EMBRYONIC DEVELOPMENT

INTRODUCTION

All events which change a zygote or a blastos (a reproductive unit in asexual reproduction *e.g.*, whole organism *e.g. Amoeba*, a bud *e.g. Hydra*, or a body fragment *e.g.* sea anemone) into a fully developed organism is called development. The entire process of development, which passes through embryo formation is called embryogenesis. Von Baer is commonly called "The father of modern embryology."

12.1 EMBRYONIC DEVELOPMENT

It includes a definite series of phases which are fundamentally similar in all sexually reproducing organisms and transform a one-celled zygote to a multicellular and fully formed development stage till hatching or birth. It is divided into following types.

(i) **Pre natal or embryonic period :** It is the period of development from the diploid one-celled zygote to a multicellular embryo. It occurs either inside the egg or mother's womb and extends upto hatching or birth. The study of the changes during this period is called embryology.

(ii) **Post natal or post embryonic period :** It is the period of development which extend from hatching or birth to death. The branch of science which deals with the study of progressive, orderly and gradual changes in structure and functioning of organism during entire life history from zygote or blastos to death, is called development biology.

12.2 PHASES OF EMBRYONIC DEVELOPMENT

Embryonic development involves following dynamic changes and identifiable process.

(i) **Gametogenesis :** It involve the formation of haploid sex cells or gametes called sperms and ova from diploid primary germ cells called gametogonia present in the reproductive organs called gonads (testes and ovary). It is of two types

(a) **Spermatogenesis :** Formation of sperm. (b) **Oogenesis :** Formation of ova

Note : ❑ (See detail in module-2 Chapter-Reproduction)

(ii) **Fertilization :** It involve the fusion of haploid male and female gametes to form diploid zygote. The fusion of gametic pronuclei is called Karyogamy while the mixing of two sets of chromosomes of two gametes is called amphimixis.

(iii) **Cleavage :** It includes the rapid mitotic division of the zygote to form a single layered hollow spherical larva called blastula and its formation is called blastulation.

(iv) **Implantation :** The process of attachment of the blastocyst (mammalian blastula) on the endometrium of the uterus is called implantation.

(v) **Gastrulation :** It includes the mass and orderly migration of the organ specific areas from the surface of blastula to their predetermined position which finally produces a 3 layered gastrula larva. It is with 3 primary layers.

(vi) **Organogenesis :** It includes the formation of specific organs system from three primary germ layers of gastrula and also includes the morphogenesis and differentiation.

Important Tips

Historical background of Embryonic Development :

- **George Newport :** Observed fertilization of frog's egg.
- **Oscar Hertwig :** Described the fusion of sperm and egg nuclei in sea urchin.
- **Prevost and Dumas :** Reported cleavage of frog's egg.
- **Swammerdam** : Observed the first cleavage of frog in 1738.
- **Spallanzani :** Detailed process of cleavage of frog's egg.
- **Von Bear :** Proposed recapitulation theory.
- **Ernst Haeckel :** Modified recapitulation theory to "Biogenetic law". It states "Ontogeny repeats phylogeny."
- **H. Spemann and Mangold :** Reported embryonic induction on newt and gave concept of primary organizers.
- **Pander :** Formation of three germinal layers in chick embryo.
- **Oviparity :** Fertilization may be external or internal but development always outside the female body and inside the egg e.g. most of non-chordates, fishes, amphibians and reptiles; all birds and prototherians.
- **Ovoviviparity :** Fetilization always internal. Development also inside the uterus and baby is born but there is no placenta formation so egg is yolky e.g. rattele snake, Dog fish
- **Viviparity :** Fertilization and development always inside the body. Placenta is formed and female gives birth to young one e.g. most of mammals.

12.3 Fertilization

(i) **Definition :** Fusion of a haploid male gamete (spermatozoon) and a haploid female gamete (ovum) to form a diploid cell, the zygote, is called fertilization or syngamy.

(ii) **Site of fertilization :** Fertilization in human female is internal as in other mammals. It takes place usually in the ampulla of the fallopian tube.

(iii) **Steps of fertilization**

(a) **Approach of sperm to ovum :** Male discharge semen (3.5 *ml*) high up in the female's vagina, close to the cervix during coitus. This is called ejaculation or insemination. This ejaculation contains as many as 400 million sperms but only about 100 sperms reach the fallopian tube because many sperms are either killed by the acidity of female genital tract or engulfed by the phagocytes of the vaginal epithelium. The sperm swim in the seminal fluid at the rate of 1-4 *mm* per minute by the aspiratory action of the uterus and peristaltic movement of the fallopian tube.

Capacitation is the phenomenon of physiological maturation of sperms by breaking of acrosome membrane inside the female genital tract. It takes about 5-6 hours. Ovum is released on the 14^{th} day of menestrual cycle trapped by the fimbriae of the ampulla of fallopian tube and move towards the uterus by peristalsis and ciliary action. At the time of ovulation, egg is at secondary oocyte stage. Fertilizability of human sperm in the female genital tract is of 12 to 24 hours while its survival value is upto 3 days and of ovum is only 24 hours though it can live for about 72 hours.

(b) **Penetration of sperm :** The ovum secretes a chemical substance called fertilizin, which has a number of spermophillic sites on its surface where the sperm of species specific type can be bound by their antifertilizin site. This fertilizin-antifertilizin interaction, causing agglutination (sticking together) of egg and sperm.

The sperm generally comes in contact with ovum in the animal pole (side of ovum with excentric nucleus) while the opposite side of ovum is called vegetal pole. Ovulation in the human female occurs at secondary oocyte stage in which meiosis-I has been completed and first polar body has been released but second maturation is yet to complete. Penetration of sperm is a chemical mechanism. In this acrosome of sperm undergoes acrosomal reaction and releases certain sperm lysins which dissolve the egg envelopes locally and make the path for the penetration of sperm. Sperm lysins are acidic proteins. These sperm lysins contain a lysing enzyme hyaluronidase which dissolves the hyaluronic acid polymers in the intercellular spaces which holds the granulosa cells of corona radiata together; corona penetrating enzyme (that dissolves the corona radiata) and acrosin (which dissolves the zona pellucida). Then it dissolves the zona pellucida. Only sperm nucleus and middle piece enter the ovum. The tail is lost.

(c) **Cortical reaction :** Immediately after the entry of a sperm into the egg, the later shows a cortical reaction to check the entry of more sperms. In this reaction, the cortical granules present beneath the egg's plasma membrane release chemical substance between the ooplasm and the plasma membrane (vitelline membrane). These substances raise the vitelline membrane above the egg surface. The elevated vitelline membrane is called fertilization membrane. The increased space between the ooplasm and the fertilization membrane and the chemical present in it effectively check the entry of other sperm. If polyspermy occurs, that is more than one sperm enter the secondary oocyte, the resulting cell has too much genetic material to develop normally.

Sperm penetration into ovum also induces following metabolic activities :

(1) The egg surface produces fertilization cone.

(2) The vitelline membrane is lifted and is converted into fertilization membrane.

(3) The cortical granule explode.

(4) The cytoplasm exhibits movements.

(5) The permeability of plasma membrane increases.

(6) The coenzyme NAD is phosphorylated.

(7) The rate of protein synthesis increases.

(8) Mitosis is initiated.

(9) The breakdown of polysaccharide occurs.

(10) The enzyme dehydrogenase increases.

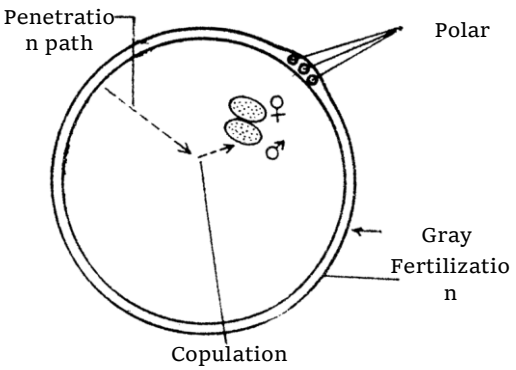

Fig : Penetration and copulation paths of the sperm nucleus in frog egg during fertilization

(d) **Fusion of gametic nuclei :** Entrance of spermatozoon serves to acts as stimulus which causes the second maturation division. As the head and middle piece of the sperm advance into the egg, those parts rotate through an angle of 180° so that the mitochondria and proximal centriole of the associated middle piece assume the leading position. Beside this rotation, the chromatin itself starts swelling by absorbing fluid from the surrounding cytoplasm and becomes vesicular. It is now called male pronucleus. This direction of movement of male pronucleus is called penetration path. The centriole brought in by the spermatozoon subdivides into two and as achromatic spindle is established in the center of the active cytoplasm. With the production of the second polar body, the egg nucleus or female pronucleus is ready for union with the male pronucleus provided by the sperm head.

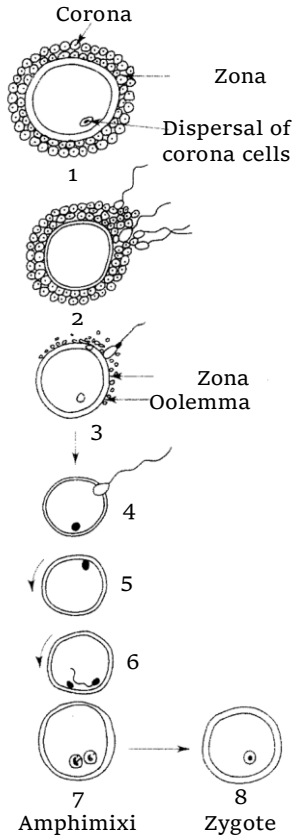

Fig. Steps of fertilization

The male pronucleus which has been advancing the penetration path, now moves directly toward the female pronucleus. This in many cases involves a slight change in the course of sperm. In such cases, the later portion of its course is called the copulation path. The centrioles of middle piece of sperm form a spindle. The nuclear membrane of the gametic nuclei degenerates and two sets of chromosomes initially lie on two poles of the spindle but later these sets of chromosomes mix up and the process is called amphimixis. The fertilized egg is now called zygote and the zygote nucleus is called synkaryon.

(iv) **Types of fertilization**

(a) **External fertilization :** In this, the gamete fuse outside the female body and is found in most of bony fishes (*e.g.* Labeo), amphibians (*e.g.* frog), all echinoderms (*e.g.* starfish) and lower chordates (*e.g. Herdmania*).

(b) **Internal fertilization :** In this, the fusion of gametes in some part of female genital tract and generally near the ostium. It is found in all terrestrial animals which may be oviparous (all birds, prototherians), ovo-viviparous (rattle-snake) or viviparous (all marsupials and eutherians).

(c) **Self fertilization (Endogamy) :** In this, two fusing gametes are derived from the same parent (uniparental) *e.g. Taenia*, *Fasciola* (sheep, liver fluke).

(d) **Cross fertilization (Exogamy) :** In this, two fusing gametes are derived from different parents (biparental). It is found in all unisexual animals and some bisexual animals *e.g. Pheretima* (earthworm-due to protandry), *Scypha* (Sycon-due to protogyny) *Fasciola* and *Taenia* (have both self and cross fertilization).

(e) **Monospermic fertilization :** When only one sperm enters and fuses with ovum. It is found in most of animals.

(f) **Polyspermic fertilization :** When many sperms penetrate the ovum and may be pathological polyspermy (due to over-ripening of egg) or physiological polyspermy (natural entry of sperms). But only one sperm fuses with ovum.

(v) **Significance of fertilization**

(a) It provides stimulus for the egg to complete its maturation.

(b) It activates the ovum to develop into a new individual by repeated mitotic division.

(c) Fertilization restores the diploid number of chromosomes (46 in man) in the zygote by adding male's haploid set of chromosomes.

(d) It makes the egg more active metabolically.

(e) It combines the character of two parents and introduces variations. So help in evolution.

(f) Sex chromosomes of sperm is either X or Y and helps in sex determination.

(g) Fertilization membrane formed after sperm entry, checks the entry of additional sperms.

(h) Copulation path sets the axis of division.

Important Tips

- **Termones : Chemical released by algae in water for attraction of gametes.**
- **Pheromones :** Chemical released by insects in air and generally acts as sex attractants e.g. in gypsy moth.
- **Gamones :** Chemical released by the human gametes for their attraction.
- Zygote is called the first cell of next generation.
- **Isogamy :** When two fusing gametes are morphologically and physiologically similar e.g. monocystis.
- **Anisogamy :** When two fusing gametes are morphologically and physiologically different e.g. frog, human beings etc.
- **Twins :** When 2 or more babies are born in multiple births then these are called twins. These may be identical twins (or monozygotic twins) or fraternal (or dizygotic or non identical twins). Identical twins are attached to same placenta while fraternal twins are attached to uterine epithelium by separate placentae.
- **Siamese twins :** Conjoined twins joined at the hip, chest, back, face etc. these are surgically separated (first time in siam) and are always monozgotic.

- **Free martins :** A sexually under-developed female calf joined with a male.
- **Polyspermy :** Penetration of many sperms into an ovum simultaneously. Only one of the spermatozoa will be successful in uniting with female pronuclei.
- **Polygyny :** When two female pronuclei unite with a male pronucleus.
- **Polyandry :** Conjugation of two or more male pronuclei with a female pronucleus.
- **Gynogenesis :** Activation of egg by sperm, but there is no fusion of its pronucleus.
- **Androgenesis :** Non-participation of female pronucleus in fertilization.
- **Cone of reception (Fertilization Cone) :** A conical outgrowth given by egg of frog to receive the sperm. Not found in human egg.
- **Fertilizin** is a glycoproteinous or mucopolysaccharide molecule, while **antifertilizin** is a proteinaceous substance of acidic amino acids on the surface of head of sperm.
- Fertilizin-Antifertilizin reaction was proposed by **F.R. Lillie**
- Sperms swim in the seminal fluid at the rate of 1-4 mm per minute and time taken by the sperm entry into the oocyte is about 30 minutes.
- The slow block to polyspermy develops, in response to the formation of the fertilization membrane and within a minute after the fast block.
- The motion of sperm is Random.
- Polyspermy is of common occurance in birds.
- Bindin is a protein in acrosome which ensure that the egg is being fertilized by a sperm of the same species.

12.4 CLEAVAGE

(i) **Definition :** The term cleavage refers to a series of rapid mitotic division of the zygote following fertilization, forming a many celled blastula. The cleavage follows fertilization and ends with the formation of a characteristic development stage called blastula.

(ii) **Cleavage versus typical mitosis :** The cleavage division are no doubt mitotic as they produce diploid cells, they differ from typical mitosis in a couple of significant points.

S.No.	Characters	Cleavage	Normal mitosis
(1)	Site of occurrence	In zygote or parthenogenetic egg	In most of somatic cells
(2)	Interphase	Of shorter period	Of longer period
(3)	Growth	Does not occur	Occurs during interphase
(4)	Oxygen consumption	High as is very rapid process	Low as is slow process

(5)	Size of daughter cells	Decreases	Remains same after growth
(6)	DNA synthesis	Faster	Slower
(7)	Nuclear-cytoplasmic ratio	Increases	Remain same

(iii) **Planes of cleavage :** The cleavage is initiated by the appearance of a constriction or groove called cleavage furrow. The cleavage furrows may divided the egg from different angles or planes. These are four important planes of cleavage. They are as follows.

(a) **Meridional plane :** When cleavage furrow bisects both the poles of the egg, passing through the animal vegetal axis, the plane of cleavage is called meridional plane.

Example : Ist and IInd cleavage furrow of frog and Ist cleavage furrow of chick.

(b) **Vertical plane :** When cleavage furrow passes from the animal pole to the vegetal pole, but it does not pass through the median axis of the egg.

Example : IIIrd cleavage furrow of chick.

(c) **Equatorial plane :** When cleavage furrow bisect the egg at right angles to the median axis and half way between the animal and vegetal poles.

Example : Ist cleavage plane of eggs of higher mammals.

(d) **Latitudinal or transverse or horizontal plane :** The transverse plane resemble the equatorial plane, but it passes either above (towards the animal pole) or below (towards the vegetal pole) the equator of the egg.

Example : IIIrd cleavage plane of Amphioxus and frog.

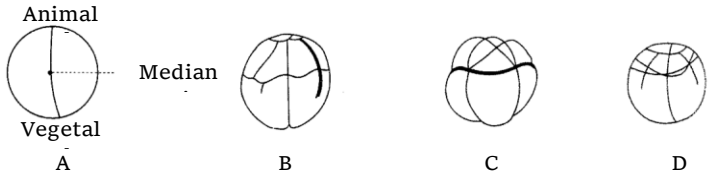

Fig : (A) Meridional plane; (B)Vertical plane; (C) Equatorial plane; (D)

(iv) **Patterns of cleavage :** During segmentation, the cleavage furrows are not formed at random but are oriented in a particular manner with reference to the main (animal-vegetal) axis of the egg. The orientation of successive cleavage furrows with respect to each other and to the main axis of the egg is, however, unlike in different species. As such various patterns of cleavage are found among animals. Based upon symmetry, four patterns of cleavage have been recognized. They are as follows

(a) **Radial cleavage :** In this cleavage pattern, division take place in such a manner that all the blastomeres are placed in a radially symmetrical fashion around the polar axis. When such an egg is viewed from the poles, the blastomeres seem to be arranged in a radially symmetric form.

Example : Sponges, coelenterates, sea urchin, sea cucumber, amphioxus.

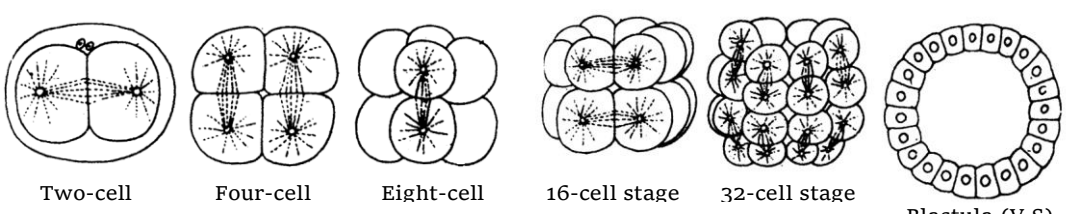

Fig : Radial cleavage in sea-cucumber *Synapta*

(b) **Biradial cleavage :** In this pattern four blastomeres arise by the usual two meridional cleavages. The third cleavage plane is vertical resulting in the formation of a curved plate of 8 cells arranged in two rows of 4 each. In these rows, the central cells are larger than the end ones.

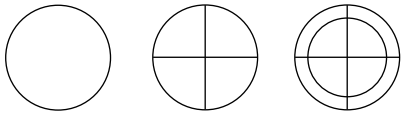

Fig : Biradial (dorsal

Example : Ctenophores like Beroe.

(c) **Spiral cleavage :** The spiral cleavage is diagonal to the polar axis. In this type, the spindles for the third cleavage, instead of being erect, are oriented diagonally so that the resulting upper tier of cells is sidewise. The upper 4 cells are placed over the junction between the four lower cells. The upper smaller cells are called micro and lower larger cells are known as macromeres. The spiral cleavage results due to oblique positions of the mitotic spindles. This type of cleavage is called the spiral type because the four spindle during the third cleavage are arranged in a sort of spiral.

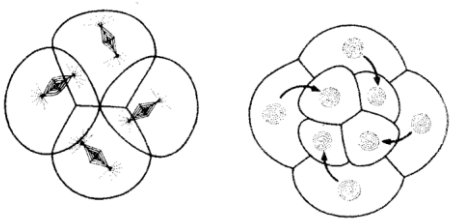

Fig :

Examples : Eggs of annelids, molluscs, nemerteans and some of the planarians.

(d) **Bilateral cleavage :** In this pattern of cleavage, the blastomeres are so arranged that the right and left sides becomes distinct. In this case, two of the first four blastomeres may be larger than the other two, thus establishing a plane of bilateral symmetry in the developing embryo.

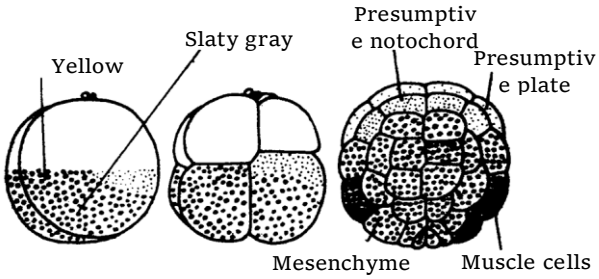

Fig : Bilateral

Examples : Nematodes, cephalopodes, molluscs, some echinoderms and tunicates.

(v) **Cleavage on the basis of potency :** According to potentialities of early blastomeres, cleavage may be of following types.

(a) **Determinate cleavage or mosaic cleavage :** In determinate cleavage, each early blastomere is destined to become a particular portion of embryo.

Examples : Ascaris, annelids, molluscs, ascidians, polyclads (platyhelminthes) and nemerteans.

(b) **Indeterminate or regulative cleavage :** In contrast, early blastomeres are equivalent in their potentialities. If separated, each will give rise to a complete normal embryo.

Example : All chordates, echinoderms and arthropods.

(vi) **Types of cleavage :** The amount of yolk (Lecithality) also determines the type of cleavage. Which are as follows

(a) **Holoblastic cleavage :** Alecithal, homolecithal and mesolecithal eggs show rapid and complete division of zygote are called total or holoblastic cleavage. Resulting 8 blastomeres after the third cleavage may be equal or unequal to each other. Accordingly they are of two types

(1) **Equal holoblastic cleavage :** If the blastomeres are approximately equal, it is called equal holoblastic cleavage.

Examples : Echinoderms, amphioxus and placental mammals.

(2) **Unequal holoblastic cleavage :** If the upper 4 blastomere are smaller (micromeres) than the lower 4 yolk-laden larger blastomere (macromere), it is calld unequal holoblastic cleavage.

Example : Fish and amphibians.

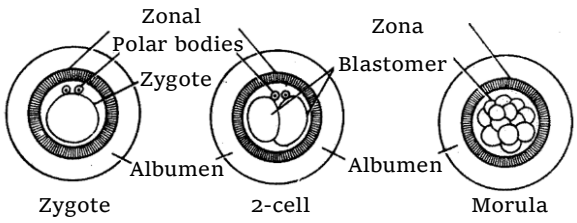

Fig : Holoblastic equal cleavage

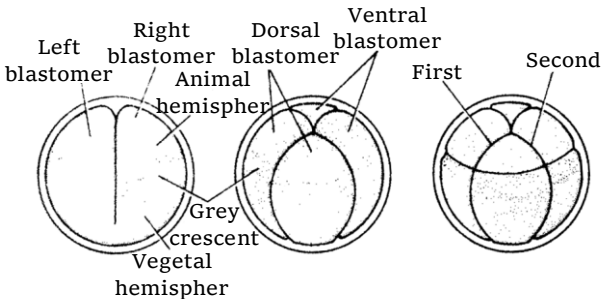

Fig : Holoblastic unequal cleavage

(b) **Meroblastic cleavage :** In large polylecithal eggs cleavage furrow cannot cut through the enormous yolk present so that the entire egg is not divided into cells. Thus cleavage is incomplete or partial, termed meroblastic. It is of following two types

(1) **Discoidal cleavage :** Cleavage are restricted only to the small cytoplasmic cap at the animal pole resulting in a rounded embryonic or germinal disc is termed discoidal cleavage.

