



Cell Growth and Division (Mitosis and Meiosis); Reproduction



B11CH4



Learning Objectives

Upon completion of topics, learners will:

- Describe the stages of the cell cycle
- List and diagram the phases of mitosis and meiosis
- Distinguish mitosis and meiosis and explain the importance of meiosis in sexual reproduction
- Distinguish between sexual and asexual reproduction
- List and explain some forms of asexual reproduction in plants and animals
- Discuss reproduction and parenting in humans (sexuality)
- Recognize sexual decisions that has impact on the family
- Initiate advocacy on substance abuse and SBV

4.1 CELL GROWTH AND DIVISION

4.1.1 Cell Cycle

Cell cycle is an ordered series of events required for the faithful duplication of one eukaryotic cell into two genetically identical daughter cells. In a cell cycle, precise replication of deoxyribonucleic acid (DNA) duplicates each chromosome. Subsequently, the duplicated chromosomes separate away from each other during **karyokinesis** (division of nucleus) followed by **cytokinesis** (division of the cytoplasm).

These transformations in chromosomes are accompanied by general cell growth, which provides enough material of all sorts (membrane, organelles, cytosol and nucleoplasm) required for the resultant doubling

of cell membrane. This cycle continues indefinitely in specializing cells called **stem cells**, found in the skin (Malpighian layer) or bone marrow, causing constant replenishment of cells which are discarded by natural physiological processes. Repetition of cell cycle may produce a clone of identical cells, such as Baker's yeast on a Petri dish, or it may be accompanied by intricate changes that lead to differentiation into distinctive cell types or ultimately to development of a complex organism. In all cases, the DNA sequence of each cell's genome remains unchanged, but the resultant cellular form and functions may vary. Now they enter Interphase during which they prepare for the next cell division and grow to the same size as the mother cell. However, no change in chromosomes occurs in this stage.

Most eukaryotic cells repeat a process of growth and division referred to as the cell cycle. The cycle can vary in length from a few minutes to several years.

Interphase

Just before initiating the mitosis, a stage called **interphase** prepares the cell for division. In this phase, the cell grows to its maximum size by increase in volume of nucleus and nucleolus. The nucleus starts to double the quantity of DNA and the chromosomes become long and thread-like structures. Interphase is also called the **resting phase** because no change in chromosomes occurs in this phase. The interphase has three distinct phases—**G₁ phase** or first growth phase, **S phase** or synthesis phase and **G₂ phase** or second growth phase.

Interphase is that portion of the cell cycle in which the chromosomes are invisible under the light microscope because they are not yet condensed. It includes the G₁, S, and G₂ phases. In the G₂ phase, the cell mobilizes its resources for cell division.

G₁—First Growth Phase

During G₁ phase cells undergo the major portion of their growth. The RNA and protein of the cell are synthesised and the volume of cytoplasm increases. Mitochondria (in both plant and animal cells) and chloroplast (only in plant cells) divide because they have their own DNA. It is a larger growth phase for the cells. In the late G₁ phase, all cells either withdraw from the cell cycle and enter the R phase (resting phase) or start preparing themselves for the next S phase (synthesis phase).

S phase—Synthesis phase

The S phase is a DNA synthesis phase. In this phase, each chromosome replicates to produce two sister chromatids, which remain attached to each other at the **centromere**. The centromere is the point of constriction on the chromosome, containing a specific DNA sequence to which is bound a disk of protein called **kinetochore**. This disk functions as an attachment site for fibers that assist in cell division. In the S phase, more DNA is synthesised and the chromosomes start to get duplicated.

In a metaphase chromosome, kinetochore microtubules are anchored to proteins at the centromere.

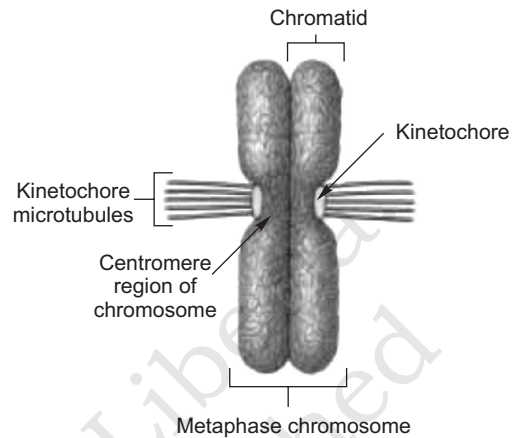


Fig. 4.1. Kinetochores.

G₂ phase—Second Growth phase

In G₂ phase, they begin the long process of **condensation**, coiling ever more tightly. Special *motor proteins* are involved in the rapid final condensation of the chromosomes that occurs early in mitosis. Also during G₂ phase, the cells begin to assemble the machinery they will later use to move the chromosomes to opposite poles of the cell. In animal cells, a pair of microtubule organizing centers called **centrioles** replicate. All eukaryotic cells undertake an extensive synthesis of *tubulin*, the protein of which microtubules are formed.

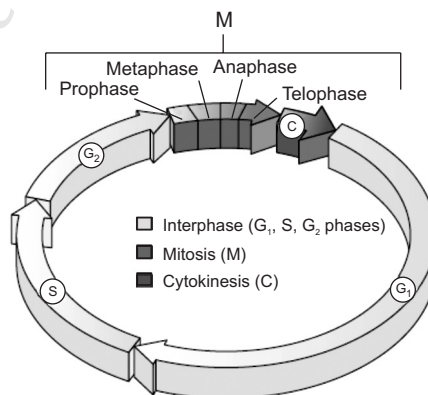


Fig. 4.2. Cell cycle

4.1.2 Cell Division

When a cell has attained its maximum size, it usually splits into half, forming two **daughter cells**. This process is called **cell division**. In this process, all structures in a parent cell are duplicated and distributed to each daughter cell. The daughter cells grow and divide. The process of cell division is controlled by the nucleus. In unicellular organisms, cell division is a means of multiplication of cells. In the multicellular organisms, it brings about **growth, replacement** of old cells, **repair** of wear and tear tissues and **reproduction** in organisms.

Types of Cell Division

There are two major types of cell divisions—**mitosis** and **meiosis**.

1. Mitosis responsible for growth and development in an organism.
2. Meiosis responsible for production of gametes (sperm and ovum).

Mitosis Cell Division

Mitosis (*mitos* meaning thread, referring to chromatin thread) is a kind of cell division which leads to growth and repair of the body. The two daughter cells formed as a result of mitosis are similar to the parent cell in all respect. Hence, mitosis is also called equational cell division. Mitosis generally occurs in somatic or body cells that are not involved in the formation of gametes. The number of chromosomes in each somatic cell is diploid ($2n$).

Phases of Mitosis

There are four phases of mitosis. These are, prophase, metaphase, anaphase and telophase.

1. **Prophase:** Formation of the Mitotic Apparatus: When the chromosome condensation initiated in G_2 phase reaches the point at which individual condensed chromosomes first become visible with the light microscope, the first stage of mitosis, **prophase**, has begun. The condensation process continues throughout prophase; consequently, some chromosomes that start prophase as minute threads appear quite bulky before its conclusion. Ribosomal RNA synthesis ceases when the portion of the chromosome bearing the rRNA genes is condensed.
2. **Metaphase:** Alignment of the Centromeres: The second stage of mitosis, **metaphase**, is the phase where the chromosomes align

in the center of the cell. When viewed with a light microscope, the chromosomes appear to array themselves in a circle along the inner circumference of the cell, as the equator girdles the earth. An imaginary plane perpendicular to the axis of the spindle that passes through this circle is called the **metaphase plate**.

