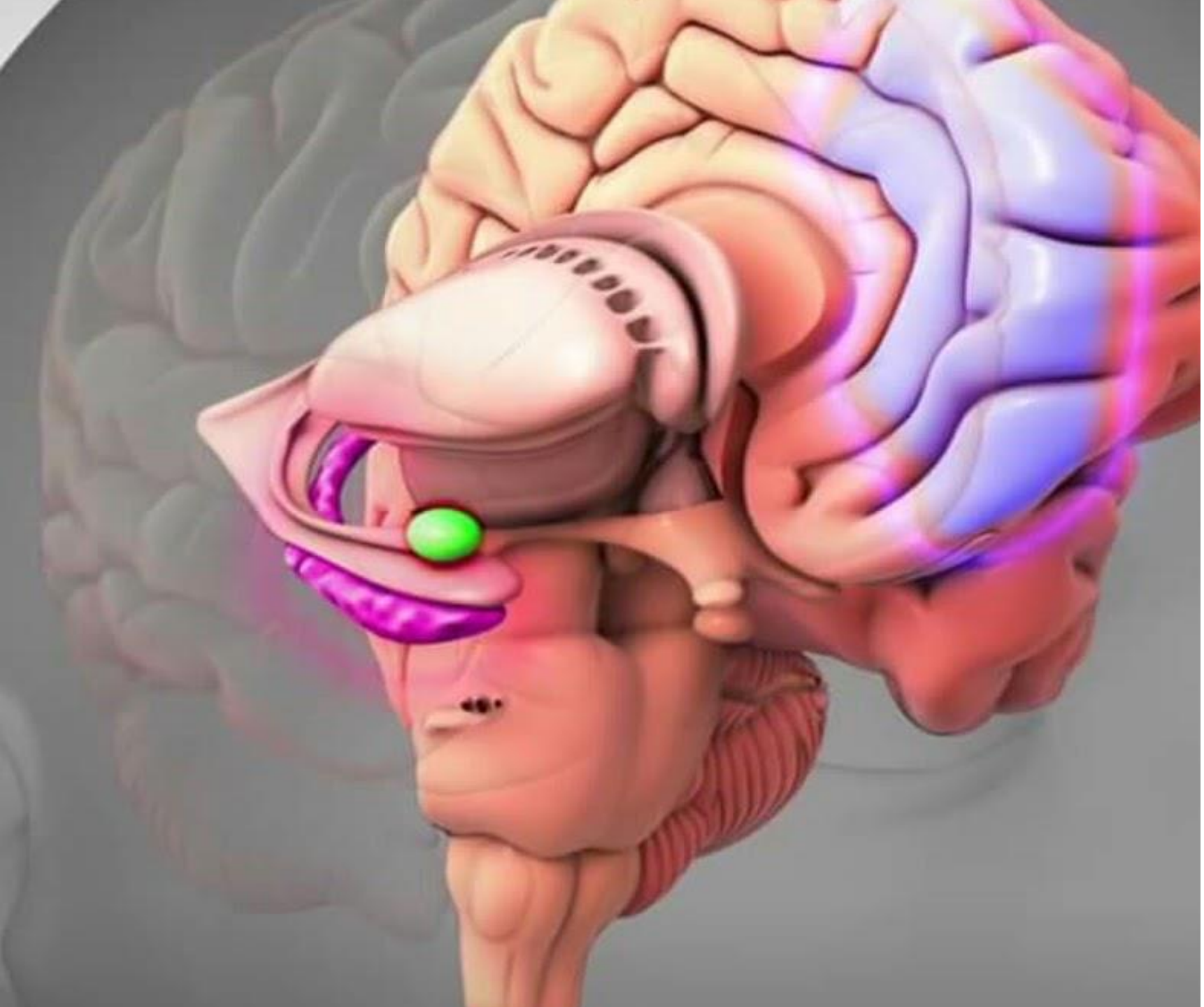
- **Amygdala:**
- It is associated with flight and flight behaviour. It has been documented that the amygdala is the seat of fear and anger and it has various connection to the hippocampus and hypothalamus. It's function is also established in reward and punishment behaviour. Because of its functions and connections it is obvious that in fearful and dangerous situations this part of primitive brain is active and promotes the primitive behaviours of fear and anxiety. Through it's connections with the hippocampus and hypothalamus this leads to retention of those memories and a physiological body response.

Amygdala and Hippocampus

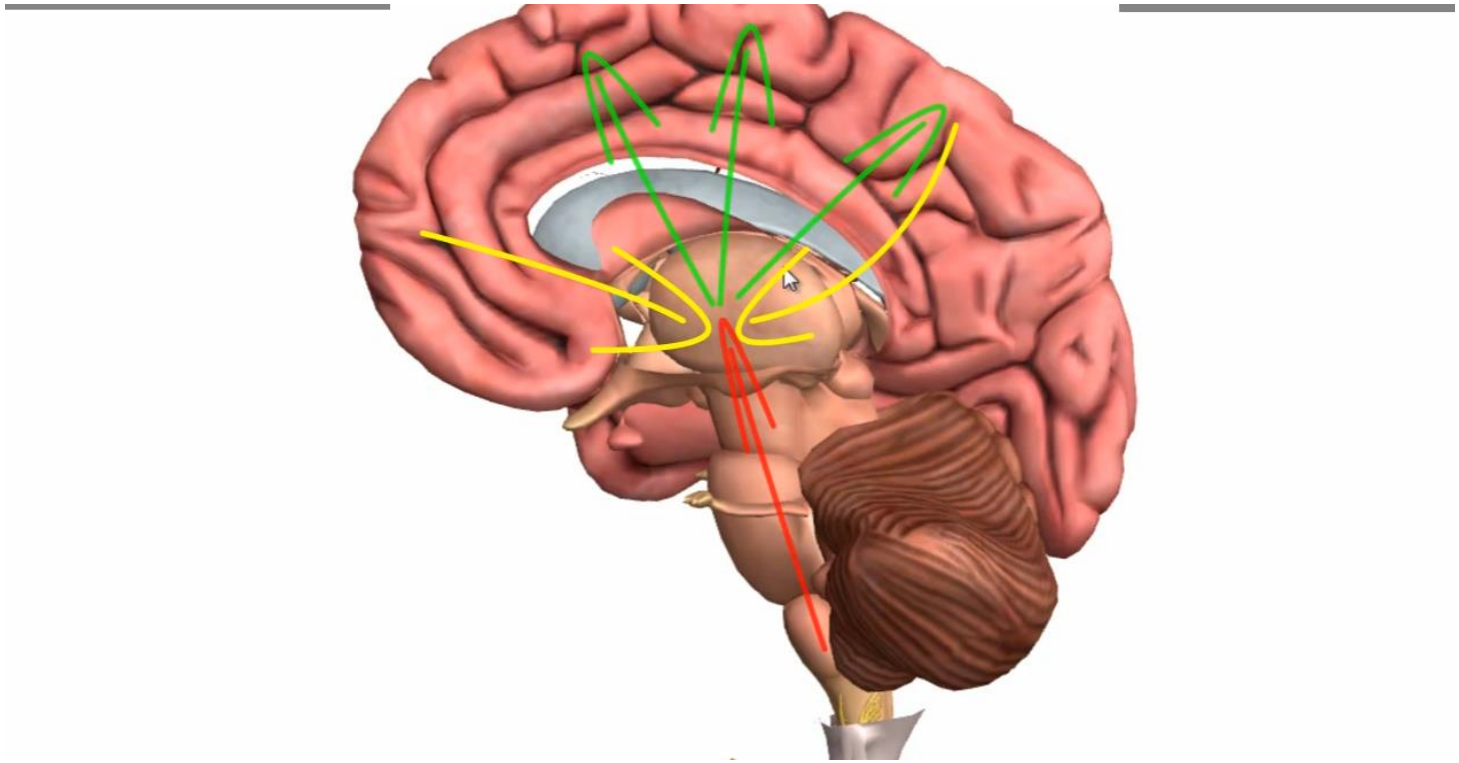


Amygdala





Thalamus sends and receives connections from cortex and receives connections from Brain stem and acts as relay station.



