

Fertilisation

- The fusion of the sperm cell nucleus with the egg cell nucleus to produce a zygote

Requirements :

- Gametes - no. of sperm cells should be large
- Liquid medium
- Timing Synchronization - ova and sperm should be available at same time.

External Fertilisation

- large no. of gametes (ova & sperm)
- occurs outside the body of the females
- Increased no. of eggs produced to insure the survival of the species
- Eg Fish and amphibians

Internal Fertilisation

- Occurs inside the body of female
- Fewer no. of eggs are produced
- Increased parental care insures species survival.

Major Events in Fertilisation

- ① Contact and Recognition b/w sperm and Egg
 - ② Acrosome reaction
 - ③ Egg activation
 - ④ Fusion of gametes - amphimixis
- ↳ 2nd & 3rd in case of external fertilisation

Chemotaxis - eggs release certain chemicals which was recognised by specific sperm of that species and move towards the egg acc. to chemical gradient.

- **Acrosome** contains many enzymes (lysozyme) which helps to break the or penetrate the membrane of egg by dissolving the membrane of egg.
- Once the sperm enter the egg, the egg become active and it will prevent polyspermy. When one sperm enter the egg, the membrane of egg will suddenly charged which blocks (fast) the polyspermy. After that slow block takes place in which the cortical granules present in membrane release their content which form a membrane around the egg which is called fertilisation membrane due to which no more sperm will enter.
- Sperm pronuclei - chromosome become loose, so that fusion can take place.

Contact and Recognition :

① chemotaxis:

It has been observed that in numerous species including mollusca, echinoderm etc, the sperm reaches a specific egg by chemotaxis i.e moving along a gradient secreted by the egg.

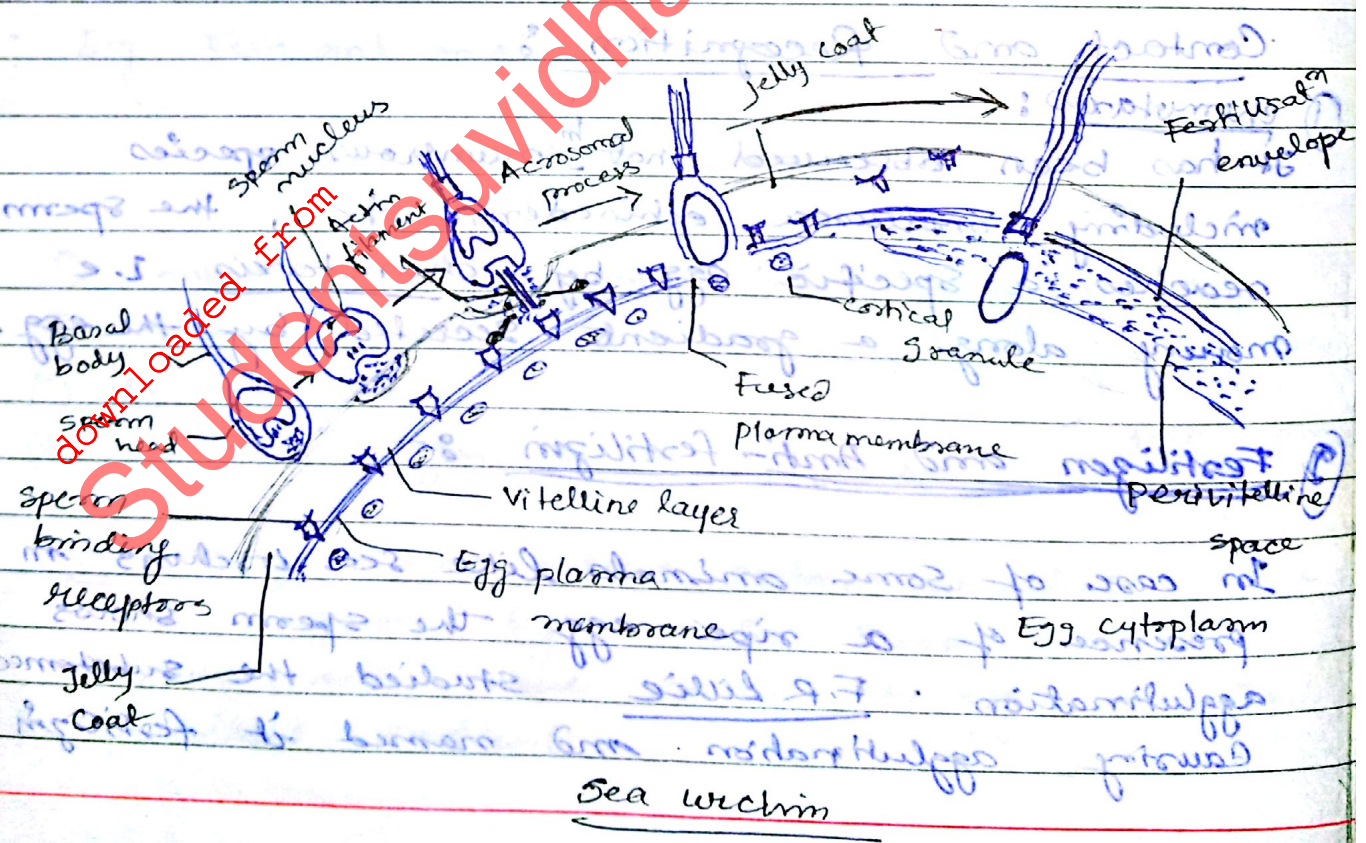
② Fertilizin and Anti-fertilizin :