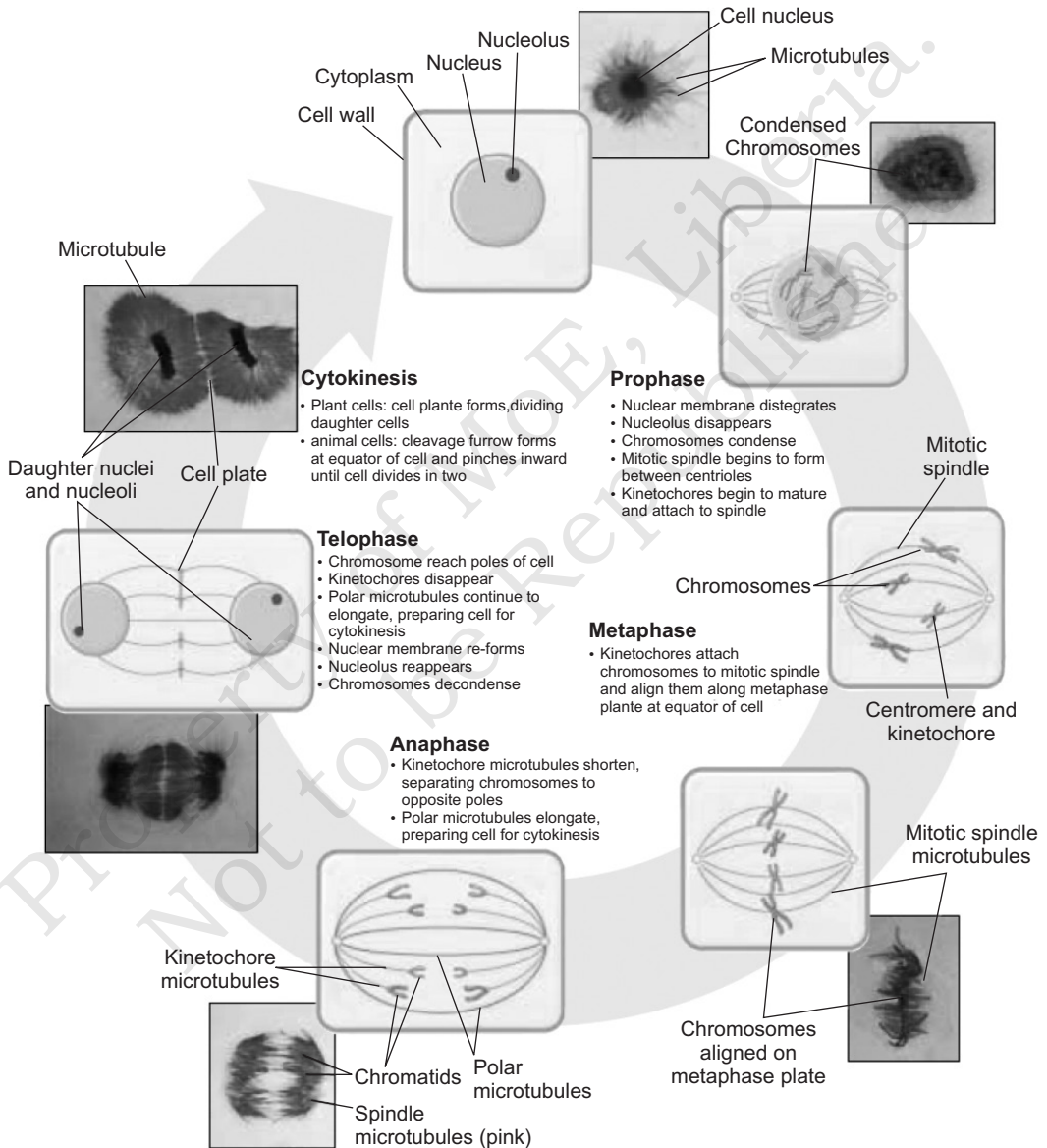


Fig. 4.3. Phases of mitosis

3. **Anaphase:** Separation of the Chromatids and Reformation of the Nuclei: Of all the stages of mitosis, **anaphase** is the shortest and the most beautiful to watch. It starts when the centromeres divide. Each centromere splits in two, freeing the two sister chromatids from each other. The centromeres of all the chromosomes separate simultaneously, but the mechanism that achieves this synchrony is not known. Freed from each other, the sister chromatids are pulled rapidly toward the poles to which their kinetochores are attached. In the process, two forms of movement take place simultaneously, each driven by microtubules. First, *the poles move apart* as microtubular spindle fibers physically anchored to opposite poles slide past each other, away from the center of the cell. Because another group of microtubules attach the chromosomes to the poles, the chromosomes move apart, too. If a flexible membrane surrounds the cell, it becomes visibly elongated. Second, the centromeres move toward the poles as the microtubules that connect them to the poles shorten.
4. **Telophase:** In **telophase**, the spindle apparatus disassembles, as the microtubules are broken down into tubulin monomers that can be used to construct the cytoskeletons of the daughter cells. A nuclear envelope forms around each set of sister chromatids, which can now be called chromosomes because each has its own centromere. The chromosomes soon begin to uncoil into the more extended form that permits gene expression. One of the early group of genes expressed are the rRNA genes, resulting in the reappearance of the nucleolus.

Significance of Mitosis

1. **Genetic stability:** Mitosis results in two daughter cells which have the same number of DNA identical to parent cell. Thus, the stability of DNA attained.
2. Somatic cells of organisms divide mitotically and add to growth of organisms.
3. Mitosis serves as the basis of asexual reproduction such as fission, budding and spore formation.
4. Mitosis forms new cells and aids the repair of worn-out tissues.

ACTIVITY 4.1 (LAB WORK)

Aim: To study mitosis by preparing the mount of an onion root tip cells

Materials Required: Compound microscope, Acetocarmine stain, Water, Burner, N/10 Hydrochloric acid, Filter paper, Cover slip, Aceto alcohol (Glacial acetic acid and Ethanol in the ratio 1:3), Glass Slide, Onion root peel, Forceps, Blade, Watch glass, Dropper, Needle, Vial

Procedure

1. Place an onion on a tile. With the help of a sharp blade, carefully snip the dry roots of the onion
2. Place the bulbs in a beaker containing water to grow the root tips. It may take around 4 to 6 days for the new roots to grow and appear.
3. Trim around 3 cm of the newly grown roots and place them in a watch glass.
4. Allow the root tips to remain in the vial for one complete day.
5. With the help of forceps, pick one root and set in on a new glass slide.
6. Heat it lightly on the burner in such a way that the stain does not dry up.
7. Excessive stain can be carefully treated using filter paper.
8. The more stained part of the root tip can be trimmed with the help of a blade.
9. Discard the lesser stained part while retaining the more stained section.
10. Add a droplet of water to it.

Observations and Conclusion

- The slide containing the stained root tip cells is placed on the stage of the compound microscope, changes taking place are noted and sketched.
- The different phases of mitosis, such as prophase, metaphase, anaphase and telophase can be observed.

Meiosis Cell Division

Meiosis is the cell division during which the number of chromosomes is reduced to half.

It takes place in the **gonads**. It is essential for sexual reproduction and for the formation of new gametes. The process of meiosis consists of two sets of cell divisions, the first meiosis division (meiosis I) and the second meiosis division (meiosis II). Meiosis I is the **reduction division** and meiosis II is similar to mitotic division.

Interphase

It is the most active phase in which nucleus becomes distinctly visible with nuclear membrane and nucleolus. The chromosomes appear as a network of chromatin threads.

The sequence of events during meiosis involves two nuclear divisions—**The first meiotic division and the second meiotic division.**

First Meiotic Division

Prophase I: In prophase I of meiosis, the DNA coils tighter, and individual chromosomes first become visible under the light microscope as a matrix of fine threads. Because the DNA has already replicated before the onset of meiosis, each of these threads actually consists of two sister chromatids joined at their centromeres. In prophase I, homologous chromosomes become closely associated in synapsis, exchange segments by crossing over, and then separate.

Metaphase I: By metaphase I, the second stage of meiosis I, the nuclear envelope has dispersed and the microtubules form a spindle, just as in mitosis. During diakinesis of prophase I, the chiasmata move down the paired chromosomes from their original points of crossing over, eventually reaching the ends of the chromosomes. At this point, they are called terminal chiasmata. Terminal chiasmata hold the homologous chromosomes together in metaphase I, so that only one side of each centromere faces outward from the complex; the other side is turned inward toward the other homologue.

