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REPRODUCTION AND POPULATION CONTROL

The ability to reproduce is one of the essential characteristics of living beings. It involves the transmission of genetic material from the parental generation to the next generation, thereby ensuring that characteristics not only of the species but also of the parental organisms, are perpetuated. In this process, one generation of living organisms gives rise to another generation. The process by which a living organism produces its own kind is known as **reproduction**.

Organisms reproduce in two ways: (1) gametes are not produced and hence there is no fusion of gametes or fertilisation (asexual reproduction), and (2) by formation and the fusion of gametes (sexual reproduction). In this lesson, types of reproduction, reproduction in sponges, insects and humans are discussed. A section deals with problems of population explosion of humans.



OBJECTIVES

After completing this lesson, you will be able to:

- *define reproduction and differentiate between asexual and sexual reproduction;*
- *describe gemmule formation as one example of asexual reproduction.*
- *describe the organs for sexual reproduction in cockroach.*
- *state functions of each part of male and female reproductive systems in humans;*
- *draw labelled diagrams of male and female reproductive systems;*
- *describe the main events in the process of reproduction in humans starting from the production of gametes to pregnancy and childbirth;*
- *describe the process of exchange of nutrients and respiratory gases across embryo and mother;*
- *explain lactation.*
- *explain how twins are produced;*
- *highlight recent advances in the area of human reproduction;*
- *define the terms—population, demography, birth rate, death rate and growth rate, etc.;*

- list the factors responsible for rapid rise of population in India;
- describe the disadvantages of enormously increasing population;
- explain the needs for controlling the population growth;
- list various methods of contraception for population control.

Reproduction: Reproduction is the ability of living organisms by which they produce offspring of their own kind. Organisms reproduce by:

1. Asexual reproduction involves the production of an offspring from a single organism without the formation of gametes. It is a common process of reproduction in bacteria, protista, lower plants and lower animals.

2. Sexual reproduction is the production of offspring by the formation and subsequent fusion of gametes. At fertilization, the male and the female gametes unite to form a zygote which develops into a mature organism. Most animals and higher plants multiply by sexual reproduction.

Two examples of sexual reproduction are given here (i) insects (ii) in humans

21.1 A SEXUAL REPRODUCTION IN ANIMALS

There are various methods of sexual reproduction in lower animals and one example, is that of production of reproduction bodies called ‘gemmules’ in sponges (Phylum Porifera)

21.1a Gemmule

Gemmule is a reproductive body for asexual reproduction found in fresh water sponges and some marine sponges (*Gemma* in Greek means bud).

A full grown gemmule (Fig. below) looks like a tiny hard ball containing an inner mass of undifferentiated cells called **archaeocytes**. The archaeocytes are surrounded by a resistant covering which protects the inner cells. The covering is made up of chitin and may be strengthened by spicules. There is a small outlet called micropyle. Gemmules tide over the unfavourable conditions. For example when the pond dries up or during the freezing cold of winter when adult sponges die, it is the gemmules that remain viable. When the favourable conditions return, archaeocytes come out of the micropyle and develop and differentiate into a sponge.

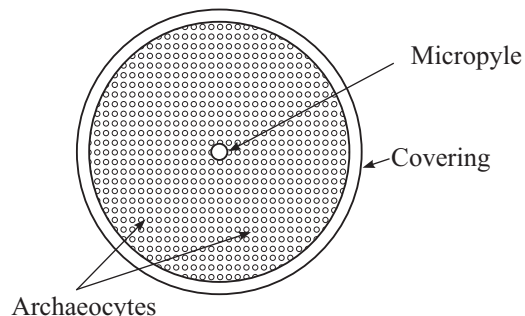


Fig. A gemmule of fresh water sponge *Spongilla*



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21.1 REPRODUCTION IN HUMANS

The humans reproduce sexually. Reproduction in humans can be studied in two parts:

- (a) Reproductive system, and
- (b) Fertilization, pregnancy and development of the embryo.

Human Reproductive System

Maturity of human sex organs begins with puberty the name given to the **changes** that occur in boys and girls as they grow up. Mostly these changes occur between the age of 10 to 14 years, and these are brought about by certain hormones. During puberty the body grows rapidly, and both *primary and secondary reproductive organs* grow and become mature. Along with these changes, *secondary sex characters* also start appearing. It is also to be noted that in males, sexual maturity is attained at the age of 13–14 years and in females, at the age of 11–13 years. Puberty ultimately leads to a stage when the child becomes an adolescent.



Some Basic Facts

What is adolescence?

The term adolescence comes from the Latin verb *adolescere*, meaning 'to grow into maturity'. In this sense, 'adolescence is a process rather than a time period, a process of achieving the attitudes and beliefs needed for effective participation in society'. The World Health Organization (WHO) defines adolescence as the period from 10 to 19 years of age characterized by developments and changes in physical, psychological, and social areas.



During adolescence, the secondary sexual characters that develop are as follows:

In males, these include deepening of voice, widening of shoulders, muscular body, appearance of beard and moustache, growth of axillary and pubic hair, enlargement of external genital organs.

In females, the changes include growth of axillary and pubic hair, widening of pelvis and hip, enlargement of breasts and initiation of the menstrual cycle.

Sexual maturation is a very significant stage in one's life, hence it is necessary to maintain the health and hygiene of the reproductive organs during this stage.

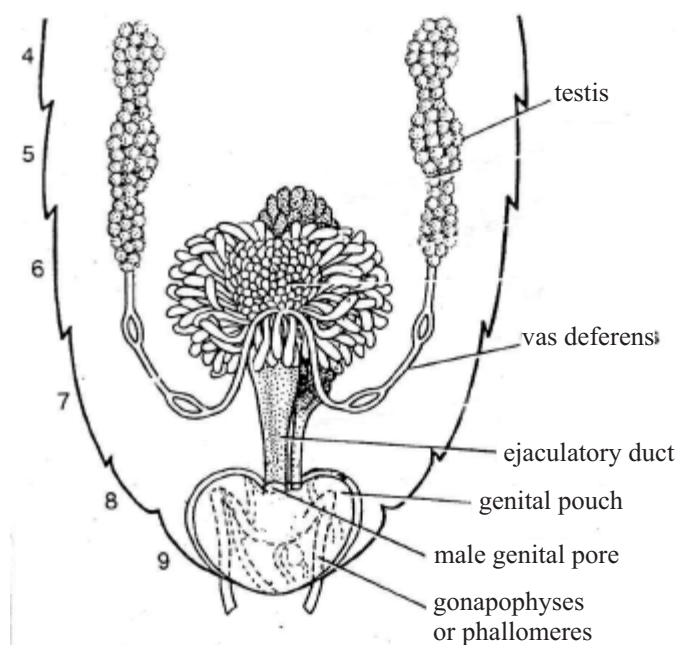
21.2a Reproductive System of Insects

Sexes are separate in most insects and reproduction is usually sexual, although in some groups of insects, eggs sometimes develop parthenogenetically (without fertilization). e.g. in aphids all generations are produced parthenogenetically and are all females.