Example : Eggs of elasmobranchs, bony fishes, birds, reptiles and egg laying mammals.

(2) **Superficial cleavage :** Cleavage is restricted to a superficial peripheral layer of cytoplasm around yolk, hence the term superficial cleavage.

Example : Centrolecithal eggs of arthropods.

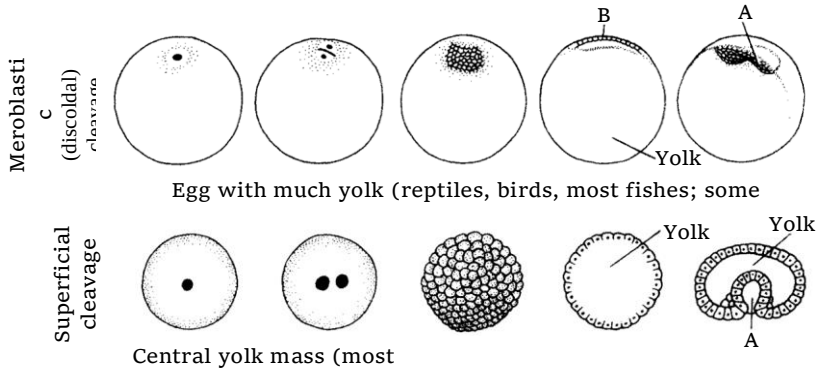

Fig : Types of cleavage and the resulting blastulae and

(vii) **Cleavage in human zygote :** Cleavage in the human zygote occurs during its passage through the fallopian tube to the uterus as in other mammals. It is holoblastic. The first cleavage takes place about 30 hours after fertilization. It is meridional, coinciding with the animal-vegetal pole axis. It produces two blastomeres, one slightly larger than the other. The two blastomeres remain adhered to each other. The second cleavage occurs within 60 hours after fertilization. It is at right angles to the plane of the first, and divides each blastomere into two by forming a mitotic spindle in each. The larger blastomere divides a little sooner than the smaller one so that there is a transitory "3-cell" stage before the characteristic "4-cell" stage of the embryo is reached. Third cleavage takes place about 72 hours after fertilization. Subsequent cleavage divisions follow one after another in an orderly manner, but in a less precise orientation. Cleavage produces a solid ball of small blastomeres.

(a) **Formation of morula :** After 4th cleavage solid ball consist of 16 to 32 cells are formed which looks as a little mulberry called morula. Due to holoblastic and unequal cleavage, two types of blastomere are formed.

There is an outer layer of smaller (micromere) transparent cells around on inner mass of larger cells (macromere). The morula reaches the uterus about 4 to 6 days after fertilization. It is still surrounded by the zona pellucida, that prevents its sticking to the uterine wall.

(b) **Formation of blastula (blastocyst) :** It involves the dynamic rearrangement of blastomere. The outer layer of cell becomes that and form trophoblast or trophoectoderm which draws the nutritive material secreted by the uterine endometrial glands. The fluids absorbed by the trophoblast collects in a new central cavity called blastocoel or segmentation cavity or blastocystic vesicle.

As the amount of nutritive fluid increases in blastocoel, morula enlarges and takes the form of a cyst and is now called blastocyst or blastodermic vesicle. The cells of trophoblast do not participate in the formation of embryo proper. These cells form only protective and nutritive extra-embryonic membranes which later form foetal part of placenta *e.g.* chorion for placenta formation, amnion for protection from injury and dessication.

Inner cell mass of macromeres forms a knob at one side of trophoblast and forms an embryonal knob and is primarily determined to form the body of developing embryo so is called precursor of the embryo. The side of blastocyst to which embryonal knob is attached, is called abembryonic pole. Zona pellucida disappears at the time of blastocyst formation. The trophoblast cells in contact with the embryonal knob are known as cells of Rauber.

(viii) **Types of blastulae :**

(a) **Coeloblastula :** A hollow blastula in which blastocoel is surrounded by either single layered (*e.g.* echinoderms, amphioxus) or many layered blastoderm (*e.g.* frog).

(b) **Stereoblastula :** Solid blastula with no blastocoel *e.g.* in coelentrates annelids and molluscs.

(c) **Discoblastula :** The blastula is as a multilayered flat disc at the animal pole lying on the top of well developed yolk. It is found in reptiles, birds, prototherians and fishes.

(d) **Blastocyst :** In this, the blastula is as a cyst with 2 types of cells : an outer epithelium – like layer of trophoblast or nutritive cells; and an inner mass of formative cells collectively called embryonal knob.

(e) **Superficial blastula or periblastula :** In this, the blastocoel is filled with yolk and is surrounded by a peripheral layer of cells. It is found in insects.

(ix) **Significance of cleavage :**

(a) Cleavage restores the cell size and nucleo-cytoplasmic ratio characteristic of the species. It does not result in growth, though it increases cell number. During cleavage, cellular activity is till mainly controlled by the organelles and molecules received from the secondary oocyte's cytoplasm, but some of the developing organism's gene become active.

(b) Cleavage beside producing a large number of cells by rapid divisions also segregates different substance present in the cytoplasm into different cells. These substances determine how the various cells develop later.

Important Tips

- ☞ **Fate map :** Diagram showing presumptive or prospective areas on the surface of blastula. It is done by using certain vital stains like neutral red, nile blue sulphate, bismarck brown, etc. It was first prepared by W. Vogt (1929).
- ☞ Zona pellucida disintegrates just after completion of cleavage.
- ☞ Cells of corona radiata disperse just before implantation.

12.5 Implantation

(i) **Definition :** The process of attachment of the blastocyst on the endometrium of the uterus is called implantation.

(ii) **Period :** Though the implantation may occur at any period between 6^{th} and 10^{th} day after the fertilization but generally it occurs on **seventh day** after fertilization.

(iii) **Mechanism ;** First of all, the blastocyst is held closely against the uterine endometrial epithelium. The uterine capillaries and uterine wall in the immediate vicinity of the embryo become more permeable and a local stromal oedema is developed. Soon the endometrium around the embryo shows the first sign of a decidual cell reaction (DCR) which involves :

(a) The epithelium becomes disrupted and the loosely packed fibroblast-like cells of the stroma are transformed into large rounded glycogen-filled cells.

(b) The area of contact becomes more vascular.

(c) The decidual cells form an "**implantation chamber**" around the embryo before the formation of a functional placenta.

(d) The trophoblast is developed from the superficial layer of the morula stage. Later, the trophoblast is lined by mesoderm to form the chorion which contributes to the placenta formation.

(e) Trophoblast of the chorion penetrates the uterine epithelium by both cytolytic and mechanical activity. The phagocytic activity of the trophoblastic cells through the decidual cells continues till it establishes intimate connection with the uterine blood vessels. The process of implantation is aided by proteolytic enzymes produced by the trophoblast. After implantation, endometrium undergoes many changes and forms decidua. It is differentiates into three parts such as : Decidua basalis present between the embryo and uterine myometrium, Decidua capsularis lies between the embryo and lumen of the uterus and Decidua parietalis is formed by the remaining part of decidua. The pattern of implantation of the blastocyst varies in different species, which are as follows

(1) **Interstitial implantation :** The blastocyst get burried into the endometrium *e.g.* human female, hedgehog, guinea pig, some bats and ape.

(2) **Central implantation :** The blastocyst remain the uterine cavity *e.g.* rabbit, cow, dog and monkey.

(3) **Eccentric implantation :** The blastocyst comes to lie in a uterine recess *e.g.* rats, mice.

(iv) **Hormonal control of implantation**

(a) **Role of estrogens :** These are a group of steroid hormones mainly secreted by follicular epithelial cells of Graafian follicle though these are also produced by adrenal cortex and placenta. These include **β-estradiol, esterone, estriol** etc. Out of which most important estrogen is β-estradiol. Secretion of estrogens is stimulated by FSH of anterior lobe of pituitary glands. These stimulate the uterine endometrial epithelium to enlarge, become more vascular and more glandular. The uterine glands become tortuous and cork-screw shaped. So the endometrium prepares itself for implantation. This stimulation by the estrogens on the uterus generally occurs on the 4th day of pregnancy.

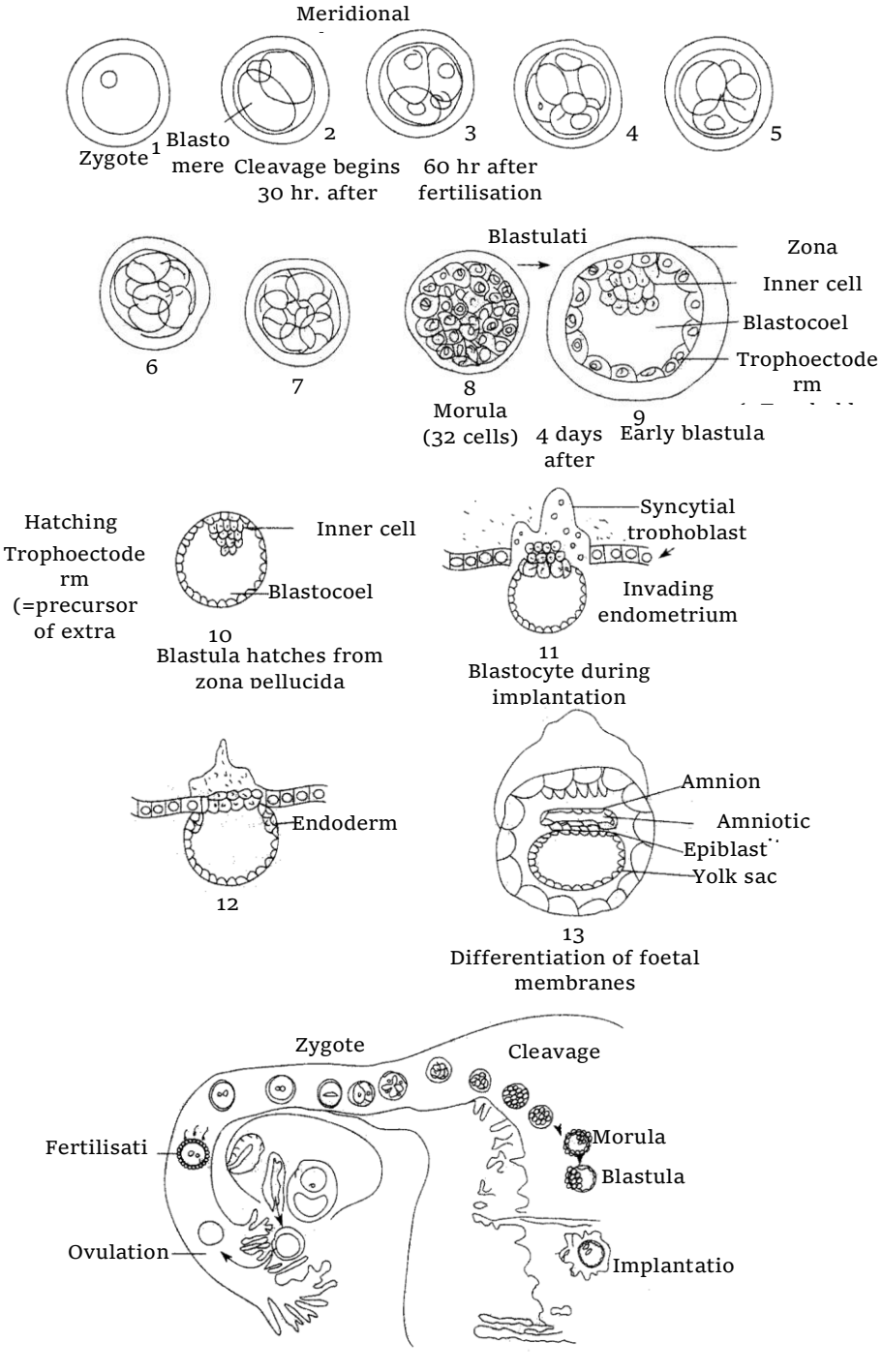

Fig : Cleavage and stages of implantation of blastocyte differentiation of foetal membranes

(b) **Progesterone :** It is also a steriod hormone secreted by yellow-coloured endocrine gland, called **corpus luteum**, formed from empty Graafian folicle during the pregnancy. Small amount of progesterone is also secreted by adrenal cortex and placenta. Secretion of progesterone is stimulated by LH of anterior lobe of pituitary gland.

Progesterone acts on only those uterine cells which have been earlier stimulated by estrogens. Progesterone further stimulates the proliferation of endometrium of uterus and prepared, placenta formation and normal development of the foetus in the uterus.

12.6 Gastrulation

(i) **Definition :** Gastrulation is a dynamic process involving critical changes in the embryo such as differentiation of cells, establishment of the three primary germ layers and transformation of the single walled blastula into a double walled gastrula.

(ii) **Types of gastrular movement or morphogenetic movement :** The movements of cells during gastrulation is called formative or morphogenetic movements. Following types of gastular movements are found in different animals

(a) **Epiboly :** It involves the morphogenetic movement of prospective ectodermal (micromeres) blastomeres antero-posteriorly to envelop the presumptive endodermal and mesodermal blastomeres. It is found in telolecithal egg of frog.

(b) **Emboly :** It involves inward movement of prospective endodermal and chorda-mesodermal blastomeres from the surface of blastula.

(c) **Invagination :** It involves insinking of endodermal cells in the blastocoel to form archenteron. It is found in amphioxus.

(d) **Involution :** It involves the rolling in of the chorda-mesodermal blastomeres inside the ectodermal cells over the lips of blastopore. It is also found in the gastrulation of frog.

(e) **Convergence :** It involves migration of blastomeres from the outer surface towards the blastoporal lips.

(f) **Ingression or polyinvagination :** In this, individual blastomeres migrate into the blastocoel either from only vegetal pole (called unipolar ingression *e.g. Obelia*; or form all sides called multipolar ingression *e.g. Hydra*) to form a solid gastrula called stereogastrula.

(g) **Delamination :** It involves splitting off the blastoderm into two layers by the appearance of grooves resulting the formation of hypoblast. It is found in birds.

(iii) **Formation of layers by gastrulation :** Gastrulation includes the formation of following structures

(a) **Formation of endoderm :** The blastodermic vesicle enlarges and cells present on the lower surface of the embryonal

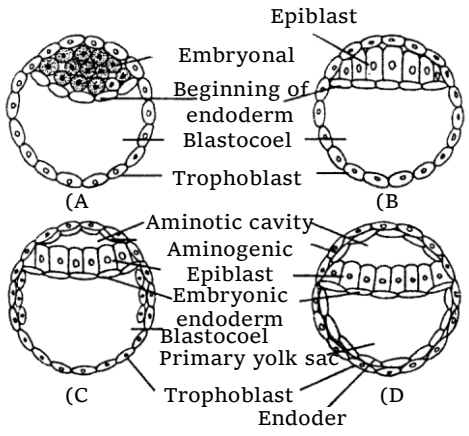

Fig : Formation of endoderm and ectoderm

knob detach by delamination from the embryonal knob. The detached cells become flat, divide increase in number and form the endoderm inside the trophoblast of the blastodermic vesicle. The embryo at this stage is tubular and encloses a hollow tube (called primitive gut or **archenteron**) lined by endoderm. The part of endoderm located under the embryonal knob is called **embryonic endoderm** which later forms **embryonic gut**, while the remaining part of endoderm along with trophoblast forms the **yolk sac**.

(b) **Formation of embryonic disc and mesoderm :** Meanwhile, the blastocyst continues to grow due to absorption of more and more uterine milk. The embryonal knob stretches and cells of Rauber start breaking off and dispersing. So the cells of embryonal knob from a regular layer called **embryonic disc** which becomes continuous with the trophoblast. Embryonic disc is differentiated into cephalic, embryonic and caudal regions. Formation of embryonic mesoderm starts at the caudal region of the embryonic disc where cells undergo rapid proliferation and form a localized thickening of the embryonic disc and form the mesodermal layer between ectoderm and endoderm.

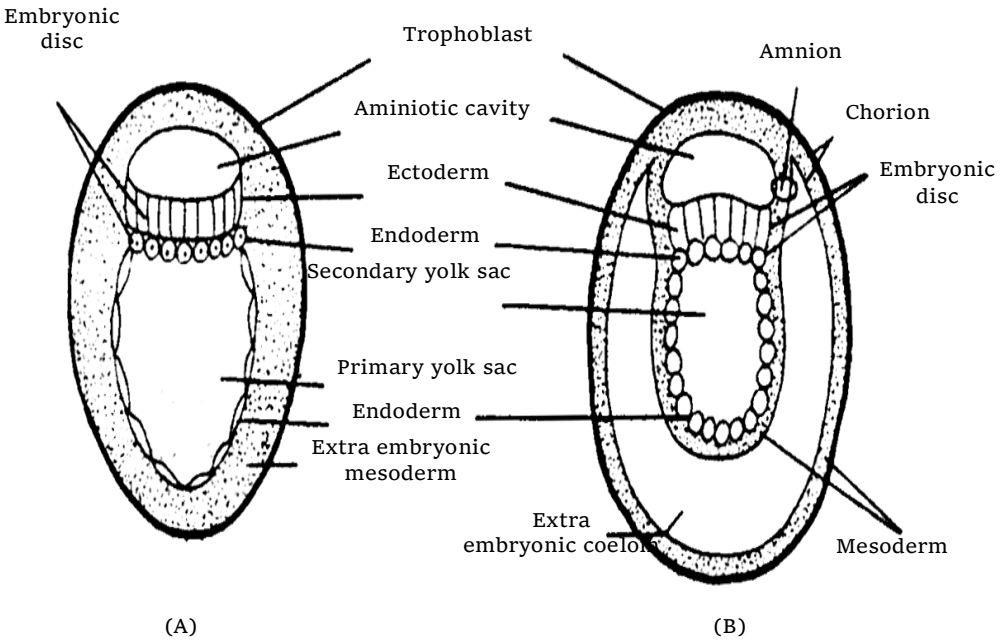

Fig : Formation of extraembryonic mesoderm and coelom

FATE OF GERM LAYER

Ectoderm	Mesoderm	Endoderm
Epidermis and skin derivatives	Dermis	Gut
Cutaneous gland	Muscular tissue	Glands of stomach and intestine
Nervous system (Brain + spinal cord)	Connective tissue	Tongue
Motor and optic nerve	Endoskeleton	Lung, trachea and bronchi
Eye (Retina, lens and cornea)	Vascular system (heart and blood vessel)	Urinary bladder
Conjuctiva, ciliary and iridial muscle	Kidney	Primordial germ cells
Nasal epithelium	Gonads (Reproductive system)	Gills
Internal ear (membranous labyrinth)	Urinary and genital ducts	Liver
Lateral line sense organ	Coelom and coelomic epithelium	Pancreas
Stomodaeum (mouth)	Choroid and sclerotic coat of eye	Thyroid gland
Salivary gland	Adrenal cortex	Parathyroid gland
Enamel of teeth	Spleen	Thymus
Proctodaeum	Notochord	Middle ear
Pituitary gland	Parietal and visceral peritoneum	Eustachian tube
Pineal body		Mesoderm (Mid gut)
Adrenal medulla		Lining of vagina and urethra
HYPOTHALAMUS		**PROSTATE GLAND**

(c) **Formation of ectoderm :** The remaining cells of blastodisc become columnar and form ectoderm.

(iv) **Fate of germ layers :** Each of the three germ layers gives rise to definite tissues, organs and systems of the body. Their fate in embryo and adult has been listed below

Fate of germ layer

(v) **Significance of gastrulation**

(a) Three primary germ, layers are formed.

(b) It marks the beginning of morphogenesis and differentiation.

(c) Metabolic activities of the cells are increased due to great morphogenetic activities of the blastomeres.

Important Tips

- First embryonic membrane to be formed is endoderm.
- Embryonal knob is called **precursor of the embryo**, while trophoblast forms protective and nutritive **extra-embryonic membranes**.
- **Cells of Rauber :** Those cells of trophoblast which are in contact with embryonal knob.
- Yolk sac is also found in some anamniotes like certain cartilage fishes (e.g. scoliodon), bony fishes and few amphibians (e.g. Necturus) having polylecithal egg.
- **Protostomous :** When blastopore forms the mouth in development and is found in **non-chordates except echinoderms, hemichordates and chordates.**
- **Deuterostomous :** When blastopore forms the anus in development. Mouth is developed later than anus e.g. echinoderms hemichordates and chordates.

12.7 Neurulation and Organogenesis

Post gastrulation involves two main process. Neurulation is process of laying the neural plate to form the nervous system. The establishment of the germ layers initiates the final phase of embryonic development, *i.e.*, organogenesis. The latter involves differentiation and specialization of groups of cells in the individual germ layers. The cells of such groups change their form and give rise to morphologically recognizable tissues and organs of the new individual. The groups of differentiated cells separate from their germ layers in an orderly manner and with unique precision. Separation of the differentiated cell groups may occur by folding off from the germ layer or by migration of cells individually and reaggregation at a new place. In this manner, the primordial cells of the germ layers gradually and accurately give rise to the tissues and organs of the offspring.

By four weeks after fertilization, the embryo has a simple heart, limb buds and eye rudiments. It also has a tail and pharyngeal pouches, the vestiges of its early vertebrate ancestors that disappear later in development. After the second month, the embryo is recognizable as a primate. From this stage on, the embryo is often called **foetus**.

Some important events in the human development

Time from fertilization	Stage/organs	Event
24 hours	Cleavage	Embryo is at two-cell stage
3 days	Morula	The morula reaches uterus
7 days	Blastocyst	Implantaion of blastocyst begins
2.5 weeks	Notochord	Notochord formed, differentiation of tissues that will give rise to heart, blood cells formed in yolk sac and chorion.
3.5 weeks	Organ system	Neural tube formed, primordial eye and ear vesicle, pharyngeal pouches formed, liver bud differentiates, respiratory system and thyroid gland begin to develop,

		heart tube bends and begins to beat, blood vessels are formed.
4 weeks	Limb buds	Development and appearance of limb buds, brain forms three primary vesicles.
2 months	Muscles and gonads	Muscles differentiate, embryo capable of movement, gonads distinguishable as testes or ovaries, ossification of bones begins, cerebral cortex is differentiated, blood vessels assume final position.
3 months	Sex differentiation	By external examination sex can be determined, notochord degenerates, lymph glands develop.
4 months	Face	Face begins to look human, eye, ear and nose look 'normal', cerebral lobes differentiate.
6-9 months (third trimester)	Lanugo (hairs) body growth	Lanugo appear but are shed later, tremendous growth of body occurs, neurons become myelinated
266 days	Birth (parturition)	Baby is born, neonate arrives in outer world.

12.8 Extra embryonic membrane

An aquatic embryo is surrounded by water, which protects the embryo, keep it moist, removes wastes and permits gas exchange. In land vertebrate (reptiles, birds and mammals), these functions are taken over by the extraembryonic membranes. These membranes are formed outside the embryo from the trophoblast only in amniotes and perform specific function. Some of these membranes take part in the formation of placenta in mammals.

