

KENDRIYA VIDYALAYA SANGATHAN

Patna Region

G.B.pant Agriculture college

Anil Rana = WWW.HortiAgri.com



STUDY MATERIAL

2016-17

CLASS XII
BIOLOGY

PREFACE

Kendriya Vidyalaya Sangathan is a pioneer organization which caters to the all round development of the students. Time to time various strategies have been adopted to adorn the students with academic excellence.

This support material is one such effort by Kendriya Vidyalaya Sangathan, an empirical endeavor to help students learn more effectively and efficiently. It is designed to give proper platform to students for better practice and understanding of the chapters. This can suitably be used during revision. Ample opportunity has been provided to students through master cards and question banks to expose them to the CBSE pattern. It is also suggested to students to keep in consideration the time-management aspect as well.

I extend my heartiest gratitude to the Kendriya Vidyalaya Sangathan authorities for providing the support material to the students prepared by various Regions. The same has been reviewed by the Regional Subject Committee of Patna Region who have worked arduously to bring out the best for the students. I also convey my regards to the staff of Regional Office, Patna for their genuine cooperation.

In the end, I earnestly hope that this material will not only improve the academic result of the students but also inculcate learning habit in them.

M.S. Chauhan
Deputy Commissioner

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Unit	Title	No. of Periods	Marks
VI	Reproduction	30	14
VII	Genetics and Evolution	40	18
VIII	Biology and Human Welfare	30	14
IX	Biotechnology and its Applications	30	10
X	Ecology and Environment	30	14
Total		160	70

How to use the support material

1. This support material is prepared to supplement the NCERT textbook. This is not the replacement of NCERT textbook. It is neither a guide nor a refresher.
2. Chapter-wise synopsis is given to show the degree of importance in respect of various concepts. While preparing for examination ** and*** concepts/questions can be given more emphasis to pass in examination.
3. Preparation of highlighted/dark words is very much helpful to achieve passing mark as well as to reach highest score in the subject.
4. Flow charts/mind map are made for instant revision of chapters.
5. Chapter-wise questions given in support material can be used for self-assessment, assignment and revision of the chapters.
6. Last three years CBSE questions and selected sure shot questions with solution have been given in the last section of every chapter. This will help students to acquaint with nature and pattern of CBSE questions.
7. NEW addition in syllabus i.e. **RICE GENOME PROJECT** Is given in chapter 6.
8. Split up of syllabus, distribution of marks as per CBSE guidelines have been given as annexures.
9. Read “points to remember” and highlighted words--- prepare mind map, flow chart/ tables----- Solve test questions---- Solve CBSE questions----- Writing practice.

KENDRIYA VIDYALAYA SANGATHAN PATNA REGION

SPLIT UP SYLLABUS 2016-17

SUB: BIOLOGY(CLASS-12th)

S · N O	Month	Expected No.of working Days	Branch of Subject	Detailed Split-up	Periods for class room Teaching	Computer Aided Teaching Periods	Total No.of Periods
1	April And May	22+8	UNIT-6 (Reproduction)	<p>Chapter-1: Reproduction in Organisms. Chapter-2: Sexual Reproduction in Flowering Plants Chapter-3: Human Reproduction Chapter-4: Reproductive Health</p> <p>Practicals- 1. Study of pollen germination on a slide 2. Isolation of DNA from available plant material 3. Study and identify stages of gametic development i.e T.S. of Testis and T.S. of ovary from permanent slides. 4. Study of flowers adapted to pollination by different agencies</p>	20	06	26
2	June & July	8+25	Genetics and Evolution (Unit-VII)	<p>Chapter-5: Principles of Inheritance and Variation Chapter-6: Molecular Basis of Inheritance Chapter-7: Evolution</p> <p>Practical- 1. Study Mendelian inheritance using seeds of different colour/size of plant 2. Study of meiosis from prepared slides 3. Study of pedigree from prepared charts</p>	40	10	50
3	August	22	Biology and Human welfare (Unit-VIII)	<p>Chapter-8: Human Health and Diseases Chapter-9: Strategies for Enhancement in Food Production</p> <p>Practical- 1. Exercise on controlled pollination-emasculation, tagging etc.</p>	20	08	28

				<p>2.To identify common diseases</p> <p>3.Study the effect of different temperatures and three different pH on the activity of salivary amylase on starch</p>			
4	September	16	Unit-VIII and Unit-IX (Biotechnology)	<p>Chapter-10: Microbes in Human Welfare</p> <p>Chapter-11: Biotechnology - Principles and processes</p> <p>Chapter-12: Biotechnology and its Application</p> <p>Practical- 1.Study and comment on Xero-phytic and aquatic plants and animals</p> <p>2.Study of pH , clarity and presence of any living organism in water sample</p> <p>3.Prepare a temporary mount of onion root tip to study mitosis.</p>	18	08	26
5	October And November	22	Ecology (Unit-X)	<p>Chapter-13: Organisms and Populations</p> <p>Chapter-14: Ecosystem</p> <p>Chapter-15: Biodiversity and its Conservation</p> <p>Chapter-16: Environmental Issues</p> <p>Practicals-1. Collect and study soil, texture, moisture etc.</p> <p>2.Study pH and water holding capacity of different soil samples</p> <p>3.Study of presence of suspended particulate matter in air.</p> <p>4.Population density and population frequency by quadrat method.</p>	25	05	30

NOTE- 1. Syllabus is to be completed by 31st October followed by Pre-Boards and revision in the months of November, December and January.

BIOLOGY (Code No. 044)
QUESTION PAPER DESIGN

Class - XII (2016-17)

Time 3 Hours

Max. Marks: 70

S. No.	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer-I (SA-I) (2 marks)	Short Answer –II (SA-II) (3 marks)	Value based question (VBQ) (4 marks)	Long Answer (LA) (5 marks)	Total Marks	% Weightage
1.	Remembering- (Knowledge based) Simple recall questions, to know specific facts, terms, concepts, principles, or theories, identify, define, or recite, information)	2	1	1			7	10%
2.	Understanding- (Comprehension) -To be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information		2	4		1	21	30%
3.	Application (Use abstract information in concrete situation, to apply knowledge to new situations, use given content to interpret a situation, provide an example, or solve a problem)		2	4		1	21	30%
4.	High Order Thinking Skills (Analysis & Synthesis) - Classify, compare, contrast, or differentiate between different pieces of information, Organize and/or integrate unique pieces of information from a variety of sources	2		1		1	10	14%
5.	Evaluation- (Appraise, judge, and/ or justify the value or worth of a decision or outcome, or to predict outcomes based on values	1		2	1		11	16%
	TOTAL	5X1=5	5X2=10	12X3=36	1X4=4	3X5=15	70 (26)	100%

CHAPTERWISE SYNOPSIS AND DIGREE OF IMPORTANCE

CHAPTER	Concepts	Degree of imp.	Ref. NCERT text book.: page nos.	Common errors
Reproduction In Organisms	Types of reproduction A) Asexual reproduction B) Sexual reproduction, phases and events in sexual reproduction	* **	NCERT text book xii fig . 1.2(a) (b) fig. 1.3, 1.4 page 5-8 NCERT book p – 15 - 19 ex q 2,6,9,13,15,18 NCERT book fig 2.2. 2.3 , 2.5 p – 21 –23	fail to differentiate asexual reproductive structures-zoospores, conidium, gemules etc. differentiation in monoecious & dioecious
Sexual Reproduction In Flowering Plants	1. Pre fertilization: structures and events (i) stamens microsporangium & pollen grain microsporogenesis (ii) pistil megasporangium (ovule) embryosac- megasporogenesis 2) pollination (i) autogamy , xenogamy, geitonogamy (ii) agents of pollination (iii) out breeding devices (iv) pollen pistil interaction 3. Double fertilization 4. Post fertilization :	*** ** ** ** *** ***	NCERT book fig 2.7(d) 2.8 p – 24 – 27 NCERT book p – 27 – 28 NCERT book p – 31 – 33 NCERT book p – 34 fig 2.12. (c,d,e) fig – 2.13,2.14, 2.15 p – 35 NCERT p – 38 NCERT	no. of cells in mature pollen grains no. of cells & nuclei in embryo sac , role of synergids self-incompatibility triple fusion free nuclear & cellular endosperm, embryo of monocot fail to differentiate apomixes , parthenocarpy

Human Reproduction	1 male reproductive system (i) diagram & description (ii) parts of male reproductive system (structure) (iii) functions of parts of system (iv) accessory ducts (v) accessory glands	* * *** ** **	NCERT P – 43 , FIG 3.1 (B) NCERT P – 43-44 NCERT P – 43-44	Exact Location & Function Of Leydig Cells & Sertoli Cells
	2. Female reproductive system (i) diagram & description (ii) parts of female reproductive system (structure) (iii) functions of parts of system (iv) accessory ducts (v) uterus & its layers (vi) mammary glands	** * ** * ** *	NCERT P –44- 46 , FIG 3.3 (B) -DO- NCERT P –44-46 NCERT P –44 NCERT P –46 NCERT P –47	
	3 gametogenesis (i) spermatogenesis & diagram (ii) stages of spermatogenesis with names of cells & no of chromosomes (iii) structure of sperm	** * ***	NCERT P – 47 FIG – 3.2 & 3.5 , 3.8 (a) P – 49 Page no 47	Exact Stage Where Meiosis I & II Occurs During Gametogenesis As Well As The Ploidy Of Cells At Each Stage Of Gametogenesis

	(diagram) (iv) functions of each part of sperm & organelles (v) composition of semen	** * ** * **	Fig 3.6, page no 48 page no 48 page no 48	
	4 oogenesis i) structure and description ii) development of follicles iii) stages with names of cells and no. of chromosomes with events iv) significance of polar bodies	*** ** *** ***	Fig 3.7 ,Fig 3.8(b) Page no 48-49 Page no48-49 Page no48-49	Difficulty in relating different stages of oogenesis with different life stages.
	5 menstrual cycle (i) menarche and menopause (ii) phases of menstrual cycle with diagram (iii) role of hormones in cycle	* ** ***	Page no – 49, 51 Fig 3.9	Co-relation of levels of pituitary hormones and events during menstrual cycle
	6 fertilization and implantation (i) structure of ovum (ii) cleavage- formation of morula and blastula (iii) implantation- meaning, stage and site (iv) sex determination in humans (v) three germ layers	* * * * * * * * * *	Fig – 3.1, Page no – 51 Fig – 3.11 Page no – 52 Page 53 Page 52 Page 54	Labelling of mature graffian follicle

	7 pregnancy and embryonic development (i) placenta as endocrine gland (ii) embryo and extra-embryonic layers	* * * * *	Page 53 Fig – 3.12 Page 53	
	8 parturition (i) meaning (ii) foetal ejection reflex (iii) Role of hormones 9. lactation Meaning, colostrum and its importance	* * *	Page no – 54 Page no – 54	Hormones involved at the time of parturition
Reproductive Health	1. Reproductive health (i) Problems & Strategies	**	Page 57-58	Amniocentesis
	2. Methods of birth control 3. Infertility – Corrective treatments 4. Sexually transmitted diseases	*** ** ***	Page 59-61 Page 64 Page 63	Specific site for transplantation of embryo in GIFT and ZIFT
	5 methods of birth control (i) natural methods (ii) barrier methods (iii) IUDS (iv) oral contraceptives (v) injections and implants (vi) surgical methods	**	Page 66	

Principles of inheritance and variations	1. Mendel's laws of inheritance		Page 11/7 of Pradeep's Textbook	
	(i) Reasons for choosing garden pea	*	Fig 5.1 page 70—71	
	(ii) Seven contrasting traits of pea plant	**	Page 71-73	
	(iii) Symbols and terms used in mendel's experiment	**	Page 70-71	
	(iv) Steps involved in mendel's experiments (v) Monohybrid cross (vi) Test cross	*	Page 71-75 Fig 5.5 74-75	
	(vii) Incomplete dominance	***	Fig 5.6 page Table 5.3 page 77-78	
	(viii) Codominance and multiple alleles	***	Fig 5.7 page 79	Gamete formation in dihybrid cross
	(ix) Dihybrid cross	***	Table 5.3 fig 5.8-5.9	
	2. Chromosomal theory of inheritance	**		
	3. Linkage and recombination	**	Page 83-84	
	4. Sex determination in animals	***	Fig 5.12 page 85-86	
	5. Mutations	**	Page 87	
	6. Genetics disorder	**		
(i) Pedigree analysis	**			
(ii) Mendelian disorders	***	Page 87-88 fig 5.13, 5.14	Heterogamety in sex determination	
(iii) Chromosomal disorder	***	Page 89-90 Page 90-91	Use of symbols for autosomal and sex linked disorders	

Molecular basis of inheritance	1. DNA	**	Page no. 96-98	Polarity of two stands
	(i) structure and salient features			
	(ii) packaging of DNA helix	**	Fig 6.4 page 99	Histone and non histone chromosomal protein
	2. Search for genetic material			
	(i) transforming principle	***		
	(ii) Hershey and Chase experiment	***	Page 100-101	Differentiation between transformation and transfection
	(iii) properties of genetic material	**	Fig 6.5 Page 102	
	3. Replication – experimental proof	***	Page 103	Leading and lagging strand direction

	4. Transcription	***	Fig 6.7, 6.8 page 105-107	
(i) transcription unit	**			
(ii) type of RNA and process of transcription	**		Polycistronic, monocistronic, capping, tailing	
5. Genetic code (ii) Mutations and Genetic Code	***	Fig 6.9, page 107-108		
(iii) tRNA-The adapter Molecule	**	109-111	Frame Shift and Point mutation Charging of tRNA	
	*	page 112		
6. Translation	**	Page 113		
7. Regulation of Gene Expression	**	Fig. 6.12		
	***	Page-114		
(i) Levels of Regulation	**		Expresses Sequence Tags Sequence Annotation	
(ii) The lac operon	**	Fig. 6.13 Page 115	BAC/YAC	
8. Human Genome Project		Fig. 6.14, Page 116, 117		
9. DNA Finger printing		Page 118-120	Satellite	
		Fig. 6.16	DNA, VNTR	
		Page 121-122		

Evolution	1. Origin of Life 2. Evidences of Evolution 3. Adaptive Radiation 4. Biological Evolution 5. Mechanism of Evolution 6. Hardy- Weinburg principle 7. A Brief Account of Evolution 8. Origin and Evolution of Man	* ** ** ** * ** ** * *	Fig 7.1 Fig. 7.3 Page130-132 Fig.7.5,7.6,7.7Page 133 Page 134 Page 135 Fig. 7.8 Page136-137 Fig. 7.9,7.10 Fig. 7.11Page 140	Branching Desent and Natural Selection Darwinism versus de-Vries- -Saltation Hardy-Weinburg Equilibrium, Founder Effect
Human Health & Diseases	1.Common Diseases in human 2. Immunity (i) Innate immunity (ii) Aquired immunity (iii) Active and Passive immunity (iv) Vaccination and immunity (v) Allergy (vi) Autoimmunity (vii) Immune System of Body 3. AIDS 4.CANCER 5. Drug and alcohol abuse (i) Adolescence and drugs	** ** *** * ** * ** ** *** ** **	 Fig. 8.1 Page 146-149 Page 150-154 NCERT Fig. 8.4 Fig 8.6 Text156 Text Page 156-158 Text Page 158-163	 Specific Role of histamines and serotonin Mucosal associated lymphoid Tissue MALT Contact Inhibition

Strategies for Enhancement in food Production	1. Animal husbandry (i) Management of farm and farm Animal (ii) Animal Breeding (iii) Bee Keeping (iv) Fisheries 2. Plant breeding (i) Method (ii) For disease Resistance (iii) For Pest Resistance (iv) For Improved food quality 3. Single cell Protein 4. Tissue Culture	* ** ** * ** *** *** ** *** **	Page 165-170 Text Page 170-176 Text Page176 Text Page 177 Text	
Microbes in Human Welfare	1. Role of Microbes in:- (i) House Hold (ii) Industrial Product (iii) Sewage Treatment (iv) Production of Bio Gas (v) As Biocontrol Agent (vi) As Biofertilizers	* *** ** * *** ***	Text Page181 Page 182,183 Ex. Question12 Page 184-185 Ex. Question 7,8,11 Page 185 Page 186-187 Page 188	

Biotechnology principles and processes	<p>1. Principles of biotechnology (i) techniques used in modern biotechnology (ii) genetic engineering includes recombinant DNA, gene cloning, gene transfer (iii) meaning and use of plasmid, restriction enzymes (iv) basic steps for GMO</p> <p>2. Tools of Recombinant DNA Technology</p> <p>3. Cloning Vectors</p> <p>4. Processes of Recombinant DNA Technology – Steps</p>	<p>*</p> <p>* *</p> <p>***</p> <p>***</p> <p>***</p>	<p>NCERT text book xii fig . 1.2(a) (b) fig. 1.3, 1.4 page 5-8</p> <p>NCERT book p – 15 - 19 ex q 2,6,9,13,15,18 Fig. 11.1-11.2-11.3 Page-195-198 Fig. 11.4 Page-198-200 Fig. 11.6,11.7 Page 201-205</p>	<p>Pallindromic sequences</p> <p>Distinction between transformants and recombinants</p> <p>Diagram of pBR322 Selectable marker</p>
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<p>Biotechnology and its applications</p>	<p>1. Applications of Biotechnology in agriculture (i) Advantages of GMO (ii) Bt Cotton (iii) RNA interference 2. Applications of Biotechnology in Medicines (i) Genetically engineered insulin. (ii) Gene Therapy-ADA (iii) Molecular Diagnosis of diseases. 3. Transgenic animals 4. Ethical issues , Biopiracy</p>	<p>* ** *** *** *** *** ** ** ** *</p>	<p>Page 207-208 Page 208 Page 208-209 Page 209-210 Page-210-211 Page 211 Page-112 Page-213 Page-214</p>	<p>Differentiation of Cry and cry nRNA silencing , nematode – <i>Meloidegynce incognitia</i> Steps in production of insulin Role of Biotechnology in molecular diagnosis.</p>
<p>Organisms and Populations</p>	<p>1. Organisms and its Environment (i) Major Abiotic Factors (ii) Responses to Abiotic Factors (iii) Adaptations 2. Populations:- (i) Population Attributes (ii) Population Growth (iii) Life History variation (iv) Population interactions</p>	<p>** ** *** *** *** * **</p>	<p>Page -221-223 NCERT Fig. 13.3 Page 223-225 Page 225-226 Fig. 13.4 Page 226-228 Fig. 13.5 Page 228-231 Page 231-232 Table 13.1 Page 232-238</p>	<p>Eurythermal & stenothermal Conformers, Regulators Distinction between Expanding, stable, declining population. Distinction between Exponential and Logistic growth curve. Distinction between commensalism and Amensalism.</p>

Ecosystem	<ol style="list-style-type: none"> 1. Structure and function 2. Productivity 3. Decomposition 4. Energy Flow 5. Ecological Pyramids 6. Ecological succession 7. Nutrient cycling 	<p style="text-align: center;">*</p> <p style="text-align: center;">**</p> <p style="text-align: center;">**</p> <p style="text-align: center;">*</p>	<p>Page 242 Ex Q. 9 Fig. 14.1 Page 243-244 Ex. Q10 Page 245,247 Ex. Q. 11 Fig. 14.4 Page 248 Fig. 14.5 Page 250-251 Fig. 14.6 Page 253-255 Ex. Q. 12,13</p>	GPP,NPP
Biodiversity and Conservation	<ol style="list-style-type: none"> 1. Patterns of Biodiversity 2. Importance of species diversity to ecosystem. 3. Loss of Biodiversity 4. Conservation of Biodiversity 	<p style="text-align: center;">***</p> <p style="text-align: center;">*</p> <p style="text-align: center;">***</p> <p style="text-align: center;">***</p>	<p>Fig. 15.1 Text page 259 Ex.Q 3 Page 263 Page 264-265 Ex. Q. 5 Page 265-267 Ex. Q. 7</p>	<p>Graphical representation, species are relationships</p> <p>Cryopreservation</p>

NEW ADDITION IN NCERT BOOK

SUPPLEMENTARY MATERIAL

UNIT VI: CHAPTER 1; 1.1, PAGE 6 AT THE END OF FIRST PARA

Under unfavourable condition the *Amoeba* withdraws its pseudopodia and secretes a three-layered hard covering or cyst around itself. This phenomenon is termed as **encystation**. When favourable conditions return, the encysted *Amoeba* divides by multiple fission and produces many minute amoeba or pseudopodiospores; the cyst wall bursts out, and the spores are liberated in the surrounding medium to grow up into many amoebae. This phenomenon is known as **sporulation**.

UNIT VI: CHAPTER 1; 1.1, PAGE 7 AT THE END OF SECOND PARA

In some organisms, if the body breaks into distinct pieces (fragments) each fragment grows into an adult capable of producing offspring (e.g., *Hydra*). This is also a mode of asexual reproduction called **fragmentation**.

UNIT VII: CHAPTER 5; PAGE 85 (TO BE GIVEN AS SECTION 5.4)

POLYGENIC INHERITANCE

Mendel's studies mainly described those traits that have distinct alternate forms such as flower colour which are either purple or white. But if you look around you will find that there are many traits which are not so distinct in their occurrence and are spread across a gradient. For example, in humans we don't just have tall or short people as two distinct alternatives but a whole range of possible heights. Such traits are generally controlled by three or more genes and are thus called as polygenic traits.

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Besides the involvement of multiple genes polygenic inheritance also takes into account the influence of environment. Human skin colour is another classic example for this. In a polygenic trait the phenotype reflects the contribution of each allele, i.e., the effect of each allele is additive. To understand this better let us assume that three genes A, B, C control skin colour in human with the dominant forms A, B and C responsible for dark skin colour and the recessive forms a, b and c for light skin colour. The genotype with all the dominant alleles (AABBCC) will have the darkest skin

colour and that with all the recessive alleles (aabbcc) will have the lightest skin colour. As expected the genotype with three dominant alleles and three recessive alleles will have an intermediate skin colour. In this manner the number of each type of alleles in the genotype would determine the darkness or lightness of the skin in an individual.

UNIT VII: CHAPTER 5; PAGE 85 (TO BE GIVEN AS SECTION 5.5)

PLEIOTROPY

We have so far seen the effect of a gene on a single phenotype or trait. There are however instances where a single gene can exhibit multiple phenotypic expression. Such a gene is called a pleiotropic gene. The underlying mechanism of pleiotropy in most cases is the effect of a gene on metabolic pathways which contributes towards different phenotypes.

An example of this is the disease phenylketonuria, which occurs in humans. The disease is caused by mutation in the gene that codes for the enzyme phenyl alanine hydroxylase (single gene mutation). This manifests itself through phenotypic expression characterised by mental retardation and a reduction in hair and skin pigmentation.

UNIT VII: CHAPTER 5; 5.4, PAGE 86 AFTER SECOND PARA

SEX DETERMINATION IN HONEY BEE

The sex determination in honey bee is based on the number of sets of chromosomes an individual receives. An offspring formed from the union of a sperm and an egg develops as a female (queen or worker), and an unfertilised egg develops as a male (drone) by means of parthenogenesis. This means that the males have half the number of chromosomes than that of a female. The females are diploid having 32 chromosomes and males are haploid, i.e., having 16 chromosomes. This is called as haplodiploid sex determination system and has special characteristic features such as the males produce sperms by mitosis (Figure 5.13), they do not have father and thus cannot have sons, but have a grandfather and can have grandsons.

Fig.5.13 Sex determination in honey bee

SUPPLEMENTARY MATERIAL

UNIT VII: CHAPTER 5; 5.6.2, PAGE 89 AFTER FIRST PARA

COLOUR BLINDNESS

It is a sex-linked recessive disorder due to defect in either red or green cone of eye resulting in failure to discriminate between red and green colour. This defect is due to mutation in certain genes present in the X chromosome. It occurs in about 8 per cent of males and only about 0.4 per cent of females. This is because the genes that lead to red-green colour

blindness are on the X chromosome. Males have only one X chromosome and females have two. The son of a woman who carries the gene has a 50 per cent chance of being colour blind. The mother is not herself colour blind because the gene is recessive. That means that its effect is suppressed by her matching dominant normal gene. A daughter will not normally be colour blind, unless her mother is a carrier and her father is colour blind.

UNIT VII: CHAPTER 5; 5.6.2, PAGE 90 AFTER SECOND PARA

THALASSEMIA

This is also an autosome -linked recessive blood disease transmitted from parents to the offspring when both the partners are unaffected carrier for the gene (or heterozygous). The defect could be due to either mutation or deletion which ultimately results in reduced rate of synthesis of one of the globin chains (α and β chains) that make up haemoglobin. This causes the formation of abnormal haemoglobin molecules resulting into anaemia which is characteristic of the disease. Thalassemia can be classified according to which chain of the haemoglobin molecule is affected. In α Thalassemia, production of α globin chain is affected while in β Thalassemia, production of β globin chain is affected. α Thalassemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16 of each parent and it is observed due to mutation or deletion of one or more of the four genes. The more genes affected, the less alpha globin molecules produced. While β Thalassemia is controlled by a single gene HBB on chromosome 11 of each

parent and occurs due to mutation of one or both the genes. Thalassaemia differs from sickle-cell anaemia in that the former is a quantitative problem of synthesising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectly functioning globin.

UNIT VII: CHAPTER 7; 7.3, PAGE 129 AFTER SECOND PARA

Embryological support for evolution was also proposed by Ernst Haeckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult. For example, the embryos of all vertebrates including human develop a row of vestigial gill slit just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates. However, this proposal was disapproved on careful study performed by Karl Ernst von Baer. He noted that embryos never pass through the adult stages of other animals.

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UNIT X: CHAPTER 13; 13.1, PAGE 221 AT THE END OF FIRST PARA

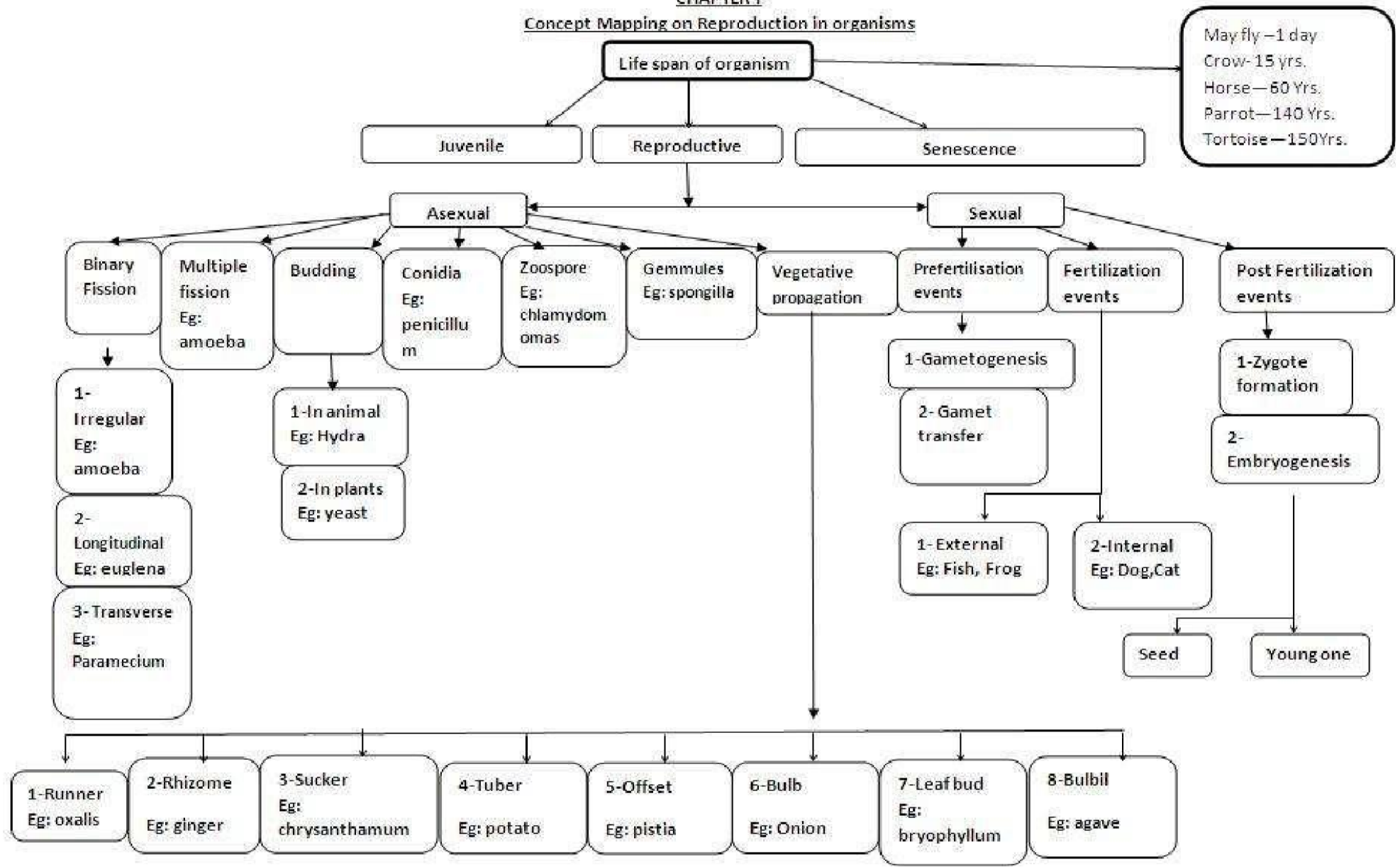
Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources it utilises and a distinct functional role in the ecological system, all these together comprise its **niche**.

UNIT X: CHAPTER 15; PAGE 266 IN FOURTH LINE OF 15.2.2 AFTER THE WORD THREATENED

(organisms facing a very high risk of extinction in the wild in the near future)

CHAPTER-I

Concept Mapping on Reproduction in organisms



Chapter – 1: - REPRODUCTION IN ORGANISMS

REPRODUCTION IN ORGANISMS

Life Span

- Period from birth till natural death. Every organism lives only for certain period of time Eg Elephant 60 -90 years, Fruit fly 4-5 weeks.

Every organism live only for a certain period of time.

- Reproduction –Producing young-ones of their kind, generation after generation.
- Types of reproduction:**
- Asexual reproduction** :single parent capable of producing offsprings .**Somatogenic reproduction**
- Sexual reproduction** :two parents are involved in producing offspring.

Modes of asexual reproduction

- Binary fission**: parent body divides into two halves, genetically identical to parent.

Amoeba: It is simple or irregular. Paramecium: Transverse binary fission. **Organisms considered immortal**

- Multiple fission**: parent body divides into many daughter organisms : Plasmodium.
- Budding**: daughter organisms grow from small buds arising in parent body.

Exogenous budding: out side the body eg. Hydra, Yeast.

Budding in Yeast Endogenous budding : inside the body eg. Gemmule in sponge. **Conidia of rhizopus**

- Conidia**: non-motile, exogenous spores in chains eg. Fungi.
- Zoospores**: microscopic motile structures eg. Algae. **In plants** : term vegetative reproduction frequently used instead of asexual reproduction, units of vegetative propagation called **vegetative propagules**. Eg runner, rhizome, sucker, tuber offset, bulb give rise to new plant
- All organisms show remarkable similarity. Vast difference in their reproductive structure. Similar pattern or phases in their life cycles
- PHASES OF LIFE SPAN.**
- Juvenile phase**: The phase of growth before reproductive maturity.
- Reproductive phase**: Reproductive maturity.
- Senescent phase**: Phase between reproductive maturity and death.

➤ **The main events of sexual cycle are:**

i. Pre-fertilisation events:

a. Gametogenesis :

- The process of formation of male and female gametes by meiosis (cell-division).

- ❖ Homogamete (Isogamete): - gametes similar eg. Algae
- ❖ Heterogamete(an-isogamete): - morphologically dissimilar gamete ,male gamete (antherozoid or sperm) ,female gamete (egg or ovum) eg. Human.
- ❖ **Sexuality in organisms** : **In plants Bisexual term is used for Homothallic and Monoecious plants**
Both male and female reproductive structures in same plant eg. Higher plants, cucurbits and coconut.
- ❖ **Unisexual term used for Heterothallic and Dioecious plants**
Male and female reproductive-structure on different plants.

Flowering plants – male flower–**staminate flower** and female flower–**pistillate flower** eg. papaya and date-palm.

