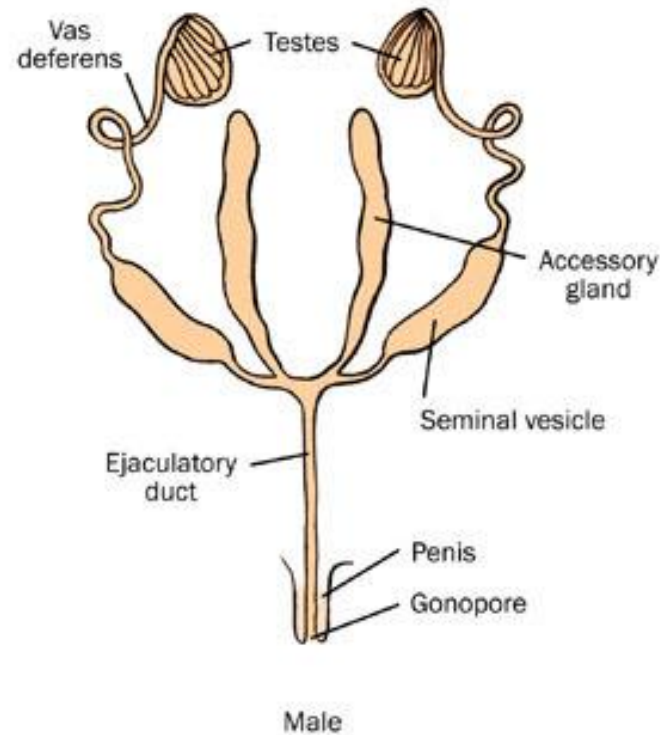
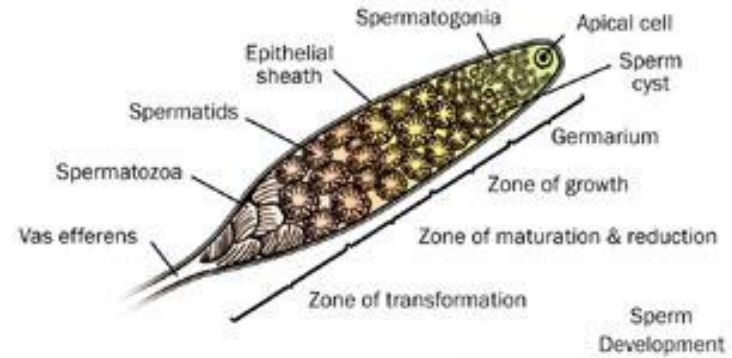
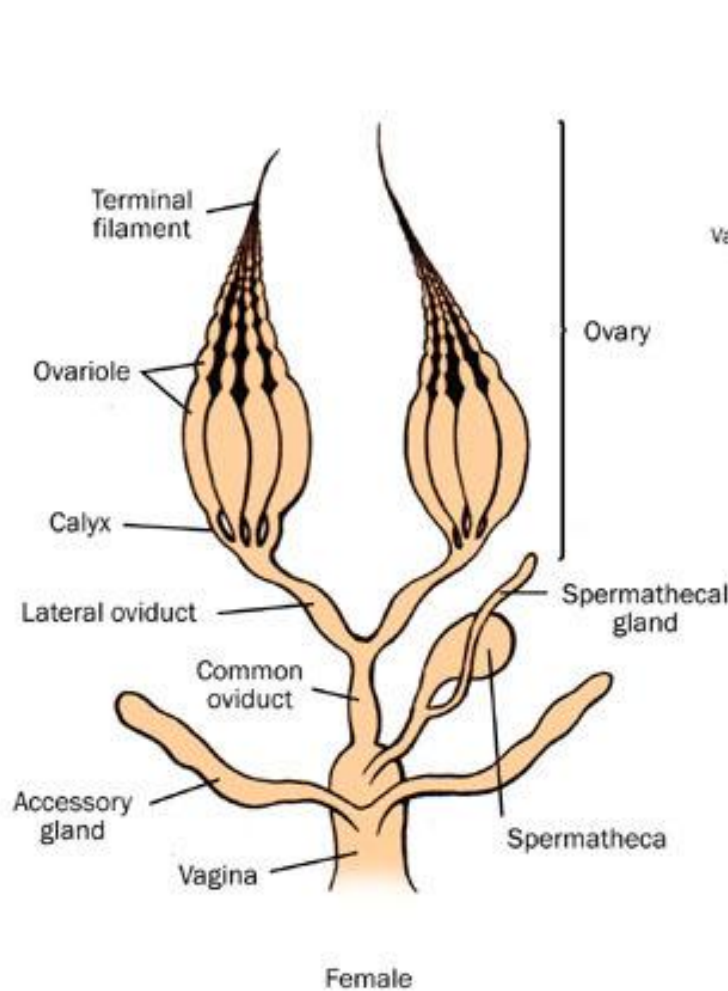