(i) **Yolk sac :** It is formed below the embryo. It contains fluid, not yolk. The yolk sac is a vestigeal organ inherited from the oviparous reptilian ancestors. Yolk sac encloses by outer mesoderm and inner endodermal layer.

Function : It is mainly digestive in function. It also absorbs the dissolved yolk and passes it to developing embryo in reptiles, birds and prototherian. In human beings, it is vestigial. In human embryo it act as the site of blood cell formation until about the 6^{th} week, when the liver takes over this role.

(ii) **Amnion :** It is formed above the embryo. It consist of outer mesoderm and inner ectoderm. The amnion and the fluid filled amniotic cavity it encloses, enlarge and nearly surround the embryo. The embryo is suspended in the amniotic cavity by an umbilical cord. The latter is formed of the stalks of the yolk sac and allantois. The main blood vessel from the placenta reach the foetus through the umbilical cord. Amniotic fluid secreted by both embryo and amnion. The cells of amniotic fluid are the basis of parental test called amniocentesis, for the sex of the foetus and for checking chromosomal defects in it.

Functions

(1) The amniotic fluid cushions the embryo.

(2) It protecting embryo against bumps and bacterial infections.

(3) It maintains a constant temperature and pressure.

(4) It protects the embryo from jerk, injury and shocks.

(5) It prevents desiccation of the embryo.

(iii) **Allantois :** It is a fold of splanchnopleur developed from the hind gut of the embryo. It consist of outer mesoderm and inner endoderm. It is well developed in amniotes with polylecithal egg (*e.g.* reptiles, birds and prototherians) and stores the nitrogenous waste of the embryo so act as extra embryonic kidney. In most of eutherians, it combines with chorion to form allantochorion placenta. But in man it remains small or reduced and does not reach the chorion. However, it forms umbilical arteries and veins which grow up to the chorion to vascularise it.

Functions

(1) The cavity of the allantois serves as a urinary bladder. It stores the protein breakdown product in the form of water-insoluble crystals of uric acid and inside the egg upto the time of hatching. But with the acquisition of viviparity in the marsupials and the placental mammals, the original function of the allantois as a urinary bladder becomes altogether lost.

(2) The vascular "chorioallantoic membrane" lies in a close proximity to the inner surface of the porous shell. It acts as an extraembryonic lung by supplying the embryo with oxygen.

(3) Together with the chorion, the allantois also surrounds the albumen to form the albumen sac and thus assists in the absorption of nutritionally rich albumen.

(4) In mammals, allantois supply oxygen and nutrient to the embryo.

(iv) **Chorion** : It is outermost fold of somatopleur (outer ectoderm and somatic mesoderm) and surrounds the embryo. In reptiles birds and prototherians, allantochorion act as extra embryonic lungs help in exchange of gases. But in primates including human beings, only chorion forms the placenta (chorionic placenta).

Function : It protects the embryo and forms placenta for metabolic exchange between the foetus and the mother.

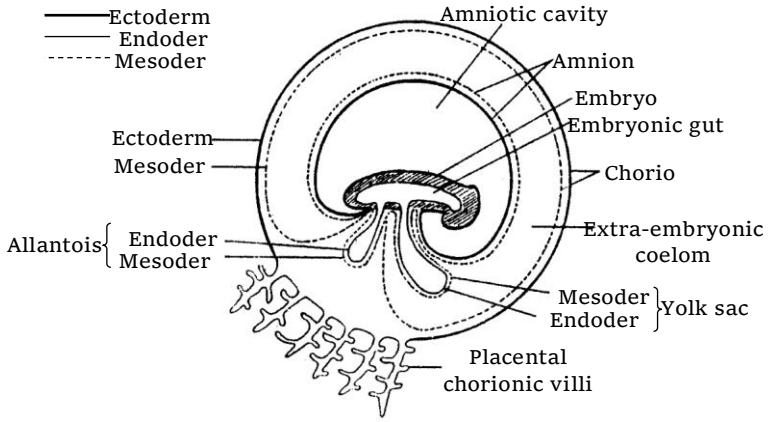

Fig : Foetal membranes and placenta (early stage)

Types and functions of extra embryonic membrane

S.No.	Name of membrane	Characteristics and functions	Remarks
(1)	Yolk sac	(1) Formed by inner endoderm and outer mesoderm (= splanchnopleura) (2) Digestive function (= extra embryonic duct) (3) Absorbs dissolved yolk and supplicate it to developing embryo.	Vestigeal in humans. Well developed in reptiles, bird and prototherians.
(2)	Amnion	(1) Formed by inner ectoderm and outer mesoderm (somatopleur) above the embryo. (2) Between the embryo and amnion there is a cavity called amniotic cavity filled with amniotic fluid secreted by amnion and embryo. (3) Amniotic fluid act as shock absorber and prevent desiccation of embryo. (4) Ex-foliated embryonic (= foetal) cells are used for (a) pre-natal sex determination (b) congenital defects (c) inborn metabolic disorders. This technique is called amniocentesis.	Well developed in all amniotes
(3)	Allantois	Develops as fold of splanchnopleur; developed from gut of embryo.	(1) In placentals, it combines with chorion to form allanto-chorion placenta. (reduced in human) (2) Acts as extra-embryonic kidney in reptiles, birds and prototherians.
(4)	Chorion	Outermost fold of somatopleur and surrounds the embryo	(1) Takes part in forming the true chorio allantoic placenta (2) Acts as extra-embryonic lung in reptiles, birds and prototherians.

12.9 PLACENTA

(i) **Definition :** Placenta is defined as a temporary intimate mechanical and physiological connection between foetal and maternal tissues for the nutrition, respiration and excretion of the foetus.

(ii) **Structure :** Human placenta consist of chorion only. Hence, it is called a **chorionic placenta**. Allantois remains small. The allantoic blood vessels, however, extend to vascularize it. A large number of branching villi from the vascular chorion penetrate the corresponding pits, the **crypts**, formed in the uterine wall. The latter becomes very thick and highly vascular to receive the villi. The intimate connection established between the foetal membrane and the uterine wall is known as the **placenta**. The placenta has two parts : the part contributed by the foetus, *i.e.*, chorionic villi, is called the **foetal placenta**; and the part shared by the mother, *i.e.*, part of uterine wall, is termed the **maternal placenta**. The chorionic villi receive blood from the embryo by umbilical artery and return it by umbilical vein. These blood vessels are derived from the allantois and run between the foetus and the uterine wall in the tough umbilical cord covered with cells derived from the amnion and chorion. The choroinic villi come to lie in uterine lacunae that receive blood from the uterine arteriole and return it by uterine venule. The cells forming the wall of chorionic villi bear microvilli which increase their surface area for quick and adequate exchange of materials by diffusion, active transport and pinocytosis.

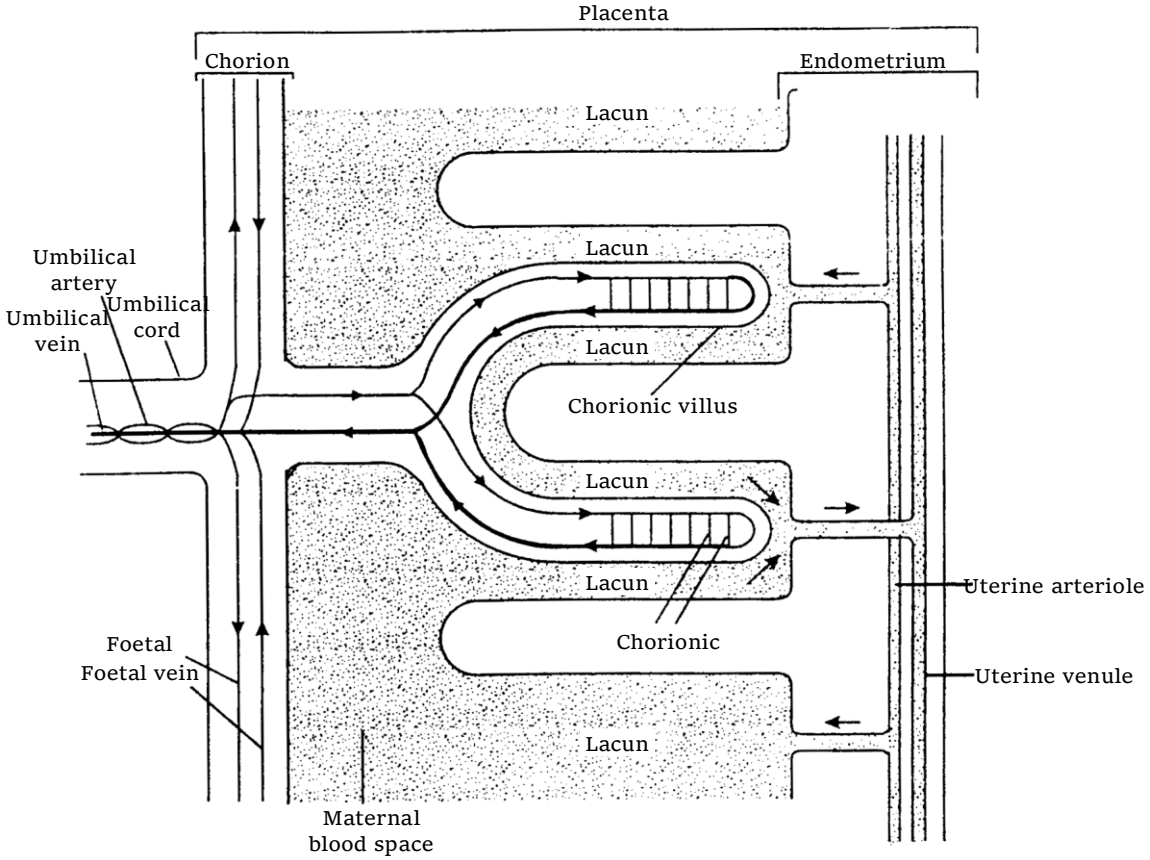

Fig : Diagram showing relationship between foetal and maternal blood

The placenta is fully formed by the end of the third month and it lasts throughout pregnancy. When complete, it is a reddish – brown disc. In the placenta, the foetal blood comes very close to the

maternal blood, and this permits the exchange of materials between the two. Food (glucose, amino acids, simple proteins, lipids), water, mineral salts, vitamins, hormones, antibodies and oxygen pass from the maternal blood into the foetal blood, and foetal metabolic wastes, such as carbon dioxide and urea, also water and hormones, pass into the maternal blood. The placenta, thus, serves as the nutritive, respiratory and excretory organ of the foetus. The continuous uptake of oxygen by foetal blood is ensured by the difference in affinity for oxygen between foetal and maternal haemoglobin.

The maternal and foetal blood are not in direct contact in the placenta, because (i) the two may be incompatible; (ii) the pressure of maternal blood is far too high for the foetal blood vessels; and (iii) there must be a check on the passage of harmful materials (blood proteins, germs) into the foetal blood.

(iii) **Functions**

(1) Placenta helps in the **nutrition** of the embryo as the nutrients like amino acids, monosugars, vitamins, etc. pass from the maternal blood into foetal blood through placenta.

(2) It also helps in **respiration** of the embryo as O_2 of the maternal blood and CO_2 of the foetal blood diffuse through placenta into the foetal blood and maternal blood respectively.

(3) It also helps **excretion** of the embryo as nitrogenous wastes of foetal blood like urea pass into maternal blood through placenta.

(4) It also acts as an **endocrine gland** as it secretes certain hormones like estrogens, progesterone and **human chorionic gonadorophin (HCG)**. HCG maintains the corpus luteum for the continued secretion of progesterone to maintain the pregnancy. At the end of gestation period, it also secretes **relaxin** which helps in softening of pubic symphysis and child birth. It also secrete small amounts of chorionic thyrotrophin, chorionic corticotropin and chorionic somatomammotropin.

(5) **Antibodies** against diphtheria, smallpox, scarlet fever, measles, etc. pass from maternal blood to foetal blood through placenta and provide **passive immunity.**

(6) It stores the glycogen till the formation of liver.

(7) Though the placenta acts as an **effective barrier** for certain toxic chemicals like histamine but certain germs like AIDS virus, syphilis bacteria, viruses of German measles, etc, intoxicants like nicotine of cigarette smoke; and addictive drugs like heroin and cocaine can pass through the placenta and cause the developmental defects.

(iv) **Placenta and disease**

(1) Viral and bacterial infections of placenta are known as placentitis.

(2) If the mother suffer from certain diseases like syphilis, smallpox, chickenpox, AIDS and measles; their pathogen enter into the foetus through placenta.

(3) Many drugs used medicinally may penetrate the placental barriers.

(4) Drugs such as thalidomide taken as a sedative by woman in early pregnancy (25 to 44 days) cause extensive deficiencies in the development of limbs, the alimentary canal (non perforation of the anus) and the heart in children.

(5) Nicotine from cigarette smoke crosses the placenta and stunts foetal growth.

(6) Addictive drugs such as heroin and cocaine reach the foetus, causing addiction to the new born.

(v) **Classification of placenta**

(a) **According to the foetal membrane involved in the formation of placenta**.

(1) **Yolk sac placenta :** In metatheria or marsupials, such as kangaroo (macropus) and opossum (Didelphys), placenta is derived from yolk sac and chorion. In metatheria, yolk sac placenta is only weakly developed so that embryonic nutrition and growth remain limited and the young is born very small and immature. To compensate the deficiency of intrauterine development, it is transferred to the abdominal pouch or marsupium and fed on milk until fully formed. In higher mammals (Eutheria) a yolk sac placenta is usually not found but in some mammals (Hedgehogs and rabbit) it may be temporarily develop in early stages.

(2) **Allantoic placenta :** In the majority of Eutherian, the chief organ of embryonic nutrition is the allantoic placenta consist of allantois and chorion and also called allantochorionic placenta. Outside Eutharia, a primitive allantoic placenta occurs only in perameles (bandicoot) which is a metatherian.

(3) **Chorionic placenta :** It occurs in primates (man and apes) and is formed only by chorion. Allantois remains small, burrows into body stalk (umbilical cord) and does not reach chorion. However, its mesoderm and blood vessels grow upto chorion whose villi enter the uterine crypts forming chorionic placenta.

(b) **According to the intimacy between the foetal and maternal part**.

Histologically there are six barriers are found in placenta which are as follows.

(1) Endothelium of foetal blood vessels
(2) Chorionic connective tissue
(3) Chorionic epithelium — Foetu
(4) Uterine epithelium
(5) Uterine connective tissue — Moth
(6) Endothelium of maternal blood vessel

On the presence or absence of above barriers histologically placenta is divided into following types

(1) **Epithelio-chorial :** Most primitive and simplest type with all six placental barriers.

Examples : Odd hoofed mammals such as horse, ass, pig and lemurs.

(2) **Syndesmo-chorial :** Uterine epithelium absent, with five placental barriers.

Examples : Even hoofed mammals such as cow, sheep, goat, camel etc.

(3) **Endothelio-chorial :** Uterine epithelium and uterine connective tissues are absent, with four placental barriers.

Examples : Carnivores (dog, cat, lion, tiger etc.), Tree shrew and mole.

(4) **Haemo-chorial :** Uterine epithelium, uterine connective tissue and endothelium of maternal blood vessel absent, with 3 foetal layers.

Examples : Primates (man, apes and monkey).

(5) **Haemo-endothelial :** Foetal capillaries indirect contact with maternal blood, only one placental barrier.

Examples : Rat, guinea pig and rabbit.

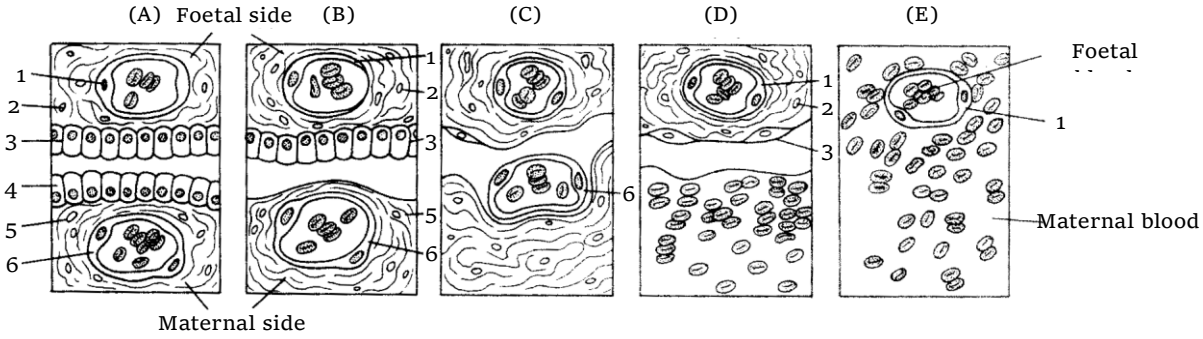

Fig : Histological types of placenta
(A) Epithelio-chorial, (B) Syndesmo-chorial, (C) Endothelio-chorial, (D) Haemo-chorial, (E) Haemo-endothelial, (1) Endothelium of foetal blood vessel, (2) Chorionic connective tissue (3) Chorionic epithelium, (4) Uterine epithelium, (5) Uterine connective tissue (6) Endothelium of maternal blood vessel

(c) **According to shape and distribution of villi :** Depending on the shape of placenta, manner of distribution of villi, degree of connection between foetal and maternal tissues and behaviour of placenta at the time of birth, the following types and subtypes of allantoic placenta can be recognized.

(1) **Non deciduous placenta :** In most mammals villi are simple, unbranched and merely opposed without intimate contact between foetus and uterine wall. At the time of birth or parturition, villi are easily withdrawn from maternal crypts without causing any tissue damage. Thus no part of uterine tissue comes out and no bleeding occurs. Non deciduous or non-deciduate placenta has following subtypes according to the manner of distribution of villi.

(i) **Diffuse :** Villi remain scattered all over the surface of allantochorion. *e.g.* pig, horse, lemur.

(ii) **Cotyledonary :** Villi are arranged in separate tufts or patches called cotyledons. *e.g.* goat, sheep, cow, deer.

(iii) **Intermediate :** Villi are arranged in cotyledons as well as scattered. *e.g.* camel, giraffe.

(2) **Deciduous placenta :** Villi are complicated, branched and intimately connected. At birth, a variable amount of

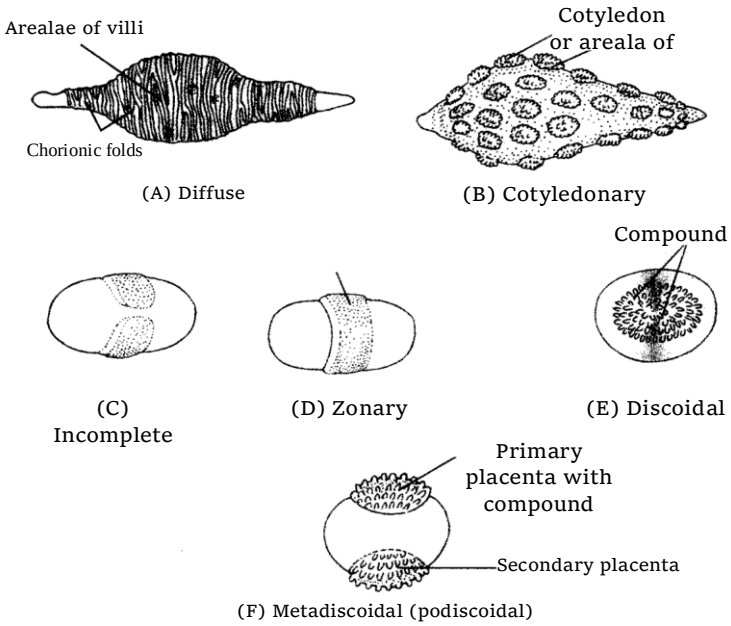

Fig : Types of placentae according to the distribution of villi

maternal tissue is pulled out with the shedding of blood. Deciduous or deciduate placenta is also differentiated in the following subtypes

(i) **Zonary :** Villi form an incomplete (*e.g.* racoon) or complete girdle encircling the blastocyst. *e.g.* cat, dog, seal.

(ii) **Discoidal :** Villi are restricted to a circular disc or plate on the dorsal surface of blastocyst. *e.g.* insectivores, bats, rodents (rat, mouse), rabbit, bear.

(iii) **Metadiscoidal :** Villi are at first scattered but later become restricted to one or two discs. It is monodiscoidal in man and bidiscoidal in monkeys and apes.

(3) **Contra-deciduous :** Foetal villi and uterine crypts are so intimately connected that even most of foetal placenta is left behind at birth to be broken and absorbed by maternal leucocytes *e.g.* bandicoot (perameles), mole (Talpa).

Important Tips

- **Yolk sac** is also found in some anamniotes like certain cartilage fishes (e.g. **Scoliodon**), bony fishes and a few amphibians (e.g. Necturus) having polylecithal egg.
- **Amnion, chorion and allantois** are formed only in amniotes embryo as their development occurs on land either inside egg or in the uterus of mother. These are not formed in anamniotes as their development occurs in water so there is no problem of dessication, supply of oxygen and removal of oxygen.
- **Splanchnopleur :** A fold formed of endoderm and splanchnic mesoderm.
- **Somatopleur :** A fold formed of ectoderm and somatic mesoderm.
- **Amniocentesis :** Prenatal diagnostic technique in which amniotic fluid is withdrawn to know sex of developing foetus congential chromosome defects and inborn errors of metabolism.
- Human placenta is fully formed in about 10 weeks and lasts throughout pregnancy.
- Presence of HCG in the urine sample of a female confirm the pregnancy.

12.10 Gestation period and parturition

(i) **Gestation period :** Gestation period is the duration between fertilization and parturition.

Gestation period

S.No.	Animal	Days
(1)	Mouse (Minimum)	19-20
(2)	Rat	20-22
(3)	Rabbit	28-32
(4)	Cat	52-65
(5)	Dog	60-65

(6)	Pig	112-120
(7)	Goat	145-155
(8)	Man	270-290
(9)	Cow	275-290
(10)	Horse	330-345
(11)	Elephant (Maximum)	607-641

(ii) **Parturition :** It is the expelling of the fully formed young from the mother's uterus after the gestation period (about 280 days in human female).

(a) **Mechanism :** A developing foetus secretes hormones from its adrenal glands. These hormones diffuse into the maternal blood and accumulate to stimulate the release of **oxytocin** (birth hormone) from the mother's posterior pituitary. Oxytocin causes the forceful contraction of smooth muscles of myometrium, called **labour pains** which pushes the young gradually out through the dilated cervix (caused by relaxin) and vagina, with the head foremost. It is aided by a **reflex** (whose centre lies in the lumbar region of spinal cord) and voluntary contraction of **abdominal muscles**. In the beginning, the labour pains occur once every half or quarter of an hour but soon become more frequent. The foetal membranes burst and amniotic fluid is released but foetal membranes remain behind. This **expulsion stage** lasts about 20 minutes to one hour. It is followed by **placental stage** of 10-45 minutes during which the umbilical cord, placenta and foetal membranes are expelled as **decidua** or **after birth**. It is because after the child birth, the uterus reduces in size causing detachment of placenta. Umbilical cord is tied and then cut which finally shrinks into a depressed scar called **umblicus** or **navel**. Sometimes, the foetus fails to come out then the baby is delivered by a surgical procedure. Such a baby is called **cesarean**.

