As per New Revised Syllabus of
SHIVAJI UNIVERSITY KOLHAPUR, KOLHAPUR
AND SOLAPUR UNIVERSITY, SOLAPUR

A TEXT BOOK OF

CELL BIOLOGY AND GENETICS

B.Sc. PART-I : ZOOLOGY (PAPER-II) : SEMESTER-I

PRIN. Dr. KISHORE R. PAWAR
Dr. L. B. DAMA
Dr. ASHOK E. DESAI
Dr. R. N. PATIL

NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

As Per New Revised Syllabus of Shivaji University, Kolhapur and Solapur University, Solapur

A Text Book of...

CELL BIOLOGY & GENETICS

For

B.Sc. ZOOLOGY (Paper - II)

Semester – I

By

DR. KISHORE PAWAR
(M.Sc. Ph.D)
Formerly Principal
Karmveer Shantarambapu Kondaji Wavare, Arts, Sci. & Com. College, CIDCO,
NASHIK – 422008.

DR. ASHOK E. DESAI
(M.Sc. Ph.D.)
Reader in Zoology, P.G. Deptt. of Zoology, K.T.H.M. College,
NASHIK – 422002.

DR. DAMA L. B.
(M.Sc. Ph.D)
D.B.F. Dayanand College of Arts & Science, Solapur
Dist. SOLAPUR.

DR. PATIL R. N.
(M.Sc. Ph.D)
Head, P.G. Department of Zoology and Chairman BOS, Shivaji University,
SGM College Karad,
Dist. SATARA.

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Dedication ...

This Book is Dedicated to
Our Students Who Love
Subject Zoology

Authors...

PREFACE

The authors are indeed very happy to present this book **'A Text Book of Cell Biology & Genetics'** for the students of B.Sc. Part I Zoology Paper II, Semester I of Shivaji and Solapur University.

The book has been written according to the new revised syllabus. Board of Studies of Zoology has thoroughly revised the syllabus which has been designed with the topic of Cell Biology and Genetic.

There was a long felt need of the students as well as teachers community for a text book which covers the entire syllabus prescribed by Board of studies. The present book is an outcome of our sincere efforts. We tried our level best to present the subject matter in easy style and in a comprehensive manner. The text book is profusely illustrated with number of clear line drawings.

No doubt, there are several textbooks written by Indian and foreign authors on the subject, but they are costly and number of copies are very limited in the college libraries. The students can not get the matter on prescribed syllabus in one book and they also cannot afford the costly books. Therefore, we have presented all the topics in one book in a low price. We sincerely feel that this book will fulfill the requirements of students and teachers.

We are thankful to Shri. Dineshbhai Furia, Shri. Jignesh Furia, Shri. M.P. Munde and the entire staff of Nirali Prakashan for taking keen interest in publishing this book and bringing out in time.

Constructive suggestions for improvement of the book are most welcome.

Authors

SYLLABUS

(SHIVAJI UNIVERSITY)

B.Sc. PART-I, SEMESTER-I

PAPER – II : CELL BIOLOGY AND GENETICS

UNIT – I : Cell Biology

1. Study of principles & applications of light and electron microscope (2)
2. General organization of Prokaryotic & Eukaryotic cell (2)
3. Nucleus with reference to Nuclear membrane, Nucleoplasm, Chromatin and nucleolus. (2)
4. Chromosome with reference to morphology and organization (solenoid model) (2)
5. Polytene Chromosome-structure and significance. (2)

UNIT – II : Cell Biology

Ultra structure and functions of the following.