- **Animals – Bisexual term is used for Hermaphrodite animals**-eg. Earth-worm, Tape-worm, Leech, Sponge.
- **Unisexual animals have male & female sexes in separate individuals**-e.g. insects, frogs, human beings

Cell division during gamete formation:

Haploid-parent (n) produces haploid gametes (n) by mitotic division, eg. Monera, fungi, algae and bryophytes.

Diploid parent (2n) produces haploid gametes(n) by meiosis division (possess only one set of chromosomes)and such **specialized parent cell** is called **meiocyte or gamete mother cell**.

- Example-

Name of organism	Meiocyte (2n)	gamete (n)
Human	46	23
Housefly	12	6
Ophioglossum (fern)	1260	630
Potato	48	24

b) Gamete transfer:- to facilitate fusion.

- ❖ Male gametes mostly motile and female non-motile, exception few fungi and in algae both gametes are motile in some cases
- ❖ Water medium for gamete transfer- in lower plants. Large number of male gametes produced to compensate loss
- ❖ Higher plants, pollen-grains are transferred by pollination.
- ❖ **Fertilization:** Fusion of male and female gametes diploid zygote.
- ❖ **Parthenogenesis.**-development into new organism without fertilisation eg. Rotifers, honey-bees, some lizard, bird(turkey).

ii. Fertilization

Two types- external and internal .

- **External fertilisation-** outside the body of organism in external- medium (water) eg. majority of algae, fishes, amphibians.
- **Advantage-** show great synchrony between the sexes –
 1. Release of large number of gametes into surrounding medium
 2. Large number of offsprings produced.
- **Disadvantage-** offspring vulnerable to predators, natural disasters.
- **Internal fertilisation-** fusion occurs inside female body eg. majority of plants and animals. Egg non-motile and formed inside female body. Male gamete motile, produced in large numbers to reach egg and fuse with it. In seed plants, non- motile male gamete carried to female gamete by pollen-tube.

iii. Post -fertilisation events- formation of zygote.

- Zygote.** One celled , diploid, vital link between two generations.
- **External fertilization** –zygote formed in external medium water eg. Frog,

- **Internal fertilization** –zygote formed inside the body eg. Human beings. Development of zygote depends on type of **life cycle and environment**. Some develop thick wall (prevent damage and desiccation) & undergo period of rest eg. Algae, fungi.
- **Haplontic life cycle**- zygote (2n) divides by meiosis to form haploid (n) spores.
- **Diplontic life-cycle**- zygote (2n) divides mitotically, develops into embryo (2n).
- ZYGOTE → UNDERGO **MEIOSIS** –HAPLOID SPORES----**HPLONTIC LIFE CYCLE**
- ZYGOTE → UNDERGO **MITOSIS** ---**DIPLONTIC LIFE CYCLE**

- **Oviparous animals** lay eggs out-side the female body.Eggs can be fertilized/ unfertilized. Fertilized eggs covered which hard calcareous shell, laid in safe place in the environment. Unfertilised eggs laid in water. Example- fishes, frogs, reptiles, birds
- **Viviparous animals** bear and rear the embryo inside female body, give birth to young-ones. Advantage- proper embryonic care, protection, survival chances of young-ones greater. Example- cows, whales, human beings.
- **Embryogenesis**: development of embryo from zygote by cell division (mitosis) and cell differentiation.
- **Cell- division** increases the number of cells in the developing embryo

Cell differentiation - groups of cells undergo certain modifications for the formation of different kinds of tissues and organs.

- **In flowering plants**- zygote formed inside ovule
- ❖ **Post fertilization Changes occur in flowering plants:**

Sepal	Fall off
Petal	Fall off
Stamen	Fall off
Zygote	Embryo
Primary endospermnucleus	Endosperm (3 N)
Synergid	Disintegrate
Antipodals	Disintegrate
Ovary	Fruit
Ovule	Seed
Ovary wall	Pericarp (epicarp + mesocarp + endocarp)
Integument	Seed coat (testa + tegmen)

- **Parthenogenesis**: Female gamete develops into new organism.
- **Seedless fruits** formed by **parthenogenesis**
- **Clone**: A group of individuals of the same species that are morphologically and genetically similar to each other & their parents
- **Turion** :Fleshy overwintering buds in aquatic plants help in perrenation Eg *potomegaton*, *utricularia*
- **Bulbil** :Fleshy buds that produce new plant Eg *Agave and Oxalis*

PREVIOUS YEARS CBSE QUESTIONS AND ANSWERS

SET- I

VSA (1 mark)

1. What are vegetative propagules? (CBSE-2014)
2. What is clone? (CBSE-2011)
3. Name a multicellular organism which reproduces by budding.
4. What is life span? (CBSE-2009)
5. Which type of organisms reproduces by binary fission?

SA (2 mark)

6. Define external fertilization? Mention its disadvantages ?
7. Compare monoecious & dioecious plants ? (CBSE-2010)
8. Distinguish between.
 - 1) Oviparous & viviparous.
 - 2) External & internal fertilization.

LA (5 mark)

9. Describe major events of sexual reproduction?
10. Describe vegetative reproduction in plants?

SET-II

VSA (1 mark)

1. Name the common asexual reproductive structures found in penicillium and sponge? (CBSE-2014)
2. Give two examples of animals in which oestrus cycle occurs? (CBSE-2015)
3. What is Parthenogenesis?
4. Name the two stages that a zygote undergoes during embryogenesis?
5. Identify whether the following parts are haploid (n) or diploid (2n)
 - a) Zygote
 - b) Ovary

SA (2 mark)

6. Define :
 - a) Juvenile Phase
 - b) Senescent Phase.
7. Define external fertilization ? Mention its disadvantages.
8. What are staminate and pistillate flowers? Name the types of gametes that are formed in staminate and pistillate flowers ? (CBSE-2013)

LA (5 mark)

9. Which are the negative propagules found in the following angiosperms?
 - a) _____ of ginger.
 - b) _____ of Agave.
 - c) _____ of water hyacinth.
 - d) _____ of potato
 - e) _____ of onion.
10. Describe with suitable diagrams.
 - a) Budding in yeast
 - b) Binary fission in amoebae.
11.
 - a) Differentiate between gametogenesis from embryogenesis.
 - b) Differentiate between zoospore & Zygote.

ANSWERS

SET-I

- 1) The unit of propagation such as runner, rhizome, sucker, tuber, offset, bulbs, etc. are capable of giving rise to new offspring. Such structures are vegetative propagules.
- 2) Clone is morphologically and genetically similar individuals of a single parent.
- 3) Hydra.
- 4) The period from birth to natural death of an organism.

- 5) Unicellular organisms reproduce by binary fission.
 6) Syngamy occurs in the external medium. i.e. water outside the body of the organism.
Disadvantage- offspring are extremely vulnerable to predators. Threatening their development up to adulthood.
 7) Monoecious-Bisexual condition- having both male and female reproductive organs.
 Dioecious -Unisexual condition- having either of the reproductive organs.

8-a)

S.No	Oviparous	S.No	Viviparous
1	Lay eggs.	1	Give birth to young one.
2	Development of zygote takes place outside the body of female parent	2	Development takes place inside the body of female parent
3	Chances of survival of young one are lesser	3	Chances of survival of young one greater.
E.g.	Reptiles, Birds	E.g	Man, Mammals.

8-b)

S.No	External Fertilization	S.No	Internal Fertilization
1	Syngamy occurs outside body	1	Syngamy occurs inside the body of the organism.
2	Danger of predation is always there.	2	No danger of predator to offspring because they are protected inside the body of female.
3	Both the gametes are produced in large numbers and released into the surrounding medium(water)	3	Male gametes are produced in large numbers but the number of eggs produced is less.

- 9) 3 stages- Pre fertilization
 Fertilization
 Post fertilization
 Pre fertilization events- Gametogenesis & gamete transfer.
 Fertilization- Syngamy resulting in diploid zygote.
 Post fertilization events- Embryogenesis after the formation of zygote.

10) In plants different plant parts which are modified into structures like runner, rhizome, sucker, tuber, etc. are capable of giving rise to new plants, such a method of reproduction is called vegetative propagation.

Different types of vegetative propagation by.

- i) Offset eg.- Water hyacinth.
- ii) Tuber eg.- Potato.
- iii) Rhizome eg.- Banana.
- iv) Leaf eg.- Bryophyllum.

SET-II (ANSWERS)

- 1) Conidia - Penicillium
 Gemmules- Sponge.

- 2) Non – Primate mammals like cows, sheep.
- 3) Development of a new organism without fertilization of gametes.
- 4) Zygote undergoes cell division (mitosis) and cell differentiation.
- 5) Zygote (2n), Ovary (2n).
- 6) Juvenile phase:- The period of growth involving an increase in the body dimensions before attaining sexual maturity is called juvenile phase.
Senescence phase:- The part of life involving an increase in degenerative changes rather than repair.
- 7) The fusion of gamete takes place outside the body of organism in the external medium, such as water. It is called external fertilization .
Disadvantage: Eggs and embryos are extremely vulnerable to predators reducing their chances of survival.
- 8) Staminate – unisexual male flower bearing stamen is called staminate flower.
Pistillate - the unisexual female flower bearing pistils .
i) Staminate flower – male gamete, ii) Pistillate flower – female gamete.
- 9) Refer handouts.
- 10 a) Budding in yeast:- In yeast the organism divides to produce buds. The division is unequal and the small part (bud) remain attached initially to the parent cell which eventually gets separated and mature into new yeast organism.
b) Binary fission in amoeba:- Single celled amoeba divides into two equal halves and each rapidly grows into an adult. In it nucleus divides first, followed by invagination of cell membrane resulting in division of cytoplasm.
Diagram 4.2 Page no. 5, NCERT text book 12th.
- 11)

Gametogenesis	Embryogenesis
<ol style="list-style-type: none"> 1. The process of formation of two types of gametes male and female. 2. Gametes are haploid. 	<ol style="list-style-type: none"> 1.The process of development of embryo from the zygote 2.Zygote is diploid.

Zoospore	Zygote
<ol style="list-style-type: none"> 1. They are special asexual reproductive structure formed during asexual reproduction. 2. It is haploid 	<ol style="list-style-type: none"> 1. It is formed by fusion of gametes in sexual reproduction 2. It is diploid

Chapter 1: REPRODUCTION IN ORGANISMS

TEST QUESTIONS

1 mark questions:

Q) What is a meiocyte?

Q) Why is date palm referred to as dioecious?

Q) What is special in flowering in bamboo?

Q) Define clone?

Q) What is vegetative propagule?

Q) Diagrammatically represents asexually reproduction in yeast?

Ans) See Figure 1.2 (page-5)

Q) Cucurbits are called monoecious. Justify?

Q) If chromosomes number in meiocyte in rat, elephant and rice is 42,56,24 what will be the chromosomes number in their gamet?

Ans) Rat 21, elephant 28, rice 12

2 marks Questions

Q)i. Amoeba is immortal. Explain?

Q)ii. Which is the first diploid single cell which begins life?

Q iii What is the fate of zygote in organism which show

1 Haplontic life cycle

2 Diplontic life cycle

Q)iv What type gamete are formed in staminate and pistillate flowers?

Ans) Pollen grains and egg cell respectively.

Q)v Name the organisms with respect to their sexuality?

i) Monoecious animal

ii) Dioecious animal

iii) Monoecious plant

iv) Dioecious plant

Ans :- i) Earthworm ii) Cockroach iii) Chara iv) Marchantia.

3 marks questions:

Q) Why higher organisms have resorted to sexual reproduction in spite of its complexity?

Ans) 1. It brings about variations.

2. Variation helps in better adaptation in nature.

3. Variation is the basis of evolution.

Q) What is parthenogenesis. Give Example?

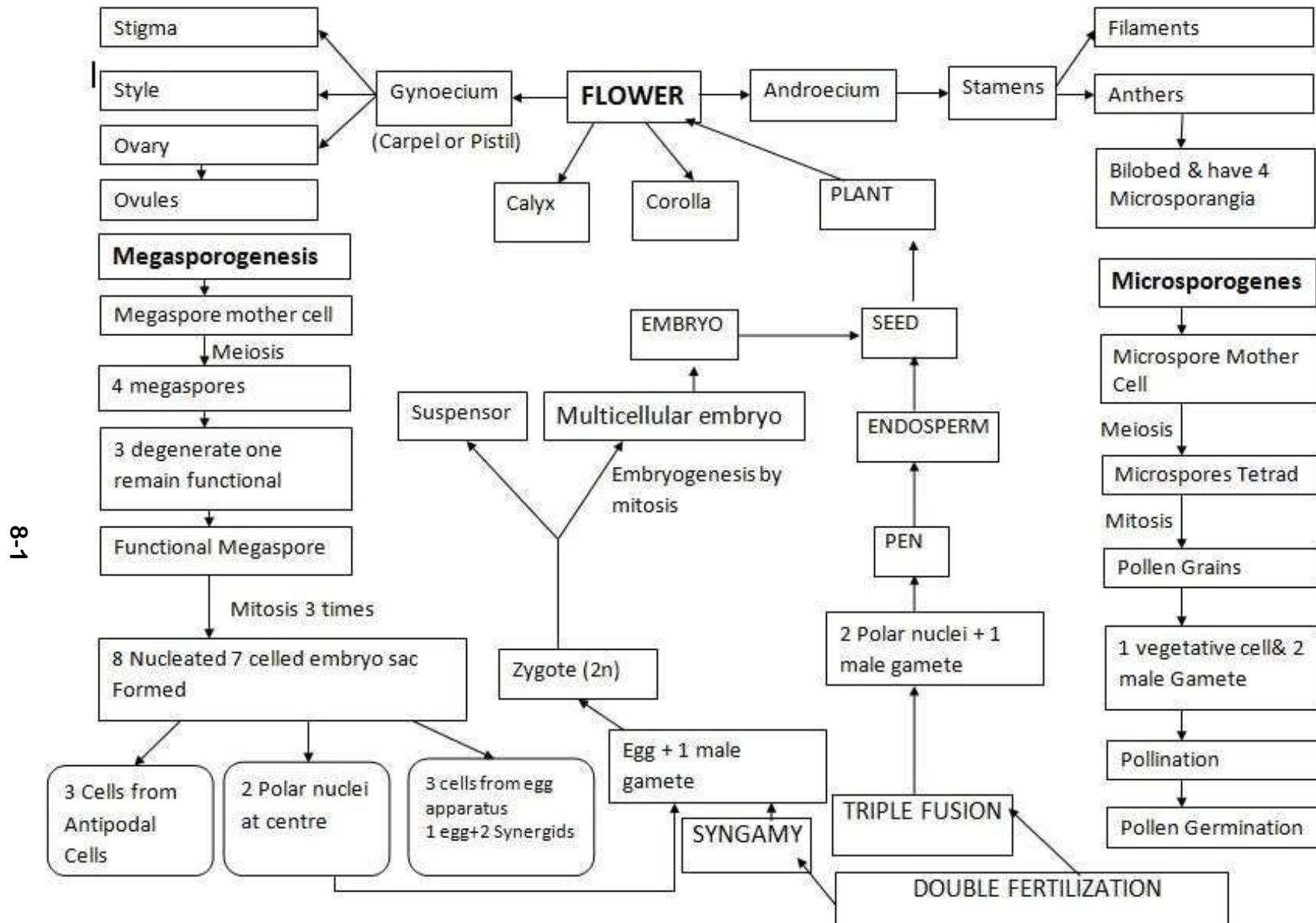
Q) Mention the reason for difference in ploidy of zygote and primary endosperm nucleus in angiosperm

5 Marks. questions:

Q) What are vegetative propagules. Name any four of them and give example?

Eg.- rhizome of ginger, leaf bud of bryophyllum, bulb of onion, offset of pistia.

CHAPTER- 2 Sexual reproduction in flowering plants



8-1

CHAPTER-2 SEXUAL REPRODUCTION IN FLOWERING PLANTS

FLOWERS

□ Site of sexual Reproduction.

□ Male and female reproductive organs are borne on flowers.

Refer fig. 2.1 of NCERT (L.S. OF A FLOWER WITH DIFFERENT PARTS)

PARTS OF A FLOWER:

Four whorls – calyx (sepals), corolla (petals), androecium (Male reproductive organ), gynoecium (Female reproductive organs)

Function of calyx: protects the bud.

Function of corolla :attracts insects by its colour

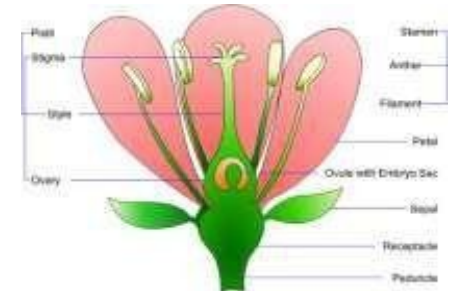
Male Reproductive Organ

□ Androecium consists of Stamens.

□ Stamen consists of anther, filament & connective (when anther is bilobed)

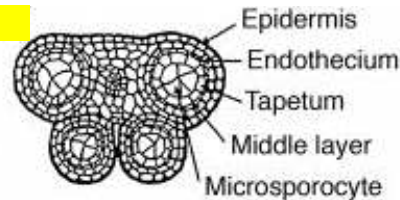
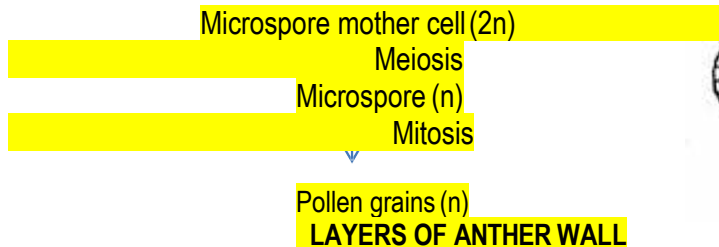
□ Anther bilobed 4 Microsporangia.

Refer fig. 2.1 of NCERT (L.S. OF A FLOWER WITH DIFFERENT PARTS)



MICROSPOROGENESIS: The process of formation of micro spores from pollen mother cell through meiosis is called microsprogenesis.

Tapetum :Inner most layer of wall of microsporangium .Cells have dense cytoplasm. Generally have more than one nucleus .Nourishes the developing pollen grain



LAYERS OF ANTHR WALL

Pollen grains have two outer walls; i) Exine ii) Intine

□ Exine is made of sporopollenin.(Hardest natural substance). Intine is made of cellulose and pectin.

□ Mature pollen grains have two cells – large vegetative cell & small generative cell.

□ Generative cell forms two male gametes by mitotic division.

□ Pollen grains (Refer fig 2.7 of text book)shed in 2-celled / 3 celled stage

See Fig 2.5 a and b page 23

Gynoecium / carpel (the female reproductive organ)

(Structure of anatropous ovule) **Megasporangium**

□ Each Carpel consists of ovary, style & stigma.

□ Ovules are attached to ovary by placenta.

□ Funicle – stalk of ovule

□ Hilum, a region where funicle is attached

□ Integuments –cover embryo sac.

□ Micropyle – a pore for entry of pollen tube & to imbibe water

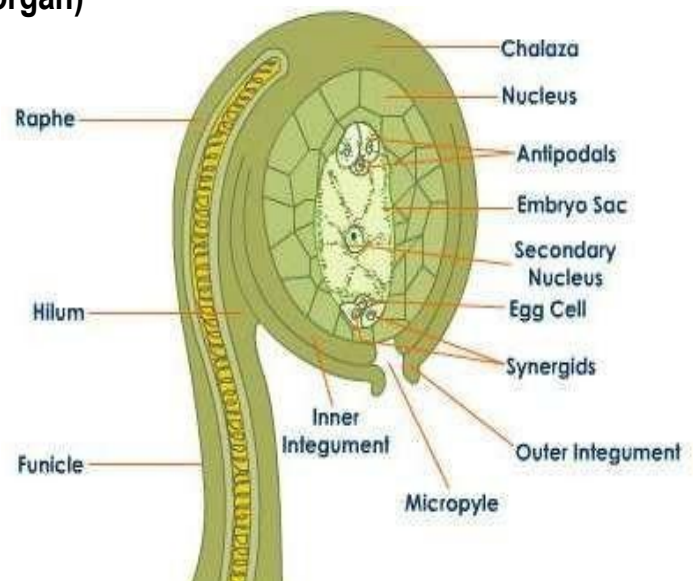
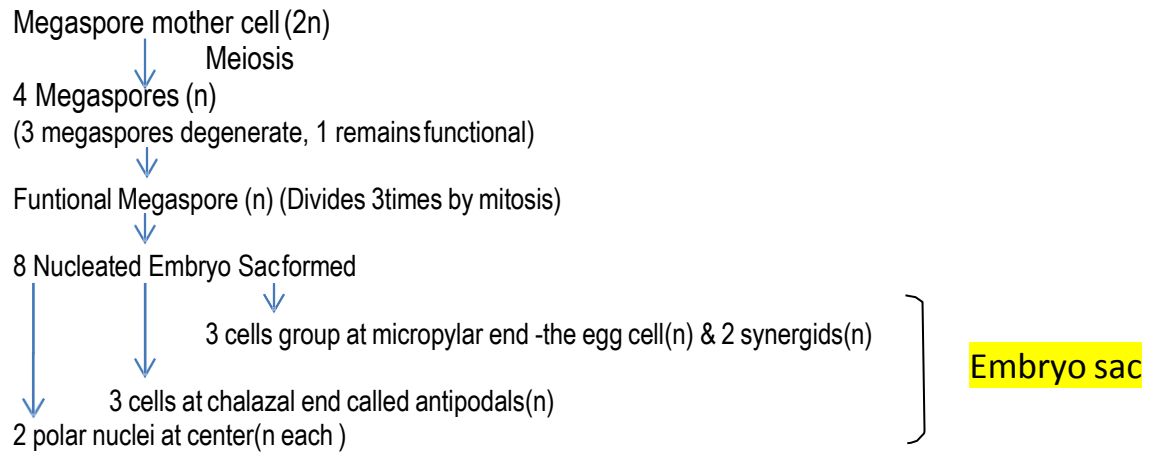


Diagram: An Anatropous ovule

Megasporogenesis



Ref fig 2.7 and 2.8 of textbook

POLLINATION– The transfer of pollen from anther to stigma.

Agents of pollination –air, water, insect .bat, bird, man.

Autogamy Transfer of pollen grains from the anther to the stigma of the same flower.
 Geitonogamy – Transfer of pollen grains from the anther to the stigma of another flower of the same plant
Xenogamy (From different flowers on different plants of the same species)

Double fertilization

- Pollen grains germinate on stigma & pollen tube grows through style.
- Pollen tube reaches micropyle & releases two male gametes into embryo-sac

Fertilisation is the process of fusion of male & female gametes (n+n) to form a diploid (2n) zygote.

Syngamy: Fusion of one male gamete (n) with egg (n) → Zygote(2n) Produced
 First Fusion → Fusion of two Polar Nuclei (n+n=2n) → Second fusion. →
 Male Gamete (n) Fuses with the fusion product of the two polar nuclei
 (3n) Third Fusion → fusion of male gamete with egg cell.

- ▮ **Double fertilization:** i) Fusion of male gamete with egg – First fertilization, **SYNGAMY**
 - ii) Fusion of fusion product of polar nuclei with male gamete – Second fertilization, **TRIPLE FUSION**
- Double fertilization = syngamy + triple fusion

Refer fig 2.13 in NCERT

Post fertilisation changes:

Stages of embryo development after fertilization:

1. Zygote divides by mitosis into suspensor & embryo cells
2. Suspensor cell forms a globular basal cell which remains embedded in the endosperm & a multicellular suspensor bearing the embryo
3. Globular embryo becomes heart-shaped & then mature embryo with radicle, plumule & Cotyledons

▮ Primary endosperm nucleus – divides repeatedly to form endosperm, food for the embryo.

▮ Mature ovary becomes fruit.

▮ Mature ovule becomes seed.

▮ **True Fruit** develops only from the **ovary**, e.g. mango, tomato

False Fruit develops from parts of the flower **other than the ovary** e.g. apple, peach etc.

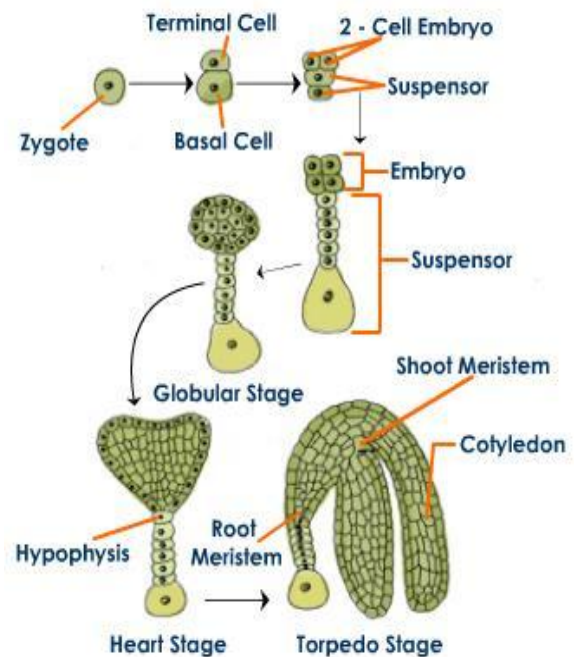
Seeds two types: i) Albuminous (with Endosperm)

ii) Non albuminous (without Endosperm)

Special mechanism of reproduction:-

i) **Apomixis**- Production of seeds without fertilisation e.g. species of Asteraceae and grasses.

ii) **Polyembryony**- Occurrence of more than one embryo in a seed e.g. Orange.



Outbreeding devices:

Continued self-pollination result in **breeding depression**. Flowering plants have developed many devices to discourage self-pollination & encourage cross-pollination such as

Bearing unisexual flowers **Unisexuality**

Anther & stigma mature at different times **Dichogamy**

Anther & stigma placed at different positions **Heterostyly**

Pollen grains of a flower do not germinate on the stigma of the same flower **Selfincompatibility**

Artificial Hybridisation

Types of cross-pollination performed by man for crop improvement. Achieved by

i) Emasculation i.e. removal of anthers from the flower bud of a bisexual flower before the anther dehiscence using a pair of forceps and

ii) Bagging i.e. covering the emasculated flowers with a bag of suitable size to protect them from contamination with unwanted pollen

If flower is unisexual, emasculation is not needed. Flower bud bagged & when the stigma becomes receptive, pollination is done using desired pollen & the flower is rebagged

Pollen –pistil Interaction

- i) All the events from pollen deposition on the stigma until the entry of the pollen tube into the ovule are together called pollen-pistil interaction.
- ii) It is a dynamic process involving pollen recognition by stigma/pistil for compatible pollen by accepting them and if incompatible rejecting them.

Chapter 2

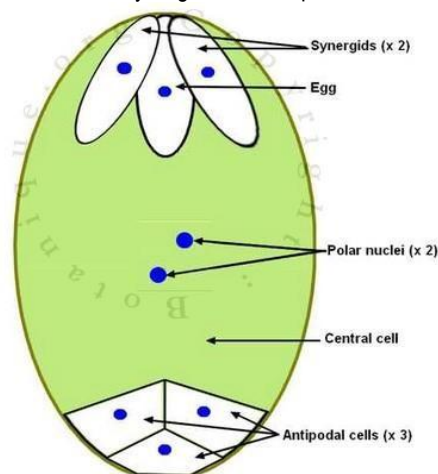
Sexual reproduction in flowering plants

One word answer questions (1 mark only)

1. The single layered inner most nutritive layer of microsporangium is
2. The pollination occurs between two flowers of same plant is
3. Name a flower shows cleistogamous condition.
4. The most common type of dicot embryo is
5. The ploidy of angiospermic endosperm is

Very short answer questions (2 marks)

1. How can you distinguish between Xenogamy and geitonogamy?
2. How can we say that PEN is the result of triple fusion?
3. Why cellular endosperm is the most common type of endosperm in Plant kingdom?
4. Name the ploidy of meiocyte cells, which undergoes meiosis division for the development of mature embryo sac and show it diagrammatically .
5. What will be the adaptive features in an anemophyllus flower?
6. Distinguish b/w :
 - a) Apomixis & parthenogenesis
 - b) Syngamy & triple fusion
7. Why is bagging essential during artificial hybridization?
8. what type of pollination will take place if plant shows self incompatibility?
9. observe the diagram carefully and answer the following questions a):is it a fertilized or unfertilized embryo sac?
 b) how many cells & nucleus are there in the embryo sac?
 c) mention the fate of polar nuclei , synergids and antipodal cells.



Embryo sac of an Angiosperm

PREVIOUS YEARS CBSE QUESTIONS

Very Short Answer Type Question

1. Only the functional megaspore develops into embryo sac. What type of development would you call it? (CBSE-20 12)

Ans: Megasporic development.

2. What is the main function of sporopollenin? (CBSE-2013)

Ans: It is the hardest known substance and helps in fossilisation of pollen grains.

3. Banana is the parthenocarpic fruit where as oranges show polyembryony. How are they different from each other with respect to seeds? (CBSE14)

Ans:

Banana	orange
This parthenocarpic fruit is seedless.	The ovule contains many embryos in a seed.

4. An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give one reason. (CBSE-2016)

Ans: Because the tapetum nourishes the developing pollen grain.

5. The meiocyte of rice has 24 chromosomes. How many chromosomes are present in endosperm of rice? (CBSE12)

Ans: 36 chromosomes (12X3)

Short Answer Type Questions (2 Marks Each)

1. What do you technically call the water that you drink and the kernel that you eat in a tender coconut? (CBSE-2011)

Ans: -coconut water is free nuclear endosperm.

-The white colored kernel that we eat is cellular endosperm.

2. Cleistogamous flowers of Commelina are invariably autogamous. Mention one advantage and one disadvantage to the plant. (CBSE-2013)

Ans: ADVANTAGE: -The seeds are produced even in the absence of a pollinator.

DISADVANTAGE: There is no chance of cross pollination on the stigma of the flower that is cleistogamous.

3. Why is an apple called a false fruit and a banana a parthenocarpic fruit? Explain. (CBSE14)

Ans: Apple is an enlarged thalamus and not developed from the ovary.

Banana develops without fertilization.

4. Distinguish between geitonogamy and xenogamy. (CBSE-2013)

Ans:

Geitonogamy	Xenogamy
Transfer of pollen grains from anther of flower to stigma of another flower of same plant. No opportunity for genetic recombination and genetic viability	Cross pollination It provides opportunity for genetic recombination and genetic viability.

5. Name the blank spaces a, b, c and d from the table given below

Item	What it represents in the plant
Pericarp	a
b	Cotyledon in the seeds of grass family
Embryonal axis	c
d	Remains of nucellus in a seed

- Ans: (a) wall of ovary
 (b) scutellum
 (c) At lower end coleorhiza and above coleoptile.
 (d) Perisperm

Short Answer type Questions (3 marks each)

1. Write the advantages of cross pollination (CBSE- 2015)

- Ans: (i) Improved varieties
 (ii) Introduction in variations
 (iii) healthy and vigorous seeds.
 (iv) High yield seed

2. Trace the development of megaspore mother cell up to the formation of a mature embryo sac in a flowering plant. (CBSE- 2013)

Ans: NCERT Pg 26 Fig: 2.8

3. Define apomixis. Mention two applications of apomicts to hybrid seed industry. How is it different from polyembryony?

Ans: Apomixis: It refers "to the development of the seed without fertilization". It is a form of asexual reproduction. It mimics to the sexual reproduction of higher plants

IMPORTANCE OF APOMIXIS:

- (a) Apomicts have many advantages in agriculture and horticulture.
 (b) It has increase productivity.
 (c) It is important to hybrid seed industry.

Apomixis	Polyembryony
Development of seeds without fertilization.	It is occurrence of more than one embryo in a seed.
Example grass family	Example citrus

4. Draw the embryo sac of a flowering plant and label (CBSE 2015)

- (i) central cell
 (ii) chalazal end of the embryo sac
 (iii) synergids

Ans: NCERT Pg NO 26 Fig c

LONG ANSWER TYPE QUESTIONS (5 MARKS EACH)

1. (a) Draw a schematic labelled diagram of a fertilized embryo sac of an angiosperm
 (b) Describe the stages in embryo development in a dicot plant. (CBSE -2011)

Ans: Discuss and explain the diagrams NCERT Pg No. 26 fig:2.8 (b) & pg No 34 fig 2.13

2. Draw a labelled diagram of an anther lobe at microspore-mother cell stage. Mention the roles of different wall layers of anther? (CBSE- 2014)

Ans: NCERT pg no. 22 fig: (a) & (b)

Also write the functions of epidermis, endothecium, middle layers, tapetum

3. Give reasons why:

- (i) Most zygotes in angiosperms divide only after certain amount of endosperm is formed.