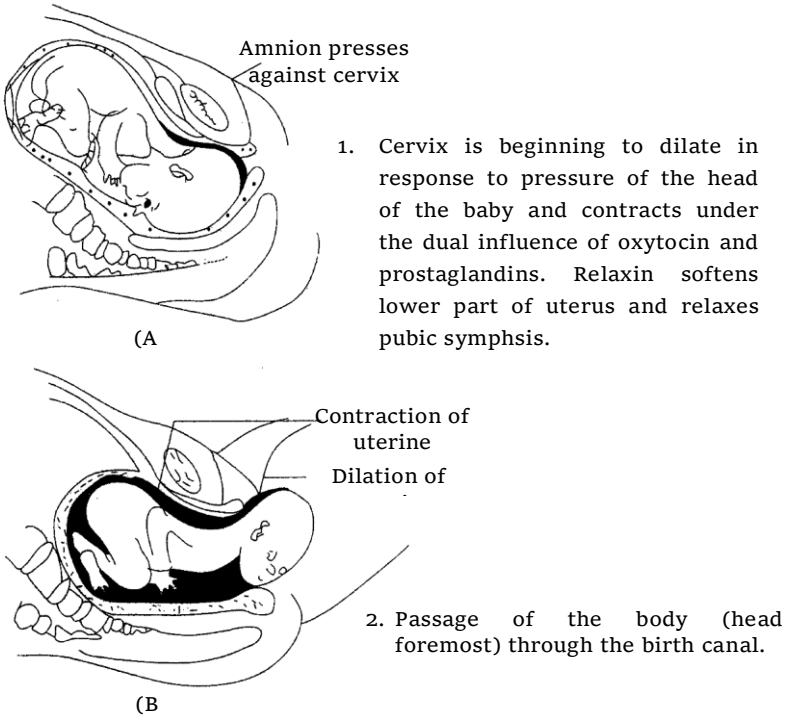

Fig : Two stages in parturition. The placental hormones play a critical role in tandem with oxytocin

(b) **Control :** Parturition is controlled by hormones :

(1) **Oxytocin :** Causes powerful contractions of myometrium during parturition.

(2) **Relaxin :** Causes widening of pelvis by relaxing the pubic symphysis of the pelvic girdles.

Important Tips

- Teratogens are those physical, chemical and biological agents, which may cause malformations in the developing embryo.
- **Teratology :** Branch of developmental biology which deals with the study of abnormal development during embryogenesis.
- **Morning sickness :** A desire for unusual food during pregnancy.
- **Gestosis :** Any disorder of pregnancy.
- **Postpartum care :** Care after childbirth.
- **Lanugo :** Most of the body of foetus is covered with downy hairs called lanugo which are generally shed before birth
- **Uterine milk :** Nutritive endometrial secretion.
- **Miscarriage or Abortion :** Loss of embryo due to breakdown of endometrium due to lowering of progesteron secretion from corpus luteum.
- **Nidiculous or Altricial young :** Underdeveloped and helpless young born e.g. cats, dogs, rats, etc.
- **Phocomelia :** Abnormal baby born with flipper-like limbs due to continued use of **Thalidomise** (sleeping pills) by the pregnant female. This drug passes through placental care.

12.11 Development in Frog

(i) **Breeding**

- Frog breeds in the rainy season, June to September.
- Male frogs produce crocking sound (mating call) by their vocal sacs.
- The sexual embrace of the male and female frogs is called amplexus (false copulation).

(ii) **Ovulation**

- Ovulation is the release of eggs from ovary in the body cavity.
- The eggs in the stage of secondary oocytes are released into the body cavity by rupture of ovary during ovulation.

(iii) **Spawning**

- Spawning is the act of laying of eggs by the female frog stimulated by the male during amplexus.
- **Spawn** is a cluster or mass of eggs laid by a female.
- A spawn of *Rana tigrina* contains about 3000-4000 eggs.
- The diameter of frog's egg varies from about 0.75 to 2.5 *mm*.
- The egg is surrounded by a thin vitelline membrane and three layers of jelly coats made of gelatin.
- Gelatin protects the egg from predators and also acts as an insulator keeping the egg warm.

(iv) **Fertilization**

- Fertilization in frog is external taking place in water.

- The sperms are released on the egg mass before it reaches water.
- When a sperm enters into the egg of frog, second meiotic division occurs.
- A sperm enters into the ovum at some point in animal hemisphere.
- A **gray crescent** appears in the equitorial zone geometrically opposite to the sperm entrance.
- Gray crescent marks the dorsal side of the future embryo.
- Sperm entrance point marks the anterior side of the future embryo.
- The bilateral organization is established at the time of sperm penetration.
- The region where sperm enter the egg cell is called '**reception cone**'.
- Entry of sperm induces following changes in the ovum

❑ Formation of fertilization membrane around the ovum.

❑ Completion of second maturation division of egg nucleus.

❑ Activation of the egg for development.

❑ Fusion of male and female pronuclei, *i.e.*, **amphimixis**.

❑ Formation of gray crescent.

(v) **Structure of egg**

- Frog's egg is mesolecithal (based on distribution of yolk).
- Upper black of darkly pigmented part is **animal hemisphere**. Lower unpigmented or white part is **vegetal hemisphere**.
- Cytoplasm is concentrated in animal pole. It is directed dorsally and pigmented animal pole is related with camouflage, to escape notice of predators.
- Vegetal hemisphere of frog's egg contain yolk. It remains directed downwards.
- The correct sequence in the development of frog is fertilization, cleavage, morula, blastula and gastrula.

(vi) **Cleavage**

- Cleavage is a term used for the early cell divisions of the zygote upto the completion of blastula stage.
- First cleavage of frog is **meridional** passing through median longitudinal axis, **holoblastic** and equal.
- The first cleavage furrow appears at animal pole and results in two blastomeres, right and left.
- The second cleavage is right angle to first one, again meridional results in four blastomeres, identical with respect to cytoplasm, pigment and yolk gradient.
- Second cleavage is again holoblastic and equal.
- Gray crescent is present only in two blastomeres of future dorsal side.
- All divisions from third cleavage are **unequal holoblastic**.
- Holoblastic equal cleavage in frog ends after second cleavage division.
- Third cleavage plane is **horizontal**, but above the level of equator (latitudinal).

- Third cleavage results in the formation of embryo with eight blastomeres, four upper one are smaller and pigmented and four lower most are larger and yolk laden.
- Smaller cells are **micromeres** and larger ones are called **macromeres**. The micromeres contain no yolk and macromeres contain large amount of yolk.
- Fourth cleavage involves two synchronous meridional divisions resulting in the formation of 16 blastomeres.
- Fifth cleavage involves two simultaneous latitudinal divisions resulting in the formation of 32 blastomeres.
- The divisions after the fifth cleavage becomes very irregular and asynchronous. The micromeres divide faster than macromeres.
- After sixth or seventh cleavage division, the embryo looks like a mulberry-shaped ball of cells. This called morula stage.
- **Morula** is a solid ball of cells. A cavity called blastocoel appears towards animal hemisphere. The blastula of frog is called **coeloblastula.**
- Blastocoel is filled with an albuminous fluid secreted by surrounding cells.
- The two cells of frog's egg formed by the first cleavage represent the right and left half of the embryo.
- In frog, there is a **regulative development**. The cleavage is **indeterminate**. If one of the two blastomeres of frog is damaged, the development will be normal.

(vii) **Gastrulation**

- Gastrulaion is the process by which a blastula is converted into gastrula.
- Blastula is a hollow ball of cells. By the end of gastrulation, it is converted into a three-layered embryo made of ectoderm, mesoderm and endoderm often enclosing an **archenteron**.
- Gastrulation includes three kinds of morphogenetic movements of cells namely

❑ Epiboly of ectoderm

❑ Invagination of endoderm

❑ Involution of chordamesoderm

- Epiboly is migration and spreading of micromeres over the embryo is known as epiboly.
- Invagination of prospective endoderm cells occurs below equator, exactly below the midpoint of gray crescent of blastula. It results in the formation of a slit later giving rise to blastopore.
- Involution is the insinking and movement of chordamesoderm cells towards anterior side along the roof of blastocoel.
- Gastrulation results in the formation of a new cavity, archenteron which opens outside through blastopore.
- Archenteron is present the lumen of future gut.
- Blastopore occurs in gastrula and opens into archenteron.
- Blastopore will give rise to future anus in frog.

- If involution does not takes place (chordamesoderm cells evaginates instead of involution) no gastrulation takes place. The development will be stopped.
- Ingression is the migration of individual vegetal cells to the interior of the embryo.
- By the end of gastrulation, blastocoel will be reduced. A yolk plug of endodermal origin closes the blastopore.
- Posterior side of future tadpole is represented by the side of frog's embryo bearing the yolk plug.

(viii) **Organizer**

- The dorsal lip of blastopore in the amphibian gastrula is called **primary organizer**.
- The theory of organizer (inductor) in amphibian was introduced by **Spemann** in 1938. He was awarded Nobel prize for this work.

(ix) **Neurulation**

- Neurulation takes place after gastrulation. During this stage a neural tube is formed.
- The embryo lengthens along its anterior-posterior axis, neural plate (ectodermal) become thickened and raised above the general level as ridges called neural folds.
- Neural folds meet and fuse at the mid dorsal line.
- Neurulation includes the formation of neural tube, notochord and gut.
- Formation of notochord is known as **notogenesis**.

(a) **Post neurular development**

❑ The development takes place inside egg membrane upto tail bud larval stage.

❑ Hatching occurs in 6^{th} day of embryonic life.

❑ During hatching, the young frog is called **tadpole larva.**

❑ Newly hatched tadpole larva remain attached to aquatic plants by its oral sucker.

❑ After 24 hours of hatching, mouth and anus are perforated.

❑ The larval body is elongated forming head, trunk and tail.

(b) **External gill stage of tadpole**

❑ Just above one day after hatching, the external gill stage starts.

❑ Eyes become fully developed and functional.

❑ Horny jaws with teeth appear along the rim of mouth.

❑ Tail elongates and becomes a powerful swimming organ.

❑ **Pronephric** kidneys become fully developed. Frog's tadpoles are **ammonotelic**. Nitrogenous waste matter excreted by frog's tadpole is **ammonia**.

❑ The branchial clefts are perforated and finger-like external gills project from the sides of the head in branchial region.

❑ External gills are **three pairs** in number; tadpole respires mainly by gills using oxygen dissolved in water.

❑ Gut is differentiated into pharynx, oesophagus, lung rudiments, stomach, liver, gall bladder and intestine.

❑ Tadpole is **herbivorous** (phytophagus), feeds on aquatic plants.

❑ Tadpole has a long coiled intestine because digestion takes place relatively long time.

(c) **Internal gill stage of tadpole**

❑ Tadpoles grow older, the hind limb buds and internal gills develop.

❑ External gills are replaced by **four pairs** of internal gills covered with a fold of skin called **operculum**.

❑ Operculum encloses a chamber, opercular chamber, opens to exterior by **spiracle**.

❑ Spiracle is present only on the **left side** of the tadpole.

❑ During respiration, the water currents enter the mouth, bath the gills of pharynx and exit through the spiracle.

❑ Oral sucker disappear and **lateral line receptor** develop. This serves to perceive stimuli of movements, currents and vibrations of water.

❑ A tadpole of frog resembles a fish in many features except that the tadpole does not possess paired fins and scales on the body.

❑ The tadpole cannot survive when exposed to air because its skin is thin and delicate.

❑ Exposure of tadpole to land leads to dehydration and death.

❑ First sign of metamorphosis is the appearance of hind limbs.

❑ End of tadpole in the life history is marked by appearance of forelimbs.

(x) **Metamorphosis**

- Metamorphosis is the abrupt transition from larval to adult form.
- Metamorphosis includes morphological, anatomical, physiological and behavioural changes.
- Two or three weeks after breathing with gills, the tadpole larva undergoes drastic changes called metamorphosis.
- Two types of changes during metamorphosis are **regressive** and **progressive**.
- Some of the regressive morphological changes are :

Disappearance of larval sucker, long tail, gill clefts, internal gills and lateral line sense organ.

- Some of the **progressive morphological** changes are :

❑ Formation of forlimbs breaking through operculum.

❑ Replacement of **pronephros** with **mesonephric kidney**.

❑ Enlargement and development of hindlimbs.

❑ Development of tongue and teeth.

❑ Thickening of skin and development of mucous glands.

❑ Two chambered heart becomes three chambered.

❑ Development of lungs.

- During metamorphosis, the disappearance of larval organs is by histolysis and formation of adult organs is by histogenesis.
- The tail is shortened by reabsorption with the help of lysosomal enzyme **cathepsin**. This process is also known as **autolysis**.
- Nervous system undergoes no special changes (least changes) during metamorphosis.
- Respiratory system undergoes maximum changes during metamorphosis.
- During metamorphosis, skin gets cornified and mucous and poison glands develop.
- The feeding habit changes from herbivorous habit of tadpole to carnivorous habit of adult.

(xi) **Hormonal control of metamorphosis**

- Hormonal control of metamorphosis in amphibian was discovered by **Gudernatsch** (1912).
- Metamosphosis occurs only when adequate amount of **thyroxine** is secreted by thyroid of tadpole.
- Since **iodine** is the main constituent of thyroxine, it is found that deficiency or abundance of iodine in pond water also affect metamorphosis.
- When there is no iodine in pond water or thyroxine is not secreted in the body, metamorphosis fail to begin. The tadpole continues growing and becomes abnormally large.
- If thyroxine is given, the tadpoles metamorphose too rapidly giving rise to vary small black frogs which soon die.
- If thyroids are removed, giant tadpoles can be reared which are unable to metamorphose.
- On removing the thyroid from the tadpole of frog, it will remain tadpole throughout life.
- If a small quantity of thyroid extract is added to water in which frog tadpoles are present, it will hasten the metamorphosis.
- The endocrine gland which initiates metamorphosis in frog is **thyroid.**
- Thiourea is antithyroid drug, it inhibits metamorphosis of frog.

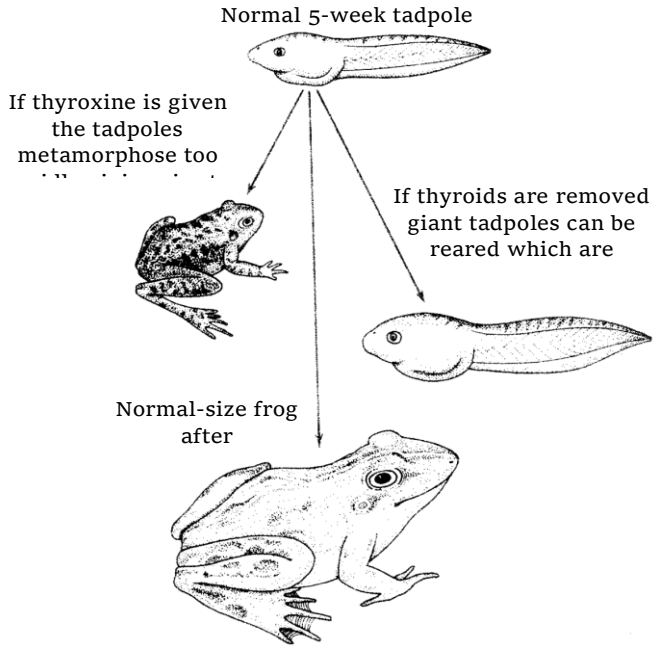

Fig : The effect of thyroxine on metamorphosis of tadpoles

• Neoteny refers to the retention of a larval or embryonic trait in the adult body, *e.g.*, Cartilaginous skeleton in adult chondrichthyes and larval gills in some adult salamanders.

• Paedogenesis or paedomorphosis refers to development of gonads and production of young ones by larval or pre adult animal *e.g.* liverfluke and ambystoma.

- Deficiency of iodine in the soil results in the failure of metamorphosis in ambystoma.
- Axolotl is the larva of ambystoma, it shows paedogenesis.

Important Tips

- **Metamorphosis :** Transformation of young into a morphologically and physiologically different adult is called **metamorphosis**.

  It is of 2 types :

- **Retrogressive metamorphosis :** When an advanced larva changes into a degenerate adult e.g. **Herdmania, Sacculina**.
- **Progressive metamorphosis :** When a simplified larva changes into an advanced adult e.g. **Frog**.
- **Embryonic induction :** Morphogenetic effect of one embryonic part on another embryonic part. Inducing embryonic part is called **inductor** or **organizer**, while responding embryonic part is called **responding tissue**. This induction is through certain chemicals called **evocators**.
- **Primary organizers** include dorsal lip of **blastopore; grey crescent** (neural inductor) and **chorda-mesoderm** (induces forebrain).
- **Secondary organizer** e.g. optic area induces formation of lens.
- **Tertiary organizer** e.g. Lens induces formation of cornea.

ASSIGNMENT

FERTILIZATION

Basic Level

1. What helps in the penetration of egg by the sperm
   (a) Fertilizin (b) Antifertilizin
   (c) Sperm lysin (d) Fertilization membrane
2. After a sperm has penetrated an ovum in the process of fertilization, entry of further sperms is prevented by
   (a) Development of the vitelline membrane (b) Development of the pigment coat
   (c) Condensation of yolk (d) Formation of fertilization membrane
3. Sperm entry into the ovum is assisted by
   (a) Fertilizin (b) Antifertilizin (c) Hyalunic acid (d) Hyaluronidase
4. External stimulus which induces cleavage in an unfertilized ovum is called
   (a) Fertilization (b) Chemotaxis (c) Paedogenesis (d) Neoteny
5. Function of fertilizin is/are
   (a) Makes the sperm sticky (b) Clumping of sperms
   (c) Makes sperm to adhere the surface of egg (d) All the above
6. During the development, the point of entry of sperm in the eggs at fertilization
   (a) Establishes the antereo- posterior axis (b) Forms the centre of rotation of egg
   (c) Forms the grey crescent (d) Forms the dorsal lip of blastopore
7. The point of sperm entry during fertilization forms
   (a) Centre of rotation of embryo (b) Axis of cleavage
   (c) Grey crescent (d) Dorsal lip of blastopore
8. The rule of embryonic development was given by
   (a) Von baer (b) Haeckel (c) Wallace (d) Morgan
9. Fertilizin is a chemical substance produced from
   (a) Mature eggs (b) Acrosome
   (c) Polar bodies (d) Middle piece of sperm
10. Just after fertilization the first change is
   (a) Formation of grey crescent (b) Activation of egg
   (c) Formation of receptacle cone (d) Cortical reaction
11. Androgamones are secretions from
   (a) Sperm (b) Ovum (c) Testes (d) Uterus masculinus
12. Culperine is a protein present in the sperm head of
   (a) Salmon fish (b) Birds (c) Mammals (d) Frog

13. After the sperm entry into the egg cytoplasm rotates through
(a) 180^o (b) 90^o (c) 75^o (d) 60^o

14. Antifertilizins are contained in
(a) Spermatozoa (b) Ovary (c) Testis (d) Germinal epithelium

15. Gyanogamones are secretions from
(a) Ovum or unfertilized egg (b) Spermatids (c) Cells of Graffian follicle (d) Ovary

16. Penetration of ovum by sperm during fertilization is done by the
(a) Acrosome (b) Mitochondria (c) Centrosome (d) None of the above

17. The acrosome plays important role in
(a) Motility of sperm (b) Penetrations of ovum by sperm
(c) Providing energy to sperm (d) None of the above

18. In mammals the egg when released from ovary is commonly encased in a layer of cells of ovarian origin, corona radiata. These cells are held together by a cementing substance known as
(a) Hyaluronidase (b) Hyaluronic acid (c) Hydrochloric acid (d) All the above

19. Repressor theory of activation of fertilization was given by
(a) Heilbrunn (b) Runnstrom (c) Monray and Tyler (d) Batallion

20. The hormones of the sperm are called
(a) Gynogamones-I (b) Androgamones (c) Gynogamones-II (d) None of the above

21. In mature oocytes cortical granules are formed on which side of plasmalemma
(a) Outer (b) Inner (c) Upper (d) All the above

22. The fertilization membrane during fertilization is synthesized by
(a) Mitochondria (b)Golgi bodies
(c) Acid mucopolysaccharides of cortical granules (d)All the above

23. Basic requirement of external fertilization is
(a) Delivery of large quantities of spermatozoa
(b) Delivery of spermatozoa in the body of female
(c) Both (a) and (b) (d) None of the above

24. Movement of sperm is done by
(a) Tail (b) Head (c) Acrosome (d) Middle piece

25. Chemical substance present on the surface of sperm is
(a) Hyalouronidase (b) Antifertilizin (c) Agglutinin (d) Fertilizin

26. Breaking of acrosome membrane is
(a) Agglutination (b) Activation (c) Cavitation (d) Capacitation

27. Onset of pregnancy
(a) Stimulates testosterone secretion (b) Inhibits further ovulation
(c) Leads to degeneration of ovary (d) Inhibits fusion of egg and sperm nuclei

28. Acrosome aids the sperm to
(a) Penetrate vitelline membrane of ovum (b) Find ovum
(c) Swim (d) Higher activity

29. At the time of fertilization
(a) First maturation division is completed (b) Embryo is formed
(c) Second maturation division is completed (d) First polar body is formed

30. Which chemical of the egg attracts and holds sperm
(a) Fertilizin (b) Antifertilizin (c) Agglutin (d) Antiagglutin

31. Sperms produce an enzymatic substance for dissolving egg coverings. It is called
(a) Hyaluronic acid (b) Hyaluronidase (c) Androgamone (d) Diastase

32. In corona radiata, the cells are held together by
(a) Cytoplasmic connections (b) Cell membrane interdigitations
(c) Thin layer of intercellular cement (d) Hyaluronic acid

33. Cells of corona radiata disperse just
(a) After fertilization (b) Before implantation
(c) At the time of coming in contact with sperm (d) After cleavage

34. Fertilization was first discovered by
(a) Aristotle (b) Leeuwenhoek (c) Harvey (d) Pander

35. Centrioles of sperm control
(a) Movement of tail (b) Haploid number of chromosomes
(c) Help in fertilization (d) None of the above

36. The fertilization membrane is secreted because
(a) It checks the entry of more sperms after fertilization
(b) It checks the entry of antigens in ovum
(c) It represents the left out tail of sperm (d) It represents the plasma membrane of sperm

37. Site of fertilization in a mammal is
(a) Ovary (b) Uterus (c) Vagina (d) Fallopian tube

38. Hyaluronidase is present in
(a) Ovary (b) Ovum (c) Sperm (d) Blood

39. Fertilization occurs in humans in
(a) Ovary (b) Fallopian tube (c) Vasa deferentia (d) Outside the body

40. Fertilization is fusion of
(a) Diploid spermatozoan with diploid ovum to form diploid zygote
(b) Haploid spermatozoan with diploid ovum to form diploid zygote
(c) Diploid spermatozoan with haploid ovum to form diploid zygote
(d) Haploid spermatozoan with haploid ovum to form diploid zygote.

