

1. Reproduction in Organisms

1 MARKS:

1. In which type of parthenogenesis are only males produced?

- a) Arrhenotoky b) Thelytoky
- c) Amphitoky d) Both a and b

2. Animals giving birth to young ones:

- a) Oviparous b) Ovoviviparous
- c) Viviparous d) Both a and b

3. The mode of reproduction in bacteria is by

- a) Formation of gametes b) Endospore formation
- c) Conjugation d) Zoospore formation

4. In which mode of reproduction variations are seen

- a) Asexual b) Parthenogenesis
- c) Sexual d) Both a and b

5. Assertion and reasoning questions:

In each of the following questions there are two statements. One is assertion (A) and other is reasoning (R). Mark the correct answer as

- A. If both A and R are true and R is correct explanation for A
- B. If both A and R are true but R is not the correct explanation for A
- C. If A is true but R is false
- D. If both A and R are false.

I. Assertion: In bee society, all the members are diploid except drones.

Reason: Drones are produced by parthenogenesis.

- A B C D

II. Assertion: Offsprings produced by asexual reproduction are genetically identical to the parent Reason: Asexual reproduction involves only mitosis and no meiosis.

- A B C D

III. Assertion: Viviparous animals give better protection to their offsprings.

Reason: They lay their eggs in the safe places of the environment.

- A B C D

2 MARKS AND 3 MARKS:

1. Factors involving in the lifecycle of living organisms - 6

- 1. Birth 2. Growth 3. Development
- 4. Maturation 5. Reproduction 6. Death

2. Reproduction-

Reproduction is the fundamental feature of all living organisms. It is a biological process by which organisms produce their young ones. The young ones grow and mature to repeat the process.

Reproduction results in continuation of species and introduces variations in organisms, which are essential for adaptation and evolution of their own kind.

Reproduction is a process by which the living beings propagate or duplicate their own kind.

3. Basic features of reproduction – 5

- 1. Synthesis of RNA & Proteins 2. Replication of DNA
- 3. Cell division & growth 4. Formation of reproductive units
- 5. Fertilization to form new individuals.

4. Modes/Classification/types of reproduction – 2

- 1. Asexual reproduction 2. Sexual reproduction

5. Asexual reproduction-

Reproduction by a single parent without the involvement of gamete formation is **asexual reproduction** and the offspring produced are genetically identical.

6. Somatogenic or blastogenic reproduction:

Asexual reproduction is usually by amitotic or mitotic division of the somatic (body) cells, hence is also known as somatogenic or blastogenic reproduction.

7. Mode of asexual reproduction – 6

- 1. Fission 2. sporulation 3. budding
- 4. Gemmule formation 5. fragmentation 6. regeneration

8. Fission-

Fission is the division of the parent body into two or more identical daughter individuals.

9. Types of fission – 4

1. Binary fission
2. Multiple fission
3. sporulation
4. strobilation

10. Binary fission-

In **binary fission**, the parent organism divides into two halves and each half form a daughter individual.

11. Karyokinesis- division of the nucleus during mitosis.

12. Cytokinesis - division of the cytoplasm.

13. Types of binary fission – 4

1. Simple irregular binary fission
2. Transverse binary fission
3. Longitudinal binary fission
4. Oblique binary fission

14. Simple irregular binary fission –

Plane of division is hard to observe. The contractile vacuoles cease to function and disappear. The nucleoli disintegrate and the nucleus divides mitotically. The cell then constricts in the middle, so the cytoplasm divides and forms two daughter cells.

E.g *Amoeba like irregular shaped organisms.*

15. Transverse binary fission –

In **transverse binary fission**, the plane of the division runs along the transverse axis of the individual. In paramecium, the macro molecule divides by amitosis, the micromolecule divides by mitosis.

E.g *Paramecium & Planaria*

16. Longitudinal binary fission –

In **longitudinal binary fission**, the nucleus and the cytoplasm divide in the longitudinal axis of the organism. In flagellates, the basal granule is divided into two and the new basal granule forms a flagellum in the other daughter individual.

