How The Brain Creates Mind
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Lecture - 05
Electrical activity in brain-2

So, welcome again to the last lecture of this 1st week, where the take me pick up from where I left, how the brain evolves and how the species evolve from motor to emotional to thinking brain, which is us NEO Cortex which is the latest develop in evolution. The individual brain evolves from in the 1st month of in the home when you draw and it is like. So, let me come to that, so the basic question which we asked is, why does it need so many neurons, when the brain is evolving now; this is what I told.

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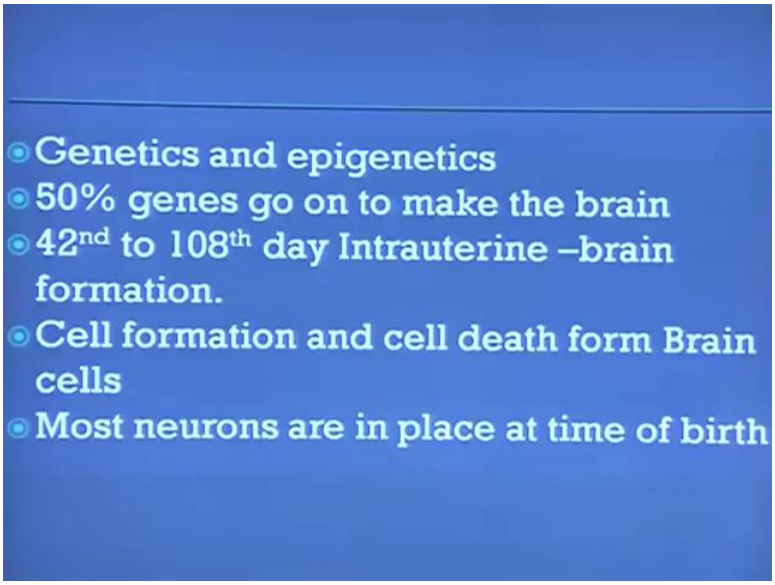

So, between Genetics and epigenetics as I mentioned 50 percent genes go on to make the brain, this period within the (Refer Time: 01:23) 42nd to 108th day. Most of the areas of the brain, are already there, they all forming. So, after that relocation will be very difficult, cells are been formed and at the same time lot of cell death is happening. So, out of all the cells which are formed, 50 percent of them die. So, imagine how many cells would have been formed, and most neurons are in the place in the brain at the time of birth, they take some time to understand this, anyway do not do not bother about it too much it is like a small cell, 1 cell is permits over then they divide 2 cells then 2 to 4, 4 to

all this cells are Totipotent. Totipotent means, they can form any type of cell in the body; as the growth occurs they become glory potent, some of them can forms, some specialized cells, some of them can form some.

So, in this ball which is called "zygote" which later on becomes peters, on the top of it appears plate which is call a neural plate this neural plate divides into such a form now the top is the brain and then spinal cord now imagine a circle from the center of the circle this cells are formed, and from the center they move on to the periphery of the circle in the rim; it is formed here and it moves to this, it just migrates the each cell which divides initially is call a progenitor, progenitor gives rise to progenitor initially it is a symmetric device division.

Later on each progenitor divides gives to un rise to another progenitor, and the neuron and each neuron from the center moves on to the those 6 layers if you remember. So, the earliest cell will remain in layer 6 the later cell will move on to layer 5, 3,2, 1 and as they move; they also start getting specialized under the influence of there is no light which is reaching there, but there is a sound which reaching the (Refer Time: 04:19).

So, the fitters starts hearing very early, but it is not becoming a hearing neuron under the influence of sound, it already has a capacity to be there to hear, if it moves to the auditory area it is there to here, if it moves to the visual area it is there to receive the pattern of the image, if it is in motor area it is there to fire and a create a motor thing, so the 50 type of neurons which come up in various areas. And there is a (Refer Time: 04:56) of glial cells, glial cells are many more than neurons, glial cells are like a packing, glial cells also helped to form what you call myelin sheet which we will talk about over the exon. Glial cells are there to keep the electro chemical balance of the brain character, if a brain is largely filled with water, so 50 percent of body is water. Water is very important in the brain actually, beyond certain water threshold brain will shrink or if there is a more water the brain will stop functioning.