41. Part of sperm involved in penetrating egg membrane is
(a) Tail (b) Acrosome (c) Allosome (d) Autosome

42. Mobility of mature sperm is controlled by mitochondria present in
(a) Head (b) Middle piece (c) Tail (d) All the above

43. Ovum receives the sperm in the region of
(a) Animal pole (b) Vegetal pole (c) Equator (d) Pigmented area

44. Enzyme secreted by sperm is
(a) Sperm trypsin (b) Sperm lysin (c) Male hormone (d) Sperm gastrin

45. A crosomal reaction occurs during
(a) Copulation (b) Puberty (c) Menopause (d) Fertilization

46. Maturation of sperm before penetration of ovum is called
(a) Capacitation (b) Spermatid (c) Ovulation (d) None of the above

47. Through which part of egg, the sperm enters
(a) Micropyle (b) Animal pole (c) Megapyle (d) Vegetal pole

48. Polyspermy refers to
(a) Changes in sperm nucleus (b) Formation of many sperms
(c) Penetration of many sperms into an ovum simultaneously
(d) None of the above

49. Following are some stages in the embryonic development
(1) Organ formation (2) Blastulation (3) Gametogenesis
(4) Gastrulation (5) Fertitization
Correct developmental sequence is
(a) 5, 3, 2, 4, 1 (b) 3, 5, 2, 4, 1 (c) 1, 2, 3, 4, 5 (d) 5, 4, 3, 2, 1

50. The region where sperm enters the egg is called
(a) Equator (b) Reception cone (c) Micropyle (d) Vegetal pole

51. The main significance of fertilization is to
(a) Restore chromosome number (b)Double chromosome number
(c) Reduce chromosome number (d)None of the above

52. Grey-crescent is an area formed soon after fertilization in
(a) Zygote of all animals (b)Zygote of non chordates
(c) Zygote of vertebrates (d)Blastula of vertebrates

53. Motion of sperm is
(a) Chemotaxis (b) Rheotaxis (c) Hydrotropism (d) Random

54. Corticle granules composed of
(a) Albumin (b) Keratin (c) Mucopolysaccharide (d) Melanin

55. Hyaluronic acid which binds corona radiata cells is a
(a) Hommopoly saccharide (b)Amino acid (c) Mucopoly saccharide (d)Glyco protein

56. Polyspermy is of common occurrence in
(a) Frog (b) Man (c) Birds (d) Sea-urchin

57. The life history of an organism completed in the egg or in womb of the mother is called

(a) Post natal development (b)Pre-natal development

(c) Antogenetic development (d) All the above

Advance Level

58. Conjoint twins are those which

(a) Develop from same zygote (b) Develop from two different zygotes

(c) Are wholly or partly fused (d) Are fused by placenta

59. Which statement is correct for fertilization

(a) Restore euploidy (b) Brings male & female gametes together

(c) Entry of whole sperm in egg (d) All of these

60. Who demonstrated the acrosome reaction in *Saccoglossus*

(a) F.R. Lillie (1919) (b) Colwin and Colwin (1967)

(c) Both (a) and (b) (d) None of the above

61. Cortical granules on swelling and exploding release

(a) Lamellar and folded parts (b) Globules

(c) Liquid material (d) All the above

62. Cortical granules are absent in

(a) Bony fishes (b) Frog (c) Mammals (d) Rat and guinea pig

63. Sperm nucleus follows which path for fertilization

(a) Sperm path (b) Copulation path (c) Both (a) and (b) (d) None of the above

64. Which of the following statement is not correct

(a) Fertilizin of one species of animal will react with antifertilizin of another species

(b) Fertilizin of one species of animal will react with antifertilizin of the same species

(c) Fertilizin is a glycoprotein and antifertilizins are acidic proteins

(d) Molecular weight of fertilizin is about 3, 00, 000 and antifertilizin 10,000

65. The plasma membrane of oocyte and that of follicle cells show close connections at some points in the form of

(a) Microvilli (b) Desmosomes

(c) Cytoplasmic processes (d)None of the above

66. Function of gynogamone-I is

(a) Conserves sperm activity

(b) Dissolves vitelline membrane

(c) Neutralizes androgamone-I thereby increasing sperm activity

(d) Makes sperm head sticky to facilitate attachment of sperm to egg surface

67. Sperm of animal species *a* cannot fertilize ovum of species *b* because

(a) Fertilizin of *a* and *b* are not compatible

(b)Antifertizin of *a* and *b* are not compatible

(c) Fertilizin of *a* and antifertilizin of *b* are not compatible

(d)Antifertilizin of *a* and fertilizin of *b* are not compatible

68. First step in activation of ovum during process of fertilization is

(a) Formation of fertilization membrane (b) Fertilizin-antiferilizin reaction

(c) Penetration of sperm in ovum (d) Formation of fertilization cone

69. Cortical granules are associated with

(a) Oogenesis (b) Spermatogenesis (c) Cleavage (d) Fertilization

70. Acrosome reaction in sperm is triggered by

(a) Capacitation (b) Release of lysin (c) Influx of Na^+ (d) Release of fertilizin

71. On fertilization of egg nucleus with sperm nucleus

(a) Second maturation is completed (b)Embryo is formed

(c) First polar body is formed (d) First maturation is completed

72. What is true about the process of fertilization

(a) Only acrosome of sperm enters the egg

(b) Two haploid nuclei fuse but the fusion nucleus divides immediately to form two haploid nuclei

(c) Entry of sperm activates the egg to complete meiosis-I

(d) Only one sperm enters in egg

73. The rate of active movement of sperms is

(a) 1.5-3. 0 cm/min. (b) 1.5-3. 0 mm/min (c) 1.5 –3. 0 m/min (d) 1.5-3.0 m/hr

74. Enzyme hyaluronidase is synthesised in

(a) Head of sperm (b) Golgi bodies of acrosome

(c) Lysosome of acrosome (d) Tail of sperm

75. During fertilization of frog egg, cortical reaction occurs

(a) Before the penetration of sperm (b) After the fusion of the two nuclei

(c) Soon after the penetration of sperm (d) At the time of contact of sperm with egg

76. Drugs that cause malformation in embroyo during pregnancy are called

(a) Nicotin (b) Sedatives (c) Teratogens (d) Tranquillizer

77. Non-participation of male pronucleus in fertilization is

(a) Polygyny (b) Polyandry (c) Androgenesis (d) Gynogenesis

78. The function of bind (a protein) in the acrosomal process is to

(a) Prevent more than one sperm entering in to the egg

(b) Digest the vitelline layer

(c) Ensure that the egg is being fertilized by a sperm of the same species

(d) Severe the sperm's tail

79. The slow block to polyspermy develops in response to the

(a) Opening of sodium gates in the plasma membrane(b)Release of bindin

(c) Spreading of the fertilization cone around egg (d)Formation of fertilization membrane

80. After fertilization, the vitelline membrane gets separated from the plasma membrane. This is

(a) To prevent polyspermy (b)Facilitate cleavage

(c) To maintain osmotic tension (d)For free cell movement during gastrulation

81. Antifertilizin is

(a) Glycoprotein (b) Acidic protein (c) Carbohydrate (d) None of the above

82. Type of fertilyzation (external or internal) depends on

(a) Structure of egg (b) Site of embryo developement

(c) Type of sperm (d) Both (a) and (b)

83. Androgamone-I

(a) Inhibits sperm activity (b)Stimulates sperm activity

(c) Stimulates ovum (d)Both (a) and (b)

CLEAVAGE

Basic Level

84. Unit cell of blastula is

(a) Micromere (b) Megamere (c) Blastomere (d) None of the above

85. In an egg, the type of cleavage is determined by the

(a) Shape and size of the sperm (b) Size and location of the nucleus

(c) Amount and distribution of yolk (d) Number of egg membranes

86. How many cleavages occur for the formation of 32 cells

(a) 3 (b) 4 (c) 5 (d) 6

87. The cleavage having incomplete division of egg is known as

(a) Holoblastic (b) Meroblastic (c) Meridional (d) Spiral

88. Blastula lacks

(a) Blastomeres (b) Blastoderm (c) Blastocoel (d) Blastopore

89. In spiral cleavage turn of spiral may be

(a) Clockwise (b) Anticlockwise (c) Both (a) and (b) (d) None of the above

90. Blastocyst is a modified blastula of

(a) Placental mammals (b) Frog (c) Fish (d) Birds

91. Cleavage in bird's egg is

(a) Equal and holoblastic (b)Unequal and holoblastic

(c) Discoidal meroblastic (d)Superficial meroblastic

92. The blastula of prototherians is called

(a) Blastocyst (b) Stereoblastula (c) Coeloblastula (d) Discoblastula

93. In frog equal holoblastic cleavage does not found due to

(a) A dark pigment in animal pole (b) Heavy yolk in vegetal pole

(c) Yolk concentrated in center of egg (d) Nucleus is assymetrical in position

94. Spiral cleavage is found in

(a) Synapta (b) Amphibia

(c) Nematoda, annelida and rotifera etc (d) None of the above

95. In teleosts fish, reptiles and birds the cleavage pattern is

(a) Equal holoblastic (b) Unequal holoblastic

(c) Incomplete meroblastic (d) Complete meroblastic

96. Cleavage is followed by which stage

(a) Invagination (b) Evagination (c) Gastrula (d) Blastula

97. Meroblastic cleavage is

(a) Partial cleavage (b) Spiral cleavage (c) Equal cleavage (d) Complete cleavage

98. The third phase in the development of a mammal is

(a) Cleavage (b) Gastrulation (c) Gametogenesis (d) Fertilization

99. Which distinguishes a morula from a blastula

(a) Presence of more yolk (b)Absence of yolk (c) Presence of a cavity (d) Absence of a cavity

100. If the first cleavage furrow divides the zygote completely into two, the cleavage type is

(a) Radial (b) Equatorial (c) Meroblastic (d) Holoblastic

101. In which stage is blastocoel formed

(a) Morula (b) Blastula (c) Gastrula (d) None of the above

102. Type of cleavage in fertilized egg depends on

(a) Amount of yolk (b) Number of cells

(c) Number of mitochondria in the sperm (d) Number of testes

103. What is true about cells during cleavage

(a) They move from animal pole to vegetal pole (b) They do not grow in size

(c) They consume little O_2 (d) Their divisions resemble ordinary mitosis

104. Cleavage divisions differ form normal mitotic divisions in that

(a) There is no nuclear division during cleavage

(b) There is no division of the cytoplasm during cleavage

(c) There is no period of growth in between the divisions

(d) The division of the cytoplasm follows nuclear divisions

105. When the cleavage furrow extends from animal pole is vegetal pole and does not bisects the egg equally into two blastomeres the plane of cleavage is

(a) Meridional (b) Equatorial (c) Latitudinal (d) Vertical

106. The cleavage is such method of divisions of fertilized egg in which the egg

(a) Does not divide but only increase in size (b) Divides repeatedly but without growth

(c) Divides repeatedly and grows (d) None of the above

107. How many cleavages are completed in16 celled stage of egg

(a) 3 (b) 4 (c) 8 (d) 12

108. The blastula in mammals is referred as

(a) Blastoderm (b) Blastodisc (c) Blastocyst (d) Coeloblastula

109. Type of cleavage found in mammals is

(a) Holoblastic (b) Meroblastic (c) Superficial (d) None of the above

110. If the nuclei from an 8-celled stage of an embryo are transplanted into enucleated eggs, which of the following events is likely to occur

(a) Formation of viable embryo in the recipient eggs (b)Donor nuclei die in the new environment

(c) Cleavage occurs but is arrested after some time (d)Recipient egg dies

111. Cleavage is found in

(a) Zygote (b) Eggs (c) Undivided cell (d) After gastrula stage

112. The superficial blastula is the characteristic of

(a) Birds (b) Reptiles (c) Insects (d) Annelids

113. Spiral cleavage is found in

(a) Coelenterata (b) Annelids (c) Echinodermata (d) Mollusca

114. Meroblastic cleavage takes place in

(a) Hydra (b) Amphioxus (c) Frog (d) Chick

115. During cleavage, what is true about cells

(a) Nucleocytoplasmic ratio remains unchanged (b) Size does not increase

(c) There is less consumption of oxygen (d) The division is like meiosis

116. Determinate cleavage is found in

(a) Sponges (b) Coelenterates (c) Annelids (d) Nematodes

117. Coeloblastula is found in

(a) Labeo (b) Snakes (c) Star fish (d) Unio

118. The discoblastula is found in

(a) Echidna (b) Man (c) Branchiostoma (d) Rana

119. In some eggs the future organs can be demarcated as to the regions even before the beginning of cleavage. It is

(a) Regulated development (b)Mosaic development

(c)Gynogenesis (d) Determined development

120. Amount of yolk and its distribution are changed in the egg. Which one is affected

(a) Pattern of cleavage (b) Formation of zygote (c) Number of blastomeres (d)Fertilization

121. In centrolecithal eggs, the cleavage is

(a) Equal holoblastic (b) Unequal holoblastic

(c) Meroblastic discoidal (d)Meroblastic superficial

122. Total cleavage is possible in eggs

(a) Isolecithal (b) Mesolecithal (c) Megalecithal (d) Telolecithal

123. In insect egg, cleavage is

(a) Equal holoblastic (b) Unequal holoblastic

(c) Meroblastic superficial (d) Meroblastic discoidal

124. Point of sperm entry forms

(a) Axis of cleavage (b) Grey crescent

(c) Dorsal lip of blastopore (d) Centre of embryo rotation

125. Type of cleavage that occurs in human zygote is

(a) Holoblastic and equal (b)Holoblastic and unequal

(c) Meroblastic discoidal (d)Meroblastic superficial

126. If an unfertilized egg is pricked with a microneedle it will

(a) Die immediately (b) Start dividing (c) Remain undivided (d) None of the above

127. Zona pellucida disintegrates just

(a) Before fertilization (b) After fertilization

(c) Midway during cleavage (d) After completion of cleavage

128. Holoblastic equal cleavage occurs in

(a) Insects (b) Frog (c) Birds (d) Mammals

129. During cleavage all divisions are

(a) Equal (b) Reductional (c) Mitotic (d) Determinate

130. The type of blastula formed in birds is

(a) Teloblastula (b) Holoblastula (c) Coeloblastula (d) Discoblastula

131. Blastocoel, used as yolk space in other vertebrates, possesses in mammals

(a) Yolk (b) Fat reserve (c) Outer cell mass (d) Trophoectoderm

132. Meroblastic cleavage is found in

(a) Bird (b) Frog (c) Lancet (d) Mammal

133. The hollow ball of cells formed from cleavage is called the

(a) Gastrula (b) Morula (c) Blastula (d) Neurula

134. Development of fertilized egg starts from

(a) Invagination (b) Fragmentation (c) Regeneration (d) Cleavage

135. Blastopore is

(a) The opening of neural tube (b) Found in blastula

(c) Present at future anterior end of embryo (d) The external opening of archenteron

136. Superficial blastula is found in

(a) Rabbit (b) Cockroach (c) Chick (d) Frog

137. Embryogenesis begins from

(a) Cleavage (b) Involution (c) Emboly (d) Gastrulation

138. When cleavage furrow passes through the centre of animal vegetal axis, cleavage is

(a) Meridional (b) Vertical (c) Equatorial (d) Latitudinal

139. Spiral cleavage occurs in

(a) Rabbit (b) Starfish (c) Earthworm (d) Frog

140. What is true of cleavage

(a) There is no growth of daughter cells

(b) Cytoplasm of blastomeres increases after each division

(c) Daughter cells or blastomeres grow in size equal to parent cell

(d) Blastomeres separate

141. A cell formed from cleavage is called a

(a) Blastomere (b) Morula (c) Neurula (d) Blastula

142. During cleavage one of the following remain same

(a) Size of egg (b) Volume of the egg (c) Both (d) None of the above

143. Cleavage in Hydra is

(a) Radial (b) Bilateral (c) Asymmetrical (d) None of the above

144. Spiral and determinate type of cleavage occurs in

(a) Ascaris (b) Mollusca (c) Frog (d) Both (a) and (b)

145. Spiral and determinate cleavage is common amongst

(a) Amphibia (b) Nematoda, annelids, mollusc

(c) Amniotes (d) Mollusca and amphibia

146. Cell division in zygote is called

(a) Cleavage (b) Segmentation (c) Cellulation (d) All the above

147. Fate mape of embryo is prepared in which stage

(a) Morula (b) Blastula (c) Gastrula (d) Neurula

148. Patterns of cleavage

(a) 2-types (b) 5-types (c) 4-types (d) 3-types

149. Who first prepared fat map of blastula by vital staining

(a) Vogt (b) Bismark (c) Von Baer (d) Spellanzani

150. Preparation of cell differentiation are completed in

(a) Morula (b) Blastula (c) Gastrula (d) Neurula

151. What happens in embryo during cleavage

(a) Decrease in cytoplasm and increase in nuclear material

(b) Increases in cytoplasm and decrease in nuclear material

(c) Decrease in both (d) Both remains constant

152. The blastula is mostly a

(a) Double layered embryo without cavity (b) Triple layered embryo enclosing a cavity

(c) Double layered embryo enclosing a cavity (d) Hollow spherical uniepithelial thick embryo

153. The size of blastomere is

(a) Equal to a normal body cell (b)Much smaller than a body cell

(c) Variable in individuals (d) More than body cell

154. As a result of oblique cleavage the symmetry produced is known as

(a) Radial (b) Biradial (c) Spiral (d) Bilateral

155. Which of the following is correct statement

(a) In blastulation major presumptive and organ forming areas are segregated into definite points of the blastoderm

(b) Blastulation establishes the three germinal layers

(c) Blastulation of frog is known as discoblastula

(d) Fluid filled space in blastula is known as archenteron

156. Implantation is the process of

(a) Fertilization of egg (b) Movement of egg

(c) Degeneration of egg (d) Attachment of blastocyst to the uterine wall

157. The solid mass of cells formed at the end of cleavage of mammalian egg is

(a) Blastula (b) Morula (c) Blastocyst (d) Blastodisc

158. The development of eye in vertebrate embryology is studied under

(a) Notogenesis (b) Neurogenesis (c) Mesogenesis (d) Organogenesis

159. The concept that organiser is essential for embryonic development was given by **or** For the 'theory of organiser'. Nobel prize was given to

(a) J. Axelrod (b) C. Landsteiner (c) H. Spemann (d) I. P. Pavlov

Advance Level

160. The rate of cleavage is inversely proportional to the duration of

(a) Anaphase (b) Metaphase (c) Interphase (d) Telophase

161. Which of the following structure is found in blastula

(a) Segmentation cavity (b) Notochord (c) Gill (d) Tail

162. In which of the following animal cleavage divisions are restricted to a small part of cytoplasm and nucleus in animal pole of egg

(a) Cockroach (b) Frog (c) Chick (d) Rabbit

163. Select the correct statement

(a) Cleavage follows gastrulation (b)Yolk content of egg has no role in cleavage

(c) Cleavage is repeated mitotic division of zygote

(d)Gastrulation and blastulation are followed by each other

164. Cleavage is unique form of mitotic cell division in which

(a) The nucleus does not participate (b) There is no growth of cells

(c) No spindle develops to guide the cells

(d) The plasma membranes of daughter cells do not separate

165. Holoblastic cleavage may occur in eggs which are

(a) Oligolecithal only (b) Mesolecithal only

(c) Macrolecithal only (d) Oligolecithal and mesloecithal both

166. As a result of cleavages, if blastomeres are symetrically placed around the polar axis the type of cleavage is known as

(a) Spiral (b) Discoidal (c) Biradial (d) Radial

167. Meroblastic cleavage refers to one of the following types of division of eggs

(a) Total (b) Partial (c) Spiral (d) Horizontal

168. The ratio of the nucleus to cytoplasm at the beginning of cleavage is

(a) Very low (b) Very high

(c) Normal (d) A bit higher than the normal

169. A blastula which is solid, is known as

(a) Stereoblastula (b) Coeloblastula (c) Superficial blastula (d) Discoblastula

170. When are the identical twins born

(a) One sperm fertilizes two ova

(b) One ovum is fertilized by two sperms

(c) Two ova are fertilized

(d) One fertilzed ovum divides into two blastomeres and both of them separate

171. Which of the following is true about cleavage in the fertilized egg in humans

(a) It is meroblastic (b) It is identical to the normal mitosis

(c) It starts when the egg reaches uterus (d) It starts while the egg is in fallopian tube

172. During the fourth and sixth cleavage of the zygote

(a) Mesomeres give rise to endoderm (b) Micromeres give rise to ectoderm

(c) Mesomeres give rise to mesoderm (d) Macromeres give rise to ectoderm

173. Periblastula is found in

(a) Man (b) Insects (c) Sycon (d) Reptiles

174. In which of the following animals is a discoblastula stage found

(a) Star fish (b) Frog (c) Bird (d) Insect

175. The term blastocyst is applied to the blastula of which one of the following

(a) Kangaroo (b) Platypus

(c) Monkey (d) Both kangaroo and monkey

176. In indeterminate cleavage the fate of blastomeres is fixed at which of the following stage

(a) Blastula (b) Gastrulation (c) 32-celled stage (d) 64-celled stage

177. The fluid filled in the blastocoel cavity of blastula is

(a) Acidic (b) Albuminous (c) Saline (d) Pure water

178. Embryologists can presume the future organs of the embryo in

(a) Blastula (b) Early gastrula (c) Morula (d) Post gastrula

179. Which of these sets of cells divide slowly

(a) Micromeres (b) Megameres (c) Blastomeres (d) Mesomeres

180. Fraternal twins in man are produced when

(a) Two sperms fertilize an ovum and the first two blastomeres separate from each other

(b) One sperm fertilizes an ovum and first two blastomeres separate from each other

(c) Egg develops parthenogenetically and first two blastomeres separate from each other

(d) Two ova are fertilized simultaneously

181. Which of the following is not evident that the pattern of cleavage is determined by factors in the egg cytoplasm rather than by genes of zygote

(a) Cleavage is prevented by injection of a protein synthesis inhibitor

(b) Cleavage is not affected by injection of inhibitors of RNA synthesis into the zygote

(c) Interspecific hybrid zygotes go through normal cleavage but die at the beginning of gastrulation

(d) The direction of the first division of cleavage in the snail Cepaea is determined by the mothers genotype (maternal effect)

182. In a mesolecithal egg, one would expect

(a) Meroblastic cleavage (b)Unequal holoblastic cleavage

(c) Equal holoblastic cleavage (d) None of the above

183. Meridional cleavage results in blastomeres numbering

(a) 8 (b) 4 (c) 10 (d) 16

184. Blastodisc or germinal disc refers to the protoplasm of egg, this is restricted to small area in

(a) Amphibian egg (b) Avian egg (c) Ascidian egg (d) Mammalian egg

185. Which one of the following statements with regard to embryonic development in humans is correct

(a) Cleavage division bring about considerable increase in the mass of protoplasm

(b) In the second cleavage division, one of the two blastomeres usually divides a little sooner than the second

(c) With more cleavage divisions, the resultant blastomeres become larger and larger

(d) Cleavage division results in hollow ball of cells called morula

186. Which is incorrect

(a) Fertilization occurs in fallopian tube (b) Fertilization is physico chemical event

(c) Cleavage leads to increased mass of protoplasm

(d) Cleavage produces morula

187. **Assertion**. Holoblastic cleavage with almost equal sized blastomeres is characteristic of placental mammal.

