IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

SEXUAL REPRODUCTION IN PLANTS AND ANIMALS

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ABSTRACT.

One essential biological mechanism by which plants and animals maintain the genetic diversity of their species is reproduction. There are two main ways that reproduction happens in both plants and animals: asexual and sexual. Asexual reproduction yields genetically identical offspring when it includes a single parent. This technique, which is common in plants, involves vegetative propagation, fragmentation, and budding. On the other hand, sexual reproduction creates genetically varied offspring by fusing male and female gametes. This approach is predominant in higher plants and most animals.

Flowers, which contain reproductive parts such as male stamens and female carpels, are where plants reproduce sexually. Fertilization is aided by pollination, which is the movement of pollen from the stamen to the carpel. Animal reproductive techniques differ greatly between species. More complex creatures usually use internal fertilization for better protection of the growing progeny, although external fertilization—where eggs and sperm are released into the environment—is prevalent in smaller organisms.

Additionally, plants exhibit a variety of reproductive adaptations, such as self- and cross-pollination, which guarantee reproduction in the event of mate scarcity or promote genetic diversity. On the other hand, in order to increase the survival of their progeny, animals have evolved a variety of reproductive methods, including oviparity, viviparity, and parental care.

The complexity, diversity, and balance of nature's reproduction methods are highlighted by our understanding of these mechanisms.

INTRODUCTION.

One of the most important aspects of biology is that life begets life. All organisms develop from pre-existing organisms. Reproduction involves the transfer of characters from one generation to another. The definition involves how the parents pass biological traits to their offspring.

In plants, flowers are specialized sexual reproduction organs. Great variations in size, shape and colour can be observed in flowers. Sexual reproduction helps in variations and also formation of new combination of genes and this helps in a gradual adaptation to a changing environment.

All organisms grow, develop and reproduce.

Growth: increase in mass or overall size of a tissue or organisms or its parts is called growth. Growth is the result of the synthesis of two distinct types of material: apoplasmic substances, which include cartilage, the matrix of bone marrow, and connective tissues, and protoplasmic substances, which include cytoplasm and the nucleus. Apoplasmic substances are those which are produced by the cells and form a constituent of the tissues.

Types of reproduction

There are two types of reproduction namely

1. Asexual reproduction
2. Sexual reproduction

Asexual reproduction

Asexual reproduction involves a single parent to produce its offspring. It is a rapid process of multiplication. New individual is produced after the cell division and they are genetically identical to parents.

Modes of Asexual reproduction

1. **Fission**

It is a simplest mode of reproduction by which a unicellular organism divides into two or more daughter cells.

It is of two types- Binary Fission and Multiple Fission.

Binary fission

The fission where the unicellular parent organism divides into two daughter organisms.

At first the nucleus of the cell divides into two followed by division of cytoplasm. Then, finally division of parent cell into two daughter cells occurs.

e.g. *Amoeba, Leishmania*

- Multiple fission

The fission where the unicellular parent organism divides into many daughter organisms at a time.

e.g. *plasmodium*

2. **Fragmentation**

It is a method of reproduction by which some multicellular organisms after the maturation they break up into smaller pieces. These parts or fragments will combine into new individuals.

This kind of reproduction in multicellular organisms with a simple body organisation occurs under favourable conditions of moisture, temperature and nutrition availability.

e.g. *spirogyra*

3. **Regeneration**

It is a type of Asexual reproduction where the new organisms regenerate from the broken or cut part of the parent organism.

Regeneration is carried out by specialised cells which makes a larger number of cells. this mass of cells, now undergo changes to form various tissues and organs to make a complete organism.

e.g. *Hydra* and *planaria*

4. **Budding**

It is a Asexual reproduction in which the daughter organism is formed or developed by a small projection of the parent organism called bud.

Because of repeated cell division the parent organism develops an outgrowth, when it is fully mature it separates from the parent living thing.

e.g. *Hydra*

5. **Vegetative propagation**

This kind of plant reproduction is called asexual reproduction, and it results in the formation of new plants from segments of the parent plant. in ideal circumstances, such as a suitable temperature and humidity. Where the parts of plants like root, stem, leaves etc. developed into the new daughter plant. Artificial vegetative propagation techniques include layering, cutting and grafting.