So, this is the critical balance of everything of Sodium, Potassium, Salt, and Glucose it uses in energy it is warm moist structure, but it uses 30 percent of the energy of the body keep functioning all it is life. So, what happens is now a neuron in layer 4 will function as something which takes input, in the initial few days; if we replace suppose we take a neuron from layer 6 and put it in layer 4 it will start functioning as layer 4, but only in

the very initial few days of it is migration, after few days it will not and that is why it has been seen what we call neuron plasticity; is a neuron can take over function if in the critical period of migration and development if suppose a neuron from occipital areas taken and put it in to the area of hearing it will take up that function.

So, if you take a neuron from one area put it on the, it will take up that function, but only in the critical face of development not after that. So, most of the brain areas are in place called forty second between 40 second (Refer Time: 06:48) the day, what is left after that is forming the association. So, if you remember there was something call association area one of the slide that show you showed you, it is so one area is hearing, one area is seeing, one area is moving, one area is sensing; how to the unide, they unide by rest of the connections call "association areas" Temporalis with palatial, palatial with occipital, Occipital with Fontal these are association areas, now association area start developing.

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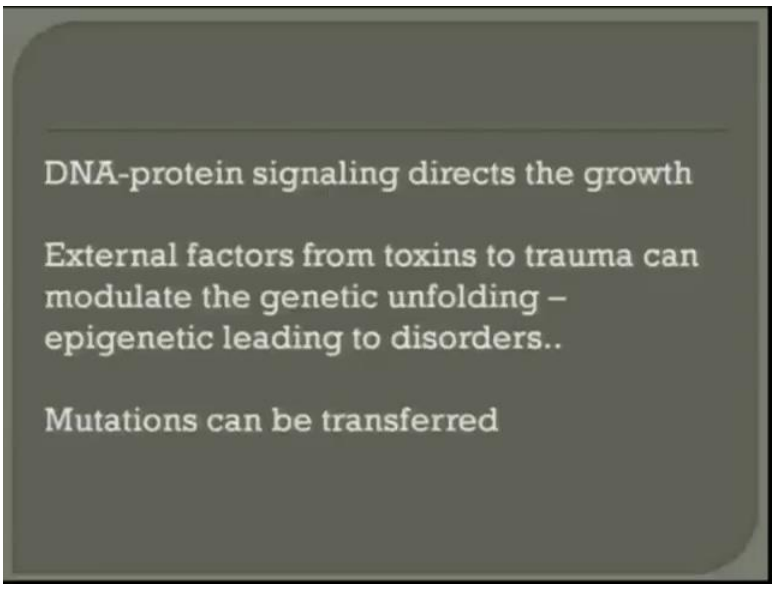

So, neural migration as happen the DNA and protein the signal the growth external factors at that time so; that means, in the (Refer Time: 07:29) it is very important that the (Refer Time: 07:33) is protected, some of the genetic mutations like down syndrome, like other syndromes can happen; which leads to disable T and rest of the things, but lot Epigenetics happen, in mother stress; increases the cortisol harmone level 1 of the harmones in the body which menagerie stress is in , which covers the peters that itself can alter the gene alter the brain formation. So, direct hurt to brain where a brain

structure is damaged, can happen with genes, but a lot more damage is especially with psychiatry enology happens because of Epigenetic factors or may be genetic factors, and that is the problem of this formation of this cells. Layer by Layer this layers when get disrupted. What we do not know is really; what we do not know is also I am just throwing a (Refer Time: 08:33) it because the brain has the certain orientation, it is the electromagnetic field which may be also orienting it.

So, there is the geometry of the arrangement of cells, in the columns and semi column, if this geometry disrupted for some reason, then probably what happens is the functioning also get salted, and I will give you example very soon; now after once this cells are in place, then how do the Dendroid, I showed you the Dendroid with other antenna, how do you synapses from these synapses start forming, but 2 3 things, 1 is, pointiness firing as the chemistry alters, this is a spontaneous firing, this firing is not like the EG waves which will be talking about in the next week, it is like Spikes, you know what Spike of current is, EG spikes leads to current passing from one to the other. Reading to synapse formation, chemical synapse Neuro transmitters are I showed you the synapse.