E.g *Vorticella & Euglena*

17. Oblique binary fission –

In **oblique binary fission** the plane of division is oblique. It is seen in dinoflagellates. **E.g** *Ceratium*

18. Multiple fission –

In **multiple fission** the parent body divides into many similar daughter cells simultaneously. First the nucleus divides repeatedly without the division of the cytoplasm, later the cytoplasm divides into as many parts as that of nuclei. Each cytoplasmic part encircles one daughter nucleus. This results in the formation of many smaller individuals from a single parent organism. **E.g** *Vorticella*

19. Repeated fission –

If multiple fission produces four or many daughter individuals by equal cell division and the young ones do not separate until the process is complete, then this division is called **repeated fission**. **E.g** *Vorticella*

20. Difference between Schizogony and Sporogony

Sl.no	Schizogony / merozoites	Sporogony / sporozoites
1.	When multiple fission occurs in the schizont, the process is called schizogony and the daughter individuals are called merozoites. E.g <i>Plasmodium</i>	When multiple fission occurs in the oocyte, it is called sporogony and the daughter individuals are called sporozoites. E.g <i>Plasmodium</i>

21. Difference between Schizogony and Sporogony

Sl.no	Encystment	pseudopodiospore or amoebulae
1.	During unfavorable conditions (increase or decrease in temperature, scarcity of food) <i>Amoeba</i> withdraws its pseudopodia and secretes a three-layered, protective, chitinous cyst wall around it and becomes inactive. This phenomenon is called encystment. E.g <i>Amoeba</i>	In favourable, the encysted <i>Amoeba</i> divides by multiple fission and produces many minute amoebae called pseudopodiospore or amoebulae. E.g <i>Amoeba</i>

22. Strobilation -

In some metazoan animal, a special type of transverse fission is seen is called strobilation. In the process of strobilation, several transverse fissions occur simultaneously giving rise to a number of individuals which often do not separate immediately from each other. **E.g Aurelia**

23. Plasmotomy -

Plasmotomy is the division of multinucleated parent into many multinucleate daughter individuals with the division of nuclei. Nuclear division occurs later to maintain normal number of nuclei.

E.g Opalina & Pelomyxa (Giant Amoeba)

24. Sporulation -

During unfavourable conditions *Amoeba* multiplies by **sporulation** without encystment. Nucleus breaks into several small fragments or chromatin blocks. Each fragment develops a nuclear membrane, becomes surrounded by cytoplasm and develops a spore-case around it. **E.g Amoeba**

25. Budding-

In **budding**, the parent body produces one or more buds and each bud grows into a young one. The buds separate from the parent to lead a normal life.

The buds separate from the parent to lead a normal life. In sponges, the buds constrict & detach from the parent body & the bud develops into a new sponge.

E.g Sponge

26. Difference between Exogenous budding and Endogenous budding-

Sl.no	Exogenous budding	Endogenous budding
1.	When buds are formed on the outer surface of the parent body, it is known as exogenous budding . E.g Hydra	In Noctiluca , hundreds of buds are formed inside the cytoplasm and many remain within the body of the parent. This is called endogenous budding . E.g Noctiluca

27. Gemmules-

In freshwater sponges and in some marine sponges a regular and peculiar mode of asexual reproduction occurs by internal buds called **gemmules**. **E.g Sponge**

28. Fragmentation -

In **fragmentation**, the parent body breaks into fragments (pieces) and each of the fragment has the potential to develop into a new individual.

E.g Tapeworm & sea anemone

29. Apolysis -

In the tapeworm, *Taenia solium* the gravid (ripe) proglottids are the oldest at the posterior end of the strobila. The gravid proglottids are regularly cut off either singly or in groups from the posterior end by a process called apolysis. **E.g Taenia**

This is very significant since it helps in transferring the developed embryos from the primary host (man) to find a secondary host (pig).

30. Regeneration –

Regeneration is regrowth in the injured region. Regeneration was first studied in *Hydra* by Abraham Trembley in 1740. **E.g Hydra**

Regeneration is the development of the whole body of an organism from a small fragment.