In case of some animals like sea urchins in presence of a ripe egg the sperm shows agglutination. F.R Lillie studied the substance causing agglutination and named it fertilizin

It is secreted from by the jelly surrounding the egg. Fertilizin is a glycoprotein and differs from species to species. The spermatozoa contains anti-fertilizin. These are small acidic proteins. The fertilizin and anti-fertilizin are highly species specific.

⑤ Acrosome reaction :-

The acrosome reaction is triggered when the sperm meets the egg. The acrosome at the tip of the sperm releases hydrolytic enzymes that digest the material surrounding the egg. In mammals the spermatozoa produced an enzyme called hyaluronidase that dissolves the hyaluronic acid that cements the follicular cells [or cells of corona radiata].



Interaction of the Sperm with egg jelly leads to exocytosis of sperm egg acrosomal vesicles and release of proteolytic enzymes that digest a path through the jelly coat to the egg surface. Acrosome process is formed by the polymerisation of actin filament. The acrosomal reaction is calcium dependent process and the in flow of calcium initiates the process.

In mammals, the zona pellucida binds the sperm.

(3) Egg activation: When the acrosomal filament touches the surface of the egg the cytoplasm of the egg bulges forward at the pt of contact forming fertilisation cone.

(a) Prevention of polyspermy:

Polyspermy can be prevented by -

(a.1) Fast block to polyspermy - Gamete Contact depolarizes the egg cell membrane and sets up fast block of to polyspermy. This block is temporary and lasts for 1 min. It is only seen in certain animals like frog, sea urchin etc but not in human.

(a.2) Slow block to Polyspermy:

Cortical granule rxn is activated 1 min after the sperm egg fusion. Upon sperm entry the cortical granule fuses with the egg cell membrane and release its content in the space b/w cell membrane and vitelline envelope. The mucopolysaccharide of cortical granules created osmotic pressure and water collects b/w the cell membrane and vitelline envelope. The fertilisation envelope is

formed beneath the vitelline envelope and prevent polyspermy.

In case of mammal, released enzyme modify the zona pellucida sperm binding ~~sperm~~ receptors so that they can no longer bind sperm. Ca plays an important role in cortical granule ~~me~~ Ca^{2+} . The \uparrow in intracellular Ca cause the cortical granule membrane. Thus, releasing its content. This Ca is released from ER

- a) Fertilization cone
- b) Block to polyspermy
- c) \uparrow in metabolism

Fertilisation results in a series of metabolic re^{n} . $NADP^{+}$ is formed and this can be used for lipid biosynthesis required for new cell membrane during cleavage. Also entry of sperm is responsible for egg entry into the cell cycle again. Synthesis of DNA and protein takes place.

\Rightarrow Fusion of genetic material known as amphimixis. Once inside the male gametes decondensed to form male pronucleus. The nuclear envelope vacillate into small packet exposing the compact sperm chromatin. The histones are loosen which leads to decondensation of chromatin. The male pronucleus turns 180° so that sperm centriole is b/w the sperm pronucleus and egg pronucleus. The centriole act as microtubule organising centre. These microtubule extend throughout the egg and brings 2 pronuclei close when the fusion takes place b/w the diploid zygote