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NPTEL ONLINE CERTIFICATION COURSE

Course Name

Stress Management

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Lecture 06: Stress and Nervous System

Welcome to the second week on the course on stress management this week we shall study about stress psychophysiology that is how the stress is modulated in the human body, how the brain response during a stressful situation and how does stress affect the immune system the organs different organs of the body and what are the disorders that are caused by stress in the first module.

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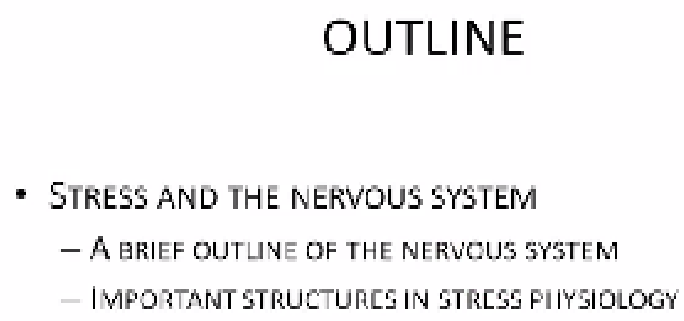

Today we shall discuss about the stress and the nervous system and we will give you a brief outline on the nervous system and what are the structures that are involved in the stress physiology to begin with we shall again go back to Hand Selye and his general adaptation syndrome.

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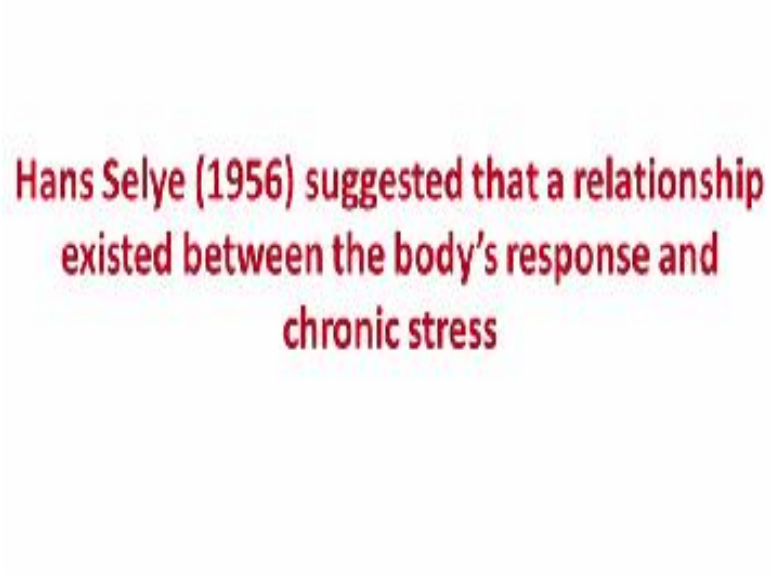

Hans Selye develops the idea that a direct relationship exists between chronic stress and excessive wear and tear throughout the body. He spoke about when he spoke about facing resistance and the period stage of exhaustion he was talking about the excessive wear and tear that the body goes through during stress now in today's a lesson we shall discuss how this happens and how the brain functions during this wear and tear of the body.

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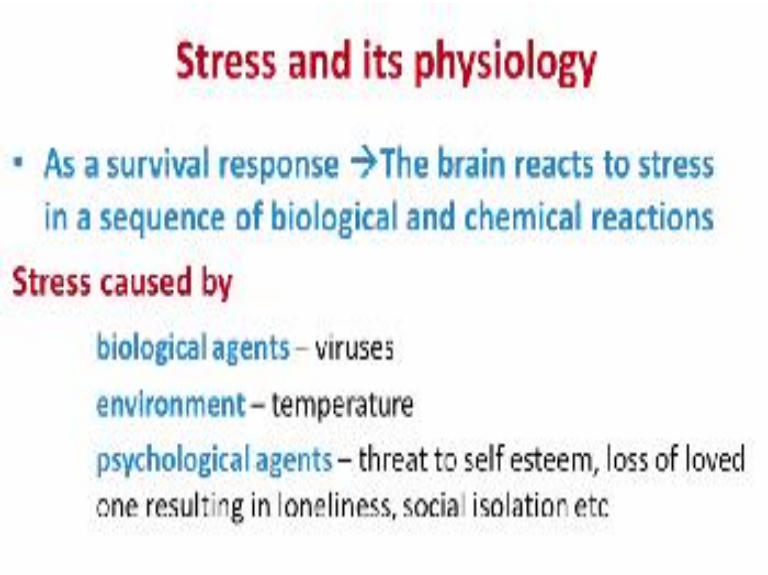

So to begin with when we are talking about the brain and stress we must understand that the brain reacts to stress in a series of neural and chemical reactions that are meant for physical survival now this brings us to a very interesting notion that we have studied in week one where we mentioned that the brain is used to react for physical survival but unfortunately over the years even now when physical survival is not at stake in all social situations the brain still responds in the same way that shall bring us to the effects of stress.

And how it causes illness which we will study in the next module but again to come back to it stress may be caused by biological agents like viruses and bacteria environment that can be temperature weather conditions and psychological agents where it is like a threat self-esteem loss of a loved one resulting in loneliness social isolation being publicly ridiculed extra.