31. Types of Regeneration – 2

1. Morphallaxis
2. Epimorphosis

32. Difference between Morphallaxis and Epimorphosis-

Sl.no	Morphallaxis	Epimorphosis
1.	In morphallaxis the whole body grows from a small fragment. E.g Hydra & planaria	Epimorphosis is the replacement of lost body parts. E.g Star fish & wall lizard

33. Difference between Reparative and Restorative Regeneration.

Sl.no	Reparative	Restorative
1.	In reparative regeneration, only certain damaged tissue can be regenerated. E.g Invertebrates & Vertebrates	In restorative regeneration severed body parts can develop. E.g Tail of wall lizard

34. Sexual reproduction-

When two parents participate in the reproductive process involving two types of gametes (ova and sperm), it is called **sexual reproduction**.

Sexual reproduction involves the fusion of male and female gametes to form a diploid zygote, which develops into a new organism.

35. Types of Sexual reproduction -2

1. Syngamy (fertilization)
2. Conjugation

36. Syngamy (fertilization)-

In **syngamy**, the fusion of two haploid gametes takes place to produce a diploid zygote.

37. Types of fertilization (syngamy) - 2

1. External fertilization
2. Internal fertilization

38. Difference between External fertilization and internal fertilization-

Sl.no	External fertilization	Internal fertilization
1.	In external fertilization , the fusion of male and female gametes takes place outside the body of female organisms in the water medium. E.g Sponges, Fishes & Amphibians	In internal fertilization , the fusion of male and female gametes takes place within the body of female organisms. E.g reptiles, aves & mammals

39. Autogamy-

In **autogamy**, the male and female gametes are produced by the same cell or same organism and both the gametes fuse together to form a zygote. **E.g Actinosphaerium & paramecium**

40. Exogamy-

In **exogamy**, the male and female gametes are produced by different parents and they fuse to form a zygote. So it is biparental.

E.g Human –dioecious / Unisexual animals.

41. Hologamy-

In lower organisms, sometimes the entire mature organisms do not form gametes but they themselves behave as gametes and the fusion of such mature individuals is known as **hologamy**. **E.g. Trichonympha.**

42. Paedogamy-

Paedogamy is the sexual union of young individuals produced immediately after the division of the adult parent cell by mitosis.

E.g Protozoans

43. Merogamy-

In **merogamy**, the fusion of small sized and morphologically different gametes (merogametes) takes place.

E.g Elphidium

44. Isogamy-

The fusion of morphological and physiological identical gametes (isogametes) is called **isogamy**. **E.g Monocystis**

45. Anisogamy-

The fusion of dissimilar gametes is called **anisogamy** (*Gr. An-without; iso-equal; gam-marriage*).

E.g Higher vertebrates & Vertebrates

46. Conjugation-

Conjugation is the temporary union of the two individuals of the same species. During their union both individuals, called the conjugants exchange certain amount of nuclear material (DNA) and then get separated.

E.g Paramecium, Vorticella & Bacteria

47. Phases of life cycle – 3

1. Juvenile phase
2. Reproductive phase
3. Senescence phase

48. Juvenile phase-

Juvenile phase/ vegetative phase is the period of growth between the birth of the individual upto reproductive maturity.

49. Reproductive phase-

During **reproductive phase/ maturity phase** the organisms reproduce and their offspring reach maturity period.

50. Types of breeding animals – 2

1. Seasonal breeders
2. Continuous breeders

51. Difference between Seasonal breeders and continuous breeders

Sl.no	Seasonal breeders	continuous breeders
1.	Seasonal breeders reproduce at particular period of the year such as <i>frogs, lizards, most birds, deers.</i>	Continuous breeders continue to breed throughout their sexual maturity <i>E.g. honey bees, poultry, rabbit.</i>

52. Senescent phase-

Senescent phase begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.

53. PARTHENOGENESIS-

Development of an egg into a complete individual without fertilization is known as parthenogenesis.