Primitive Brain (cont'd)

- **The Pituitary Gland**:
- It lies immediately below the hypothalamus at the base of the brain: it has two parts, the anterior pituitary gland and the posterior pituitary gland which are connected to the hypothalamus. The hypothalamus secrets various hormones which either stimulate or inhibit the release of release of hormones pituitary gland.

- **The Anterior Pituitary:**
- It is linked to the hypothalamus by blood vessels. The hypothalamus controls the activity of the anterior pituitary by secreting hormones and factors which travel through these blood vessels to reach it. The anterior pituitary in turn releases trophic hormones which control the activity of the thyroid gland, adrenal cortex, ovaries (female sex hormones ovulation and menstrual cycle) and gonads in males. The hormones released by the target gland in turn control the activity of hypothalamus through a negative feedback system.

Primitive Brain (Cont'd)

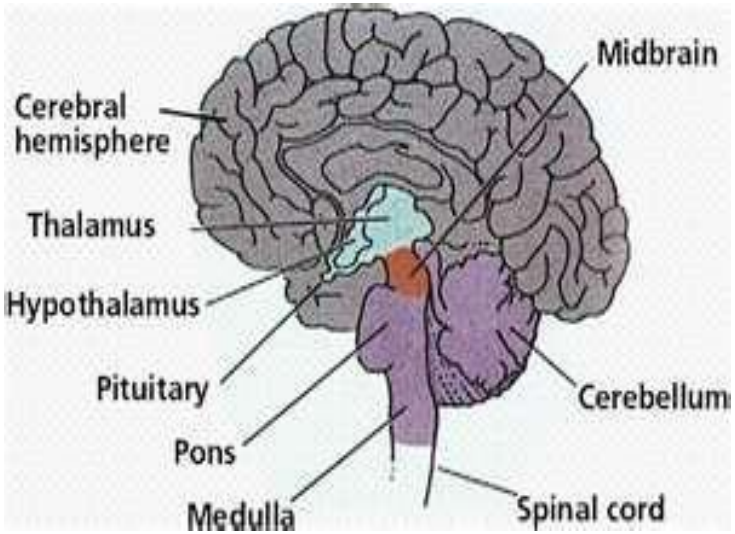
- **Posterior Pituitary:**
- The posterior pituitary is connected through nerve fibres.

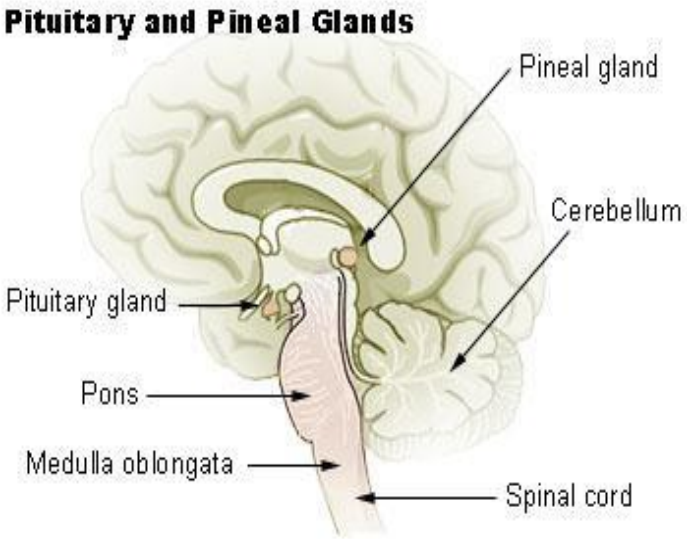
- This gland releases oxytocin and antidiuretic hormone (ADH). These hormones are made in the hypothalamus and travel through nerve fibres to posterior pituitary where they are stored.

- The principal function of ADH is water retention by the kidneys and fluid balance.

- Oxytocin causes contraction of uterus and helps in breast feeding mechanism by allowing the flow of milk.

Deeper Structures





Autonomic Nervous System

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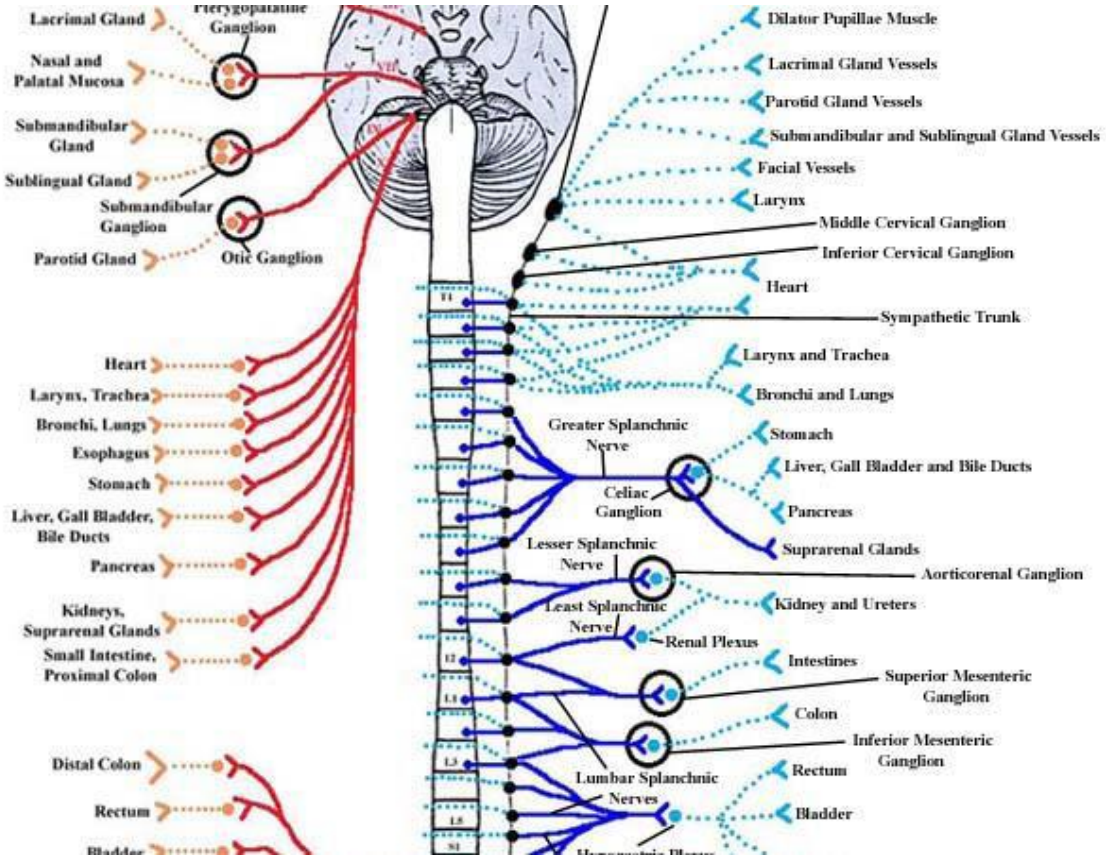
Autonomic Nervous System

- **Central Control of ANS:**
- The fibres of the ANS ascend to the base of brain and synapse with brain stem, thalamus and hypothalamus.