In grafting a part of one plant is taken and is attached to a part of another plant. Many varieties of apple, grapes, mango, etc. are produced by grafting method.

e.g. leaf buds of *Bryophyllum*

Plants grown by vegetative propagation can give fruits and flowers faster that produced from seeds. Some plans have lost the capacity to produce seeds like banana, orange, rose and jasmine this method makes the propagation possible. All the plants raised by vegetative propagation are genetically stable, they are genetically similar to their parents and they have all the characteristics of their parent plant.

6. **Spore formation**

It is a kind of Asexual reproduction. In many simple multicellular organism's blob-on-a-stick like structures are reproductive parts. The blob is called as sporangia which has the cells or spores. These spores have the capacity to produce new individuals. The spores have a thick protective wall that protects the spores in unfavourable conditions. When the spores come to contact with moist surface it will gives raise to new individual.

e.g. *Rhizopus*

Sexual reproduction

The sexes of two parents are involved in sexual reproduction. That is one sex cell (germ cell) from the male parent another sex cell from female parent. The sex cells from both the parents will fuse together to form new individual called zygote.

The sex cell which is bigger in size and non-motile is female gamete. The other sex cell which is motile and smaller in size is male gamete. The male gamete goes and fuses with the female gamete and hence the zygote is formed. If the zygote has developed and have specialised tissues and organs to become a complete organism it requires some amount of energy.

Sexual reproduction in flowering plants

Sexually reproducing flowers are also called as angiosperms. Sepals, petals, pistil and stamens are the parts of a flower. Pistil and stamens are the reproductive parts of the flowers. Pistil has the female gamete and stamens has male gamete. Some flowers have only pistil or only stamens and is called unisexual flowers (watermelon, papaya). the flowers which have both pistil and stamens are called as bisexual flowers (hibiscus, mustard).

The male reproductive organ is the stamen. which produces male gamete which is pollen grains. It may present in any number in a single flower. Anther is a part stamen contains pollen sacs which produces pollen grains. Pollen grains are sticky and yellowish in colour.

Pistil is the female reproductive part which has three parts, that is ovary it is a bulged part at the centre of the flower bottom of the pistil. Ovary contains ovules each ovule has an egg cell which is female gamete. Style it is the long elongated from the ovary to the stigma. Stigma is the end part of the pistil which is sticky what trap the pollen grains.

The pollen grains that is male gamete has to land on the stigma and fuse with the female gamete. For the fertilisation to occur which will result in formation of zygote. The process via which pollen grains go from an anther to a stigma is called pollination. Pollen grains can be dispersed by humans, water, insects, and the wind. Self-pollination and cross-pollination are the two types of pollination. Pollen grains transfer from an anther to the stigma of the same flower through a process known as self-pollination. Cross-pollination occurs when pollen grains are transferred from one flower's anther to another flower's stigma.

When the pollen grain lands on the suitable stigma it develops the pollen tube and travels through the style and thus reaches the ovary, then the male gamete goes and fuses with the egg cell and fertilisation occurs and the zygote is formed. Now the zygote divides multiple times to form embryo which is multicellular within the ovule. Now the ovule develops into coat and the embryo becomes the seed and the ovary into a fruit. While the other parts sepals, petals, stamens fall off. The seed is the future plant. The process by which a seed develops into a new plant is called as seed germination.

STAMEN

The stamen has long slenderical stalk called filament. The thalamus or a flower petal are where the filament's proximal end is attached. The terminal of the stamen is a bilobed structure called anther. Each lobe has two theca and are diethecous. A longitudinal grove separates the theca. Anther is four-sided tetragonal structure which consists of four microsporangia at each theca.