The reproductive organs of cockroach are described here as a representative of insects.

Male Reproductive System

The male reproductive system consists of a pair of **testis** a pair of delicate ducts called the **vas deferens**, (plural: vasa deferentia) and a single median **ejaculatory duct**. The ejaculatory duct opens into a **genital pouch** through a **male genital pore**. Surrounding the male genital pore are the **gonapophyses** which help in copulation. **Seminal vesicles** are small white sacs at the anterior end of the ejaculatory duct. **Mushroom gland** and **phallic** or **conglobate gland** are accessory reproductive glands of male. (See figure below)



Periplaneta americana. Male reproductive organs in dorsal view.

Female Reproductive System:

Female reproductive system consists of a pair of **ovaries**, one on either side of the hind gut embedded in the fat bodies. Each ovary consists of blind tubes called **ovarioles**. All the ovarioles unite posteriorly and open into a short lateral oviduct. The two lateral oviducts unite to form a short median **oviduct**. The posterior part of the oviduct is wide and is called the **vagina**. Vagina opens into the **genital pouch** through the female **genital pore** or **vulva**. A **receptaculum seminis** or **spermatheca** opens into the genital pouch. Spermatheca receives the sperms during copulation from the male. Three pairs of **gonapophyses** are present between the female genital pore and anus. They assist in copulation, in laying eggs and in the formation of oötheca (see Fig. below) or egg cover.



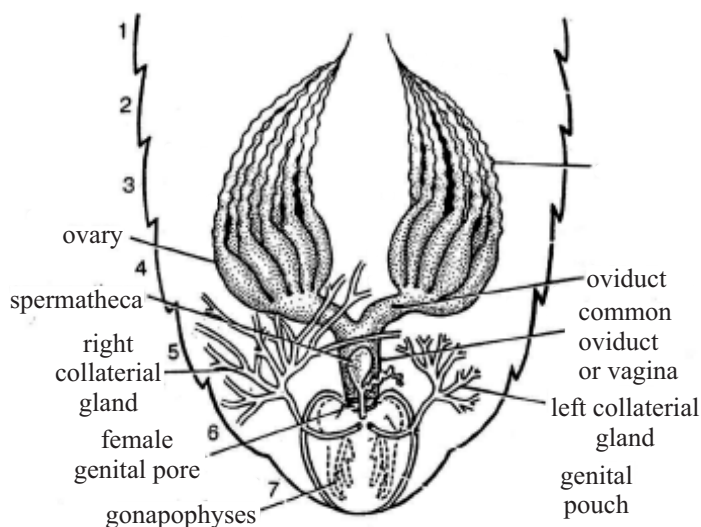
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A pair of branched accessory glands called the **colleterial glands** open into the genital pouch. The secretion of these glands form the oötheca (hard egg case).

However, different insects may show a variation from this basic plan.



Periplaneta americana. Female reproductive organs in dorsal view.

Human reproductive organs are described and illustrated below.

Male reproductive system

The reproductive system in male consists of the following organs – a pair of **testes**, a pair of epididymis, a pair of vasa deferentia (singular : vas deferens), urethra, penis and accessory glands (Fig. 21.1) (Table 21.1).

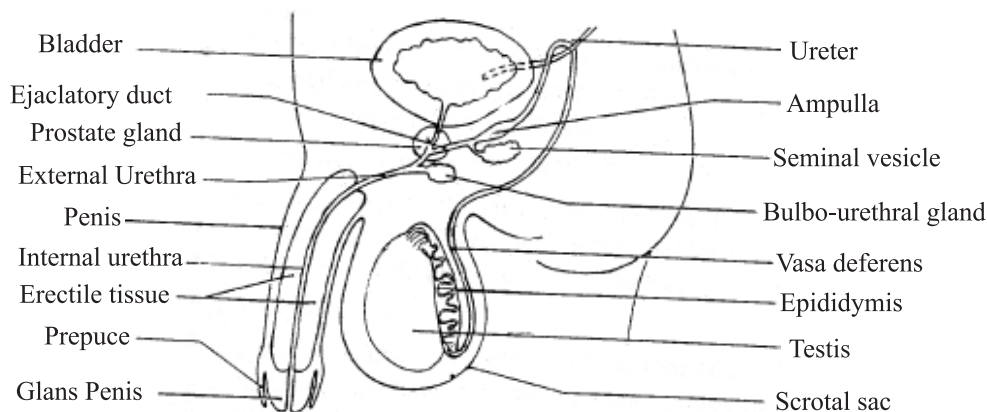


Fig. 21.1 Male Reproductive system

(i) Testes

Testes (singular: testis) as depicted in Fig. 21.2 are the male gonads. In an adult male, each testis is approximately 4-5 cm long and about 12 g in weight. Testes are **extra-abdominal**, that is, present outside the abdomen in a pouch made up of

skin and connective tissue called **scrotal sac** or **scrotum** that hangs in the region between the legs.

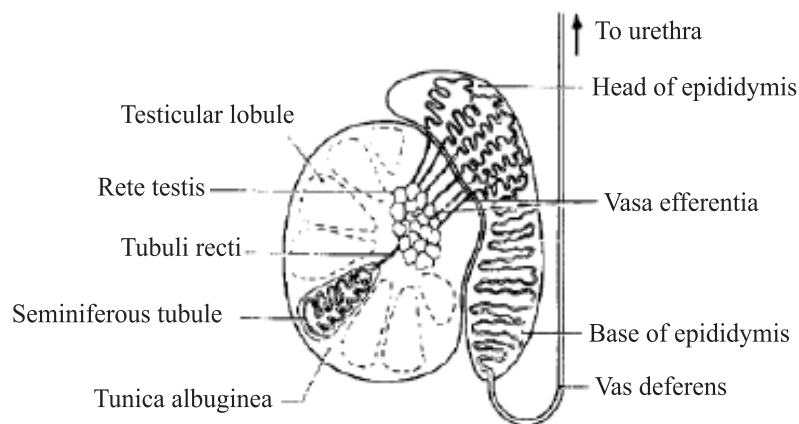


Fig. 21.2 Microscopic Structure of Testis

The scrotum acts as a thermoregulator. It helps in maintaining the temperature of testes at about 2-3°C lower than the body temperature. This temperature is suitable for the development of sperms.

