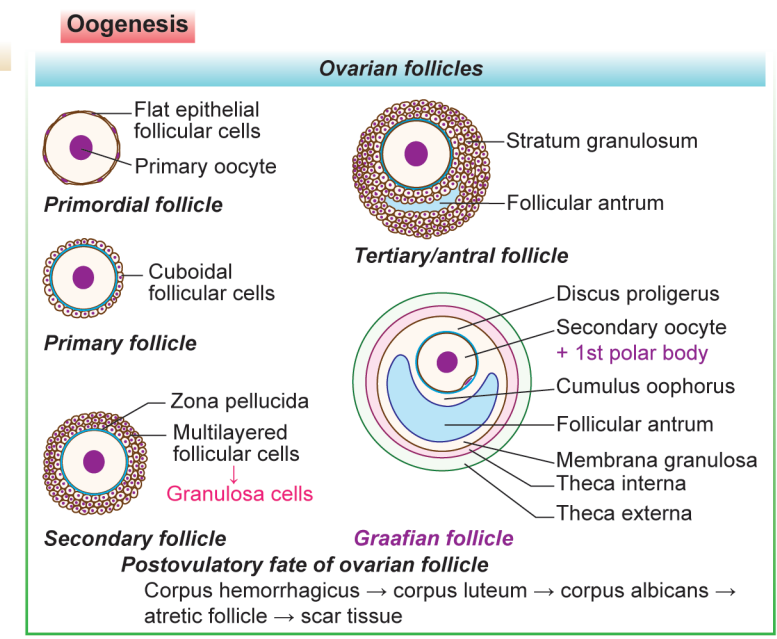
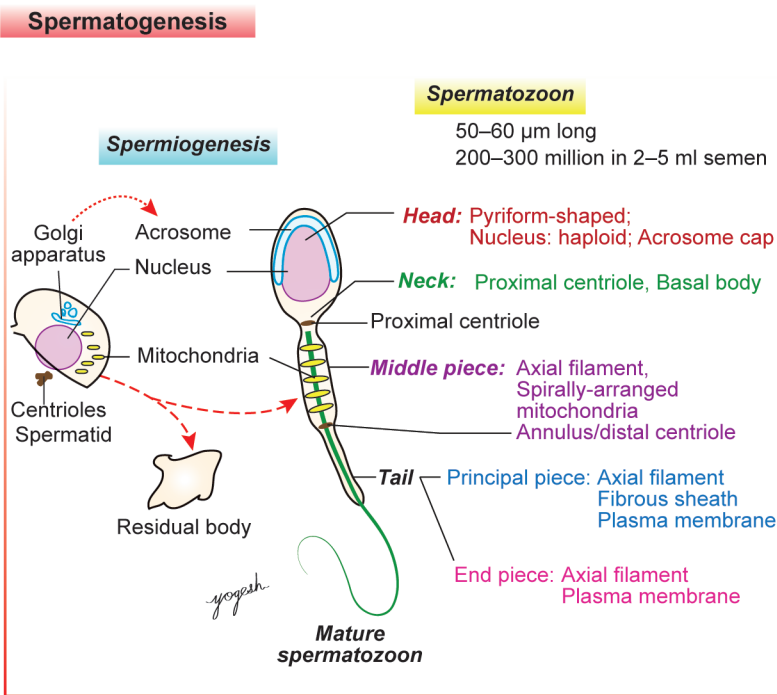
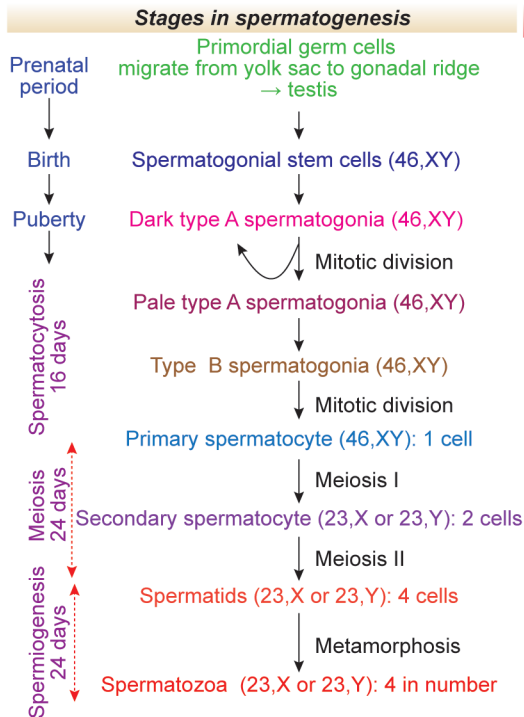
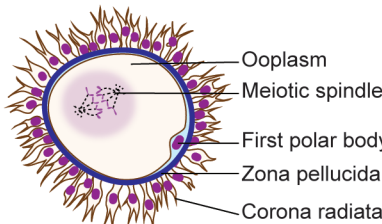