Insect Reproductive System



- Insects are bisexual. But also occurs by **Parthenogenesis and hermaphroditism**
- The reproductive system is divided in to **internal and external genitalia**
- internal genitalia serve to the **development of germ cells**
- external genitalia **accomplish the mating** and enable **female to deposit eggs**

Female reproductive system:

Ovaries :

- present on the **either side of alimentary canal**
- connected to body wall by **suspensory ligaments**
- covered with fat body and **trachea**
- consists of a no of **ovarioles or egg tubes**

Ovarioles:

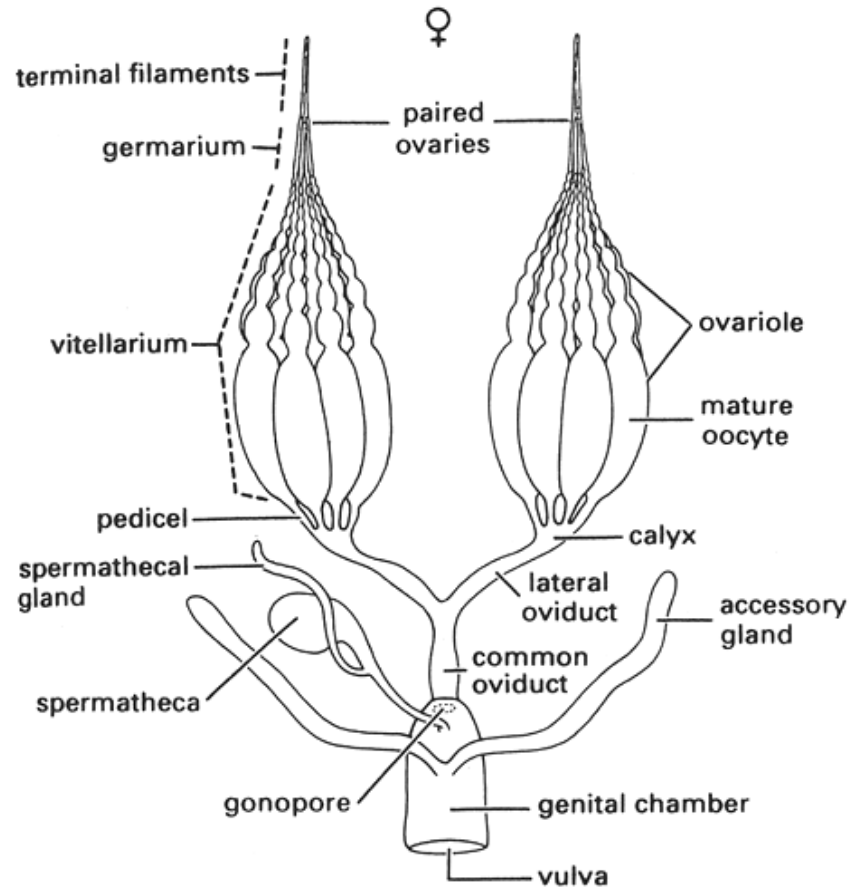
- enveloped by a double layered cellular wall
- **outer ovarian sheath** with supply of tracheae
- The inner layer is **elastic tunica propria**
- Terminal filaments unites to form **suspensory ligament**
- ligament is attached to body wall or dorsal diaphragm
- The eggs are discharged in to the lateral oviducts