Reason. Eggs of most mammals including humans are centrolecithal

(a) Point out if both are true with reason being correct explanation

(b) Both correct but reason is not correct explanation

(c) Assertion true but reason wrong

(d) Both are wrong

188. During cleavage

(a) Size of resulting cells decreases (b)Size of resulting cells increases

(c) Size of early embryo increase (d)Size of early embryo decreases

189. **Assertion**. In morula stage the cell divides without increase in size.

Reason. Zona pellucida remains till cleavage is finished

(a) Point out if both are true with reason being correct explanation

(b) Both correct but reason is not correct explanation

(c) Assertion true but reason wrong

(d) Both are wrong

190. Nereis has

(a) Stereoblastula (b) Discoblastula (c) Coeloblastula (d) Superficial blastula

191. During cleavage, nucleocytoplasmic ratio (nucleus/ cytoplasm)

(a) Increases (b) Decreases (c) Remains same (d) None of the above

192. Monozygotic twins are produced when

(a) Two ova are fertilized simultaneously (b) Incomplete cleavage of zygote

(c) First cleavage of zygote is followed by separation into two

(d) There is no cleavage

193. Mosaic cleavage occurs in

(a) Camel (b) Dog fish (c) Whale (d) Echinococcus

194. In embryo, cleavage brings about

(a) Increased DNA content (b)Increased mass of protoplasm

(c) Increased size (d) Change in shape and size

195. The neurenteric canal opens to the outside by

(a) Mouth (b) Blastopore (c) Neuropore (d) None of these

196. Cleavage differs from mitosis because

(a) In cleavage there is no growth phase (b)In cleavage consumption of O_2 increases

(c) In cleavage nucleas-cytoplasmic ratio increases (d)All the above

197. Which of the following is incorrect

(a) Fertilization is a physicochemical event

(b) Cleavage of fertilized ovum results in blastula

(c) Fusion of sperm and ovum occurs in fallopian tube

(d) Cleavage leads to increase in the mass of protoplasm

198. Spiral cleavage is observed in

(a) Frog (b) Fish (c) Turbellaria (d) Hydra

199. Which three features are characteristic of protostome

(a) Spiral cleavage, indeterminate cleavage and schizocoely

(b) Spiral cleavage, indeterminate cleavage and enterocoely

(c) Spiral cleavage, determinate cleavage and enterocoely

(d) Spiral cleavage, determinate cleavage and schizocoely

200. In which type of cleavage, do the cleavage furrow divide a small amount of active cytoplasm at the animal pole

(a) Meroblastic (b) Holoblastic (c) Determinate (d) Unequal holoblastic

201. Meroblastic cleavage occurs during the development of

(a) Human (b) Pigeon (c) Frog (d) Dogfish

202. In centrolecithal eggs. The cleavage is

(a) Equal holoblastic (b) Unequal holoblastic

(c) Meroblastic discoidal (d) Meroblastic superficial

203. Cleavage differs from mitosis in that

(a) It occurs in all body cells (b) It occurs in zygote

(c) It results into identical daughter cells (d) It occurs only in vertebrates

204. During cleavage, the cell division is very rapid. The daughter cells do not undergo any growth and the cells thus become gradually smaller in volume. Hence

(a) There is no growth in the volume of the embryo

(b) The embryo grows in volume

(c) The embryo becomes smaller in volume (d) The embryo remains static

205. Which is mismatched

(a) Coeloblastula - Amphioxus (b) Stereoblastula- Neries

(c) Discoblastula-Birds (d) Amphiblastula-Reptiles

206. Cleavage can be inhibited by

(a) Decrease in oxygen (b) Increase in CO_2 (c) Colchicine (d) All the above

207. Rate of cleavage is inversely proportional to amount of yolk it is called

(a) Baer's law (b) Balfour's law (c) Sach's law (d) Hertwig's law

208. The first reported cleavage in mammalian egg was made in 1838 by

(a) Swammerdam and Spallanzani (b) Von Baer and Spallanzani

(c) Prevost and Dumas (d) Leeuwenhoek

209. The attachment of the mammalian blastocyst to the uterine wall is

(a) Incest (b) Implantation (c) Intromission (d) Incorporation

210. An avian blastula is called

(a) Blastocyst (b) Trophoblast (c) Blastoderm (d) Foetal blastula

211. Implantation of blastocysts occur on

(a) 4^{th} day (b) 5^{th} day (c) 6^{th} day (d) 7^{th} day

212. The branch of embryology which concerns with the study of abnormal embryonic development is termed as

(a) Gerantology (b) Teratology (c) Embryology (d) None of the above

213. Fertilised ovum is transplanted in uterus after

(a) 1 day (b) 7 days (c) 8 days (d) 10 days

GASTRULATION

Basic Level

214. During the development of an embryo, migration and rearrangement of cells lead to a pattern formation known as

(a) Epiboly (b) Emboly (c) Involution (d) Gastrulation

215. From which embryonic structure develops the vertebral column

(a) Neural canal (b) Archenteron (c) Notochord (d) Blastocoel

216. The endodermal derivatives includes

(a) Thyroid (b) Pineal gland (c) Spleen (d) Pituitary

217. Relative sizes of an egg cell, morula, blastula and gastrula are

(a) Egg cell is largest and morula is smallest (b) Egg cell is smallest and gastrula is largest

(c) Egg cell is largest and gastrula is smallest (d) All are of equal size

218. In which stage of development the embryonic cells form the germinal layers by the movement

(a) Morula (b) Blastula (c) Gastrula (d) Neurula

219. Skeletal muscle develops from

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) All the above

220. In vertebrates the nails are formed from

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Ecto-mesoderm

221. Nervous system in vertebrates develops from

(a) Endoderm (b) Ectoderm

(c) Mesoderm (d) Endoderm and mesoderm both

222. Gonads are derived from embryonic

(a) Mesoderm (b) Endoderm

(c) Ectoderm (d) Mesoderm and endoderm

223. Spleen develops from

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) None of the above

224. Neural canal develops from

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) All the above

225. Development of structure and shape of an organism is

(a) Morphology (b) Multiplication (c) Morphogenesis (d) Budding

226. The blastopore develops into future

(a) Mouth (b) Ear (c) Anus (d) Neuropore

227. The yolk plug of gastrula represents in the later stage its

(a) Anterior end (b) Posterior end (c) Dorsal side (d) Ventral side

228. From which layer of the embryo do the liver and pancreas develop

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Both (a) and (c)

229. The structure which differentiate gastrula from blastula

(a) 3 germ layers (b) Micromeres (c) Blastocoel (d) None of the above

230. Which one of the following list contains only the mesodermal structures

(a) Muscles, blood, notochord, liver (b) Bones, blood, heart, liver

(c) Muscles, blood, heart, liver (d) Bones, blood, heart, notochord

231. In which order, three germ layers appear in the development

(a) Ectoderm- mesoderm-endoderm (b) Ectoderm-endoderm- mesoderm

(c) Mesoderm- endoderm-ectoderm (d) None of the above

232. In the first phase of gastrulation of amphibians there occurs the separation of

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Mesoectoderm

233. Internal ear develops from

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) None of the above

234. Which cavity arises by the invagination of endoderm and mesoderm

(a) Coelenteron (b) Archenteron (c) Pseudocoel (d) Coelom

235. The epidermis of the skin is derived from the germinal layer

(a) Mesoderm (b) Endoderm (c) Ectoderm (d) Neuro-endoderm

236. During gastrulation ..... is formed

(a) Heart (b) Gill (c) Archenteron (d) Vitelline membrane

237. The only human system that is derived from all the three germ layers is

(a) Digestive system (b) Excretory system (c) Respiratory system (d) Nervous system

238. The formation of the notochord takes place by

(a) Primary ectoderm (b) Primary mesoderm (c) Primary endoderm (d) None of the above

239. The outer layer of the blastocyst which forms the ectoderm is called

(a) Cnidoblast (b) Germinal vesicle (c) Trophoblast (d) Amnion

240. Which of the following is correct

(a) Mesoderm produces brain (b) Ectoderm produces liver

(c) Mesoderm produces skeleton (d) Endoderm produces heart

241. Which of the following develops from ectoderm

(a) Spinal cord and brain (b) Liver and heart

(c) Notochord and vertebral column (d) Eye and skin

242. Formation of notochord or the central axial chord in vertebrates is known as

(a) Neurulation (b) Blastulation (c) Morulation (d) Notogenesis

243. The rolling of endodermal and mesodermal cells from the surface of embryo into its interior is called

(a) Ingression (b) Invagination (c) Involution (d) Inversion

244. Gastrulation is the process which involves the differentiation of the following layers in a vertebrate embryo

(a) Ectoderm and mesoderm (b) Ectoderm and endoderm

(c) Endoderm and mesoderm (d) Ectoderm, endoderm and mesoderm

245. The skeleton and muscles originate in the development from **or** During embryonic development endoskeleton and muscles develop from which germinal layer

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) Yolk plug

246. The nerve cells, brain and spinal cord or central nervous system develops from embryonic

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) Both (a) and (b)

247. Ontogenetically liver and pancreas are **or** During embryonic development pancreas and liver develop from which germinal layer

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Blastopore

248. Mesoderm gives rise to all the structures except

(a) Nervous system (b) Muscular system (c) Circulatory system (d) Gonads

249. The primordial germ cells make their appearance from wall of

(a) Amnion (b) Chorion (c) Allantois (d) Gonad

250. Brain originates from which germ layer

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Ectomesoderm

251. Which is the correct sequence in the development of man

(a) Fertilization, zygote, cleavage, morula, blastula, gastrula

(b) Zygote, morula, blastula, differentiation

(c) Fertilization, cleavage, gastrula, morula, blastula

(d) Cleavage, zygote, blastula, morula, gastrula

252. The period of preparation with reference to developmental phenomena in vertebrates means

(a) Formation of gastrula (b)Formation of germ layers

(c) Tissue differentiation (d) Parents preparation and elaboration of gametes

253. Among the following who is regarded to be the founder of modern embryology

(a) Aristotle (b) Newport (c) Von Baer (d) Spallanzani

254. The cavity of gastrula is called

(a) Blastocoel (b) Coelom (c) Archenteron (d) Haemocoel

255. Amniotic fluid is found in

(a) Uterus (b) Scrotal sac (c) Kidney (d) Liver

256. Emboly is

(a) Migration of micromeres into the blastocoel

(b) Migration of macromeres into the blastocoel

(c) Migration of endoderm, mesoderm and notochord in the blastocoel

(d) None of the above

257. The origin of germ layers in chick embryo was described by

(a) Hans speman (b) Pander (c) Charles Bonnet (d) None of the above

258. Primary germ layers are

(a) Trophoblast, ectoderm, mesoderm and endoderm

(b) Endoderm, trophoectoderm and trophomesoderm

(c) Trophomesoderm and trophoectoderm (d) Ectoderm, mesoderm and endoderm

259. Pancreas is

(a) Ectodermal (b) Mesodermal (c) Endodermal (d) None of the above

260. Kidneys are

(a) Ectodermal (b) Mesodermal (c) Endodermal (d) None of the above

261. Splanchnocoel is

(a) Haemocoel (b) Pseudocoel (c) True coelom (d) Pseudocoelom

262. The organ not formed by ectoderm is

(a) Brain (b) Spinal cord (c) Internal ear (d) Gonads

263. Which is formed first

(a) Primitive gut (b) Ectoderm (c) Mesoderm (d) Endoderm

264. Part of primitive gut is

(a) Yolk sac (b) Embryonic disc (c) Trophoblast (d) Inner cell mass

265. Which is not formed by endoderm

(a) Pancreas (b) Kidneys (c) Liver (d) Lungs

266. Nerves develop from

(a) Ectoderm (b) Mesoderm

(c) Endoderm (d) Both layers of mesoderm and endoderm

267. Morphogenetic movements occur in

(a) Cleavage stage (b) Morula (c) Blastula (d) Gastrula

268. The hypoblast (inner germ layer of gastrula) forms the

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) None of the above

269. The epiblast (outer germ layer of gastrula) forms the

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) None of the above

270. Heart is

(a) Ectodermal (b) Mesodermal (c) Endodermal (d) None of these

271. During gastrulation is formed

(a) Notochord (b) Nerve cord (c) Myotome (d) Archenteron

272. Skeleton and muscles originate from

(a) Yolk plug (b) Mesoderm (c) Endoderm (d) Ectoderm

273. In which organ the bulk is formed of endoderm

(a) Intestine (b) Liver (c) Heart (d) Kidney

274. Alimentary canal is derived from

(a) Endoderm (b) Ectoderm

(c) Mesoderm and endoderm (d) Ectoderrn and endoderm

275. Which one develops from mesoderm

(a) Testes and pancreas (b) Nervous system and skeleton

(c) Sense organs and muscles (d) Blood vessels and excretory organs

276. Sensory receptors, such as retina, develop from

(a) Ectoderm (b) Endoderm

(c) Mesoderm (d) Mesoderm and endoderm

277. True coelom is lined by

(a) Mesoderm (b) Mesoderm and ectoderm (c)Endoderm (d) Ectoderm

278. In development, Eustachian tube is

(a) Ectodermal (b) Mesodermal

(c) Endodermal (d) Both mesodermal and endodermal

279. Retina, eye lens, brain and skin are formed from

(a) Mesoderm (b) Ectoderm

(c) Endoderm (d) Both ectoderm and endoderm

280. Blastopore is

(a) Opening of neural tube (b) Opening of gastrocoel

(c) Future anterior end of embryo (d) Found in blastula

281. Archenteron begins forming in

(a) Early gastrula (b) Late gastrula (c) Early morula (d) Blastula

282. Olfactory epithelium develops from

(a) Embryonic endoderm (b)Embryonic ectoderm

(c)Embryonic mesoderm (d)Embryonic mesenchyme

283. Notochord grows form

(a) Neuropore (b) Prechordal plate (c) Hypochordal rod (d) Chorda-mesoderm

284. Which one is not formed from ectoderm

(a) Notochord (b) Epidermis (c) Internal ear (d) Adrenal medulla

285. Which is derived from ectoderm

(a) Epidermis (b) Spinal cord (c) Retina (d) All the above

286. The proctodaeum develops from

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) None of the above

287. Intestine develops form

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) Pharyngeal pouch

288. Early embryonic stage that follows blastula is

(a) Morula (b) Amphiblastula (c) Radula (d) Gastrula

289. Rearrangement of layers occurs during

(a) Gastrulation (b) Blastulation (c) Morulation (d) Organogenesis

290. Morphogenetic movements convert hollow spherical blastula into

(a) Gastrula (b) Morula (c) Neurula (d) Embryonic disc

291. Which one develops from ectoderm

(a) Adrenal medulla (b) Adrenal cortex (c) Blood (d) Lymph

292. When do the three germinal layers differentiate

(a) Blastula (b) Gastrula (c) Cleavage (d) Fertilization

293. Which one is produced by mesoderm

(a) Heart and notochord (b) Heart and brain

(c) Spinal cord and notochord (d) Brain and notochord

294. In mammals, the body of embryo is formed from

(a) Trophoblast (b) Trophoectoderm (c) Outer cell mass (d) Inner cell mass

295. The mesoderm in chick embryo gives rise to all of the following organs except the

(a) Brain (b) Heart (c) Kidney (d) Skeleton

296. Which of the following is not ectodermal

(a) Inner ear (b) Optic nerve (c) Middle ear (d) Epithelial tissue

297. Study of different phases of development of organ is known as
(a) Histogenesis (b) Pathogenesis (c) Morphogenesis (d) Embryogenesis

298. Which of these in frog develops from mesoderm
(a) Spleen (b) Eye lens (c) Adrenal medulla (d) Thyroid gland

299. Nephrogenous tissues are derived from embryonic
(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Two of these

300. Endoderm in a mammalian embryo is formed by
(a) Epiboly (b) Ingression (c) Delamination (d) Invagination

301. Which of the following organs develops first
(a) Liver (b) Notochord (c) Heart (d) Kidney

302. In rabbit, the blastopore develops into future
(a) Anus (b) Mouth (c) Neuropore (d) Notochord

303. Theory of germ layers in the embryo was first proposed by
(a) De Graaf (b) Harvey (c) Haeckel (d) Von Baer

304. In which stage rate of cell division decrease
(a) Morula (b) Gastrula (c) Blastula (d) Zygote

305. Which statement is not correct for gastrulation
(a) Formation of archenteron (b) Cell division stops
(c) Oxidation reaction increase (d) Elongation of embryo starts

306. The first indication of division of labour in the blastomeres appear at
(a) Morula stage (b) Blastula stage (c) Gastrula stage (d) Neurula stage

307. Gastrulation is a process
(a) Which begins the segregation of germ layers (b) That occurs just after blastulation
(c) That occur just after cleavage (d) Of rapid growth in blastomeres

308. A definate polarity such as dorsoventral and antero posterior can be recognised at
(a) Morula stage (b) Gastrula stage (c) Blastula stage (d) Zygote stage

309. Mass separation of cells during gastrulation is
(a) Epiboly (b) Emboly (c) Delamination (d) Differentiation

310. One of these is not an ectodermal derivation
(a) Lens of eye (b) Dermis of skin
(c) Entire nervous system (d) Epidermis of skin

311. Blood is derived from
(a) Ectoderm (b) Endoderm (c) Mesoderm (d) None of the above

Advance Level

312. The mammalian primitive streak gives rise to
(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Germ layers

313. Rathke's pouch is

(a) Rudimentary pouch of the ectoderm posterior to the last gill

(b) A diverticulum from the buccal cavity in the embryo

(c) Rudiment of pars nervosa (d) All the above

314. Proctodaeum in rabbit is

(a) A part of large intestine lined by ectoderm (b) A part of large intestine lined by endoderm

(c) A part of large intestine lined by mesoderm (d) Embryonic intestine

315. Blastopore is found in

(a) Blastula and is opening of archenteron (b) Blastula and is opening of blastocoel

(c) Gastrula and is opening of archenteron (d) Gastrula and is opening of blastocoel

316. True coelom develops as a split in

(a) Mesoderm (b) Endoderm

(c) Ectoderm (d) Between ectoderm and endoderm

317. Pasteels (1945) described gastrulation takes place in aves by

(a) Infiltration (b) Delamination (c) Concrescence (d) Polyinvagination

318. When mouth develops from blastopore, the organism is called

(a) Deutrostomia (b) Protostomia (c) Blastostomia (d) None of the above

319. During the development of embryo which of the following occur first

(a) Differentiation of tissue (b) Differentiation of cells

(c) Differentiation of organs (d) Differentiation of organ system

320. If the ectoderm from neural tissue area is removed from the embryo and transplanted in place of presumptive belly ectoderm embryo will develop

(a) Without a neural tube (b)With a neural tube

(c) With two ectodermal coats (d) With two neural tube

321. In both chordates and non-chordates intestine develops from

(a) Pharyngeal pouch (b) Ectoderm (c) Endoderm (d) Mesoderm

322. Coelom is found between the cavity of

(a) Ectoderm and endoderm (b) Mesoderm and ectoderm

(c) Body wall and ectoderm (d) Mesoderm and body wall

323. In the development of the human body, the ectoderm is responsible for the formation of

(a) Sweat glands (b) Nervous system (c) Lens of the eye (d) All the above

324. True coelom is a space between the body wall and alimentary canal. It is lined by

(a) Mesoderm on one side and ectoderm on the other side

(b) Endoderm on one side and ectoderm on the other side

(c) Mesoderm on both the sides

(d) Ectoderm on both the sides

325. In *Pheretima* mouth develops from which of the following

(a) Mesoderm (b) Ectoderm (c) Blastopore (d) Endoderm

326. A phenomenon of embryonic induction was first described in amphibia by

(a) Aristotle (b) Spemann (c) Von Baer (d) Spallanzani

327. During gastrulation the dorsal lip of blastopore (1 external sign of gastrulation) appears

(a) Anteriorly in the pigmented area of egg (b) Posteriorly in the yolky cytoplasmic area

(c) In the centre of the egg (d) Behind the grey crescent area

328. Archenteron is lined with (in frog)

(a) Ectoderm (b) Mesoderm

(c) Endoderm (d) Mesoderm and endoderm

329. The literal meaning of "gastrulation" is

(a) Formation of primary germ layers (b) Formation of a gut

(c) Morphogenetic movement (d) Commencement of organogenesis

330. Termination of gastrulation is marked by

(a) Obliteration of archenteron (b) Closure of neural tube

(c) Obliteration of blastocoel (d) All the above

331. Epiboly is the process of

(a) Mass migration of cells from the animal hemisphere so that upper micromeres begin to migrate over the edge of the dorsal lip and roll inside and are tucked beneath the outer layer

(b) Over growth when the micromeres divide rapidly and begin to spread down wards over the megameres except at the yolk plug

(c)Rotation of gastrula within the vitelline membrane so that the animal pole becomes anterior

(d) Formation of a small slit like invagination occuring on the gray crescent

332. Sex of the embryo in the uterus is determined by

(a) GIFT (b) Amniocentesis

(c) Using X-chromosome killer cream (d) All the above

333. Amniocentesis is a technique used for

(a) Estimating amino acid content in the amnion (b) Measuring size of the amnion

(c) Determining sex of the foetus (d) Determining position of the foetus

334. The yolk plug is a structure in gastrula which is formed by the protrusion of

(a) Endodermal cells (b) Endo-mesodermal cells (c)Ectodermal cells (d) Mesodermal cells

335. Vascular system and excretory organs are developed from

(a) Mesoderm (b) Ectoderm (c) Endoderm (d) None of the above

336. The central nervous system develops as a result of

(a) Metamorphosis (b) Gastrulation (c) Neurulation (d) Invagination

337. Which of the embryo has parasite mode of nutrition

(a) Bird's embryo (b) Amphibian embryo (c) Reptilian embryo (d) Mammalian embryo

338. The aminotic fluid is taken out with the help of surgical needle and separation of the embryo cells present in this fluid is done by

(a) Amniotic fluid study (b) Amniocentesis (c) Centrifugation (d) None of the above

339. By the amniocentesis, one of the following group can be possible to study

(a) Study of cytoplasmic behaviour

(b) Study of cellular organelles

(c) Study of abonormal behaviour of chromosomes and physiological activities

(d) Study of nature of embryo

340. From the egg in gastrula stage if you remove all cells which form endoderm, the new organism will lack of

(a) Eyes (b) Heart

(c) Eyes and brain (d) Some of the visceral organs

341. The main function of tropho ectoderm in mammalian embryo is

(a) Protection of the developing cells (b) Drawing food for the developing cells

(c) Formation of yolk sac (d) Formation of body of developing embryo

342. During the course of development, cells in various regions of embryo become variable in morphology and eventually perform diverse functions. This process is known as