- (ii) Groundnut seeds are exalbuminous and castor seeds are albuminous.
- (iii) micropyle remains as a small pore in the seed coat of a seed.
- (iv) integuments of an ovule harden and the water content is highly reduced, as the seed matures.
- (v) Apple and cashew are not called true fruits.

Ans: (i) adaptation to give assured nutrition to the embryo for development – provide nourishment.

- (ii) Groundnut seed – fully absorbed during the development of embryo.
Castor seed not fully used.
- (iii) micropyle – small pore – entry of oxygen and water for seed germination.
- (iv) Integuments harden – water content reduced on maturity – metabolic activities slow down – embryo enters dormant stage.
- (v) Instead of ovary, thalamus participates in fruit formation.

VALUE BASE QUESTIONS (4 MARKS EACH)

1. Vishal went to the market with his mother to buy fruits. He saw a fruit seller selling green coconuts. His mother purchased 4 coconuts for the family to drink its milk at home. She told Vishal that coconut is a useful tree and provides livelihood to a large section of people across the country.

Read the above passage and answer the following questions.

- (i) What is the nutritive value of coconut milk?
- (ii) What is the morphological nature of coconut milk?
- (iii) Why did Vishal's mother say that coconut is a useful tree?
- (iv) Which type of reproduction is involved in the formation of coconut milk?

Ans: (i) Rich in nutrients, amino acids, vitamins, sugars and growth factors.

(ii) It is liquid endosperm

(iii) Coconut is a source of oil, coir fibre used in thatching huts in coastal areas and used to eat, and worshiping god.

(iv) Sexual reproduction – One male gamete with two polar nuclei (Endosperm)

2. Raghav noticed that in ATAL PARK flowers of same species were different in one or the other characters from the flowers growing in his house garden. He was surprised and asked the gardener (Ramesh) of the ATAL PARK who was carefully removing anthers from some flowers. The gardener explained him emasculation and bagging to obtain desired variety of flowers. Now answer the following questions.

- (i) Name the technique used by ATAL PARK gardener.
- (ii) Give one commercial use of this technique.
- (iii) What information is required for using this technique?
- (iv) What value is displayed by Ramesh?

Ans: (i) Artificial hybridization

(ii) Commercial production of ornamental plants

(iii) knowledge about sexual reproduction and life cycle of flowering plants species

(iv) Ramesh is an experienced gardener and keen to explain his techniques to Raghav on observing his curiosity.

3. When you visited a garden a month back, you saw a number of moths, butterflies, dragonflies, etc. hovering round the flowers/plants and many ants, other insects and some worms in the soil. Now, after a month or so, when you happen to visit the same garden, to your dismay, you don't see any butterflies or dragonflies or the ants in the soil. The gardener said he had used some 'medicines' to avoid the insects causing damage to the plants.

(a) Was it a wise decision ?

(b) How would the yield from the garden be affected ? Explain with reasons.

(c) Can this act of the gardener cause any health problems to the consumers ?

Explain the value of organisms.

Ans: (a) no

(b) will be reduced because insects like butterflies, dragonflies etc. helps in pollination.

(c) yes, because insecticides used to kill the insects are non-biodegradable, also effects our health.

HOTS

1. Do you think the microspore and pollen grains are the same structures. If not give reason.

Ans- No, diploid microspore mother cell---meiosis---4 haploid microspores---tetrads---each microspore has haploid nucleus---nucleus divides mitotically---2 haploid nuclei inside the spore---2 celled spore---large tube cell and small generative cells---this is young male gametophyte called pollen grain.

2. Name the following structures---

(a) Single cotyledon of the monocot embryo of grass family

(b) portion of the embryonal axis above the level of cotyledons in dicot embryo.

(c) Occurrence of more than 1 embryo in a seed

(d) seedless fruits produced without fertilization.

Ans-(a) Scutellum

(b) epicotyl

(c) polyembryony

(d) parthenocarpic fruits

3. Two students A and B received unknown floral parts. Characteristics of part received by A are it is 7 celled 8 nucleate structure developed from single megaspore.

Characteristics of part received by B are—it is haploid and contains male gametophyte it has 2 wall layers in which outer one is made up of sporopollenin.

Ans-A received embryo sac and B received pollen grain.

Chapter-3 HUMAN REPRODUCTION

Ref.: Concept map: Page-C1 & C2

The Male reproductive system

1. Penis

- a. Urination
- b. Sexual intercourse
 - 1. Corpus cavernosum- spongy tissue that fills with blood to make penis erect
 - 2. Glans- the head, end of penis
 - 3. Foreskin
 - i. Covers glans,
 - ii. May be removed surgically in an operation (circumcision)

2. Scrotum

- a. Located behind penis
- b. Contains two testes
- c. Temperature sensitive (Sperm must be made in cooler conditions i.e, 2-3° C lower than bodytemperature)

3. Testes

- a. Sperm is produced by the seminiferous tubules due to FSH
- b. Testosterone is produced by Leydig cells due to LH
 - 1. Causes the development of the male sex organs at ~8 weeks after conception.
 - 2. Responsible for facial, armpit, and pubic hair, bone growth and muscular development.
- c. Testes formed in the abdomen before birth. Descend through the "inguinal canal" during fetal or post-natal life. Sometimes it may take months/years to reach right place. Possible site for hernia.

4. Epididymis: Stores sperm until they have matured.

5. Vas deferens: Tube that leads from the epididymis to the urethra.
Many sperm cells are stored here too.

6. Prostate gland: Provides an alkaline fluid that can protect sperm from harsh vaginal acids.

7. Seminal Vesicles: Produce food for sperm. Food "Fructose"

8. Cowper's gland: Produces clear lubricating fluid

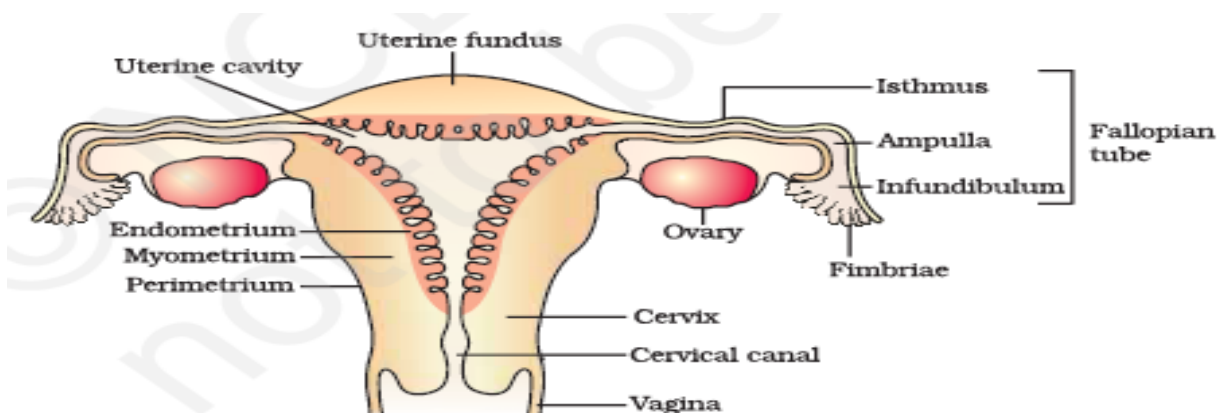


Figure 3.3 (b) Diagrammatic sectional view of the female reproductive system

The Female Reproductive System

Ovary:

- i) Each ovary contains immature ova (eggs) in follicles.
- ii) Females born with lifetime supply of eggs(250,000-400,000 in each ovary)
- iii) Ovaries release ovum -. Almost all ova degenerate between birth and puberty.
- iv) Approx. 400 eggs will be ovulated over woman's life.
- v) Egg is the largest human cell.
- vi) Ovaries are located lower abdomen. 1 left and 1 on the right.

Fallopian tubes

- i)Two thin tubes attached to the upper sides of uterus
- ii) Tubes terminate near the ovaries but are not attached
- iii)"Fimbriae" are finger-like structures on the end of each tube
- iv)Tubes conduct egg to uterus by use of small hairs called "cilia"
- v)**Fertilization** of ovum takes place in the **ampullary-isthmic junction of the fallopian tubes**.
Egg - viable for only 24-48 hours after ovulation.

Uterus:

- i)**Pear-shaped** organ located in lower abdomen
- ii)**Muscles**(myometrium) stretch to allow baby to develop. Oxytocin starts labor contractions.
- iii)**Lining of uterus** (endometrium) thickens with blood-rich tissue due to progesterone
- iv)**Endometrium** supports embryo/foetus during growth
- v)**Placenta** It is the interface between baby and mother. If not pregnant, lining breaks down and is discharged from *body* through vagina. This is **menstruation** (period)
- vi)**Cervix connects uterus to vagina**. Like a door that opens during ovulation. Cervical mucous closes the door at all other times.

Vagina:

Birth canal:

- i)**Menstrual** blood leaves the body
- ii) Organ of intercourse
- iii) Muscular stretches to allow a baby to grow
- iv)Vaginal opening partly remains closed by thin membrane of tissue called **hymen**. May be stretched or torn during any physical activity

Cervix:

- i) Located at inner end of vagina
- ii) Opening of uterus into vagina
- iii) Mucous prevents bacteria and viruses from entering uterus
- iv) Lets sperm into uterus after ovulation
- v) Where baby also passes through during vaginal birth

Labia:

2 layers of skin, which fold over the opening to vagina and urethra

- ii) Inner labia (**labia minora**)
- iii) Outer labia (**labia majora**)
 1. Two folds of skin, surround vaginal area
 2. Pubic hair grows on outer labia

Clitoris:

- i) Small organ, 5 to 10 millimeters long
- ii) Located at junction of inner labia near front of body
- iii) Contains erectile tissue & sexually sensitive

Mons pubis : Cushion like fatty tissue covered by skin and pubic hair

Gametogenesis & its hormonal regulation :

Ref: Concept Map Page C3

Differentiate between: Spermatogenesis and Oogenesis :

Spermatogenesis	Oogenesis
Produces male gametes (sperm)	produces female gametes (oocytes)
–occurs in the seminiferous tubules (in testes)	–occurs in the ovaries
–involves meiosis –occurs throughout life after puberty	– involves meiosis occurs after puberty until menopause
may produce 400,000,000 per day	–humans normally produce one oocyte during each ovarian cycle
Primary spermatocyte divide equally to form two similar secondary spermatocytes	Primary oocyte divide unequally to form one large secondary oocyte and a small polar body
One spermatogonium produces 4 functional spermatozoa	An oogonium produces one functional ovum and 3 non functional polar bodies

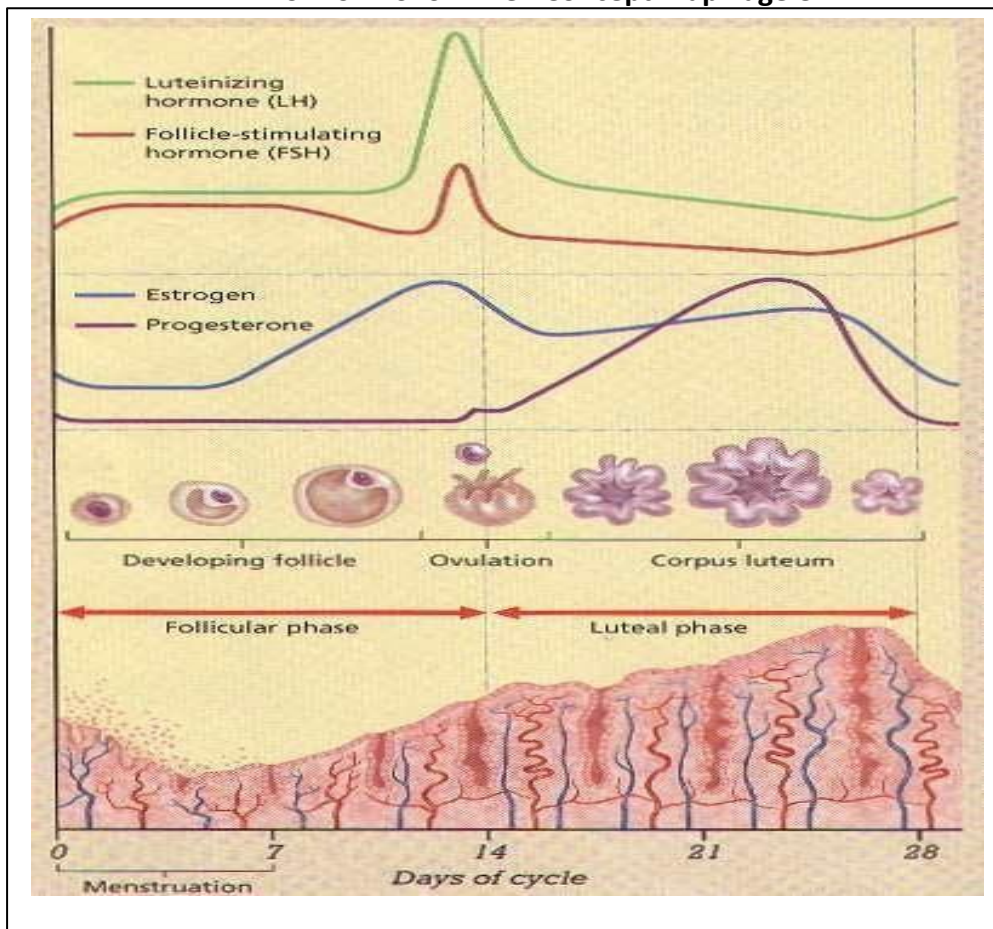
2) Follicular phase (Proliferative phase) and Luteal phase (Secretory Phase)

Proliferative phase	Secretory Phase
Follicular phase	Luteal phase
Stage of repair and proliferation	Prepares endometrium for implantation
It extends from the end of menstruation to ovulation	It extends after ovulation to menstruation
LH and FSH increases	LH is high (LH surge)
Estrogen level increases	Progesterone level increases
Estrogen is secreted by Graffian follicle	Progesterone secreted by corpus luteum

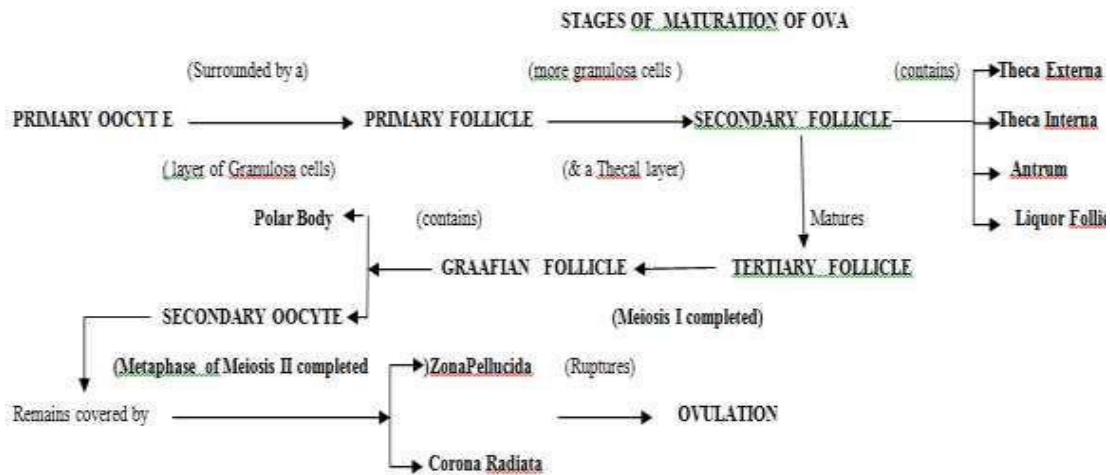
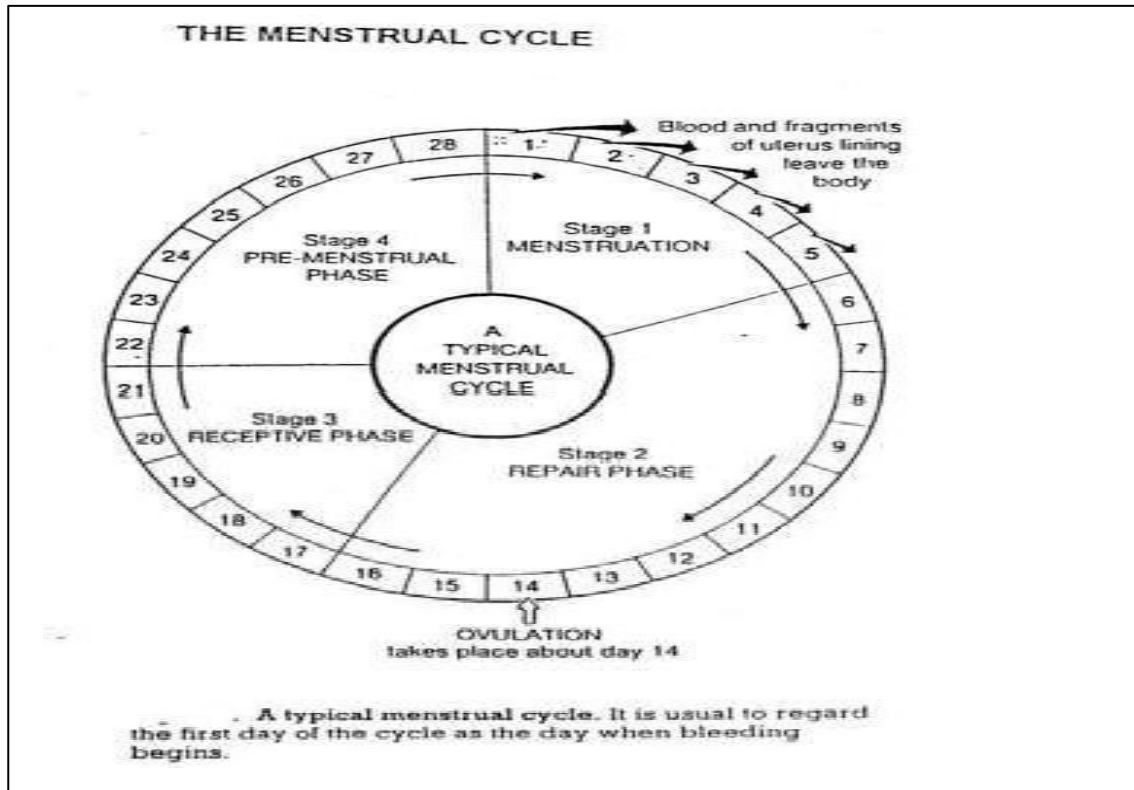
Menstrual Cycle

Menstruation →	Repair of the endometrium →	Ovulation →	Thickening of the endometrium →	Breaking down →
Follicular Phase FSH/Estrogen		Due to LH	Luteal Phase LH/Progesterone	

MENSTRUAL CYCLE: Ref. Concept Map Page C 4



Functional Activities of FSH and LH



DEVELOPMENT OF OVARIAN FOLLICLE

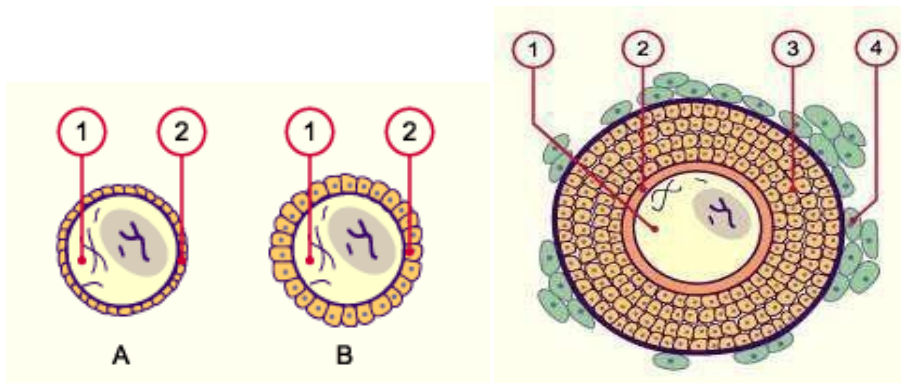
FSH and LH from the pituitary:	FUNCTION / PRODUCTION	
	In Females	In Males
Hormone		
FSH Controls →	Eggs + Estrogen	Spermatogenesis
LH Controls →	Ovulation + Corpus Luteum	Testosterone

From Primordial Follicle to Tertiary Follicle

Primordial follicle: The surviving primary oocytes, at birth, are surrounded by **thin, single layers cells** of so-called follicular epithelial cells.

Primary follicle

The primordial follicles while developing into primary follicles the follicular epithelium that surrounds the oocyte becomes **iso-** to highly **prismatic**



- A Primordial follicle
- B Primary follicle
- 1 Oocyte
- 2 Follicular epithelium

- 1 Oocyte
- 2 Pellucid zone
- 3 Stratum granulosum
- 4 Theca folliculi cells

Secondary follicle

Secondary follicles with follicular epitheliums encompassing **multiple rows** are formed called the **stratum granulosum**. **Pellucid zone**, between the oocyte and follicular epithelium becomes visible.

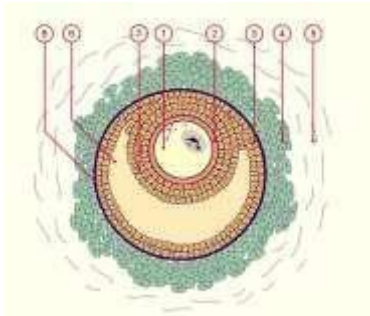
Tertiary follicle

A well-developed net of capillaries in the theca interna.

Antrum – a fluid filled cavity develops

The **theca** layer organized into Theca internal & Theca external



Tertiary follicle

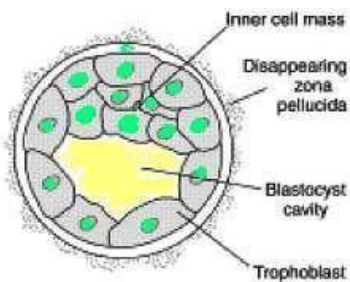




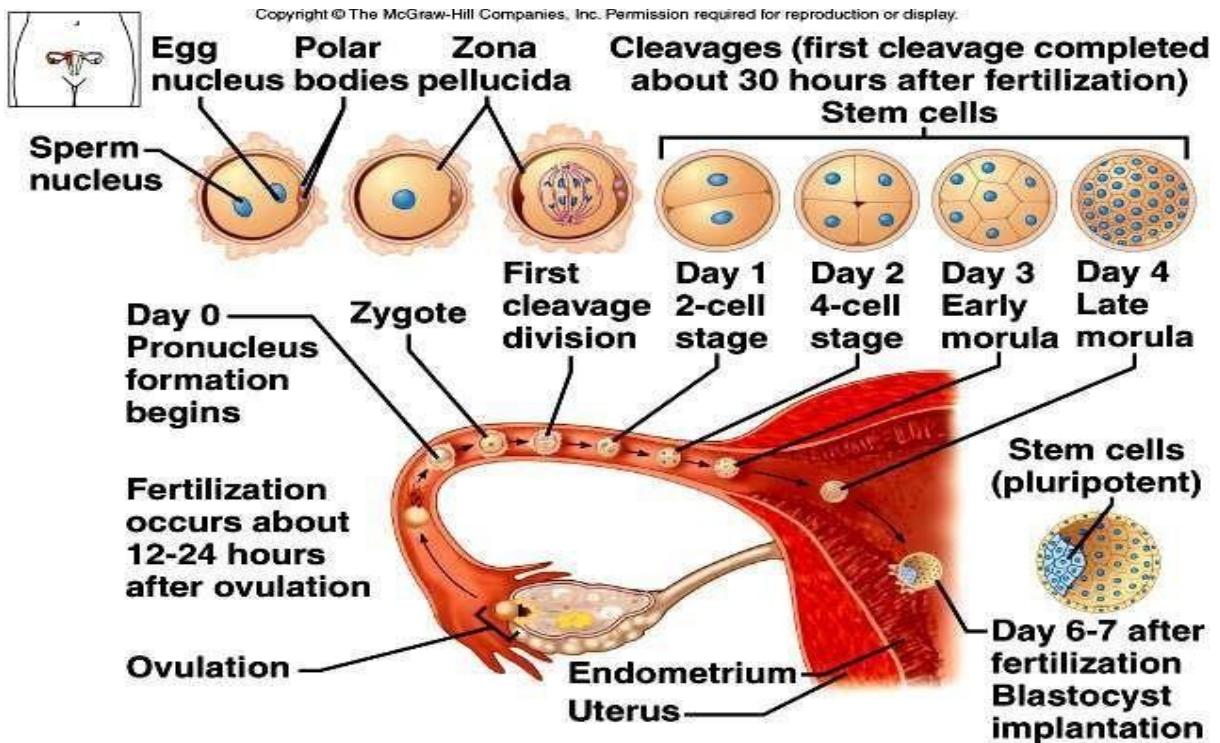
- 1 Oocyte
- 2 Pellucid zone
- 3 Stratum granulosum
- 4 Theca interna
- 5 Theca externa
- 6 Antral follicle
- 7 Cumulus oophorus (Granulosa cells, together with the oocyte)
- 8 Basal lamina between theca and stratum granulosum

Conception to Birth

The following shows some of the many stages of human development:

Zygote		The single cell that results from fertilization of an ovum by a sperm.
Morula		<p>*The morula (little mulberry)</p> <ul style="list-style-type: none"> • Solid ball (16 → 64 cells). • Morula arises from mitotic (cleavage) divisions.

Blastocyst		<p>The blastocyst is a liquid-filled ball of cells. Occurs around 5 – 8 days after conception. Implantation in the endometrium occurs at this stage.</p>
Embryo		<p>Human considered an embryo from implantation until about 8 weeks after conception.</p>
Foetus		<p>8 weeks after conception until birth.</p>



Fate of three germ layers

Ectoderm	Mesoderm	Endoderm
Nervous system	Skeleton	Digestive tract
Epidermis of skin	Muscles	Respiratory system
	Circulatory system	Liver, pancreas
	Gonads	Bladder

Mnemonics

Tubules in male reproductive system

–SEVEN UPII

Seminiferous tubules

Epididymis

Vas deferens,

Ejaculatory duct

(Nothing)

Urethra

Penis

Menstrual Cycle

–FOL(d) M(a)PSII

Ovarian cycle:

Follicular phase

Ovulatory phase

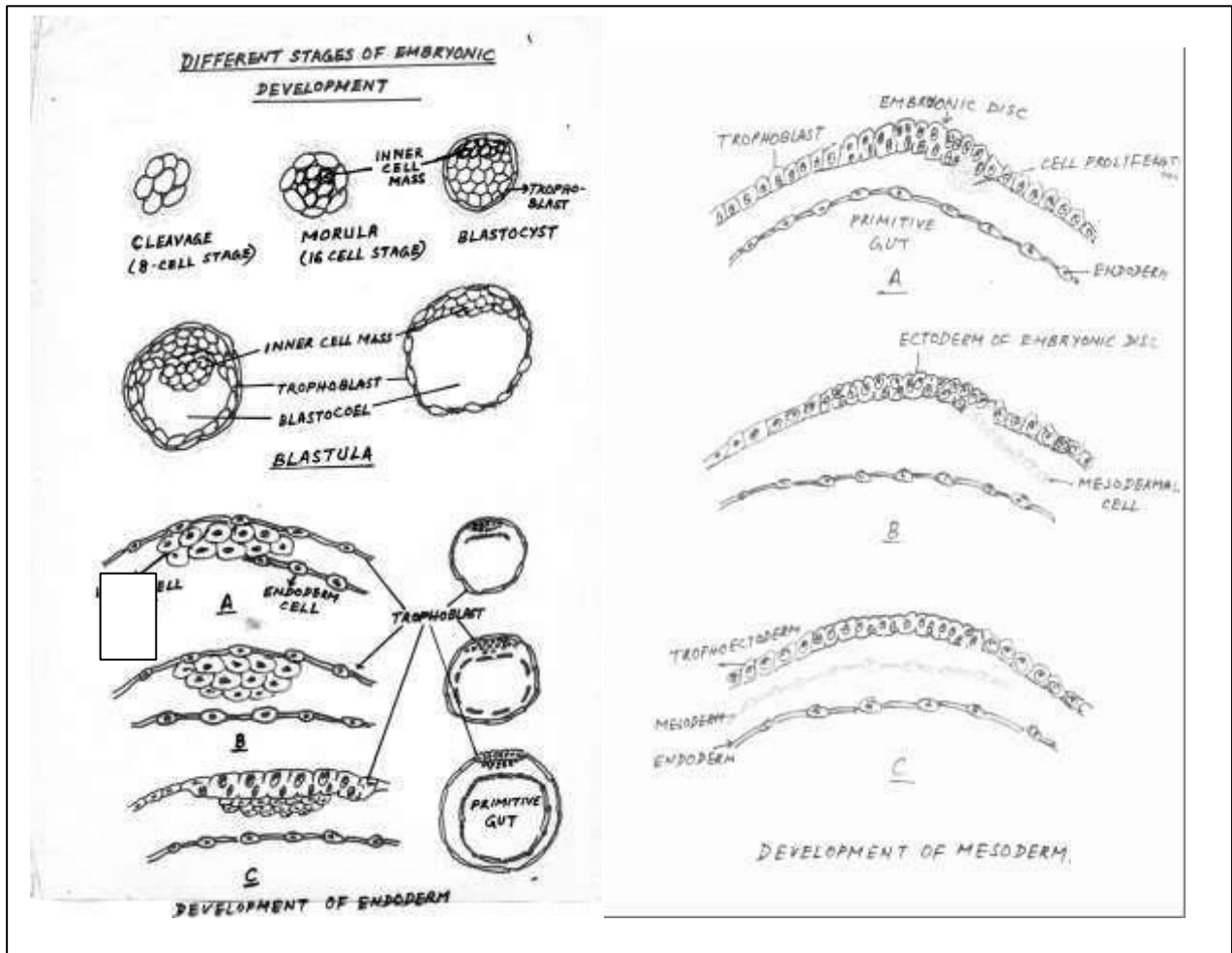
Luteal phase

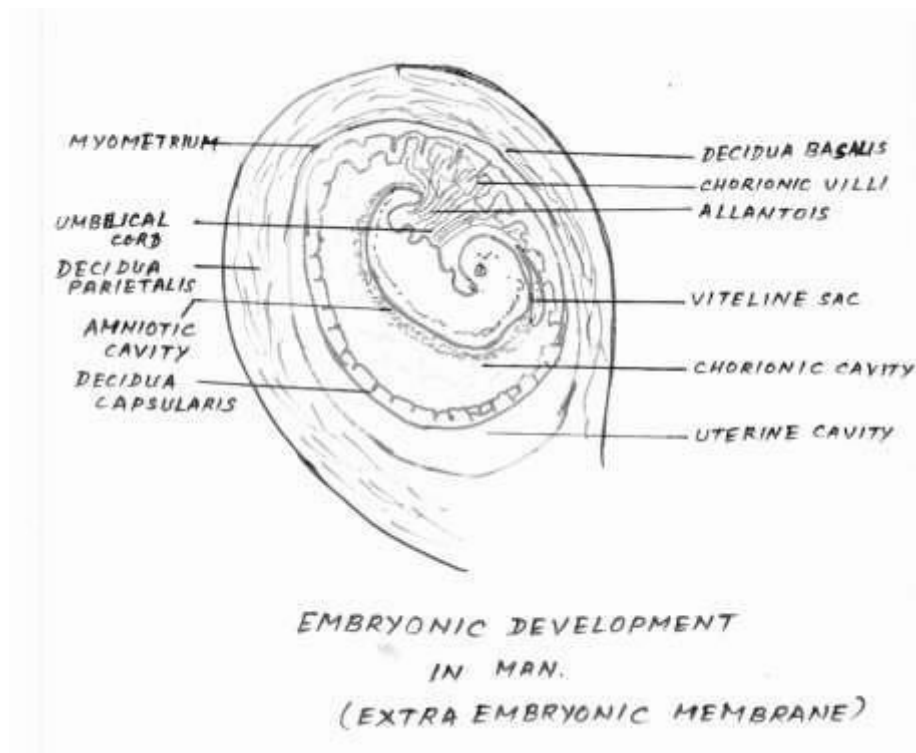
Menstrual cycle:

Menstrual flow,

Proliferative phase

Secretory phase





TERMS TO REMEMBER

Acrosome- the part of a sperm cell that contains an enzyme – (This enables a sperm cell to penetrate an egg.)

