

BIOLOGY (863)

CLASS XII

There will be two papers in the subject:

Paper I: Theory: 3 hours ... 70 marks

Paper II: Practical: 3 hours ... 15 marks

Project Work ... 10 marks

Practical File ... 5 marks

PAPER I- THEORY: 70 Marks

There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.

S. No.	UNIT	TOTAL WEIGHTAGE
1.	Reproduction	16 Marks
2.	Genetics and Evolution	15 Marks
3.	Biology and Human Welfare	14 Marks
4.	Biotechnology and its Applications	10 marks
5.	Ecology and Environment	15 Marks
TOTAL		70 Marks

PAPER I –THEORY – 70 Marks

All structures (internal and external) are required to be taught along with diagrams.

1. Reproduction

(i) Sexual reproduction in flowering plants

Development of male and female gametophytes; pollen-pistil interaction; double fertilization; post fertilization events - development of endosperm and embryo, special modes - apomixis, parthenocarpy, polyembryony.

Pre-fertilisation structures and events.

Structure of microsporangium, T.S. of anther microsporogenesis, structure and development of pollen grain, viability of pollen grain, economic importance of pollen grain. Pistil – structure of megasporangium (L.S. of anatropous ovule), megasporogenesis, structure and development of female gametophyte.

Pollen-pistil interaction in terms of incompatibility/compatibility, events leading to fertilisation, definition of triple fusion and double fertilization. Significance of double fertilization. Apomixis, polyembryony, parthenocarpy to be explained briefly.

Post-fertilisation events - embryo formation (dicot); types of endosperm (cellular, nuclear and helobial); definition of perisperm.

(ii) Human Reproduction

Microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).

Internal structure of testis and ovary to be taught with the help of diagrams; gametogenesis- spermatogenesis (including spermiogenesis and spermiation) oogenesis; hormonal control of gametogenesis, structure

of sperm and mature ovum, menstrual cycle - different phases and hormone action, menarche and menopause, physico-chemical events during fertilisation, implantation, embryonic development up to blastocyst formation, important features of human embryonic development (formation of heart, limbs, digits, appearance of hair on head, eyelashes, separation of eye lids, external genital organs and first movement of foetus with reference to time period) placenta and its functions. Parturition; lactation – hormonal control and importance.

(iii) Reproductive Health

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control - need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies - IVF, ZIFT, GIFT (elementary idea for general awareness).

Definition of reproductive health, programs of reproductive health (family planning, RCH), contraceptive methods and their methods of action (natural-periodic abstinence, withdrawal or coitus interruptus, lactational amenorrhea; artificial – barriers, IUDs, oral pills, implants and surgical methods, definition of medical termination of pregnancy (MTP) and reasons for it; causes of infertility. Amniocentesis and its role in detecting genetic defects. Assisted reproductive technologies: IVF, IUT, ZIFT, ICSI, GIFT, AI, IUI. - definition and application only. Causes, symptoms and methods of prevention of sexually transmitted diseases (gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis- B, AIDS).

2. Genetics and Evolution

(i) Principles of inheritance and variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism - incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosomal theory of inheritance; chromosomes and genes; sex determination - in humans, fruit fly, birds and honey bee; linkage and crossing over; mutation; Mendelian disorders in humans; chromosomal disorders in humans.

*Explanation of the terms heredity and variation; Mendel's Principles of inheritance; reasons for Mendel's success; back cross and test cross, definitions to be taught with simple examples using Punnett square. Incomplete dominance with examples from plants (snapdragon - *Antirrhinum*) and co-dominance in human blood group, multiple alleles - e.g. blood groups, polygenic inheritance with one example of inheritance of skin colour in humans (students should be taught examples from human genetics through pedigree charts. They should be able to interpret the patterns of inheritance by analysis of pedigree chart). Biological importance of Mendelism. Pleiotropy with reference to the example of starch synthesis in pea seeds. Chromosomal theory of inheritance; autosomes and sex chromosomes (sex determination in humans, fruit fly, birds, honey bees and grasshopper), definition and significance of linkage and crossing over. Mutation: spontaneous, induced, gene (point - transition, transversion and frame-shift); chromosomal aberration: euploidy and aneuploidy; human genetic disorders: phenylketonuria, thalassaemia, colour blindness, sickle cell anaemia; chromosomal disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome.*

(ii) Molecular basis of Inheritance

Search for genetic material and DNA as genetic material; structure of DNA and RNA; DNA packaging; DNA replication; central dogma; transcription, genetic code, translation; gene expression and regulation - lac operon; human genome project; DNA fingerprinting.