(i) Plasma membrane (Fluid Mosaic Model) (2)
(ii) Mitochondria (2)
(iii) Endoplasmic reticulum (2)
(iv) Ribosomes (2)
(v) Golgi complex (2)
(vi) Lysosome (2)
(vii) Cytoskeleton - Microtubules & microfilaments (2)

UNIT – III : Genetics

1. Mendelian Principles (8)
   (a) Principle of unit characters
   (b) Principle of dominance (Monohybrid cross)
   (c) Principle of segregation (Monohybrid cross)
   (d) Principle of independent assortment (Dihybrid cross)

UNIT – IV : Genetics

1. Co-dominance and Incomplete Dominance (3)
2. Multiple alleles - Coat colour in Rabbit and ABO blood group system (3)
3. Human genetics (4)
   (a) Phenylketonuria
   (b) Sickle cell anaemia

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SYLLABUS

(SOLAPUR UNIVERSITY)

B.Sc. PART-I, SEMESTER-I

PAPER – II : CELL BIOLOGY AND GENETICS

1) Compound and Electron microscope : Principle and applications. (2)
2) Ultrastructure of Prokaryotic and Eukaryotic cells. (2)
3) Study of Nucleus with reference to Nuclear membrane, Nucleoplasm, Chromatin and nucleolus. (3)
4) Study of Ultra structure and functions of the following: (12)
   (i) Plasma membrane (Fluid mosaic model)
   (ii) Mitochondria
   (iii) Endoplasmic reticulum
   (iv) Golgi complex
   (v) Lysosome
   (vi) Ribosomes
   (vii) Giant chromosomes and lamp brush chromosome
5) Mendelian inheritance : Law of dominance, segregation and independent assortment with suitable examples. (3)
6) Study of Co-dominance and incomplete dominance with suitable examples (2)
7) Multiple alleles – Characterstics, ABO - Blood group system & Rh factor and Coat colour in rabbit (3)
8) Sex determination : Chromosomal theory of sex determination,
   XO, XY, ZW, Environmental and Hormonal methods of sex determination. (4)
9) Human genetics (4)
   (a) Phenylketonuria (PKU)
   (b) Sickle cell anemia

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UNIT 1...

Microscopy, Nucleus and Chromosomes

Contents ...

1.1 Methods in Cell Biology

The word microscope is derived from two Greek words, **'micro'** = small and **'scope'** = to view. Thus, microscope is an instrument designed for visual examination of small object which can not be examined by the naked eye. There are different types of microscopes such as Simple, Compound, Phase-contrast and Electron microscope. The study of different microscopes is called *microscopy*.

The earliest recorded use of magnifying lens goes back to **Conrad Gesber** (1558), a Swiss biologist who published work on the structures of *foraminiferans* (Protozoans). It was **Zacharias Janssen**, a Dutch Astronomer, who in 1590 added another lens to the telescope and thus provided for the first time a prototype of the present day telescope and the compound microscope.

Anton Van Leeuwenhoek (1674), the father of biology, was the first to use the microscope for biological studies. The compound microscope was constructed by **Robert Hooke** (1665) and the forerunner of the present day compound microscope.

1.1.1 Light Microscopy

1.1.1.1 Simple Microscope

The simple microscope is commonly used in the laboratory which is nothing but a magnifying glass. It is used when very small animal have to be dissected, or for magnification of the parts in the sections or of small organisms which are not seen by naked eye. The simple microscope is made up of two parts (1) Viewing or optical part and (2) Mechanical part.

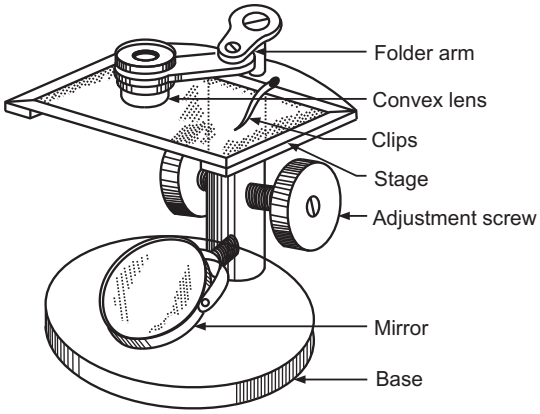

Fig. 1.1 : Simple Microscope

Optical part consists of single convex lens. Whereas the mechanical part hold the lens in the proper position. With the help of knob proper magnification can be obtained. Mirror is present for light and clips for holding the slide.