So, there is a small gap, how does it happen, though that electrical activity converts to what you call a chemical activity. Chemical synapses from, after in the in the very soon in the 3, 4 month within the womb sound. So, we do not know whether Abimanyu is the stories true in Mahabharata, because not he is very well proven that, if you play music; the synapse formation and the peters responds to it. Sound is already reaching, sound is already reaching through the vibration of the mothers steamy and that is sound triggers formation of synapses gets in to neurons light. We do not know, but this triggers of this continuous till after birth, and after birth the neuron is already participating in it, is growth because what does it do it suddenly take a gas oxygen goes in and what is let out is a cry, which is the motor act.

So, as it acts, the environment the mother or the caretaker responds to it; by feeding, by doing other things, that reciprocal thing is that forming synapses, then within the 1st 1 the growth smile, social smile, moment. The moment starts in the within the womb also, but there is a spontaneous jerking.

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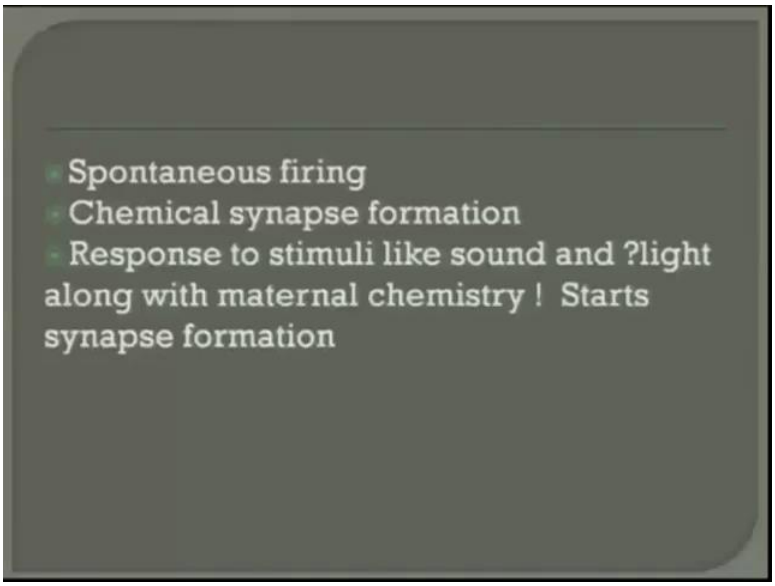

When you would have seen it, when mother say, I feel that they as kidding is actually kidding, what happens the 1st the motive moment happens; that means, neurons fired may be from the motor area, but after few firing like this, 1st the moment happens the neurons fired, womb had happened, neurons fire; after few firingly is the brain is start controlling this moment, that is how it evolves; lot of sound goes in neurons fire sound goes in (Refer Time: 11:53) but then neurons start discriminating between the sound, surprisingly at the time of birth a normal healthy new born, can differentiate between the voice of father and mother, it is the very very surprising thing.

But it is there, because by the time; brain has already learn to play do the 4 year of in the frequency analysis of the various pitch and which is going in, is brain there is already highly functional at that time as in the 1st 2, 3 months lot of activity increase it evokes response from the environment. Environment does something do, it this respond and that is how synapses start forming, this is what I initial told you.

So, what is the important is that we should understand and that is the reason while people cannot be very very objective, you know what being objective is say that. Why are you reacting you be objective think it to the situation, do not carry pass into it; all that is very well set, but all that requires hell lot of training because your basic neurons are or firing that way, you basics neuron embed in the environment, so much that it is very difficult to really detach from it requires training plus. If you look at it, your basic network which is

formed in the 1st 3 months or in the1st few months of life, is essential for survival for your safety, your cry is for a discomfort of a food; your basic networks always keep evaluating any stimulus, which comes on the basis of threat and survival 1st.