Structure of microsporangium

Microsporangium is surrounded by four layers, that is epidermis the outer most layer, endothecium, middle layer and tapetum the inner most layer. The outer three layers perform protection and help in dehiscence of anther to release pollen grain. Tapetum provides neutrinos and nourishes the developing pollen grains. Tapetum possess dense cytoplasm and has more than one nucleus. The tapetum of a juvenile anther is made up of sporogenous tissues, which are compactly organized homogenous cells.
Every sporogenous tissue has the ability to give a microspore tetrad its race. Every cell has the capacity to be a pollen mother cell (PMC). To create the microspore tetrad, PMC goes through meiosis. Microsporogenesis is the process by which a PMC undergoes meiosis to produce microspores.
The microspores separate from one another and grow into pollen grains as the anther ages and becomes dehydrated. Several thousand pollen grains are generated inside each microsporangium and expelled together with the anther's dehiscence.

Pollen grains

The male gametophyte, or androecium, is represented by the pollen grains. The spherical, 25–50 micrometer-diameter pollen grains are formed. Apart from the hard outer layer composed of sporopollenin, pollen consists of two layers. As an organic material, sporopollenin is the most resistant to harsh temperatures, acids, and alkalis. Since sporopollenin is lacking from the exine's germ pore, it is a discontinuous layer. The cellulose and pectin that make up the inner layer, referred to as intine, are thin and continuous. The pollen's plasma membrane covers the cytoplasm. The pollen divides into two cells inside the cell during mitosis as it ages. The two types of cells are called vegetative and generative. The former contains a huge, irregularly shaped nucleus and is a food reserve. A generative cell has a dense nucleus and cytoplasm and is tiny and spindle-shaped. The pollen consists of two cells at this stage. The generative cell now undergoes a mitotic division, producing two male gametes. This stage has three cells.

Allergies and long-term respiratory conditions such as bronchitis and asthma can be brought on by pollen grains. The reason behind pollen allergies in India is that Parthenium, often known as carrot grass, entered the country as a contaminant with imported wheat. Nutrient-rich pollen grains are available. Products containing pollen can be found as syrups, pills, and dietary supplements. Both race horses and athletes will perform better after eating pollen. Pollen grains can survive. For fertilization, it must land on stigma before it loses its viability. Pollen grain viability varies greatly and is influenced by temperature and humidity. Certain members of the Rosaceae, Leguminosae, and Solanaceae families contain grains that remain viable for months, while other cereals, such as rice and wheat, lose viability after 30 minutes of release. In pollen banks, liquid nitrogen (-196°C) can be used to retain pollen grains for a long time.

Pistil

The female reproductive part of a flower is called as gynoecium. If the gynoecium has only one pistil it is monocarpellary and more than one pistil it is multicarpellary. If the pistils are fused together, it is called as syncarpous if it is free, it is called as apocarpous. In the ovary there is ovarian cavity called locule. Placenta is located inside the ovarian cavity.

Megasporangium

Funicle: Stalk of an ovule, which is attached to placenta.

Raphe: Long ridge formed by lengthwise fusion of funicle with body of ovule.

Hilum: It is a junction between ovule and funicle and even extends to form raphe.

Integuments: Multicellular, one or two layered which surrounds ovule and protective in function.

Nucellus: these are the cells with abundant reserve food material enclosed with in integuments. It nourishes the developing embryo cells.

Micropyle: Ovule is surrounded by integuments except at the tip resulting in a small opening known as micropyle. Through this pore pollen tube enters into the ovule.

Chalaza: the basal part of an ovule opposite to micropyle, swollen part of the nucellus.

Embryo Sac: it is the male gametophyte which contains egg apparatus antipodals cells and secondary nucleus.