- In defence reaction, fight or flight, there are marked changes in the activity of the ANS in which normal control by cerebral cortex is overridden. The ANS causes symptoms of increased heart rate, sweating, increased gut motility, hyper breathing etc.

Autonomic Nervous System



The sympathetic division predominates during stress and is responsible for the ‘fight or flight’ response.

Table 2.1 Main sympathetic and parasympathetic effects

Target organ/function	Sympathetic response	Parasympathetic response
Pupil	Dilatation	Constriction
Heart rate	Increased	Decreased
Blood flow to heart and skeletal muscles	Increased	Decreased
Blood pressure	Increased	Decreased
Airways	Dilatation	Constriction
Respiratory rate	Increased	Decreased
Gut peristalsis	Decreased	Increased
Saliva production	Reduced	Increased
Gut secretions	Reduced	Increased
Bladder muscle	Relaxation	Constriction
Urethral sphincter	Contraction	Relaxation
Sweat production	Increased	
Body hair	Erect—goose bumps	
Adrenal glands	Secrete adrenaline and noradrenaline	

The Enteric Nervous System

The sympathetic and parasympathetic nervous systems act on the special neurones present in the walls of gastrointestinal tract which are called enteric nervous system. There are two sets of such neurones embedded inside the muscles of walls of gut at different depths.

These are called sub Mucosal plexus and Myenteric plexus. Its neurones play an important part in the regulation of motility and secretory activity of the digestive system.

ENS

- It comprises an estimated 500 million neurons. It plays an important role in our physical and mental well-being. It can work both independently of and in conjunction with the brain.

- It produces a wide range of hormones and around 40 neurotransmitters of the same classes as those found in the brain. In fact, neurons in the gut are thought to generate as much dopamine as those in the head. Intriguingly, about 95 per cent of the serotonin present in the body at any time is in the ENS.

- The feeling of "butterflies" in your stomach is the result of blood being diverted away from it to your muscles as part of the fight or flight response instigated by the brain. However, stress also leads the gut to increase its production of ghrelin, a hormone that, as well as making you feel more hungry, reduces anxiety and depression. Ghrelin stimulates the release of dopamine in the brain both directly, by triggering neurons involved in pleasure and reward pathways, and indirectly by signals transmitted via the vagus nerve.

Ref: Gut instincts: The secrets of your second brain
17 December 2012 by Emma Young

Neurotransmitters (NT)

A substance which is released at the end of a nerve fibre by the arrival of a nerve impulse and by diffusing across the synapse or junction effects the transfer of the impulse to another nerve fibre.

There are known to be over 100 neurotransmitters whose effects are still being researched.

Name	Effect	Action
Serotonin	Modulates hunger sensations, controls behaviour, sleep and affects neuro-endocrine control	Inhibitory
Dopamine	Involved with fine motor movement from the basal ganglia.	Inhibitory
Norepinephrine	Major transmitter in parts of the autonomic nervous system.	Excitatory and inhibitory
Gamma-aminobutyric acid (GABA) and glycine	Affects the synapses in the spinal cord, cerebellum, basal ganglia and some higher centre in the brain.	Excitatory

Sympathetic division

The sympathetic division predominates during stress and is

Structure and Function of Neurone and Synapse:

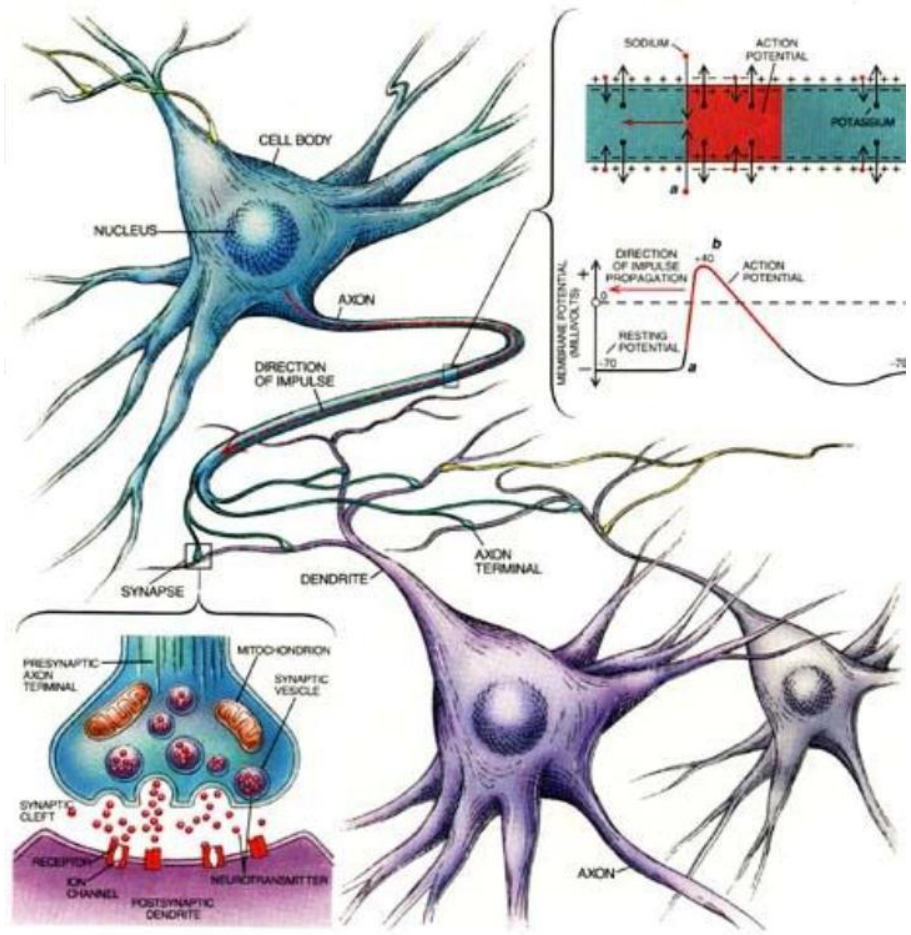
- There are about 50 to 100 NT. They carry out signaling between the neurones and hence communicate between different parts of brain. Various complex circuitries are formed by this transmission through out the brain. These circuits determine the physiological output of body and mind.
- Synapses also integrate the information coming from a number of sources which is influenced by thousands of other neurones. Some synapses are excitatory and others are inhibitory. Each neurone receives hundreds of these excitatory and inhibitory inputs and in turn influences many other neurones either by exciting or inhibiting them.