Afterbirth-placenta and fetal membrane expelled from the uterus after the birth of a baby

Amniotic sac-fluid-filled membrane or sac that surrounds the developing embryo while in the uterus.(protects baby from hard shocks, keeps it at a constant temperature.)

Birth-the process of being born. Process by which baby moves from the uterus into the outside world
(**Parturition**)

Blastocyst = blastula = early stage of an embryo; a liquid-filled sphere whose wall is composed of a single layer of cells; during this stage (about eight days after fertilization) implantation in the wall of the uterus occurs.

Cervix- lower part, or neck, of uterus. (Opening to the uterus.)

Clitoris-small, sensitive organ in front of the vagina

Coitus-synonym for sexual intercourse

Conception-fertilization of an egg cell by a sperm cell

Corpus Luteum - After ovulation, this crater-like structure produces progesterone and estrogen. The corpus luteum is the old RUPTURED GRAFFIAN follicle. It means—yellow bodyll.

Cowper's glands - 2 glands that secrete an oily liquid, which cleans and lubricates the urethra of the male

Egg cell-a female sex cell (female gamete or ovum or **secondary oocyte**)

Ejaculation-the discharge of semen from the penis

Embryo-the unborn child developing in the uterus between the second and eighth weeks of life

Endometrium - the lining for the uterus – site for blastocyst implants and develops.

Epididymis-the tightly coiled tube at the back at each testis that holds newly created sperm – (each epididymis is like a nursery where sperm mature and learn to swim.)

Erection- condition of penis when it fills with blood and becomes firm, enlarged, and erect.

Fallopian tubes -tubes leading from each ovary to the uterus. Tubes carry the egg from ovary to the uterus. Fertilization occurs here. (Also known as the **oviducts**.)

Fimbria - A **fimbria** (plural **fimbriae**) Latin word, literally means "fringe." a fringe of tissue near the ovary leading to the fallopian tube

Fertile- able to conceive a child

Fertilization union of sperm and egg. Conception.

Fertilized egg- egg after sperm has united with it. Zygote.

Fetus-unborn child developing in the uterus after the first eight weeks of life

Follicle - In ovaries. Each holds and nourishes an egg until ovulation. Nest. Becomes corpus luteum after ovulation.

Foreskin – A sheath of skin that surrounds the penis.

Follicle Stimulating Hormone - secreted from pituitary gland in both men and women. In women, FSH promotes the development of eggs and estrogen. In men, FSH promotes the development of sperm cells.

Fraternal twins-babies that develop from two eggs, each fertilized by a sperm cell; may or may not be of the same sex

Gamete – a sex cell. Sperm cells and egg cells are gametes.

Genitals-the reproductive or sex organs, especially the external organs

Germ Cell- egg or sperm cell (Gamete). In humans, germ cell contains 23 chromosomes

Hormones-chemical substances produced by the endocrine glands; they act in other parts of the body and affect maturation, growth, and behavior; LH, FSH, GH, Testosterone, Estrogen, Progesterone are all hormones.

Hymen-a thin bit of tissue, or membrane that may partially cover the opening of the vagina

Identical twins-babies that develop from a single fertilized egg that separates into two halves; identical twins are always of the same sex

Labia-two folds of skin surrounding the entrance of vagina

Labor-the muscular contractions that expel a baby from uterus during childbirth

Leydig Cells – when prompted by LH, Leydig cells create testosterone.

LH - Luteinizing Hormone - Secreted from pituitary gland, causes ovulation and formation of corpus Luteum in women. In men, LH causes Leydig cells to produce testosterone.

Menstrual cycle - periodic building up and sloughing off of lining of uterus approximately every twenty-eight days

Menstruation-the periodic discharge of blood and waste material (unfertilized secondary oocyte / ova and the degenerating endometrium lining) from the uterus

Miscarriage- expulsion from the uterus of a fetus before it is developed sufficiently to live Also called spontaneous abortion

Myometrium – muscles of the uterus that stretch to accommodate the growth of the baby. These muscles contract during labor and push baby out.

Orgasm-the peak of sexual excitement when the male ejaculates semen,

Ovary- female sex glands; they produce egg cells, estrogen and progesterone.

Ovulation-the discharge, or release, of an egg cell / secondary oocyte from the ovary

Ovum-scientific name for an egg cell / secondary oocyte

Oxytocin - hormone, released from the pituitary gland , stimulates contraction of the myometrium of the uterus during labor and facilitates ejection of milk from the breast during nursing.

Penis-the male sex organ through which sperm cells leave the body; it also discharges urine

Placenta- network of blood vessels and other tissues by which the unborn child is attached to the wall of the uterus.grows out of the endometrium The umbilical cord is attached to it. It is the interface between mother and developing fetus.

Pregnancy-the process in a woman from conception to birth

Pregnant-the condition of a woman with an embryo or fetus in her uterus

Progesterone – pregnancy hormone, which is first produced by the corpus luteum and then by the placenta.

* increases lining of endometrium.

*maintains pregnancy

*helps develop mammary glands.

Prostate gland- surrounds the upper end of male urethra and produces part of the fluid that mixes with the sperm to form semen. Prostate fluid alkaline helps to protect sperm from vaginal acids.

Scrotum- pouch of loose skin containing the testes. Houses and air-conditions the testicles by moving and sweating.

Semen-the mixture of sperm and fluids released during ejaculation. Semen comprised of sperm, fructose, prostate fluid and oil from Cowper's gland.

Seminal vesicles-small saclike organs opening into each vas deferens near the upper end of the urethra; produce part of the fluid that mixes with the sperm to form semen; provide food (fructose) for the sperm.

Seminiferous tubules - tubes in testes that produce sperm

Sexual intercourse- entry of penis into vagina and subsequent release of semen; also called coitus

Sperm-the male sex cell (male gamete or spermatozoon), which contains 23 chromosomes in human.

Spermatozoon-scientific name for sperm

Spontaneous abortion--synonym for miscarriage

Testes- male sex glands; produce sperm cells and testosterone;

Testicles-synonym for testes

Testosterone – male hormone that regulates development of penis, muscles, body hair, change of voice.

Umbilical cord- ropelike structure connecting embryo or fetus to placenta within the uterus.

Urethra-the tube through which urine is expelled from the bladder in both males and females and through which semen leaves the male body

Uterus = womb - the hollow pear-shaped organ in which a baby develops before it is born;

Vagina- passage from the uterus to the outside of the body, accepts the penis during intercourse. It is the birth canal & menstrual fluids leave through it

Vas deferens- tube extending from each epididymis to the urethra in males

Womb-synonym for uterus

Yolk sac-a structure that develops for the nutrition of embryo during early embryonic life and then ceases to function

Zygote - The cell formed by the union of two gametes. [fertilized ovum before cleavage.]

IMPORTANT NOTES

- An adult male produces over 10^{12} to 10^{13} sperms each day.
- Human female oogonial development by mitosis is completed by 25 weeks of foetus and no oogonia are formed after birth.
- Sperm entry into the ovum stimulates MPF (M phase promoting factor) & APC (Anaphase promoting complex) for completion of Meiosis II.
- During Spermatogenesis, spermatogonium produces four sperms while in oogenesis, oogonium produces one ovum and two polar bodies.
- Human Sperm contains Clupein proteins.
- Yolk nucleus: A mass of mitochondria and golgi bodies near nucleus is called as yolk nucleus and controls vitellogenesis.
- Maximum level of estrogen – 12th day, LH-13th day, Progesterone – 21st day, Corpus luteum formation – 19th day of menstrual cycle.
- Menstrual cycle is absent during pregnancy, lactation periods and permanently during menopause.
- Two ovaries alternate in ovulation.
- 13 mature eggs are released per year, so about 416 eggs (13x32 years) are ovulated during whole reproductive period of human female.
- Menstruation is also called –Weeping of uterus for the lost ovum or Funeral of unfertilized eggs.
- In human embryo, yolk sac degenerates since egg is microlecithal, which shows evolutionary significance.
- Placenta acts as a physiological barrier and an ultra-filter between foetal and maternal blood.
- Progesterone is also called pregnancy hormone since its secretions control pregnancy.
- Teratogens are physical, chemical, biological agents which may cause malformation in developing embryo.
- Period between fertilization and parturition is called gestation periods. Varies between 266 days up to 280 days (49 weeks)

TEST Questions

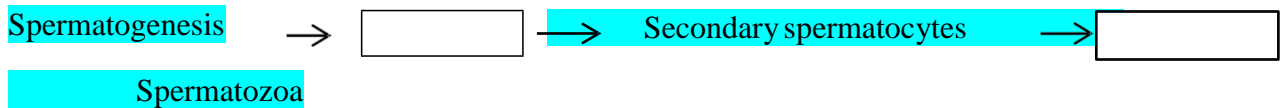
1) Zygote undergoes mitosis to form 16 celled embryo. What is the stage known as? (1)

Hint-Blastomeres.

2) Name the important mammary gland secretions that help in resistance of the new born baby. 1)

Hint-Colostrum

3) Fill in the boxes



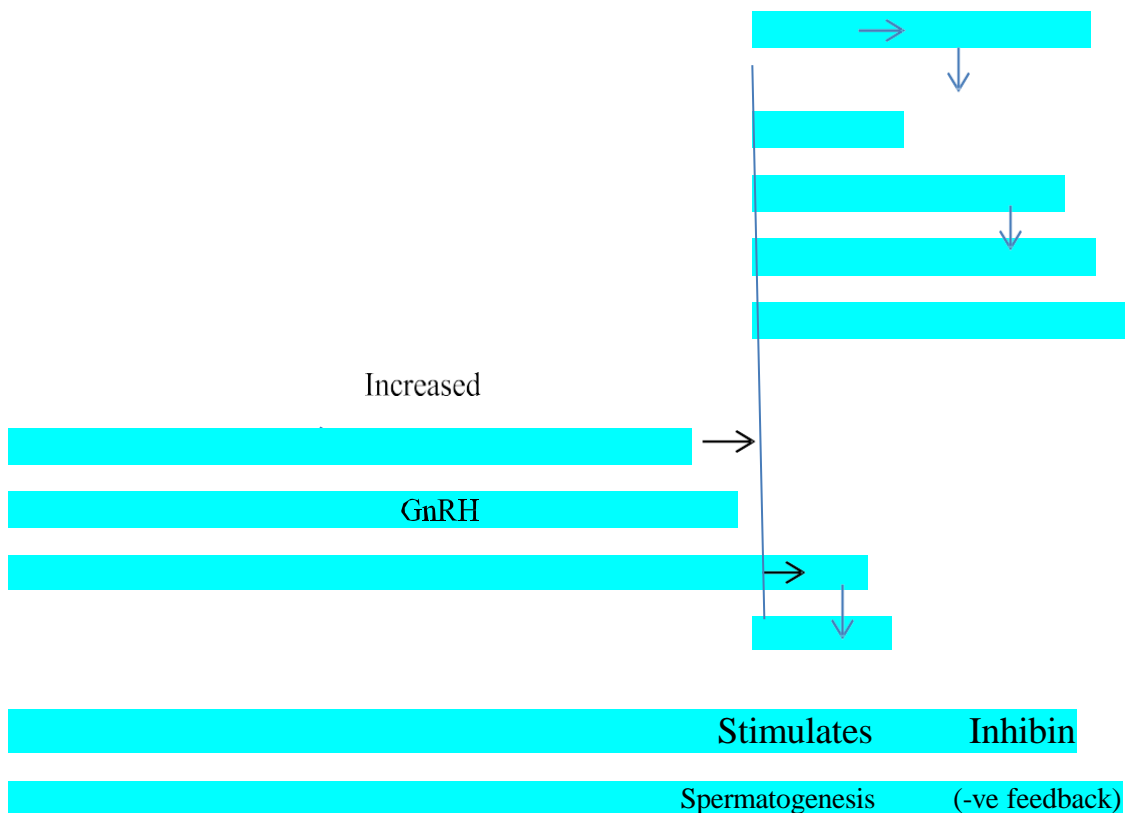
4) Why does fertilization take place in fallopian tube and not in the uterus.(2)

Hint-ovum and sperms must be transported to the ampullary –isthmic region simultaneously for fertilization.

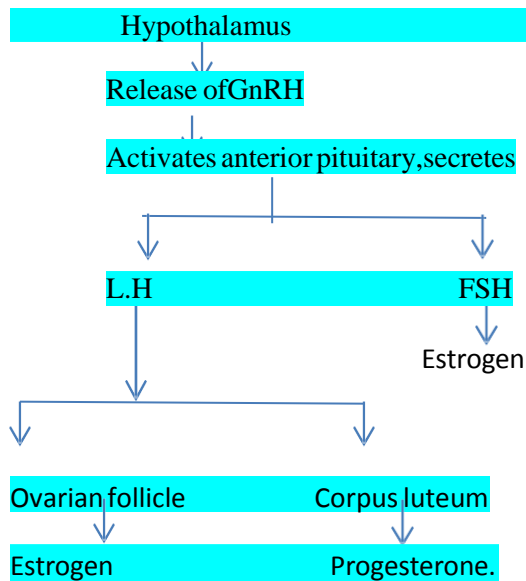
5) Which cell organelle is present in the neck of the sperm? What is its significance? (2)

Hint-Acrosome, enzymes.

6) Give Hormonal regulation for spermatogenesis? (5) Hint-



7) Give hormonal control for Oogenesis? (5) Hint-



Q.8. Where does fertilization occur? What is the name of divisions in the isthmus region of fallopian tube?

Q.9. Name the hormone secreted from empty tertiary oocyte and what is the future of such structure?

Q.10. Name the hormones secreted during pregnancy.

Q.11. Which part of blastocyst help in the formation of placenta? Give one more function of this layer.

PREVIOUS YEAR CBSE QUESTIONS:

Very short answer type questions (One Mark)

1. Which part in the male reproductive system stores sperms? (CBSE-2012)

--- **Seminal vesicle**

2. When a male is known as sterile?

----- **Nil sperm in Semen**

3. What is the site for spermatogenesis?

--- **Seminiferous tubules in Testis**

4. In which part corpus luteum is formed? (CBSE-2014)

---- **Ovary**

5. Name the site of fertilization in humans? (CBSE-2013)

----- **Ampullary Isthmic Junction of Fallopian tube**

Short answer type questions (Two Mark)

1. Describe the terms menarche and menopause. (CBSE-2015)

---- **Commencement and stoppage of menstrual cycle respectively**

3. Where are leydig cells located? Which hormone they secret?

---- **In Interstitial space of Testis.... Testosterone hormone**

4. What is pregnancy hormone? Why it is called so?

----- **Progesterone..... Maintain endometrium of uterus throughout the gestation period**

4. Define (i) Insemination (ii) Gestation

----- **(i) Transfer of sperm in female uterine tract (ii) Period from formation of zygote to birth of child**

5. Give any four functions of placenta. **NCERT page 53** (CBSE-2012)

Short answer type questions (Three Mark)

1. Describe menstrual cycle in detail.

2. How does parturition takes place in humans?

3. Differentiate between spermatogenesis and oogenesis? (CBSE-2014)

4. Describe the events taking place during embryogenesis?

5. How polyspermy is prevented in humans?

Long answer type questions (Five Mark)

1. Differentiate between spermatogenesis and oogenesis in human ? (CBSE-2015)

2. Describe the various stages in the development of human embryo.

3. Describe the following: (CBSE-2016)

- Various stages of Spermatogenesis.
- Various stages of oogenesis
- Hormonal control of spermatogenesis
- Hormonal control of oogenesis.
- Structure of mature ovum.

▪ HOTS

1. Why cleavage is called as fractionating process?

2. Which type of placenta is found in man?

3. Describe the mechanism the prevent polyspermy in human.

Chapter-4: REPRODUCTIVE HEALTH

Reproductive Health:

A total view of human reproductive health is basic to personal well-being as well as to interpersonal relationships.

Adolescents are vibrant, fragile and prone to experimentation and risk taking, as a result they are the most vulnerable population as far as delinquent behavior and attitude is concerned.

Every decision has its own consequence. Any wrong decision can lead to disastrous consequence, which in turn can ruin one's life.

Sexual adjustment is part of total personality adjustment. Self-esteem is the key to sexual maturity.

Broad based community and institutional support for reproductive health is essential.

Adolescence Reproductive and Sexual Health(ARSH) topics are to be taken care of to dispel the myths and misconception about this important aspect with focus on:

- Reducing risky behavior
- Theories which explain what influences people's sexual choices and behaviour
- Reinforced message about sexual behavior and risk reduction
- Providing accurate information about, the risks associated with sexual activity, about contraception birth control, methods of avoiding or deferring intercourse
- Dealing with peer and other social pressures on young people; providing opportunities to practice communication, negotiation and assertion skills
- Uses a variety of approaches to teaching and learning that involve and engage young people and help them to personalize the information
- Uses approaches to teaching and learning which are appropriate to young people's age, experience and cultural background

Methods of birth control

CONCEPT MAP Ref: CH-4 (Page-3)

- **Behavioural methods:** Behavioural methods depend on a good knowledge of the menstrual cycle as well as adequate self control by the couple.
 - **Coitus Interruptus:** Coitus interruptus means 'interrupted sex". In this birth control method, the penis is withdrawn from the vagina just before ejaculation.
 - **Rhythm method or Safe Period:** Method requires a good knowledge of the female partner's menstrual cycle to identify the days on which sexual intercourse is possible without the risk of pregnancy.
- **Barrier methods:** In barrier methods of birth control, a barrier is placed between the penis and the vagina during intercourse so that the sperm cannot meet the ovum for fertilization.
 - **Male Condoms:**, usually made of latex that covers the erect penis during penetration of the vagina.

- **Female Condoms:** made of polyurethane, loose sheath with two rings on either side. can be inserted about 8 hours prior to sexual intercourse and can be kept in for about another 12 hours after intercourse. Can be used more than once during this period.
 - **Condoms protect against pregnancy as well as sexually transmitted diseases (STDs), including HIV/AIDS.**
 - **Diaphragm:** vaginal - a small saucer shaped rubber sheath with a metal coil in its rim which is fitted across the mouth of the uterus (cervix).
 - **Cervical Cap:** The cervical cap is a small dome-shaped rubber device fitted on the cervix. It is uncomfortable to apply and is rarely used nowadays.
- **Hormonal Methods:** Drugs are used to either prevent ovulation or to prevent implantation of the embryo after fertilization.
 - Combined oral contraceptives contains two hormones similar to the natural hormones in a woman's body---an estrogen and a progestin.

How the Birth Control Pill works

Mainly work by preventing ovulation. In a normal menstrual cycle, the pituitary gland secretes the hormones FSH and LH to stimulate the ovary to release an egg ("ovulation").

Progesterone in pills make the cervical mucus hostile to the sperm.

- Causes changes that make the endometrium unreceptive to a fertilized ovum if ovulation and fertilization do take place
 - **Oral Contraceptive pills:** Combined oral contraceptive pills or birth control pills contain two hormones - estrogen and progesterone. They have two functions. The main one is to prevent ovulation. The second function is to disrupt the normal growth of the internal uterine lining (endometrium) so that the embryo cannot implant in it.

Subdermal Implants

The Norplant (a registered trademark of The Population Council for levonorgestrel subdermal implants) Implant system set of six small plastic capsules. Capsules placed under the skin of a woman's upper arm.

Norplant capsules contain a progestin, similar to natural hormone that a woman's body makes. It is released very slowly from all six capsules. Thus the capsules supply a steady, very low dose. Norplant implants contain no estrogen.

Norplant capsules thicken cervical mucus making it difficult for sperm to pass through. It stops ovulation (release of eggs from ovaries) in about half of the menstrual cycles after the first year of use.

Emergency Oral Contraception

After unprotected sex, emergency oral contraception can prevent pregnancy. Sometimes called postcoital or 'morning after' contraception.

Mainly stops ovulation

Regular use of emergency contraceptives has serious health hazards.

Vaginal Pessaries, Tablets, Creams or Foams:

These contain spermicides which are toxic to the sperm and should be inserted into the vagina just before coitus. Their advantages are that they are easy to apply, do not interfere with coitus and act as lubricants. Disadvantage is that they are not very effective always.

Intra-Uterine Contraceptive Devices (IUCD):

IUCDs or IUDs are contraceptive devices which are placed inside the uterus. Small, flexible plastic frame. Has copper wire or copper sleeves on it. Inserted into a woman's uterus through her vagina. Have two strings, or threads, tied to them. Strings hang through the opening of the cervix into the vagina. A provider can remove the IUD by pulling gently on the strings with forceps.

Preventing sperm and egg from meeting. Perhaps the IUD makes it hard for sperm to move through the woman's reproductive tract, and it reduces the ability of sperm to fertilize the egg. Prevent the egg from implanting itself in the wall of the uterus.

IUCDs prevent pregnancy by making the endometrium unreceptive to the fertilized ovum.

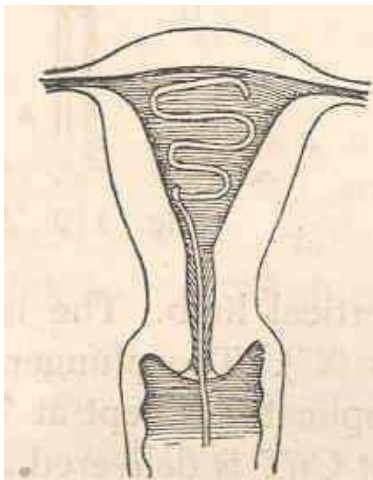
Stimulates the endometrium to release leukocytes (WBCs) and prostaglandins making it hostile to the sperm. Causes bizarre and irregular growth of the endometrium.

Prevents implantation of a fertilized ovum.

IUDs like Copper-T's also come wrapped in copper. Copper is toxic to sperms and is a method of enhancing the contraceptive effect of the IUDs.

The IUCDs can come in various shapes and sizes.

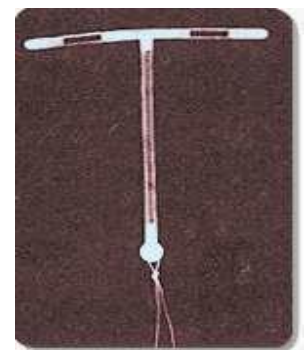
- **Lippes Loop:** The Lippes loop consists of a thin plastic (or polyethylene) wire bent in a series of S-shapes.



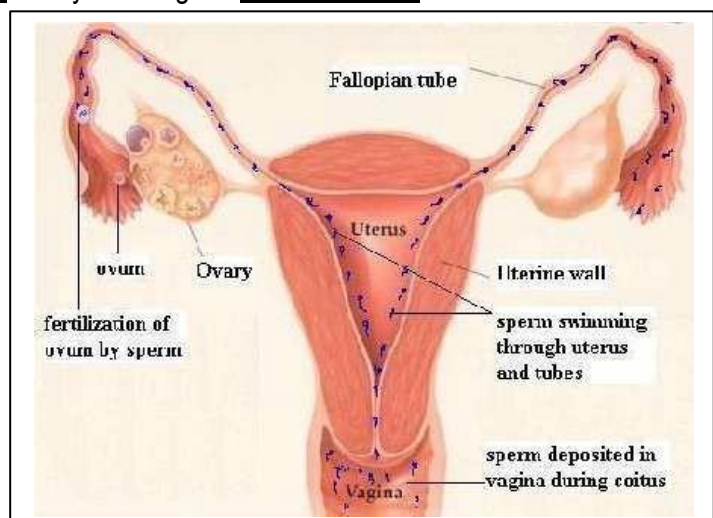
Lippes loop



Copper-Ts



- **Copper T:** T-shaped structure which stays inside the uterus with the long arm of the T along the uterine cavity (endometrium) and the shorter arms transversely across the upper part of the endometrium.
- **Mirena:** Releases a progesterone called levonorgestrel. Works by affecting ovulation, affecting the normal growth of the endometrium and by affecting the cervical mucus so that the movement of sperm is obstructed. In the United Kingdom, hormone based IUDs are known as Intra-uterine Systems (IUS).
- **Surgical Methods:** These are more or less permanent methods of contraception.

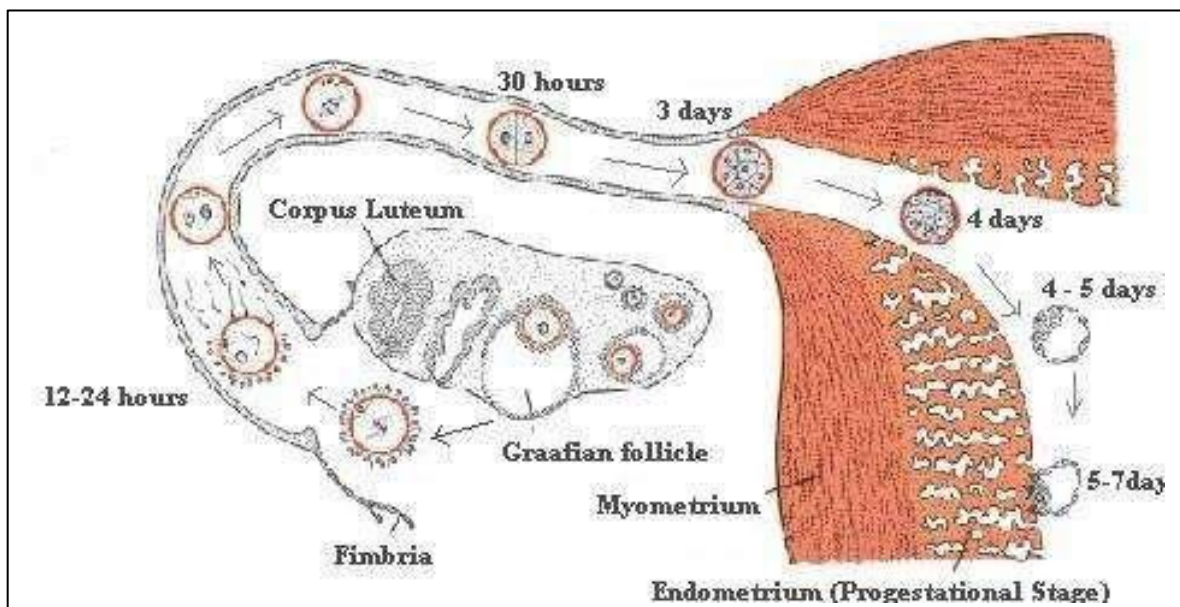


- **Tubal Ligation:** Both the female tubes are tied off and usually cut during tubal ligation to prevent the sperm from reaching the ovum during intercourse.
- **Vasectomy:** The two tubes which carry sperm from the testes to the penis are the vas deferens. Tying them off and cut.
- **Essure:** Essure is a method in which small micro-inserts are placed at the mouth of the fallopian tubes to cause scarring and block them. This prevents sperm from reaching the ovum for fertilization.

HOW PREGNANCY OCCURS

Occurs when a sperm meets with an ovum.

Ovum round about 100 microns in diameter. Ovum picked up by the fallopian tube on the same side. Tubes have long fingerlike projections called fimbria which it uses, rather like hands to pick up the ovum. Ovum moves through the tube, propelled along by long hairs growing from cells in the tubes. Like grass bending before the wind, the hairs bend towards the uterus in waves, pushing the ovum slowly towards the uterus. The egg remains viable, (alive) for about 72 hours, but is capable of being fertilized for only about 12 - 24 hours. If it remains unfertilized during this period, it disintegrates in the tube without leaving any trace. Its end products (mainly proteins) are absorbed into the bloodstream and excreted through the urine or stool.



Fertilization, Implantation and Pregnancy

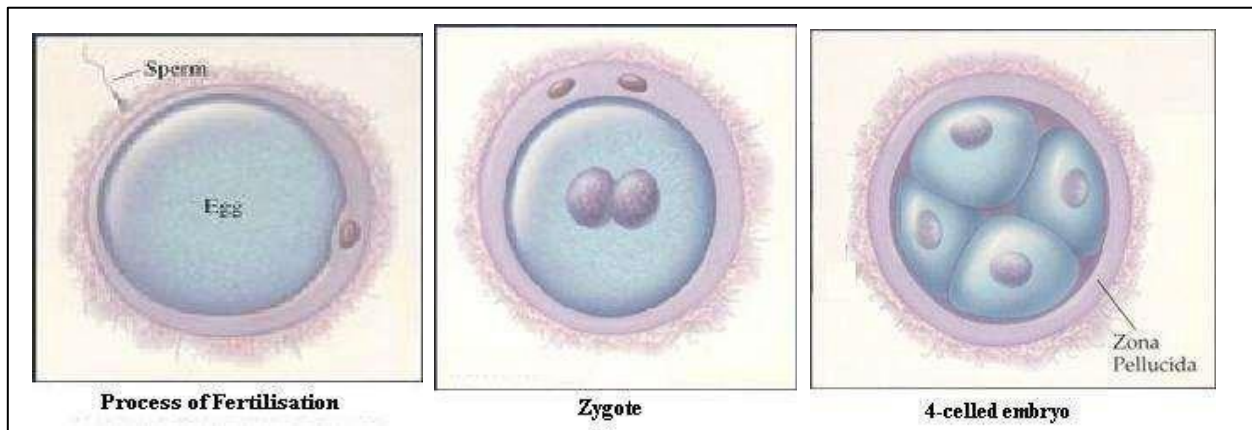
Sperm viable for a longer period, found in uterus 5 – 7 days after coitus. But capable of fertilizing an ovum for only 48 - 72 hours after being ejaculated. Time taken by sperm to reach tubes is between 6 – 12 hours but many authorities say it can be as early as 1 hour.

Intercourse has to take place within this narrow time frame (1-2 days before ovulation or immediately after ovulation), for a pregnancy to occur. At every intercourse normal man deposits 2 – 5 millilitre of semen in the upper part of the vagina (see diagram). Each millilitre of semen normally contains about 50 – 200 million of sperms.

Sperms swim rapidly upwards into the uterus and from there into the two tubes on either side at the rate of 3mm per hour. Takes an average of 10 hours for sperm to reach tubes.

All the sperms deposited in the vagina cannot swim into the uterus. Only about 1 % of the total number of sperms deposited in the vagina make the journey.

Hundreds of sperm (estimated to be around 300) surround the ovum in the tube. They press against the membrane of the ovum attempting to penetrate it and fertilize the ovum. Finally one sperm succeeds. At once a chemical reaction is triggered off in the wall of the ovum, making it impenetrable to any other sperm. No other sperm can enter the ovum now.



Unsuccessful sperms slowly degenerate, break down and become indistinguishable from any other protein end product in the female partner's body (sperm made up mainly of protein). These get absorbed into the blood stream, are carried away to be expelled from the body in the stool or the urine.

Sperm that manages to penetrate the ovum fuses with it to form a single cell called a zygote. Zygote starts to divide as it is propelled towards the uterus – dividing first into 2 cells, then into 4, then 8 and so on. Dividing zygote called an embryo.

When the process of in-vitro fertilization (IVF) is carried out, the ovum and the sperm is allowed to fertilize in a laboratory dish (petri dish). The embryo is usually transferred into the mother's uterus at the 4 – 8 celled stage, usually on the third day after fertilization.

By the time the zygote reaches the uterus at about the 6th to 9th day after ovulation, it is a 16-celled cluster of cells called a morula. The morula looks rather like a bunch of grapes. Each of its cells is identical to each other.

Theoretically, it is from the 2-celled to the 16-celled stages that the cells can be separated from each other and allowed to develop into clones of each other (identical twins). In nature, separation occurs spontaneously – usually at the 2-celled stage – to form identical twins. Separation at later stages can lead to the potentially fatal condition of conjoint twins or Siamese twins.

When it reaches the uterus, the morula sticks to the inner lining of the uterus (called the 'endometrium'). By this time, the hormone progesterone released by the ovaries finishes preparing the endometrium to receive the morula.

The morula burrows deep into the endometrium and by the 9th - 12th day after ovulation, is fully buried in it. Burrowing can cause a little bleeding called 'implantation bleeding'. Buried embryo begins to develop, Its cells increasing in number and gradually becoming different from each other in the way they function.

The development of the embryo continues until at the end of 9th month of pregnancy (40 weeks or 280 days), a fully formed baby, capable of leading a life independent from its mother is ready to be born.

INFERTILITY AND ITS TREATMENT

'Infertility' when a couple fails to conceive after one year of sexual life without contraception. 80% of all women desiring children, conceive within 1 year of marriage and another 10% within the second year.

According to the World Health Organisation, incidence of infertility is about 10 % worldwide. Another 10-12% of all the other couples have only one child and wish to have more. The incidence of infertility is gradually increasing all over the world.

