Welcome to the module from the Course Developmental biology. Myself Dr. K. K. Therisa from Dhempe College of Arts and Science, Miramar, Goa. The module is basically related to the previous module that we have learned, ie, biochemical changes during fertilization and this module will be briefing it little furthermore followed by the significance of fertilization.

So the name of the module is Biochemical changes during fertilization Part 2 and the significance of fertilization. The outline of this module consisted of, in the beginning, the metabolic and structural changes during fertilization followed by Gammones in fertilization and the significance of fertilization.
The learning outcome expected at the end of this module is the students will be able to understand various metabolic and structural changes occurring during fertilization.They will be able to know about gamones in fertilization and explain the significance of the process of fertilization.

To start with the module of biochemical changes or fertilization Part 2. As we have already seen in the previous module, there are certain stages involved in the process of fertilization, such as capacitation, acrosome reaction, cortical reaction, etc. And there are a lot of transformations that take place within the egg as far as its metabolic, structural, physiological and biochemical changes are concerned. There is an increase in rate of oxygen intake which has been observed in case of search and reported by Warburg wherein oxygen consumption was found to be increased to five to six times, then the original rate otherwise in case of unfertilised egg there was an increase in protein metabolism as well. It's because of the breakdown of yolk that takes place, which is essential for the synthesis of new components because as the process of fertilization continues and gets over. The cell needs to be ready for the next embryogenic process, called cleavage. There is an increase in the rate of protein synthesis as well in the unfertilised egg. It has been seen that the enzymes remain in an inactive form for protein synthesis and mask the mRNA, but this is remote. As soon as the fertilization takes place there is a completion of reduction division. As we know that the egg before fertilization usually enters into the meiotic division, which is a reductional division, but it remains at a resting phase at a certain point, but this gets resumed and completed as soon as the entry of sperm takes place. Besides, there is a change in the plasma membrane that is its permeability within the plasma membrane increases for certain molecules like water, ethylene glycol, phosphate, calcium, etc. Even changes in physical properties of our egg are concerned, that is, there is a redistribution of the cytoplasmic constituent that takes place as soon as the sperm enters into the egg and this changes the retractability and the permeability. Also, there is a redistribution of the calcium that brings about a change in the viscosity of the cortical cytoplasm. Followed by that is the initiation of cleavage. That means fertilization helps to initiate the mitosis process within the egg, resulting in cleavage. There is a change in overall shape of the egg. First, the Ovum assumes a ball shape in certain species, then finally ends up having a spherical shape. So this is a chart depicting a concise method and the process involved in the process of fertilization, specially pertaining to the egg activation.
So as soon as the sperm binds to the egg and fuse to the egg membrane first and foremost, there is a sodium influx that takes place across the membrane and this leads to the membrane potential change, ultimately leading to the first block to the polyspermy so that no more sperm can enter through this membrane. At the same time, when this sperm binds to the egg membrane, there is a kind of stimulation that is a protein kinase which is released. Which will in turn activate the Phospholipase C and these molecules activate two important molecules, that is, the IP3 production (inositol triphosphate) and the

diacylglycerol production. The diacylglycerol production, in turn, leads to the activation of protein kinase. And this will increase the intracellular pH of the cytoplasm because there is opening of sodium hydrogen exchanger. And then leading to the stimulation of protein synthesis, DNA replication and cytoplasmic movement of morphogenetic material. Before that, there are certain more changes that take place as IP3 production is being activated. This will in turn release the calcium and the amount of calcium influx inside one from the opening where the sperm nucleus enters and the other side the cortical granules exocytosis takes place. And this will in turn lead to the slow block of polyspermy. At the same time, the release of calcium helps in the degradation of cyclin molecules and an inactivation of MAP kinase, thus leading to the restoration of the mitotic cell cycle. Otherwise the DNA was blocked till then. At the same time the calcium release also activates. NAD+ kinase and that will get converted to NAD to NADP and it has been observed that NADP is required for lipid biosynthesis as now the cell will enter further cleavage process. There are a lot of changes that have to take place and have to be involved in membrane biosynthesis as well. The cortical granule exocytosis also helps in the formation of a hyaline layer, which also helps in the block of polyspermy. And ultimately, all this leads to the stimulation of protein synthesis, DNA replication, cytoplasmic movement of the morphogenetic material. So this is what happens during the process of fertilization as far as biochemical and metabolic changes are concerned and which has been studied very well in case of sea urchin eggs.

Coming to the next topic, that is the gamones in fertilization. Gametes of several marine invertebrates and this is more applicable to those animals which leads to external fertilization known to produce certain substances that initiates the processes leading to the fertilization, and these substances are similar to the hormones and hence being referred as Gamones. Gametes produce hormones called Gamones, these are not actually hormones, but there are certain chemicals which are similar to hormones but produced by the gametes. So they are of two kinds, one is Gynogamones and the other one is Androgamones.

The Gynogamones are again of two types and the term itself says gyno means over something related to the female, so the active substances produced by the ova are gynogamones. There are two types, Gynogamone I and Gynogamone II. One is concerned with the activation of the sperm to vigorous swimming movement and increasing the sperm activity. And gynogamone II makes sperm heads sticky and causes agglutination.
So in two modules before this we have learnt that there is chemotaxis and there is a fertilizin- antifertilizin interaction that takes place as this permits sperm to approach the egg and that is because of these molecules.

The Androgamones are the active substances that have been produced by the spermatozoa or the sperm. They are of three types and Androgamones I, II and III. Androgamone One is believed to inhibit excessive sperm movement done to conserve energy until critical time of fertilization. Whereas Androgamones 2 brings about the precipitation of substances of the egg membrane at the time of fertilization. And Androgamones three is believed to affect the Liquifying action on the egg surface, thereby facilitating their entrance. So that was all about the process of fertilization.

Let us move on to the significance of fertilization. The results of fertilization are. First and foremost, activation over the entrance of sperm activates the secondary oocyte to complete its second maturation division. It also induces the movement of cytoplasm and the pigment granules as seen in some of the Organism and marks The fertilization track which is used in the natural method of fate map study. It induces the second centriole to initiate spindle formation as a part of machinery of cell division restoration of diploidy. Because the fact that each gamete has got a single set of chromosome that is haploid, they are haploid and now at the same time as the fertilization takes over and gets over, there is a restoration of diploidy, so restores the diploid number of chromosomes vary in the maternal and paternal genetic traits are combined. There is the introduction of centriole, which is by inducing changes in the periphery of the egg, and this change includes the entry of other sperm. This causes separation of Vitelline membrane, which allows the rotation of egg inside. This enhances the metabolic activities, and this renews the vigor as well as the vitality. The amount of cytoplasm lost due to the separation of polosytes has also been restored. It establishes a new plane of the egg axis. And causes rearrangement and organization of egg cytoplasm into distinct organ forming areas.

This is all about the biochemical changes that take place in fertilization. And also the importance of fertilization and what are the results of fertilization.
At the end these are the references used for preparing this module.

Thank you.