Anatomically, each testis is encased in a capsule of white fibrous connective tissue called tunica albuginea. Each testis has several highly coiled tubules called **seminiferous tubules** (Fig. 21.2) where the sperms are produced. Between the seminiferous tubules is the connective tissue, which contains clumps of interstitial cells, also called **Leydig cells**. These cells secrete **testosterone** the male sex hormone. Testosterone maintains the primary and secondary sexual characteristics in males.

(ii) Epididymis

It is a long highly coiled tube which remains attached to the testis and lies within the scrotal sac. Epididymis stores spermatozoa (sperms) and serves as a passage for their transport from the testis.

(iii) Vas deferens (sperm duct)

Each epididymis continues as **vas deferens**. It enters the abdominal cavity, passes over the urinary bladder and joins the duct of seminal vesicle to form the **ejaculatory duct**. The ejaculatory duct opens into the urethra.

(iv) Urethra

The urethra in males is about 15-20 cm long and is differentiated into three parts—an anterior prostatic part which passes through the prostate gland; a middle membranous part; and a posterior penile part which passes through the copulatory organ, the penis. Urethra functions as a passage for both semen and urine.

(v) Penis

Penis is a cylindrical, spongy, muscular and a highly vascular (supplied with blood vessels) copulatory organ in males. The urethra runs through it centrally and serves



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as a common passage for urine and semen. During sexual excitement, the spongy tissue gets filled-up with blood, making it erect and stiff. Externally, the penis is covered by skin. The tip of the penis is soft and highly sensitive. It is called **glans penis**. It is covered by a loose fold of skin called prepuce which can be retracted. The functions of various male parts are given in table 21.1.

Table. 21.1 Important functions of male reproductive organs in humans.

Organ	Function
Seminiferous tubules in testes	Produce sperms
Epididymis	Stores sperms in a viable but immobile state
Sperm duct (vas deferens)	Contractions help in the passage of sperms into urethra during ejaculation
Seminal vesicles and prostate gland	Secrete fluid which activates and nourishes sperms
Urethra	Contractions expel semen from penis during ejaculation (urethra also carries urine to exterior)
Penis	Contains spongy tissue and serves as the copulatory organ

21.2 b (iii) Organs associated with human male reproduction system

Accessory glands

The accessory glands include seminal vesicles, prostate glands and Cowper's glands.

Seminal vesicles. A pair of seminal vesicles are present at the base of the urinary bladder. The seminal vesicles store sperms that descend from the testis and secrete seminal fluid. The seminal fluid is a viscous fluid which provides nourishment to the sperms. This secretion forms about 40-80 per cent of the ejaculate (semen thrown out of the penis).

Prostate gland. Prostrate gland surrounds the first part of the urethra. It secretes an alkaline fluid which is discharged into the urethra. This fluid keeps the sperms alive and helps them to swim vigorously. Secretion of prostrate gland forms about 5-30 per cent of the ejaculate.

Cowper's glands or Bulbo-urethral glands. These are paired glands that lie below the prostate gland and join the urethra at a short distance from that of the prostate gland. Cowper's glands secrete a white, viscous, alkaline secretion resembling mucous which acts as a lubricant.

21.2b (iii) Spermatozoa and semen

The process of formation of sperms is termed Spermatogenesis

The spermatozoa are male gametes produced by the testes. Structurally, human sperm has three main parts—head, neck and tail. The tip of a sperm is covered by a cap-like structure, **acrosome**, which helps the sperm to penetrate inside the egg during fertilization. The structure of a human sperm is shown in Fig. 21.3.

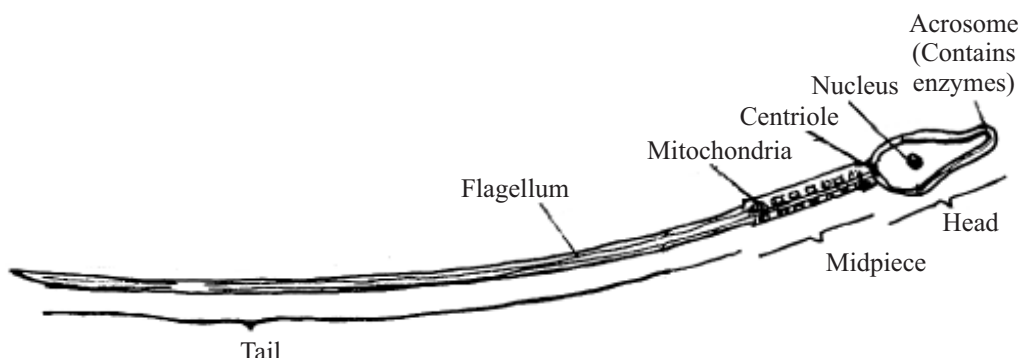


Fig. 21.3 Structure of human sperm.

Spermatozoa are immotile when stored in the epididymis but get activated and motile by the secretions from the accessory reproductive glands in males. The secretions of various accessory glands along with sperms form the **semen**. The sperms are released in millions. In one ejaculation about 200,000,000 (2×10^8) sperms are discharged. Sperms when introduced into the vagina of the female move with the speed of 2 mm/minute in side the body of the female.

Fig. 21.4 shows the course of sperms from their production in the testes to reach the urethra in penis.

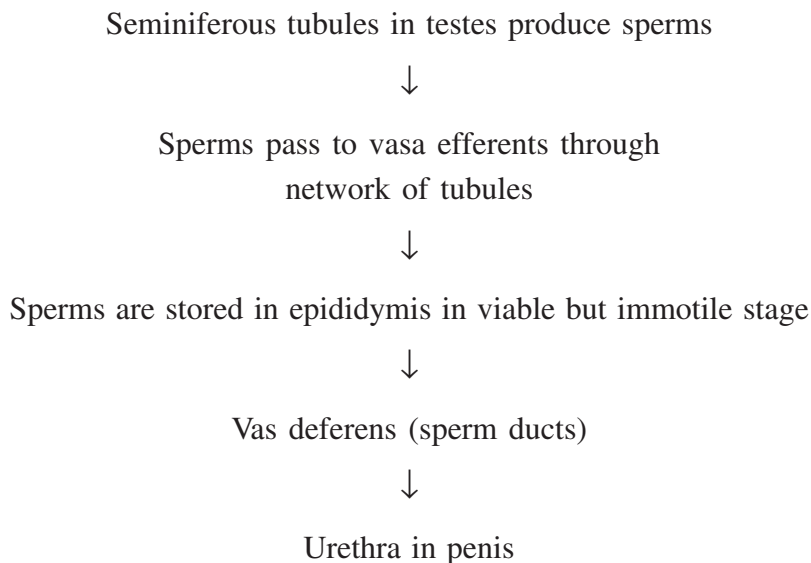


Fig. 21.4 The course of sperms in male.

21.2.2 Female reproductive system

The female reproductive system consists of the following organs :

A pair of ovaries, a pair of fallopian tubes, uterus, vagina and external genitalia (Fig. 21.5).