Discovered by Charles Bonnet-1745

54. Types of parthenogenesis – 2

1. Natural parthenogenesis
2. Artificial parthenogenesis

55. Difference between Natural parthenogenesis and Artificial parthenogenesis

Sl.no	Natural parthenogenesis	Artificial parthenogenesis
1.	In certain animals, parthenogenesis occurs regularly, constantly and naturally in their life cycle and is known as natural parthenogenesis . <i>E.g Komodo Dragon & honey bees</i>	In artificial parthenogenesis , the unfertilized egg (ovum) is induced to develop into a complete individual by physical or chemical stimuli. <i>E.g Annelid & seaurchin eggs.</i>

56. Types of natural parthenogenesis – 2

1. Complete parthenogenesis
2. Incomplete parthenogenesis

57. Difference between Complete parthenogenesis and Incomplete parthenogenesis

Sl.no	Natural parthenogenesis	Artificial parthenogenesis
1.	Complete parthenogenesis is the only form of reproduction in certain animals and there is no biparental sexual reproduction. These are no male organisms and so, such individuals are represented by females only. Males are completely absent. <i>E.g Aphids</i>	Incomplete parthenogenesis is found in some animals in which both sexual reproduction and parthenogenesis occurs. e.g. In honeybees; fertilized eggs (zygotes) develop into queen and workers, whereas unfertilized eggs develop into drones (male). <i>E.g honey bees</i>

58. Paedogenetic parthenogenesis (paedogenesis)-

In **paedogenetic parthenogenesis (paedogenesis)** the larvae produce a new generation of larvae by parthenogenesis. It occurs in the sporocysts and Redia larvae of liver fluke. It is also seen in the larvae of some insects. *E.g. Gall fly.*

59. Oviparous-

In **Oviparous** (Fig 1.14) (*L., Ovum*-egg-, *Parere*- to produce) animals (egg laying animals), the young hatch from eggs laid outside the mother's body. e.g. reptiles and birds (their eggs are covered by hard calcareous shells), invertebrates, fishes and amphibians (eggs are not covered by hard calcareous shells but covered by a membrane).

E.g Reptiles & birds

60. Viviparous-

Viviparous (Fig 1.15) (*L., Vivus* - alive, *Parere* - to produce) animals give rise to young ones. Viviparity is a type of development in which the young ones are born alive after being nourished in the uterus through the placenta.

E.g Mammals- including human beings

61. Ovoviviparous-

In **Ovoviviparous** animals, the embryo develops inside the egg and remains in the mother's body until they are ready to hatch (Fig 1.16). This method of reproduction is similar to viviparity but the embryos have no placental connection with the mother and receive their nourishment from the egg yolk.

E.g fishes like shark

EXTRA POINTS:

1. Automixis:

The chromosomes of a haploid gamete divide without nuclear division resulting in formation of a diploid nucleus.

2. Somatogenic reproduction:

In asexual reproduction, only one parent is involved, so it is also called uniparental reproduction.

In it, new organisms are produced from the somatic part of parental organism, so it is called somatogenic reproduction.

3. Blastogenic reproduction:

Reproduction of unicellular organism by budding.

4. oocyte:

A cell in an ovary which may undergo meiotic division to form an ovum.

5. Sporogony:

The sexual process of spore formation in parasitic sporozoans.

6. Schizogony:

Asexual reproduction by multiple fission, found in some protozoa, especially parasitic sporozoans.

7. Pedal laceration:

A type of asexual reproduction in sea anemones in which parts of the pedal disc break off and are left behind as the anemone moves.

8. Dioecious:

Male & female gametes are separated.

9. Difference between mitosis & meiosis.

Sl.no	Mitosis	Meiosis
1.	4 stages	8 stages
2.	In somatic cells	In germ cells
3.	Purpose – cellular proliferation	Purpose - sexual reproduction
4.	Chromosome number - remain same	Chromosome number – halve in daughter cells
5.	Genetic variation does not change	Genetic variation increases

10. Difference between mitosis & amitosis

Sl.no	Mitosis	Amitosis
1.	It is a process in which the cells separate their chromosomes into two identical sets.	Cell division by simple cleavage of the nucleus and division of the cytoplasm without spindle formation or appearance of chromosomes.

11. Difference between asexual and sexual reproduction-

Sl.no	Asexual reproduction	Sexual reproduction
1.	Reproduction by a single parent without the involvement of gamete formation is asexual reproduction and the offspring produced are genetically identical.	When two parents participate in the reproductive process involving two types of gametes (ova and sperm), it is called sexual reproduction . Sexual reproduction involves the fusion of male and female gametes to form a diploid zygote, which develops into a new organism.