Structure and Function of Neurone and Synapse:

- Each neurone has a cell body which has a nucleus and is filled with cytoplasm. The wall of the cell extends several small thread like terminals. These terminals are of two types axons and dendrites. Through these terminals neurones are connected to one another. The point of this connection is a special structure called synapse. There is a tiny space where these terminals meet each other, called synaptic cleft.

- Upon arrival of an impulse NT is released by one neurone onto the synaptic cleft and binds to the receptors in the wall of another neurone. Through this process the impulse is transmitted. After the impulse is passed on, the NT is reuptaken by the releasing neurone. The longer the NT is available in the synaptic space the greater is the effect (the physiological out come of this effect).

Neuronal Synapses



Serotonin and Depression

- Serotonin has a positive effect on mood. Decreased levels of serotonin in brain can cause depression. Serotonin is synthesized and stored in the neurones and is released in the synaptic cleft on arrival of an impulse where it binds with the receptors in the wall of other neurone. This binding causes effective transmission of an impulse.

- Serotonin is then reputaken by the neurone that released it. It can also be degraded by some enzymes present in the synaptic cleft. Anti depressants block this enzyme and hence prolong the availability in the synaptic cleft. Drugs like Prozac inhibit the reuptake and achieve same effect. A natural and optimum flow of serotonin can be achieved by positive thoughts and experiences.

Synaptic Plasticity

One who brings
A mind not to be chang'd by Place or Time.
The mind is its own place, and in it self
Can make a Heav'n of Hell, a Hell of Heav'n.
What matter where, if I be still the same,
John Milton from Paradise Lost

- When information repeatedly flows along a neuronal circuit the strength of the synapses involved increases this is called long-term potentiation (LPT) and forms the basis of memory. This happens by increased release of NT in the synapse. Also by increased number of receptors on the wall of receiving neurone and by increase in actual number of synapses. This is called sensitivity and is more pronounced in hippocampus. Once LPT has occurred.

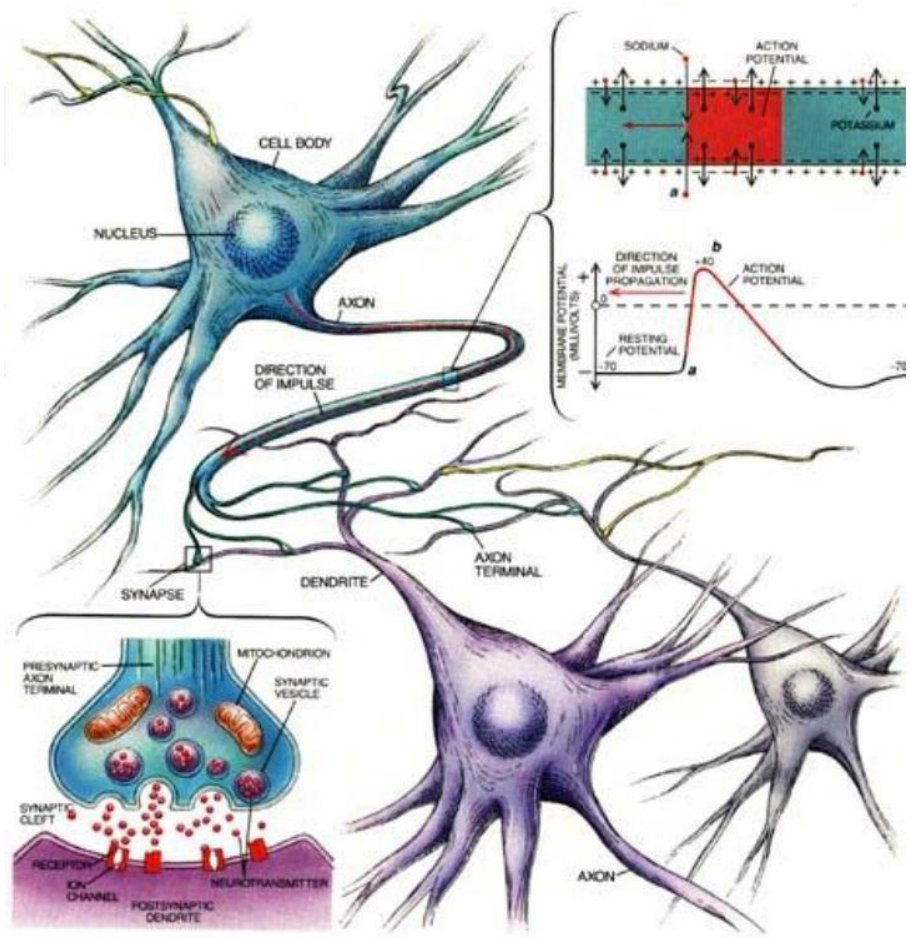
- For example, exposure to stress hormone can change the number and shape of neurone in hippocampus with long term consequences. These circuits can be reformed/ replaced, sensitivity changed and neurones reshaped with a different kind of repeated stimulus. This suggests that solution focused suggestions through hypnosis can manipulate the brain activity by modulating the plasticity.

Synaptic Plasticity

- **Habituation:**
- Modification of behavioural response to a repeated weak stimulus in simple learning. The response may become weaker as the stimulus is perceived to have no particular importance or cause threat.

- If an unpleasant or other wise repeated strong, threatening stimulus is given it can result in an enhanced response which is due to sanitization. This can be the basis of rewind technique.

Neuronal synapse



Stress:

- The body responds to a threat whether it is real or perceived. If the demands outstrip an individual's ability to cope it causes a state of stress. A stressor is called a stress producing factor which can be physical or psychological e.g. fear or social like, bad relations, poverty or a situation. It’s a primitive response controlled by the primitive components of brain which override the intellectual function of higher centres.

- Stress causes changes in the normally balanced chemicals and fluids in the body. The purpose of these changes is to prepare the body to tackle the stress physically. The response to stressor involves the nervous system, endocrine(hormones), neurotransmitters and immune systems activation which produce physiological effects like increased heart rate, changes in respiration and gut motility etc.

Stress:

- The response occurs in two steps, first is rapid and called 'fight or flight'. This is a primitive alarm reaction. This is due to secretion of adrenaline (from medulla(base) of adrenal gland which is situated on the top of the kidneys) and the secretion of noradrenaline from sympathetic nerve fibres. Both prepare body for physical exertion to deal with the predators by fighting or fleeing.

- In the second step the hormone cortisol is secreted by cortex (outer upper part) of adrenal gland. Cortisol is involved in increasing metabolism, and employing cardiovascular, respiratory and immune systems to deal with the threat. However, if the stressful situation is persistent the cortisol secretion continues but eventually decreases so there is a loss of resistance to stress as body's mechanisms can no longer keep up with increased cortisol levels and are exhausted and eventually damaged.