*Properties of genes such as ability to replicate, chemical stability, mutability and inheritability. Search for DNA as genetic material - Hershey and Chase's experiment, double helical model of DNA (contributions of Meischer, Watson and Crick, Wilkins, Franklin and Chargaff); Differences between DNA and RNA; types of RNA (tRNA, mRNA and rRNA, snRNA, hnRNA); central dogma - concept only; reverse transcription (basic idea only), Meselson and Stahl's experiment, replication of DNA (role of enzymes, namely DNA polymerase and ligase), transcription, essential features of genetic code. Definition of codon. Protein synthesis - translation in prokaryotes. Gene expression in prokaryotes; lac operon in *E. coli*.*

Human Genome Project: goal; methodologies [Expressed Sequence Tags (EST), Sequence Annotation], salient features and applications. DNA finger printing - technique, application and ethical issues to be discussed briefly.

3. Biology and Human Welfare

(i) Human Health and Diseases

Pathogens; parasites causing human diseases (common cold, dengue, chikungunya, pneumonia, malaria, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug abuse.

Communicable and non-communicable diseases; modes of transmission, causative agents, symptoms and prevention; viral diseases (common cold, chikungunya and

dengue), bacterial diseases (pneumonia, diphtheria and plague), protozoal diseases (malaria, graphic outline of life cycle of Plasmodium); fungal (ringworm); cancer - types of tumour (benign, malignant), causes, diagnosis and treatment, characteristics of cancer cells (loss of contact inhibition and metastasis).

Immunity (definition and types – innate and acquired, active and passive, humoral and cell-mediated), Interferons – definition, source and function; structure of a typical antibody molecule, types of antibodies - IgG, IgA, IgM, IgD and IgE (function and occurrence, e.g. in serum, saliva, colostrum); vaccination and immunisation, allergies and allergens – definition and general symptoms of allergies; autoimmunity, primary and secondary lymphoid organs and tissues, brief idea of AIDS – causative agent (HIV), modes of transmission, diagnosis (ELISA), symptoms, replication of retrovirus in the infected human cell (including diagram) and prevention.

Drugs: effects and sources of opioids, cannabinoids, cocaine and barbiturates.

Reasons for addiction; prevention and control of drug abuse.

(ii) Microbes in Human Welfare

In industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilisers.

Use of microbes in: (i) Industrial products: beverages (with and without distillation); sources (microbes) and uses of organic acids, alcohols and enzymes (lipase, pectinase, protease, streptokinase) in industry, source (microbes) and applications of Cyclosporin-A, Statins; (ii) Production of biogas (methanogens, biogas plant, composition of biogas and process of production); (iii) Microbes as biocontrol agents (*Bacillus thuringiensis*, *Trichoderma*, Nucleopolyhedrovirus (*Baculovirus*), and (iv) Microbes as

biofertilisers (*Rhizobium*, *Azospirillum*, *Azotobacter*, *Mycorrhiza*, *Cyanobacteria*), IPM - harmful effects of chemical pesticides.

4. Biotechnology and its Applications

(i) Biotechnology - Principles and processes

Genetic Engineering (recombinant DNA technology).

Definition and principles of biotechnology; isolation of genomic (chromosomal) DNA (from plant cell, by cell lysis), isolation of gene of interest (by electrophoresis), steps of formation of recombinant DNA, discovery, nomenclature, features and role of restriction enzymes (*EcoRI*) and role of ligase; cloning vectors (features of a good cloning vector, examples of cloning vectors like *pBR322*, *Agrobacterium*, retroviruses, bacterial artificial chromosome (BAC), yeast artificial chromosome (YAC)), methods of transfer of rDNA into a competent host, e.g. by direct-method (temperature shock), microinjection, gene gun, methods of selection of recombinants (antibiotic resistance, blue-white selection), cloning of recombinants, i.e., gene amplification (by in vivo or in vitro method - using PCR technique), bioreactor (basic features and uses of stirred tank and sparged tank bioreactors), downstream processing.

(ii) Biotechnology and its applications

Applications of biotechnology in health and agriculture: human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issues, biopiracy and biopatents.

In agriculture: for production of crops tolerant to abiotic stresses (cold, drought, salt, heat); pest-resistant crops (Bt-crops, RNAi with reference to *Meloidogyne*

incognita); crops with enhanced nutritional value (golden rice).

In medicine: insulin, gene therapy - with reference to treatment of SCID, molecular diagnosis by PCR, ELISA and use of DNA/RNA probe.

Transgenic animals for bioactive products like alpha-1-antitrypsin for emphysema, alpha-lactalbumin; vaccine safety testing, chemical safety testing; study of diseases.