For many people going through infertility treatment, the level of distress and tension can be very high. Mutual trust and faith in the doctor can help the couples to enquire about different modalities of treatment for both the male as well as the female partner, and make informed decisions of their reproductive status azoospermia (complete absence of sperm). In these cases, sperm has been aspirated from the testes directly.

- **Intra-Uterine Insemination (IUI)**: This method is used in men with moderately low sperm count. the semen is collected by masturbation, washed and centrifuged to increase the sperm density. This high density sperm sample is now injected into the uterus, bypassing the vagina. The chances of hostile cervical mucus is thus eliminated. Since the sperm is injected into the uterine cavity, chances of pregnancy is increased. The procedure should be done within 2 hours of collecting the semen.
- **Insemination with Husband's Semen (AIH)** This is done in cases of impenetrable cervical mucous or when disease or deformity of the cervix makes it impossible for the sperm to enter the uterus. It is also carried out in cases of impotence or premature ejaculation.
- **Insemination with Donor Semen (AID)** AID is usually carried out in couples where the husband suffers from azoospermia.

InVitro Fertilisation (IVF) process by which egg cells are fertilised by sperm (usually 100,000 sperm / ml) outside the womb, in vitro. IVF is a major treatment in infertility when other methods of assisted reproductive technology have failed. The process involves hormonally controlling the ovulatory process, removing ova (eggs) from the woman's ovaries and letting sperm fertilise them in a fluid medium. The fertilised egg (zygote) is then transferred to the patient's uterus with the intent to establish a successful pregnancy. The first successful birth of a "test tube baby", Louise Brown, occurred in 1978. Prior to that, there was a transient biochemical pregnancy reported by Australian Foxton School researchers in 1973 and an ectopic pregnancy reported by Steptoe and Edwards in 1976.

In vitro, (Latin) meaning *within the glass*, biological experiments involving cultivation of tissues outside the living organism were carried out in glass containers such as beakers, test tubes, or petri dishes. Term in vitro used to refer to any biological procedure that is performed outside the organism. In vivo procedure, tissue remains inside the living organism within which it is normally found. A colloquial term for babies conceived as the result of IVF, **test tube babies**, However, in vitro fertilisation usually performed in shallow containers called Petri dishes. (made of glass or plastic resins.)

Zygote intrafallopian transfer (ZIFT) infertility treatment where blockage in the fallopian tubes prevents the normal binding of sperm to the egg. Egg cells removed from woman's ovaries, and in vitro fertilised. Resulting zygote placed into the fallopian tube by laparoscopy. The procedure spin-off of the gamete intrafallopian transfer (GIFT) procedure. ZIFT has a success rate of 64.8% in all cases.

Takes an average five weeks to complete a cycle of ZIFT. First, the woman must take a fertility medication to stimulate egg production in the ovaries. The doctor will monitor growth of ovarian follicles, once they are mature, woman will be injected with human chorionic gonadotropins (hCG). Eggs will be harvested approximately 36 hours later, usually by transvaginal ovum retrieval. After fertilization in laboratory resulting early embryos or zygotes are placed into the woman's fallopian tubes using laparoscope.

Gamete intrafallopian transfer (GIFT) assisted reproductive technology against infertility. Eggs removed from a woman's ovaries, placed in one of the Fallopian tubes, along with the man's sperm. The technique, which was pioneered by endocrinologist Ricardo Asch, allows fertilization to take place inside the woman's body.

Intracytoplasmic Sperm Injection (ICSI): technique in which a single sperm injected into the centre of the egg, in order to achieve fertilization. Sperm is collected from the male partner by masturbation. Single healthy sperm then injected into the prepared ovum.

The advantage of this method is that only a single sperm is needed - even men with a very low sperm count can become fathers with this treatment. Men found to be azoospermic, that is with no sperm at all in the semen, sperm can be suctioned out of the vas deferens (male tubes). Sperm can also be liberated from the testes itself by careful testicular biopsy and culture by a method called MESA - Microepididymal sperm aspiration.

Prevention of Male Infertility : Undescended testes should be treated at the earliest during infancy before testicular function is damaged. Infections by mumps and other viruses should be managed by keeping a watchful eye on complications in the testes.

General Facts About STDs

Sexually transmitted diseases (also called STDs, or STIs for sexually transmitted infections): Infections transferred from one person to another through sexual contact. According to the Centers for Disease Control and Prevention, there are over 15 million STD cases reported annually in the United States. More than 25 diseases that are transmitted through sexual activity. Other than HIV, the most common STDs in the United States are chlamydia, gonorrhea, syphilis, genital herpes, human papillomavirus, hepatitis B, trichomoniasis, and bacterial vaginosis. Adolescents and young adults are the age groups at greatest risk for acquiring an STD. Approximately 19 million new infections occur each year, almost half of them among people ages 15 to 24.

Some STDs can have severe consequences, especially in women, if not treated, which is why it is so important to go for STD testing. Some STDs can lead to pelvic inflammatory disease, which can cause infertility, while others may even be fatal. STDs can be prevented by refraining from sexual activity, and to a certain extent, some contraceptive devices, such as condoms.

Specific STDs: An Overview

Human Papilloma Virus: Thought to be one of the main causes of cervical cancer. Has been linked with other types of cancers of female reproductive system. HPV can be treated to reduce signs and symptoms. Currently no cure for this virus. HPV vaccine recently developed to prevent HPV infection.

Herpes Virus: STD that presently with no cure. Treatment available. Home remedies & natural

treatment available. Herpes symptoms include blisters or sores that periodically break out on the genitals. Refer FAQs.

Hepatitis: To cure for those already infected, a Hepatitis B (HBV) vaccine available to prevent spread of this infection. Many are asymptomatic, however those who do suffer from Hepatitis B symptoms may have many unpleasant discomforts. Infection may clear up on its own. Some people may suffer from chronic infections for many years. Treatment available for chronic sufferers. Other types of hepatitis infections that can be passed through sexual contact include Hepatitis A and Hepatitis C.

HIV/AIDS: Most dreaded STD. New ways of treating this infection significantly prolongs an infected person's life. For many this infection eventually progresses to AIDS and, ultimately, death. More than 40 million people worldwide are infected with the HIV virus; women account for 50% of those infected.

Syphilis: Throughout history, cases of syphilis have been recorded. Can easily be treated and cured. Without treatment, syphilis symptoms can progress and affect the nervous system and brain leading to dementia and even death.

Trichomoniasis: most common, curable STDs. However, symptoms may be mistaken for a yeast infection causing women to use wrong type of treatment for her vaginal discharge.

Common Infections: Chlamydia and gonorrhea often infect a person at the same time. Although the symptoms of chlamydia are different from gonorrhea not unusual for person to be asymptomatic. If testing for chlamydia, good idea to test for gonorrhea. Both STDs can be cured but can damage reproductive system if left untreated.

KNOW THE SYMPTOMS OF STDs

Men

- Swelling or tenderness in genital area.
- Blisters, sores or bumps around the mouth or genitals.
- Fever, chills and aches.
- Unusual itching.
- Burning sensation when you pass urine or move your bowels.
- White, watery or yellow discharge from the penis.

Women

- Have fewer symptoms than men, often none at all. STDs can lead to cancer. Women should watch for-
- Bleeding that is not part of their period.
- Pelvic or vaginal pain.
- Discharge from the vagina.
- Painful urination.
- Unusual rash, sore or growth in the genital area.

DON'T LET STDs TAKE YOU BY SURPRISE

Pelvic Inflammatory Disease Overview

Pelvic inflammatory disease (PID) is infection of a woman's reproductive organs. Infection spreads upward from the cervix to the uterus, Fallopian tubes, ovaries, and surrounding structures

Pelvic Inflammatory Disease (PID) Symptoms

If a woman has PID, she may have any of these symptoms:

- Abdominal pain (especially lower abdominal pain) or tenderness
- Back pain
- Abnormal uterine bleeding
- Unusual or heavy vaginal discharge
- Painful urination
- Painful sexual intercourse

- Symptoms not related to the female reproductive organs include fever, nausea, and vomiting. PID symptoms may be worse at the end of a menstrual period and during the first several days following a period.

INFERTILITY IN HUMAN: Causes & Consequences :-

IN MALES	IN FEMALES
Oligospermia: Low sperm count	Anovulation: Absence of ovulation.
Azospermia: Absence of sperm.	Oligoovulation: Deficient ovulation.
Asthenozoospermia: Low sperm motility.	Hyperprolactinemia: Ovum remain trapped inside the follicle.
Teratozoospermia: Defective sperm morphology.	Idiopathic Infertility: Failure or abnormal fertilization.
Cryptorchidism: Failure of Testes to descend in the scrotal sac.	Tubal Infertility: Damaged/ligated fallopian tube

COMMON SEXUALLY TRANSMITTED DISEASES (STDs)

SL. NO.	STD	CAUSAL AGENT	SYMPTOMS	EFFECT ON FOETUS	EFFECT ON PERSON AFFECTED
1	CHLAMYDIOSIS	<i>Chlamydia trachomatis</i>	Painful urination & intercourse Mucus discharge from penis/vagina	Premature birth, blindness, Pneumonia	Pelvic inflammatory disease, Infertility, Ectopic pregnancy
2	GONORRHOEA	<i>Neisseria gonorrhoea</i>	Painful urination in men	Still birth, Blindness	Pelvic inflammatory disease, Infertility, Rash, Death
3	TRICHOMONIASIS	<i>Trichomonas vaginalis</i>	Inflammation, Itching & vaginal white discharge (Leucorrhoea)	Not known	Valvar erythema, Burning dysuria
4	GENITAL HERPES	<i>Herpes simplex virus</i>	Genital sores, Fever	Still birth, Brain damage	Cervical cancer.
5	SYPHILIS	<i>Trepanema pallidum</i>	Initially sores in genitalia & mouth, Rashes	Premature birth, Miscarriage, Still birth	Death
6	GENITAL WART	<i>Human papilloma virus</i>	Warts on genitalia	Not known	Cervical cancer
7	HEPATITIS-B	<i>Hepatitis -B virus</i>	Fatigue, Fever, Jaundice, Rash, Abdominal pain	Low birth weight	Liver cirrhosis, Liver cancer
8	AIDS	<i>HIV</i>	Fever, Prone to infection, Inflammation	AIDS affected	Dementia, Death

IMPORTANT NOTES

- Indian population is identified as ‘Young population’ whereas population of USA, England, Germany etc. are identified as ‘Ageing population’.
- In India, Kerala has lowest Birth rate & U.P. highest.
- Deficiency of Manganese causes infertility & Vitamin E is considered as Antisterility Vitamin.
- 11th July celebrated as World Population Day.
- Every 16th person in the world is an Indian.
- Main objectives of National Population Policy, 2000 are : population stabilization, compulsory school education, reduce infant mortality rate, decrease fertility rate, promote delayed marriage, incentive for sterilization, restrain child marriage etc.
- Kerala declared as the ‘First baby friendly state of the world’ by first Human Development Report 2002.
- I-pills or Intelligent pills are Emergency Contraceptive pills that should be used in emergency only. Frequent use of it may bring ovarian damage & Menstrual problem.
- Contraceptive Corn: Scientists have produced a genetically modified corn crop which produces antisperm antibodies & suggest that a plant based jelly may be prepared which will prevent pregnancy & spread of STDs simultaneously.

IMPORTANT TERMS TO REMEMBER

AMNIOCENTESIS: Foetal test based on chromosomal pattern in amniotic fluid surrounding the developing embryo. can be used for sex determination.

LACTATIONAL AMENORIA: Absence of menstruation due to disruption of ovulation during the period of intense lactation following parturition.

INTRA UTERINE DEVICES(IUDs): A medical device of insertion of artificial barrier in the uterus through vagina for obstructing sperm entry.

STERILISATION: Surgical intervention for stopping pregnancy by blocking gamete transport pathway in male/female.

ASSISTED REPRODUCTIVE TECHNOLOGIES(ART): Artificial technological devices to enable couples to have children when fail they to get child due to any reproductive disorder.

ARTIFICIAL INSEMINATION: Medical technological devices by which semen collected from a healthy donor is artificially introduced into the vagina or uterus of female.

ETIOLOGY: Study of causes of diseases.

EPIDEMIOLOGY: Mode of transmission of diseases.

RECANALISATION: Attachment of cut Vasa deferentia with plastic tubes during Vasectomy.

CASTRATION: Surgical removal of Testes.

POPULATION CRASH: Rapid decline in the population.

POPULATION EXPLOSION: Rapid increase in the population.

AGE COMPOSITION: Relative abundance of the organisms of different ages in the population.

IN-VITRO FERTILISATION: Artificial technique of fusion of gametes outside the body in laboratory condition, in almost similar conditions as that of the body.

INFERTILITY: Inability of a couple to produce children in spite of unprotected sexual cohabitation.

CBSE QUESTION AND ANSWERS

1. Define the term population explosion?
2. On which date, Indian population touched one billion mark?
3. Which day is celebrated as World Population Day? (CBSE-2009)
4. What was human population in India according to 2001 census?
5. Name two causes which have declined the death rate.
6. List two factors which hinder the measures to control human population in India. (CBSE-2014)
7. What is significance of IUDs?
8. Give technical name of female used to bring up in vitro fertilized ovum to maturity.
9. Do you think that reproductive health in our country has improved in the last 50 years? If yes, mention some such areas of improvement.
10. Amniocentesis, the fetal sex determination test is banned in our country. Is it necessary? Comment.
11. Expand the term GIFT ? (CBSE-2011)
12. At what stage is the embryo implanted in uterus of mother(test tube baby)?
13. When was MTP legalized in India ? (CBSE-2013)
14. Expand the term RCH care ?
15. What are two advantages of technique amniocentesis?
16. What are the measures one has to take to prevent from contacting STDs?
17. Differentiate between Tubectomy and Vasectomy? (CBSE-2016)
18. Name some assisted reproductive technologies which have decreased the number of cases of infertile couples? (CBSE-2012)
19. Describe the methods of birth control by which fertilization of ovum by sperm is prevented ?
20. Suggest measures for control of human population growth rate in our country.

ANSWER

1. Rapid growth rate of population.
2. 11th May, 2000.
3. July 11.
4. 1027lions.
5. Control of human diseases and increased agriculture production.
6. Low female literacy and low usage of contraceptives.
7. These check the fertilization or implantation of the blastocyst in the uterus.
8. Surrogate mothers.
9. Yes, in the last 50 years reproductive health in our country has improved. Some such areas of improvement are:-
 - a) Massive child immunization
 - b) Maternity and child health.
 - c) Family planning.
 - d) Increasing use of contraceptives
10. Amniocentesis (a foetal sex determination technique) is being misused in female foeticide cases. It is necessary to legally ban the foetal sex determination test, other wise it damage the stability of human race. Sex ratio have already been imbalanced.
11. Gamete Intra fallopian transfer.
12. At 32-cell stage
13. In 1971.
14. Reproductive and child health care.
15. Amniocentesis is a prenatal diagnostic technique and is used to know-
 - a) Sex of the developing foetus

- b) Congenial diseases due to change in chromosome number
 - c) Metabolic disorder of foetus
16. a) Restrict to one sexual partner .
- b) Use of condoms
 - c) Avoid sharing of injection needles, surgical instruments
 - d) In case of doubt, immediately specialist must be contacted for early detection and cure of STDs
17. Tubectomy involves cutting and ligating of fallopian tube of female while Vasectomy involves cutting and ligating of vasa deferentia of male to prevent fertilization of ovum by the sperm.
18. a) IVF-ET (In vitro fertilization –embryo transfer)- Fusion of ovum and sperm in culture medium and then ZIFT (Zygote intra fallopian transfer) or IUT (Intra uterine transfer)- Embryo is transferred into uterus at 32- cell stage.
- b) GIFT (Gamete Intra fallopian transfer)- Ovum is transferred in the fallopian tube of female who is unable to bear Ova but can carry pregnancy.
- c) ICSI (Intra cytoplasmic sperm injection)- Sperm is injected into ovum in-vitro followed by embryo transfer.
- d) AI (Artificial insemination)- Sperms of husband or donor are deposited in the vagina of the wife/female.
19. a) Mechanical/Barrier methods-
- i) Use of condoms by male before starting copulation.
 - ii) Diaphragms and cervical caps fitted in the vagina of female.
 - iii) Intrauterine devices like copper-T and loops.
- b) Chemical barriers-
- i) Use of spermicidal jellies, pastes etc. in the vagina of female before copulation
 - ii) Use of birth control pills containing synthetic progestins and estrogens
- c) Surgical Methods-
- i) Male sterilization by castration (removal of testes) or vasectomy.
 - ii)Female sterilization by ovariectomy and tubal ligation
20. a) Marriage age should be increased and early marriage and early child-bearing tendency should be avoided.
- b) Female literacy rate should be increased.
 - c) Proper care of pregnant and lactating females.
 - d) Favourable sexual behaviour of the male partners
 - e) Providing facilities like contraceptives, IUDs, birth control pills, sterilization etc.

HOTS QUESTIONS

- 1.What is the mechanism of the action of contraceptive pills?
- 2.How are injectables or implants useful in preventing conceptions?
3. Why are sperms produced in such a large amount at one time to fertilise one ovum only?

Answers

1. The contraceptive pills contain hormones estrogens and progesterone (combined pill).
These pills
 - i) suppress the ovulation;
 - ii) make the mucus of the cervix hostile to sperm and ultimately avoid the passage of sperm;
 - iii) create unfavourable conditions in the uterus endometrial lining for implantation.

The combined pills are to be taken every day at the same time except during menstrual bleeding period. These pills are very effective with the lesser side effects. The 'Saheli' (the new oral contraceptive, non-steroidal preparation) is used once a week with very few side effects and high contraceptive value.

2. The female, as an emergency contraceptive to avoid possible pregnancy due to rape or casual unprotected intercourse, uses the injections or implants of progesterone alone or in combination with estrogen. These inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent or retard the entry of sperms.

3. The human male ejaculates about 200 to 300 million sperms during a coitus of which, for normal fertility, at least 60% sperms must have normal shape and size and for at least 40% of them must show vigorous motility. Sperms have to travel through vagina to uterus and then to fallopian tube and some of the sperms lose their mobility during their journey to ampullary junction of fallopian tube. Only a few sperms reach this region and maintain their vigour and motility.

CHAPTER 5: PRINCIPLES OF INHERITANCE AND VARIATION

Know the terms

TERMS	MEANING
Locus	Address/ location of a gene in a chromosome
Allele	Alternative forms of a gene
Homozygous	Both alleles of a gene at a locus similar
Heterozygous	Both alleles of a gene at a locus dissimilar
Dominant	Allele expresses itself in homozygous and heterozygous conditions
Recessive	Allele expresses itself in homozygous condition only get masked in heterozygous conditions

MENDEL'S LAW OF INHERITANCE He selected pea plant for following reasons:

<ul style="list-style-type: none"> • Pea is a self pollinated plant & cross pollination is also possible. • Many varieties were available with observable alternate forms for a trait. • Short life span. • Can be easily grown in small place. • Seeds easy to handle. 	<table border="1"> <thead> <tr> <th colspan="3">CONTRASTING CHARACTERS</th> </tr> <tr> <th>S.No.</th> <th>Characters</th> <th>Contrasting Traits</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Stem height</td> <td>Tall/dwarf</td> </tr> <tr> <td>2.</td> <td>Flower colour</td> <td>Violet/white</td> </tr> <tr> <td>3.</td> <td>Flower position</td> <td>Axial/terminal</td> </tr> <tr> <td>4.</td> <td>Pod shape</td> <td>Inflated/constricted</td> </tr> <tr> <td>5.</td> <td>Pod colour</td> <td>Green/yellow</td> </tr> <tr> <td>6.</td> <td>Seed shape</td> <td>Round/wrinkled</td> </tr> <tr> <td>7.</td> <td>Seed colour</td> <td>Yellow/green</td> </tr> </tbody> </table>	CONTRASTING CHARACTERS			S.No.	Characters	Contrasting Traits	1.	Stem height	Tall/dwarf	2.	Flower colour	Violet/white	3.	Flower position	Axial/terminal	4.	Pod shape	Inflated/constricted	5.	Pod colour	Green/yellow	6.	Seed shape	Round/wrinkled	7.	Seed colour	Yellow/green
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7.	Seed colour	Yellow/green																										

Mendel's first law (Law of dominance) characters are controlled by discrete units called genes (allele) which occur in pair. In heterozygous condition only one gene that is dominant can express itself. (Can be explained by monohybrid cross)

Mendel's second law (Law of segregation): The two alleles received, one from each parent, segregate independently in gamete formation, so that each gamete receives one or the other with equal probability. (Can be explained by monohybrid cross)

Mendel's third law (Law of recombination): Two characters determined by two unlinked genes are recombined at random in gamete formation, so that they segregate independently of each other, each according to the first law (note that recombination here is not used to mean crossing-over in meiosis). (Can be explained by dihybrid cross)

(Refer NCERT text book for diagram.) **Test Cross** : Individual with dominant phenotype is crossed with homozygous recessive individuals to find the homozygosity/heterozygosity

Basic outline of Mendel's cross

1. Pure breeding parents for a pair of contrasting character (allelic pair) are taken Eg. Tall pure-bred pea plants (TT) & short pure-bred pea plants (tt)
- ↓
2. Gamete formation (Meiosis)
- ↓
3. Hybridization (crossing is done)
- ↓
4. F1 generation - the product of the above cross (are called hybrids)
- ↓
5. Selfing (allowed to self fertilize / self breeding)
- ↓
6. Gamete formation (Meiosis)
- ↓
7. F2 generation - the product of the above selfing
- ↓
8. Analysis of result (Phenotype and Genotype)

EXCEPTIONS OF MENDEL'S EXPERIMENT

Incomplete Dominance: Dominant gene is not fully expressed on recessive gene. So, the phenotype of hybrid do not resemble with any of the parents. Eg- **Antirrhinum majus (snapdragon), Mirabilis jalapa (4 O' clock plant).**

Genotype & phenotype ratio : 1:2:1 . (REFER NCERT TEXT BOOK FOR DIAGRAM)

Co-dominance: Both parental genes expressed in F1 progeny so the offspring shows resemblance with both the parents. Eg- **ABO blood group types in human.**

Blood group	Possible genotype
A	$I^A I^A$ OR $I^A i$
B	$I^B I^B$ OR $I^B i$
AB	$I^A I^B$
O	ii

Crosses of blood group (CO DOMINANCE)

Blood group	Possible genotype	Possible phenotype
A X A	$I^A I^A$ X $I^A I^A$	A
	$I^A I^A$ X $I^A i$	A
	$I^A i$ X $I^A i$	A ; O
B X B	$I^B I^B$ X $I^B I^B$	B
	$I^B I^B$ X $I^B i$	B
	$I^B i$ X $I^B i$	B; O
AB X AB	$I^A I^B$ X $I^A I^B$	AB: A; B
O X O	ii X ii	O

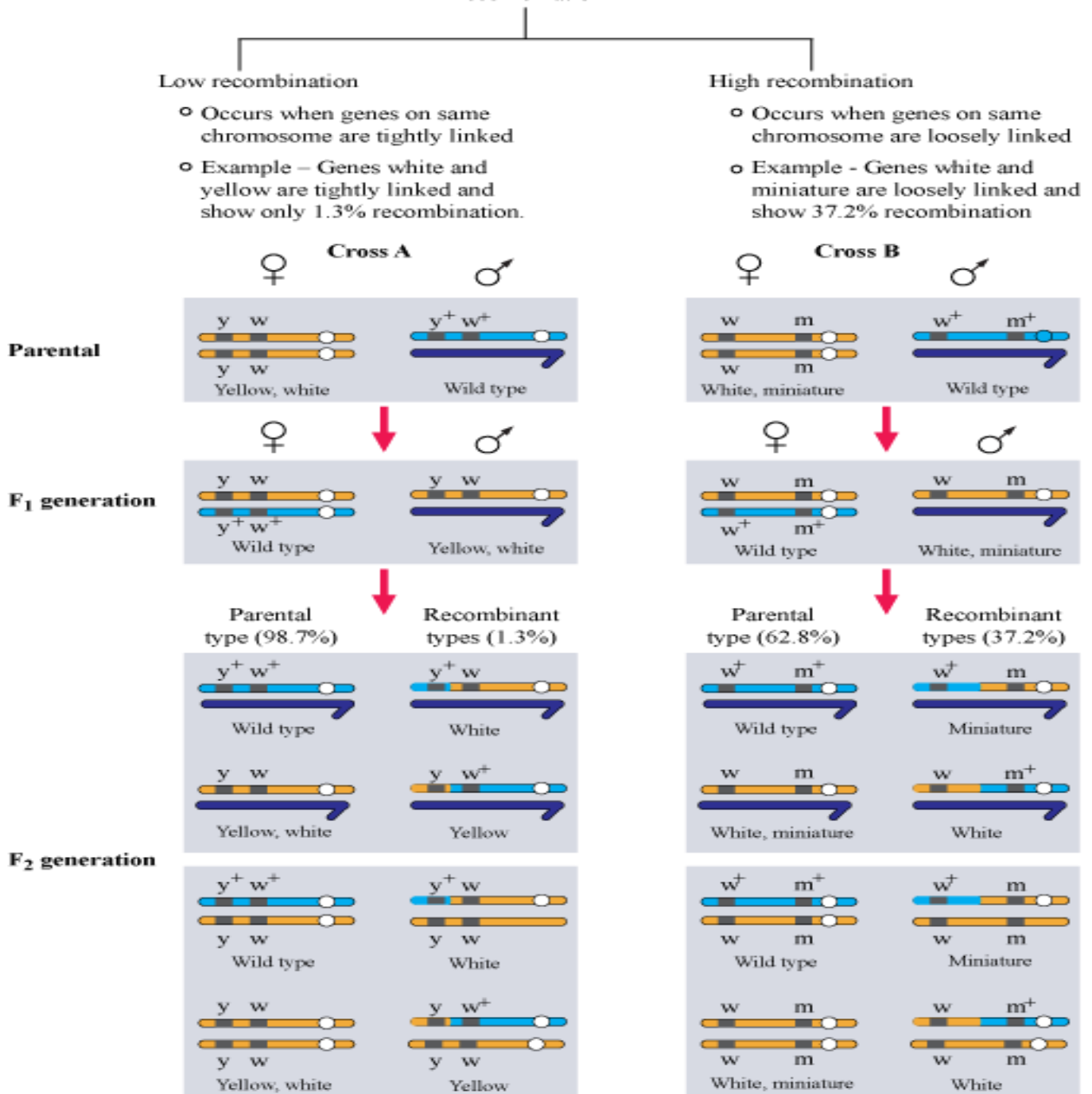
Cross	Result of F2 generation	
	Phenotypic ratio	Genotypic ratio
Monohybrid eg. Tt X Tt	3:1	1:2:1
Dihybrid eg. RRrr X YYyy	9:3:3:1	1:2:1:2:4:2:1:2:1
Incomplete dominance Rr X Rr	1:2:1	1:2:1

Linkage: Tendency of genes on same chromosome to remain together

Such genes are called – linked genes.

Linked genes present only parental types

Recombination



Linked genes present only parental types

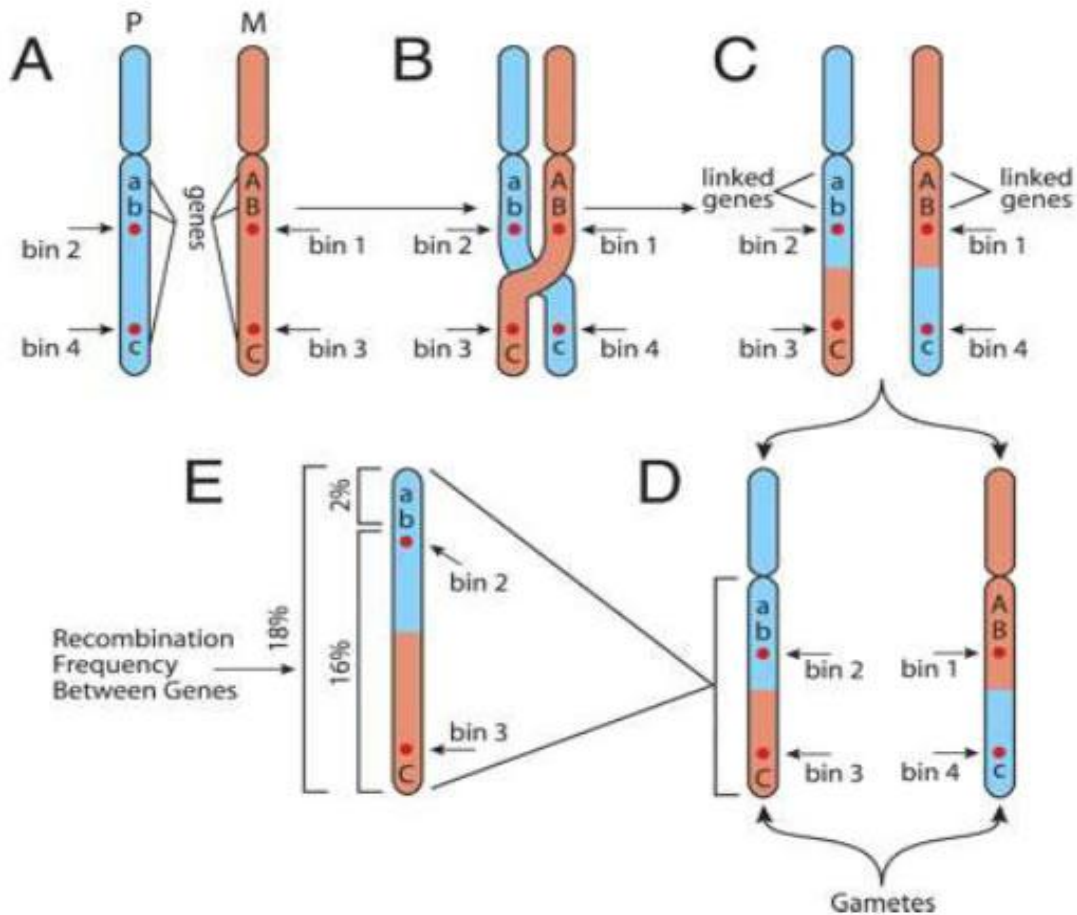


Figure Schematic of Genetic Linkage and Recombination

- (A) Two homologous chromosomes: (paternal) and (maternal). Three genes with separate alleles and linkage " noted (*A,a*; *B,b*; *C,c*);.
- (B) Crossing over during meiosis. (**chiasma formation**)
- (C) Two alleles and their linked genes have switched locations via recombination. Four additional alleles and their associated (*A, a*; *B, b*;) have not switched and are considered linked.
- (D) Recombined haploid chromosomes segregate separately during meiosis as gametes before fertilization.
- (E) Sample recombination frequencies between genes demonstrating higher rates of recombination for genes further apart.

SEX DETERMINATION:

- Sex chromosome: the chromosomes determine the sex of living organism.
- Autosomal chromosomes: they determine the characters other than sex of living organism

Sex determination and sex chromosome

Organism	Male	Female
Human beings	XY	XX
Birds	ZZ	ZW
Insects	XO	XX
Bird	ZZ	ZW
Honey Bee	X M (Drone), XM X M (Male)	XX

Male Heterogamety : Male produced two type of gametes. Eg. Human, Drosophila.

Female heterogamety : Female produced two type of gametes. Eg. Birds. Mutation : Sudden changes in DNA.

Mutagens: Chemicals/agents that caused mutation

Type of gene mutation	Reason	
Point mutation	Change in single base eg. sickle-cell anaemia	
Frame shift mutation	Deletion/insertion/duplication/addition of one or two bases	
Type of chromosomal mutation		
Aneuploidy	Addition/ deletion one or more chromosomes	Trisomy $2n+1$ monosomy $2n-1$
Polyploidy	Addition/ deletion one or set chromosomes	$3n, 4n$ etc.

