S. Chand's

ICSE BIOLOGY

BOOK II
FOR CLASS X

SARITA AGGARWAL

S. CHAND School

Strictly according to the Latest Syllabus for CISCE (Class X) prescribed by the Council for the Indian School Certificate Examinations, New Delhi

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ICSE BIOLOGY

BOOK II

FOR CLASS X

ACCORDING TO THE NEW SYLLABUS

Including Question Paper 2014 (with solved)

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S. CHAND SCHOOL BOOKS

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PREFACE TO THE REVISED EDITION

This edition of ICSE Biology (Book II for Class X) has been revised and upgraded to a bigger size with an attractive two-colour set-up. It has been thoroughly updated in accordance with the latest syllabus prescribed by the Council for the Indian School Certificate Examinations (CISCE), New Delhi for the students of Class X. In this edition, I have made various additions, which the biology students shall find immensely useful as per their latest examination requirements.The salient features of this book are :

- The book is written in a simple lucid language and easy-to-understand style.
- Subject matter (encompassed in the well-etched fifteen chapters) is written in such a way that makes the scientific concepts clear and understandable.
- All the chapters contain new material as per the latest syllabus.
- A totally new chapter on **Pollution** (as per the fresh incorporation in the latest syllabus) has been added to cater to the needs of the students. They shall get comprehensive information on burning topics like greenhouse effect, global warming, ozone depletion, etc.
- Important information has largely been in tabular and point - wise form to provide quick learning and easy grasp of the topic.
- Well-labelled illustrations, diagrams, tables, figures and experiments have been given to support the text wherever necessary.
- At the end of each chapter, **Key Terms** have been given for quick summary of the chapter.
- A variety of **Review Questions**, according to the latest examination pattern, has been provided for adequate practice.
- **Solved Questions from Board Examination Papers** and Miscellaneous Questions form an added attraction. Students shall find highly useful the feature of the latest ICSE Biology Paper of Class X (year 2013). The latest Question Paper (2013) gives a concise idea of the latest style and format of the incorporated sections.

I am thankful to the management and the editorial team of S. Chand & Company Pvt. Ltd. for all help and support in the publication of this book.

Hope this book will meet the aspirations of the students for whom it has largely been written. Suggestions for further improvement, along with constructive criticism, from teachers and students will be gratefully acknowledged. You can send them at the following email id..

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ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my husband and daughters Shruti and Samridhi for their constant support and encouragement shown throughout the preparation of this book. I also wish to extend gratitude to my parents without whose inspiration, this book would not have been possible.

PREFACE TO THE PREVIOUS EDITION

One of the main features of the book is that it has been written by a practising teacher. Since the author has been teaching secondary and senior secondary classes for more than two decades, author is fully aware about the needs of the students. Accordingly, the book is student-centred and examination-oriented.

The author has attempted to visualize herself as a student. The book primarily aims at giving the clarity of concepts. The content in the book is provided in a comprehensive and relevant manner. An effort has been made to cover the syllabus in a way that it caters to the individual differences of the students, the gifted, the good and the average.

Following are some of the special features of the book :

- Language used is very simple and within the easy comprehension of the students.
- Treatment of subject-matter is psychological as well as logical.
- Every possible effort has been made to clarify, elucidate and simplify concepts with the help of diagrams, illustrations and tables.
- The extension boxes contain topics of special interest, the historical aspects, practical techniques, and cover ideas beyond the normal syllabi. This information has been included to give more in-depth knowledge and better understanding of the concepts.

This book provides a complete coverage of the class X syllabus framed by the ICSE.

All healthy criticism and suggestions are welcomed from the teachers as well as students.

Author

NEW SYLLABUS

CLASS X (ICSE)

There will be one paper of one and half-hours duration of 80 Marks and Internal Assessment of Practical Work Carrying 20 Marks.

The paper will be divided into **two** sections, Section I (40 Marks) and Section II (40 marks).