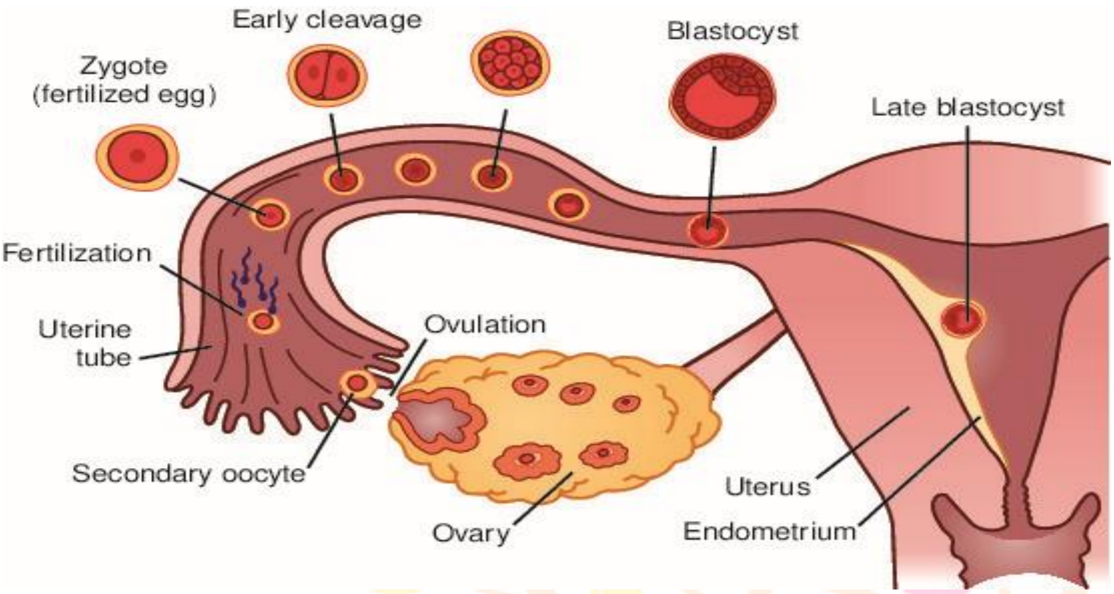
SEXUAL REPRODUCTION IN ANIMALS:

To understand sexual reproduction, we should know about the terms like male sex, female sex, gametes, sperms, ova, fertilisation, zygote and embryo which are involved in sexual reproduction.

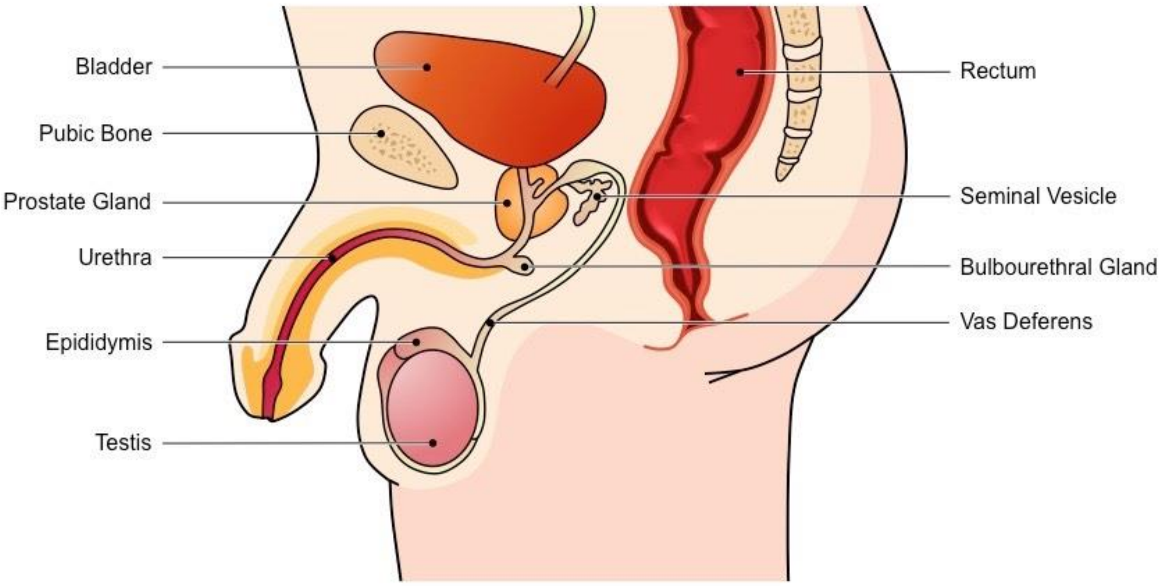
Our father is a male and our mother is a female. We also say that our father has a male sex and our mother has a female sex. Similarly, a boy has a male sex and a girl has a female sex. The cells involved in sexual reproduction are called gametes. The male gamete is called sperm and the female gamete is called ovum or egg. Sperm and ova are microscopic in nature. The ovum contains water and stored food. The main part of ovum is its nucleus. The sperm cell is thousands of times smaller than the ovum and also it has a long tail. The sperm can move independently as it has a tail which helps in motility. As we study further, the fusion of male and female gametes forms a zygote. In simplest words, zygote is a fertilised egg. Lastly the process of fusion of gametes is called fertilisation.