Number of ovarioles in an ovary varies, usually 4 to 8. In Isoptera more than 2000

Typical ovariole or egg tube consists of 3 parts namely

1. Terminal filament
2. Egg tube
3. Supporting stalk or pedicel

The Egg tube is divided in to two parts



Germarium /egg chamber-

contain the **primordial germ cells**

These cells give rise to three types of cells

1. Germ cells developing in to oogonia and finally oocytes
2. Nutritive cells or nurse cells or trophocytes
3. Follicle cells

Vitellarium or Zone of growth-

- Contains large number of oocytes and eggs in different stages of development
- In the anterior, the nurse cells and oocytes remain mixed at centre , follicle at periphery
- In posterior end oocytes are enclosed by follicle cells to form follicular layer
- nurse cells absorb nutrients from haemolymph through follicular cells and transmit to oocytes
- In some case follicle cells provide nutrients to the oocytes where nurse cells are absent

Types of ovarioles :

Based on the presence or absence of nutritive cells and their location

1. **Panoistic:** nutritive cells are absent and oocytes develop by follicular cells

e.g.: Odonata, Dictyoptera, Orthoptera and Ephemeroptera

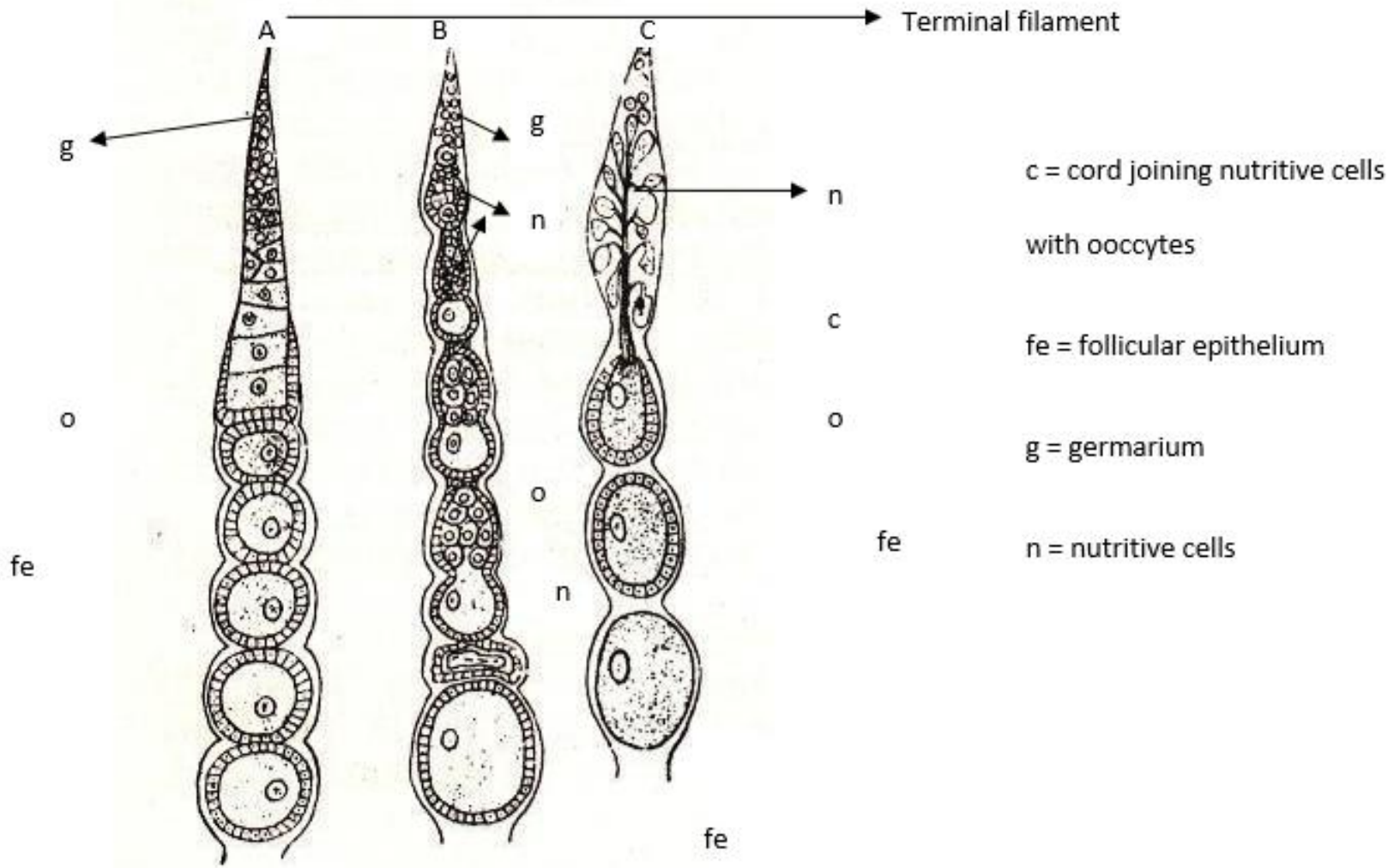
2. **Meriostic:** They contain trophocytes / nutritive cells