Section I (compulsory) *will contain short answer questions on the entire syllabus.*

Section II *will contain six questions. Candidates will be required to answer any* ***four*** *of these* ***six*** *questions.*

1. Basic Biology

(*i*) Cell Cycle and Cell Division
Cell cycle - **Interphase** (G_1, S, G_2) and M.Phase
Cell Division : Mitosis and its stages. A basic understanding of Meiosis as a reduction division (stages not required). Significance and major differences between mitotic and meiotic division.

(*ii*) Structure of chromosome :
Basic structure of chromosome with elementary understanding of terms such as chromatin, chromatid, chromatid, gene structure of DNA and centromere.

(*iii*) Genetics : Mendel's laws of inheritance and sex linked inheritance of diseases.
Monohybrid cross, dihybrid cross. The following terms to be covered: gene allele, heterozygous, homozygous, dominant, recessive, mutation, variation, phenotype, genotype. Sex determination in human beings.
Sex liked inheritance of diseases to include haemophilia and colour blindness (only criss cross inheritance).

2. Plant Physiology

(i) Absorption by roots, imbibition; diffusion and osmosis; osmotic pressure, root pressure; turgidity and flaccidity; plasmolysis and deplasmolysis; the absorption of water and minerals, active and passive transport (in brief); the importance of root hair.
Characteristics of roots, which make them suitable for absorbing water, should be discussed with the process of absorption. Structure of a single full grown root hair should be explained.

(ii) The rise of water up to the xylem ; a general idea of Cohesive, Adhesive forces and transpiration pull); demonstrated by the use of dyes.
Experiments to show the conduction of water through the xylem should be discussed. Mention of the causative forces must be made for better understanding but as per the syllabus.

(iii) Transpiration, process and significance; experimental work includes the loss in weight of a potted plant of a leafy shoot in a test tube, the use of cobalt chloride paper and the effect of external conditions on the rate of water loss; Ganong's potometer and its limitations should be stressed.
Mechanism of stomatal transpiration must be explained so that concept of the process is clear. Adaptations in plants to reduce transpiration to be discussed. A brief idea of guttation and bleeding should be given.

(iv) Photosynthesis; the nature of the process itself and the great importance of photosynthesis to life in general; experiments to show the necessity of light, carbon dioxide & chlorophyll and also the formation of starch and the output of oxygen; carbon cycle.
The internal structure of chloroplast should be explained to give an idea of the site of light and dark reaction. Opening and closing of stomata should be explained. Teachers should stress upon the importance of a correct balanced chemical equation. The terms "photochemical" for light phase and "biosynthetic" for dark phase must be introduced. In the light reaction, activation of chlorophyll molecule followed by photolysis, release of O_2 formation of ATP and NADPH should be taught. In the dark reaction (detailed equations are not required), only combination of hydrogen released by NADP with CO_2 to form glucose to be discussed. Adaptations in a plant for photosynthesis and experiments with regard to the factors essential for the process should be discussed.

3. Human Anatomy and Physiology

(i) Circulatory System: Main features; the structure and working of the heart, blood vessels, structure and functions of blood and circulation of blood (only names of main blood vessels entering and leaving the heart, liver and kidney will be required).

Composition of blood (Structure and functions of RBC, WBC and platelets). Brief idea of tissue fluid and lymph. Increase in efficiency of mammalian red blood cells due to absence of certain organelles should be explained with reasons. A brief idea of blood coagulation. Structure of vein, artery and capillary should be explained with the help of diagrams to bring out clearly the relationship between their structure and function. ABO blood group system, Rh factor: concept of double circulation ; concept systole and diastole; blood pressure. Reference to portal system should be made. Working of the heart along with names of the main blood vessels entering and leaving the heart , the liver and the kidney must be taught. Examination of a blood smear under a microscope.

(ii) Excretory System: Elementary treatment of the structure and function of the kidneys; the kidneys treated as comprising cortex and medulla and consisting of a branched system of tubules well supplied with blood vessels leading to the ureter (details of the courses of the tubules and their blood vessels not required).

External and internal structure of the kidney; parts of the excretory system along with the blood vessels entering and leaving it should be taught with the help of charts or models. Students should be able to draw the diagrams with correct labelling and know the functions of various parts. A general idea of the structure of a kidney tubule nephron should be given. A brief idea of ultra filtration, selective reabsorption and tubular secretion in relation to the composition of blood plasma and urine formed.