Role of GEAC, definition and two examples of biopiracy, biopatient; ethical issues.

5. Ecology and Environment

(i) Organisms and Populations

Organisms and environment: habitat and niche, population and ecological adaptations; population interactions - mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution.

Definition of ecology; definition of habitat and niche.

Definition of population; population attributes: sex ratio, types of age distribution pyramids for human population; definition of population density, natality, mortality, emigration, immigration, carrying capacity. Ways to measure population density. Calculation of natality and mortality.

Population growth: factors affecting population growth and population growth equation; growth models: exponential growth and logistic growth along with equations, graph and examples of the same; life history variations: definition of reproductive fitness and examples.

Population interactions – definition of mutualism, competition (interspecific, interference, competitive release and Gause's Principle of Competitive Exclusion), predation (adaptations in organisms to avoid predation), parasitism (ecto-, endo-, and brood parasites), commensalism, amensalism.

(ii) Biodiversity and its Conservation

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks, sanctuaries and Ramsar sites

Definition of biodiversity, few examples of each type of biodiversity - species, ecosystem and genetic. Global biodiversity and proportionate number of species of major taxa of plants, invertebrates and vertebrates; patterns of biodiversity (latitudinal gradients, species-area relationship – graph and equation), “rivet popper hypothesis”, importance of species diversity to the ecosystem (narrowly utilitarian, broadly utilitarian, ethical terms).

Examples of some recently extinct organisms, causes of loss of biodiversity (habitat loss and fragmentation, over-exploitation, alien species invasion, co-extinction).

Biodiversity conservation: In-situ methods - protected areas: biosphere reserves, national parks, wildlife sanctuaries, sacred groves; ex-situ methods - captive breeding, zoo, botanical gardens, cryopreservation, wild life safari, seed banks. Definitions and examples of each of the above. Hotspots, Ramsar sites and Red Data Book.

The place, year and main agenda of historic conventions on biological diversity (the Earth Summit and the World Summit).

PAPER II

PRACTICAL WORK – 15 Marks

- 1) **Taxonomy:** Study floral characteristics through dissection of flowers, drawing floral formula and diagrams of following families:
 - (i) Malvaceae: type – China rose / Hollyhock or any other locally available flower of the family.
 - (ii) Solanaceae: type – *Petunia* / *Datura* / Brinjal Flower / *Solanum nigrum* any other locally available flower of the family

Floral characteristics should be explained by dissection of flowers. Students should be taught how to cut vertical section of the flower and draw accurately labelled diagrams. The technique of drawing floral diagrams with the **mother axis in the right position is necessary**. Floral formula should be correctly written. Identification of the correct family giving reasons, technique of cutting T.S. and L.S of ovary should be explained and accordingly correct labelled-diagram should be drawn.

Students should know the examples of plants (belonging to each family) which are of economic importance. The examples of common names of plants must be supported with correct scientific names as well.

NOTE: In the examination, candidates will be tested on any one of the above families.

2) Simple biochemical and physiological experiments

To isolate DNA from available plant material.

Isolation of DNA from spinach leaves, green pea seeds, pulp of banana and papaya.

Take half a ripe and peeled banana into a beaker and add 50 ml of extraction fluid (1.5gm table salt +10 ml liquid detergent +90 ml distilled water). Place the beaker in a water bath set at 60 °C for 15 minutes. Stir gently with a glass rod. Filter 5ml of cooled content into a clean test tube and add 5ml of cold 90% ethanol. DNA molecules separate out and appear as white fibres.

3) Slide preparation

T.S. of ovary of any locally available flower, to show marginal / axile placentation.

*The technique of staining and mounting neatly should be explained. Students should also know how to make labelled outline diagrams. They should also be taught to identify the mount under low/ high power of microscope. **Two** identifying features of the above need to be mentioned.*

4) Spotting: (three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing at least two identifying characteristics).

NOTE: Spotting must be done on a separate answer sheet during examination, which should be handed over to the Examiner immediately after spotting.

(i) Identify and comment on the following:

- (a) T.S. of ovary of mammal (Permanent slide).
- (b) T.S. of testis of mammal (Permanent slide).
- (c) T.S. of blastula / blastocyst of a mammal (chart/ slide).
- (d) Whole mount of *Plasmodium* sporozoite (slide /chart).
- (e) Whole mount of *Entamoeba histolytica* trophozoite (slide/chart).
- (f) Preserved specimen/ chart/ model of *Ascaris*.

(ii) Comment upon ecological adaptations of plants and animals.

Models/ virtual images/ charts of one plant and one animal found in xeric and aquatic habitats. Examples: Hydrilla, cactus, fish and camel.