Once that is done then you move on, if you again as let us go back to the 1st thing which I said the psychology has given lots of definition, where I still not away from that. If you know Abraham Maslow and Maslow's pyramid, it shows the basic1st thing which you have to do basic security food and hunger. Once you do that, then you had security and then achievement and then finally, self actualization. So, all self actualization happens when they lot of other parameters and basic networks are satisfied, if we translate this, so psycho social growth to networks of the brain networks itself are operating from very basic survival network to higher complexity; there may be a Gandhi I do not know we did not preserves Gandhi's head, because probably we are not.

So, scientifically oriented that time, but I am sure Gandhi. Gandhi was one person who jumped all this things, he had no security for food, never bothered money, but he still was self actualize and there been people like Buddha was who have done it. So, in the history of human rights, there have been few people, who have really done it, but without you the human and you do not have to go for you just look at our own life, when we are secured, when we are welfare ,we talk of would philosophy theory.

I give example that lot of people who are telling you about getting detached and detached should practice detachment is a difficult thing, because how can you get detached, as when your own brain firing is so attached to the survival and to the environment, now all this is like how many people who are giving you all this sermons as a very interesting thing which has suddenly thought not to dis-respect anybody, if somebody is giving you sermon get it as and now you as tell them there is nippers are and you do not have a bullet proof jacket no security, somebody really shoot you; now give you sermon award detachment, 1st reaction will be a fear.

So, if you look at our own life, suppose you are waiting for a result, then you know the result will come on 3rd June; may be of your child or yourself you know it will come on 3rd June, but unnecessarily anxiety will keep every now in than will keep thinking. Sometimes it appears that, as if our basic networks have evolved from the jungle, from the predator (Refer Time: 16:24) always risk of life at that time, when they were hunters,

all the security which we have created in our houses in all that much liter phenomenon, man lived in a huge danger of getting eliminated from illness, from predators, from being pray, from wars, from the self destruction, from fire, from natural calamity, we also still have those fears and lot of thinks which we do in our life is essential to eliminate that fear and one as to just examine in your own life you want a good career, whether want to good money, because the assumption is good money, can give you security faith; when you are helpless what you look at god.

So, god is been replaced by money, money is been replaced by power something. So, you need power, why do people need power because the thing fine give me sense of sort of security, imagine the 1st man who would have looked at tsunami coming to him or lightening coming he would got scared, that fear is so entrained in the network of the brain may be genes, as I said the 1st gene would have thought multiple and survive it never goes away, most of our efforts are just to eliminated that fear and that is how the brain has continuously learned to keep responding to the environment and reacting to thread full situation; once there is no thread full situation, then you move on to the other things like if I am sitting here, and suddenly there is spark of light or either short circuit here, I know I just have 2 more slides I can tell in fear, you think I will do it. No because my only fear would be should not fall on me.

So, brain 1st will fire and keep you activated to keep you safe and then so on. So 4th and that is by lot of now you can ask me why do not you get an answer why do not people change in spite of all right from cries to everybody telling, because most people they are they context is the immediate. Immediate means one immediate physical survival 2nd anticipation prediction and that is what makes us different from an animals, animals did not have the capacity to anticipate and predict, they can anticipate and predict only when they get a sensation from the environment like a dear; you may smell or you may feel that the lion is coming, only then the dear will run; human beings can anticipate that, if you go to this area you may have a lion. So, you will go protected and all that. We can anticipate and predict our feature, if you do not earn money; if you do not have a house where you live, what we have developed is anticipation and prediction of the future. This separates humans from lot of other animals.