Anaphase I: In anaphase I, the microtubules of the spindle fibers begin to shorten. As they shorten, they break the chiasmata and pull the centromeres toward the poles, dragging the chromosomes along with them. Because the microtubules are attached to kinetochores on only one side of each centromere, the individual centromeres are not pulled apart to form two daughter centromeres, as they are in mitosis. Instead, the entire centromere moves to one pole, taking both sister chromatids with it. When the spindle fibers have fully contracted, each pole has a complete haploid set of chromosomes consisting of one member of each homologous pair.

Second Meiotic Division

After a typically brief interphase, in which no DNA synthesis occurs, the second meiotic division begins.

Meiosis II resembles a normal mitotic division. Prophase II, metaphase II, anaphase II, and telophase II follow in quick succession.

Prophase II: At the two poles of the cell the clusters of chromosomes enter a brief prophase II, each nuclear envelope breaking down as a new spindle forms.

Metaphase II: In metaphase II, spindle fibers bind to both sides of the centromeres.

Anaphase II: The spindle fibers contract, splitting the centromeres and moving the sister chromatids to opposite poles.

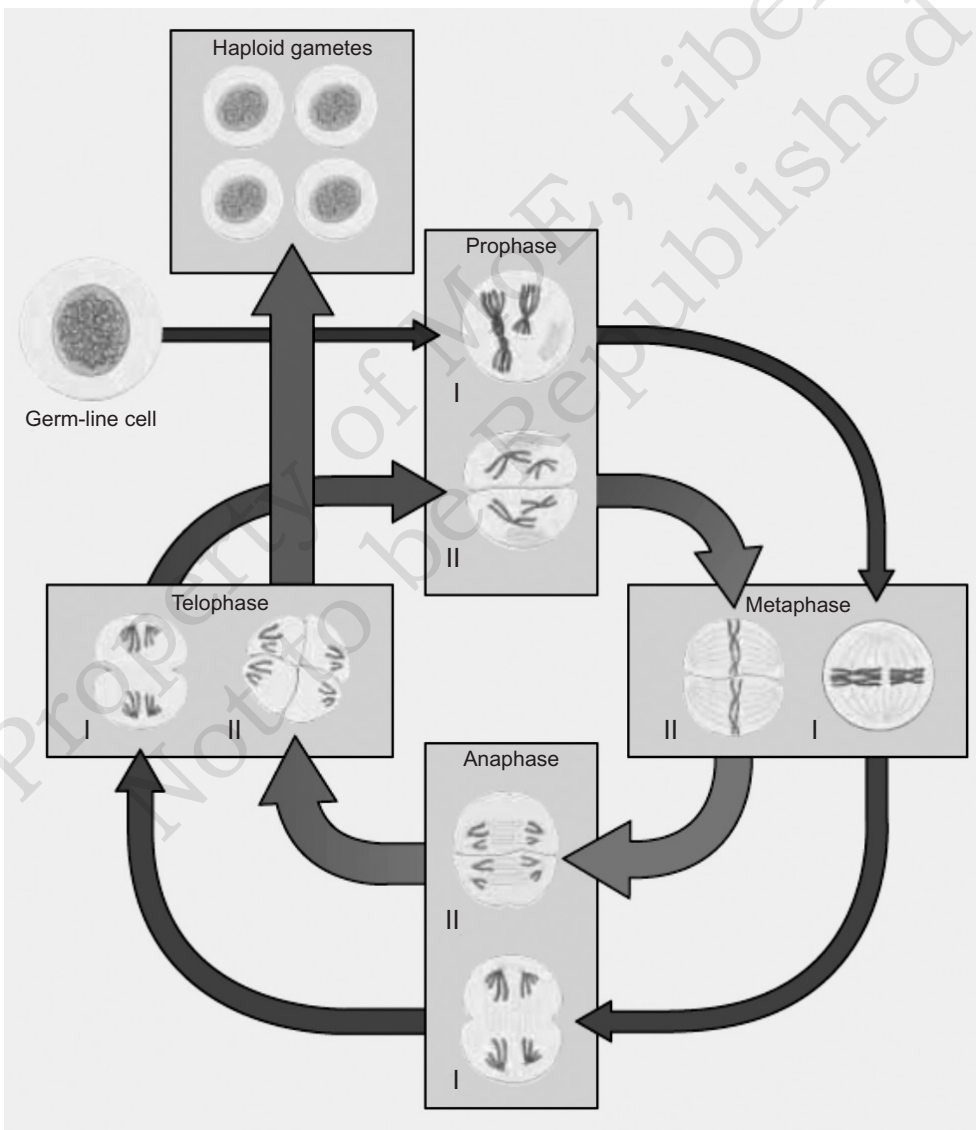


Fig. 4.4. Phases of Meiosis I and Meiosis II

Telophase II: Finally, the nuclear envelope re-forms around the four sets of daughter chromosomes.

The final result of this division is four cells containing haploid sets of chromosomes. The cells that contain these haploid nuclei may develop directly into gametes, as they do in animals. Alternatively, they may themselves divide mitotically, as they do in plants, fungi, and many protists.

Significance of Meiosis

1. **Meiosis restores the diploid number of chromosomes present in the somatic cells:** As the gametes (male and female sex cells) contain haploid number (n) of chromosomes, they fuse to form a zygote with diploid number ($2n$) of chromosomes.
2. **It reduces the number of chromosomes to half:** For example, humans have 46 chromosomes, but the egg and sperm cells have only 23 chromosomes each.
3. **It maintains the stability of the species:** This occurs because it inhibits the multiplication of chromosomes.
4. **It brings about variations in the offspring by crossing over:** **Crossing over** is a process of exchange of genetic material between the homologous chromosomes. Due to crossing over, the four cells formed during meiosis are different in genetic constitution from parent cells. It leads to variation in offspring.

ACTIVITY 4.2 (INDIVIDUAL WORK)

On a chart paper, draw and label different stages of mitosis and meiosis. Present the respective chart in your class.

Table 4.1 represented the differences between mitosis and meiosis.

Table 4.1. Differences between mitosis and meiosis

Characteristics	Mitosis	Meiosis
Occurrence	Occurs in vegetative body cells	Occurs in gonads
Time	Occurs throughout life	Occurs only at reproductive age
Number of daughter cells formed	Two daughter cells which are genetically similar to the parent cell	Four daughter cells which are genetically dissimilar to the parent cell

Number of chromosomes	Diploid ($2n$) numbers of chromosomes	Haploid (n) number of chromosomes
Number of nuclear division	A single nuclear division occurs after the duplication of chromosomes	Two nuclear divisions occur after the duplication of chromosomes

4.2 REPRODUCTION

The production of new organisms from the existing one is known as **reproduction**.

It is the process of creating new individuals from the existing one. Reproduction ensures continuity of life forms. This enables their species to live forever.

Modes of Reproduction

Organisms can reproduce mainly by two different modes. These are:

1. Asexual reproduction in which no gamete is formed.
2. Sexual reproduction in which formation of gametes takes place.

4.2.1 Asexual Reproduction

Asexual reproduction involves the participation of a single parent. The production of a new organism from a single parent which occurs without the involvement of sex cells (gametes) is called **asexual reproduction**. It is a simplest method of reproduction, mostly occurs in unicellular organisms (like Bacteria and Protozoa), some lower plants (like algae and fungi), and certain multicellular organisms (like Sponges and Hydra).

The basic features of asexual reproduction are as follow:

- It involves only one organism.
- The cell division during this type of reproduction is mitotic.
- New individuals produced are genetically identical to the single parent.

Types of Asexual Reproduction

The common methods of asexual reproduction include:

1. **Fission:** Fission is the simplest type of asexual reproduction in which a single unicellular organism splits into two or more daughter cells. In the splitting process, the parent organism duplicates its genetic material (DNA) along with the duplication of cytoplasm and

finally divides into two parts, with each new part receiving one copy of DNA. This type of reproduction allows the organisms to colonize new habitat very fast. Examples are found in Amoeba, Paramecium and some bacteria.