FERTILISATION.

As we know, in human beings, internal fertilisation takes place. The sperms made in the testes of a man are put into the vagina of a woman through penis during mating. In this way, millions of sperms are released into the vagina at once. The sperms are highly active and moving. The sperms move up through cervix into the uterus. From uterus, the sperms move into the oviducts. One of the oviducts have an ovum which is sent by the ovary during ovulation. Only one sperm fuse with the ovum to form zygote. This process is called fertilisation.



THE REPRODUCTIVE SYSTEM OF MALE.

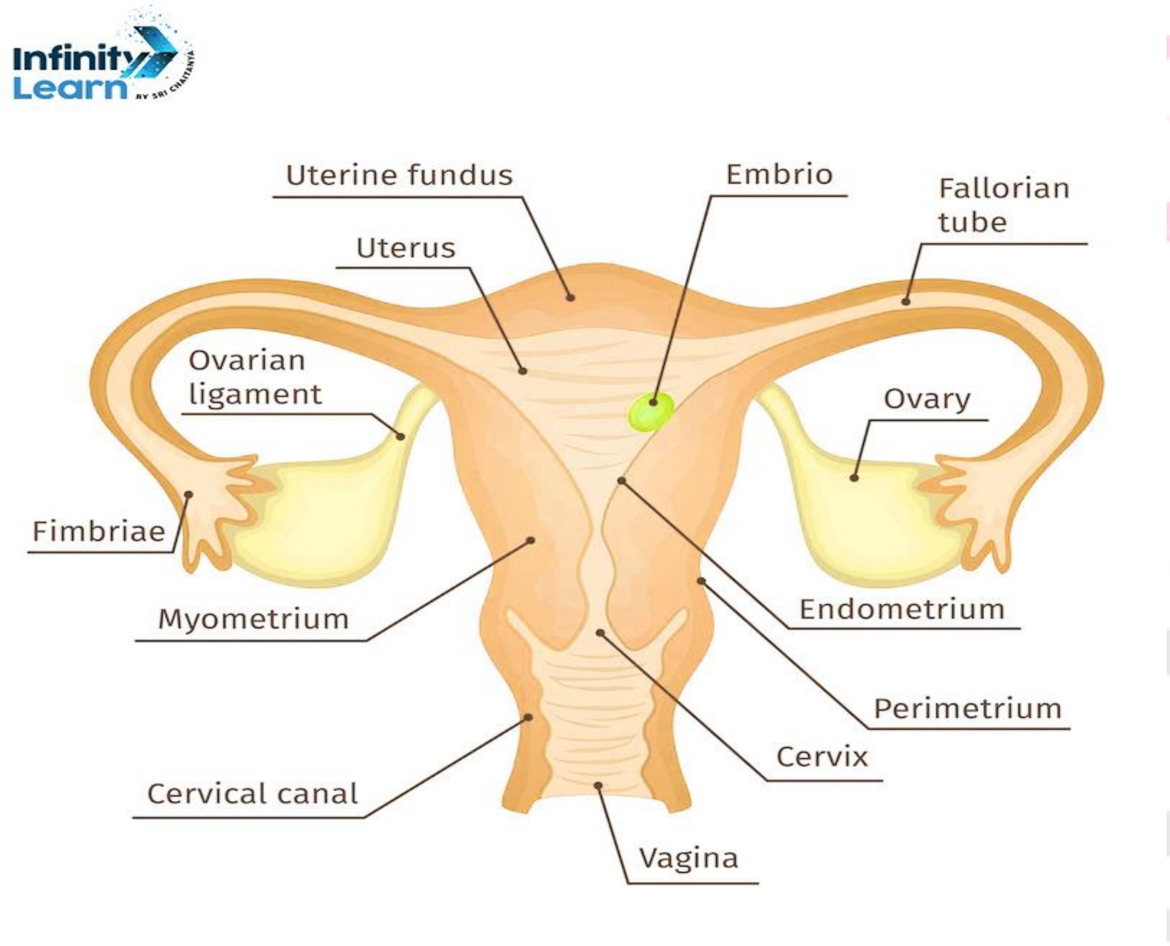


The human male reproductive system consists of following organs. Testes, scrotum, Epididymis, vas deferens, seminal vesicles, prostate gland and penis.

Testes are the oval shaped organs that which are present outside the abdominal cavity of a man.

The function of the testes is to make male cells that is sperms and male sex hormone called testosterone. The testes lie in small muscular pouch called scrotum which lie outside the abdominal cavity. The testes are located outside the abdominal cavity of a body because the sperm formation requires low temperature that the normal body temperature. Being outside the abdominal cavity, the temperature of scrotum is about 3 degree C lower than the temperature inside the body. In this way, testes provide a suitable temperature for the sperm formation.

THE REPRODUCTIVE SYSTEM: FEMALE



The human female reproductive system consists of following organs ovaries, oviduct, uterus and vagina.

Ovaries are oval shaped organs which are present inside the abdominal cavity near the kidneys. A woman has two ovaries. They are primary reproductive organs in female. The function of ovaries is to make female gametes called ova or eggs and also the female sex hormones which are called oestrogens and progesterone.

Just above the ovaries are the tubes called oviduct which are also known as fallopian tubes. The oviducts are not connected directly to the ovaries but the funnel shaped openings are which almost covers the ovaries. The ovum which is released by an ovary goes into the oviduct through a funnel shaped opening. The fertilization of egg by a sperm occurs in oviduct.