MindMap 1: Gametogenesis



Structure of ovum



Tests for ovulation

1. Calendar method
2. Basal body temperature (falls 0.3°–0.5°C) just before the ovulation
3. Spinnbarkeit cervical mucus method
4. Hormonal estimation (LH surge)
5. Ultrasonography monitoring
6. Mittelschmerz (short-lived lower abdominal, mid-cycle pain)
7. Endometrial biopsy

Q.1. Explain: “Mature ovum” is somewhat of a misnomer.

Answer: During ovulation, the secondary oocyte enters meiosis II but it is arrested at metaphase. This arrest persists until fertilization, when a sperm penetrates the oocyte, triggering the completion of meiosis II. Therefore, the term “mature ovum” is somewhat misnomer, as fertilization involves a secondary oocyte rather than a fully developed ovum. In the absence of fertilization, the secondary oocyte undergoes degeneration.

Note: The mitochondrial DNA of all human adult cells is of maternal origin only.

The **prochordal plate** is a circular, midline thickening of hypoblast cells that are firmly attached to the overlying epiblast cells. The plate develops into a membrane called the oropharyngeal membrane.

Chordoma (CD) is a benign or malignant tumor that arises from remnants of the notochord. It may be found either intracranially or in the sacral region and occurs more commonly in men, late in adult life (age 50 years).

The most common of all cardiac congenital malformations seen clinically are membranous ventricular septal defects.

The most common *atrial septal defect* is foramen secundum defect, which is caused by excessive resorption of the septum primum or the septum secundum.

Q.2. Explain: hCG is useful for detection of pregnancy.

Answer: Human chorionic gonadotropin (hCG), a glycoprotein from the syncytiotrophoblast, supports progesterone production essential for pregnancy maintenance. It becomes detectable in maternal blood by day 8 and urine by day 10, forming the basis of pregnancy tests. Persisting throughout pregnancy, low hCG levels may suggest miscarriage or ectopic pregnancy, while elevated levels could indicate multiple gestation, a hydatidiform mole, or gestational trophoblastic disease, necessitating further evaluation.

Q.3. Explain the competence to respond as part of the process of induction with two examples.

Answer: “Competence to respond” in induction refers to a target tissue’s ability to react to an inducing signal from another tissue. This requires the presence of specific receptors and intracellular pathways.

The most commonly involved tissues are the ectoderm and mesoderm.

Examples:

- Notochord inducing the overlying ectoderm to form the neural plate
- Apical ectodermal ridge (AER) inducing limb mesenchyme differentiation.

Q.4. What is the most common example of a clinical syndrome involving abnormal numbers of chromosomes? What is the most common cause of abnormal chromosome number?

Answer: The most common clinical syndrome involving abnormal chromosome numbers is **Down syndrome** or trisomy 21. The most frequent cause of an abnormal chromosome number is **non-disjunction**, a process where chromosomes fail to separate properly during cell division, leading to cells with an abnormal number of chromosomes. This typically occurs with increasing maternal age.

Q.5. A 32-year-old woman with a history of multiple episodes of pelvic inflammatory disease (PID) presented with infertility despite trying to conceive for two years. She reported chronic pelvic pain and irregular menstrual cycles. What is likely to be the cause of infertility in this case? Which investigation is useful for its detection?

Answer: Multiple episodes of pelvic inflammatory disease (PID) resulted in bilateral fallopian tube obstruction. This can be detected using hysterosalpingography.

Q.6. Explain: The second week of development is often called the “Week of Twos”.

Answer: It is due to the formation of several paired structures. These include:

- Embryoblast differentiates into two layers:
 - Epiblast
 - Hypoblast
- Trophoblast differentiates into two layers:
 - Cytotrophoblast
 - Syncytiotrophoblast
- Two cavities:
 - Amniotic cavity
 - Yolk sac
- Extraembryonic mesoderm splits into two layers:
 - Somatic (parietal) layer
 - Splanchnic (visceral) layer
- Two components of the placenta begin forming:
 - Chorionic cavity (formed by extraembryonic mesoderm)
 - Primary chorionic villi (early placental structures)

1. During *in vitro* fertilization, a sperm is used to fertilize an ovum. A cell from resultant morula showed a normal female karyotype. Which of the following chromosome compositions was present in the sperm in this case?