(a) Rearrangement (b) Differentiation (c) Metamorphosis (d) Organisation

343. In vertebrates the central nervous system develops under the influence of

(a) Pituitary hormones (b) Phospholipids

(c) Glycolipids (d) Phospholipids and glycolipids

344. Blastopore is found in

(a) Gastrula (b) Blastula (c) Morula (d) Neurula

345. Which one of the following is derived from ectoderm

(a) Enamel of teeth (b) Dentine (c) Skull (d) Axial skeleton

346. The best definition of the process of gastrulation is that, it is a process where the

(a) Single layered blastula becomes two layered (b) Archenteron is formed

(c) Cells move to occupy their definite position (d) Zygote gets converted to a larva

347. After gastrulation the roof of archenteron is formed by

(a) Neural plate (b) Mesoderm (c) Ectoderm (d) Chorda- mesoderm

348. Which of the following is not correct for gastrulation

(a) Archenteron is formed (b) All germinal layers are formed

(c) Morphogenetic movements (d) Some blastomeres and blastocoel degenerate

349. Which of the following structure originates from ectoderm

(a) Stomodaeum (b) Proctodaeum (c) Mesodaeum (d) Both (a) and (b)

350. Match the items ABCD of table 'A' with that of items in table 'B' then the correct pairing sequence of ABCD will be

'A'	'B'
A. Cleavage	1. Formation of 3 germ layers
B. Gastrulation	2. Formation of embryo spinal cord
C. Neurulation	3. Results in formation of skeleton and muscles from mesoderm
D. Organogenesis	4. Pattern depends on the amount and distribution of yolk

(a) 4, 1, 2,3 (b) 2, 3, 1, 4 (c) 4, 2, 3, 1 (d) 3, 1, 2, 4

351. Mesoderm proliferates from

(a) Trophoblast (b) Cephalic end of embryonic disc

(c) Caudal end of embryonic disc (d) Ectoderm of embryonic disc

352. What is true of deuterostomes

(a) Presence of schizocoel (b) Nonformation of anus from blastopore

(c) Coelom lined by mesoderm on both sides (d) Presence of false coelom

353. During gastrulation blastomeres move from the surface to their destination in the embryo. These movements are called

(a) Migratory movements (b)Formation movements

(c) Morphogenetic movements (d) All the above

354. The medullary tube is formed by

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) None of the above

355. Morphogenetic movements involve

(a) Movements of organs (b) Movement of small cell masses

(c) Movement of large cells masses (d) Differentiation of cells

356. If chorda mesoderm evaginates instead of invagination

(a) Only ectodermal and endodermal structures develop

(b) Only mesodermal and endodermal structures develop

(c) No development occurs

(d) Only ectodermal and mesodermal structures develop

357. Germinal layer formed from trophoblast of mammalian blastocyst is

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) None of the above

358. Which one develops from endoderms

(a) Nervous system, urinary bladder and eye (b) Liver, connective tissue and heart

(c) Thymus, spinal cord and brain (d) Liver, pancreas and thymus/ thyroid

359. Sense organs are formed from

(a) Ectoderm (b) Mesoderm

(c) Partly ectoderm and partly mesoderm (d) Endoderm

360. Vascular tissue is derived from

(a) Epithelium (b) Ectoderm (c) All germinal layers (d) Mesoderm

361. Two formative movements that take place during gastrulation are

(a) Involuation and invagination (b)Epiboly and emboly

(c) Invagination and ingression (d) Ingression and delamination

362. In deuterostomes second opening forms

(a) Anus (b) Mouth (c) Nose (d) Both (a) and (b)

363. Adrenal medulla and membranous labyrinth develop from

(a) Ectoderm (b) Endoderm (c) Mesoderm (d) Both (b) and (c)

364. Spreading of presumptive ectoderm on underlying mass of cell is

(a) Epiboly (b) Invagination (c) Ingression (d) Delamination

365. Jaw bones are formed from

(a) Ectoderm (b) Endoderm

(c) Mesoderm (d) Ectoderm and endoderm

366. An organ not formed form ectoderm is

(a) Optic nerve (b) Middle ear (c) Inner ear (d) Skin

367. Ganglia of sympathetic and other neural systems develop from

(a) Neural cell (b) Neural plate cells (c) Notochord cells (d) Neural crest cells

368. Gastrulation comprises

(a) Morphogenetic movements (b) Differentiation of archenteron

(c) Differentiation of three germ layers (d) All the above

369. Study of formation of sensory organs is

(a) Organogenesis (b) Neurogenesis (c) Mesogenesis (d) Notogenesis

370. In the fate map of early gastrula of frog, what is the correct sequence in which the three consecutive presumptive embryonic cell masses

line upon the axis lying perpendicular to the dorsal lip, counting from the same

(a) Notochord, medullary plate, epidermis (b)Epidermis, medullary plate, notochard

(c) Prechordal plate, notochord, mesoderm (d) Prechordal plate, notochord, medullary plate

371. Formation of primitive streak in the chick embryo is the first sign of

(a) Blastulation (b) Gastrulation (c) Neurulation (d) Notogenesis

372. During the development of frog, which one of the following sets of structures is derived from the endoderm

(a) Skin and skin glands (b) Pituitary and adrenal medulla

(c) Kidneys and their ducts (d) Trachea, lungs, liver and pancreas

373. The process by which the developing notochord causes dorsal ectoderm above it to form a neural plate is known as

(a) Induction (b) Invagination (c) Differentiation (d) None of the above

374. Stage of embryonic development in which differentiation of cell occurs

(a) Neurula (b) Gastrula (c) Blastula (d) Morula

375. Which of the following is correct grouping

(a) Ectoderm-Retina, epidermis, nervous system (b) Mesoderm-Ovary, urinary bladder, kidney

(c) Mesoderm-Lungs, connective tissue, testis (d) Endoderm- Thyroid, pineal gland, thymus

376. Somatopleur is combination of

(a) Ectoderm and endoderm (b) Mesoderm and endoderm

(c) Mesoderm and ectoderm (d) None of the above

377. Somite is part of

(a) Ectoderm (b) Mesoderm (c) Endoderm (d) Archenteron

378. Vital dyes for fat mapping is

(a) Netural red (b) Nile blue sulphate (c) Bismarck brown (d) All the above

379. Epiboly refers to morphogenetic or formative movements of prospective

(a) Ectodermal cell (b) Endodermal cell

(c) Mesodermal cell (d) Chorda-mesodermal and endodermal cell

380. Significance of gastrulation lies in the fact that

(a) It is the real starting point of the constructive of multi cellular body

(b) It initiates the formation of nervous system

(c) It brings presumptive areas into their normal position in the embryo

(d) All the above

381. "Isthmus of pander" is located in

(a) In germinal vesicle (b) Below blastodisc

(c) Between shell membrane (d) In chalaza

382. If the chorda- mesoderm tissue formed from grey crescent is killed by boiling and an extract from this is placed on ectoderm it will

(a) Induce neural plate formation (b)Not induce neural-plate formation

(c) Sometime induce mesoderm formation (d) All the above

383. The lateral mesoderm splits to form visceral and parietal layer which encloses the

(a) Proctodaeum (b) Stomodaeum (c) Splanchnocoel (d) None of the above

384. Trophoectoderm or trophoderm in embryonic development of mammals is formed at the stage of

(a) Blastocyst (b) Zygote (c) Morula (d) Gastrula

385. Which of the following is not diploblastic

(a) Sponge (b) Cnidarian (c) Nematoda (d) Ctenophora

386. The cavity formed during gastrulation is

(a) Archenteron (b) Gasterocoel (c) Primitive gut (d) All the above

387. The term, 'metaplasia' refers to the process by which

(a) Differentiated cell is able to become transformed into a differentiated cell of another type

(b) Cell becomes differentiated

(c) Cell grows abnormally fast

(d) None of the above

388. The process by which one part of a developing embryo influences the differentiation of other parts is known as

(a) Transduction (b) Induction (c) Metamorphosis (d) None of the above

389. The somites which are metamerically segmented blocks of mesoderm differentiate into all of the following except

(a) Myotome which forms the muscles (b)Dermatome which forms the dermis

(c) Sclerotome which gives rise to the axial skeleton (d) None of the above

390. When a piece of tissue is able to respond to an organising substance by producing a definite tissue eg. neural plate ; the process is

(a) Induction (b) Competence (c) differentiation (d) None of the above

391. Presumptive ectoderm is that

(a) Layer which presumabley is ectoderm

(b) Layer which may or may not develop into ectoderm

(c) Area around the margin of the blastopore which rolls into the interior of the embryo thus forming the lining of the primitive gut (d) None of the above

392. All the following structures are ectodermal except one which is mesodermal

(a) Epithelium of retina (b) Optic nerve (c) Eye lens (d) Outer eye layers

393. Collection and dispersion of embryonic cells is called

(a) Differentiation (b) Induction (c) Morphogeneis (d) Blastomy

394. The cells of the trophoblast in mammals which lie over the embryonic disc are known as

(a) Primitive streak (b) Hensen's node (c) Cells of Rauber (d) None of the above

395. Ingression is defined as

(a) The rolling movement of meso and endodermal cells

(b)Insinking of meso and endodermal cells

(c) Detachment of meso and endodermal cells in groups (d)None of the above

EXTRA EMBRYONIC MEMBRANE

Basic Level

396. All extra embryonic membranes

(a) Take part in the formation of embryo (b) Does not take part in the embryo formation

(c) Form the placenta (d) Perform the function of excretion of embryo

397. Chorion is found

(a) Inside the amnion (b) Outside the amnion (c) Inside the allantois (d) Inside the yolk sac

398. Middle gastrula is characterised by

(a) Formation of yolk plug (b) Archenteron just beings to form

(c) Blastopore and archenteron are present (d) Yolk plug shifts towards blastopore

399. The technique which makes use of amniotic fluid for the detection of prenatal disorders is called as

(a) Endoscopy (b) Laproscopy (c) Natal endoscopy (d) Amniocentesis

400. Function of allantois in mammals is

(a) Respiration only (b) Excretion

(c) Nutrition, excretion and respiration (d) Protection from shocks

401. Mammalian embryo is directly surrounded by

(a) Amniotic cavity (b) Allantoic cavity

(c) Primary digestive cavity (d) Yolk sac cavity

402. Mammalian placenta has minute finger like projections called

(a) Chorionic villi (b) Chorionic network

(c) Chorionic extensions (d) Chorionic plexus

403. Foetal membranes provide

(a) Protection to embryo (b) Nutrition to embryo

(c) Protection and nutrition to embryo (d) None of the above

404. The extra-embryonic membranes of the mammalian embryo are derived from

(a) Formative cells (b) Follicle cells (c) Inner cell mass (d) Trophoblast

405. Amnion helps in

(a) Respiration (b) Excretion

(c) Nutrition (d) Protection from shocks

406. Allantois develops from the embryonic

(a) Fore gut (b) Mid gut (c) Hind gut (d) Tail region

407. The respiratory function of embryo is performed by

(a) Chorion (b) Amnion (c) Allantois (d) Yolk sac

408. Urinary bladder of the embryo is or which is the urinary bladder of child placed in the womb

(a) Yolk sac (b) Allantois

(c) Amnion (d) Chorion and allantois both

409. The shock absorber fluid of the developing embryo is known as

(a) Chorionic fluid (b) Amniotic fluid (c) Allantoic fluid (d) Coelomic fluid

410. The function of amniotic cavity is

(a) Respiration (b) Protection from desiccation and shocks

(c) Protection from desiccation (d) Protection from shocks

411. Number of foetal membranes in humans is

(a) 2 (b) 3 (c) 4 (d) 0

412. Amniotes include

(a) Fishes, reptiles and amphibians (b)Amphibians, birds and reptiles

(c) Birds, reptiles and mammals (d) Amphibians, reptiles and mammals

413. Amnion surrounds

(a) Allantois (b) Chorion (c) Embryo (d) Yolk sac

414. Villi of human placenta develop from

(a) Chorion (b) Allantois (c) Yolk sac (d) Both (a) and (b)

415. Membrane that gives protection to embryo from external shocks is

(a) Amnion (b) Allantois (c) Chorion (d) Placenta

416. Amniotic fluid protects the foetus from

(a) Shock (b) Encystment (c) Degeneration (d) Disease

417. Foetal membranes produced by trophoblast are

(a) Chorion and allantois (b)Chorion and amnion

(c) Amnion and allantois (d)Allantois and yolk sac

418. In birds, allantois helps in

(a) Excretion (b) Respiration (c) Nutrition (d) Protection

419. Allantois is extraembryonic membrane found in

(a) Reptiles (b) Birds (c) Mammals (d) All the above

420. Yolk containing cytoplasm is called

(a) Ooplasm (b) Protoplasm (c) Deuteroplasm (d) Trophoplasm

421. In the organisms having amnion, the foetal membranes are

(a) Zona pellucida, vitelline membrane (b) Allantois, chorion

(c) Choroid, vitelline membrane (d) None of the above

422. Which of the foetal membrane is directly connected with blood

(a) Allantois (b) Amnion (c) Chorion (d) Yolk sac

423. Which of these is an extra embryonic membranes

(a) Henson's line (b) Diencephalon (c) Allantois (d) Primitive streak

424. In mammals since the ovum does not have yolk the yolk sac is

(a) Rudimentary (b) Absent

(c) Sizeable through ovum has little yolk (d) None of the above

Advance Level

425. The amnion and chorion consist of which type of composition

(a) Somatopleure (b) Splenchnopleure

(c) Somatic mesoderm only (d) Somatic endoderm only

426. The allantois has the similar layers as present in the yolk sac. These are

(a) Outer mesoderm and inner endoderm (b) Outer endoderm and inner mesoderm

(c) Outer endoderm and inner ectoderm (d) Outer endoderm and inner endoderm

427. In man the foetal membrane which forms the intimate connection with the uterine tissue is

(a) Amnion only (b) Chorion only

(c) Allantois only (d) Allanto-chorionic structure

428. Umbilical cord in mammals, contains

(a) Placenta (b) Umbilicus

(c) Allantoic artery and vein (d) Discus poligerous

429. Chorion is composed of

(a) Cytotrophoderm (b) Syncytial trophoblast

(c) Outer ectoderm and somatic mesoderm (d) All of the above

430. Extra embryonic membrane amnion is not found in amphibians because

(a) They lay eggs in water (b)Egg hatches in tadpole

(c)Amphibious habit (d)They have smooth skin

431. The embryo of man is protected by

(a) Amniotic cavity (b) Peritoneal cavity (c) Pleural cavity (d) Allantois

432. In the development of man which structures are formed from splanchnopleure

(a) Muscles and connective tissue of digestive tube (b)Vertebral column and spinal cord

(c) Brain and its coverings (d)Urinogenital organs

433. The foetal membrane which is the source of first blood corpuscle to enter the circulation of the embryo is called

(a) Amnion (b) Chorion (c) Trophoblast (d) Yolk sac

434. In early haemopoietic tissue of embryo, there is

(a) Chorion (b) Amnion (c) Allantois (d) Yolk sac

435. In mammals the chorion and the allantois together form

(a) Placenta (b) Endometrium (c) Uterus (d) Yolk sac

436. Which one of the following can be determined by amniocentesis

(a) Klinefelter's syndrome (b)Turner's syndrome

(c) Sex of the unborn child (d) All the above

437. Amniocentesis is

(a) An inutero diagnosis

(b) Withdrawl of allantoic fluid from pregnant woman

(c) Anlaysis of chemical composition of fluids of pregnant woman

(d) Culturing of cells and study of metaphase chromosomes from amniotic fluids to identify chromosomal abnormality

438. Amnion is a membrane which develops on the outside of embryo in

(a) Fish (b) Cockroach (c) Toad (d) Lizard

439. Match List-I (Foetal membrane in chick) with list –II (Function) and select the correct answer using the codes given below the lists

List I (Foetal membrane in chick)	**List II** (Function)
A. Amnion	1. Excretion
B. Chorion	2. Protection against mechanical shock
C. Yolk sac	3. Nutrition
D. Allantois	4. Protection from desiccation
	5. Absorption of water and albumen

Answer codes

(a) A/2 B/3, C/4 D/1 (b) A/1 B/5 C/3 D/2 (c) A/1 B/3 C/4 D/2 (d) A/2 B/5 C/3 D/1

440. Which of the following is a thin membrane that forms about the 8^{th} day after fertilization

(a) Chorion (b) Coelom (c) Amnion (d) Yolk sac

441. Amnion is found in

(a) Crocodile (b) Shark (c) Salamander (d) Frog

442. Amnion and allantois are found in

(a) Fish, frog and fowl (b) Fish and frog (c) Fowl and fox (d) Frog, fowl and fox

443. The amnion in mammals consists of extra- embryonic

(a) Endoderm and somatic mesoderm (b) Ectoderm and somatic mesoderm

(c) Ectoderm and splanchnic mesoderm (d) Endoderm and splanchnic mesoderm

444. Which of the following pairs are correctly matched

1. Amnion- Vascularised foetal membrane
2. Chorion- Somatopleure in origin
3. Allantois- Organ of respiration

Select the correct answer using the codes given below

(a) 1, 2, and 3 (b) 1 and 2 (c) 1 and 3 (d) 2 and 3

445. Which of the following extraembryonic membranes in reptiles and birds acts both as embryonic "lung" and urinary bladder

(a) Chorion (b) Amnion (c) Allantois (d) Yolk sac

446. The portion of the endometrium that covers the embryo and is located between the embryo and uterine cavity is the

(a) Decidua basilaris (b) Decidua umbilicus (c) Decidua capsularis (d) Decidua functionalis

447. Yolk is composed of

(a) Carbohydrate (b) Protein (c) Phospholipid (d) All the above

448. Protein of yolk is

(a) Casine and phosvitine (b)Lecithine and Lipoviteline

(c) Phosvitine and Lipovitelline (d) Casine and Lecithine

449. The deutoplasm of egg contains yolk, which is formed of

(a) Carbohydrate (b) Protein (c) Fats (d) All the above

450. In mammals the structure decidua basalis is a part of

(a) Chorion (b) Endometrium (c) Chorion frondosum (d) Pseudogametes

451. The first extra embryonic membrane to make its appearence in the mammals is

(a) Allantois (b) Amnion (c) Yolk sac (d) Serosa

PLACENTA

Basic Level

452. The eutherian placenta is derived from or in mammals placenta is formed by
(a) Yolk sac (b) Amnion (c) Allantois (d) Chorion allantois

453. Placenta is the region, where
(a) Foetus is supplied by maternal blood
(b) Embryo is attached to mother by umbilical cord
(c) Foetus receives maternal blood and nutrition (d) Embryo is enclosed by membranes

454. Placenta acts like a
(a) Semipermeable membrane (b) Fully permeable membrane
(c) Impermeable membrane (d) None of the above

455. Which of the following structure is lacking from the placenta
(a) Arteries (b) Veins (c) Smooth muscles (d) Nerves

456. Which of the following is an embrynic connection tissue
(a) Endometrium (b) Mediastinum (c) Mesenchyme (d) Endothelium

457. Placenta in human beings is
(a) Haemochorial (b) Epitheliochorial (c) Syndesmochorial (d) Haemoendothelial

458. Zonary placenta is found in
(a) Carnivore mammals (b) Herbivore mammals (c) Both (a) and (b) (d) None of the above

459. True placenta is present in
(a) All mammals (b) Metatherians (c) Eutherians (d) Prototherians

460. The type of placenta found in human beings is of type
(a) Diffuse (b) Zonary (c) Cotyledonary (d) Discoidal

461. Placenta is formed from
(a) Maternal part only (b) Embryonic part only
(c) Maternal and foetal portions both (d) None of the above

462. The role of placenta is
(a) To convey nerve impulses (b) To act as storage organ
(c) To protect embryo from shocks (d) To provide nutrition for developing embryo

463. In which of the following the placenta forms an important structure in development
(a) Amphibian (b) Reptiles (c) Birds (d) Mammals

464. The villi which are formed by the allantochorion to form the intimate connection with uterine endometrium functions as
(a) Gaseous exchange organ only (b) Attachment arrangement only
(c) Placental structure (d) None of the above

465. The layer of uterus which becomes much eroded due to placental villi is known as
(a) Endothelium (b) Endometrium (c) Endoderm (d) Trophoblast

466. To ensure effectiveness of reproduction in mammals
(a) Formation of yolk sac (b)Retention of yolk sac
(c)Reduced number of egg (d)Formation of placenta

467. Blood flowing in umbilical cord is
(a) 50% maternal and 50% foetal (b) 100% foetal
(c) 100% maternal (d) 75% maternal and 25% foetal

468. Foetus is nourished by
(a) Placenta (b) Yolk (c) Blood (d) Phagocytosis

469. Placenta is formed in humans by
(a) Amnion (b) Allantois (c) Chorion (d) All of the above

470. Placenta is
(a) Channel for providing essential requirements for growth of embryo
(b) Storage organ
(c) Conductor for nerve impulse
(d) Meant for protecting the embryo from shocks

471. Syndesmochorial and cotyledonary placenta are found in
(a) Cat (b) Cow (c) Man (d) Rabbit

472. Nitrogenous and metabolic wastes are stored in which of the following ?
(a) Exocoel (b) Yolk sac (c) Allantois (d) Amniotic bag

473. Histologically carnivores have..... placenta
(a) Haemo-chorial (b) Syndesmo- chorial (c) Epithelio-chorial (d) Endothelio-chorial

474. The placenta in a mammal is
(a) Allantoic type (b) Yolk sac type
(c) No placenta occurs in mammals (d) None of the above

475. As a result of metabolism in mammalian embryo
(a) Wastes are absorbed by embryo
(b)Wastes are eliminated through mother's body
(c) Accumulated wasted are eliminated after birth (d)No wastes are produced

476. In mammals, embryo is nourished by an additional structure called
(a) Amnion (b) Placenta (c) Umbilicus (d) Ootheca

477. What structure serves as a lung, digestive tract and kidney for the developing embryo
(a) Liver (b) Amnion (c) Placenta (d) Endometrium

478. In embryos of placental mammals
(a) Yolk sac does not develop (b) Yolk sac develops but has no yolk
(c) Yolk sac develops and has yolk (d) None of the above

Advance Level

479. Which of the following cannot pass through the placenta into the foetus

(a) Bacteria of syphilis (b) Thalidomide

(c) Virus of german measles (d) None of the above

480. The placental barrier between the maternal and foetal blood is minimum in

(a) Goat (b) Pig (c) Cow (d) Human

481. Placenta has an outer layer which is selectively permeable and hormone secreting which is known as

(a) Trophoblast (b) Chorion (c) Amnion (d) Mesoderm

482. The permeability of the human placenta to macro-molecules is evidenced by the presence of following in foetal blood

(a) Globulin (b) Albumin (c) Anti Rh factor (d) None of the above

483. The placenta of human beings belong to the category of

(a) Haemo-chorialis (b) Syndesmo-chorialis

(c) Endothelio- chorialis (d) Epithelio-chorialis

484. Which of the following substances can pass through the placenta from the mother into foetus

(a) Proteins (b) Viruses of small pox (c) WBCs (d) RBCs

485. In a simplest type of placenta the foetal blood is separated from the maternal blood by six barriers. How many barriers are lost in human placenta

(a) One (b) Two (c) Three (d) Four

486. Haemoendothelial placenta occurs in

(a) Man and Ape (b) Cow and Goat (c) Deer and camel (d) Rat and Rabbit

487. The most primitive type of mammalian placenta is

(a) Syndesmochorial (b) Endotheliochorial (c) Haemochorial (d) Epitheliochorial

488. Placenta is

(a) A part of mother's uterine wall through which exchange of materials occur between mother and foetus

(b) A part of foetus through which exchange of materials takes place between foetus and mother

(c) Chorionic villi of foetus and a part of mother's uterine wall through which chemical exchange between foetus and mother occurs

(d) A cord that connects the foetus with wall of mother's uterus

489. In Eutheria, if the fertilized ovum is implanted in the uterine wall, then further development of the foetus cannot occurs

(a) Without the formation of placenta (b) In the presence of progesterone

(c) In the presence of foetal membranes (d) With mother's hormones

490. Placental barriers are maximum in

(a) Rabbit (b) Man (c) Pig (d) Cat

491. A disease transferred from mother to child through placenta is

(a) AIDS (b) German measles (c) Syphilis (d) All the above

492. In syndesmochorial placenta, the sequence of maternal tissue between the maternal blood and the foetal tissue is

(a) Maternal endothelium, connective tissue and epithelium

(b) Maternal connective tissue and epithelium

(c) Maternal epithelium, endothelium and connective tissue

(d) Maternal endothelium and connective tissue

493. A deciduate placenta is one in which union of chorionic villi and uterine mucosa is extensive and complete; one of the following is not a deciduate placenta

(a) Zonary deciduate (b) Discoidal deciduate

(c) Contradeciduate (d) Metadiscoidal deciduate

494. Rabbit has .....Placenta

(a) Allantoic (b) Deciduate (c) Haemoendothelial (d) All the above

495. A placenta in which foetal and maternal tissues can be easily separable is

(a) Semiplacenta (b) True placenta

(c) Omphaloidean placenta (d) None of the above

GESTATION AND PARTURITION

Basic Level

496. Implantation of egg is followed by

(a) Fertilization (b) Copulation (c) Parturition (d) Gestation

497. Which one of the following statements is correct with reference to a test tube baby

(a) Fertilization of the egg is effected outside the body fertilized egg is then placed in the womb if the mother wherein gestation is completed

(b) Fertilization of the egg and growth of the embryo are affected in a large test tube

(c) A prematurely born baby is reared in an incubator

(d) Fertilization of the egg is effected in the female genital tract. The fertilized egg is then taken out and grown in a large test tube.

