FERTILIZATION AND DEVELOPMENT

1. Fertilization

- In rabbit, ovulation occurs **8-10 hrs after copulation**. During ovulation, ovum is in the form of secondary oocyte. Secondary oocytes discharged into the body cavity reach the Fallopian tube through the oviducal funnel.
- Sperms discharged in the vagina during copulation also reach the fallopian tube, where fertilization takes place.
- After the entrance of the sperm, secondary oocyte undergoes **second maturation division** *(i.e.,* meiosis II).
- When an actively motile sperm reaches the secondary oocyte, it makes its way through corona radiata and zona pellucida.
- In this process, the enzyme **hyaluronidase** present in acrosome of sperm, plays an important role. Though several sperms penetrate through the zona pellucida into the perivitelline space, actually one sperm enters the ovum.
- In rabbit, entire sperm enters the ovum. But soon tail degenerates.
- By this time, a second polar body comes out from the secondary oocyte. Now the nucleus of sperm (**male pronucleus**) and the nuclues of ovum (**female pronucleus**) fuse (amphimixis) with one another and form a **zygote nucleus**.
- The ovum is then called **egg** or **zygote**. [In rabbit, amphimixis occurs 20 to 30 hours after copulation]. Corona radiata disappears after feritilization.
- The egg passes down and reaches the uterus and undergoes further development.

2. Development

a) Cleavages

- Egg of rabbit is spherical, minute and contains negligible amount of yolk. Hence the egg is described as microlecithal egg (Kent 1969 described it as alecithal egg). Due to the presence of negligible amount of yolk, the cleavages are of **holoblastic type**.

The first cleavage is meridional and two blastomeres are formed. During second cleavage, which is meridional at right-angles to the first cleavage.

- In this cleavage four cells are formed.
- Third cleavage is horizontal. Eight blastomeres are formed.
- From then, cleavages are irregular and a small pinhead sized ball of cells is formed, called **morula**.

b) Morula

- Morula is a solid mass of cells in which some cells are superficial and others lie inside. During the development, superficial cells form the **trophoblast** that gives rise to most of the extra embryonic trophectoderm.
- They serve to attach the embryo to the uterine wall. The inner cell mass (of larger polyhedral cells) constitute **formative cells**, from which the embryo develops.
- The cells of the trophoblast above the region of formative cells are called **cells of Rauber**.

c) Blastocyst

- Crevices appears between the formative cell mass and cells of trophoblast. They unite with one another and form a **cavity**.
- This cavity is filled with fluid absorbed from the uterine cavity. The cavity enlarges and lifts the trophoblast from the inner cell mass.
- But still the inner cell mass remains attached on one side, which forms the embryonic pole.
- Now the embryo is called **blastocyst**, which is not similar to the blastula of other animals.

d) Implantation

- The zona pellucida present around blastocyst gradually disappears and the cells of trophoblast come in direct contact with uterine epithelium *(i.e.,* endometrium).
- The trophoblast cells aggressively invade the uterine tissue till maternal blood vessels are reached and breached.
- This process of intimate attachment of embryo with uterine wall is called implantation. Implanted embryo gets nourishment from the uterine wall.
- After implantation the uterine endometrium undergoes changes to become **deciduas]**
- The deciduas between embryo and uterine myometrium is **deciduas basalis**
- Deciduas between embryo and lumen of uterus is called **decidua capsularis**
- Decidua other than the site of implantation is **deciduas parietalis**

e) Discoblastula

- From the lower aspect of inner cell mass, some cells get separated (by **delamination**) and eventually form a layer of cells on the surface of the inner cell mass.
- This cell layer develops into **endoderm or hypoblast**. The remaining part of the inner, cell mass is called the **epiblast**.

- The fully developed blastocyst is disc shaped and hence, it is called **discoblastula**. Soon, cells of Rauber disappear exposing the blastodisc.
- The cells of hypoblast increase in number and spread along the inner surface of the trophoblast.
- The hypoblast finally encloses a cavity which is similar to the yolk sac of reptilian and avian embryos. But in rabbit, it is not filled with yolk.
- Meanwhile, the inner cell mass, after emigration of hypoblast cells, become regularly arranged and form an **embryonic disc**.
- The thickness of embryonic disc increases towards the caudal end. Gradually the embryonic disc becomes oval.
- Along the long axis of the embryonic disc, a **primitive streak** is formed, which is very short.
- A longitudinal furrow known as the **primitive groove** forms along the middle of the primitive streak.
- On either side of it are primitive folds. Anteriorly primitive streak has a shallow **primitive pit**.
- Anterior part of it bears a **primitive knot** or **Hensen's node**.

f) Gastrulation : Endoderm, mesoderm notochord and nerve chord formation

- The mesodermal cells converge towards primitive folds, involute through the primitive groove and reach between epiblast (trophoblast) and hypoblast.
- Some mesodermal cells converge towards Hensen's node, involute and extend anteriorly as **notochordal rudiment**.
- With the formation of notochord, mesoderm and endoderm, the surface layer of embryo is described as ectoderm.
- The neural ectodermal cells converge towards Hensen's node and form a **neural plate** externally (above the notochordal rudiment), which develops into a neural tube.

Coelom formation :

- After involution of mesoderm, primitive streak shirks. The mesoderm spreads in all directions between outer ectoderm and inner endoderm. The part of mesoderm that lies beneath the embryonic disc is called **embryonic mesoderm** and the mesoderm that lies beyond it, is called **extra embryonic mesoderm.**
- From the mesoderm - dermis, skeleton, muscles etc., are formed. The mesoderm splits into outer somatic layer and inner splanchnic layer. Coelom is formed between these two layers.
- The part of coelom, beneath the embryonic disc is called embryonic coelom, which gives rise to circulatory system, peritoneal cavities etc.
- The part of coelom outside the disc is extra embryonic coelom. The part of primitive gut enclosed within the embryo forms fore gut and hind gut. Mid gut still opens into the yolk sac.

g) Extra embryonic membranes

- From the exposed blastodisc, amniotic folds develop and form an **amnion** and enclose the embryo. The outer walls of amniotic folds become **chorion.**
- Amniotic cavity is filled with amnitoic fluid, which acts as a shock absorber, prevent desication and malformations.
- From the hind gut, **allontois** is formed. It stores the waste materials. Allantois and chorion are fused to form **chorio-allantoic membrane.**
- **Yolk** sac encloses a fluid filled cavity. It has no nutritive role.

3. Placenta

- The **chorio allantoic membrane** and uterine **endometrium** are intimately associated and form a bridge, known as placenta.
- Through the placenta exchange of materials takes place between mother and embryo and vice versa. At the time of birth the young one is still attached to the uterus of mother by an umbilical cord.

4. Gestation

- The period of intra uterine development is known as gestation period. At the end of gestation a miniature of adult *(i.e.,* young animal) is born. The process of birth is known as **parturition.** Gestation period in rabbit is about 30 days.