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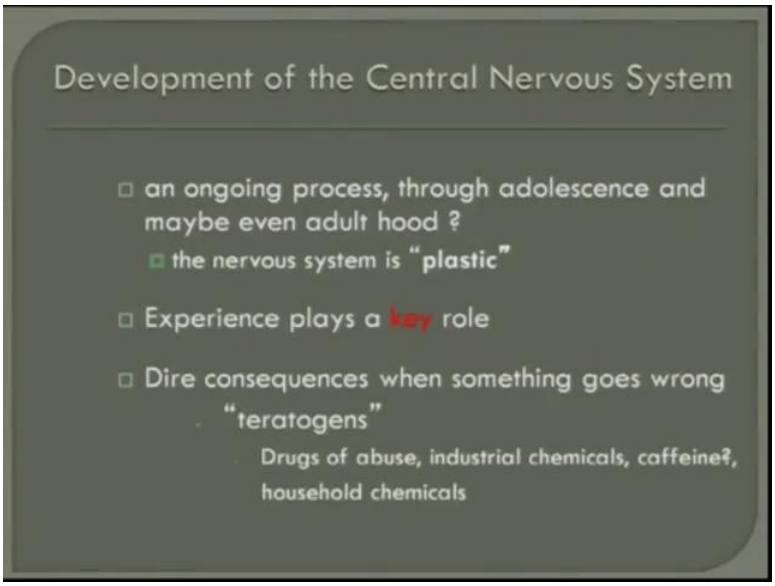

So, it is ongoing process through adolescence and the nervous system is plastic said experience plays key role, when something goes wrong "teratogens" drugs of abuse, chemicals, and household chemicals.

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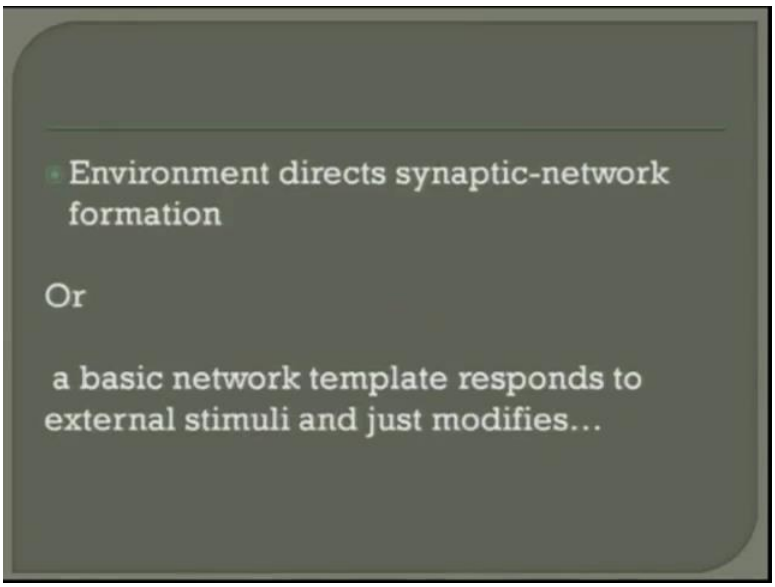

So, environment largely directs synaptic network formation, or is it a basic network template with responds to external stimuli and just modifies. Now this is what is important question; environment, experience, sensations are they acting on the nerve growth or synaptic formation or is it that over millions of years, our brain network is

already there to ready for to fire or a may be multiple potentialities like multiple like in quantum mechanics you have possibilities probabilities.

So, there may be a multiple probabilities in which a brain network is existing, depending on what environment stimulus comes in that is like all most like wave collapse or and it (Refer Time: 20:56) rest of the potentialities repeatedly once twice thrice that multiple times if the same circuit goes on, that becomes established in the form of synaptic formation, but environment just utilized what was already existing. Now this is the big question because possibly this is the truth second, because if environment is the only factor which direct synaptic growth and behavior patterns and all that, in the similarities would not exist, then would be entirely is different, but over certain layers of behavior most of the human beings are the same.

So, possibly we all are born with basic network template, which responds to the external stimuli and environment just triggers and brings out those frame works of reality.