Based on the position of trophocytes

- (i) **Polytrophic:** oocyte and trophocytes arranged alternatively in vitellarium

e.g.: Mecoptera, Dermaptera, Psocoptera

- (ii) **Acrotrophic /teletrophic:** trophocytes are present in the germarium (apex) and connected with developing oocytes by cytoplasmic strands e.g.: Hemiptera and Coleoptera



A = Panoistic; B = Polytrophic; C = Acrotrophic

Lateral oviducts:

- Proximal end of all ovarioles join forms lateral oviduct
- The wall of oviduct is glandular and muscular

Median Oviduct:

- Two lateral oviducts combine to form a median oviduct

Vagina:

- median oviduct opens in to a **tubular vagina**
- formed by invagination of **bodywall from VIII segment**
- opens outside and the opening is called **vulva**
- **receive the sperms and discharge the eggs**

Bursa Copulatrix:

- **vagina develops a separate pouch** called Bursa Copulatrix
- It has two reproductive openings,
vulva for receiving the sperms open on VIII sternum
ovipore or gonopore on IX segment for egg discharge

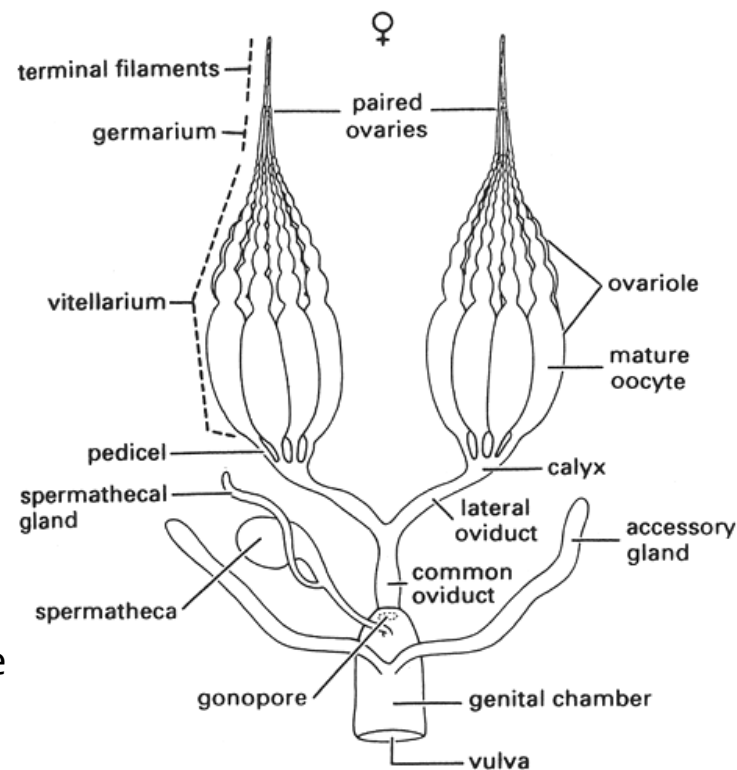
Eg: Lepidoptera and water beetles

Spermathea:

- opens in to vagina through spermathecal duct
- used for storing the sperms
- also produces some fluids responsible for longevity of cells

Accessory glands:

- a pair of collateral glands which open in to the distal portion of vagina
- secrete the substance responsible for the formation of ootheca of cockroach, preying mantid
- poisonous secretions in case of Hymenoptera
- This sticky substances are useful for attachment of egg to the substrate



Male reproductive system

Testis :

- lie above the gut and connected to the body wall through translucent ducts
- consists of number of oval shaped follicles covered by a peritoneal membrane
- testis is completely enveloped within a scrotum

Structure of follicle

divided into a series of zones by the presence of the sperms in different stages of development

- (i) Germarium :** contains spermatogonia which undergo multiplication
- (ii) Zone of growth:** spermatogonia increase in size with mitosis and form **spermatocytes**
- (iii) Zone of division:** spermatocytes undergo meiosis and give rise to **spermatids**
- (iv) Zone of transformation :** spermatids get transformed in to **spermatozoa**

Spermatozoa enclosed in testicular cyst cells from which they are released in to vasa efferens

2. Vasa deferens : formed by the union of vasa efferens receives the sperms from testis and allow their transport to the ejaculatory duct