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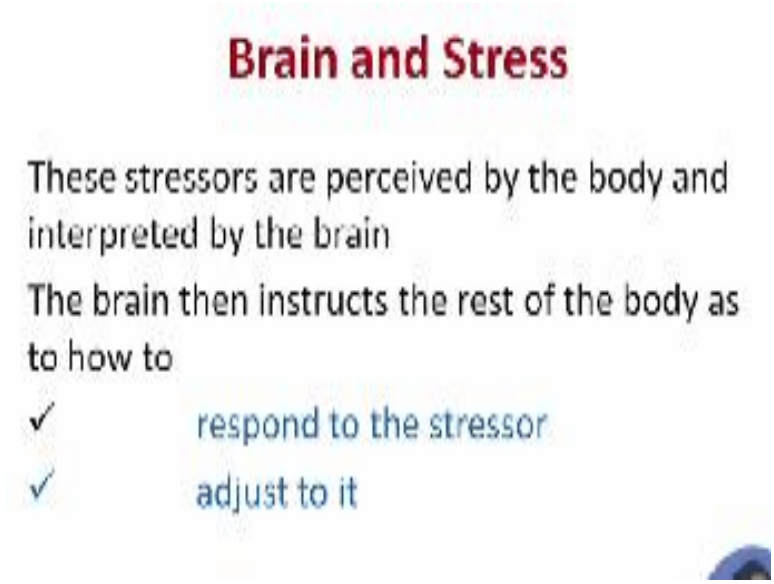

These stresses are actually perceived by the body and then interpreted by the brain so the stressor may be from outside and or maybe from within that is it may be a biological stressor it may be an environmental stressor we've spoken up earlier and these are perceived by the various sense organs and then they are interpreted by the brain. The brain then instructs the rest of the body as to how to respond to it and also adjust to it that is whether this is a stressor that the body can cope with or that is to adapt to it and adjust to it and many times also whether to give a fight or flight or in fact of freeze response as well.

So this brings us to Lazarus's cognitive appraisal theory which I have spoken about earlier and will speak of again later the way it is not the stress or by itself that is actually the cause of stress with in an individual it is the perception of the stressor how the individual or in this case how the brain sees the stressor and then how does it respond instruct the body to respond to it.

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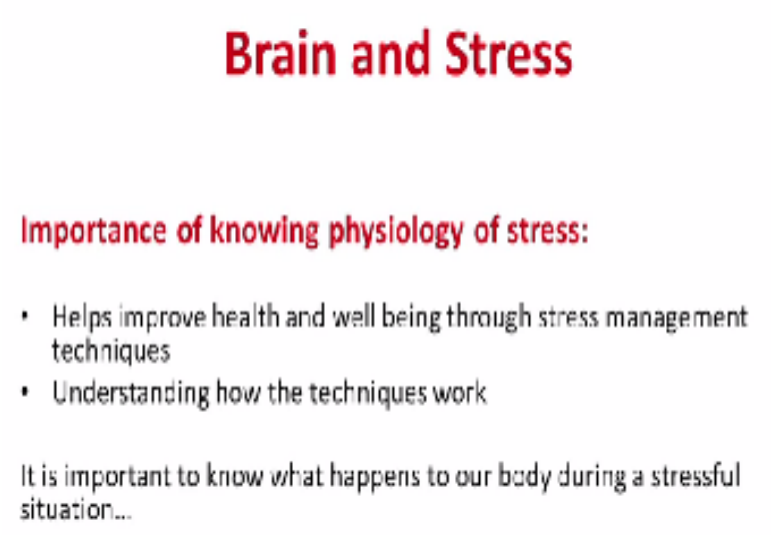

Now why is it important to understand the physiology of stress if one understands the physiology of stress then one can begin to use this knowledge to argument one's own health and well-being through different stress management techniques like for example we will discuss the relaxation techniques the autogenic training and several other method if you are aware that how this is actually working with in your body you will also be able to understand the changes that your body is going through and that will help you to develop a sense of control over yourself we have spoken about sense of control and how it actually affects the stress response.

So once we feel that we have and we have a control over our system then it helps us to deal with the stress or more effectively.

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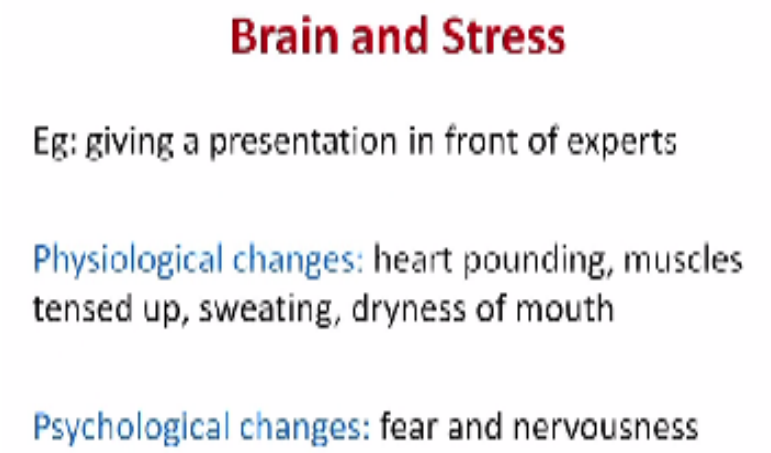

So it is important to know what happens to our body during a stressful situation for example say giving a presentation in front of experts where you shall be evaluated so we know that in such a situation there are physiological changes that a body may go through like pounding of the heart muscles, tensing up, sweating, dryness of the mouth extra and there may be the psychological changes or the psychological responses of being fearful and being very anxious so why is the body going through these changes.