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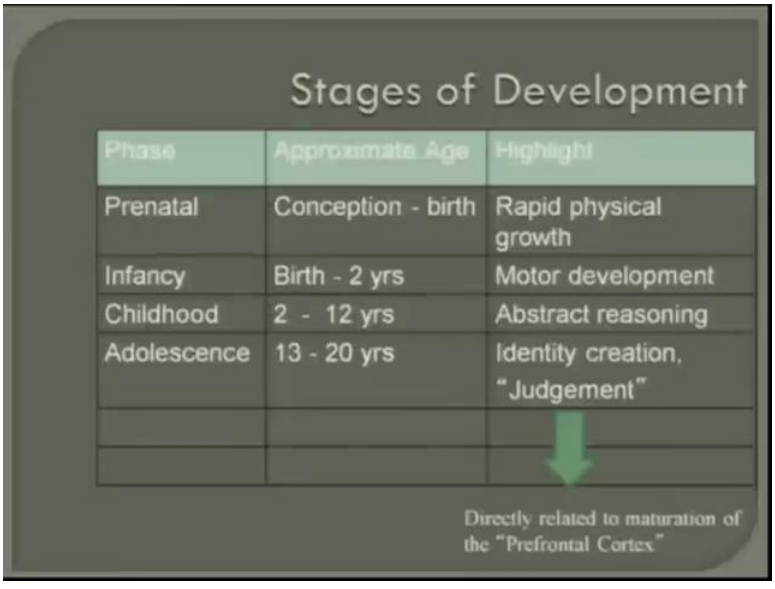

So, this is the type of stages of development, prenatal conception till birth is rapid physical growth, infancy motor development, childhood abstract reasoning, adolescence, 13 to 20 years identity creation judgment Etcetera and. So this part adolescence this you think, directly related to maturation of prefrontal. I told you the central executive network which has prefrontal cortex, which makes judgment an insight, this area is the last to develop. In fact, thinking brain, if you ask me in that sense of wisdom maturity

does not develop before 20 because whole fallacy of the society how asking kids to think the brain is not mature enough, their brain is mature enough to think that they will be impulsive, they will be bit of intentionally deposit, they will be pi, they will be thinking irrational discussion because normally round 13 hormonal changes puberty start; that is one of the critical periods.

So, this whole tip with adolescence and parents is probably not based on biology. Thinking starts in the 2 sense of judge, through judgment around 20, but society is such that, we want our kids to think very early in life, which I do not think will be a very very smart thing to do, and it also is with the Myelination. Myelination of neurons, as they now that imaging shows will talk about imaging, the lack of Myelination leads to lot of immaturity of the thing and this is one of the stages of development. We will see how the whole things look like.

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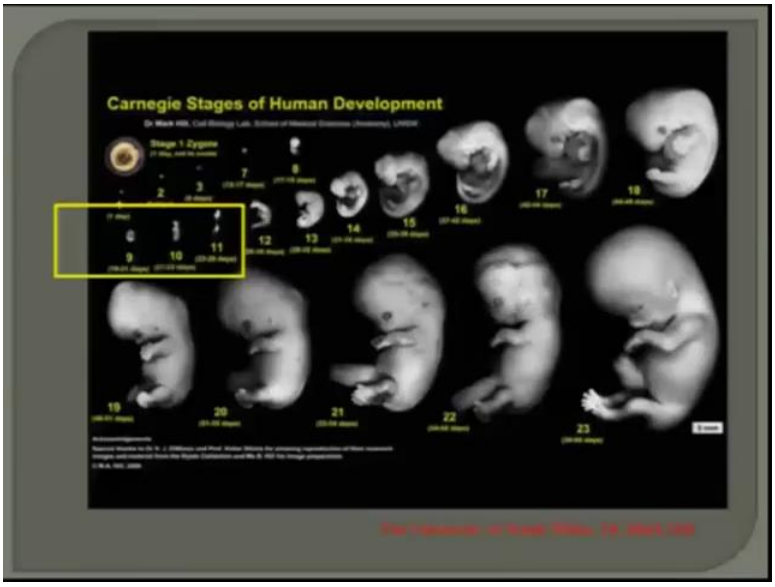

So, I will wrap up this week's lecture at this basically. So, I hope you got an idea of what the structure does, and when we are talking of the structure, in the sense of that whether structure is primary or the function is primary, I think in human body or in biology at least both have evolved together.