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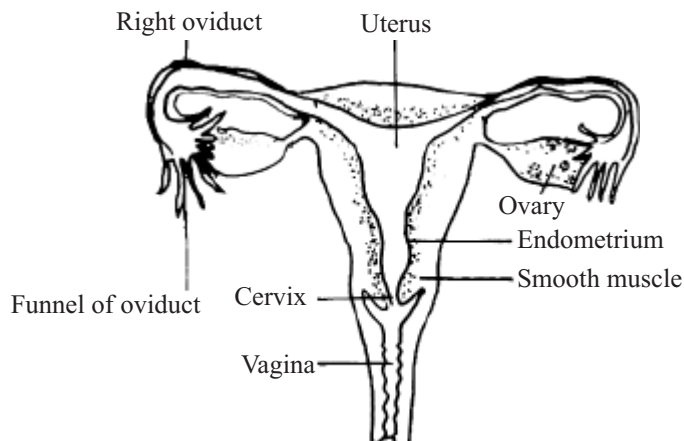


Fig. 21.5 Female reproductive system

(i) Ovaries

There is a pair of ovaries, which lie in the lower part of the abdominal cavity, one on each side of the body. Ovaries produce ova and also secrete female sex hormones, oestrogen and progesterone. The process of formation of egg in the ovary is known as **oogenesis**.

If a section of the ovary is cut, eggs at various stages of maturing can be seen. Each egg begins as a primary follicle. Follicular cells then cover the egg and a cavity called **antrum** is formed. This is the mature egg called **Graafian follicle**. The egg then gets released (ovulation) from the ovary leaving the empty follicle called **corpus luteum** (Fig. 21.6).

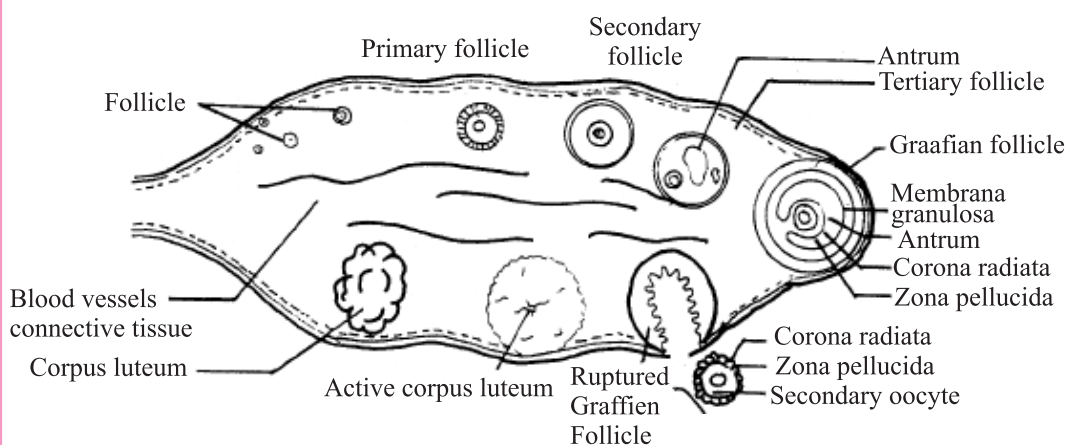


Fig. 21.6 Ovary showing microscopic structure

(ii) Fallopian tubes (oviducts)

There are two oviducts (or Fallopian tubes) in female reproductive system. Each oviduct is about 10-15 cm long. The proximal funnel-shaped end of each oviduct lies near the ovary and is called **infundibulum**. Its margin bears finger-like

projections called **fimbriae**. Each infundibulum continues as a thin and coiled tube called oviduct or **Fallopian tube**. Both Fallopian tubes open into the uterus.

(iii) Uterus

The uterus is a pear-shaped, muscular, thick-walled organ. It is about 7 cm long, 5 cm broad, and 2.5 cm thick. The wall of the uterus comprises of three coats—the innermost **endometrium**, middle **myometrium**, and outermost **perimetrium**. The endometrium layer is richly supplied with blood vessels. There is a sphincter muscle that closes the lower end of the uterus where it joins the vagina.

(iv) Vagina

Vagina is the organ where the penis is inserted during coitus (sexual act) for the discharge of semen. It is a muscular tube about 7-10 cm in length. It serves as the birth canal during child birth and also acts as a duct for the passage of uterine secretions and menstrual flow.

The vagina opens to the outside by an opening. The opening of vagina is normally obstructed in a virgin female by a perforated membrane, the **hymen**. In a human female, the urethra and the genital duct have separate openings. Functions of various female reproductive parts are summarised in table 21.2.

Table 21.2. Important functions of female reproductive organs in humans.

Organ	Function
Ovary	Manufactures eggs
Oviduct (or Fallopian tube)	Site of fertilization; transfers fertilized egg/embryo to the uterus
Uterus	Inner lining receives, protects and nourishes embryo; contractions of muscular wall expel baby during birth
Cervix (neck of uterus)	Produces watery mucous that serves as a lubricant for the penis and as medium, in which sperms swim after ejaculation
Vagina	Receives penis during intercourse; passage for baby during birth
Clitoris (external sensual organ)	Equivalent to the male penis;

21.2.3 Menstrual Cycle in Human Females

In a human female, the fertility period extends from the age of puberty, i.e. about 12-13 years up to menopause, i.e. 45-50 years. The stage of puberty is marked by the appearance of secondary sexual characteristics.



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Some Basic Facts

Does an irregular menstrual cycle cause any problems?

When a girl begins menstruating, it may take sometime for her periods to become regular. Also, sometimes her menstrual cycle may become irregular, and her periods may be delayed or may occur earlier than the expected date because of illness or mental tension such as stress or depression. Irregularities in the menstrual cycle are quite common among young girls who have just begun to menstruate. However, if one does not menstruate then it is important to consult a doctor or a health worker.

How does one maintain hygiene during the menstrual period?

- Daily bathing along with regular/daily washing of the genital area is essential.
- Sanitary pads and/or cloths used should be changed at least twice a day, if not more frequently.
- It is important to maintain menstrual hygiene in order to reduce the risk of contracting an infection of the female reproductive tract.
- If pads or napkins are not changed frequently, the old blood begins to smell. This may lead to social embarrassment.
- Home-made sanitary napkins should be washed thoroughly with hot water and soap, and should be dried in a sunny and airy place. They should be stored in a clean and dry place.
- Moderate exercise and sufficient rest are also important.



The onset of menstruation in a female is called **menarche**. It starts at an age of about 11-13 years. The permanent stoppage of menstruation in a female is called **menopause**. It occurs at an age of about 45-50 years. At the time of menopause, ovulation and menstruation stop and the reproductive organs decrease in size.