- a. 23 autosomes and X chromosome
- b. 23 autosomes and Y chromosome
- c. 22 autosomes and X chromosome
- d. 22 autosomes and Y chromosome

2. A student while discussing cell division and gametogenesis came across the fact that one of the female gametes which is formed in 5th week of intrauterine life remains dormant until puberty or even up to the age of 40 years. Which of the following cells has this property?

- a. Primordial germ cell
- b. Primary oocyte
- c. Secondary oocyte
- d. First polar body

3. Approximately _____ millions of sperm are ejaculated by a normal fertile male during sexual intercourse.

- a. 50
- b. 150
- c. 350
- d. 750

4. A normal young woman enters puberty with approximately 40,000 primary oocytes in her ovary. If it is planned to use each of the ovulated primary oocytes over the entire reproductive life of the woman to be utilized for *in vitro* fertilization, how many primary oocytes will be ovulated?

- a. 10–50
- b. 400–500
- c. 1000–10000
- d. Can not be predicted

5. A 19-year-old female reported presents to the emergency department with acute right-sided lower abdominal pain and clinical signs of intraperitoneal hemorrhage. Her history reveals unprotected sexual activity and amenorrhea. The treating physician suggested ultrasonography and β -hCG testing for accurate diagnosis. Based on the clinical presentation, which of the following may be the diagnosis?

- a. Normal pregnancy
- b. Ruptured tubal pregnancy
- c. Ovarian tumor
- d. Appendicitis

6. In the *in vitro* fertilization lab, individual blastomeres were isolated from a blastula at the 8-cell stage. Out

of these, 2 blastomeres were cultured *in vitro* to the blastocyst stage and individually implanted into two different surrogate mothers. Which of the following would you expect as outcomes of these pregnancies with all medical care?

- a. Birth of no baby
- b. Birth of one baby
- c. Birth of two genetically different babies
- d. Birth of two genetically identical babies

7. After fertilization, when does the blastocyst begin implantation?

- a. By day 1
- b. By day 7
- c. By day 11
- d. By day 21

8. All of the following are the components of the definitive chorion, EXCEPT:

- a. Syncytiotrophoblast
- b. Cytotrophoblast
- c. Decidua basalis
- d. Extraembryonic somatic mesoderm

9. A 19-year-old girl consulted the physician. She experienced sexual intercourse for the first time, without using any means of birth control 8 days back. Which of the following tests the physician should do to alleviate her fear?

- a. Serum hCG
- b. Urine hCG
- c. Ultrasound examination
- d. Karyotyping

10. A 42-year-old woman reported with severe headaches, blurred vision, slurred speech, and difficulty with coordination. She had a hydatidiform mole five years ago, and her present lab results showed elevated hCG levels. Which of the following conditions is a probable diagnosis?

- a. Missed abortion
- b. Placenta previa
- c. Choriocarcinoma
- d. Ectopic pregnancy

11. Which of the following is the first indication of gastrulation in the embryo?

- a. Formation of the primitive streak
- b. Formation of the notochord
- c. Formation of the neural tube
- d. Formation of prechordal plate