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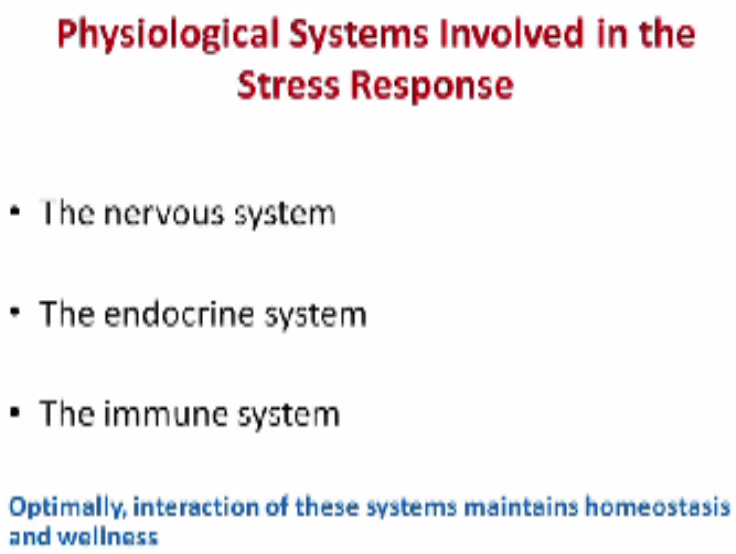

Now that brings us to the different physiological systems that are involved in the stress response so primarily the three systems that is the nervous system, the endocrine system and the immune system are involved in the modulating of stress within the individual optimally when these three systems are working ideally the interaction helps to maintain homeostas is and wellness but when there is a problem with any of these systems then it causes an eruption of over stressful responses and it may also affect the different systems of the body like one may develop some independent problems like this regulation of the thyroid hormone or it one may develop several immunological problems due to stress.

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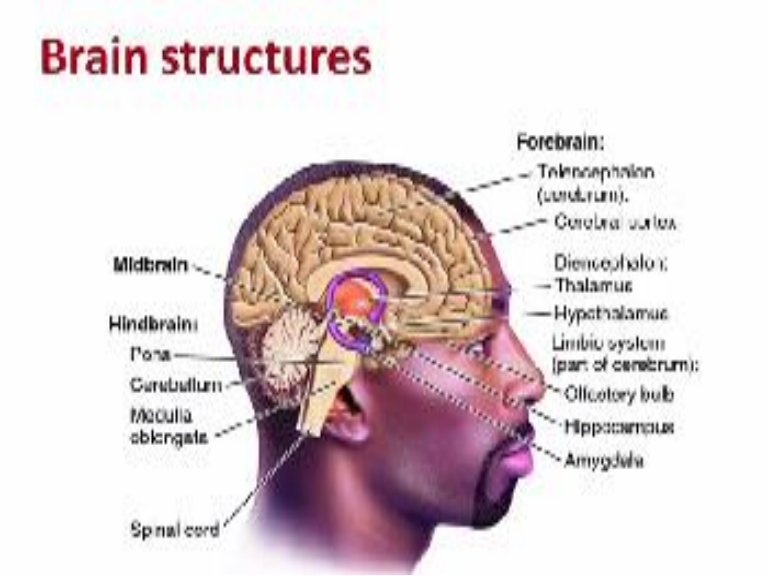

Now coming to the brain and it is several structure the brain consists of primarily the three parts the fore brain, the midbrain and the hind brain. So the forebrain is the higher part of the brain or which is actually involved in the higher-order functioning and it consists of the cerebrum. The cerebral cortex and also the diencephalon that is the thalamus and the hypothalamus the mid brain is a very important part which is related to the sensory impulses and the hind brain consists of the cerebellum the ponsmedulla oblongata and the spinal cord. Now for our convenience we shall discuss the brain today in a different way.

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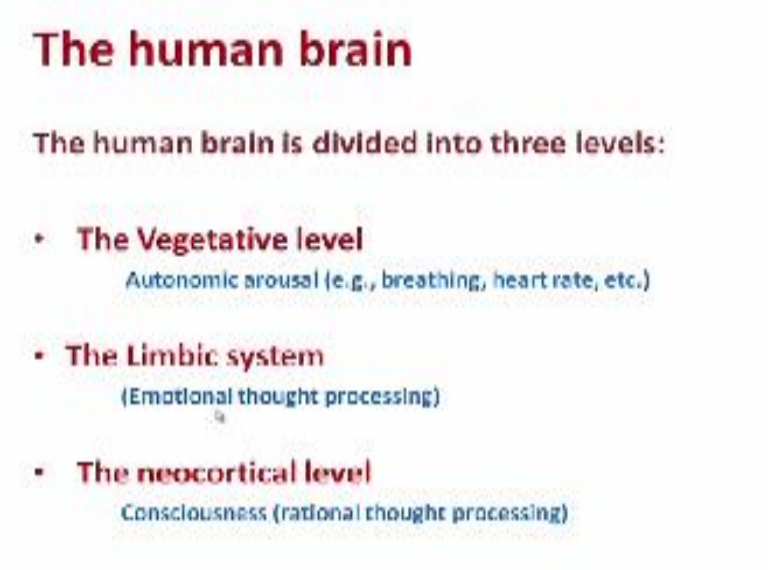

So primarily we will divide the human brain into three levels that is the vegetative level, the limbic system and the neocortical level. The reason for doing this is these we will understand how these responses how these structures actually are involved in the stressful situation as you can see the vegetative level is primarily related to the autonomic arousal so that is the breathing heart rate so these are more of the physiological responses, limbic system is related to the emotional thought processing and the cortical level is for the higher-order functions that what we were talking about the front the forebrain structures okay and primarily the cerebral cortex.