Physiology of Stress

- Physiology of Stress
- The stress response is regulated by two pathways.
- 1.Sympathetic-Adreno-medullary system.
- 2.Hypothalamo-Pituitary-Adrenal (HPA) axis

Physiology of Stress

- **Sympathetic adreno medullary system:**
- Corticotrophic releasing hormone (CRH) is secreted by neurones in the hypothalamus which project to the areas in the brain stem that control sympathetic nervous system and also locus coeruleus, another region in the brain stem. Noradrenaline secreting neurones arise in locus coeruleus and project to the spinal cord, the hypothalamus and medulla oblongata. This organization forms a positive feedback loop which reinforce the fight and flight reaction. Hypothalamic neurones project to the autonomic region in the spinal cord through which they control the heart rate, blood pressure, respiration.

- Sympathetic stimulation also increases blood glucose level and fatty acids to provide energy for fight or flight. Moreover sympathetic impulses release adrenaline from adrenal medulla which also increases heart rate, respiration, sweating and gut motility. Adrenaline and noradrenaline also produce alert reaction making the individual more vigilant.

Physiology of Stress

- **HPA axis**
- The CRH is released from hypothalamus which in turn stimulates the release of adrenocorticotrophic hormone (ACTH) from anterior pituitary gland. ACTH enters the blood circulation and acts on adrenal cortex to stimulate the release of cortisol. Cortisol level is usually kept in the controlled boundaries in non-stress situation by feedback as the cortisol act on hypothalamus to stop the secretion of CRH. In non stressed situation cortisol is released in bursts 3 times an hour in the early morning hours.

- The stress response is designed to be limited as the body's ability is finite to adapt to this response. The limited and controlled stress response is said to be beneficial as it changes the physiology of body to deal with a difficult situation. However, if the stress response continues the body's mechanism to maintain the physiology become exhaustive and start failing. Prolonged stress hence produces tiredness, lack of energy, lack of sleep, gastrointestinal symptoms(IBS, peptic ulcer), cardiovascular diseases, mental dysfunction and depression. The childhood stress may influence brain development and programme the individual's responsiveness to stressful situation. Psychological stress also contributes to asthma and some skin disorders like eczema and psoriasis.

Stress and Immune Response

- The links between stress and immune system are widely accepted. Psychoneuroimmunology is the field of study that provides framework for examining the interrelationships between nervous, endocrine and immune system. The mind-body interrelationship relies on the bi-directional flow of hormones, neurotransmitters and cytokines (Blalock 1984, Haddad et al 2002).

- Autonomic nerve fibres connect to lymphoid organs including the thymus and spleen, and cells of immune system such as lymphocytes have receptors for neurotransmitters and hormones. This illustrates that the nervous and endocrine system are capable of modulating the immune system (Felten 2002, Shorr & Aranson 1999, Yang & Glaser 2002). Neurones , cells of endocrine glands and cells of immune system have receptors for NT, hormones and cytokines, so an interrelationship is inevitable.

- The alteration in immune system is thought to be mediated by sympathetic adrenal-medullary system in acute stress and by HPA axis in chronic stress (O'Leary 1990). Stress can delay wound healing and make individual more susceptible to infections (Kiecolt-Glaser 95, Yang and Glaser 2002).

Stress and Immune Response

- Cortisol is considered to be the principal agent to mediate suppression of immune response. Cortisol kills the lymphocytes and cause repression of genes necessary for producing an effective immune response (Auphan et el 1996). Inhibition of cytokine production by immune cells also contribute to immunosuppression (O'Connor et el 2002).

Stress and Immune Response

- **Stress and Mental Illness**
- Stress hormones cortisol and CRH have impacts on neuronal function on the brain (O'Connor et el 2000).

- Changes in hormones resulting from stress may also regulate monoamines (Herbert 1998). Monoamines such as dopamine, noradrenaline, and serotonin are implicated in the development and course of depression (Nemeroff 1998). Prolonged activity in the HPA axis, especially the increased secretion of CRH, is considered significant in depression (Nemeroff 1998, Dinan 2001). The dysfunction of the CRH-secreting neurones in the hypothalamus is thought to be key to the chronic hyperactivity that develops in the HPA axis, and to the onset of depression.

- **Stress and Cancer**
- Although there is a great controversy about the interrelationship between stress and cancer. There is research suggesting that women with breast cancer had sever life event 5 years before cancer.

Sleep

Circadian Rhythms

The physiological functioning of body is operated in 24 hour rhythmic cycles. During these rhythms secretions of hormones, activity of brain and metabolism vary throughout the 24 hours in relation to day and night including sleep and wakefulness. Due to these variations of body's physiology certain attacks of diseases are more likely to occur at certain times e.g. asthma attacks are more common at 04.00, stokes at 08.00 and pain is worst around 21.00, heart attacks are more common between 06.30 to 08.30 and at midnight. (et el young, 2000, Thompson1992, Wright 2000).

Night shift can have adverse effects on health (Clancy& McVicar1994, Baxendale et el 1997). Jet lag happens travelling between the time zones where body's physiology is desynchronized with day and night. However body is capable of adjusting to new time patterns (Wright 2002). Sleep-wake cycle is regulated by very complex brain circuitries involving many neuronal pathways and various neurotransmitters.

Sleep

- **Circadian Rhythms** (contd)
- The main centre is supra-chiasmatic- nucleus which receives connection from retina and many brain areas including hypothalamus and spinal cord. The other pathway is ascending reticular activating system (ARAS). Reticular formation receives sensory input from the body and in turn connect to the cerebral cortex.

- During sleep activity of ARAS is suppressed and in waking it is active. The physiology of sleep is still not well understood. The pineal gland secrets melatonin which induces sleep. The release of melatonin is synchronized with circadian rhythm. The other main NT involved are acetylcholine, adrenaline, noradrenaline, dopamine. Evidence shows that severing the connections between cerebrum and primitive brain induces (NREM) sleep. This suggests that there is some dissociation between intellectual brain and primitive brain during sleep.

- **Drug Induced Sleep**
- All sleep inducing drugs (apart from anaesthetics) inhibit GABA an inhibitory NT and directly suppress neuronal activity. All these drugs increase slow wave sleep and decrease REM sleep which is why there is an irritable behaviour and cognitive deficit associated with these drugs.

Sleep and EEG

- EEG or elector-encephalo-gram is the recording of electrical activity of the brain.
- Non-rapid eye movement (NREM) sleep or slow wave sleep(SWS).
- During wakefulness the EEG is random and synchronized with low amplitude and high frequency (wave closely packed) waves. These originate in cerebral cortex, called beta waves

EEG

- **There are four stages of NREM**
- 1.Relaxation with eyes closed (trance), the EEG becomes synchronized with a clear rhythm with high amplitude and low frequency waves called alpha rhythm.
- 2.Person feels drowsy with illusive thoughts (deep trance). The frequency decreases waves are more spaced out, with high amplitude called theta waves.
- 3.As the drowsiness starts turning to sleep, these theta wave are interspersed with brief periods of high frequency activity known as sleep spindles'. Research suggests that NREM sleep is linked to synaptic plasticity and LTP(Long term potentiation) Research suggests that spindles in NREM sleep have been shown to produce long-lasting changes in neuronal responsiveness. The increased activity of cortex in NREM suggest that it is important in plasticity process and consolidation of memory (et al J. Allan Hobson and Edward F. Pace-Schott).
- 4.Deep slow wave sleep SWS (no rapid eye movements): The EEG shows very high amplitude but very low frequency. They are big waves (high voltage) but spanned out. These are called delta waves.
- 5.The research shows that the alpha waves(in trance) are produced as a result of feedback between cerebral cortex and hypothalamus and theta waves ((deep trance) originate in the hippocampus. This suggest that in trance and deep trance hypothalamus and hippocampus are accessible.