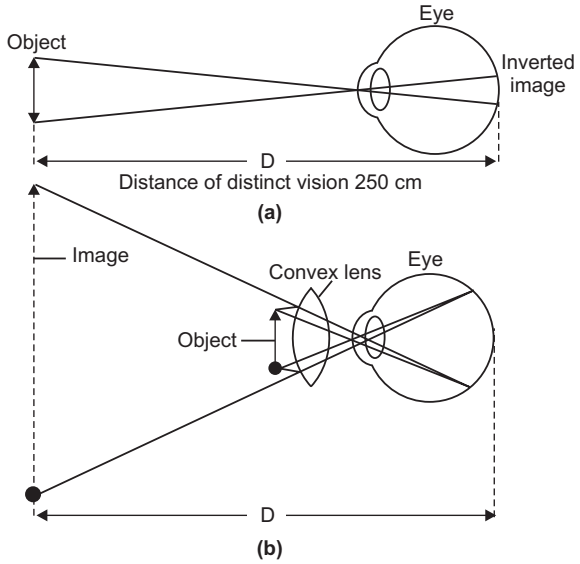

Fig. 1.2 : (a) Perception of an Object by the Human eye at a Distance of Distinct Vision

(b) Perception of an Object through a Simple Convex Lens. Which Produce a Magnified Image at the Distance of Distinct Vision

A simple microscope consists of single lens or a combination of lenses which functions as convex lens. A convex lens magnifies the object and helps to produce a magnified image of a near object which appears to be at the distance of distinct vision. The enlarge image is formed on the retina. It show details which cannot be seen by naked eye. The magnification obtained with a convex lens can be easily calculated by the following formula.

$$M = \frac{250 + 1}{f}$$

Where, f is the focal length of the lens in centimetres and 250 is distance of the distinct vision in centimetres. The magnification that can be obtained with a simple lens cannot exceed three times (3 × magnification). However, magnification more than 3 × 6 can be achieved by using a combination of several lenses. The combination of several lenses fused together acts as a single convex lens. The lenses fused together one called elements. Each element cancels out the distortions and defects produced by the other element. The net result of the combination is the formation of an image free from distortions. A magnification of about 20 times can be obtained. Such microscopes are used by biologists for smaller magnification during field work. It consists of a combination of double concave lens of crown glass fitted between two double convex lenses of flint glass. This is called an achromatic triplet or a planner lens. The three lenses are one cemented together and function as one lens.

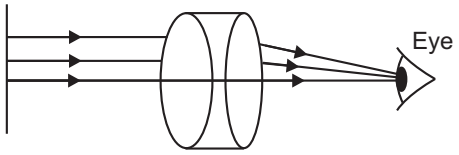

Fig. 1.3 : An Achromatic Triple or a Planner Lens Showing the Path of Light Rays while Functioning as a Magnifier

1.1.3 Compound Microscope

A microscope magnifies the image of an object. The modern compound microscope which is also called light microscope, is most important optical instrument for the study of cells and tissues. It is

important apparatus in a medical laboratory. It is a precision instrument and needs careful handling. Improper use of the microscope leads to the loss of clarity of the image.

The light microscope uses white light, either the external sunlight or the internal tungsten filament lamp, as a source of illumination. While observing under microscope, the objects either look dark or coloured, contrasted against a lighted background.

The Microscope and its Accessories :

Accessories or components of commonly used light monocular microscope is shown in Fig. 3.5. All the components of monocular and binocular microscopes are the same except that the binocular microscope has two eye pieces (ocular), which allow the user to keep both eyes while viewing through the microscope. Both the microscopes have three main systems such as support system, illumination system and magnification system.

I. Support System : It consists of the following parts :

(i) Foot Rest : It is used to hold the microscope while transporting.