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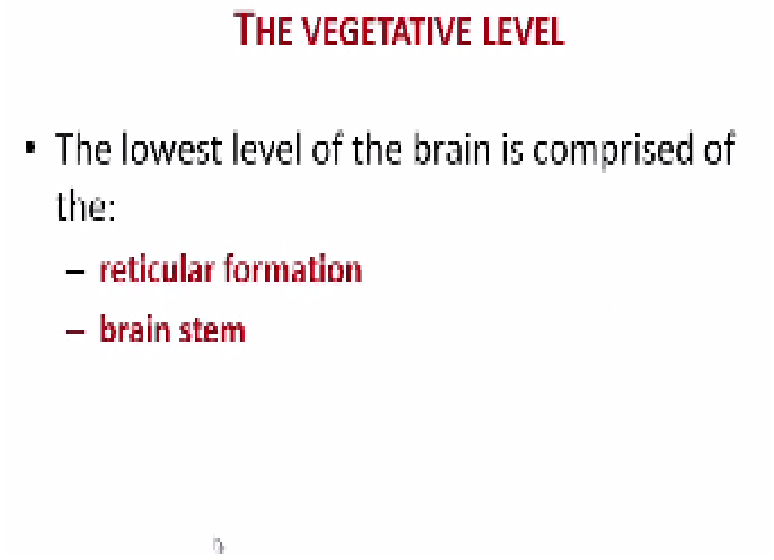

So this is related to rational thought processing so coming to the vegetative level the lowest level of the brain the vegetative level consists of the two structures the reticular formation and the brain stem. Now both these structures as we have seen are related to the regulation of the responses so like heart rate breathing sleep extra.

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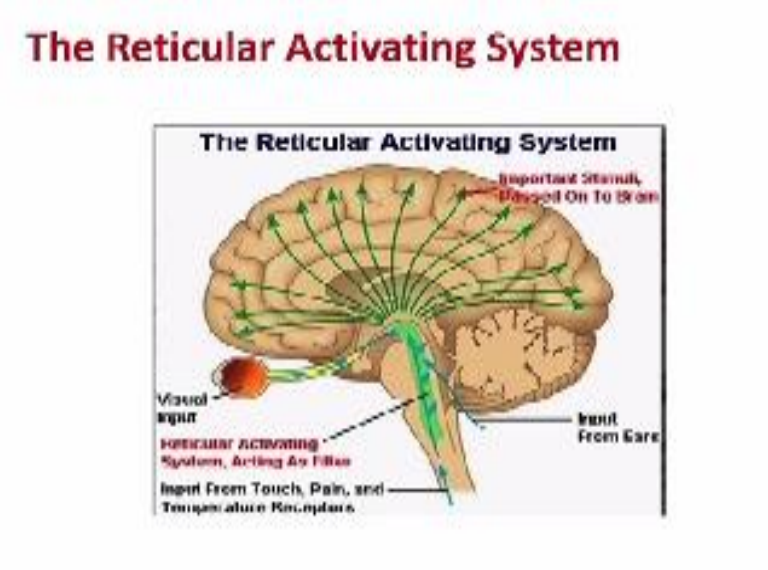

So again going back see the Reticular Activating System takes its impulses from the optic fibers, the auditory fibers. So from the various cranial nerves and this actually screens the stimulus and with the help of the relay center or the thalamus sends the impulses to the various parts of the brain.

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Now why is where the reticular activating system so important in stress physiology we have already discussed about the reticular activating system being a network of 9 and nerves that connects the mind and the body and when functioning normally it provides the neural connections that are needed for the processing and learning of information and the ability to pay attention to the correct task so that is when the filtering is done properly.

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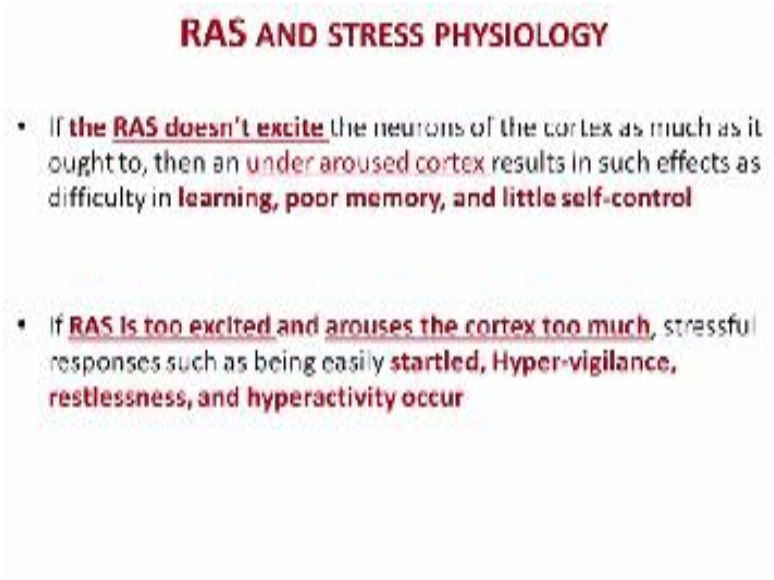

So if the reticular activating system does not excite the neurons of the cortex as it much as it ought to then an under aroused cortex results in effects like difficulty in learning your memory and very less self control. On the other hand if arias is 2 X I excited and arouses the cortex too much then stressful responses are resulted that is an individual may be easily startled may be may become hyper-vigilant may be restless and also be very hyperactive.