(iii) Nervous System : Structure of Neuron: central, autonomous and peripheral nervous system (in brief); brain and spinal cord: reflex action and how it differs from voluntary reflex.

Sense organs - Eye and ear: Eye defects and corrective measures (myopia, hypermetropia, presbiopia, astigmatism and cataract).

Various parts of the external structure of the brain and its parts (Medulla Oblongata, Cerebrum, Cerebellum, Thalamus, Hypothalamus) and their functions; reference should be made to the distribution of white and gray matter internally. Diagrammatic explanation of the reflex arc, showing the pathway from receptor to effector, differences between natural and acquired reflex should be taught. Structure and function of the Eye and Ear and their various parts. The external and V.S of the eye must be taught with a brief idea of stereoscopic vision. The course of perception of sound in human ear. Role of ear in maintaining balance.

(iv) Endocrine System: General study of the following glands ; Adrenal, Pancreas, Thyroid and Pituitary. Difference in Endocrine and Exocrine glands.

Correct location and shape of the gland in the human body should be discussed along with the hormones they secrete (Pancreas; insulin and glucagon to be taught; Thyroid: only thyroxin to be taught). Effects of hyposecretion and hyper secretion of hormones must be discussed. The term tropic hormones should be explained in the study of pituitary. Brief idea of feedback mechanism must be given.

(v) Reproductive System: Organs, fertilisation and a general outline of nutrition and respiration of the embryo. (Menstrual cycle: outline of menstrual cycle.

Functions of organs and accessory glands must be discussed. An idea of secondary sexual characters, structure and functions of the various parts of the sperm and an egg. Fertilization, implantation, placenta, foetal membranes, gestation and parturition, identical and fraternal twins to be explained briefly.

(vi) Population: Problems posed by the increase in population in India; population control.

Main reasons for the sharp rise in human population India and in the world. The terms demography, population density, birth rate, death rate and growth rate of population should be explained. With population growth, increased consumption and urbanization, there is a need to keep a check on demands of urban areas over rural areas, of exploitative use of resources rather than sustainable use. Methods of population control to be taught.

4. Physical Health and Hygiene

(*i*) Aids to health : an understanding of the use and action of the following - vaccination; immunisation; antitoxin; serum; antiseptics; disinfectants; penicillin; sulphonamide drugs; First Aid.
An idea of local defense system and their merits, active and passive immunity, difference between antiseptics and disinfectants to be discussed. Basic principles of first aid to be taught.

(ii) Health organisations: Red Cross, WHO; common health problems in India.
Major activities of Red Cross and WHO should be discussed. Common health problems in India.

5. Pollution

(*i*) Types of pollution air, water, (fresh and marine) soil, radiation and noise.
Sell explanatory

(ii) Sources of pollution and major pollutants
Air : Vehicular, Industrial, burning gas, huge brick kilns.
Water: Household detergents. Sewage, industrial waste, oil spills, thermal pollution.
Soil : Industrial waste, urban commercial and domestic waste, chemical fertilisers. biomedical waste, like needles, Syringes, soiled dressings etc. biodegradable waste, like paper, vegetable peels etc. Non biodegradable waste like plastics, glass, Styrofoam etc: Pesticides like DDT etc.
Radiation : X-rays, radioactive fallout from nuclear plants.

(iii) Effects of pollution on climate, environment. human health and other organisms and its abatement.
Greenhouse effect and global warming. Acid rain. Ozone layer depletion.
Meaning of the terms, causes, effect on life on earth, idea about setting standards– EuroBharat Stage vehicular standards.

INTERNAL ASSESSMENT OF PRACTICAL WORK

The practical work will be designed to test the ability of the candidates to make accurate observation from specimens of plants and animals. For this, the candidates should be familiar with the use of a hand lens of not less than x6 magnification. Candidates should be trained to make simple and accurate drawings and brief notes as a means of recording their observations.
The practical examiners will assume that candidates would have carried out the practical work outline below.

PLANT LIFE

(*i*) Observation of permanent slides of mitosis. Self-explanatory.