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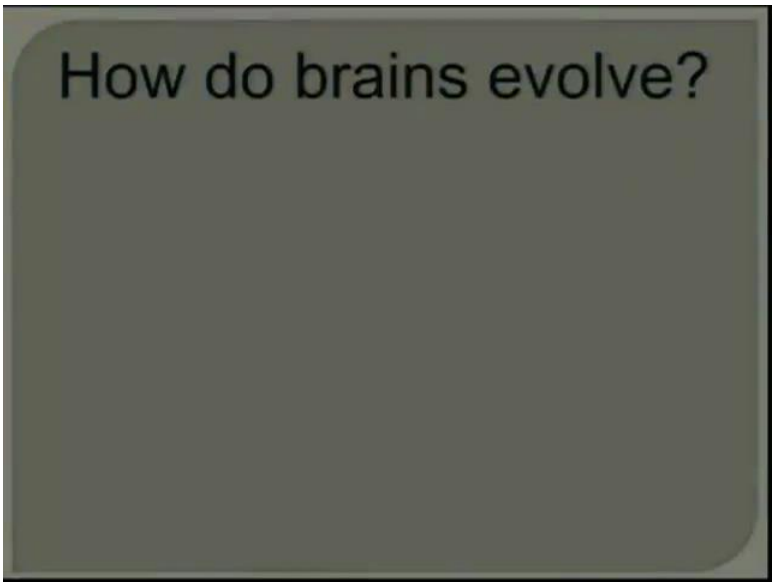

Why does brain have one more last thing before I wrap up, I ask about the wiring ,what does brain as so many neurons, it could have then with less, my guess is because while evolution, all this neurons have evolved by taking up data from the environment information right. So, to survive, very human being has grown so much in complexity, that it requires everything in the brain to be present.

So, that one something comes, it nothing should be missing that is 1 reason for neurons 2nd that is also 1 reason why do you see this Garai and Salkai because how do you packed into the power 10 11 neurons. So, this folding in the brains, gives a more surface area and helps you packing. Now why do you want to packed in to the power layer neuron that is wiring injuring problem because transmission from one point to the another as to be pretty fast, transmission if it is point 5 to 120 meter per second, which is the naturally speed; when you talk of physiology we will talk about this.

So, how do you increase the transmission? Though transmission fast, transmission has to be for faster response to save yourself, or to act how do you do it, if you make it thick, the transmission will be faster, but thicker neurons will not pack. So, thicker neurons will mean less neurons, less neuron will mean less data set, which will mean less information which brain does not want. So, what you do you have, so you do not increase the volume, you have more number of neurons right, as I interface with a world one and inter neurons, if you can pose a lots of connections, then the speed changes and not in a

linear sense of it, you can put it in a sort of a network. So, dendrites have 100 of it where antenna like thing exon has 100 of it.

So, as I said 1000 to10000 of connections that gives huge networks. So, now, what is brain doing in if you ask me to just summarize till now, we know brain takes information it is almost digitizes right, in a logarithmic function you can see how the visual thing goes in, integrates, distributes like in vision if you as it a small signal electro magnet which comes from the retina has it goes deeper in to the brain, the receptive field increases because lot of imagery comes into it, image formation is different. So, integrates and differentiates first it differentiates the external sensation, then later in the deeper integrate (Refer Time: 27:45) to give a composite image parallely distributed hierarchical decision, parley distributed because. So, many inputs have to be integrated. So, it has to be parallel distributed, no brain function really shuts off at any point of time.

Neurons are at rest, but they are always in the readiness and the potential to fire and no point of time. So, when we talk about the physiology and when we talk about the future experiment to study brain, one big problem is all though way I told you how to study brain and all the bit that is all again peripheral a times.

What is the brain at rest, what is the brain at rest basically that is one thing and the biggest problem with studying brain which is specially consciousness is we are trying to study brain with, with brain itself. I will extent within the painting and then trying to studying. The painting that is the biggest hurdle and at least understanding the hire functions, but broadly physical process go in making the mind is (Refer Time: 29:01) clear.

From next week we will try to cover, how a process is work and then network and so on and so forth.

Thank you.