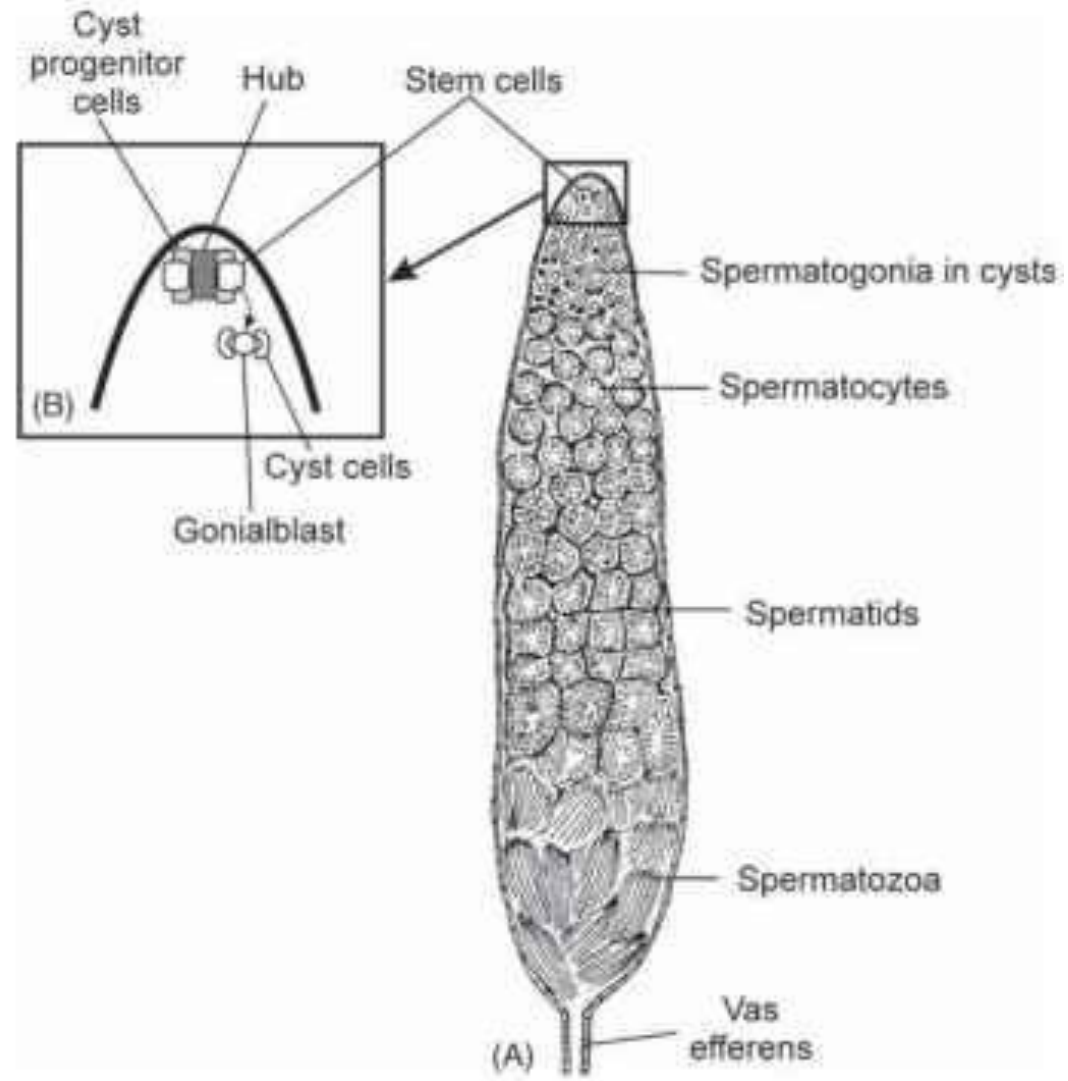
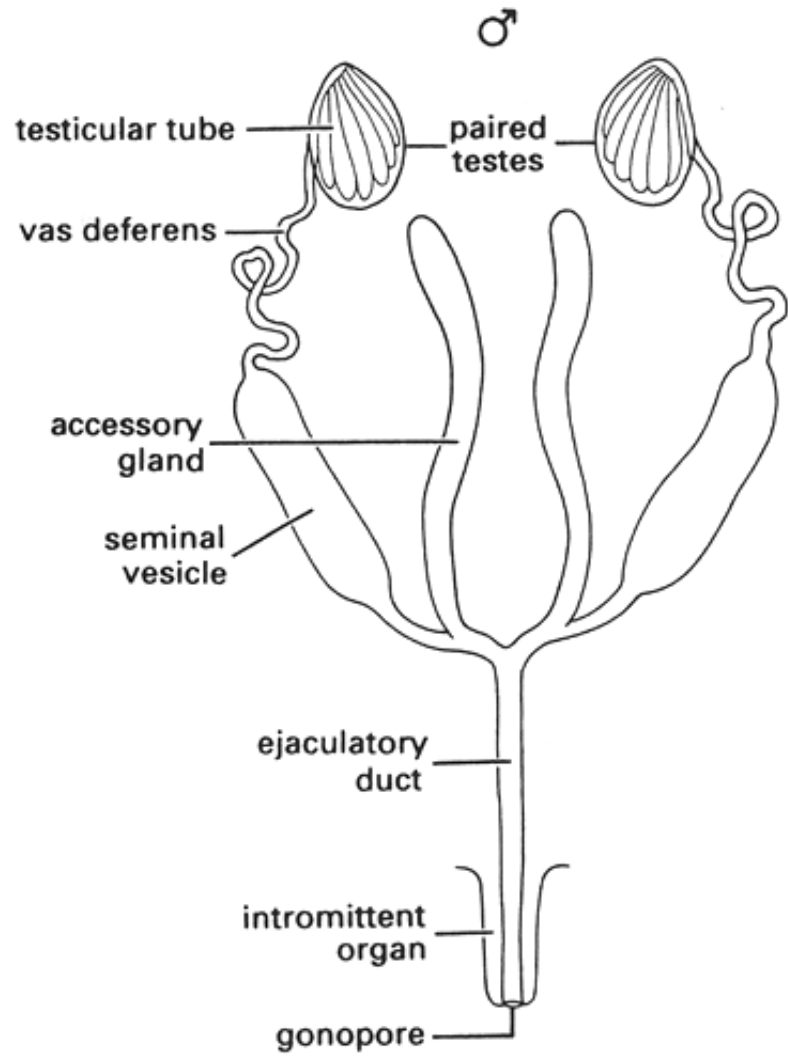
3. Seminal vesicles: vasa deferens enlarge posteriorly into a sac for storage of spermatozoa