Between puberty and menopause, the female reproductive system passes through a regular monthly sequence of events called the **menstrual cycle**.

During **menstrual cycle** (Fig. 21.7), an ovum is matured and released once every 28 days. However, many a times, due to some reasons this period may increase or decrease. The menstrual cycle starts with the menstrual flow, during which the cellular lining of the uterus, with blood flow, is shed off. This process continues for 3-4 days. From the 5th upto the 13th day of the onset of menstrual cycle, growth and maturation of the Graafian follicle takes place. Graafian follicle is the final stage



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in the maturation of an ovum inside the ovary. It consists of an ovum and a mass of cells surrounding it. The Graafian follicle also produces a hormone, **oestrogen**, which stimulates the uterus to prepare itself to receive the ovum. The cells lining the uterus grow rapidly and develop a dense network of blood vessels.

Ovulation takes place 13-14 days after the onset of menstruation. The Graafian follicle ruptures to release the ovum. The cells of the ruptured follicle form the **corpus luteum** which secretes the hormone, **progesterone**. The ovum reaches the uterus via the fallopian tube on the 13th or 14th day and remains there up to the 16th day (for 48-72 hours). If the ovum does not receive any sperm during this period it starts degenerating. At the end of the 28th day this ovum is rejected along with the uterine lining. This marks the start of a slow disintegration of the thickened lining of the uterus and the next menstrual cycle.

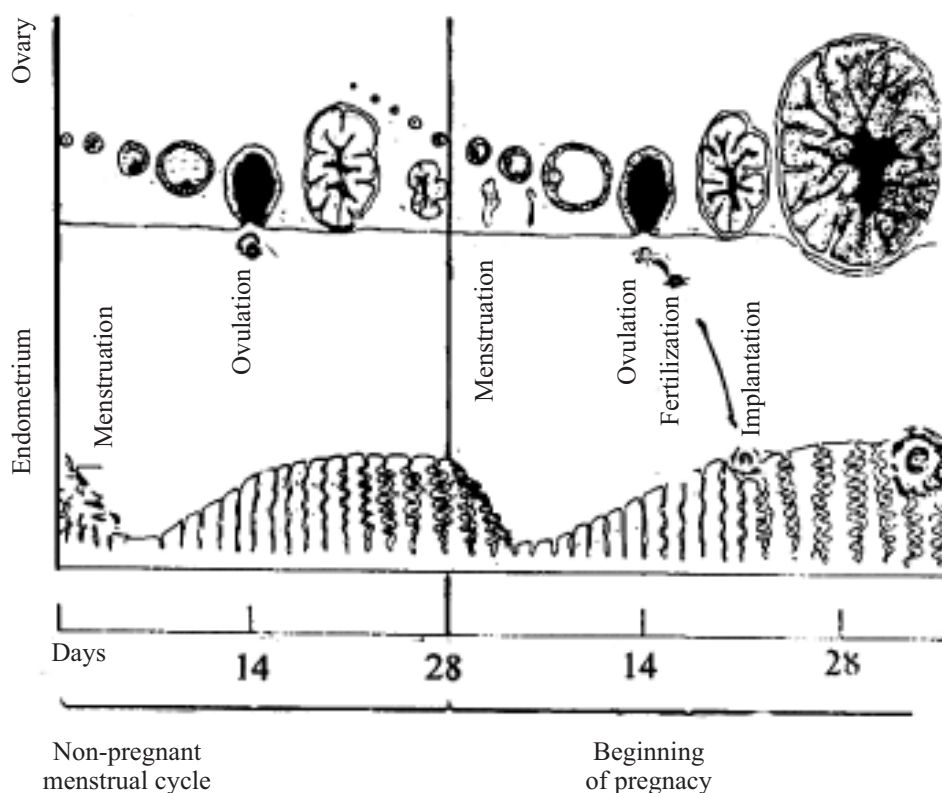


Fig. 21.7 Graphical representation of menstrual cycle

What happens to the menstrual cycle if the ovum receives sperm and fertilization occurs?

If the ovum receives sperm and gets fertilized, menstruation (and ovulation) cease for as long as the woman is pregnant. This is because progesterone is produced continuously first by the corpus luteum (which persists in the ovary) and later by the placenta.



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INTEXT QUESTIONS 21.1

1. At what age do human males and females attain puberty?
.....
2. Name the tubules present in the human testis.
.....
3. Name the various parts of the following,
 - (i) Human male reproductive system
.....
 - (ii) Human female reproductive system
.....
4. Name the three types of accessory glands found in the human male reproductive system.
.....
5. State the functions of the following.
 - (a) Seminal vesicles
 - (b) Prostate glands
 - (c) Uterus
6. What is a gemmule? Explain its importance in the life of sponges.
7. State the functions of the following in insects:
 - (a) seminal vesicles in male
 - (b) spermatheca in female
 - (c) testes in males
 - (d) ovaries in females

21.2 FERTILIZATION, PREGNANCY AND DEVELOPMENT OF THE EMBRYO

21.2.1 Fertilization and implantation

Spermatozoa remain viable in the female genital tract from 24 to 72 hours. For fertilisation, sperms are introduced into the female body. One sperm fuses with the ovum in the fallopian tube.

If the ovum happens to meet a sperm, the two unite to form a **zygote**. 13-14 days after onset of menstruation are most favourable for conception (pregnancy). The zygote immediately begins to divide and passes down the fallopian tube to the uterus and fixes itself to the wall of the uterus. This fixing of the embryo in the wall of the uterus is called **implantation** and the female is said to be pregnant. Implantation takes place about a week after fertilization.



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21.2.2 Placenta

Placenta is an association between maternal and foetal tissue meant for some extremely important physiological exchange. The developing embryo is attached to the uterus by a tissue called **placenta** (Fig. 21.8). **Umbilical cord** is a tough structure that serves as the blood vascular connection between the foetus (developing embryo) and uterine wall. From the first few weeks of development, the embryo is enclosed in a sac called **amnion** which is filled with **amniotic fluid**. Amniotic fluid acts as a shock-absorber and helps to protect the embryo from damage.