The uterus, which resembles a bag, is where the two oviducts connect at their other ends. An ovum that has been fertilized grows and develops into a baby inside the uterus. The cervix, a small aperture, connects the uterus to the vagina, a tube that is widely accessible to the exterior of the body. When a woman wants to inject sperm into her body, her vagina and penis meet. The vagina is shaped like a tube. Another name for the vagina is the birth canal. The female vaginal opening is different from the entrance used to pass urine. It's evident from the description above that humans' female reproductive systems are more sophisticated than their male counterparts.

OVARIES.

Ovaries are the female sex organs which produces the female gamete called as ovum. The ovaries are located one on each side of the lower abdomen. Each ovary is about 2 to 4cm in length and 2cm in width. The ovaries are connected to the pelvic wall and uterus by ligaments.

These ovaries apart from producing ova also secrete female hormones like oestrogen, progesterone, relaxin etc.

OVIDUCTS OR FALLOPIAN TUBE.

Each fallopian tube is ciliated, tubular passage measuring about 10-12cm long. It extends from ovary to the uterus. Oviducts are funnel- shaped structure present near to the ovary and is called infundibulum. The edges of infundibulum have finger like projections called fimbriae, one of which is attached to one end of the ovary. The fimbria helps in collection of the ovum after ovulation.

The infundibulum leads to a wider part of the oviduct called ampulla and the last part of the oviduct is isthmus which has a narrow lumen and it joins the uterus.

UTERUS OR WOMB

The uterus is a large, hallow, muscular inverted pear-shaped organ which is about 8cm long and 5cm width. The walls of the uterus is made up of the three layers namely Outer perimetrium, middle myometrium and inner endometrium where the embryo gets implanted.

VAGINA OR BIRTH CANAL

During the sexual intercourse, the vagina receives the penis and semen. The sperms in the penis pass through uterus into the fallopian tube where the fertilization takes place.