4. Ejaculatory duct: formed by the union of both the vasa deferens posteriorly terminal section of ejaculatory duct is enclosed in a **male copulatory organ or aedeagus or penis**

5. Accessory glands: 1-3 pairs of glands open in to the ejaculatory duct

Their secretion facilitates sperm transmission from male to female

Mushroom glands in cockroaches and mantids as appear mushrooms



Types of Reproduction

1. Oviparity : reproduce by laying eggs by the female which later hatch and produce young ones
e.g.: moths and butterflies

2. Viviparity : female gives birth to the young ones instead of laying eggs

It is of 4 types based on the source of nourishment-

Ovo-viviparity: retain the eggs within the genital track and immediately after hatching , the young ones will be released outside **e.g.: Thysanoptera**

Adenoparous: eggs have sufficient yolk, and young ones nourished from milk glands

young ones after release pupates immediately without feeding **e.g.: Glossina pupipara of Diptera**

Pseudoplacental : eggs with little (or) no yolk and nourishment is through **pseudoplacenta**

e.g.: Psocoptera, Dermaptera, aphids etc.

Haemocoelous: nourishment of young one takes place from the haemolymph of mother

young one comes out either through genital canal or by the rupture in the walls of the parent

Eggs have a **trophic membrane** through which nutrients are supplied from the **maternal tissues**

e.g: strepsipterans & some larvae of cecidomyids (Diptera)

3. Parthenogenesis :

ability of the females to reproduce without fertilization / copulation with males

occurs due to the **genetic characters, heredity, failure in finding a mate, hormonal changes** within the body and **weather factors**

This parthenogenesis is classified as

Sporadic: occurs occasionally **e.g.:** silkworm

Constant : occurs regularly **e.g.:** thrips

Cyclic : it is nothing but the alternation of generations **e.g.:** aphids

II. Based on the sexes of the off springs produced, parthenogenesis can be

Arrhenotoky : only males are produced **e.g.:** Hymenoptera

Thelytoky : only females are produced **e.g.:** acridids

Amphytoky : both females and males are produced **e.g.:** hymenopterans

4. Paedogenesis (or) Neoteny : the immature insects or stages give birth to young ones

This usually occurs due to the hormonal imbalance

insects reproduce by paedogenesis also reproduce by parthenogenesis **e.g.: cecidomyids**

5. Polyembryony: Insects reproduce by giving birth to two or more young ones instead of a single one, as two or more embryos are produced from a single egg

e.g.: endo parasitic Hymenoptera like platygaster

6. Hermaphroditism : both male and female gonads are present in the same individual may be functional as in **Icerya purchasi** (or) non functional as in of **stonefly, Perla marginata**

7. Castration : The separation of the individuals occurs mainly due to the development of the reproductive organs

The insects with well developed ovaries develop in to females (queens)

the insects with well developed testis develop in to males (drones)

insects with underdeveloped ovaries develop in to workers **e.g.: honey bees**

8. Alternation of generation : Insects reproduce by parthenogenesis and bisexual reproduction

e.g.: aphids reproduce by parthenogenesis in summer and sexual reproduction in winter