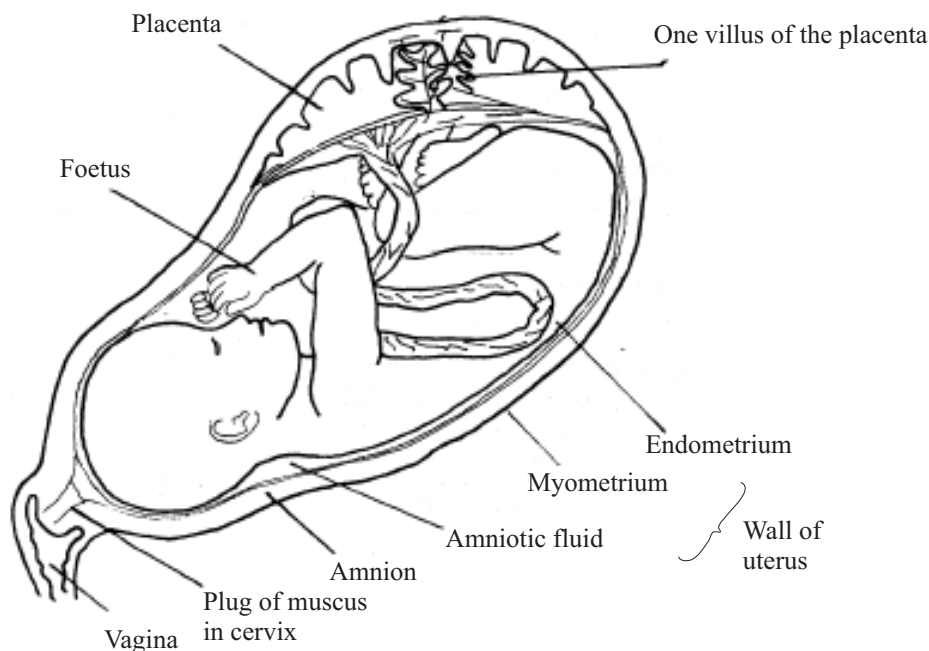


Fig. 21.8 Foetus and placenta

Placenta serves as a tissue through which oxygen and food are supplied from the maternal blood to the foetus. It also transports carbon dioxide and excretory waste from the foetal blood to the maternal blood.

Fig. 21.9 Summarises the steps in fertilisation of human egg, its implantation and development in the uterus upto birth.



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Sperms from male are deposited into the female reproductive system



Egg released from the ovary



Union of the sperm and egg in the fallopian tube



Fertilization and formation of zygote (Day 1)



Repeated division of zygote leading to formation of a spherical mass of cells called morula (Day 4)



Early embryonic stage is (called blastocyst) formed (Day 5)



Blastocyst attaches to uterine wall
(i.e. Implantation occurs) (Day 6-7)



The developing Embryo about the size of a pea is formed (4 weeks)



Embryo (now called foetus) with human features, limbs appear.
It floats in amniotic fluid (6 weeks)



Birth of human infant (about 40 weeks)

Fig. 21.9 Development of human embryo

Placenta is permeable to respiratory gases, nutrients and antibodies. The membrane prevents harmful material from reaching the embryo. It does not allow the passage of germs from the mother to the foetus. However, if the mother is already infected with HIV, then HIV can pass through the blood to the embryo. Placenta produces the hormone progesterone. Egg-formation (ovulation) and menstruation also stop as pregnancy continues. However, these are resumed after child birth.

The hormone Oxytocin from posterior pituitary is responsible for uterine contractions for child birth.

21.2.3 What happens during childbirth?

- The uterus undergoes occasional contractions (labour).
- The amnion bursts and the amniotic fluid is discharged.
- The uterus contracts vigorously, expelling the baby.
- The baby's lungs start functioning and the baby takes its first breathe.
- The umbilical cord is tied and cut.

- After birth the placenta gets discharged.
- The breasts start producing milk.

21.2.4 Lactation

The secretion of milk from the mammary glands is called lactation and the period during which the mammary gland secretes milk is called **lactation period**. The first secretion that comes out from the mammary glands of the mother, just after child birth, is called **colostrum**. It is rich in nutrients, fats and proteins. Colostrum also contains antibodies (Immunoglobulin A-IgA) that provide passive immunity to the new born infant.

The synthesis of milk from the mammary glands is stimulated by the hormone **prolactin** which is secreted by the anterior lobe of the pituitary gland. Another hormone called **oxytocin** secreted by the posterior lobe of pituitary gland stimulates the release of the milk from the mammary glands.

21.2.5 How twins are Produced

Usually, only one ovum is released by an ovary in every reproductive cycle. If this ovum receives sperm and gets fertilized, one baby is born to the mother. But sometimes two eggs may be released and fertilized by two different sperms. Such siblings are called **fraternal twins** who may be brother and sister, or brother-brother, or sister-sister. But in certain cases, only one egg is released and gets fertilized. After this, it divides into two, and the two cells then separate and start developing independently into two separate individuals. They are identical in all respects and called **identical twins**. They are always of the same sex.

Siamese twins

The twins produced from one egg which fail to separate are called Siamese twins. The first case of Siamese twins was of twin boys born to a Chinese mother in Siam, (now Thailand) in 1811. These were joined at the thoracic region. These twins lived up to an age of 65 years.

The Siamese twins can sometimes be surgically separated. However, it depends upon the extent of their joining.

21.3 NEW MEDICAL TECHNIQUES IN REPRODUCTION

There are many new medical techniques in the field of reproduction to help infertile males and females produce babies. Some of these are given here.

Test tube babies

In some women the oviducts (Fallopian tubes) are blocked. This prevents the ova from being fertilized. This problem can be overcome by the **test tube baby technique**. In this technique, one or more ripe ova are sucked from a woman's



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ovaries using a special syringe. These ova are placed in a dish containing sperms from her male partner under optimum conditions for a few hours. Sperms fertilize the ova which form an embryo. One embryo is then inserted into the woman's uterus where there is a chance it will implant and develop into a baby.

Artificial insemination

Human semen can be rapidly frozen using liquid nitrogen and stored in sperm banks for several years without losing its fertile condition. It is then thawed, and introduced into a woman by means of a syringe at a time when ovulation takes place. This is called **artificial insemination**.

Fertility drugs

In some women ovaries fail to develop the Graafian follicles needed to release ripe ova into their reproductive tract. It is now possible to artificially stimulate follicle production by injecting sterile women with a fertility drug containing FSH (follicle stimulating hormone) obtained from animals.



INTEXT QUESTIONS 21.2

- State the main function of placenta.
.....
- Define the following terms.
 - Implantation
 - Placenta
 - Morula
 - Amnion
- Name the fluid surrounding the foetus in the uterus.
.....
- Write the function of:
 - Prolactin
 - Oxytocin
- The first milk that comes out of the mammary gland of the mother is called Why is this first milk important for the child?

21.4 POPULATION-PROBLEMS AND CONTROL

21.4.1 Few terms to remember

- Human population** : The sum total of human beings on earth.

- **Demography** : The scientific and statistical study of human population. It deals with population growth, its composition (age, sex ratio) and its distribution in space.
- **Population density** : The number of individuals per square kilometre (km^2) at any given time.
- **Birth rate (natality)** : The number of live births per 1000 individuals of population per year.
- **Death rate (mortality)** : The number of deaths per 1000 individuals of population per year.
- **Population growth rate** : The difference between the birth rate and the death rate.
- **Census** : The official data of registered number of people in a selected area.