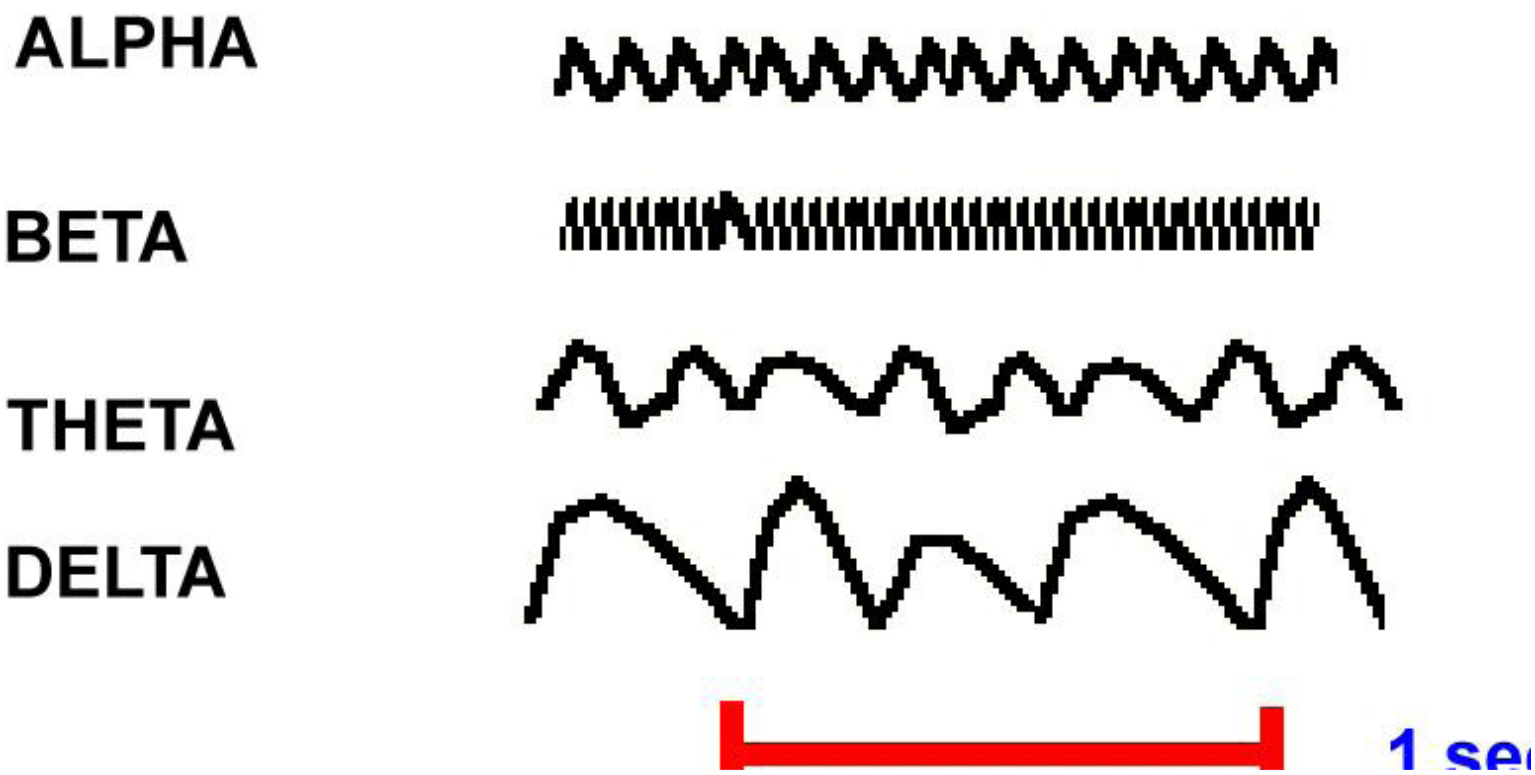
Sleep and EEG (contd)

- **REM Sleep**
- After about one to two hours of sleep the EEG again forms the pattern of beta waves which is same as awakened state. In this stage the eye ball shows jerky movements, hence called rapid eye movement (REM) sleep.

- In a single night it occurs about 4 to 6 times, each episode lasting about 20 minutes. In young children half of sleep is REM as one grows older the REM decreases to 20% of sleep. In old age it further decreases to 10-15 %.

- REM is associated with dreams. If an individuals deprived of REM sleep he or she becomes anxious and irritable suggesting that REM is associated with relief from anxiety. However too much of REM can also exhaust the brain and body as REM consumes of energy.

EEG



- The maximum, average and relative energy of different frequency bands in hypnosis EEG with respect to the normal EEG has been investigated along different time windows. Obtained result showed that the effect of the hypnosis on brain waves energy is different in various frequency bands.

- Statistical analysis showed that hypnosis suggestion and the level of the hypnotic susceptibility have no significant effect on brain wave energy in Theta, Alpha and Gamma bands. But these analyses showed some notable and significant results in the effect of hypnosis on Delta and Beta bands in different hypnotizable groups.

- The beta brainwave state is associated with a heightened state of alertness and focused concentration. When your mind is actively engaged in mental activities, listening and thinking during analytical problem solving, judgment, decision making, processing information, the dominant brainwave state will be beta (17)-(18). Increasing the activity of the high frequency band (beta) and decreasing the activity of the low frequencies (delta) after hypnosis induction, especially in high hypnotizable groups suggest that in hypnosis, the brain is not in deep attitude like different mental activities such as solving an analytical problem. Therefore, the result is evidence on this concept that hypnosis is not a sleep.
- Baghdadi, Golnaz, MS; Nasrabadi, Ali Motie, PhD. Sleep and Hypnosis 11.2 (2009): 40-45.

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Sleep helps making memories (Cont)

- Sounds played as you sleep can reinforce memories, suggest Ken Paller and his colleagues at Northwestern University in Evanston, Illinois Published 2014.

- They asked people to memorise images and their associated sounds. They played half the group the sounds in their snooze, (just before nod off) and these people were better at remembering the associations than the rest when they woke up.

"Spindles appear to play a central role whenever memories during sleep are undergoing transformation that might be necessary to integrate them into neocortical long-term storage networks."
—Jan Born, University of Tübingen

Minding the Pulse of Memory Consolidation
Studying sleep spindles could help...
the-scientist.com

Sleep

- Neuroscientists believe that memory involves the modification of synapses, which connect brain cells, and numerous studies published over the past decade have shown that sleep enhances the consolidation of newly formed memories in people.

- learning a new task led to the formation of new dendritic spines – tiny structures that project from the end of nerve cells and help pass electric signals from one neuron to another – but only left to sleep.

- This happened during the non-rapid eye movement stage of sleep. Each task caused a different pattern of spines to sprout along the branches of the same motor cortex neurons.

- Wenbiao Gan of the Skirball Institute of Biomolecular Medicine at New York University Medical School

Pain

An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP definition)

Analgesia: Absence of pain in response to stimulation which would normally be painful.