Now as you understand the arousal the over arousal of the reticular activating system does is very much related to the vigilant's response or the arousal over arousal responses that happen during a stressful situation.

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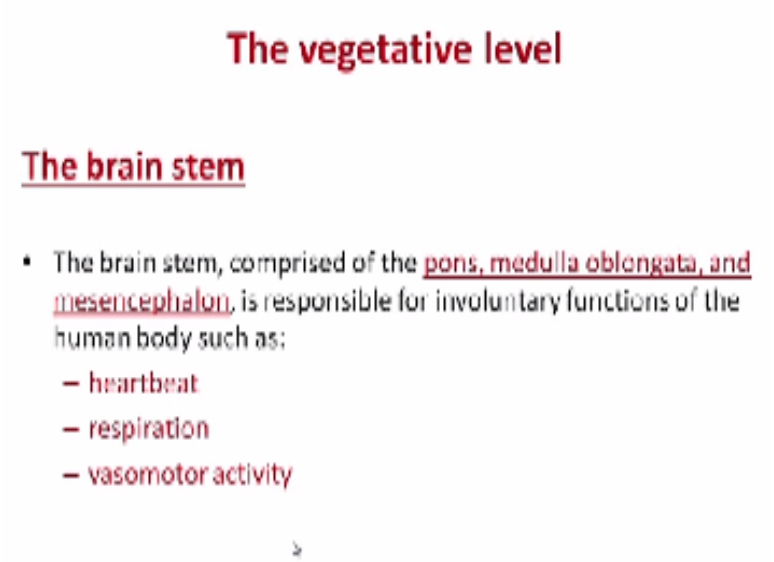

Now again going back to the brain structures so we will discuss the brain stem so as you can see the brainstem consists of the pons, the medulla oblongata and the messcephalon. Now the brain stem is responsible for involuntary functions of the body. So they are like the heartbeat the respiration and the vasomotor activity.

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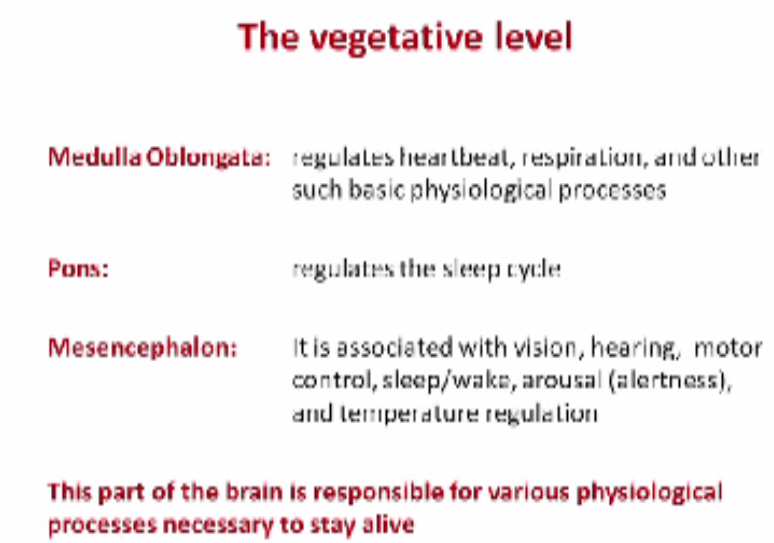

So getting to more specific details the medulla oblongata regulates the heartbeat respiration and other such basic physiological processes. The pons regulates the sleep cycle, the mesencephalon is associated with vision, hearing motor control, sleep/wake arousal system that alertness and temperature regulation. So primarily as you see the vegetative level is responsible for the various physiological processes that are required to stay alive so we have spoken about the reticular activating system and the medulla oblongata polls and masoncephalon which are responsible for the physiological processes.

Now coming to the limbic system, we all know that the limbic system is related to the emotional response and then why is it so important in understanding stress so we know that when an individual faces a stressful situation there are several times many emotion responses that occur. On the other hand an emotional situation an emotional stressors or a stressor that is perceived as an anxiety provoking stresses or a fear provoking stressor will also induce a stressful response.

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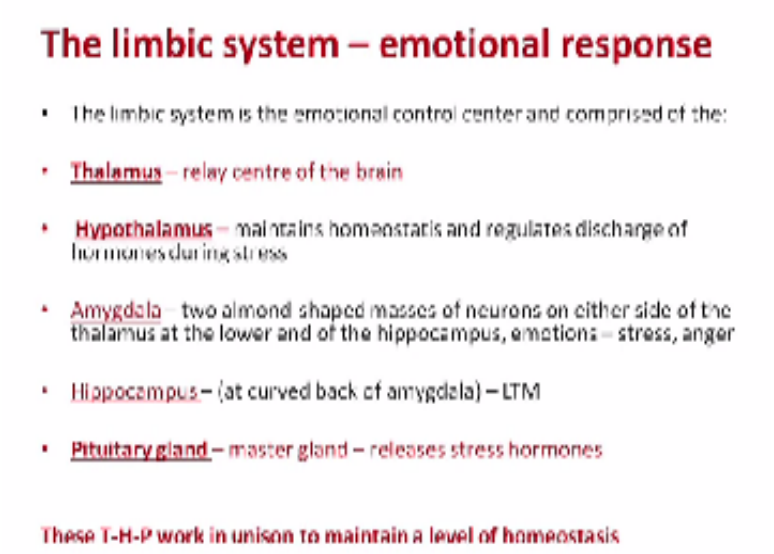

Thus the limbic system is very closely associated with stress the limbic system consists of the Thalamus, Hypothalamus, Amygdala, Hippocampus and the Pituitary gland. So basically the major areas the thalamus is actually not a structure of the limbic system but it is related to relaying the responses of the limbic system to other areas of the brain. The hypothalamus is a very small structure that is just below the thalamus so hypo stands for under and just under the thalamus there is a very small structure which actually is one of the major regulators of homeostasis in the body. It is also a regulator for releasing several human hormones within the body.