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21.4.2 Population growth in India

Did you know that India is the second most populous country in the world, next to China. India comprises more than 15% of world's total population. The population of India was about 24 crores in the year 1901. Except for a slight fall in 1911-21, the population of India has been steadily increasing for the last 100 years. As per the census of 2001, as on 1st March 2001, the population of India was 1,027,015,247, i.e. about 102.7 crores. This alarming rate of rise in human population is a cause of concern. Now in 2014, the population of India is:

Table 21.3 The population of India during last 100 years

Year	Approximate population (in crores)
1901	23.8
1911	25.2
1921	25.1
1931	27.9
1941	31.8
1951	36.1
1961	43.9
1971	54.8
1981	68.5
1991	84.6
2001	102.7



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21.4.3 Factors responsible for population explosion in India

Advancement in agriculture : With the advancement in the agriculture sector, the availability of food has increased leading to less of starvation and malnutrition.

Advancement in medicine : With the advancement in medicine, various diseases can be controlled now. This has led to increase in life span. Thus, more and more people live longer, reach reproductive age and produce more children.

Religious and social customs : Because of prevailing social custom and beliefs many people do not accept family planning measures, leading to rise in population.

Industrialization : Advancement in industrialization helps in better storage and distribution of food, more employment opportunities and more prosperity.

Illiteracy : A sizeable number of our population is educated, and yet a large proportion is still illiterate. They are not aware of the functioning of reproductive system and hence the consequence of overpopulation.

Economic reasons : Children instead of attending school go to work and increase the income of the family.

Desire for a male child : Even after so much emphasis on gender equality, because of patriarchy in many families, the male child is considered to be essential for continuing the name of the family. The parents want to have at least one son and in this process they give birth to many children sometimes.

21.4.4 Problems posed by increasing population

The problems posed by increasing population are of two types:

1. Problems posed to large families, and
2. Problems posed to the Country.

1. Problems for large families

A large family having many children suffers many problems such as

- (a) **Poor health of the mother :** Because of frequent pregnancies, the mother may suffer from ill-health.
- (b) **Poor housing :** More family members need more space. The family may not be able to afford a good, clean and spacious house.
- (c) **Economic pressure :** The large family will need more resources, leading to immense economic pressure on the parents and children affecting the quality of life.
- (d) **Poor health :** The family members may not get enough food, leading to malnutrition and deficiency diseases. They will require constant medical support.

Also, because of medical facilities being expensive, it may not be possible to provide everyone adequate medical support.

- (e) **Improper education** : Proper educational facilities for children may not be affordable.

Problems Posed to the Country

A high population growth has severe environmental implications like over-crowding, decrease in per capita income, depletion of food, land, fuel and consumer resources. Some such problems are listed below:

- (a) **Urbanization and environmental degradation** : Due to increasing population, farmlands in the rural areas can no longer support additional people. Thus, a large number of people migrate to urban areas with the hope of finding jobs and a better life. This leads to an increase in the urban population.

The growth in urban population stresses the urban environment by increasing the number of squatter settlements, and slums with no proper sanitation facilities, thus causing air, water and soil pollution beyond permissible limits.

- (b) **Increasing population and transportation** : Increase in population requires a corresponding increase in the means of transport. Increase in the number of automobiles as a consequence of phenomenal growth in population has increased the pollution load (air pollution, water pollution and solid waste pollution).
- (c) **Increasing population and education** : Education is most important for economic and social upliftment. Although literacy rate is growing, we still have a very large number of illiterates in the country. The increasing population further adds up to the problems of providing education to all.
- (d) **Increasing population, agricultural development and environmental degradation** : In order to meet the food requirement of the ever-increasing population of the country new agricultural techniques have been adopted. Some of these have proved to be detrimental to the environment.
- (e) **Increasing population and food requirements** : Increasing population will need more food. For this purpose new agricultural land has to be created. So, forests have been cut down for cultivation. Due to deforestation, excessive irrigation and natural hazards, such as floods are frequent, land is being degraded and wasteland is increasing. The increased use of fertilizers and pesticides to boost agricultural productivity has immense adverse effects on land and water resources of our country. Agricultural land has been extensively polluted due to pollution from fertilizers and pesticides.
- (f) **Increasing population and water** : The availability of water is limited. Increasing population needs more water for drinking, bathing, washing etc. Thus, availability of water is becoming scarce.



Notes



Notes

- (g) **Increasing population and depletion of mineral reserves** : Our mineral reserves are limited, once finished they cannot be replenished (i.e. they are non-renewable). More population means more requirements of minerals, leading to fast depletion of mineral resources.
- (h) **Increasing population and depleting energy sources** : Energy is needed for almost all our day-to-day activities whether for cooking, transportation, factories or at home. Presently we are largely dependent on fossil fuels such as coal and petroleum for energy. At the current rate of consumption, our fossil fuel reserves will be exhausted in a short time.



INTEXT QUESTIONS 21.3

1. List any **four** reasons for population explosion in India.
.....
2. What is the inter-relationship between population, environment and development?
.....
3. What is the effect of uncontrolled population growth on us and our nation?
.....
4. How does population growth influence urbanization and environmental degradation?
.....
5. Relate the indiscriminate increase in population with the standard of living in our country.
.....

21.4.5 Population control and family planning

It is very necessary to control the overgrowing population. It is necessary to educate people to accept small family norms and create awareness about population explosion and its impact on the family, society and the nation. The government has taken many measures for providing family planning guidance and support, and family welfare measures.

There are various ways of preventing fertilization and hence to check the increase of population. Some of these are discussed here.

Education

The most effective method for control of population is to impart education to the masses about the consequences of population explosion and make them aware of various ways of fertility control. Education helps to make people aware of the advantages of a small family and the disadvantages of a large family.

Preventive methods for population control and family planning.**Following are some methods of birth control**

- (i) **Rhythm method** – The period in the menstrual cycle before ovulation phase is termed ‘safe period’ as no egg is available for fertilization by the sperm. This method, however, is not reliable.
- (ii) **Use of condoms in males and diaphragms in females** prevent sperms from meeting the ovulated egg.
- (iii) **Intrauterine devices** such as copper T are inserted in the female body so that implantation is not possible. This method requires advice and help from the medical doctor.
- (iv) **Oral contraceptive pills** are tablets which have to be taken as per directions from a medical practitioner. These pills interfere with ovulation and in turn prevent fertilization.
- (v) **Vasectomy and Tubectomy** are surgical methods. In males, the vas deferens through which sperms travel out of epididymis is ligated (tied) by the surgeon to prevent sperms from going out of the body. This method is temporary and can be reversed by the surgeon if required. For permanently preventing fertilization the vas deferens is cut and the open ends ligatured (tied by thread). Tubectomy is sterilization of the woman by cutting fallopian tubes and ligaturing them so that ovulated egg cannot pass down for fertilisation.