In the 2012 Health Survey for England, The Health and Social Care Information Centre found that 31% of men and 37% of women reported pain or discomfort that troubles a person all of the time or on and off for more than 3 months

- Pain is almost invariably accompanied by an emotional reaction of some kind either anxiety or fear.
- Pain may arise spontaneously without and obvious cause or in response to an earlier injury long since healed. This kind of pain arises in the brain e.g. pain in a phantom limb or functional pain where medical profession believes that the brain function is modulated to perceive pain although there is no pathological cause.
- The research shows that the activation of primitive brain structures that control rewarding experiences, such as the nucleus accumbens can relieve pain. Profoundly rewarding experiences such as love may naturally reduce pain, via the close neurological ties between reward-processing and pain-processing regions in the brain. (Stanford University School of Medicine study).

Transmission of Pain

- **Nociceptors:**
- These are specialised structures on nerve endings present in the skin, joints, muscles, visceral glands and walls of arteries. Pain is can be of three classes.

- The nociceptors carry the pain sensation to the spinal cord through nerve fibres which reach spinal cord (substantia gelitinosa) where they cross over.

- A (Fast mylenated) and C fibres (small and unmyelated therefore slow conducting 1m/sec) carry it to thalamus and then to sensory cortex.

- Fibres from thalamus project to limbic system especially amygdala which explain emotional aspect of pain manifestation e.g. fear, anxiety and depression.

- Fibres to hypothalamus explains autonomic changes (increased heart rate, sweating etc.) during pain. Fibres from thalamus also project to frontal lobes which are responsible for behavioural affection.

Classification of Pain

- Pain can be classified in a number of ways, such as:
- 1-By duration Acute pain vs Chronic pain

  2-By physiological origin Nociceptive pain vs Neuropathic pain

  3- By physical origin Somatic pain vs Visceral pain

Occasionally, if visceral and somatic nerves converge, visceral pain can be felt in somatic, dermatomal patterns; this is known as referred pain.

It is important to have a clear idea of each of these concepts, because frequently the clinical manifestations of pain evolve to include some or all of them.

Type of Pain	Cause	Description
Nocicptive	Stimulation of nociceptors by: •Heat and chemicals, i.e. burns or impact, e.g. crushing or tearing	Usually includes: •Sharp or, the opposite, dull •Exact location
Neuropathic	Damage to or dysfunction of: •The central nervous system or •The peripheral nervous system	May include some of the following: •Tingling •Pins and needles •Prickling •Crawling sensation •Burning •Stabbing •Shooting •Like an electrical shock

Acute Pain

Most pain is short-lived and resolves when the painful stimulus is removed: this is called acute pain.

Chronic Pain

pain that persists beyond the expected time of healing or for longer than 3 months: this is called chronic pain.

- **Neuropathic pain: Pain caused by a lesion or disease of the somatosensory nervous system**

This type of pain accompanies organic diseases like cancer, heart disease, bladder, kidney, AIDS, diabetes etc. or a an injury to skin. If it is arising from an internal organ, it can be felt somewhere else this is called referred pain. Pain is produced by chemical released at site of injury or disease. It is described as burning, stabbing, shooting. The painful symptoms associated with can be pins and needles, numbness, tingling, cramp and tightness.

Types of Pain

1.Pricking pain: can be well localized. It does not cause sweating or increase in heart rate etc. (autonomic response). It is also called fast pain, it is transmitted via A fibres. This kind of pain is protective mechanism.

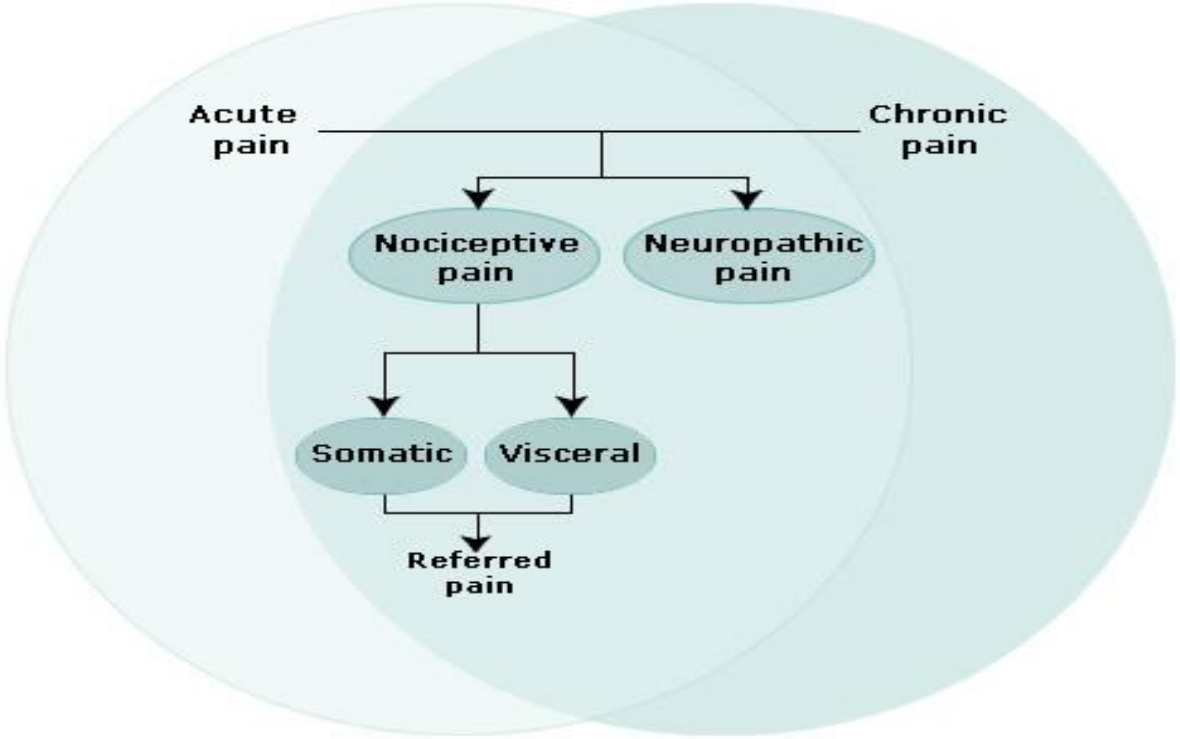
2.Burning pain: more intense, difficult to localize, causes sweating and increased heart rate. Rapid shallow breathing and breath holding. It is slower in onset and more persistent and is transmitted to CNS via C fibres. It is also called slow pain.

3.Deep pain: arises from deep muscles or organs when they are damaged. It is of aching quality and is usually difficult to localize.

Pain

- Nociceptive pain

- Nociceptive pain is pain perceived following the activation of specialized pain sensing receptors in the peripheral nervous system, named 'nociceptors'.
- Nociceptive pain arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors.



The nociceptive

Nociceptive pain is normally associated with injury, burns and inflammation. It is the most common type of pain and it is frequently experienced during acute trauma.

Many patients find it easy to describe nociceptive pain. It is usually proportional to the severity of an injury and serves as a protective function.