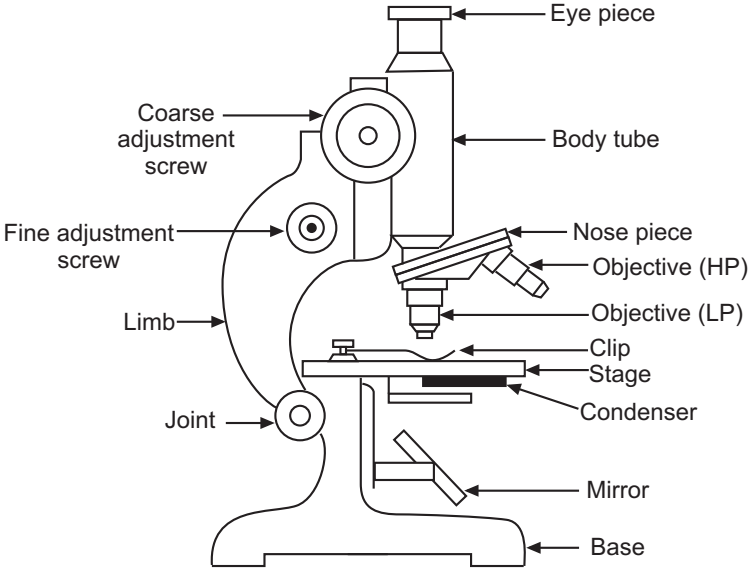

Fig. 1.4 : Microscope

(ii) Tube : It holds the optical system for magnification. It may be straight and fixed (older models), or bent and movable (modern models) for convenient viewing. The tube has eye piece at upper end i.e. near the eye. In case of bent tube, a special prism is put in the middle of the tube where it is bent. The prism directs the light beam coming through the objective lenses towards the eye piece. In binocular microscope, the light beam further shifts and reaches both the eye pieces.

(iii) Stage : It is used to hold the object slide in place for viewing. The stage has central hole for passing the light in order to illuminate the object. The stage can be fixed or a mechanical stage can be screwed on to the fixed stage which can move the object slide across the stage or along the stage, horizontally or vertically. Focusing of optical system can be done either by moving the stage up and down (older models) or by the movement of the limb (modern models). The support system helps to carry the microscope in an upright position with one hand holding the base.

II. Illumination System :

This system provides proper illumination to the object. It consists of the following parts :

(i) The Source of Light : Electric light should be preferably be used, since it is easier to adjust. It is provided by the lamp, placed in front of the microscope. An opaque electric bulb of the daylight type of 60 watts is used. Otherwise, daylight can be used.

(ii) Mirror : The mirror reflect rays from light source on the object. One side has a plane surface and the other side has a concave surface. The concave side forms a low power condenser and is used if there is no condenser.

(iii) The Condenser : The condenser brings the rays of light to a common focus on the object to examined. It is situated between mirror and the stage. It can be raised (maximum illumination) and lowered (minimum illumination). The common type of condenser consists of two or three lenses.

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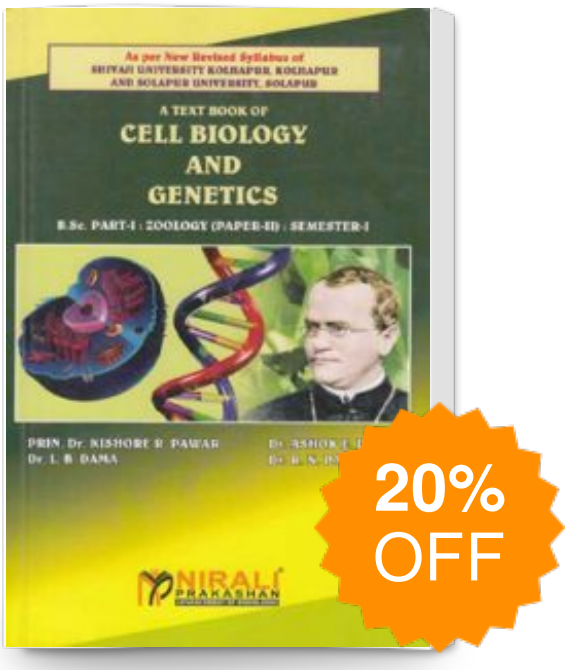

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Author : Dr. Kishore Pawar, Dr. Ashok E. Desai, Dr. Dama L. B., Dr. Patil R. N.