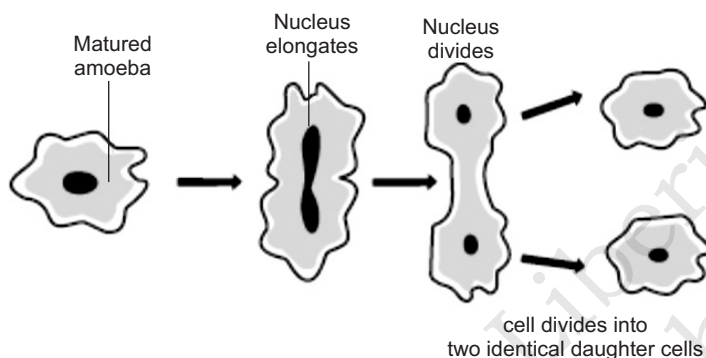


Fig. 4.5. Fission in Amoeba

2. **Budding:** In **budding**, a bulb-like outgrowth called **bud** develops from the parent body, which grows and finally detached to form a new organism. The bud may form on an external or internal surface of the parent body. **Internal buds** are formed in some sponges and are released when the parent dies.

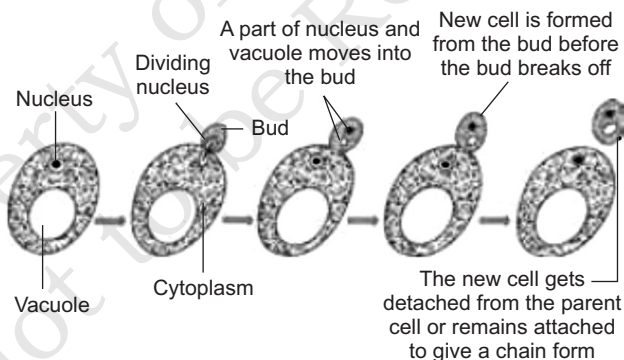


Fig. 4.6. Budding in Yeast

ACTIVITY 4.3 (LAB WORK)

To study the budding in yeast, prepare a yeast culture by adding a few dry yeast pellets to 10% glucose solution in a conical flask. Plug the flask tightly with cotton wool and place it in a dark and warm place. After 2 to 3 days, prepare a wet-mount of yeast culture. Stain the yeast cells with methylene blue. Examine the slide under a microscope. Draw a single cell showing cell wall, cytoplasm, nucleus and vacuole. Now look for the formation of buds in yeast cell. Make the sketch of yeast showing buds.

3. **Fragmentation:** This type of asexual reproduction can be seen in Spirogyra. In Spirogyra, a single parent Spirogyra cell, after attaining a maximum length breaks into fragments and each fragment has the ability to develop into a whole new individual.

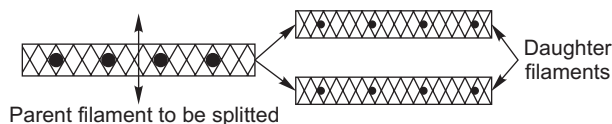


Fig. 4.7. Fragmentation in Spirogyra

4. **Vegetative Propagation:** *Vegetative propagation* is an ability of plant to produce new plants without reproducing sexually but simple as an outgrowth of old vegetative structures like leaf, stem and roots.

There are two types of vegetative propagation of plants—**natural vegetative propagation** and **artificial vegetative propagation**.

Natural vegetative propagation: In natural vegetative propagation, the stored food will be used by the new plant during the early growth stages until it can photosynthesize. It can be done by the following ways:

1. The sweet potato is a **root tuber** [(Fig. 4.8 (a)]. It has adventitious roots. When these roots are planted in the soil, new plants are produced.
2. Weak aerial stems like **runner** [Fig. 4.8 (b)] and stolon gives off adventitious roots on touching the ground. When the association with the parent plant is broken, the portion which has newly stuck roots develops into an independent plant. Grass is the example of runner which propagates vegetatively.
3. The stem tuber of Irish potato, bulb of Onion, and rhizome of Ginger [(Fig. 4.8 (c)] also propagate naturally.
4. The bulbils of Bryophyllum [(Fig. 4.8(d)] have adventitious buds on their margins. These buds when fall on the moist soil develop into small plantlets which subsequently develop into new plants.



(a) Root tuber of potato



(b) Runner of grass



(c) Rhizome of ginger



(d) Bulbils of bryophyllum

Fig. 4.8. Organs of natural vegetative propagation

Artificial vegetative propagation: This type of vegetative propagation involves human intervention. Some common methods of artificial vegetative propagation are:

1. **Cutting:** In this method, a vegetative part of a plant is cut and is planted in the soil to form a new plant. Cutting must include at least a meristematic region (node) from which growth can occur. It is commonly carried out on a sugarcane plantation (node).
2. **Grafting:** The process of joining parts of two different plants of closely related varieties in such a manner that they live as one plant is called **grafting**. This is usually practiced in dicotyledonous plants, especially fruit trees. Of the two plants, one that is rooted in the soil is known as **stock**, while the portion of other plant (bud, branch, etc.) that is grafted is called **scion**. Grafting brings cambia of both the scion and stock together. Plants that are easily propagated by grafting are mainly the citrus, e.g. orange, grape and tangerine. The process of grafting is shown in Fig. 4.9.

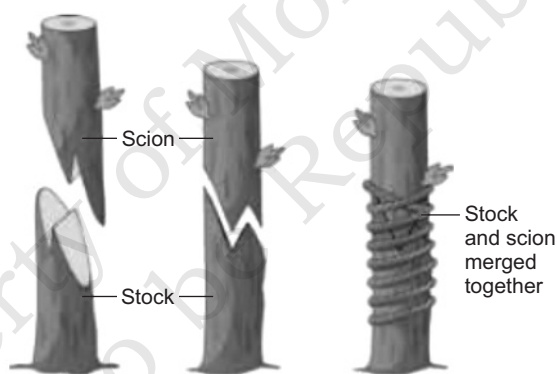


Fig. 4.9. Grafting

3. **Cloning:** In this process of asexual reproduction, new individuals are produced from genetic information received from a single parent only. As a result, the offspring has an identical set of genetic information. Example: Dolly, a sheep (female), was the first animal to be cloned from adult somatic cells by the nuclear transfer process. Tetra was the first rhesus macaque developed by embryo splitting. The ox, mule, cat, wolf, dog, rat and rabbit are the cloned animals.

4.2.2 Sexual Reproduction

Eukaryotic cells also possess the ability to reproduce sexually, something prokaryotes cannot do effectively. The production of a new organism from two parents by the fusion of male gamete (sperm) and female gamete

(ovum) is called **sexual reproduction**. It is the process of producing offspring, with two copies of each chromosome, by fertilization, the union of two cells that each has one copy of each chromosome.

Types of Sexual Reproduction

Sexual reproduction can be divided into the following types:

1. **Conjugation:** Conjugation is a simplest sexual mode of reproduction that occurs in lower organisms, e.g. Spirogyra, Paramecium, Mucor, and Rhizopus. In conjugation, the whole cell may act as a gamete. This may then pair with another cell and the exchange of nuclei takes place between the cells.
2. **Formation of Male and Female Gametes (Meiosis):** Meiosis, a two-step process gives rise to gametes. The outcome of this process is 4 haploid daughter cells, each of which contains only one set of chromosomes. Through the process of fertilization (which can either be external or internal), they unite forming the zygote. The zygote is the future foetus which is diploid in nature containing two sets of chromosomes, each from both the parents.
3. **Fusion of Male and Female Gametes (Fertilization):** The fusion of male gamete with the female gamete is called **fertilization**. Due to fertilization, a single-celled **zygote** is formed which grows and develops to form a mature organism.