- **Silent nociceptors**
- These can be found in both somatic structures, i.e. skin, muscles and joints, and visceral structures, i.e. organs such as the bowel, and develop sensitivity after prior trauma or inflammation.

Gate Control Theory of Pain

The nociceptive pain pathway

- It is only recently that the psychological and central nervous system contribution to the ability to reduce the sensation of sharp pain, i.e. pain modulation, and the processing of pain has been accepted.

- According to pain gate control theory pain can be controlled in the spinal cord, when the nerve fibres carrying pain synapse with neurones in spinal cord (substantia gelatinona) called the transmission or 'T' neurones.

- During transmission of pain these neurones are activated to release excitatory neurotransmitter (gate opened). These T neurones also synapse with other neurones in the spinal cord which have an inhibitory effect on them causing inhibition of pain transmission (gate closed). Other (not pain) receptors like touch pressure and temperature in the skin and body parts are connected to those inhibitory neurones in the spinal cord via A (fast) fibres. This explains why rubbing helps in pain relief.

Role of Descending Pathways to Modulate the Pain.

- The inhibitory neurones also receive connections(descending pathways) from brain. These impulses coming from brain can act on inhibitory neurones to close the pain gate by suppressing the T neurones. These descending pathways are basis for hypnosis and psychological factors of pain control. The descending pathways secret serotonin and noradrenaline to excite inhibitory neurones.

- The inhibitory neurones secret endorphins enkephalone to suppress the T neurones. When the T cells are suppressed the pain sensation is blocked. Its now believed that descending pathways have two dimensions inhibition and facilitation, the balance and timing is crucial between inhibition and facilitation. Any shift in this balance may contribute to chronic/persistent pain.

Sensitization of Pain

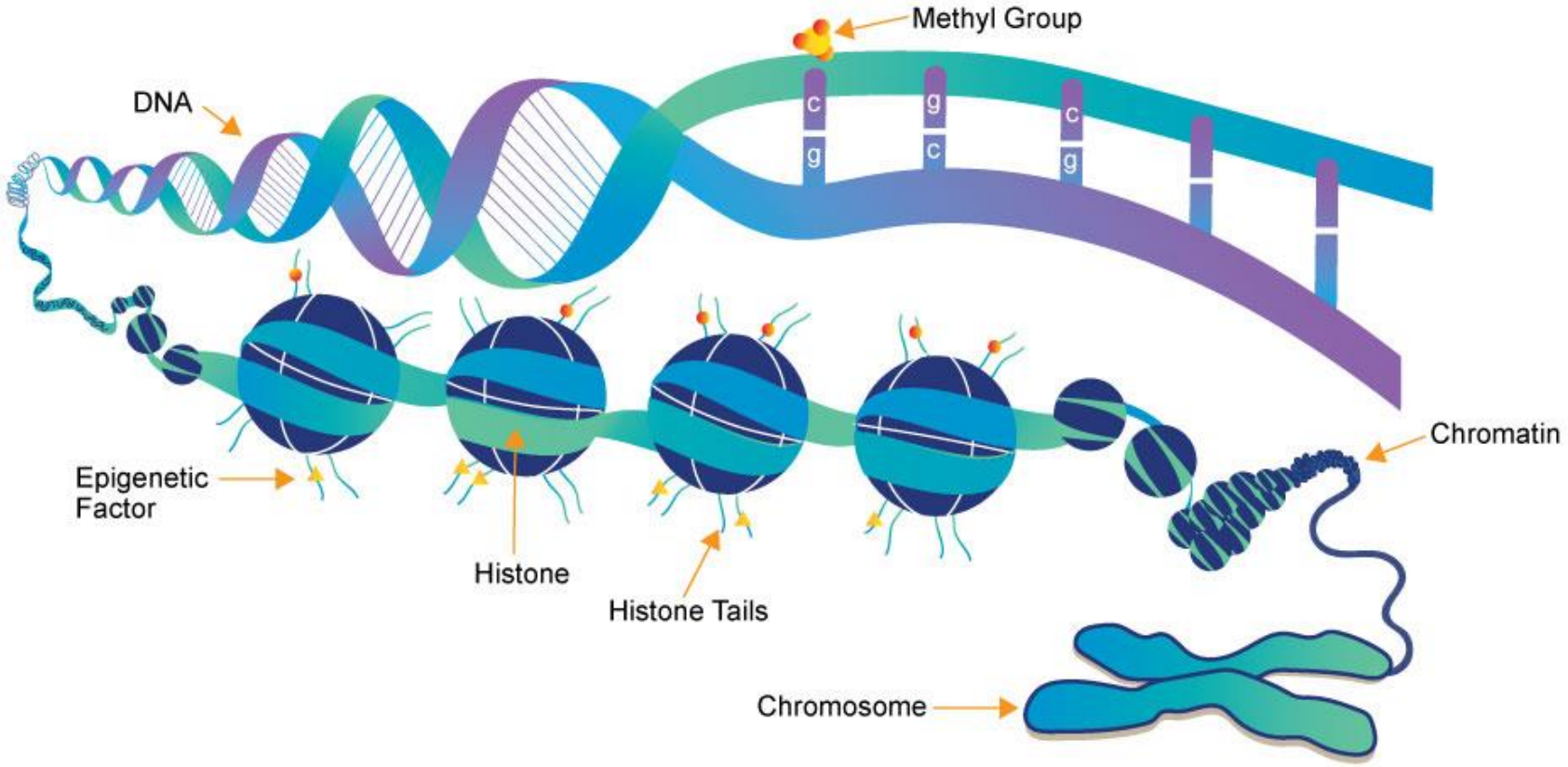
- Sensitization is an increased perception of pain. It can be peripheral i.e. at the site of a wound for example if a cut finger is placed in the warm water or burned hand is brought close to heat. This sensitization occurs due to release of chemicals at site of injury. The threshold of activation is variable and co-existing inflammation can increase the responsiveness of these nociceptors, i.e. reduce the activation threshold. When the activation threshold is reduced, this state is called sensitization. So, when peripheral nociceptors have a reduced activation threshold, this state is called peripheral sensitization.

- Central sensitization occurs in spinal cord neurones. The sensitivity of these neurones is increased and their response to the pain sensation becomes exaggerated. This can happen due to increase and longer release of neurotransmitters in the synapse, increased receptors in the wall of recipient neurone or increased number of connection formation. This is due to the synaptic plasticity.

Epigenetics and SFHT

- Epigenetics is the study of heritable changes in gene expression (active versus inactive genes) that do not involve changes to the underlying DNA sequence — a change in phenotype without a change in genotype — which in turn affects how cells read the genes. Epigenetic change is a regular and natural occurrence but can also be influenced by several factors including age, the environment/lifestyle, and disease state. Epigenetic modifications can manifest as commonly as the manner in which cells terminally differentiate to end up as skin cells, liver cells, brain cells, etc. Or, epigenetic change can have more damaging effects that can result in diseases like cancer. At least three systems including DNA methylation, histone modification and non-coding RNA (ncRNA)-associated gene silencing are currently considered to initiate and sustain epigenetic.
- https://www.whatisepigenetics.com/fundamentals/

- Through Solution focused hypnotherapy and epigenetics; it is possible to switch the genes on and off through trance as solution focused hypnotherapy can change and modify the phenotype without changing genotype.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