(*ii*) Experiments indicating osmosis, diffusion and absorption.
The teacher should give a demonstration and then the students should perform the experiments in order to have a better understanding of the processes.

(*iii*) Physiological experiments on transpiration to be set up by the teacher and the pupils to identify the products, draw and label the apparatus.
The teacher should set up the experiment stepwise so that the student gets a clear idea of the aim, apparatus, procedure and result of the experiment. For transpiration experiments, the $CoCl_2$ paper should be kept in a dessicator and its importance should be explained. Limitations for the use of Ganong's potometer should be given.

(*iv*) Experiments to show the necessity of light, carbon dioxide and chlorophyll essential for photosynthesis; release of O_2 during photosynthesis. Candidates to write down their observation and draw and label the apparatus.
Importance of destarching the plant before the experiment should be discussed. Diagrams should be drawn with the correct labelling. Pupils should be able to analyse the result.

ANIMAL LIFE

(i) Identification of the structure of the urinary system, heart (internal structure) and brain (external view) through models and charts

(ii) The identification of different types of blood cells under a microscope.
Different types of WBCs should be observed. Teacher should point out the differences between red blood cells and white blood cells. Ratio of red blood cells to white blood cells should be discussed.

(iii) The structure of the Ear and an Eye (candidates will be required to identify each structure in the models of these organs).
Models should be shown and students should draw correct labelled diagrams.

(iv) Identification and location of selected endocrine glands (Adrenal, Pancreas, Thyroid and Pituitary glands) with the help of a model or chart.
Correct labelled diagram to be drawn.

(v) Compiling material for a First Aid box.
Self- explanatory.

EVALUATION

The practical work/project work are to be evaluated by the subject teacher and by and External Examiner. (The External Examiner may be a teacher nominated by the Head of the school, who could be from the faculty, **but not teaching the subject in the relevant section/class.** For example, a teacher of Biology of Class VIII may be deputed to be an External Examiner for Class X, Biology projects.)

The Internal Examiner and the External Examiner will assess the practical work/project work independently.

Award of marks (20 Marks)

Subject Teacher (Internal Examiner)	10 marks
External Examiner	10 marks

The total marks obtained out of 20 are to be sent to the Council by the Head of the school.

The Head of the school will be responsible for the entry of marks on the mark sheets provided by the Council.

CONTENTS

CHAPTER

1

Cell Cycle and Cell Division

The cell theory by Schleiden and Schwann not only explains the cell as a basic unit of life but also that all cells come from pre-existing cells. All organisms, multicellular and unicellular, start as a single cell (zygote in sexual reproduction). This cell divides again and again and after cell differentiation forms an organism. A cell cannot live forever. The continuity of life depends on cell division. Cell can undergo two kinds of division.

(*i*) Mitosis

(*ii*) Meiosis

There are two major events which occur both in mitosis and meiosis. These are:

(*i*) The divisions of nuclear material called **karyokinesis**, and

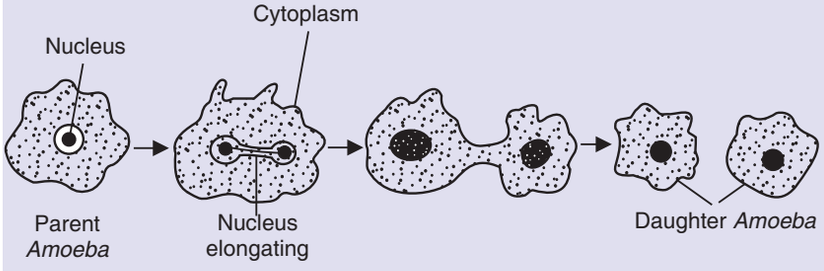
(*ii*) The division of cytoplasm called **cytokinesis**.

Mitosis retains the same number of chromosomes in daughter cells and results in the multiplication of cells while meiosis halves the number of chromosomes in the daughter cells and results in the formation of gametes.

AMITOSIS

Amitosis is a simple division also called as **direct cell division**. Amitosis is most common in certain lower algae, fungi and some protozoans (like *Amoeba*) and certain old cells in higher plants.