12. Types of syngamy – 8

1. autogamy
2. Exogamy
3. Hologamy
4. Paedogamy
5. merogamy
6. Isogamy
7. Anisogamy
8. conjugation

5 MARKS:

1. MODES OF REPRODUCTION:

All modes of reproduction have some basic features such as **synthesis of RNA and proteins, replication of DNA, cell division and growth, formation of reproductive units and their fertilization** to form new individuals. Organisms exhibit two major modes of reproduction namely **asexual and sexual reproduction**.

Reproduction by a single parent without the involvement of gamete formation is **asexual reproduction** and the offspring produced are genetically identical. Asexual reproduction is usually by **amitotic or mitotic division of the somatic (body) cells**, hence is also known as somatogenic or blastogenic reproduction.

When two parents participate in the reproductive process involving two types of gametes (**ova and sperm**), it is called **sexual reproduction**.

2. FISSION:

Fission is the division of the parent body into two or more identical daughter individuals. Four types of fission are seen in animals. They are **binary fission, multiple fission, sporulation and strobilation**.

A) BINARY FISSION:

In **binary fission**, the parent organism divides into two halves and each half form a daughter individual. The nucleus divides first amitotically or mitotically (karyokinesis), followed by the division of the cytoplasm (cytokinesis). The resultant offsprings are genetically identical to the parent. Depending on the plane of fission, binary fission is of the following types

- | | |
|------------------------------------|-------------------------------|
| i) Simple irregular binary fission | ii) Transverse binary fission |
| iii) Longitudinal binary fission | iv) Oblique binary fission |

Simple binary fission is seen in *Amoeba* like irregular shaped organisms, where the plane of division is hard to observe. The contractile vacuoles cease to function and disappear. The nucleoli disintegrate and the nucleus divides mitotically. The cell then constricts in the middle, so the cytoplasm divides and forms two daughter cells.

In **transverse binary fission**, the plane of the division runs along the transverse axis of the individual. e.g. *Paramecium* and *Planaria*. In *Paramecium* the macronucleus divides by amitosis and the micronucleus divides by mitosis.

In **longitudinal binary fission**, the nucleus and the cytoplasm divides in the longitudinal axis of the organism. In flagellates, the flagellum is retained usually by

one daughter cell. The basal granule is divided into two and the new basal granule forms a flagellum in the other daughter individual. e.g. *Vorticella* and *Euglena*.

In **oblique binary fission** the plane of division is oblique. It is seen in dinoflagellates. e.g. *Ceratium*

B) MULTIPLE FISSION: In **multiple fission** the parent body divides into many similar daughter cells simultaneously. First, the nucleus divides repeatedly without the division of the cytoplasm, later the cytoplasm divides into as many parts as that of nuclei. Each cytoplasmic part encircles one daughter nucleus. This results in the formation of many smaller individuals from a single parent organism. If multiple fission produces four or many daughter individuals by equal cell division and the young ones do not separate until the process is complete, then this division is called **repeated fission** e.g. *Vorticella*.

In *Plasmodium*, multiple fission occurs in the schizont and in the oocyte stages. When multiple fission occurs in the schizont, the process is called schizogony and the daughter individuals are called merozoites. When multiple fission occurs in the oocyte, it is called sporogony and the daughter individuals are called sporozoites. During unfavorable conditions (increase or decrease in temperature, scarcity of food) *Amoeba* withdraws its pseudopodia and secretes a three-layered, protective, chitinous cyst wall around it and becomes inactive. This phenomenon is called encystment. When conditions become favourable, the encysted *Amoeba* divides by multiple fission and produces many minute amoebae called pseudopodiospore or amoebulae. The cyst wall absorbs water and breaks off liberating the young pseudopodiospores, each with fine pseudopodia. They feed and grow rapidly to lead an independent life.

C. STROBILATION: In some metazoan animals, a special type of transverse fission called **strobilation** occurs. In the process of strobilation, several transverse fissions occur simultaneously giving rise to a number of individuals which often do not separate immediately from each other e.g. *Aurelia*. **Plasmotomy** is the division of multinucleated parent into many multinucleate daughter individuals with the division of nuclei. Nuclear division occurs later to maintain normal number of nuclei. Plasmotomy occurs in *Opalina* and *Pelomyxa* (Giant *Amoeba*).