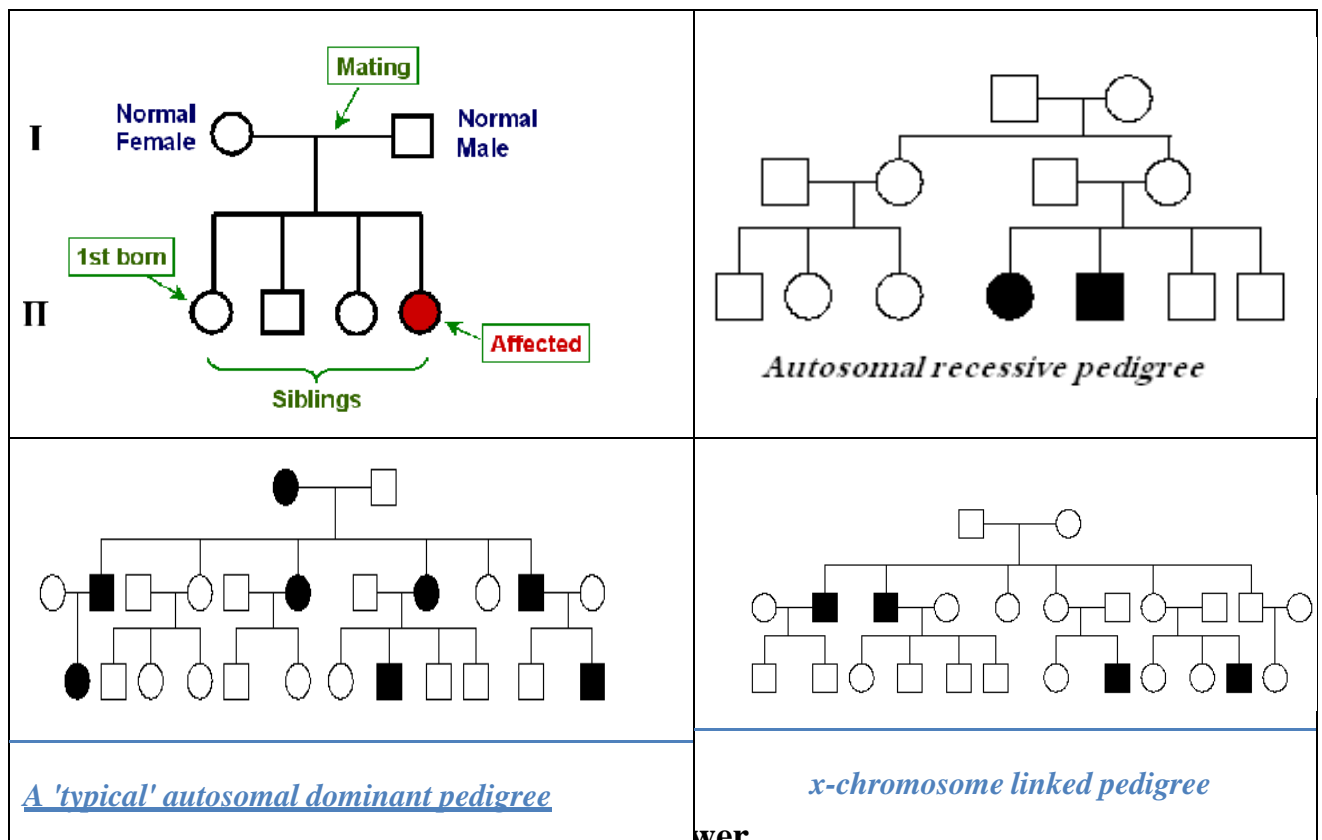
Pedigree Analysis

Pedigree is a chart of graphic representation of record of inheritance of a trait through several generations in a family

Symbols used:- refer NCERT Text Book

Four patterns of inheritance

<u>AUTOSOMAL DOMINANT</u>	<u>AUTOSOMAL RECESSIVE</u>
<ol style="list-style-type: none"> 1. Traits are controlled by dominant genes 2. Both males and females are equally affected 3. Traits do not skip generations 4. e.g. polydactyly, tongue rolling ability etc 	<ol style="list-style-type: none"> 1. Traits controlled by recessive genes and appear only when homozygous 2. Both male and female equally affected 3. Traits may skip generations 4. 3:1ratio between normal and affected. 5. Appearance of affected children from normal parents (heterozygous) 6. All children of affected parents are also affected.



GENETIC DISORDERS

Chromosomal Disorder	Mendelian Disorder
These are due to absence or excess of abnormal arrangement of one or more chromosomes. Eg. Down, Klinefelter's, Turner's syndrome.	These are due to alteration or mutation of one gene. Eg. Sickle cell anaemia, haemophilia, thalassaemia

MENDELIAN DISORDER

DISORDER	REASON
Haemophilia	Sex linked recessive disease (X). Females are unaffected carrier
Sickle Cell Anaemia	Autosomal recessive trait on chromosome 11. Sickle shape RBC due to replace the glutamic acid by valine.
Phenylketonuria	Autosomal recessive trait on chromosome 12. Mutation in phenyl alanine hydroxylase enzyme results in accumulation of phenyl pyruvate.
Colour Blindness	Sex linked recessive disorder (X).
Thalassaemia	Sex linked recessive disorder (X). mutation in the gene that codes for alpha globin

inheritance of the contrasting pairs of two characters.

Q.10. Mendel observed two kinds of ratios, 3:1 and 1 : 2 : 1 in the generation of his experiments in garden pea. Name these two ratios respectively.

Ans. 3 : 1 is the phenotypic ratio and 1 : 2 : 1 : is the genotypic ratio.

Q.11. What kind of test will you perform to find out whether the given plant is homozygous dominant or heterozygous ?

Ans : A Test cross could be performed .

Q.12. (a) How many different genotypes are possible in human population ? (b) How many phenotypes are possibly present?

Ans. (a) Six genotypes (b) Four present phenotypes.

Q.13. Who first observed the X-chromosome ? What was it called then ?

Ans. Henking first observed the X-chromosome. It was called then as X-body.

Q.14. Why is the X-chromosome called sex chromosome ?

Ans. X-chromosome is involved in the determination of sex of the individual, hence it is called sex-chromosome.

Q.15. What is heterogamety ? Give an example of an organism showing it.

Ans. Heterogamety is the phenomenon in which an organism produces two (more than one) types of gametes; e.g. human male/female fowl.

Q.16. How many autosomes are found in a single mature human sperm ?

Ans. 22 autosomes are found in a single mature human sperm.

Q.17. Define mutation.

Ans. Mutation is defined as a sudden, heritable change in the base sequence of DNA or structure of chromosome (s) or a change in the number of chromosomes, that alters the phenotype of the organism.

Q.18. Name one disease which is caused due to point mutation .

Ans: Sickle cell anaemia, Thalassemia, Haemophilia or Phenylketonuria (any one).

Q.19. What is meant by chromosomal mutation ?

Ans. A change in the structure or number of chromosomes in a cell/organism, is called chromosomal mutation.

Q.20. Name the event, during cell division cycle that results in the gain or loss of chromosomes.

Ans: Failure of segregation of chromosomes.

Q.21. What are Pleiotropic genes ?

Ans: A single gene that governs multiple phenotypic effects is called pleiotropic gene.

Q.22. What is Polygenic inheritance ?

Ans: Type of inheritance, in which traits are controlled by three or more genes. Example : Human skin colour .

Q.23. How much is one map unit for expressing distances between genes on a chromosomes?

Ans : One map unit is equivalent to 1% recombination.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

Q.24. What is a test cross? What is its significance?

Ans. A test cross is a cross devised by Mendel where the offspring or an individual with dominant phenotype, whose genotype is not known, is crossed with an individual homozygous recessive for the trait.

— This type of cross is used to determine the genotype of an individual for any given character/trait.

Q.25. Briefly mention the contribution of T.H. Morgan in genetics.

Ans: (i) Morgan conducted experiments on *Drosophila melanogaster* and discovered sex-linkage. (ii) He also found that linked genes may show a phenomenon called linkage, where the recombinants in a test cross progeny are less than 50%.

Q.26. Why do the sons of a haemophilic father never suffer from this trait ?

Ans. The gene for haemophilia is present on the X-chromosome.

- A male has one X-chromosome, which he receives from his mother.
- He receives the Y-chromosome from the male parent (father).
- The human male passes the X-chromosome to his daughters but not to the male progeny.

Q.27. A woman of 47 years delivered an abnormal child with flattened nasal bridge and mouth usually open with a large protruding tongue. Name this genetic abnormality. What causes this condition?

Ans. — The genetic abnormality is called Down's syndrome.

— It is caused by trisomy of 21st chromosome.

Haemophilia	Sickle—cell Anaemia
1. It is due to a defective recessive allele present on the X-chromosome. 2. It is a sex-linked disorder. 3. A protein necessary for clotting of blood is deficient.	1. It is due to point mutation, i.e., a single base pair change leading to a change in an amino acid. 2. It is an autosomal disorder. 3. The defective haemoglobin leads to a change in the shape of RBCs, which become sickle-shaped.

Q.28. Differentiate between haemophilia and sickle-cell anaemia.

Ans. Differences :

Q.29. Bring out the differences between Turner's syndrome and Klinefelter's syndrome.

Ans. Differences:

Turner's Syndrome	Klinefelter's Syndrome
1. The individual is a female. 2. The individual has one X-chromosome less, i.e., she has 45-chromosomes. 3. The individual has a short stature with an under developed feminine character.	1. The individual is a male. 2. The individual has an extra X-chromosome; i.e., he has 47-chromosomes. 3. The individual has a tall stature with feminised character.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

Q.30. Why are haemophilia and colour blindness usually seen in human males ? Can women also develop these disorders? Explain.

Ans. The genes for haemophilia and colour blindness are present on the X-chromosome. A male has only one X-chromosome and bears only one allele for the trait, i.e., he is hemizygous

for the trait, as Y-chromosome does not have a corresponding allele. A female has two X-chromosomes, received one from each of her parents. She has to be homozygous recessive, i.e., her father must be a sufferer and mother either a sufferer or a carrier, to develop the disease.

Q.31. Differentiate between Down's syndrome and Klinefelter's syndrome. Mention two similarities between them.

Ans. Differences :

Down's Syndrome	Klinefelter's Syndrome
1. It is an autosomal abnormality. 2. It is due to trisomy of 21st chromosome. 3. It occurs in both males and females.	1. It is a sex-chromosomal abnormality. 2. It is due to an extra X-chromosome in a male, i.e., XXY-sex chromosome. 3. The affected individual is a male with feminised characters.

Similarities :

- (i) Both the individuals have 47 chromosomes.
- (ii) The phenomenon responsible is non-disjunction of chromosomes during meiosis.

Q.32. (a) What is the cause of Down's syndrome ? Give any four characteristics symptoms of the disorder.

(b) What are mutagens ? Give two examples.

Ans. (a) Down's syndrome is caused by trisomy of 21st chromosome, i.e., presence of an extra copy of 21st chromosome.

Symptoms of Down's syndrome

Partially open mouth with furrowed tongue.

Broad, flat face with slanting eyes,

Broad palm with characteristic palm crease.

(it) Small and arched palate.

Epicantheal eye fold.

... Congenital heart disease. [any four] (b) Mutagens are these physical or chemical factors which bring about mutations i.e., alterations in DNA sequences or number and/or structure of chromosome(s). e.g., colchicine, UV-rays.

VALUE BASED QUESTION (4 MARKS)

Q. 33. A patient supposed to be suffering from malaria went to a doctor who on testing his blood sample confirmed him negative for malaria. The RBC in blood sample was found to have elongated sickle like structure. Doctor suggested him of his condition and protection from Malaria .

(a) With what disorder was the patient suffering? How it provides protection from malaria?

(b) How is it caused?

(c) What values are reflected by the Doctor?

Ans. (a) Sickle-cell anaemia, The Malarial parasite could not survive on sickle celled RBC.

(b) Sickle-cell anemia is an autosomal recessive trait that is transmitted from parents to the offspring when both the parents are carrier for the gene. This disorder is caused by the substitution of Glutamic acid by Valine at the sixth position of the β -globin chain of the hemoglobin molecule. This is due to the single base substitution at the sixth codon of β -globin gene from GAG to GUG.

(c) Care, Support to the patient, making the patient mentally strong.

Q.34. A couple has four daughters. The man blames the woman for giving birth to daughters. His wife is pregnant for the fifth time, as the couple wants at least one son.
(a) What is the probability of this couple getting a son this time, sure or only a chance
(b) Who is responsible for the birth of daughters to them?
(c) What values are insisted by convincing him to stop producing more children?

Ans.: (a) It is not sure and the chances are only 50%.

(b) The father is biologically responsible for the sex of the child.

— In humans, XY type of sex determination is seen and both males and females have same number of chromosomes

— The males have 22 pairs of autosomes plus XY-chromosomes.

— The females have 22 pairs of autosomes plus a pair of X-chromosomes.

A male produces types of sperms, 50% of them carrying one X-chromosome and other 50% of them carrying one Y-chromosome, apart from 22 autosomes in each of them.

— A female produces ova, all containing one X-chromosome plus 22 autosomes.

— The sex of the individual is determined by the type of sperm fertilizing the ovum.

— If the ovum is fertilised by X-carrying sperm, the zygote (XX) develops into a male

(c) The value of not looking down upon the girl child is insisted. It also tells that male and female children are equally important and equal opportunities should be provided to them.

Blaming women for the birth of girl child and ill-treating them is shameful.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

Q.35. (i) Construct a chromosome map with the following data. The map unit between A and B is 6, between B and C is 2, between C and D is 8 and between B and D is 6. Which of them will show a maximum recombination frequency? Why ?

(ii) Mention two situations when 50% recombination can take place.

(iii) Alleles of a gene move into different gametes. What does this demonstrate ?

Ans. (i) Maximum recombination will be between A and D because farther the genes, more will be the recombination frequency.

(ii) The two situations where 50% recombination occurs are :

— The gene must be situated on different chromosomes.

— If the genes are present on the same chromosome, the genes should be far apart', allowing crossing over between them.

(iii) It demonstrates the law of segregation; since the alleles move into different gametes each gamete gets only one allele for a character and is pure

Q.36. (i) Differentiate between aneuploidy and polyploidy.

(ii) Why did Mendel select garden pea for his experiments ?

(iii) Differentiate between codominance and incomplete dominance.

Ans. (i)

ANEUPLOIDY	POLYPLOIDY
It is the gain or loss of one or more chromosomes that results due to failure of separation of homologous pairs of chromosomes during meiosis.	It refers to the presence of more than two sets of chromosomes in a cell or an organism.

(ii) a) Many varieties of garden pea are available with observable alternate forms .

b) Peas are generally self-pollinated and can be easily cross-pollinated when self pollination is prevented.

(iii) Differences:

CODOMINANCE	INCOMPLETE DOMINANCE
— The two alleles of a gene are equally dominant and both express themselves and both their characters appear in the hybrid. e.g., AB blood group in humans.	— Neither of the two alleles of a gene is completely dominant over the other; the hybrid is intermediate between the two parents. e.g., Flower colour in snapdragon, where hybrid is pink.

CBSE QUESTIONS

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CBSE 2013

1.

In a cross between two tall pea plants some of the offsprings produced were dwarf. Show with the help of Punnett square how this is possible.

2

- (a) Why is human ABO blood group gene considered a good example of multiple alleles ?
- (b) Work out a cross up to F_1 generation only, between a mother with blood group A (Homozygous) and the father with blood group B (Homozygous). Explain the pattern of inheritance exhibited.

3.

- (a) What is Thalassemia ?
- (b) How would you counsel the family not to blame the mother for delivering a child suffering from this disease ? Explain.
- (c) List the values your counselling can propagate in the families.

CBSE 2014

1. . Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel.
2. In Snapdragon, A cross between true breeding red flower (RR) plants and true breeding white flower (rr) plants showed a Progeny of plants with all pink flowers.
 - (a) The appearance of pink flowers is not known as blending. Why?
 - (b) What is the phenomenon known as?
3. With the help of one example, explain the phenomena of co-dominance and multiple allelism in human population

4. Write the scientific name of the fruit-fly. Why did Morgan prefer to work with fruit-flies for his experiments? State any three reasons
5. **Linkage or crossing-over of genes are alternatives of each other. Justify with the help of an example.**
6. **Why is pedigree analysis done in the study of human genetics? State the conclusions that can be drawn from it.**
7. Identify 'a', 'b', 'c', 'd', 'e' and 'f' in the table given below :

No.	Syndrome	Cause	Characreristics of affected individual	Sex Male/Female/Both
1	Down's	Trisomy of 21	'a' (i) (ii)	'b'
2	'c'	XXY	Overall masculine development	'd'
3	Turner's	45 with OX	'e' (i) (ii)	'f'

CBSE 2015

A geneticist interested in studying variations and patterns of inheritance in living beings prefers to choose organisms for experiments with shorter life cycle. Provide a reason.

Differentiate between male and female heterogamety.

A teacher wants his/her students to find the genotype of pea plants bearing purple coloured flowers in their school garden. Name and explain the cross that will make it possible.

Explain the genetic basis of blood grouping in human population.

CBSE 2016

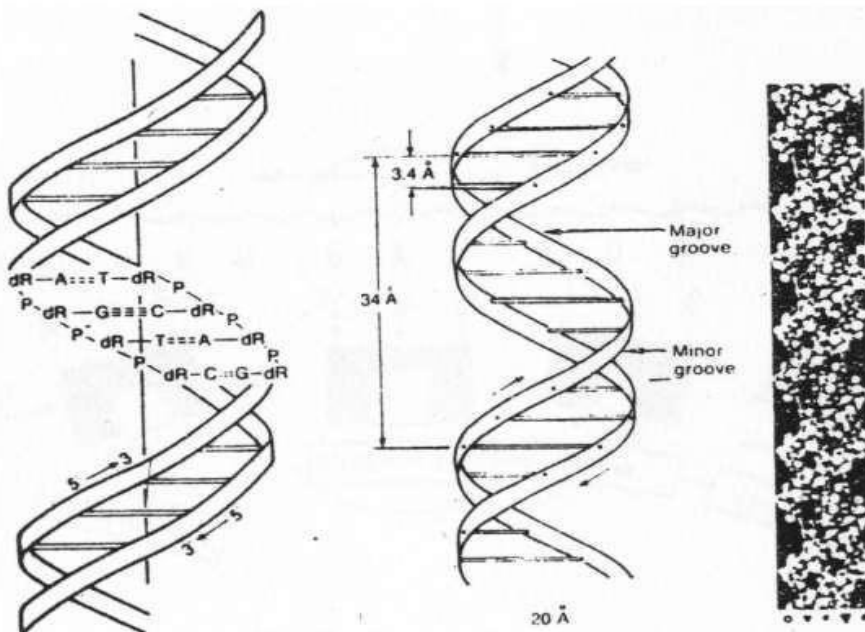
A male honeybee has 16 chromosomes whereas its female has 32 chromosomes. Give one reason.

What is a test cross ? How can it decipher the heterozygosity of a plant ?

Chapter 6. MOLECULAR BASIS OF INHERITANCE

DNA largest macromolecule made of helically twisted, two, antiparallel polydeoxyribonucleotide chains held together by hydrogen bonds.

- X-ray diffraction pattern of DNA by Rosalind Franklin showed DNA a helix.
- Components of DNA are (i) deoxyribose sugar, (ii) a phosphate, and (iii) nitrogen containing organic bases.
- DNA contains four different bases called adenine (A), guanine (G) cytosine (C), and thymine (T).
- These are grouped into two classes on the basis of their chemical structure: (i) Purines (with a double ring structure) and (ii) Pyrimidines (with a single ring structure)
- 1953. James Watson and Francis Crick proposed three dimensional structure of DNA and won the Nobel prize.
- DNA double helix with sugar phosphate back bone on outside and paired bases inside.
- Planes of the bases perpendicular to helix axis.
- Each turn has ten base pairs. (34 Å)
- Diameter of helix 20 Å.
- Two strands of DNA antiparallel.
- DNA found both in nucleus and cytoplasm.
- Extranuclear DNA found in mitochondria and chloroplasts.
- Two chains complementary
- Two chains held together by hydrogen bond.
- Adenine-Thymine pair has two hydrogen bonds.
- Guanine-Cytosine pair has three hydrogen bonds.
- Upon heating at temperature above 80-90 degree two strands uncoil and separate (Denaturation)
- On cooling two strands join together (renaturation /annealing)
- DNA is mostly right handed and B form.
- Bacterial nucleoid consists of a single circular DNA molecule .



PACKAGING OF DNA HELIX

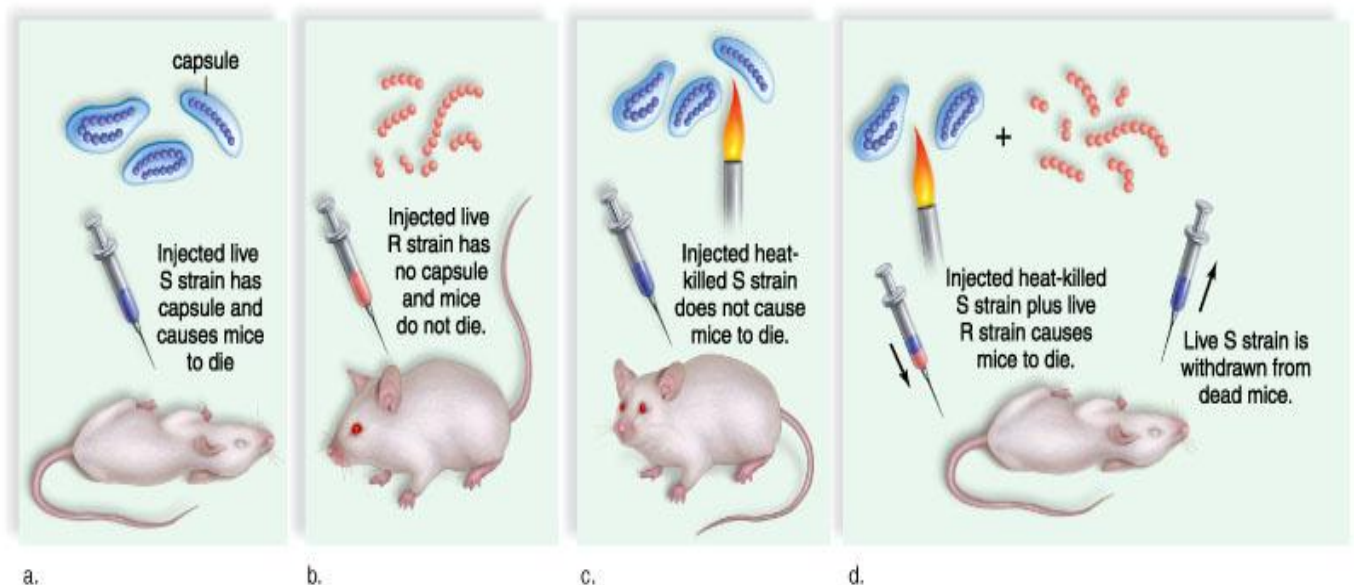
- # DNA of eukaryotes is wrapped around positively charged histone proteins to form nucleosome.
- # Nucleosome contains 200 base pairs of DNA helix.
- # Histone octamer = 2(H2a+H2b+H3+H4)
- # Linker DNA bears H1 protein
- # Chromatin fibres formed by repeated units of nucleosomes.
- # Non histone proteins required for packaging.
- # Regions of chromatin, loosely packed and stains lightly called euchromatin.
- # Regions of chromatin, densely packed and stains darkly is called heterochromatin.

Proof that DNA is Genetic Material

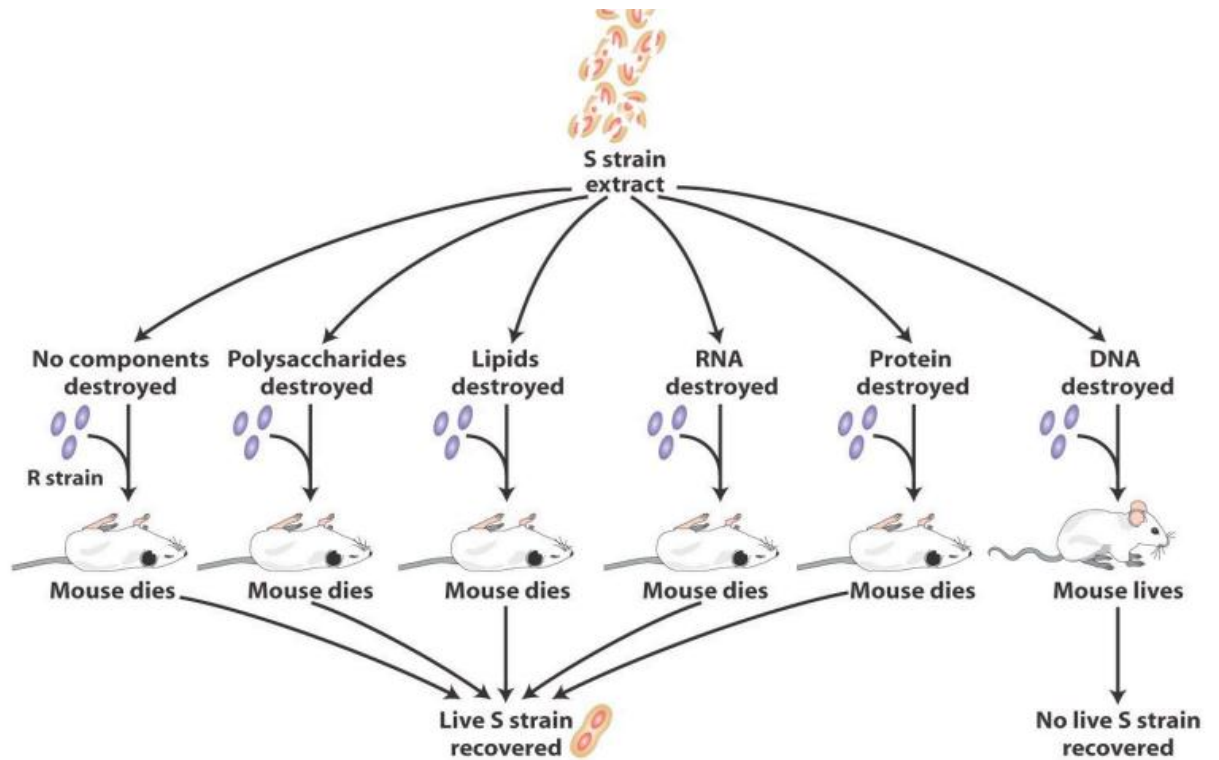
1. The transforming Principle-by Frederick Griffith(1928)

- **Transformation** results in the genetic alteration of the recipient cell
- *Streptococcus pneumonia*
- Griffith concluded that the R-strain had been "transformed" into the lethal S strain by a "transforming principle" that was somehow part of the dead S strain bacteria.

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2. Avery, MacLeod and McCarty-They used biochemical purification of cellular fractions to determine that DNA and not RNA or protein was the transforming principle

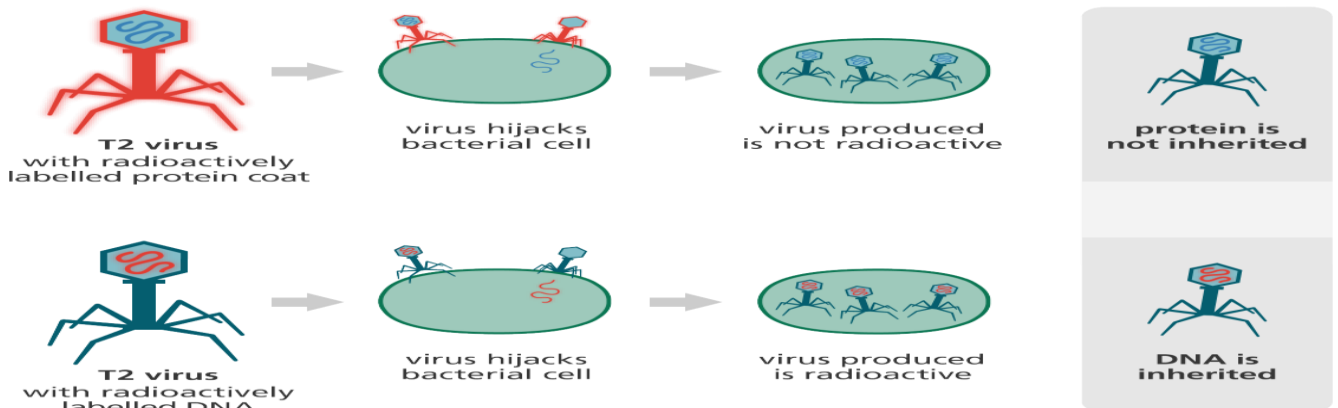


3. Hershey and Chase The "Blender Experiment"

PROVED DNA IS THE GENETIC MATERIAL

DNA - C+H+O+N+P

Protein - C+H+O+N+S



DNA REPLICATION-

*process of producing two complementary replicas from one original DNA molecule.