In case preventive measures fail or if the foetus is found to have a defect, the foetus may have to be aborted.

Abortion or Medical Termination of Pregnancy (MTP) is to remove the unwanted foetus from the mother’s body. However, it is advised to always seek professional medical help for MTP.

**WHAT YOU HAVE LEARNT**

- A process by which a living organism is able to produce more of its own kind is known as reproduction.
- In asexual reproduction only one organism is involved, no gametes are produced and no fertilization takes place. Gemmules are reproductive bodies for asexual reproduction in sponges.
- In sexual reproduction both male and female gametes are produced and the process of fertilization takes place. The human reproduce sexually.
- The age of 13-14 years in human males and 11-12 years in human females is called puberty in human beings. At this age, sex organs get matured and several secondary sexual characteristics appear in them.

**Notes**

MODULE - 3

Reproduction and Heredity



Notes

Reproduction and Population Control

- The male reproductive system consists of a pair of testes, a pair of epididymis, a pair of vasa deferentia, urethra, penis and accessory glands.
- The female reproductive system consists of a pair of ovaries, a pair of Fallopian tubes, uterus, vagina and external genitalia.
- Testes are extra-abdominal in human males.
- The fixing of the embryo in the uterine wall is called implantation.
- Placenta is an association between maternal and foetal tissues meant for exchange of material between pregnant mother and developing foetus.
- Lactation is the production of milk in a mother soon after delivering the baby.
- Twins are of two types—fraternal and identical twins.
- The scientific and statistical study of human population is called demography.
- Advancement in agriculture, medicine, industrialization, religious and social customs, illiteracy, economic reasons and desire for a male child are some factors responsible for the unchecked growth of population in India.
- The enormous increase of the population can be controlled by education, methods.
- In cockroach there are well developed sex organs in males and female as sexes are separate.



TERMINAL EXERCISES

1. Define the following terms.
 - (i) Demography
 - (ii) Vasectomy
 - (iii) IUD
2. Mention if the following statements are True (T) or False (F) and rewrite the wrong statements in the correct form.
 - (i) Fertilization occurs in vagina.
 - (ii) Oxygen and nutrients diffuse from mother's blood into foetus's blood through amnion.
 - (iii) Testes produce testosterone hormone.
 - (iv) Pregnancy in women can be prevented by the method of vasectomy.
 - (v) Tubectomy involves the cutting and tying of the vas deferens in male.
3. Choose the odd one in each of the following.
 - (i) ovary; Fallopian tube; ureter; uterus
 - (ii) epididymis; urethra; vas deferens; uterus



Notes

(iii) Graafian follicle; corpus luteum; Leydig cell

(iv) amnion; corpus luteum; amniotic fluid; umbilical cord

4. Match the terms of Column I with those of Column II and write down the matching pairs.

Column I

Column II

- | | |
|------------------|-------------------------|
| 1. Acrosome | (a) Testis |
| 2. Ovulation | (b) Luteinizing hormone |
| 3. Villi | (c) Spermatozoa |
| 4. Fertilization | (d) Progesterone |
| | (e) Placenta |
| | (f) Vagina |
| | (g) Fallopian tube |

5. What is reproduction? List the organs of the human male reproductive system.
6. What is placenta? How is the placenta beneficial to the mother and the foetus?
7. What is the significance of testes being located in scrotal sac outside the abdomen of human males?
8. Write in a sequence the region through which sperm travels from seminiferous tubules up to the urethral opening in human males.
9. How can the knowledge of process of reproduction help in reducing population growth? Give reasons.
10. How does increasing population affect environment?
11. Name the following.
 - (i) The organ in which the foetus develops in a human female.
 - (ii) The male gamete in humans.
 - (iii) The fluid surrounding the developing embryo.
 - (iv) Stage when menstruation and ovulation stops in females.
 - (v) The surgical method of contraception in human female.
12. Differentiate between the following.
 - (i) Implantation and pregnancy
 - (ii) Graafian follicle and corpus luteum
 - (iii) Identical twins and fraternal twins



Notes

- (iv) Birth rate and death rate
- (v) Vasectomy and tubectomy

13. Draw the outline of the cross section of the male reproductive system.

- (i) Label the following parts.
 - (a) testis (b) epididymis
 - (c) seminal vesicles (d) vas deferens
- (ii) Name the hormone produced by the testis.
- (iii) Why are sperms produced in large numbers?
- (iv) State the function of the seminal vesicles.

14. Write a note on:

- (i) Lactation in humans
- (ii) Gemmule (iii) Cockroach ovaries



ANSWERS TO INTEXT QUESTIONS

- 21.1** 1. Male 13-14 years; Female 11-13 years
2. Epididymis
3. (i) Testes, epididymis, vas deferens, urethra, penis
(ii) Ovaries, fallopian tubes, uterus, vagina
4. Seminal vesicles, prostate glands, cowper's glands
5. (a) Stock sperms and provide them nourishment
(b) Secretes an alkaline fluid, thin fluid keeps the sperms alive and helps them to swim vigorously.
(c) Secretes a white viscous, alkaline secretion that acts as a lubricant.
(d) Inner lining receives, protects and nourishes embryo; contraction of muscular wall exits baby during birth.
6. Gemmule is a reproductive body for asexual reproduction in sponges. Gemmules help sponges overcome periods of drought and form new sponges when favourable conditions arise
7. (a) Seminal vesicles store sperms; (b) receives sperms during copulation
(c) generate sperms (d) produce eggs.



Notes

- 21.2** 1. supplies oxygen and food from maternal blood to foetus and transports carbon dioxide and excretory waste from foetal blood to the maternal blood.
2. (i) the fixation of morula in the wall of uterus is called implantation
 (ii) Association between maternal and foetal tissue for physiological exchange, developing embryo is attached to the uterus by a tissue called placenta.
 (iii) Morula : The zygote begins to divide and form a mass of cells called morula.
 (iv) Amnion : From the first few stages of development, the embryo is enclosed in a sac called amnion.
3. Amniotic fluid
4. Prolactin stimulates synthesis of milk in mammary glands in women soon after delivering a body.
 Oxytocin stimulates uterine contraction for child birth and squeezing of milk in mother for new born infant
5. Colostrum; rich in nutrients, fats and proteins. Provides passive immunity
- 21.3** 1. (i) Advancement in agriculture (ii) Religious and social customs
 (iii) Illiteracy (iv) Desire for a male child
2. See text sub-section 21.4.4
3. See text sub-section 21.4.4
4. See text sub-section 21.4.4
5. See text sub-section 21.4.4