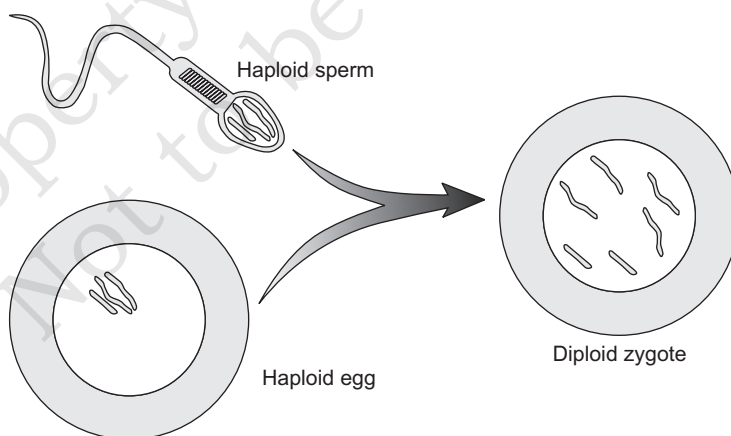


Fig. 4.10. Diploid cells carry chromosomes from two parents.

In higher organisms, male and female gametes are formed in special organs called **gonads**. The male gametes called **spermatozoa** or **sperm** is produced in **testis** by a meiotic cell division called **spermatogenesis**. The female gametes called ova or **eggs** are produced in ovary by a meiotic

cell division called **oogenesis**. Both sperm and ovum are together during mating and they fuse by the process of fertilisation to form a diploid **zygote** which later develops into a new organism.

A diploid cell contains two versions of each chromosome, one contributed by the haploid egg of the mother, the other by the haploid sperm of the father.

ACTIVITY 4.5 (INDIVIDUAL WORK)

Explain the following terms and have discussion on them in the class:

- Gamete formation
- Gametes
- Haploid
- Diploid

Also explain the importance of meiosis in sexual reproduction.

Table 4.2. Differences between asexual and sexual reproduction

<i>Asexual reproduction</i>	<i>Sexual Reproduction</i>
1. Single parent involved.	1. Both the male and female parents involved.
2. Gamete formation does not occur.	2. Male and female gametes are formed.
3. Fertilisation does not occur.	3. Fertilisation occurred by the fusion of male and female gametes.
4. Individual produced is genetically identically to parent cell.	4. Zygote produced is genetically non-identical to the parents.
5. No genetic variation is found.	5. Genetic variation occurred.
6. A fast mode of reproduction.	6. A slow mode of reproduction.

4.3 RESPONSIBILITIES OF PARENTING

Parents are among the most important people in the lives of young children. They include mothers and fathers, as well as other caregivers who act as parents. From birth, children rely on parents to provide them with the care they need to be happy and healthy, and to grow and develop well.

4.3.1 Effective Parenting Practices

Parenting takes some parenting practices that work well across diverse families and settings. Parents can support their child's healthy development by:

- Following the child's responding in a predictable way
- Showing warmth and sensitivity towards their children
- Having routines and household rules
- Sharing books and talking with children
- Supporting health and safety
- Using appropriate discipline without harshness

ACTIVITY 4.6 (INDIVIDUAL WORK)

What kind of family you intend to have in the next ten years? Ask volunteers to share. Use issues rose to encourage students to wait until they are ready to have sex and make babies.

4.3.2 Effective Parenting for Teenagers

Children in teen age show the following emotional or social changes:

- Have more interest in romantic relationships and sexuality.
- Go through less conflict with parents.
- Show more independence from parents.
- Have a deeper capacity for caring and sharing and for developing more intimate relationships.
- Spend less time with parents and more time with friends.
- Feel a lot of sadness or depression, which can lead to poor grades at school, alcohol or drug use, unsafe sex, and other problems.
- Following are some positive parenting tips that can help the teen during this time:
 - Talk them about their concerns and pay attention to any changes in their behavior.
 - Show interest in their school and extracurricular interests and activities and encourage them to become involved in activities such as sports, music, theater and art.
 - Encourage them to volunteer and become involved in civic activities.
 - Compliment them and celebrate their efforts and accomplishments.

- Respect their opinion. Listen to them without playing down her concerns.

4.3.3 Risk of Teenage Parenting

1. Children of teenagers are more likely to be premature, abused, and poor; to die before age 1; have several health problems; develop behavioral/emotional problems; and to become teenage parents.
2. The continuum of reproductive casualty leads to identification of causal factors sufficient to account for developmental deficits in children of teenage mothers.
3. The continuum of caretaking casualty suggests numerous behavioral and environmental variables that may be related to the development of children of teenage mothers.
4. Teenage fathers and mothers do tend to fail as parents, however. Parental interference limits access to their child. Dropping out of school, low income, and ignorance of child rearing and child development, and stress that comes with adolescence and with early fatherhood also contribute to parenting failure.

4.3.4 Various Roles and Responsibilities of Parenting

The responsibility of parents is known as the role, efforts and contributions of the parents for the children's physical, mental, social and emotional development as well as the development of other aspects so that children can develop themselves and contribute largely to the development of the society and nation. The important responsibilities of parents towards their children are given below:

- To give nutritious food and proper clothing
- To develop a habitat for hardworking
- To support moral life
- To create healthy environment
- To develop the concept of practical thinking
- To help them lead an independent life
- To take care of the children and provide them proper education
- To lift the children according to their social values

ACTIVITY 4.7 (PERSONAL EXPERIENCE SHARING)

Invite a respected father to talk about the role of the father in parenting. Use this talk to emphasize the need for boys to take responsibility of their babies. Highlight the challenges of babies who grow up without their fathers and the long term effects this has on them.

4.4 HOW TO AVOID UNPLANNED PREGNANCIES

To avoid unplanned pregnancies, some natural and artificial methods are to be used by humans.

Natural methods to avoid unplanned pregnancies

The natural methods include the following:

1. **Abstinence:** It is the method that involves complete abstinence from sex. It is the most reliable natural birth control method to avoid conception.
2. **Rhythm method:** This is the method that determines the avoidance of intercourse during the estimated phase of menstrual period. It is unreliable for women with irregular menstrual cycle.
3. **Withdrawal method or coitus interruptus:** This is the method that involves the withdrawal of penis from the vagina before the release of semen (ejaculation). This method is also not reliable.

Artificial methods to avoid unplanned pregnancies

These methods are also referred to as the corrective methods. They include **surgical methods** and **contraceptive methods**. **Surgical methods** include the following:

1. **Vasectomy:** It is a surgical method which involves the cutting and tying of the vas deferens, the tubes that carry sperms from the testicles to urethra. It causes sterility in men. It does not affect sexual function.
2. **Tubectomy:** It is a surgical removal of small segments of the fallopian tubes and tying the cut ends with threads to prevent the passage of eggs and its fertilisation by sperm. It causes sterility in women without harming the sexual function.
3. **Laparoscopy:** It is the mechanism of tying of oviducts to block them with the help of an instrument called **laparoscope**. It is applied in female humans.

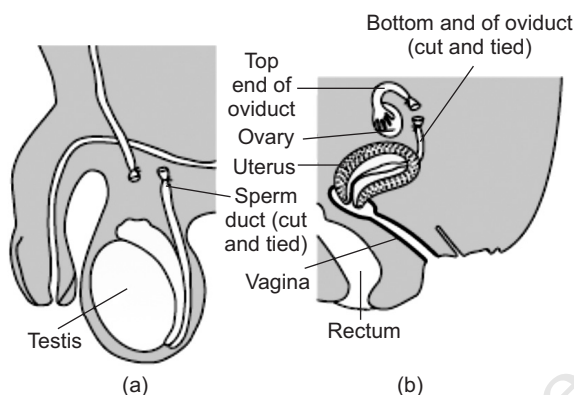


Fig. 4.11. Preventive surgical method of population
(a) Vasectomy in males (b) Tubectomy in females

Contraceptive methods involve preventing conception which is the fertilisation of an egg by the sperm. These methods include the following:

1. **Condom:** It is a rubber sheath which is used by men to prevent the passage of sperms into the female genital tract. It is worn over the penis during sexual intercourse. It is the only contraceptive method that prevents transmission of sexual diseases such as AIDS.
2. **Diaphragm or cervical cap:** It is a thin rubber cap with a metal ring. It is placed over the mouth of the uterus, *i.e.* cervix to prevent the entry of sperms.
3. **Intrauterine device (IUD):** It is used to prevent the implantation of a fertilised egg in the uterus of a female. The communally used effective intrauterine device is **copper-T**. It is inserted into the uterus to prevent the implantation of a fertilised egg on the uterine wall.
4. **Contraceptive pills:** These are the oral hormonal pills that prevent the females from producing a mature egg. However, they should be taken under the supervision of qualified doctors.
5. **Vaginal spermicidal creams:** These are the creams that kill sperms during intercourse. To increase its reliability, one should use it with a condom or a cervical cap.