* Semi-conservative (one parental + one new daughter strand)

* Each strand serves as a template

STEPS

1. INITIATION-

- **ORI**- trigger unwinding

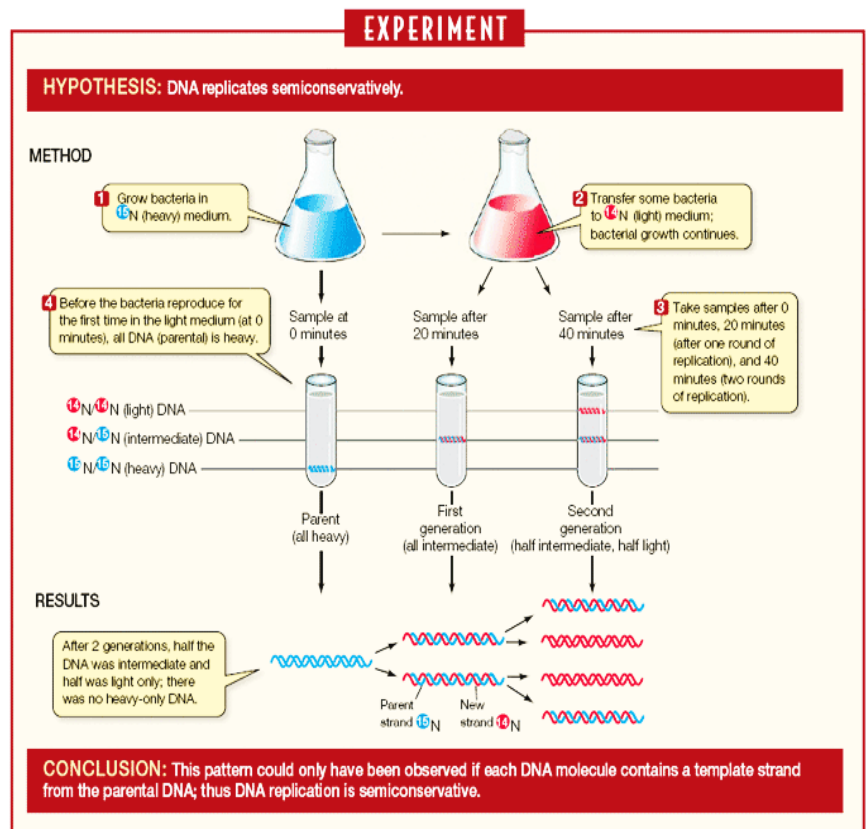
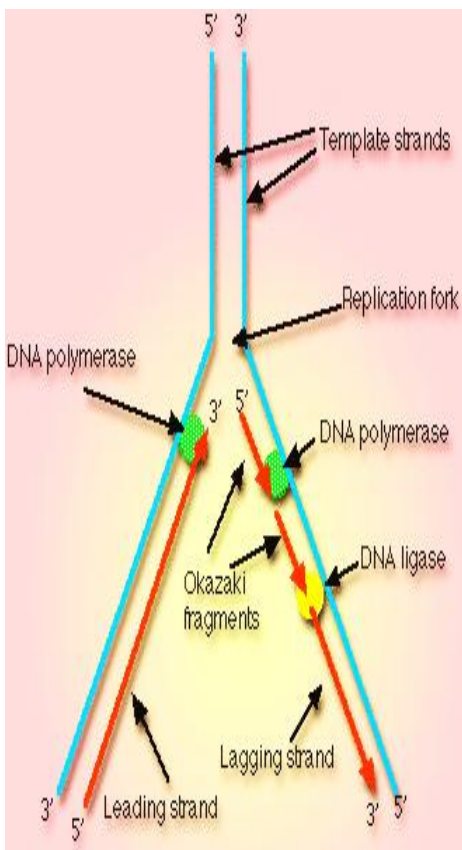
- **UNWINDING-Helicase**(unwinding)+**topoisomerase**(relax the twisting)+**SSBP**(prevent the two strands from reattaching to each other)
- **Y FORK**

2. ELONGATION-

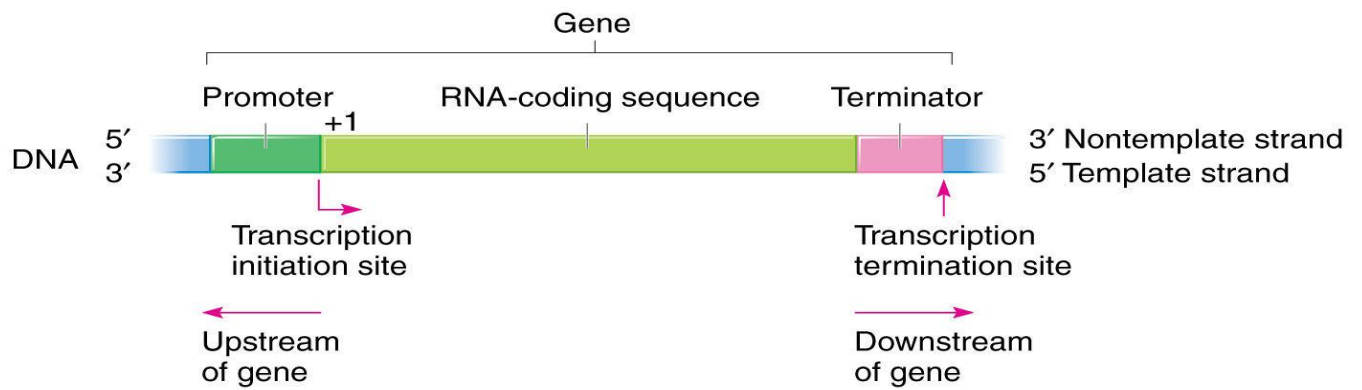
- **RNA PRIMER ANNEALING-PRIMASE, FREE 3' OH END**
- **leading strand** is made continuously, while the **lagging strand** is made in pieces called **Okazaki fragments**. **DNA POLYMERASE** (adds complementary nucleotides)

3. TERMINATION & PROOF READING

- Primers are removed and replaced with new DNA nucleotides and the backbone is sealed by **DNA ligase**
- **DNA polymerase proofreads** to make sure correct nucleotide is added



TRANSCRIPTION- DNA is copied into RNA (mRNA)



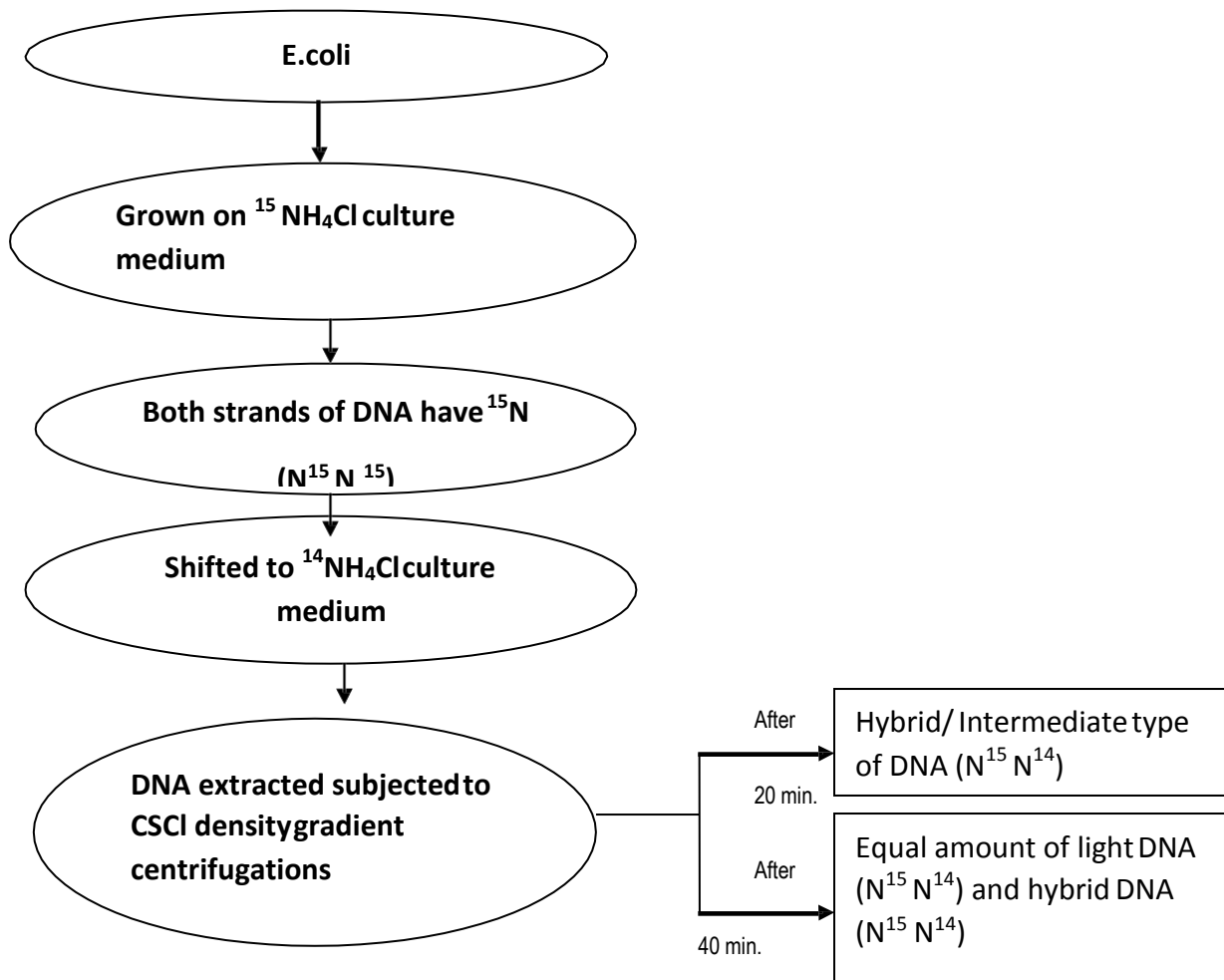
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1. **Initiation**- RNA polymerase and cofactors(**sigma factor**) bind to DNA and unwind it, creating an initiation bubble, binding of RNA polymerase to the promoter in DNA
2. **Elongation**- RNA transcript is synthesized by ribonucleotide triphosphate additions by RNA Polymerase , Base pairing rule is followed, Synthesis stops at a terminator sequence
3. **Termination**- Rho (ρ) dependent termination, release of the newly synthesized mRNA from the elongation complex



From this we conclude that DNA is the genetic material.

Semi conservative nature of DNA -Mathew Messelson and Franklin Stahl.



8. 3 Replication of DNA In Eukaryotes:

Definition: "Process by which DNA produces daughter DNA molecules. They are exact copies of the original DNA." In eukaryotes, DNA is double stranded. The two strands are complementary to each other because of their base sequences.

Semi-conservative method of DNA replication Important points:

- (i) Most common method of DNA replication.
- (ii) Takes place in the nucleus where the DNA is present in the chromosomes.
- (iii) Replication takes place in the S-phase (synthesis phase) of the interphase nucleus.
- (iv) Deoxyribose nucleotides needed for formation of new DNA strands are present in nucleoplasm. At the time of replication, the two strands of DNA first separate. Each strand then acts as a **template** for the formation of a new strand. A new strand is constructed on each old strand, and two exactly identical double stranded DNA molecules are formed. In each new DNA molecule, **one strand is old** (original) while the **other is newly formed**. Hence, Watson and Crick described this method as **semi-conservative replication**. (A) An overall process of DNA replication showing replication fork and formation of new strands template and lagging template.

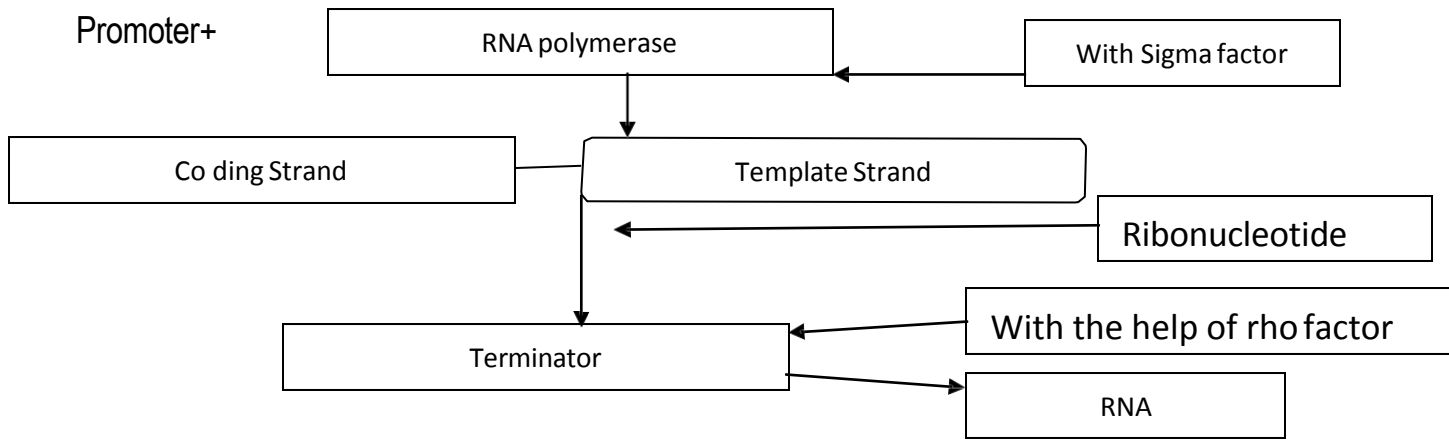
The various steps involved in this process are summarized as follows:

- i. Mechanism of replication starts at a specific point of the DNA molecule, called **origin**.
- ii. At origin, DNA strand breaks because of an **incision** (nick). This is made by an enzyme called **incision enzyme** (endonuclease).
- iii. The hydrogen bonds joining the two strands are broken by the enzyme.
- iv. The two strands start **unwinding**. This takes place with the help of a **DNA unwinding enzyme Helicases**. Two polynucleotide strands are thus separated.
- v. The point where the two strands separate appears like a fork or a **Y-shape**. This is described as a **replicating fork**.
- vi. A new strand is constructed on each old strand. This takes place with the help of a small **RNA primer** molecule which is complementary to the DNA at that point.
- vii. Each old DNA strand acts as a **template** (site) for the construction of new strand. The RNA primer attaches itself to the old strand and attracts the enzymes (**DNA polymerase III**) which add new nucleotides through **base complementation**. The deoxyribose nucleotides are present in the surrounding nucleoplasm. New DNA strand is thus constructed opposite to each old strand.
- viii. Formation of new complementary strand always begins at the 3' end of the template strand (original strand) and progresses towards the 5' end (ie in 3' - 5' direction). Since the new strand is **antiparallel** to the template strand, it is obvious that the new strand itself is always developed in the, 5'-3' direction. For this reason when the two original strands separate (then with respect to the origin of separation), one acts as 3'-5' template while the other acts as 5'- 3'template.
- ix. Of the two, the replication of 3'-5' template begins first. Hence the new strand formed on it is called the **leading strand**. The other template (5'-3') must begin replication at the fork and progress back toward the previously transcribed fragment. The new strand formed on it is called the **lagging strand**.
- x. Replication of the lagging strand takes place in small fragments called **Okazaki fragments**. These are then connected together by the enzyme **ligase**.
- xi. Replication may take place in only one direction on the DNA helix (unidirectional) or in two directions (bidirectional).
- xii. At the end of the process, two double stranded DNA molecules are formed from the original DNA molecule.

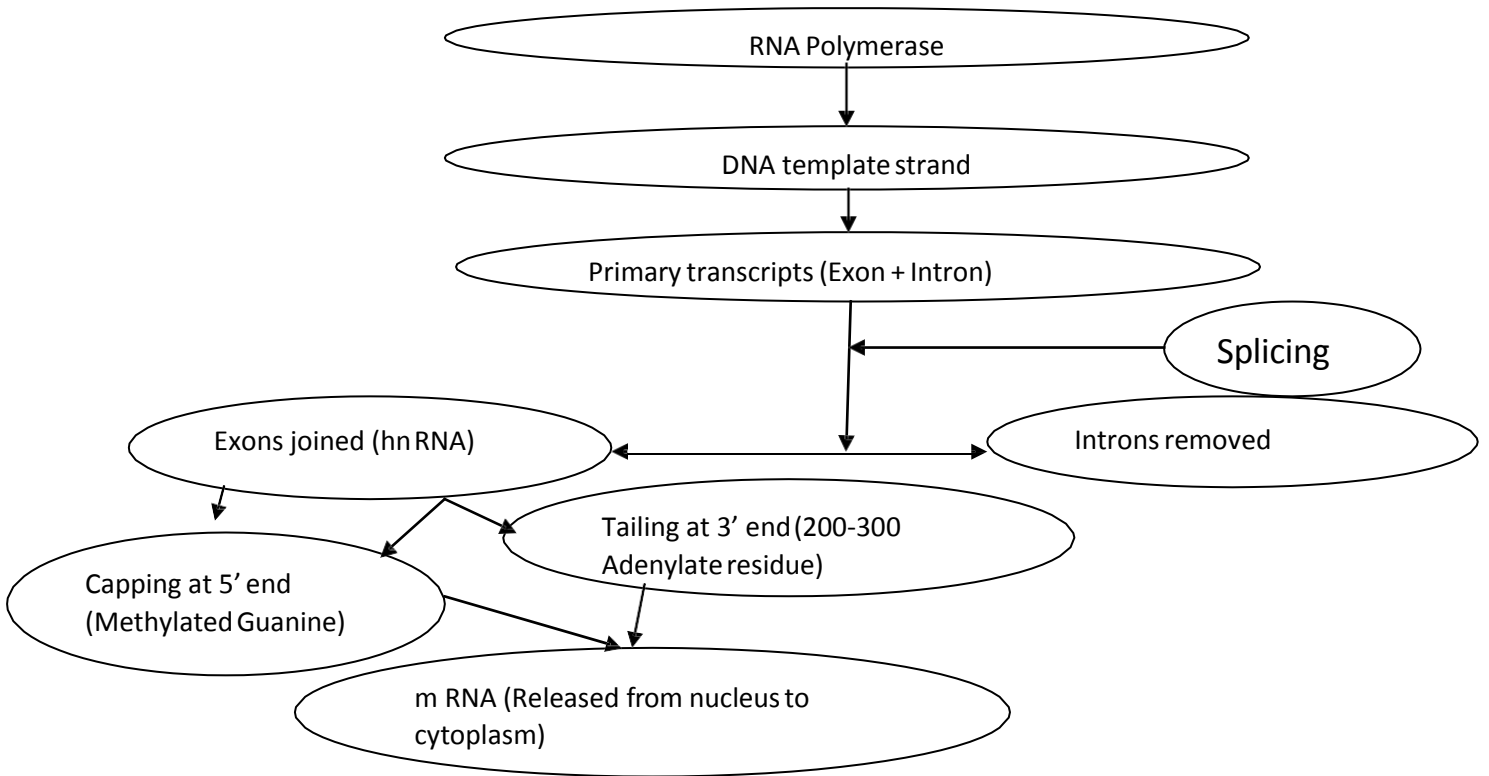
Three major types of RNA:

1. Messenger RNA or mRNA- has the information to make a protein. It is very unstable and comprises ~5% of total RNA polymer. Its length is highly variable, of the range 750-3000 nucleotides.
2. Transfer RNA or tRNA- small molecule, about 90 nucleotides long. It is highly folded into an elaborate 3-d structure and comprises about 15% of total RNA.
3. Ribosomal RNA or rRNA- 80% of the total RNA, is associated with subcellular structures called ribosomes in which the polymer length varies from 120-3000 nucleotides and is folded into an elaborate structure which give ribosomes their shape.

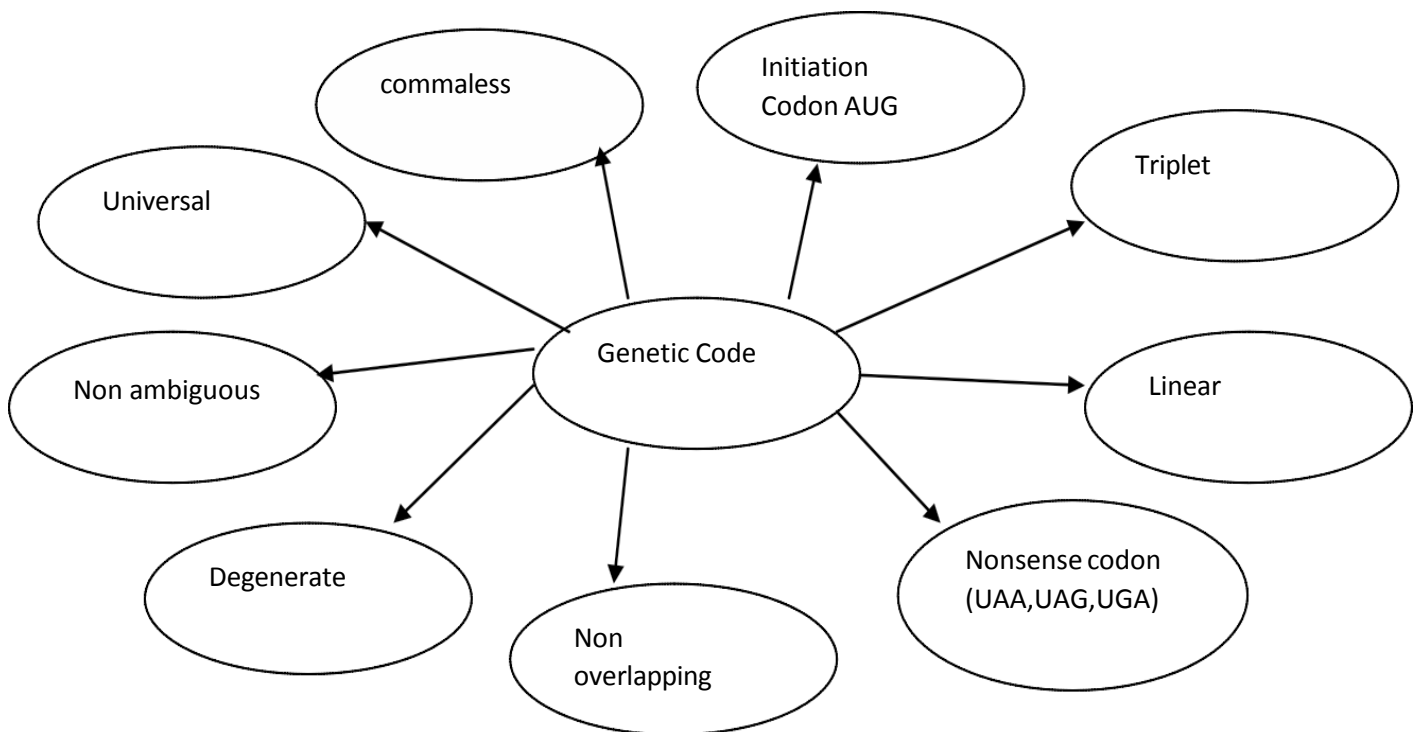
Transcription in Prokaryotes



Transcription in Eukaryotes



GENETIC CODE



Non ambiguous—Particular codon will always code for same amino acid. Degenerate—
Number of codons can code for one amino acid.

Universal—Specific codon codes for same amino acid in all organisms.

Translation:-

- ❖ Process of joining of amino acids by peptide bond to form a polypeptide.

1. Activation of amino acids

- $AA+ATP+E \xrightarrow{Mg^{+2}} AA-AMP-E+PPi$
- $AA-AMP-E+tRNA \rightarrow AA-tRNA+AMP+E$



2. Initiation

- Small subunit (40s) of ribosome binds with mRNA.
- Charged tRNA specific for initiation codon reaches P site
- Larger subunit (60s) of ribosome now combines with 40s-mRNA-tRNA^{met} complex in the presence of Mg^{+2}



3. Elongation

- Second t-RNA charged with amino acid occupies A site of ribosome.
- Peptide bond formation between methionine and second amino acids with the help of enzyme peptide transferase.
- Ribosomes moves over mRNA in $5' \rightarrow 3'$



4. Terminator

Translation stops when non sense codons (Stop codons) reached.

- No t RNA for stop codons (UAA,UAG,UGA)
- Synthesized polypeptide is released with the help of release factor.

AA—Amino acid

*ATP—Adenosine Triphosphate

E.pyrophosphate,

A—t RNA—Amino acyl-t RNA complex

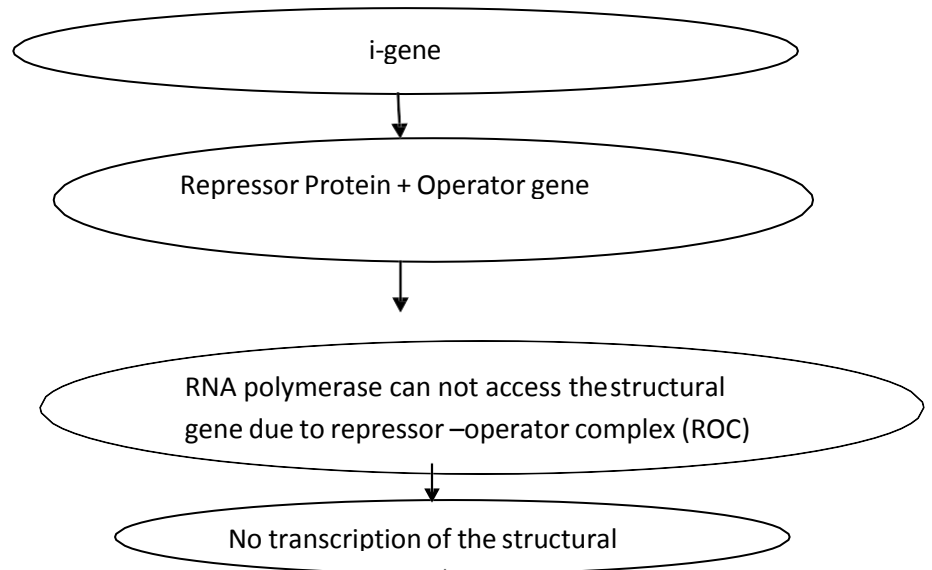
LAC OPERON

*Discovered by Jacob and Manod.

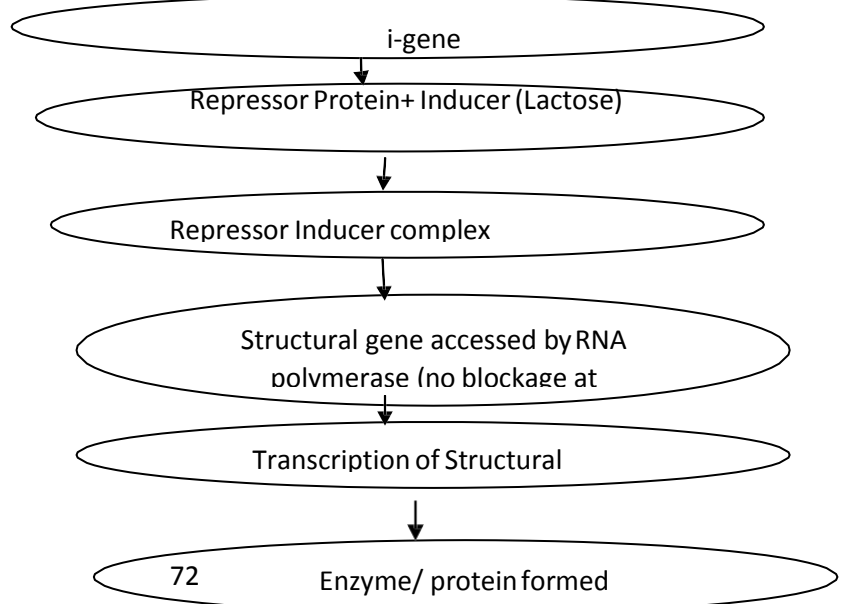
*Experimented on E.coli.

Refer to figure number 6.14 of page 117 of text Book

SWITCH OFF CONDITION



SWITCH ON CONDITION



METHODOLOGY OF HGP

Sequence Annotation

Expressed sequence Tags (EST) (Identifying all the genes Expressed as RNA)

-Isolation of total DNA from the cell

-Fragmentation by restriction endonuclease

Fragments cloned in suitable host BAC/YAC

Fragments sequenced using automated DNA sequences.

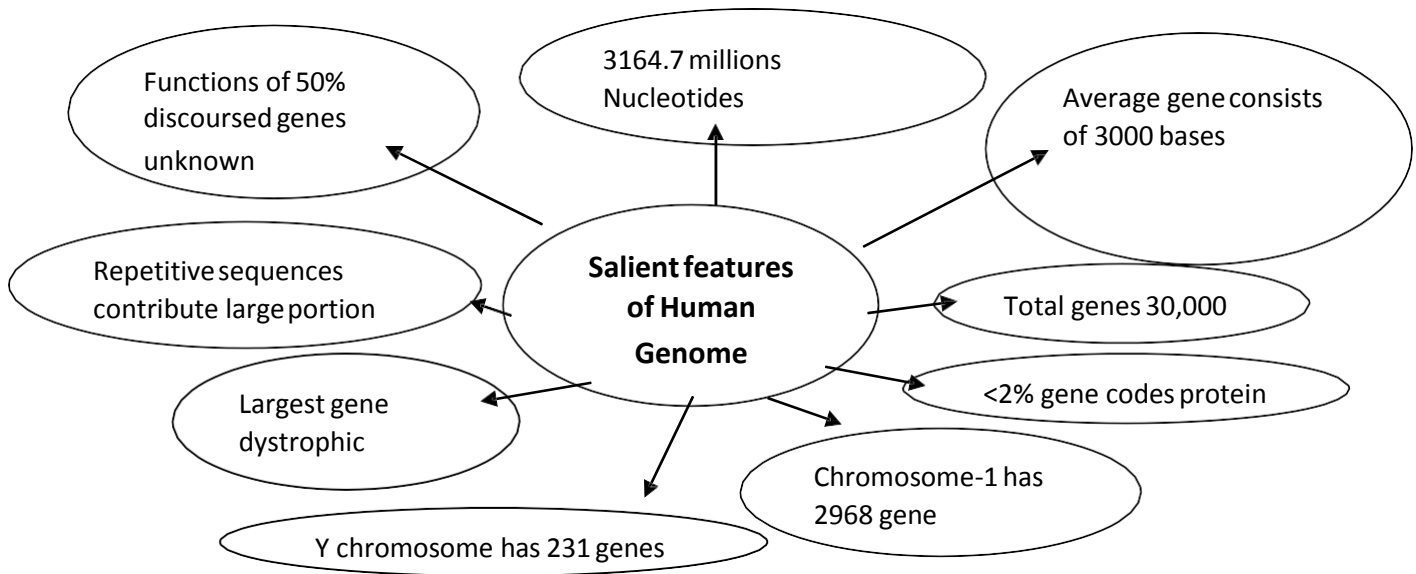
Sequences arranged on the basis of overlapping regions.

Alignment of the sequences by specialized computer based programmes

Goals of HGP

Some of the important goals of HGP were as follows:

- (i) Identify all the approximately 20,000-25,000 genes in human DNA;
- (ii) Determine the sequences of the 3 billion chemical base pairs that make up human DNA;
- (iii) Store this information in databases;
- (iv) Improve tools for data analysis;
- (v) Transfer related technologies to other sectors, such as industries;
- (vi) Address the ethical, legal, and social issues (ELSI) that may arise from the project.

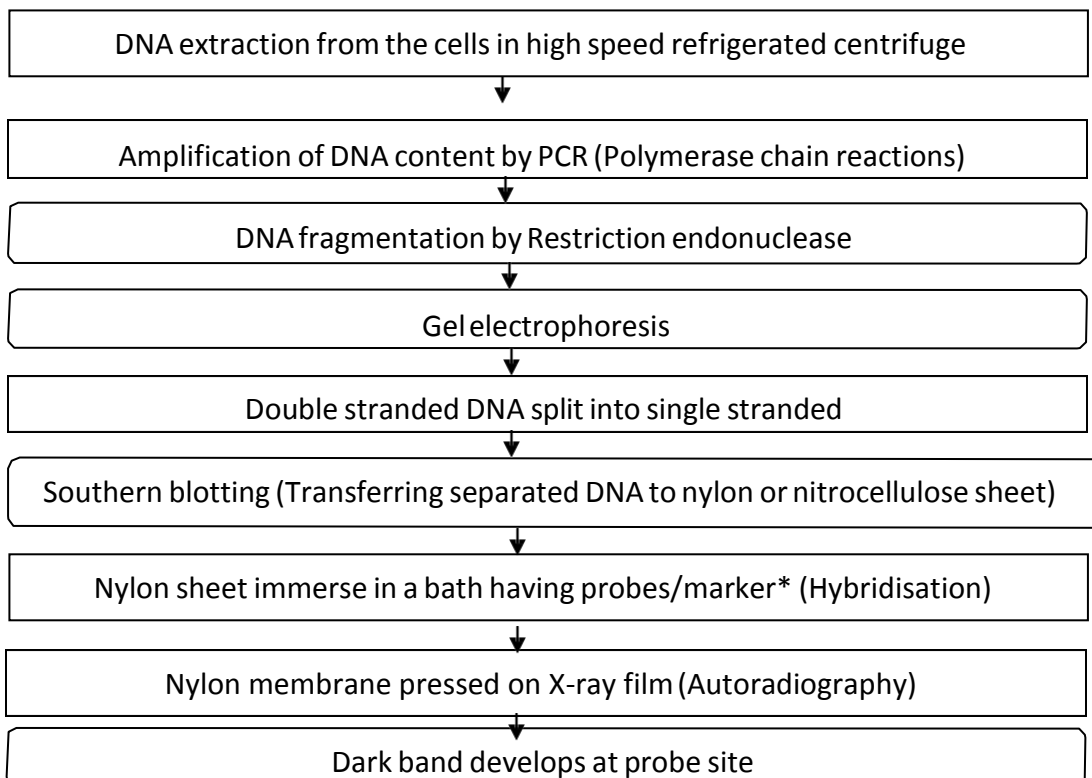


Application of Human genome project

- : Identification of defective genes.
- : Opportunity to offer early treatment.
- : Identification of genes that confer susceptibility to certain disease.
- : Prediction of protein that the genes produce.
- : Drug designing to enhance or inhibit the activities of the proteins.

TECHNIQUE FOR DNA FINGERPRINTING

- ❖ Technique developed by Dr.Alec Jeffreys.
- ❖ Process is also known as **DNA typing/DNA profiling.**



**Probes/ Markers are radioactive synthetic DNA complementary to VNTR*

NEW addition in syllabus 2016

RICE GENOME PROJECT

Rice (*Oryza sativa L.*) is the most important food crop in the world and feeds over half of the global population. As the first step in a systematic and complete functional characterization of the rice genome, the International Rice Genome Sequencing Project (IRGSP) has generated and analysed a highly accurate finished sequence of the rice genome that is anchored to the genetic map. The analysis has revealed several salient features of the rice genome

The IRGSP, formally established in 1998, pooled the resources of sequencing groups in ten nations to obtain a complete finished quality sequence of the rice genome

1. Provided evidence for a genome size of 389 Mb.
2. A total of 37,544 non-transposable-element-related protein-coding sequences were detected. A total of 2,859 genes seem to be unique to rice and the other cereals, some of which might differentiate monocot and dicot lineages.
3. The transposon content of rice is at least 35% and is populated by representatives from all known transposon superfamilies
4. The availability of a complete and high-quality map-based sequence has provided the opportunity to study genome organization and evolution. Most importantly, the order and identity of 37,544 genes of rice have been unraveled. The sequence provides the required ingredients for functional genomics and molecular breeding programs aimed at unraveling intricate cellular processes and improving rice productivity

QUESTIONS

ONE MARK QUESTION

1. Name the genetic material in TMV.
2. Write the scientific name of the plant on which Taylor et al performed their experiment.
3. What would be the proportion of light and hybrid density DNA molecules after 80 minutes of a single cell of E. coli growth?
4. When does DNA replicate in the cell cycle?
5. Name the amino acids having only one codon.

TWO MARK QUESTION

1. What is meant by semiconservative nature of DNA replication?
2. What are the functions of DNA polymerase?
3. What is frame shift mutation? Name the type of mutation that does not affect protein synthesis.
4. What are the untranslated regions (UTRs)?
5. Briefly describe polymorphism.
6. What

do you mean by phosphodiester bond?

Ans: The bond which is formed between the 3'-OH of one deoxyribonucleotide and 5'-phosphate residue of an adjacent deoxyribonucleotide.

7. What type of transcription is found in retrovirus? Name the enzyme.

Ans: In retrovirus the genetic information flows from RNA to DNA and is called reverse transcription while the enzyme involved is called reverse transcriptase.