- During amitosis the nucleus simply elongates and then undergoes a constriction, dividing into two daughter nuclei without any differentiation of chromosomes or spindle formation.
- The nuclei during amitosis may or may not be of equal sizes.



LEARNING OBJECTIVES

Syllabus: *Cell cycle – Interphase (G_1, S, G_2) and M phase.*

Cell Division: Mitosis and its stages. A basic understanding of Meiosis as a reduction division (stages not required). Significance and major differences between mitotic and meiotic division.

1.1 SOME IMPORTANT TERMS RELATED TO CELL DIVISION

1.2 CELL CYCLE

1. Interphase (G_1, S, G_2) phases)
2. Mitotic Phase (M)
3. Cytokinesis(C)

1.3 MITOSIS

1. Important features of mitosis
2. Various stages of mitosis
3. Significance of mitosis

Activity: *To study various stages of mitosis in onion root tips.*

1.4 MEIOSIS

1. Important features of meiosis
2. Various stages of meiosis
   - Meiosis I
   - Meiosis II
3. Significance of meiosis

1.1 SOME IMPORTANT TERMS RELATED TO CELL DIVISION

1. **Diploid** (2*n*). It means having **two sets** of chromosomes which are referred as homologous.

   — A cell that contains two sets of chromosomes is said to be a diploid cell. For example, human body cells are diploid in nature. Also body cells of all higher animals and plants are diploid.

   — It is represented by letter 2*n*.

   A diploid cell has 2n number of chromosomes.

   This number remains constant for a species, for example, cells of human beings have 46 chromosomes, that of onion have 16, garden pea 14 and so on.

2. **Haploid** (*n*): It refers to having only one set of chromosomes.

   — The *gametes* (egg cell and sperms) of all organisms (plants and animals) are haploid in nature.

   — It is represented by letter (*n*)

   — *A haploid cell has n number of chromosomes.*

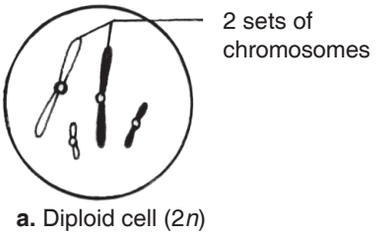
   In sexually reproducing organisms, all the body cells are diploid except gametes. Gametes are formed by meiosis. During meiosis a diploid cell undergoes two successive divisions to produce haploid gametes.

3. **Homologous chromosomes:** It refers to a pair of chromosomes in a diploid cell that are exactly similar in shape and size and have the centromere at the same location. They have genes for the same traits throughout their length. In each pair, one of the chromosomes is inherited from the mother by the egg cell and one from the father by the sperm cell. A human cell has 23 pairs of homologous chromosomes.

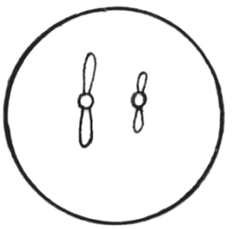
4. **Centromere:** It is a constricted region of a chromosome. During cell division, a chromosome consists of two chromatids. The two chromatids of a chromosome are attached at the centromere.

— Also chromosomes are attached to the spindle fibres at the centromere.

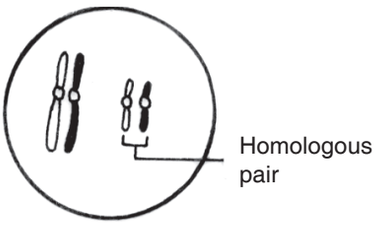
5. **Chromatid:** One of the two identical parts of a chromosome after its duplication. During cell division, two chromatids make up a chromosome.