498. The longest gestation period is found in

(a) Elephant (b) Gorilla (c) Chimpanzee (d) Man

499. In reproduction of a test tube baby

(a) Fertilization is done outside body (b) Foetus is grown in a test tube

(c) Fertilization is done inside the body (d) None of the above

500. The shortest gestation period is seen in

(a) Man (b) Elephant (c) Cat (d) Mouse

501. Gestation period is the duration

(a) Of fertilization (b) Between egg growth and ovulation

(c) Between fertilization and parturition (d) None of the above

502. The gestation period of rabbit is

(a) 28-32 days (b) 20-25 days (c) 60-70 days (d) 80-90days

503. The gestation period of elephants is about

(a) 11 months (b) 10 months (c) 15 months (d) 22 months

504. In mammals, the onset of pregnancy causes

(a) Secretion of testosterone (b) Degeneration of ovary

(c) Inhibition of further ovulation (d) Inhibition of fertilization

505. The delivery of child or child birth is called

(a) Labour (b) Parturition (c) Implantation (d) Insemination

506. Gestation period in human is

(a) 7 months (b) 9 months (c) 25 months (d) 8 months

507. Human embryo completes development in

(a) 180 days (b) 300 days (c) 250 days (d) 266 days

508. Development of foetus takes place in

(a) Vagina (b) Uterus (c) Ovary (d) Oviduct

509. Gestation period in human is

(a) 10 weeks (b) 28 weeks (c) 32 weeks (d) 38 weeks

510. Gestation period of rat is

(a) 5 weeks (b) 4 weeks (c) 3 weeks (d) 2 weeks

511. The gestation period of cow is

(a) 30 days (b) 170 days (c) 280 days (d) 300 days

512. The fluid released from the vagina just prior to childbirth is

(a) Baby's accumulated urine (b) Amniotic fluid

(c) Mother's plasma from the umbilical cord (d) Baby's plasma from its foetal circulation

513. The complete development of an organism is known as

(a) Phylogeny (b) Oogenesis (c) Ontogeny (d) Parthenogenesis

514. Ontogeny means

(a) Embryology (b) Evolution (c) Biogenesis (d) Endocrinology

515. Embryo is parasitic in

(a) Rabbit (b) Platypus (c) Birds (d) All the above

516. Maximum growth of human foetus is done in

(a) 4^{th} month (b) 2^{nd} month (c) 6^{th} month (d) 8^{th} month

Advance Level

517. Test tube babies are given birth by the woman who is unable to

(a) Implant and develop the embryo in the uterus

(b) Complete the process of fertilization in the uterus

(c) Develop the embryo upto 32 cells stage

(d) Fertilize, implant and develop the embryo

518. Hormone administered for hastening childbirth is meant for

(a) Stimulating striped muscles (b) Activation of smooth muscles

(c) Raising of blood pressure (d) Increasing energy availability

519. Human embryo is about two inch in length after

(a) Eight weeks (b) Six weeks (c) Four weeks (d) Two weeks

520. Pseudopregnancy differs from normal in

(a) Development of ovum (b) Development changes in endometrium

(c) Absence of foetus (d) Absence of corpus luteum

521. Gestation period of 280 days is calculated from time of

(a) Last menstruation (b) Fertilization (c) Next menstruation (d) Puberty

522. Embryo and larva are different because

(a) Embryo is incapable of independent existence (b) Embryo is sexually mature

(c) Larva is incapable of independent existence (d) None of the above

523. Which grouping has gestation period in decreasing order

(a) Cow, Horse, Goat, Monkey and Swine/ Pig (b) Horse, Cow, Goat, Monkey and Swine

(c) Monkey, Cow, Horse, Goat and Swine (d) Monkey, Horse, Goat, Cow and Swine

524. Correct sequence in development is

(a) Fertilization $\rightarrow$ Zygote $\rightarrow$ Cleavage $\rightarrow$ Morula $\rightarrow$ Blastula $\rightarrow$ Gastrula

(b) Fertilization $\rightarrow$ Zygote $\rightarrow$ Blastula $\rightarrow$ Morula $\rightarrow$ Cleavage $\rightarrow$ Gastrula

(c) Fertilization $\rightarrow$ Cleavage $\rightarrow$ Morula $\rightarrow$ Zygote $\rightarrow$ Blastula $\rightarrow$ Gastrula

(d) Cleavage $\rightarrow$ Zygote $\rightarrow$ Fertilization $\rightarrow$ Morula $\rightarrow$ Blastula $\rightarrow$ Gastrula

525. Human embryo will be called as a 'foetus' after

(a) Two months (b) Four months (c) Six months (d) Seven months

526. Study of foetus by ultra sound photography is called

(a) Amniocentesis (b) Sonography (c) Auto radio graphy (d) Angio graphy

527. When the pregnancy occurs in ovary itself it is called

(a) Tubual pregnancy (b)Ectopic pregnancy

(c) Abdominal pregnancy (d)None of the above

528. Epigenesis is defined as

(a) Step by step formation of embryo (b) Metamorphosis of embryo

(c) Life history of an organism (d) None of the above

DEVELOPMENT OF FROG

Basic Level

529. Cleavage of frog is

(a) Holoblastic (b) Meroblastic (c) Superficial (d) None of the above

530. Egg undergoes cleavage and forms

(a) Morula (b) Blastula (c) Gastrula (d) All the above

531. On removing the thyroid from the tadpole, it will

(a) Die immediately (b) Will grow into giant frog

(c)Remain as tadpole (d)Grow into small frog

532. Which group shows correct pair for development of structure from embryonic layer in frog

(a) Mesoderm – Skeleton (b)Ectoderm – Blood vessels

(c) Endoderm – Brain (d)Ecto-mesoderm – Liver

533. Jelly layer of frog is

(a) Primary membrane (b) Secondary membrane (c) Secreted by the egg (d) Tertiary membrane

534. The fifth cleavage of the egg of frog results in the formation of

(a) 16 cells (b) 48 cells (c) 64 cells (d) 32 cells

535. In the adult phase of frog which of the character become degenerate

(a) Tail (b) Legs (c) Skin (d) Eyes

536. In the development of a frog, the gastrulation process involves

(a) Epiboly (b) Emboly (c) Invagination (d) All the above

537. Tongue of frog/rabbit is

(a) Ectodermal (b) Mesodermal (c) Endodermal (d) None of the above

538. Which cavity arises by the invagination of endoderm in frog's embryo

(a) Coelenteron (b) Archenteron (c) Pseudocoel (d) Blastocoel

539. The overlapping of cells in frog gastrula is called

(a) Epiboly (b) Emboly (c) Involution (d) Invagination

540. The process of series of change from larva to adult, after embryonic development, is called

(a) Ageing (b) Metamorphosis (c) Regeneration (d) Growth

541. If a small amount of iodine is added to pond containing frog tadpole, it will result in

(a) Death of the tadpole (b) Early metamorphosis

(c) Adult frog with tail (d) Retrogressive metamorphosis

542. Who has discovered the hormonal control of metamorphosis in amphibia

(a) Bonnet (b) De Graaf (c) Gudernatsch (d) Needham

543. The endocrine gland which initiates metamorphosis in frog is

(a) Pituitary (b) Thymus (c) Pancreas (d) Thyroid

544. With respect to development of frog, which one of the following pairs is not correctly matched

(a) Cleavage– Holoblastic (b)Morula–Blastomeres

(c)Blastula–Blastopore (d) Gastrula –Triploblastic

545. Which one of the following is the process, which involves the epithelial sheath spreading to cover the deeper layer of the embryo with reference to frog

(a) Epiboly (b) Involution (c) Invagination (d) Coverage

546. Which of the following sets of characters are applicable in metamorphosis of tadpole larva of frog and toad

(a) Reabsorption of gill and lengthening of tail (b) Reabsorption of gill and reabsorption of tail

(c) Complete development of gill and reabsorption of tail

(d) Complex development of gill and lengthening of tail

547. Frog's tadpole metamorphoses under the influence of

(a) Insulin (b) Thyroxine (c) Calcitonin (d) Oxytocin

548. Constructive process in metamorphosis of frog is

(a) Absorption of tail (b) Apperance of forelimbs

(c) Disappearance of gills (d) Disapperance of cement gland

549. Which system does not undergo any special change during metamorphosis of frog' tadpole

(a) Digestive (b) Respiratory (c) Circulatory (d) Nervous

550. What changes occur in tadpole's skin during its metamorphosis

(a) An insoluble layer of keratin forms upon its surface

(b)Scales develop in it to prevent evaporation of water

(c) It acquires sebaceous glands and become waterproof

(d) It thickens and acquires mucous glands

551. In frog, the first cleavage always bisects the gray crescent which forms opposite to the site of

(a) Yolk plug (b) Blastopore (c) Neural tube (d) Sperm entry

552. How many cleavage are completed in a 16 cell stage of frog' egg

(a) Three (b) Eight (c) Four (d) Twelve

553. Cleavage in frog was first observed by

(a) Gudernatsch (b) Karl Ernst Von Baer

(c) Swammerderm (d) Casper Friedrich wolff

554. Blastocoel in forg's embryo is found in

(a) Geometric centre of egg (b)Vegetal hemisphere

(c)Animal hemisphere (d)None of the above

555. Cleavage in frog' development end with the formation of

(a) Blastula (b) Morula (c) Neurula (d) Gastrula

556. In frog, the micromeres contain

(a) No yolk (b) Large amount of yolk

(c) Normal amount of yolk (d) Little amount of yolk

557. Metamorphosis occurs in

(a) Neurula (b) Blastula (c) Adult (d) Larva

558. Archenteron is a cavity found in

(a) Bladderworm of Taenia (b) Blastula of all animals

(c) Gastrula of frog (d) Main body and tentacles of Hydra

559. At time of metamorphosis, frog's tadpole feeds upon

(a) Insects (b) Algae (c) Both of these (d) Nothing

560. Metamorphosis occurs when

(a) Development is by parthenogenesis (b) Growth takes place

(c) Larva changes into adult (d) None of the above

561. Yolk plug forms during

(a) Morula formation (b) Blastula formation (c) Gastrulation (d) Neurulation

562. Larva of frogs is called

(a) Maggot (b) Tadpole (c) Nymph (d) Miracidium

563. Fertilization of frog takes place in

(a) Uterus (b) Fallopian tube

(c) Water (d) Upper part of oviduct

564. In which of the following animals, the fertilization occurs externally in water

(a) Whale (b) Earthworm (c) Amoeba (d) Frog

565. Gray crescent is present in

(a) Fertilized egg of frog (b)Eye of frog (c) Brain of rabbit (d) Retina of cockroach

566. Vegetal hemisphere of frog's egg in

(a) Yolk (b) Pigment (c) Gray crescent (d) Germinal vesicle

567. Cytoplasm is concentrated in frog's egg in

(a) Peripheral region (b) Middle region (c) Vegetal pole (d) Animal pole

568. In frog, the fertilization is

(a) Exogenous and takes place on plant tissue (b) Endogenous and take place in body cavity

(c) Exogenous and takes place in water

(d) Endogenous and takes place in the middle of oviduct

569. During metamorphosis of frog's tadpole which of the following kind of change occurs

(a) Morphological and anatomical (b) Only morphological

(c) Molecular (d) Biochemical

570. In all cases the embryonic organizers

(a) Differentiates a set of organ (b)Differentiates only ectodermal structure

(c) Regulates formation of neural tube (d)Differentiates a particular region of the embryo

571. Evocators is secreted by

(a) Testes (b) Corpus luteum (c) Organizer (d) Uterus

572. Metamorphosis is associated with

(a) Excretion (b) Embryology (c) Respiration (d) Endocrinology only

573. Metamorphosis is done by

(a) Corpus callosum (b) Corpus albicans (c) Corpus luteum (d) Corpus allata

574. The unpigmented megameres are enveloped by pigmented micromeres except a circular area which is known as

(a) Archenteron (b) Yolk plug (c) Yolk sac (d) Grey crescent

575. Vitellogenesis is the process of formation of

(a) Vitelline membrane around the developing egg cells

(b) Yolk sac membrane around the yolk mass during the development of reptiles and birds

(c) Yolk and its deposition within the growing oocyte of amphibians

(d) Archenteron around the egg cell

Advance Level

576. Which of the drug inhibits metamorphosis in frog

(a) Paracetamol (b) Penicillin (c) Thiourea (d) Barbiturates

577. The third cleavage in frog's development is

(a) Holoblastic and equatorial (b) Holoblastic and unequatorial

(c) Vertical and equatorial (d) Meroblastic and vertical

578. Beginning of archenteron formation in frog's development represents the stage

(a) Morula (b) Early blastula (c) Early gastrula (d) Late gastrula

579. During embryonic development, the establishment of polarity along anterior/ posterior, dorsal/ ventral or medial/ lateral axis is called

(a) Pattern formation (b) Organizer phenomena (c) Axis formation (d) Anamorphosis

580. Which of the following is a good example of metamorphosis

(a) Reduction of tail to coccyx in man

(b) Hatching of a caterpillar from the egg of a butterfly

(c) Regeneration of broken tail in lizards (d) Development of eye in frog

581. When a small piece of dorsal lip of blastopore of frog's early gastrula is transplanted into another gastrula of similar age at ventral lip, the result is

(a) Death of the graft tissue

(b) The host gastrula undergoes abnormal development

(c) The host gastrula remains normal and unaffected

(d) The graft tissue induces development of another notochord in the host

582. During metamorphosis, the disappearance of larval organs is termed

(a) Histogenesis (b) Paedogenesis (c) Histolysis (d) Paedomorphosis

583. Addition of a trace of thyroid extract or iodine in water

(a) Restricts metamorphosis (b) Kills frog's tadpoles

(c) Slows down tadpole' metamorphosis (d) Accelerates tadpole's metamorphosis

584. During metamorphosis, the tail of tadpole is

(a) Eaten by other tadpoles (b)Broken down

(c) Converted into nutritive materials by catepsins (d)None of the above

585. During metamorphosis of frog

(a) Gills get converted into lungs

(b) Intestine develops and becomes greatly elongated

(c) Tail gets shed by breaking at its root

(d) Skin gets cornified and mucous and poisonous glands develop in it

586. Structure which remains unchanged during metamorphosis in frog's tadpole is

(a) Intestine (b) Brain (c) Heart (d) Lung

587. During metamorphosis, the tail of frog's tadpole gets

(a) Reabsorbed (b) Broken off

(c) Dried up and falls off (d) Pinched off and eaten by other tadpoles

588. Suppose frog's tadpole does not metamorphose, yet it could not be grouped under fishes because it

(a) Feeds on aquatic vegetation (b) Does not possess gills

(c) Has a spirally coiled intestine (d) Does not possess scales

589. The development of frog takes place inside egg membrane upto

(a) Gastrula (b) Todpole larva (c) Adult (d) Tailbud larva

590. If the size of a fertilized egg of frog's is compared with the size of blastula and gastrula, which of the following observations will be correct

(a) All three are almost equal in size

(b)Progressive increase in size from egg to gastrula

(c) Fertilized egg is largest and gastrula is smallest

(d)Fertilized egg is smallest and blastula is largest

591. What is true about mid-gastrula stage in development of frog

(a) Both blastocoel and archenteron are present (b) Blastopore and yolk plug are formed

(c) Archenteron just begin to appear (d) Entire surface is covered by ectodermal cells

592. During development of frog's embryo, blastopore appears at the stage of

(a) Early blastula (b) Late blastula (c) Early gastrula (d) Late gastrula

593. The yolk plug is the structure in gastrula which is formed by the protrusion of

(a) Ectodermal cells (b) Endodermal cells (c) Mesodermal cells (d) Blastomeres

594. **Assertion (A)**: The "Chorda- mesoderm" is regarded as the "Organizer" of amphibian embryo

Reason (R): The "Chorda-mesoderm" later gives rise to the notochord and the mesoderm

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not a correct explanation

(c) A is true but R is false

(d) A is false but R is true

595. Which statement regarding embryonic stages of frog is correct

(a) Blastocoel later becomes archenteron (b) Blastopore is the opening of blastocoel

(c) First cleavage is horizontal and next two vertical

(d) Archenteron is future alimentary canal

596. Main process involved in gastrulation in frog are

(a) Epiboly, involution, cleavage (b) Involution, epiboly, invagination

(c) Involution, epiboly, evagination (d) Involuation, invagination , cleavage

597. Beginning of archenteron formation in frog's development represents the stage of

(a) Neurula (b) Early blastula (c) Early gastrula (d) Late gastrula

598. Which side of future tadpole is represented by the yolk-plug side of frog's gastrula

(a) Dorsal (b) Ventral (c) Anterior (d) Posterior

599. Which cleavage in frog divides the egg into future left and right side

(a) First (b) Second (c) Third (d) Fourth

600. During gastrulation in frog, the micromeres at the animal pole proliferate and roll over the macromeres below. The process is called

(a)Invagination (b)Involution (c)Convergence (d)Epiboly

601. Gastrula is the stage in the embryonic development of frog when

(a) The embryo is hollow ball of single layered ectodermal cells

(b) The embryo has three primary germ layers as ectoderm, mesoderm and endoderm

(c) The embryo has two layer, an ectoderm and an endodermal tube opening through blastopore

(d) The embryo has an ectodermal and endo-dermal tube and a rudimentary central nervous system

602. Third cleavage in frog is

(a) Meridional (b) Equatorial (c) Vertical (d) Latitudinal

603. After which cleavage, holoblastic and equal cleavage in frog's egg ends

(a) First (b) Second (c) Fourth (d) Fifth

604. Animal pole of frog's egg represents prospective

(a) Dorsal side (b) Ventral side (c) Head end (d) tail end

605. Gray crescent is an area formed soon after fertilization in

(a) Zygote of all animals (b)Zygote of amphibians

(c) Blastula of vertebrates (d)Zygote of nonchordates

606. Vegetal hemisphere in frog's egg in water remains

(a) Upwards (b)Downwards

(c) Directed towards right (d)Zygote towards left

607. The jelly in frog's spawn keeps eggs

(a) Cool (b) Warm (c) Shockproof (d) Waterproof

608. Animal pole of frog's egg in water remains upwards, because

(a) It has no yolk (b)It absorbs light

(c) Sperm enters from this pole (d)It makes eggs invisible to enemies by absorbing light

609. When a sperm enters in an egg of frog

(a) Fertilization process is completed (b) First polar body is formed

(c) First meiotic division occurs (d) Second meiotic division occurs

610. During development of frog, the point of entry of the sperm in the egg at fertilization

(a) Establishes the axis of cleavage (b) Forms the centre of rotation of the egg

(c) Forms the gray crescent (d) Forms the dorsal lip of blastopore

611. The gray crescent of frog's embryo represent the future

(a) Anterior side of the developing embryo (b) Posterior side of the developing embryo

(c) Dorsal side of the developing embryo (d) Ventral side of the developing embryo

612. In frog, embryonic development occurs as follows

(a) Fertilization, cleavage, morula, blastula (b) Fertilization, blastula, morula, cleavage

(c) Cleavage, morula, blastula, fertilization (d) Cleavage, blastula, fertilization, morula

613. Frog's egg is covered with very sticky jelly because

(a) It protects the escape of heat from the egg (b) Protection from water

(c) Protection from enemies (d) For concentration of eggs

614. Frog's blastula is termed as

(a) Amphiblastula (b) Coeloblastula (c) Discoblastula (d) Superficial blastula

615. The avian gastrulation differs from that of amphibian gastrulation in that

(a) A true archenteron is not found in birds (b) Avian blastopore is not circular

(c) Formation of endoderms occurs by poly invagination (d) All the above

616. Differentiation of medullary plate in frog's embryo occurs in which stage

(a) Neurula (b) Blastula (c) Gastrula (d) Morula

617. Catepsin enzyme is produced by

(a) Tail of tadpole (b) Gill of tadpole (c) Jaw of tadpole (d) All the above

618. In avians

(a) Blastopore is not formed during gastrulation as with amphibians

(b) Blastopore is formed just as in amphibians

(c) Blastopore formation is different from amphibians

(d) None of the above

619. The change in oxygen carrying capacity during metamorphosis is accomplished by

(a) Formation of new hemoglobin which has lower affinity for oxygen

(b) Changes in the plasma

(c) Substances which inhibit oxygen uptake

(d) None of the above

ANSWER

ASSIGNMENT (BASIC & ADVANCE LEVEL

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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b	d	b	c	b	b	b	a	d	a	c	a	a	b	d	a	a	c	a	

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