D. SPORULATION: During unfavourable conditions *Amoeba* multiplies by **sporulation** without encystment. Nucleus breaks into several small fragments or chromatin blocks. Each fragment develops a nuclear membrane, becomes surrounded by cytoplasm and develops a spore-case around it. When conditions become favourable, the parent body disintegrates and the spores are liberated, each hatching into a young amoeba.

3. BUDDING:

In **budding**, the parent body produces one or more buds and each bud grows into a young one. The buds separate from the parent to lead a normal life. In sponges, the buds constrict and detach from the parent body and the bud develops into a new sponge.

A) EXOGENOUS BUDDING:

When buds are formed on the outer surface of the parent body, it is known as **exogenous budding** e.g. *Hydra*. In *Hydra* when food is plenty, the ectoderm cells increase and form a small elevation on the body surface. Ectoderm and endoderm are pushed out to form the bud. The bud contains an interior lumen in continuation with parent's gastro-vascular cavity. The bud enlarges, develops a mouth and a circle of tentacles at its free end. When fully grown, the bud constricts at the base and finally separates from the parent body and leads an independent life.

B) ENDOGENOUS BUDDING:

In *Noctiluca*, hundreds of buds are formed inside the cytoplasm and many remain within the body of the parent. This is called **endogenous budding**. In freshwater sponges and in some marine sponges a regular and peculiar mode of asexual reproduction occurs by internal buds called **gemmules** is seen. A completely grown gemmule is a hard ball, consisting of an internal mass of food-laden archaeocytes. During unfavourable conditions, the sponge disintegrates but the gemmule can withstand adverse conditions. When conditions become favourable, the gemmules begin to hatch.

4. FRAGMENTATION:

In **fragmentation**, the parent body breaks into fragments (pieces) and each of the fragments has the potential to develop into a new individual. Fragmentation or pedal laceration occurs in many genera of sea anemones. Lobes are constricted off from the pedal disc and each of the lobes grows mesenteries and tentacles to form a new sea anemone.

In the tapeworm, *Taenia solium* the gravid (ripe) proglottids are the oldest at the posterior end of the strobila. The gravid proglottids are regularly cut off either singly or in groups from the posterior end by a process called apolysis. This is very significant since it helps in transferring the developed embryos from the primary host (man) to find a secondary host (pig).

5. REGENERATION:

Regeneration is re growth in the injured region. Regeneration was first studied in *Hydra* by Abraham Trembley in 1740. Regeneration is of two types, **morphallaxis** and **epimorphosis**. In morphallaxis the whole body grows from a small fragment e.g. *Hydra* and *Planaria*. When *Hydra* is accidentally cut into several pieces, each piece can regenerate the lost parts and develop into a whole new individual. The parts usually retain their original polarity, with oral ends, by developing tentacles and aboral ends, by producing basal discs. **Epimorphosis** is the replacement of lost body parts. It is of two types, namely **reparative** and **restorative** regeneration. In reparative regeneration, only certain damaged tissue can be regenerated, whereas in restorative regeneration severed body parts can develop. e.g. star fish, tail of wall lizard.

6. PARTHENOGENESIS:

(*Gr. Parthenos – virgin, Genesis-produce*)

Development of an egg into a complete individual without fertilization is known as parthenogenesis. It was first discovered by Charles Bonnet in 1745. Parthenogenesis is of two main types namely, Natural Parthenogenesis and Artificial Parthenogenesis. In certain animals, parthenogenesis occurs regularly, constantly and naturally in their life cycle and is known as **natural parthenogenesis**.

A) NATURAL PARTHENOGENESIS:

Natural parthenogenesis may be of two types, viz., complete and incomplete.

Complete parthenogenesis is the only form of reproduction in certain animals and there is no biparental sexual reproduction. These are no male organisms and so, such individuals are represented by females only.

Incomplete parthenogenesis is found in some animals in which both sexual reproduction and parthenogenesis occurs. e.g. In honeybees; fertilized eggs (zygotes) develop into queen and workers, whereas unfertilized eggs develop into drones (male).

In **paedogenetic parthenogenesis (paedogenesis)** the larvae produce a new generation of larvae by parthenogenesis. It occurs in the sporocysts and Redia larvae of liver fluke. It is also seen in the larvae of some insects. e.g. Gall fly.

