Internal Fertilization
• **Fertilization** which takes place inside the female body is called *internal fertilization* (The union of the gametes within the female body after insemination)

• Occurs in the widest part of the fallopian tube (*Ampulla*)

• Sperms may remain viable in the female reproductive tract for several days, while the egg remains only for 24 hours
Oocyte Transport

1. Shortly before ovulation, fimbriae of the uterine tube sweep over the surface of the ovary.
2. The oocyte surrounded by some granulosa cells (corona radiata) is carried into the tube by these sweeping movements of the fimbriae and by motion of cilia of the epithelial lining.
3. Once in the tube, cumulus cell withdraw their cytoplasmic processes from the zona pellucida and lose contact with the oocyte.
Sperm structures & Movement

- acrosomal vesicle
- midpiece
- plasma membrane
- nucleus
- mitochondria
- flagellum

Head

Tail
Sperms Movement from vagina to the Ampulla

• 1. About 300 million of sperms are ejaculated in the vagina.
• 2. Only 1% of sperm deposited in the vagina enter the cervix.
• 3. Movement of sperm from the cervix to the uterine tube (fallopian tube) occurs primarily by their own propulsion and may assisted by the movement of fluids created by uterine cilia and the contraction of uterine muscles.
• (the trip from cervix to oviduct requires 2-7 hours)
4. Sperms after reaching the **Isthmus** become less motile and cease their migration.

5. At ovulation, sperm again become motile, because of **chemoattractants** produced by cumulus cells surrounding the egg. **Thermotaxis** as a result of difference between the temperature in the isthmus and around the egg makes sperm to swim to the ampulla, where fertilization usually occur.
Sperm Capacitation

• During the sperm trip from vagina up to ampulla, changes must occur in the sperm make it able to fertilize the egg.

• **What are these changes?**

• Glycoprotein coat and seminal plasma proteins are removed from the plasma membrane that overlies the acrosomal region of the sperm.

• **Result:** exposing the ligand (Galactosyl -transferase) in the acrosome that will bind specifically with N-acetylglucoseamine in the zona pellucida of the oocyte.
• Now, sperms that reached ampulla surrounding the egg are almost capacitated.

• Number of sperms equals about 300-500, only one will fuse with the secondary oocyte
Phases of Fertilization
Phase 1: Penetration of the Corona Radiata
Phase 2: Penetration of the zona pellucida

- The zona is constructed from three types of glycoproteins (ZP1, ZP2 and ZP3).
- The head of the sperm binds specifically with ZP3:
  - Galactosyltransferase in the acrosome binds with N-acetylglucosamine in ZP3.
- **Result**: Acrosomal reaction (rupturing the acrosome and releasing of acrosomal enzymes (acrosin) digesting a path ahead of the sperm.
Phase 3: Fusion Cell of the Oocyte & sperm Membranes

• The sperm contacts the egg not at its tip (as in the case of sea urchins), but on the side of the sperm head (tangentially).

• Integrins on the oocyte membrane binds specifically with disintegrins ligands on the sperm membrane.

• **Result**: Fusion of the two membranes. Both the head and tail of the sperm enter the cytoplasm of the oocyte, but the plasma membrane is left behind on the oocyte surface.
As soon as the sperm has entered the egg, it will respond in the following ways

- 1. Cortical and zona reaction.
- 2. Resumption of the second meiotic division:
  - Once the sperm nucleus entered the oocyte cytoplasm, its DNA will be uncoiled by Glutathione, the DNA replication begins.
- At the same time the nucleus of the oocyte will complete the second meiotic division, the DNA replication begins.
3. Egg activation

4. First cleavage occurs after 30 hours of the beginning of fertilization producing the two cell stage (two blastomeres)
Two-cell stage of human zygote
Comparison between fertilization in Sea urchin & Human