ACTIVITY 4.9 (ROLE PLAYS)

To prevent teenage parenting

- Showing steps in the correct use of condoms. Repeat the steps several times to ensure that the students understand well.
 (This activity is to be demonstrated by the teacher)
- Showing that the two girls sharing the challenges they have experienced with their family planning and how they have overcome them.

4.5 SEXUAL DECISIONS AND IMPACT ON THE FAMILY

Parents play a significant role in the sexual development and behavior of their children. Parental monitoring and supervision are important aspects for keeping adolescents from risky situations and activities while the teen develops responsible decision-making skills.

4.5.1 Making Healthy Decision on Sexual Issues

A sexually healthy teen will have the following qualities within their relationships with themselves, parents and family members, peers and intimate partners.

Relationships with Peers

1. Interact with people of different sexual orientation and gender identity in proper and respectful ways:
 - communicate well with friends.
 - show empathy in relationships.
 - Identify relationships that may not be healthy for themselves or others.
 - Avoid sexual harassment behaviour.
 - respects others' right to privacy and does not share personal information that others have shared with them.
2. Acts on one's own values and beliefs when they are not the same as their peers:
 - understand pressures to be popular and accepted and makes decisions based on their own values.

Relationships with Intimate Partners

1. Shows love and intimacy in a way which is appropriate for their age:
 - believes that everyone has equal rights and responsibilities for love and sexual relationships.
 - can say 'no' and accepts when a partner says 'no'.
 - tries to understand how a partner feels.
2. Has the skills to decide how ready they are for mature sexual relationships:
 - talks with a partner about sexual behaviors before they happen.
 - is able to communicate and negotiate sexual behaviors.

- if they choose to have sex, protects self and partner from unplanned pregnancy and sexually transmitted infections (STIs) by using birth control, condoms, and other safer sex practices.

Relationships with Parents and Family Members

1. Communicates effectively with family members about issues, including sexuality:
 - has a good balance between family roles and responsibilities and their growing need for independence
 - is able to negotiate with family on boundaries and tries to understand parents point of view
 - respects rights of others and treats adults with respect
 - understands and asks for information about parents' and family's values and thinks about them when developing their own values
 - asks parents and other trusted adults questions about sexual health issues and accepts their guidance

4.5.2 Impact of Sexual Decisions on the Family

It is important to include families in helping to shape your decisions in relation to developments you want to make. Families know their circumstances best and what types of support will work best for them. Families are the child's first and most enduring educator, this makes their input vital.

ACTIVITY 4.10

1. **Sharing Experiences:** Share your experiences with others on making sexual decisions such as, what experience you gain when you grow up with someone you love and have known for a long time and you look forward to having sex. Also share your experience with using contraceptives, condoms and abstinence methods during sex for delayed child bearing.
2. **Discussion:** Discuss about the impact of your sexual decisions on you and your family.
3. **Skit:** Compose a skit on your positive and negative decision making about sex and present it to your class.
4. **Role Play:** Show a role play of parental influence in positive and negative decision making.

4.6 CONSEQUENCES OF SEXUAL DECISION MAKING

Sexual and reproductive health and rights or **SRHR** is the concept of human rights applied to sexuality and reproduction. It is a combination of four fields such as, sexual health, sexual rights, reproductive health and reproductive rights. In the concept of SRHR, these four fields are treated as separate but inherently intertwined.

Distinctions between these four fields are not always made. Sexual health and reproductive health are sometimes treated as synonymous to each other, as are sexual rights and reproductive rights. In some cases, sexual rights are included in the term sexual health, or vice versa. Not only do different non-governmental organizations (NGOs) and government's organizations use different terminologies, but different terminologies are often used within the same organization.

Some of the notable global NGOs that fight for sexual and reproductive health and rights include IPPF (International Planned Parenthood Federation), ILGA (International Lesbian and Gay Alliance), WAS (World Association for Sexual Health - formerly known as World Association for Sexology), the Center for Health and Gender Equity, and International HIV/AIDS Alliance.

The World Health Organization defines sexual health as “Sexual health is a state of physical, mental and social well-being in relation to sexuality. It requires a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence.”

4.6.1 Reproductive Health and Reproduction Rights

Reproductive Health

The term reproductive health refers to healthy reproductive organs with normal functions. . In broader perspective, it also includes the emotional and social aspects of reproduction. The **World Health Organization** has defined the reproductive health as a state of total well-being in physical, emotional, behavioral and social aspects of reproduction. Reproductive health, therefore, implies that people are able to have a responsible, satisfying and safer sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so. According to WHO definition of reproductive health, a society can only be termed as reproductively healthy if the people have physically and functionally normal reproductive organs as well as normal emotional and behavioral interaction among them in all sex-related aspects.

Reproduction Rights

Reproductive rights are legal rights which are related to reproduction and reproductive health. The World Health Organization defines reproductive rights as follows:

- Reproductive rights rest on the recognition of the basic right of all couples and individuals to decide freely and responsibly the number, spacing and timing of their children and to have the information and means to do so, and the right to attain the highest standard of sexual and reproductive health.
- They also include the right of all to make decisions concerning reproduction free of discrimination, coercion and violence.

The area of sexual and reproductive rights is influenced by contextual cultural and social norms, socioeconomic factors and existing laws and regulations. The social-structural climate may affect both the access to and quality of sexual and reproductive health care and interventions.

ACTIVITY 4.11 (ROLE PLAY)

Show a role play of the importance of reproductive health rights and how they empower teenagers to make the right decisions about their sexuality.

4.6.2 Infertility

Infertility is a disease of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse. It affects millions of people of reproductive age worldwide –and has an impact on their families and communities. All over the world, a large number of couples are infertile, i.e. they are unable to produce children in spite of unprotected sexual cohabitation. Such a phenomenon is termed **infertility**.

What causes infertility?

Infertility may be caused by a number of different factors, in either the male or female reproductive systems. These can be categorized as physical, congenital, diseases, drugs, immunological and psychological. Either male or female or both partners can suffer from infertility disorders.

In the female reproductive system, infertility may be caused by:

- Tubal disorders such as blocked fallopian tubes, which are in turn, caused by untreated sexually transmitted infections (STIs) or complications of unsafe abortion.

- Uterine disorders which could be inflammatory in nature (such as such endometriosis), congenital in nature (such as septate uterus), or benign in nature (such as fibroids).
- Disorders of the ovaries, such as polycystic ovarian syndrome.
- Disorders of the endocrine system causing imbalances of reproductive hormones. The endocrine system includes hypothalamus and the pituitary glands. Examples of common disorders affecting this system include pituitary cancers and hypopituitarism.

In the male reproductive system, infertility may be caused by:

- Obstruction of the reproductive tract causing dysfunctional ties in the ejection of semen. This blockage can occur in the tubes such as ejaculatory ducts and seminal vesicles that carry semen. Blockages are commonly due to injuries or infections of the genital tract.
- Hormonal disorders leading to abnormalities in hormones produced by the pituitary gland, hypothalamus and testicles. Hormones such as testosterone regulate sperm production. Examples of disorders that result in hormonal imbalance include pituitary or testicular cancers.
- Testicular failure to produce sperm, for example, due to medical treatments that impair sperm-producing cells (such as chemotherapy).