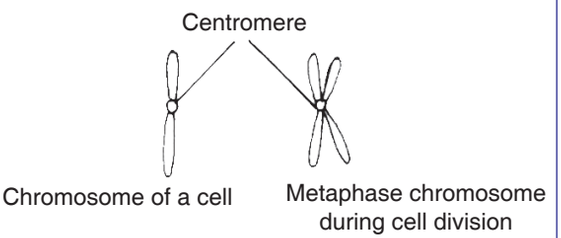
a. Diploid cell (2*n*)



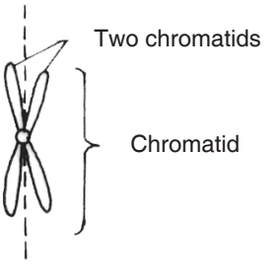
b. Haploid cell (*n*)



c. Homologous pairs in a diploid cell



d. Centromere in chromosome



e. Two chromatids in a metaphase chromosome

Fig. 1.1 Figures a to e explain the important terms

1.2 CELL CYCLE

All cells go through a basic life cycle. They may vary in the amount of time they spend in different stages. Bacteria divide once in every 20 minutes, Epithelial cells every 8-10 minutes and onion root tip cells every 20 hours. There are three main stages (Fig. 1.2) in a cell cycle.

(*i*) Interphase
(*ii*) M phase or Karyokineses
(*iii*) Cytokinesis (C)

Out of 18-20 hours that a cell takes to divide in the tissue culture, it remains for one hour only in the mitosis phase. Given below are the stages common to animal and plant cells, but are being described with reference to animal cells. *Plant cells do not have centriole*, hence except that and a few changes during cytokinesis, rest all the stages are the same.

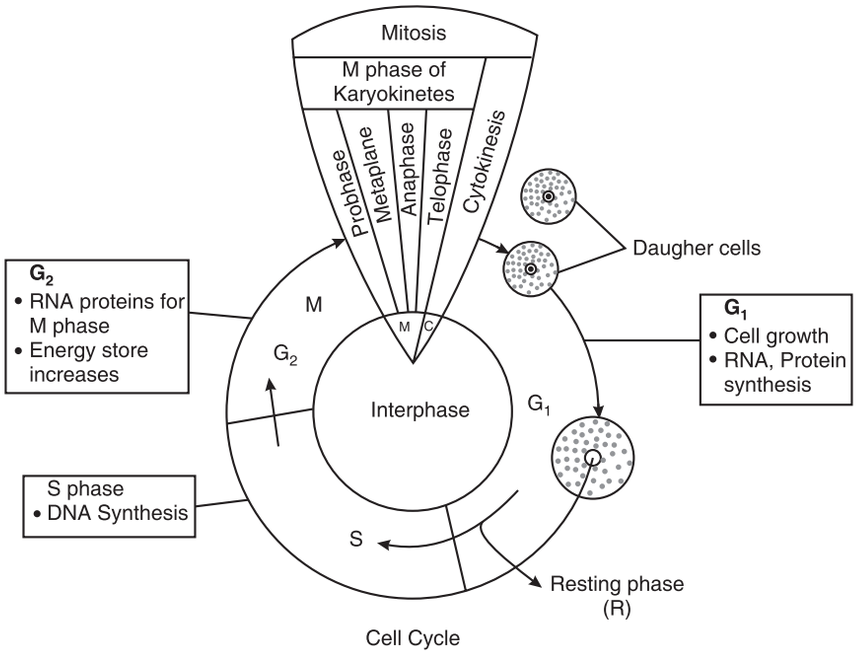


Fig.1.2 Cell cycle showing Interphase, M and C phases

1. Interphase

It is a **very active** *phase* in the cell cycle in which DNA is duplicated. Though the cell looks to be restive, physiologically it is the very active stage. It is a preparatory phase in which number of molecules needed for M phase or division of cell are synthesised. It is further divided into three stages.

(*i*) **G_1 phase or Gap one:** Cell grows in size and RNA, proteins and enzymes needed for next phase are synthesised.
(*ii*) **S phase or Synthetic phase:** DNA synthesis takes place.
(*iii*) **G_2 phase or Gap two:** Spindle and aster rays are formed.
(There is no DNA synthesis during G_1 and G_2)

G_1 Phase– (*i*) First growth phase. **Cell grows** in size. Cytoplasm of cell increases.
(*ii*) Mitochondria, chloroplasts (plants), lysosomes, endoplasmic reticulum, Golgi complex, vacuoles and vesicles are produced.
(*iii*) Structural and *functional proteins* are formed.
(*iv*) Nucleolus produces r RNA, m RNA and t RNA.
(*v*) Ribosomes are synthesised.
(*vi*) Metabolic rate of the cell becomes very high.