We will study the role of hypothalamus in stress in detail in the next section but as for now we will see that meant it hypothalamus maintains homeostasis and regulates discharge of hormones during stress the amygdala which is an almond to almond shaped structures on either side of the thalamus and then the lower end of the hippocampus deals with emotions and we actually see that the if there is a lesion in the amygdala there is a very strange team response that is seen within the individual.

So the amygdala is related to emotions like stress, anger and also aggression. The hippocampus another structure a very important structure of the limbic system is as situated at the curved back of the amygdala and it is like two horns and this is related to the long-term memory or the storage of memories. So if there is a damaged in the hippocampus then it affects new memories being formed.

Now the hippocampus is the hippocampus and the amygdala these are very important limbic structures that are related to the past how we store memory, how we store emotional responses with in the brain and that also is very important as to understanding the superseding a situation amorperceiving a stressful situation. For example if I see a dog running towards me my learnt my knowledge or my mail of the information that this dog may actually be harmful and it may be a threatening creature it may bite me well this information will come from the limbic structures and that's why it will actually trigger the fight-or-flight response along with that the pituitary gland is also a part of the limbic system.

The pituitary gland is known as a master gland and it is it releases stress hormones we will study it in detail in the next section but as for now just to mention the different limbic structures I have brought in the pituitary gland. We must remember that the thalamus the hypothalamus and the pituitary gland work in unison to maintain a level of homeostasis within the body.

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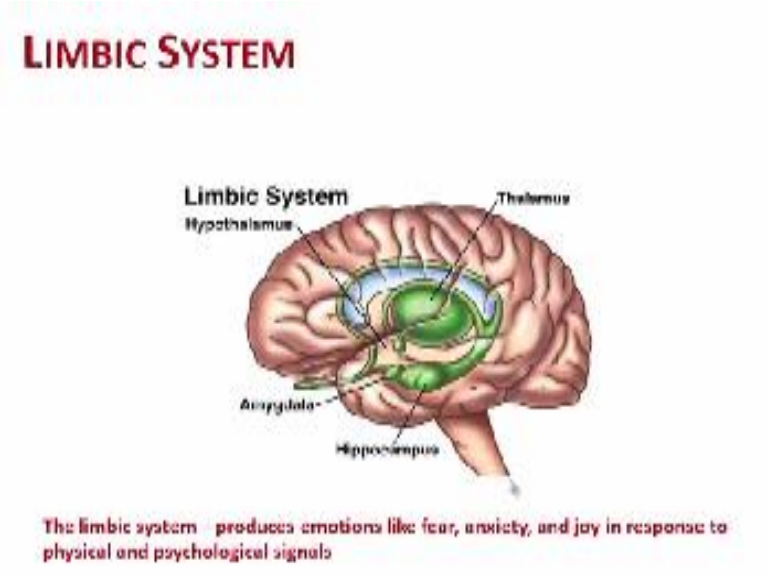

So here is the limbic system, so this is the horn like structure or the hippocampus this is the Amikdela and this is the relay center or the thalamus. Now the limbic system as we can see produces emotions like fear, anxiety and joy in response to several physical and psychological signals.

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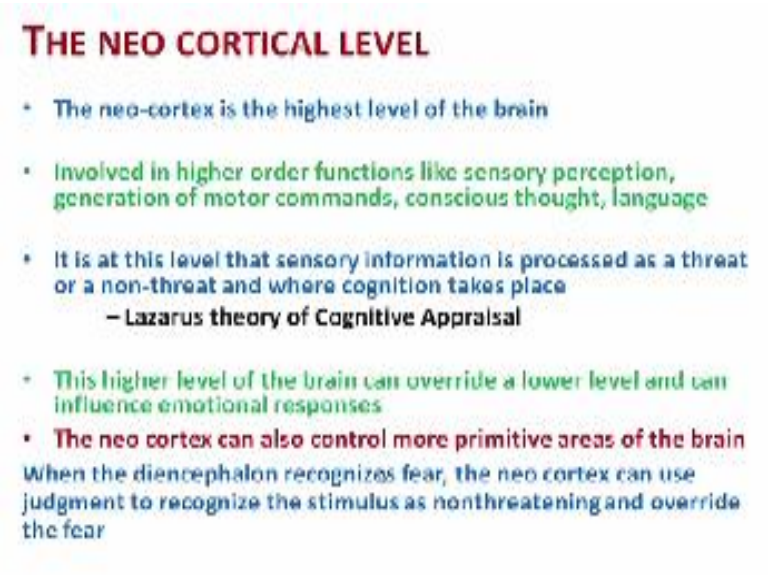

Now coming to the higher highest level of the brain that is the cortical level. The cortical level or in this case the neo cortex actually is responsible for the higher-order functioning. So it is like involved in the higher-order functions of sensory perception, generation of the motor commands conscious thought and language also it is related to decision-making and problem-solving. It is at this level that sensory information is processed as a threat or a non-threat and we're cognition takes place.