4.7 ADOVOCACY

Clinically known as substance use disorder, drug abuse or addiction is caused by the habitual taking of addictive substances. Drugs include alcohol, marijuana, hallucinogens and opioids. Substance use disorder is a disease, causing people to compulsively use drugs despite consequences.

4.7.1 Abused Drug

A drug is a chemical which, when taken, in some way alters the body functions for the benefit of the person. An abused drug is a substance that modifies the biological, psychological or social behavior of a person by stimulating, depressing or distorting the functions of the body and the mind. Abused drugs include the use of:

- Heroin
- Alcohol
- Cocaine
- Nicotine
- Marijuana
- Club drugs
- Anabolic steroids

4.7.2 Addiction

Addiction is the habitual, psychological and physiological dependence on a substance which is beyond our voluntary control. A person, who is habituated to a substance, especially a harmful one is called an **addict**.

4.7.3 Drug Abuse

Intake of a drug for a non-medical purpose and in amount, strength, manner or frequency that impairs physical and mental functions is called its **abuse**. A person, who takes a drug for a non-medical use, is called **drug abuser**.

Common features of drugs abused by addicts:

- They are used without a physician prescription.
- They are to be taken frequently and regularly.
- They are habituating substances.
- They mostly affect the brain and alter consciousness, perception and behavior.
- They give temporary pleasure.
- They are often obtained and taken secretly.

Drug abuse is a serious public health problem that affects almost every community and family in some way. Each year drug abuse causes millions of serious illnesses or injuries.

A teenager becomes drug-dependent through following stages:

- **Experimental use:** Taking the drugs first time for curiosity.
- **Recreational use:** Taking drugs for the so called pleasure.
- **Situational use:** By joining the company of drug abusers and begin to take drug more often.
- **Compulsive use:** After becoming a drug addict, the use of drug is compulsory for the person.

4.7.4 Alcohol and Drug Abuse

Addiction is the attachment to the psychological effects of any substance. For example, the consumption of drugs and alcohol gives a temporary feeling of euphoria. People get attached to this sense of euphoria and start consuming drugs and alcohol even when it is not required. Thus, the prolonged use of drugs and alcohol makes the body used to it and increases its tolerance level. As a result, a higher dose of drug or alcohol

is required to get euphoric. This cycle keeps on repeating until it leads to addiction.

Hence, it is wise to stay away from alcohol and drug addiction. But if a person is addicted to them, he/she should gradually give up on these habits as sudden discontinuation can lead to 'withdrawal syndrome'. In such a case, the person suffers extreme anxiety, diarrhoea, tightness in the chest, sweating, difficulty in breathing, shivering and becomes fidgety.

Effects of Alcohol and Drug Abuse

- Immediate physical effects might result in extreme rough behaviour. However, a very high dosage might lead to death in extreme cases.
- A person suffering from alcohol or drug abuse commonly becomes dull, antisocial, depressed, tired, aggressive, etc.
- Intravenous drug consumption might lead to the transmission of many infectious diseases like AIDS if the same syringe is shared among multiple people.
- Alcohol usage ultimately leads to the failure of vital organs like the liver and kidneys.

Substance abuse has a major impact on individuals, families, and communities. The effects of substance abuse are cumulative, significantly contributing to costly social, physical, mental, and public health problems. There are five main causes of teen drug use:

1. **Peer pressure:** One of the main causes of teen drug use is the pressure they feel from friends and even family members.
2. **Social media:** Many friends and family members show pictures of using substances on social media.
3. The Influence of culture and society
4. Curiosity
5. The desire to be themselves

ACTIVITY 4.11 (ROLE PLAY)

Show that a girl/boy discouraging another from joining a group of peers who take alcohol to avoid risky situations against early sex.

Alcohol and Drug Abuse: Prevention and Control

Young and adolescent minds could be molded in any direction depending on the kind of exposure they get. They might befriend abusers and get into the habit of drinking, smoking or taking drugs. At this point in time,

it is the responsibility of the parents as well as the teachers to handle the issue sensitively and guide them in the right direction.

Here are certain measures which need to be taken to prevent and control alcohol and drug abuse:

- In the society, the youth are often pushed beyond their limits to excel in every field. Parents want their kids to outperform their peer in studies, sports, creativity, and every other activity. Under excess pressure, the child often has the tendency to take up alcohol and drugs as a resort.
- Persistent counseling is required to teach the child to deal with failures, pressures, stress, and disappointments. In fact, guiding them towards productive activities such as music, painting, yoga, sports or one of their hobbies could also help.
- Children often pick up habits from their closed ones. Thus, the attitude of parents and older siblings towards alcohol, cigarettes, and drugs also affect the child's choices.
- In case the child is stressed out and on the verge of abuse, help must be sought from parents or even trusted friends who may guide them in the right direction, thereby helping him vent out their anxiety and guilt.

4.7.5 Role of Youth in Stopping Substance Abuse

Youth are good sources of information and can proactively participate in any awareness programs.

- Youth today plays an important role in society. They are capable of contributing greatly to society with their own perspectives and experiences and participation.
- Youth encounters difficulties as they develop in a dynamic world that constantly presents them with new learning opportunities.
- They need to build their own distinct identities while still making sense of this shifting world.
- They must make tough decisions about drugs, alcohol, and other substances during adolescence, and sometimes respond by experimenting or by disobeying conventional authorities.
- Youth communicate with each other in a way that most adults find challenging to understand. A friend can easily convince others to quit drugs.

- People may voice their ideas and personal experiences on the dangers of drugs by participating. These discussions may succeed in bringing up relevant issues and maybe help to resolve them.

ACTIVITY 4.12

- Draw on posters, write poems, compose songs, prepare speeches, plan a peaceful demonstration, and plan a radio interview against drug abuse and School Based Violence. You may involve the other young people in the school.
- Fill the school with activities and drawings and writings against drug abuse and School Based Violence.
- Organize a hot line, where victims can call for help and advice. You may involve the local NGOs like National Rehabilitation for Drugs and War Affected Persons (NARDWAP) and Liberians United Against Drug Abuse (LUADA).



KEY GLOSSARY

- **Abstinence:** A method that involves complete abstinence from sex.
- **Abused drug:** A substance that modifies the biological, psychological or social behavior of a person by stimulating, depressing or distorting the functions of the body and the mind
- **Cell cycle:** an ordered series of events required for the faithful duplication of one eukaryotic cell into two genetically identical daughter cells.
- **Cell division:** A process by which a parent cell divides into two or more daughter cells.
- **Conjugation:** It is a simplest sexual mode of reproduction that occurs in lower organisms.
- **Fertilization:** The fusion of male gamete with the female gamete.
- **Fission:** The simplest type of asexual reproduction in which a single unicellular organism splits into two or more daughter cells.
- **Gonads:** The primary reproductive organs are the testes in the male and the ovaries in the female.
- **Infertility:** A disease of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse.

- **Interphase:** A resting phase of cell division in which the cell grows to its maximum size by increase in volume of nucleus and nucleolus.
- **Karyokinesis:** The division of nucleus during cell division.
- **Meiosis:** The cell division during which the number of chromosomes is reduced to half.
- **Mitosis:** A kind of cell division which leads to growth and repair of the body.
- **Stem cells:** Special human cells that have the ability to develop into many different cell types, from muscle cells to brain cells.

SUMMARY

- Cell division is essential for growth, replacement of old cells, repair of injured cells and reproduction of living organisms.
- Interphase is also called the resting phase because no change in chromosomes occur in this phase. It has three distinct phases— G_1 phase, S phase and G_2 phase.
- There are two major types of cell divisions—mitosis and meiosis.
- Mitosis is an equational cell division which leads to growth, repair and replacement in the body. It generally occurs in the somatic or body cells.
- Karyokinesis of mitosis includes mainly four phases, namely, prophase, metaphase, anaphase and telophase.
- Meiosis is the cell division during which the number of chromosomes is reduced to half. It takes place in the gonads. It is essential for sexual reproduction and for the formation of new gametes.
- Parents play a significant role in the sexual development and behavior of their children. Parental monitoring and supervision are important aspects for keeping adolescents from risky situations and activities while the teen develops responsible decision-making skills.
- Sexual and reproductive health and rights or SRHR is the concept of human rights applied to sexuality and reproduction. It is a combination of four fields such as, sexual health, sexual rights, reproductive health and reproductive rights.
- Infertility is a disease of the male or female reproductive system defined by the failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse. It affects millions of people of reproductive age worldwide –and has an impact on their families and communities.