At this stage one of the two paths is taken up by the cells
Some cells withdraw and go to resting phase (R) and others continue to divide and proceed to the next S-phase.

S – Phase– (*i*) **Replication of DNA** takes place. Chromosomes are duplicated.
(*ii*) Protein molecules called histones are synthesised that cover each strand of DNA
(*iii*) Each chromosome is in the form of two chromatids.

G_2 – Phase– (*i*) Second growth phase in which synthesis of RNA and proteins continues.
(*ii*) *Centriole* replicates. Plant cells do not have centriole.

(*iii*) Mitotic spindle begins to form.
(*iv*) *Energy store* increases.
(*v*) Increased metabolic state.

2. M Phase or Karyokinesis

Technically it is a precise division of nuclear material especially of chromosomes i.e., karyokinesis. There is equal division of genes and DNA of daughter cells is identical to the mother cell.

Nuclear division occurs in four distinct stages, Prophase, Metaphase, Anaphase and Telophase

3. Cytokinesis (C)

After the M phase or karyokinesis, the cytoplasm is ready to divide. This is referred as *cytoplasmic division* or *cytokinesis*. In this phase the cytoplasm divides, dividing a cell into two daughter cells. The cell membrane divides the cell organelles and the cytoplasm in a way that the daughter cells formed are identical in all aspects.

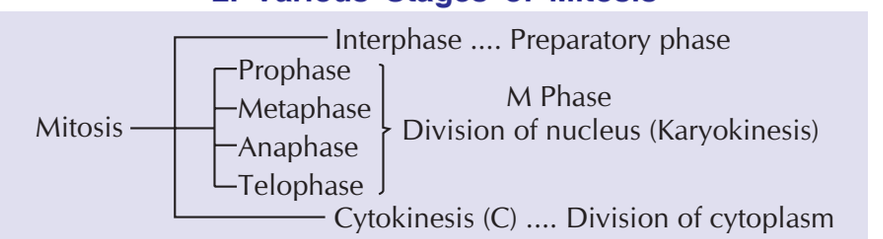
There is an equal distribution of cytoplasm and organelles into each daughter cell.

1.3 MITOSIS

1. Important features of mitosis

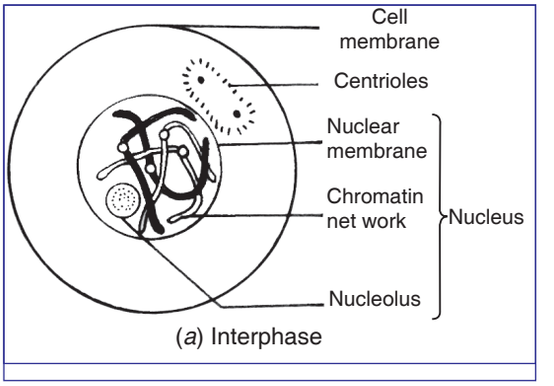
(*i*) It occurs in **somatic cells or all body cells** except germ cells.
(*ii*) A cell nucleus divides to produce **two daughter nuclei** which contain identical sets of chromosomes as in parent cell.
(*iii*) It is followed by an equal division of cytoplasm.
(*iv*) It results in **an increase in number of cells.**
(*v*) It helps in growth, **replacement** and **repair** of cells and is a method of asexual reproduction in some (unicellular organisms.
(*vi*) It is divided into four phases (Fig. 1.2) :
(a) Prophase (b) Metaphase (c) Anaphase (d) Telophase
(*vii*) Just before the division of the cell, the cell prepares for the change. This is known as the **interphase**. After interphase the nucleus passes through the above four phases.

2. Various Stages of Mitosis



Interphase

1. Physiologically the most *active* stage, though the cell looks to be in a resting stage.
2. Chromosomes are in the form of fine thread-like structures, hence they appear as a **chromatin network.**
3. Chromosomes undergo **duplication** *i.e.* make exact copies of themselves.
Now each chromosome is in the form of a pair of chromatids (the chromatids of a chromosome are not visible).



(*a*) Interphase

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