So this brings us back to the Lazarus's theory of cognitive appraisal again so just by seen a tiger coming towards me or just why by track seeing or two lights that on a railway track from far away does not mean that an individual will be threatened by it or feel stress because of seeing the two lights or by seeing a tiger it is the appraisal of the image that we see that actually causes stress.

So the information that is received by the lower level structures and which is mediated through the reticular activating system passes through the limbic system and then when it goes to the even if it is perceived as a fearful stimulus when it comes to the forebrain in this case the neocortex then the decision is made whether this is so threatening to offer the fight of light

response. In fact what response will it be whether it will be a fight response of light response or many times of freeze response as in pretending to be dead which is actually done by several animals and even by raped victim during the traumatic event.

This selection of the response is done in this cortical neocortical level the most interesting part is that this higher level of the brain can actually over ride a lower level and can influence emotional responses as I mentioned that even if the diencephalon that's the thalamus and the almaz recognizes fear. When the neocortex can use its judgment to recognize the stimulus as non-threatening and override the fear.

So if I see two lights coming towards my way when I am standing near the railway track the appraisal of the situation that well this is a train which will travel only on the track and I am outside the track will stop the fear response that has that spontaneously spurt out by seeing the signal signaling lights.

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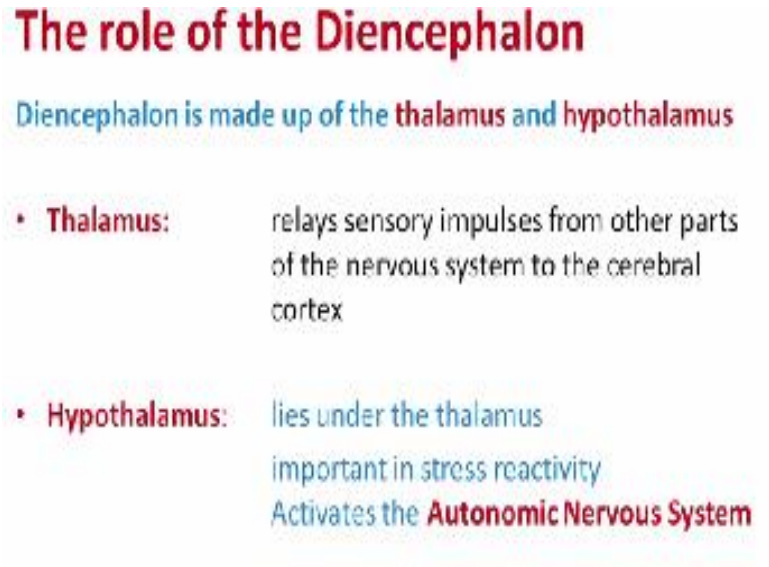

Now coming back again to the diencephalon we just spoke about the diencephalon here as the organs which recognize fear and we said that the thalamus and the hypothalamus are a part of the

Diencephalon. Now I have talked about the thalamus and hypothalamus before but just to revise once again the thalamus it relays the sensory impulses from other parts of the nervous system to the cerebral cortex and the hypothalamus is a key structure in stress reactivity and is the primary activator of the autonomic nervous system.

Now coming back to the brain again we have covered almost all these organs that are involved with stress and now to the autonomic nervous system.

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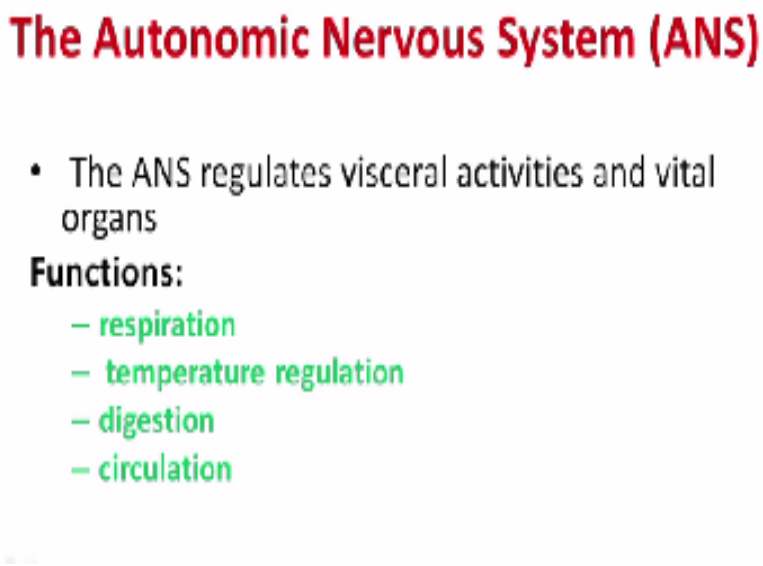

The Autonomic Nervous System is regulates the visceral activities and the vital organs that is circulation, digestion, respiration and temperature regulation. The Autonomic Nervous System consists of two parts the sympathetic activation system and the parasympathetic nervous system or the parasympathetic activation system.