- The human sexual response cycle is a four-stage model of physiological responses to sexual stimulation.
- Clinically known as substance use disorder, drug abuse or addiction is caused by the habitual taking of addictive substances. Drugs include alcohol, marijuana, hallucinogens and opioids. Substance use disorder is a disease, causing people to compulsively use drugs despite consequences.



EXERCISE

A. Multiple Choice Questions

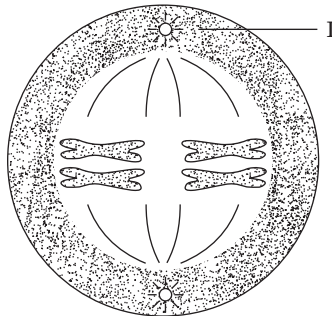
1. Select the correct statement about G_1 phase.
 - (a) DNA in the cell does not replicate.
 - (b) Cell is metabolically active.
 - (c) Cell stops growing.
 - (d) It is a larger growth phase for the cell.
2. In mitosis, cell division occurs in

(a) germ cells	(b) somatic cells
(c) roots only	(d) shoots only
3. The first stage of cell division is called

(a) prophase	(b) interphase
(c) metaphase	(d) Anaphase
4. Meiosis occurs in the

(a) gonads	(b) brain
(c) kidneys	(d) liver

The diagram below is an illustration of a stage in a biological process. Study it and answer questions 5 and 6.



5. What stage of cell division is illustrated in the diagram?
 - (a) Prophase
 - (b) Metaphase
 - (c) Anaphase
 - (d) Telophase
6. The part labelled I is the
 - (a) Centromere
 - (b) Spindle fibre
 - (c) Centriole
 - (d) Chiasmata
7. A method of vegetative propagation in which a part of a plant is cut and planted in the soil to form a new plant is called
 - (a) Marcotting
 - (b) Layering
 - (c) Cutting grafting
8. The evolution of meiosis and sexual reproduction led to the tremendous explosion of diversity among the
 - (a) Eukaryotes
 - (b) Prokaryotes
 - (c) Viruses
 - (d) Bacteria
9. New individuals produced are genetically identical to the single parent in
 - (a) Sexual reproduction
 - (b) Asexual reproduction
 - (c) Conjugation
 - (d) Fertilization
10. A type of reproduction found in Spirogyra is
 - (a) Spore formation
 - (b) Fragmentation
 - (c) Budding
 - (d) Fission
11. The male and female gametes are formed as a result of
 - (a) Mitosis
 - (b) Meiosis
 - (c) Either mitosis or meiosis
 - (d) None of them
12. The zygote is the future foetus which is _____ in nature.
 - (a) Haploid
 - (b) Diploid
 - (c) Triploid
 - (d) Tetraploid
13. Parents can support their child's healthy development by:
 - (a) Following the child's responding in a predictable way
 - (b) Showing warmth and sensitivity towards their children
 - (c) Having routines and household rules
 - (d) All of them
14. Children in teen age show
 - (a) Spend less time with parents and more time with friends.
 - (b) Spend more time with parents and less time with friends.
 - (c) They never spend their time with family and friends
 - (d) They spend most of their time with the family

15. Which of the following contribute to teenage parenting failure?
(a) low income
(b) ignorance of child rearing and child development
(c) stress that comes with adolescence
(d) All of them
16. The natural method to avoid unplanned pregnancies is called
(a) Laparoscopy (b) Tubectomy
(c) Vasectomy (d) Abstinence
17. The term reproductive health refers to
(a) Unhealthy reproductive organs with normal functions.
(b) Healthy reproductive organs with abnormal functions.
(c) Healthy reproductive organs with normal functions.
(d) Unhealthy reproductive organs with abnormal functions.
18. Which of the following are the causes of infertility in human females?
(a) Tubal disorders
(b) Uterine disorders
(c) Disorders of ovaries
(d) All of them
19. In menstrual cycle, the follicle cells start to produce egg in
(a) Ovulatory phase
(b) Follicular phase
(c) Luteal phase
(d) Menstrual phase
20. What are the common features of drugs abused by addicts?
(a) They are used without a physician prescription.
(b) They are to be taken frequently and regularly.
(c) They are habituating substances.
(d) All of them

B. Fill in the blanks.

1. In _____, the daughter cells are different from the parent cells.
2. The division of nucleus is called _____.
3. During _____, the chromosomes line up on the equator of the spindle.
4. Cutting must include at least a _____ from which growth can occur.
5. The _____ reproduction involves the participation of a single parent.
6. Parents have _____ needs; no single approach is suitable for all parents.

7. One of the responsibilities of parents towards their children is to lift the children according to their _____ values.
8. Parents play a significant role in the _____ development and _____ of their children.
9. Sexual health and reproductive health are sometimes treated as _____ to each other.
10. The uterine wall is shed off in the form of blood and this is called _____.
11. _____ has a major impact on individuals, families, and communities.
12. A person, who takes a drug for a non-medical use, is called _____.

C. True or False.

1. Just before initiating the mitosis, a stage called prophase prepares the cell for division.
2. During G_1 phase cells undergo the major portion of their growth.
3. When a cell has attained its maximum size, it usually splits into half, forming six daughter cells.
4. Haploid cells contain two versions of every gene or double the number of chromosomes.
5. In mitotic cell division, the number of chromosomes in each somatic cell is diploid ($2n$).
6. Meiosis I is the reduction division and meiosis II is similar to mitotic division.
7. During meiosis I, homologous chromosomes move toward opposite poles in anaphase II.
8. Crossing over is a process of exchange of genetic material between the homologous chromosomes.
9. Sexual reproduction is a simplest method of reproduction.
10. In budding, a bulb-like outgrowth called bud develops from the parent body, which grows and finally detached to form a new organism.
11. Conjugation is a simplest sexual mode of reproduction that occurs in lower organisms, e.g. Spirogyra.
12. In higher organisms, male and female gametes are formed in special organs called gonads.
13. People may voice their ideas and personal experiences on the dangers of drugs by participating.
14. A non-persistent counseling is required to teach the child to deal with failures, pressures, stress, and disappointments.

D. Match the following.**Column A**

1. S phase
2. Reduction division
3. Gonads
4. Fertilization
5. Karyokinesis
6. Cytokinesis
7. Crossing over
8. Interphase

Column B

- (a) Meiosis
- (b) Replication of chromosomes
- (c) Fusion of male and female gametes
- (d) Primary reproductive organs
- (e) Division of cytoplasm
- (f) Division of nucleus
- (g) Resting phase of cell division
- (h) Exchange of genetic material between homologous chromosomes

E. Answer the following Questions.

1. Name the type of cell division which occurs in the cells of the reproductive organs.
2. Mention the difference between mitosis and meiosis with reference to:
(a) the number of daughter cells formed at the end of the division,
(b) the chromosome number of the daughter cells formed.
3. What are the basic features of sexual reproduction?
4. Write short notes on the following:
(a) Fission
(b) Budding
(c) Artificial vegetative propagation
5. (a) What is a sexual reproduction?
(b) State the basic features of the sexual reproduction.
6. Why conjugation is called the simplest mode of sexual reproduction?
7. Describe the fertilization with a suitable diagram.
8. State the differences between asexual and sexual reproduction.
9. What are the positive parenting tips for a teenage parent?
10. What are the natural methods to avoid unplanned pregnancies?
11. What qualities does a sexually healthy Teenager have for a relationship with his/her parent?
12. Write short notes on:
(a) Reproductive health
(b) Reproductive rights
13. What are the causes of infertility in human male and human female?
14. What are the effects of alcohol and drug abuse?