B) ARTIFICIAL PARTHENOGENESIS: In **artificial parthenogenesis**, the unfertilized egg (ovum) is induced to develop into a complete individual by physical or chemical stimuli. e.g., Annelid and sea urchin eggs.

7. SEXUAL REPRODUCTION:

Sexual reproduction involves the fusion of male and female gametes to form a diploid zygote, which develops into a new organism. It leads to genetic variation. The types of sexual reproduction seen in animals are syngamy (fertilization) and conjugation.

A) SYNGAMY:

In **syngamy**, the fusion of two haploid gametes takes place to produce a diploid zygote. Depending upon the place where the fertilization takes place, it is of two types.

In **external fertilization**, the fusion of male and female gametes takes place outside the body of female organisms in the water medium. e.g. sponges, fishes and amphibians.

In **internal fertilization**, the fusion of male and female gametes takes place within the body of female organisms. e.g. reptiles, aves and mammals.

Different kinds of syngamy (fertilization) are prevalent among living organisms.

In **autogamy**, the male and female gametes are produced by the same cell or same organism and both the gametes fuse together to form a zygote e.g. *Actinosphaerium* and *Paramecium*.

In **exogamy**, the male and female gametes are produced by different parents and they fuse to form a zygote. So it is biparental. e.g. Human – dioecious or unisexual animal.

In lower organisms, sometimes the entire mature organisms do not form gametes but they themselves behave as gametes and the fusion of such mature individuals is known as **hologamy** e.g. *Trichonympha*.

Paedogamy is the sexual union of young individuals produced immediately after the division of the adult parent cell by mitosis.

In **merogamy**, the fusion of small sized and morphologically different gametes (merogametes) takes place.

The fusion of morphological and physiological identical gametes (isogametes) is called **isogamy**. e.g. *Monocystis*,

whereas the fusion of dissimilar gametes is called **anisogamy** (*Gr. An-* without; *iso*-equal; *gam*-marriage). Anisogamy occurs in higher animals but it is customary to use the term fertilization instead of anisogamy or syngamy. e.g. higher invertebrates and all vertebrates.

B) CONJUGATION:

Conjugation is the temporary union of the two individuals of the same species. During their union both individuals, called the conjugants exchange certain amount of nuclear material (DNA) and then get separated. Conjugation is common among ciliates, e.g. *Paramecium*, *Vorticella* and bacteria (Prokaryotes).

8. PHASES OF LIFE CYCLE:

Organisms have three phases – Juvenile phase, reproductive phase and senescent phase. **Juvenile phase/ vegetative phase** is the period of growth between the birth of the individual upto reproductive maturity.

During **reproductive phase/ maturity phase** the organisms reproduce and their offsprings reach maturity period. On the basis of time, breeding animals are of two types: **seasonal breeders** and **continuous breeders**.

Seasonal breeders reproduce at particular period of the year such as frogs, lizards, most birds, deers etc.,

Continuous breeders continue to breed throughout their sexual maturity e.g. honey bees, poultry, rabbit etc.,

Senescent phase begins at the end of reproductive phase when degeneration sets in the structure and functioning of the body.

9. DEVELOPMENT OF EMBRYO: Animals are classified mainly into three groups namely – Oviparous, Viviparous and Ovoviviparous depends on the site of development of embryo and whether they lay eggs (unfertilized or fertilized) or give birth to young ones.

In **Oviparous** (*L., Ovum*-egg-, *Parere*- to produce) animals (egg laying animals), the young hatch from eggs laid outside the mother's body. e.g. reptiles and birds (their eggs are covered by hard calcareous shells), invertebrates, fishes and amphibians (eggs are not covered by hard calcareous shells but covered by a membrane).

Viviparous (*L., Vivus* - alive, *Parere* - to produce) animals give rise to young ones. Viviparity is a type of development in which the young ones are born alive after being nourished in the uterus through the placenta. Majority of mammals including human beings are viviparous. In

Ovoviviparous animals, the embryo develops inside the egg and remains in the mother's body until they are ready to hatch. This method of reproduction is similar to viviparity but the embryos have no placental connection with the mother and receive their nourishment from the egg yolk. Ovoviviparity is seen in fishes like shark.