(iii) Flowers adapted to pollination by different agencies – insect and wind.

*Students should be able to identify the type of pollination of the given flower, draw the diagram of the flower and **give two reasons** for the type of pollination. Example: Hibiscus and grass.*

Students should be taught how to identify, draw, label and give significantly visible characteristics as observed, of each spot, in a given time of three minutes. 'T.S.', 'model', 'whole mount', 'chart', 'image' of the specimen should be mentioned as a part of identification.

PROJECT WORK AND PRACTICAL FILE – 15 Marks

Project Work – 10 Marks

The project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

The candidate is to creatively execute **one** project/assignment on an aspect of biology. Preference is to be given to investigatory projects. Teachers may assign or students may choose any **one** project of their choice. Students can choose any other project besides the ones indicated in the list. Following is **only a suggestive** list of topics:

- (i) Genetic disorders
- (ii) Gene therapy
- (iii) Human Genome Project
- (iv) DNA fingerprinting
- (v) Bio-piracy
- (vi) Cancer.
- (vii) AIDS/Hepatitis.
- (viii) Drug addiction and community.
- (ix) Role of micro-organisms in industry.
- (x) Human population.
- (xi) Mendelian Inheritance
- (xii) Environmental resistance.
- (xiii) Traditional and modern methods: Study of a few traditional methods of pest deterrence vis-a-vis modern methods of pest control - viability of traditional methods in today's scenario and limitations and dangers of modern methods.
- (xiv) Role of agrochemicals in increasing food production.

Suggested Evaluation Criteria for Project Work:

Format of the Project:

- Content
- Introduction
- Presentation (graphs, tables, charts, newspaper cuttings, handmade diagrams, photographs, statistical analysis if relevant)
- Conclusion/ Summary
- Bibliography

Projects should be handwritten by the candidate. Written pages should not exceed 15-20 pages.

Practical File – 5 Marks

The Visiting Examiner is required to assess students on the basis of the Biology Practical file maintained by them during the academic year.

Each practical done during the year, needs to be recorded by the student in the Practical file and the same must be checked, signed and dated by the teacher.

SCIENTISTS AND THEIR CONTRIBUTIONS:

1. Hugo de Vries: Mutation
2. Alec Jeffreys: DNA finger printing
3. Temin and Baltimore: Reverse transcription.
4. Jacob, Monod and Lwoff: proposed Lac operon.
5. Watson and Crick: Structure of DNA
6. Nirenberg and Khorana: Genetic code
7. Gregor Mendel: Father of genetics
8. Sutton and Boveri: Chromosomal theory of inheritance
9. Hugo de Vries: Correns and Tschermack: Rediscovered Mendelism
10. T. H. Morgan: Linkage
11. Henking: Discovered X-chromosome
12. F. Meischer: Isolated nucleic acid from pus cells, called Nuclein
13. Chargaff: Rule of equivalence in DNA structure
14. Hershey and Chase: DNA is the genetic material
15. Meselson and Stahl: Semi-conservative replication of DNA
16. G. Gamow: Triplet nature of codons
17. S. Ochoa: discovered polynucleotide phosphorylase
18. H Boyer: discovered Restriction Enzyme
19. S Cohen: method to transfer plasmid DNA in host cells
20. E. Wilson: coined the term Biodiversity
21. P. Ehrlich: Rivet Popper Hypothesis
22. Sanger: DNA/Protein sequencing

LIST OF ABBREVIATIONS TO BE STUDIED

1. ADA- Adenosine Deaminase
2. CMI- Cell Mediated Immunity
3. EFB- European Federation of Biotechnology
4. EST- Expressed Sequence Tags
5. GMO- Genetically Modified Organism
6. hnRNA - Heterogeneous Nuclear Ribo Nucleic Acid
7. IMR- Infant Mortality Rate
8. ICSI - Intra Cytoplasmic Sperm Injection
9. IUCD/IUD – Intra uterine contraceptive device
10. IUCN- International Union for Conservation of Nature and Natural Resources
11. IUT- Intra Uterine Transfer
12. MALT- Mucosal Associated Lymphoid Tissue
13. MMR- Maternal Mortality Rate
14. NACO- National AIDS Control Organisation
15. PID- Pelvic Inflammatory Diseases
16. PKU- Phenyl ketonuria
17. RCH- Reproductive and Child Health Care Programmes
18. SCID – Severe Combined Immuno Deficiency
19. SNPs - Single Nucleotide Polymorphisms
20. snRNA- Small Nuclear Ribo Nucleic Acid
21. SSBP – Single Strand Binding Protein
22. UTR - Untranslated Region
23. VNTRs - Variable Number of Tandem Repeats