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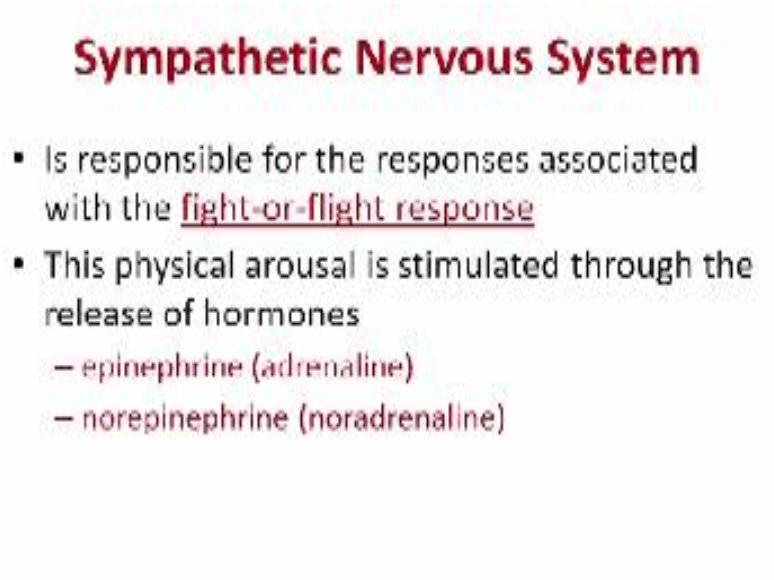

The Sympathetic Nervous System is responsible for the responses associated with the fight-or-flight response. So this physical arousal of the fight or flight risk is actually stimulate through the release of the two hormones primarily the epinephrine and the nor epinephrine .These are also known as the adrenaline and the or adrenaline as they are secreted from the adrenaline gland.

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The parasympathetic nervous system maintains the homeostasis of the body by the release of the hormone acetylcholine or ACH and is responsible for energy conversation conservation and relaxation of the body. So the body cannot remain in an active sympathic state for a longtime so initially during a stress response when the body responds to a fight-or-flight situation after a certain period of time. The body is brought back to the sympathetic system switches off when the stressor is non layer and then the parasympathetic system takes charge.

Now this is very important for the conservation of the body if the heart is in the sympathetic activation if the heart keeps pumping the blood at a higher rate for a longer time then they will the body cannot be able to sustain for long so, the parasympathetic nervous system is has to take charge after the threat responses removed several times how this is done ? We will study when we discuss the HPA axis.

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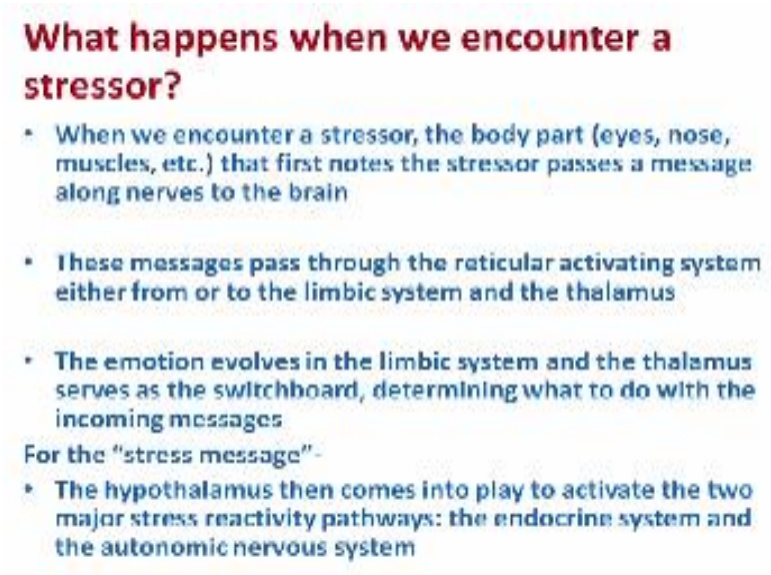

So what happens when we encounter a stressor? When we encounter a stressor the body part that is the several sense organs it could be the eyes, nose, or ears or in fact even the muscles first notes stressor and passes the message, message along the nerves that is the cranial nerves to the brain. So these messages then pass through the reticular activating system we have seen how it is filtered by the particular activating system either from or to the limbic system and the thalamus.

The emotion then evolves in the limbic system that is whether this is a fearful situation, this is a joyful situation or this is a sad situation unpleasant sad situation is decided by the limbic system so we have remember the limbic structures that are related to it primarily the amygdala, the hippocampus these are and the basal ganglia which we haven't discussed in this case and then the it travels to the thalamus which serves as the switchboard that is it determines what to do with the incoming messages? Where to send the impulse to which organ?

Now if when this is a stress message so the hypothalamus it triggers the hypothalamus and the hypothalamus comes into play to activate the two major stress reactivity pathways that is the endocrine system and the autonomic nervous system.

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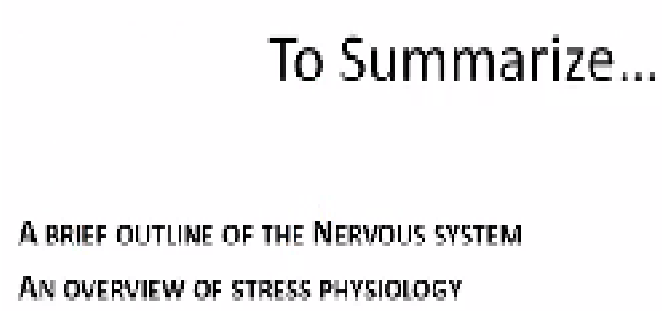

So the endocrine system we shall study later so in the next section and so finally we come to the end of this session very briefly we have discussed about the various brain structures that are involved in stress and how they have given you an over view of how it relates to these structures relate to stress physiology and creates stress with new organism and how the body responds to stress in the next session we shall discuss the end ocrine system and the hypothalamic-pituitary-adrenal axis. Thank you.