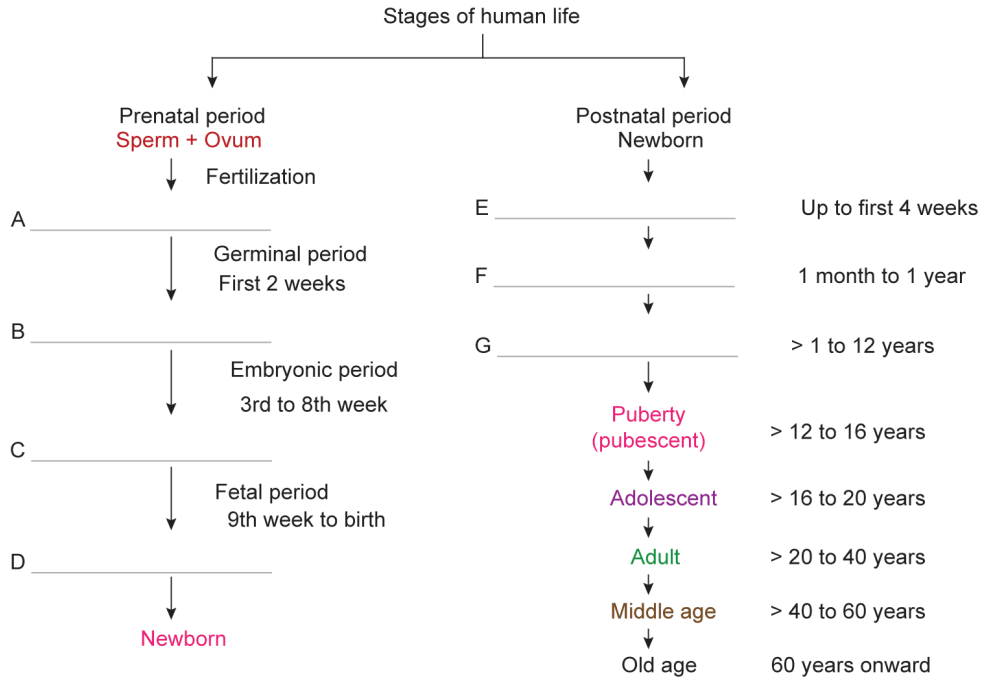


Fig. 1: Stages of human life

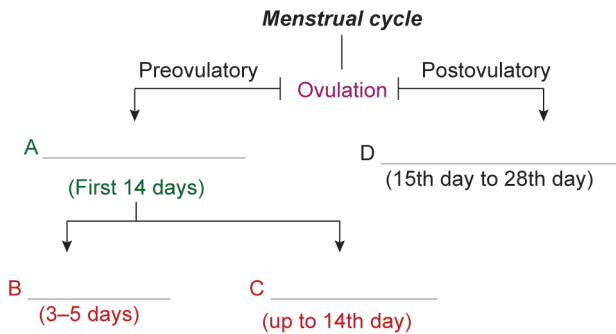


Fig. 2: Phases of menstrual cycle

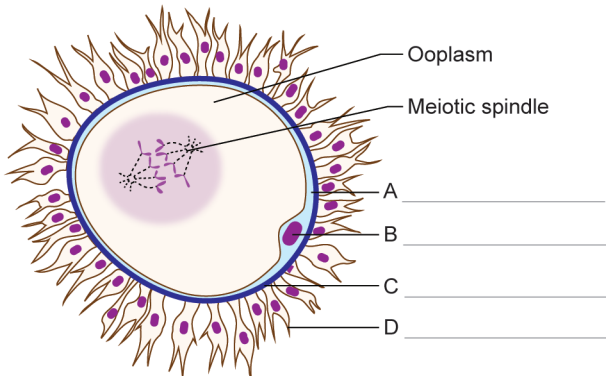


Fig. 3: Structure of ovum

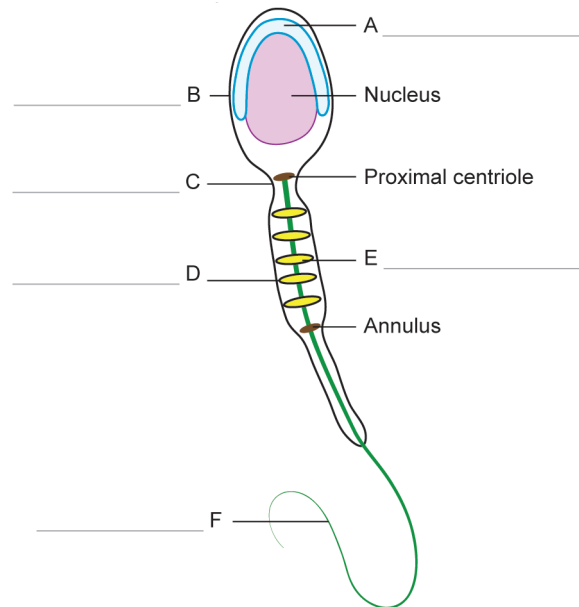


Fig. 4: Structure of sperm

Spermiogenesis is the process of metamorphosis of spermatids by which they get converted into a spermatozoon.

Capacitation is a process of conversion of immature spermatozoa to mature spermatozoa.

Oogenesis is a process of formation of a mature ovum from primordial germ cells.

Ovulation is a process of release of ovum from Graafian follicle. It takes place 14 days prior to onset of next menstrual bleeding.