8. What would happen if histones were to be mutated and made rich in amino acids aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

Ans: If histone proteins were rich in acidic amino acids instead of basic amino acids then they would not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the chromatin fibre would not be formed.

9. Explain what happens in frameshift mutation. Name one disease caused by the disorder.

Ans: Mutation in which addition/insertion or deletion of one or two bases changes the reading frame from the site of mutation is called frameshift mutation. It may result in polypeptide with different sequences of amino acids. Disease caused by frameshift mutation - sickle-cell anemia.

10. Comment on the utility of variability in number of tandem repeats during DNA fingerprinting.

Ans: Tandemness in repeats provides many copies of the sequence for fingerprinting and variability in nitrogen base sequence in them. Being individual-specific, this proves to be useful in the process of DNA fingerprinting.

11. Why is lactose considered an inducer in lac operon?

Ans: Lactose binds to repressor molecule and prevents it from binding with the operator, as a result RNA polymerase binds to promoter-operator region to transcribe the structural genes. Thus the lac operon is switched on.

12. If a double-stranded DNA has 20 % of cytosine, calculate the % of adenine in the DNA.

Ans: cytosine = 20%, therefore guanine = 20%

According to Chargaff's rule,

$$A+T = 100 - (G+C)$$

$A+T = 100 - 40$. Since both adenine and thymine are in equal amount.

Therefore, Thymine = Adenine = $60\%/2 = 30\%$

13. What is cistron?

Ans: Region of the DNA template (gene) coding for a single protein is called cistron.

THREE MARK QUESTIONS

1. Describe the discontinuous synthesis of DNA.
2. How is Lac operon – switched on in an *E. coli* cell?
3. Name the three RNA Polymerases found in eukaryotes and mention their functions.
4. Explain the two major approaches involved in the sequencing of genomes.

FIVE MARKS QUESTIONS

1. Describe the salient features of the double helical model of DNA.
2. Bring out the salient features of genetic code .
3. Describe in detail the steps in the technique of DNA finger printing.
4. Describe the process of replication of DNA.
5. What is satellite DNA ? Name their types. Mention their basis for classification of satellite DNA.
6. What are the differences between DNA and RNA?

Ans:

DNA	RNA
<ol style="list-style-type: none"> 1. Polymer of deoxyribonucleotides consisting of two antiparallel strands. 2. Purine nucleotides are- adenine and guanine. Pyrimidine nucleotides are 	<ol style="list-style-type: none"> 1. Polymer of ribonucleotides consisting of only a single strand. 2. Purine nucleotides are- adenine and guanine. Pyrimidine nucleotides are

cytosine and thymine. 3. Main function is to carry all the hereditary characteristics. 4. Mainly present in nuclear material of chromatin fibre, mitochondria and chloroplast.	cytosine and uracil. 3. Main function is to perform protein synthesis. 4. Mainly present in cytoplasm, nucleolus and chromosome.
--	--

7. What are B-DNA, A-DNA and Z-DNA?

Ans:

B-DNA	A-DNA	Z-DNA
1. Most predominant form of DNA, the conformation described by Watson and Crick, present under physiological conditions in the body, right	1. In lower concentration of salts or in a partially dehydrated state, this form is present, found in some Gram positive bacteria, right handed 2. 3.	1. It has been discovered in synthetically made oligodeoxynucleotides, left handed double helix. 2. Base pair per turn 12. 3. Diameter 1.8 nm.

8. Recall the experiment done by Frederick Griffith. If the RNA, instead of DNA was the genetic material, would the heat killed strain of strain of streptococcus have transformed the r-strain into virulent strain? Explain your answer.

Ans: RNA is more labile and prone to degradation (owing to the presence of 2'-OH group in its ribose). Hence heat-killed S-strain may not have retained its ability to transform the R-strain.

9. What do you mean by selfish DNA?

Ans: DNA whose role appears to be to mediate its own replication and survival within the genome, e.g. some satellite DNA, and transposable elements.

10. What are the differences between euchromatin and heterochromatin?

Ans:

Euchromatin	heterochromatin
1. During interphase certain areas in chromatin are loosely coiled and stain less intensely.	1. During interphase certain areas in chromatin remain tightly coiled or condensed and hence stain darkly.
2. These contain the genes or the coding DNA.	2. These contain non-coding DNA like the repetitive DNA.

TEST QUESTIONS
VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

Q. 1. Name two plants whose genomes have been sequenced.

Ans. Rice and Arabidopsis.

Q.2. Mention the function of non-histone protein.

Ans. Packaging of chromatin

Q.3. During translation what role is performed by tRNA

Ans. (i) Structural role

(ii) Transfer of amino acid.

Q.4. RNA viruses mutate and evolve faster than other viruses. Why?

Ans. —OH group is present on RNA, which is a reactive group so it is unstable and mutates faster.

Q.5. Name the technique that compares the DNA sequences of any two individuals.

Ans. DNA Fingerprinting.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

Q.6 Complete the blanks a, b, c and d on the basis of Frederick Griffith Experiment.

S Strain → inject into mice → (a)

R strain → inject into mice → (b)

S strain (heat killed) inject into mice → (c)

S strain (heat killed) + R strain (live) inject into mice → (d)

Ans. (a) Mice die

(b) mice live

(c) mice live

(d) mice die

Q.7. If the length of E.Coli DNA is 1.36 mm, Calculate the number of base pairs it contains.

Ans. The distance between two adjacent bp = 0.34×10^{-9} m length = Total no. of bp x distance between two bp.

$$\text{No. of bp.} = 1.36 \times 10^{-3} / 0.34 \times 10^{-9} = 4 \times 10^6 \text{ bp}$$

Q.8. DNA is unzipped twice in a cell. Name the two different events which can occur and the enzymes responsible for it.

Ans.

- (i) During DNA replication i.e., in the S-phase of interphase enzyme-DNA polymerase.
- (ii) During transcription for protein synthesis-enzyme-DNA dependent RNA polymerase.

Q.9. Give two reasons why both the strands of DNA are not copied during transcription.

Ans. (a) If both the strands of DNA are copied, two different RNAs (complementary to each other) and hence two different polypeptides; if a segment of DNA produces two polypeptides, the genetic information machinery becomes complicated.

(b) The two complementary RNA molecules (produced simultaneously) would form a double stranded RNA rather than getting translated into polypeptides.

(c) RNA polymerase carries out polymerisation in 5' → 3' direction and hence the DNA strand with 3' → 5' polarity acts as the template strand.

Q.10. Expand SNPs. What are they?

Ans. SNPs - Single nucleotide polymorphisms.

These are locations on DNA, where single base differences are observed.

Q.11. Mention any two applications of DNA fingerprinting.

- Ans.
- (i) To identify criminals in the forensic laboratory.
 - (ii) To determine the real or biological parents in case of disputes.
 - (iii) To identify racial groups to rewrite the biological evolution (Any two)

VALUE BASED QUESTION (4 MARKS)

Q.12. In a series of experiments with *Streptococcus pneumoniae*, Frederic-Griffith concluded that the R-Strain bacteria had somehow been transformed by the heat-killed strain.

(a) If RNA, instead of DNA was the genetic material would heat-killed strain have transformed the R-strain into a virulent one?

(b) Give one reason to explain why RNA viruses mutate and evolve faster than other viruses.

(c) What are the values shown by the Scientists while doing researches?

Ans: (a) RNA is more labile and prone to degradation owing to the presence of 2'-OH group in its ribose. Hence heat killed S – Strain may not have retained its ability to transform if RNA was its genetic material.

(b) RNA viruses mutate and evolve faster than other viruses due to its more reactive and unstable nature. It is due to the presence of 2'-OH group in ribose sugar, Uracil and enzymatic properties.

(c) Scientists have the values of knowing the unknown, to give information to face challenges of life, scientific attitudes and humankindness.

Q.13. The DNA packaging in eukaryotes is carried out with the help of lysine and arginine rich basic proteins called histamine. The unit of compaction is nucleosome.

(a) What would happen if histones were to be mutated and made rich in aspartic acid and glutamic acid in place of basic amino acids such as lysine and arginine?

(b) What is the role of non-histone chromosomal proteins in DNA packing?

Ans. (a) If histone proteins were rich in acidic amino acids instead of basic amino acids then they may not have any role in DNA packaging in eukaryotes as DNA is also negatively charged molecule. The packaging of DNA around the nucleosome would not happen. Consequently, the

chromatin fibre would not be formed.

(b) The packaging of chromatin at higher level requires non-histone chromosomal proteins (NHC).

LONG ANSWER TYPE QUESTIONS (5 MARKS)

Q.14. What is meant by semi conservative replication? How did Meselson and Stahl prove it experimentally?

Ans. Meselson and Stahl, performed an experiment using E. Coli to prove that DNA replication is semi conservative.

- They grew E. Coli in a medium containing $^{15}\text{NH}_4\text{Cl}$.
- Then separated heavy DNA from normal (^{14}N) by centrifugation in CsCl_2 density gradient.
 - The DNA extracted, after one generation of transfer from ^{15}N medium to ^{14}N medium, had an intermediate density.
 - The DNA extracted after two generations consisted of equal amounts of light and hybrid DNA.
 - They proved that DNA replicates in a semiconservative manner. (Refer figure 6.7, page 105, NCERT Biology XII).

Q.15. Describe the steps involved in the sequencing of a genome.

Ans. (i) Total DNA from the cell is isolated and converted into fragments of smaller sizes.

(ii) The fragments are cloned in suitable hosts (bacteria or yeast) using specialised vectors BAC or YAC.

(iii) The fragments are sequenced using automated DNA sequences.

(iv) The sequences are arranged on the basis of certain overlapping regions present in them.

(v) These sequences are annotated and assigned to the respective chromosomes.

Q.16. Describe the various steps involved in the technique of DNA fingerprinting.

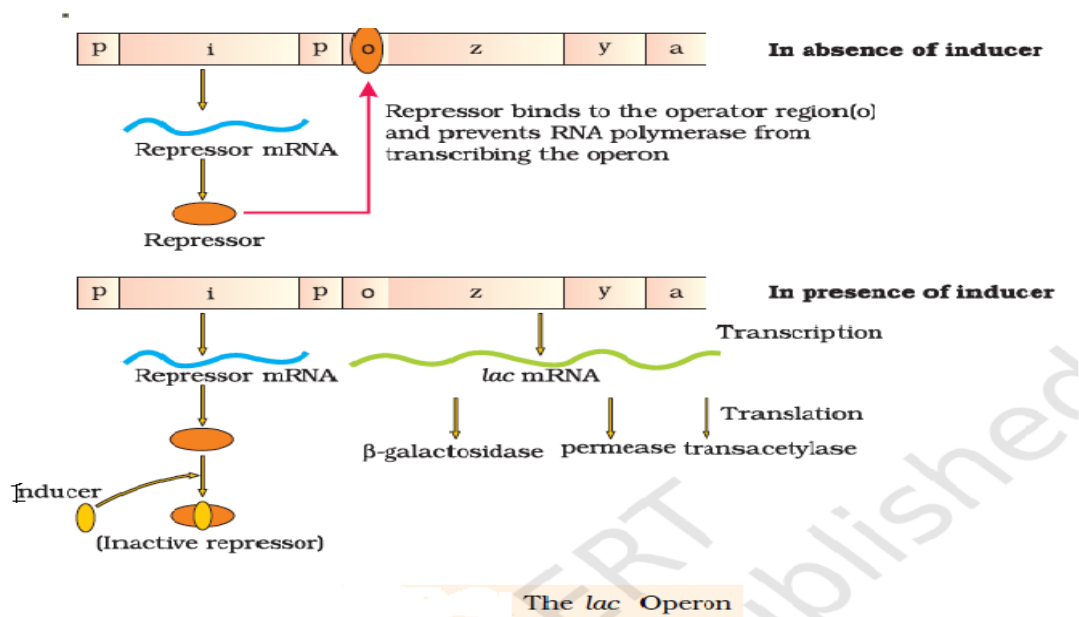
Ans. Steps/procedure in DNA fingerprinting —

- Extraction of DNA - using high speed refrigerated centrifuge.
- Amplification - many copies are made using PCR
- Restriction Digestion - using restriction enzymes DNA is cut into fragments.
- Separation of DNA fragments - using electrophoresis-agarose polymer gel.
- Southern Blotting : Separated DNA sequences are transferred onto nitrocellulose or nylon membrane.
- Hybridisation : The nylon membrane exposed to radio active probes.
- Auto radiography : The dark bands develop at the probe site.

Q.17. What does the lac operon consist of? How is the operator switch turned on and off in the expression of genes in this operon? Explain.

Ans. Lac Operon consists of the following .

- Structural genes : z, y, a which transcribe a polycistronic mRNA.
- gene 'z' codes for β -galactosidase - gene 'y' codes for permease.
- gene 'a' codes for transacetylase.
- Promotor : The site where RNA polymerase binds for transcription.
- Operator : acts as a switch for the operon
- Repressor : It binds to the operator and prevents the RNA Polymerase from transcribing.
- Inducer : Lactose is the inducer that inactivates the repressor by binding to it.
- Allows an access for the RNA polymerase to the structural gene and transcription.



CBSE QUESTION

1. Explain the process of DNA replication with the help of a schematic diagram.
 - (b) In which phase of the cell cycle does replication occur in Eukaryotes ?

What would happen if cell-division is not followed after DNA replication ?(CBSE 2014)
2. (a)What is Central dogma ? Who proposed it?
 - (b) Describe Meselson and Stahl's experiment to prove that the DNA replication is semi-conservative
3. (a) What is meant by semi conservative replication?
 - (b) Differentiate between leading and lagging strand.
 - (c) How do Meselson and Stahl proved the semiconservative nature of

replication

experimentally ?

4. Name the enzyme and state its property that is responsible for continuous and discontinuous replication of the two strands of a DNA molecule.
5. A template strand is given below. Write down the corresponding coding strand and the mRNA strand that can be formed along with their polarity
---3'ATGCATGCATGCATGCATGC5'---
6. (a) Explain with the help of schematic representation the lac operon in *E.coli*.
(b) Mention the role of lactose in this operon
(c) What is an operon?
7. Explain the structure of t-RNA with the help of a diagram. Describe its role in the process of translation
8. a) Define transcription
b) Explain a transcription unit with the help of a diagram
c) Explain the process of transcription
9. Describe how the lac operon operates, both in the presence and absence of an inducer in *E.coli*.
10. Name the major types of RNAs and explain their role in the process of protein synthesis in prokaryote

ADDITIONAL QUESTIONS FOR SELF ASSESSMENT

1. Name the scientist who suggested that the genetic code should be made of a combination of three nucleotides.
(ii) Explain the basis on which he arrived at this conclusion
2. Name the major types of RNAs and explain their role in the process of protein synthesis in prokaryote.
3. a) Name the scientist who postulated the presence of an adapter molecule that can assist in protein synthesis.
(b) Describe its structure with the help of a diagram. Mention its role in protein synthesis

4. Following the collision of two trains a large number of passengers are killed. A majority of them are beyond recognition. Authorities want to hand over the dead to their relatives.
Name a modern scientific method and write the procedure that would help in the identification of kinship
5. a) Differentiate between exons and introns.
b) How RNA processing is done?
or How hnRNA gets converted in mature RNA
6. Explain the significance of satellite DNA in DNA fingerprinting technique.
7. How do m-RNA , t-RNA and ribosomes help in the process of translation?
8. Explain the process of DNA replication.
9. Explain the process of transcription. Explain the process of transcription in prokaryotes. How is the process different in eukaryotes ?
10. Explain the process of translation.
11. Name the genes that constitute an operon. How does lac operon get switched on in the presence of lactose?
12. Draw a labelled diagram of a “replicating fork” showing the polarity. Why does DNA replication occur within such ‘fork’ ?
(b) Name two enzymes involved in the process of DNA replication, along with their Properties.

CHAPTER-7: EVOLUTION

Evolution: Process that results in heritable changes in a population spread over many generations (change in allele frequencies over time) leading to diversity of organisms on earth. It is the genetic change in a population or species over generations (Genes mutate, individuals are selected, and populations evolve).

Evidences of evolution:

From comparative anatomy: Comparison of body structures amongst different species comes under comparative anatomy. Certain anatomical similarities among species bear witness to evolutionary history. eg. the same skeletal elements make up the forelimbs of man, horse, whale and bat, but each of them perform different functions. However, structural similarities in all mammals descended from a common ancestry with prototype forelimbs are common suggesting homology. Comparative anatomy confirms that evolution is a remodeling process. Ancestral structures that originally functioned in one capacity become modified as they take on new functions- **'descent with modification'**.

Same basic structural plan and origin but different function	Different structure and origin but same function
It suggests common ancestry	It do not suggests common ancestry
Indicates Divergent evolution	Indicates Convergent evolution
Thorn of <i>Bougainvillea</i> Tendrils of <i>Cucurbitis</i>	Thorn of citrus and spine of <i>Opuntia</i> Tendrils of cucumbers and tendrils of pea
Flipper of seal, wing of bat, cats paw, human hand	Wing of insect and wing of bird

Divergent evolution	Convergent evolution
Origin of a variety of species from a common ancestral form Divergent evolution is the process of two or more related species becoming more and more dissimilar. As they adapted to different environments, the appearance of the two species diverged	Independent development of similar forms and features by unrelated organisms to adapt to a similar environment Unrelated species become more and more similar in appearance as they adapt to the same kind of environment
Homologous organs supports it	Analogous organs supports it

Adaptive radiation or mega evolution: Diversification, over evolutionary time, of a species or group of species into several different species or subspecies that are typically adapted to different ecological niches. Group of organisms diversify greatly and take on new ecological roles. (for example, **Darwin's finches in the Galapagos Island and Marsupials in Australia**).

Allopatric speciation: or **geographic speciation** is speciation that occurs when biological populations of the same species become vicariant or permutable— isolated from each other to an extent that prevents or interferes with genetic interchange. Can be the result of population dispersal leading to emigration, or by geographical changes such as mountain formation, island formation, or large scale human activities (for example agricultural and civil engineering developments).

Artificial selection: Process by which humans breed animals and cultivate crops to ensure that future generations have specific desirable characteristics. (In artificial selection, breeders select the most desirable variants in a plant or animal population and selectively breed them with other desirable individuals).

Atavism or reversion: the reappearance of those ancestral characteristics in an organism or in the organisms of a group, which do not occur normally or which represent the reminiscent of normal structures possessed by the individuals of other groups. Examples - human baby born with tail etc.

Big bang theory: States that the universe began in a state of compression to infinite density, and that in one instant all matter and energy began expanding and have continued expanding ever since.

Biological Evolution:

In the early 1800s French naturalist Jean Baptiste Lamarck suggested that evolution is a process of adaptation, the refinement of characteristics that equip organisms to perform successfully in their environment. However, unfortunately we remember Lamarck for his erroneous view of how adaptation evolved (the inheritance of acquired characters).

Branching descent and natural selection are the two key concepts of Darwinian Theory of evolution. According to him all the species inhabiting earth today descended from ancestral species (descent with modification) and natural selection is the mechanism for such descent with modification. Natural Selection states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals, resulting in a change in the population's genetic composition over time.

Convergent Evolution: Convergent evolution takes place when species of different ancestry begin to share analogous traits because of a shared environment or other selection pressure. For example, whales and fish have some similar characteristics since both had to evolve methods of moving through the same medium: water.

Darwin's finches: Divergent Evolution: Evolutionary pattern in which two species gradually become increasingly different. This type of evolution often occurs when closely related species diversify to new habitats. On a large scale, divergent evolution is responsible for the creation of the current diversity of life on earth from the first living cells. On a smaller scale, it is responsible for the evolution of humans and apes from a common primate ancestor. **Adaptive radiation is one example of divergent evolution.**

Directional selection shifts the overall makeup of the population by favoring variants of one extreme within a population. Natural selection may be directional: it may favor, for example, smaller individuals and will, if the character is inherited, produce a decrease in average body size. Directional selection

could, of course, also produce an evolutionary increase in body size if larger individuals had higher fitness.

Disruptive selection, like directional selection, favors the variants of opposite extremes over intermediate individuals. Disruptive selection differs in that sudden changes in the environment creates a sudden force favoring that. In nature, sexual dimorphism is probably a common example.

Founder Effect: A cause of genetic drift attributable to colonization by a limited number of individuals from a parent population. When few individuals colonize a new habitat, genetic drift will more than likely occur.

The founder population is small and again the alleles present in this small population will not be representative of the original population. Saltation (from Latin, saltus, "leap") is a sudden change from one generation to the next, that is large, or very large, in comparison with the usual variation of an organism. The term is used for occasionally hypothesized, non gradual changes (especially single-step speciation) that are atypical of, or violate, standard concepts involved in neo-Darwinian evolution.

Genetic drift: Changes in the frequencies of alleles in a population that occur by chance, rather than because of natural selection.

Gene flow: movement of genes into or through a population by interbreeding or by migration.

Gene frequency: The frequency in the population of a particular gene relative to other genes at its locus.

Expressed as a proportion (between 0 and 1) or percentage (between 0 and 100 percent).

Gene pool: All the genes in a population at a particular time.

Geological time scale: Tabular record of the divisions of earth history. Major divisions are known as 'eras', these in turn are divided into 'periods', which are further subdivided into 'epochs'.

Era	period	epoch	geographical time scale
-----	--------	-------	-------------------------

Imprinting: a special type of learned behavior in which the learning occurs only during a brief, sensitive period early in the animal's life; it usually cannot be unlearned. It may involve an attachment for another individual regarded as the animal's mother and may influence its choice of mate later in life.

Hardy-Weinberg principle: *In population genetics, the idea that if a population experienced no selection, no mutation, no migration, no genetic drift, and are randomly mating, then the frequency of each allele and the frequencies of genotype in the population would remain the same (constant) from one generation to the next generation.*

$$p^2 + 2pq + q^2 = 1 \text{ or, } (p + q)^2 = 1$$

Calculation of allele frequencies

Recessive traits: If the frequency of a recessive trait such as cystic fibrosis or PKU is known, it is possible to calculate allele frequencies and genotype frequencies using the Hardy Weinberg equation and its assumptions are as follows:

i. say 1 in 1, 2500 Indian newborns have cystic fibrosis which means that the frequency of homozygotes for this recessive trait is

$$q^2 = 1/2,500 = 0.0004$$

ii. The square root of the frequency of recessives is equal to the allele frequency of the cystic fibrosis allele

$$q = (0.0004)^{0.5} = 0.02$$

iii. The frequency of the normal allele is equal to 1 - the frequency of the cystic fibrosis allele

$$p = 1 - q = 1 - 0.02 = 0.98105$$

iv. The frequency of carriers (heterozygotes) for the cystic fibrosis allele is

$$2pq = 2(0.98)(0.02) = 0.04 \text{ or } 1/25$$

v. The frequency of homozygotes for the normal allele is

$$p^2 = (0.98)^2 = 0.96$$

Thus the population is composed of three genotypes at the calculated frequencies of homozygous normal = 0.96, heterozygous carriers = 0.04, homozygous affected = 0.0004

Macroevolution: large scale evolutionary changes, occurring over a long period of time and involving the origin of major taxa. Example: extinction of Dinosaurs.

Mimicry: Superficial but close resemblance of one organism to another or to natural objects among which it lives, that secures its concealment, protection or some other advantage so that it either escapes itself from observation or advertises as being harmful, which is not actually the case. The organism which mimics is known as **mimic** or **mimetic** and the organism or object which is imitated or copied is called the **model**.

The palatable viceroy butterfly, *Lementis*, which can be easily preyed upon, mimics the distasteful or a non-palatable monarch butterfly, *Danais*.

Natural Selection: states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals resulting in a change in the population's genetic composition over time.

Ontogeny: the life history or development of an individual organism.

Parallel Evolution: Parallel evolution occurs when two species evolve independently of each other, maintaining the same level of similarity. Parallel evolution usually occurs between unrelated species that do not occupy the same or similar niches in a given habitat.

Polymorphism: the existence of two or more forms or morphs of the same species within the same population at the same time and place. The differences in such forms may be morphological, physiological or biochemical and are genetically determined.

Balanced polymorphism	Transient polymorphism
<ol style="list-style-type: none"> Individuals with two or more forms coexist in the same population of a species in a stable environment and show almost constant ratio. In a population showing balanced polymorphism, the genotypic frequencies of various forms occur at equilibrium. Example: people heterozygous (Hb^A/Hb^S) for the trait of sickle cell anemia are resistant to malarial infection in malarial prone regions like Eastern Africa. In normal human population natural selection tends to eliminate gene Hb^S from the 	<ol style="list-style-type: none"> Populations undergoing a strong selection pressure and one form or morph is being strongly favoured while the other is getting eliminated. Thus this polymorphism lasts for a short period because it lasts till the disadvantageous form gets eliminated completely or is reduced to a low frequency. In a population showing transient polymorphism, the different frequencies occur at different ratios. Example: see 'industrial melanism'. Thus polymorphism in peppered moth was

population. But it has been found that the frequency of gene Hb ^S is usually high in areas prone to malaria in East Africa where it is usually high due to selective advantage of heterozygotes resulting in stable polymorphism for gene Hb ^S .	only for a short period and favoured strong selection. The transient polymorphism is seen during directional selection, where one form or character is gradually being replaced by another.
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Phylogeny: evolutionary history of a particular taxonomic group.

Stabilizing selection favors the norm, the common, average traits in a population. In nature, natural selection is most commonly stabilizing. The average members of the population, with intermediate body sizes, have higher fitness than the extremes. Stabilizing selection culls extreme variants from the populations.

Sympatric speciation: origin of new species from populations of a single species which have been genetically isolated because of physiological or behavioural incompatibility.

Vestigial organs: functionless homologous organs that have no apparent function in certain organism. (supposed to be remnants of organs that had been well developed and functional in their ancestral state but had become modified during evolution)

1. Vermiform appendix in man,
2. Pelvic girdle in python,
3. Nictitating membrane,
4. Coccyx or tail vertebrae in man.

Time period	Name	Brain capacity	Remarks
10-15 Mya	<i>Dryopithecus (ape like)</i>		East Africa, Asia; closely related to chimpanzee
	<i>Ramapithecus (man like)</i>		Shivalik Hills; erect posture, small canine
2 mya	Australopithecines (cave dwellers)	500cc	African Ape Man ; height 1.5mts
	<i>Homo habilis</i>	700cc	Tool Maker, Community Life
1.2 mya	<i>Homo erectus</i>	800cc to 1300cc	Knew how to use fire, larger teeth
100,000-40,000 mya	Neanderthal man	1450cc	East and central Asia
25000mya	<i>Homo sapiens</i>	1650cc	Modern man ; height 1.5 to 1.8 mts; flat face

Synopsis of Human evolution Major Events during Geological Periods (Time scale):

PERIOD	EVENTS
Precambrian:	Origin of life, Oxygen evolution through photosynthesis
Cambrian	Flourishing of the invertebrates, increase in algal diversity, appearance of vertebrates.
Ordovician	Plants begin to colonize land.
Silurian	Increase in diversity of fish.
Devonian	Amphibians appear
Carboniferous	Extensive forest, dominance of amphibians, increase in diversity of insects, first reptiles appear.
Permian	Age of reptiles begin
Triassic	Dinosaurs evolve and spread, first mammal appear
Jurassic	First bird and first flowering plant appear.
Cretaceous	Dominance of flowering plants.
Tertiary	Age of mammals begin
Quaternary	Evolution of human, Large mammals and birds become extinct.

EVOLUTION (CBSE Questions)

- 1 Marsupials and Australian placental mammals exhibit convergent evolution. Explain how? **(2013)**
(3 marks)
2. Differentiate between the explanations given by Darwin and de Vries respectively on the mechanism of evolution. **(2013)** **(5 marks)**
3. (a) Explain “founder effect”. **(2013)**
(5 marks) (b) State Oparin and Haldane Hypothesis.
(c) Describe Stanley and Miller’s experiment and give its significance.
4. (a) List the various causes of variations in the progeny of the population. **(2013)** **(5 marks)**
(b) Describe the three different ways in which the natural selection operates in nature
5. Identify the examples of convergent evolution from the following: **(2013)**
(1 mark)
 - (i) Flippers of penguins and dolphins
 - (ii) Eyes of octopus and mammals
 - (iii) Vertebrate brains with regard to organic evolution.
6. Explain why very small animals are rarely found in polar region. **(2013)** **(3 marks)**
7. With the help of any two suitable examples explain the effect of anthropogenic actions on organic evolution. **(2013)** **(3 marks)**
8. Identify the examples of homologous structures from the following: **(2013)**

(1 mark)

(i) Vertebrate hearts

(ii) Thorns in *Bougainvillea* and tendrils of *Cucurbita*.

(iii) Food storage organs in sweet potato and potato.

9. "Sweet potato tubers and potato tubers are the result of convergent evolution." Justify the statement. **(2013) (3 marks)**

10. (a) Select the analogous structure from the combinations given below. **(2015) (2 marks)**

(i) Forelimbs of whales and bats

(ii) Tuber of potato and sweet potato

(iii) Eyes of octopus and mammals

(iv) Thorns of *Bougainvillea* and tendrils of *Cucurbita*.

(b) State the kind of evolution they represent.

11. What is mutation? Mention any two examples where the organism involved are commercially exploited in agriculture.

(2015) (2 marks)

12. What does the following equation represent? Explain. **(2015) (2 marks)**

$$P^2 + 2pq + q^2 = 1$$

13. Select two pairs from the following which exhibit divergent evolution. Give reasons for your answer.

(2015) (2 marks)

(i) Flippers of Dolphins and Penguins

(ii) Forelimbs of Cheetah and mammals

(iii) Wings of butterflies and birds

(iv) Forelimbs of Whales and mammals

14. State Gause's Competitive Exclusion Principle.

(2014) (2 marks)

15. (a) Explain adaptive radiation with the help of a suitable example.

(2014)

(b) Cite an example where more than one adaptive radiations have occurred in an isolated geographical area. Name the type of evolution your example depicts and state why it is so named.

16. Why are analogous structures a result of convergent evolution?

(2014) (2 marks)

Solution of CBSE questions

Ans.1 Marsupials and Australian placental mammals exhibit convergent evolution by the appearance of adaptive radiation. It has occurred in an isolated geographical area representing different habitats

Ref p.134 NCERT

Ans.2 Darwin thought about minor variations are the cause of evolution. These variations are small and directional. Evolution is a gradual process. De Vries thought that evolution are due to mutations. Mutations are random and directionless.

Mutations caused speciation and hence called saltation.

Ans. 3 (a) When the original drifted population becomes founders, such effect is called **founder effect**.

(b) They opined that life could have come from pre-existing non-living organic molecules as RNA, protein,

etc. Formation of life was preceded by chemical evolution.

(c) **Ref. p.127 NCERT.**

Ans. 4 (a) The various causes of variations in the progeny of the population are (i) genetic drift (ii) crossing over

(iii) mutation.

(b) The three different ways in which the natural selection operates in nature are:

(i) Stabilising (ii) Directional (iii) Disruptive.

Ref p.136 NCERT

Ans. 5 (i) Flippers of penguins and dolphins.

Ans. 6 Very small animals are rarely found in polar region because of loss of body heat. This is called Allen's rules.

Ans. 7 Following are the effect of anthropogenic actions on organic evolution:

(i) Resistant varieties of insects due to excess use of pesticides.

(ii) Resistant varieties of bacteria due to overuse of antibiotics.

Evolution is not a directed process. It is a stochastic process.

Ans. 8 The examples of homologous structures are Thorns in Bougainvillea and tendrils of Cucurbita.

Ans. 9 Sweet potato tubers and potato tubers are the result of convergent evolution because their origin is different but function of food storage is similar in both.

Ans. 10 (a) The analogous structure from the combinations are Tuber of potato and sweet potato.

This kind of evolution is called convergent evolution.

Ans. 11 Mutation is the process by which genetic variations are created through changes in the base sequence

within genes. It results in the creation of new character.

(a) Mung bean, resistance to yellow mosaic virus.

(b) Resistant bhindi to yellow mosaic virus. (**Prabhat kranti**)

Ans. 12 This equation represents Hardy-Weinberg Principle. It says that allele frequencies in a population are stable.

It is constant from generation to generation. The gene pool remains a constant.

Ref p.137 NCERT para1

Ans. 13 (i) Forelimbs of Cheetah and mammals.

(ii) Forelimbs of Whales and mammals.

Ans. 14 Two closely related species competing for the same resource cannot co-exist indefinitely. The inferior will be eliminated.

Ans. 15 Ref. p.132, 133 NCERT

Ans. 16 Ref.p.134 NCERT

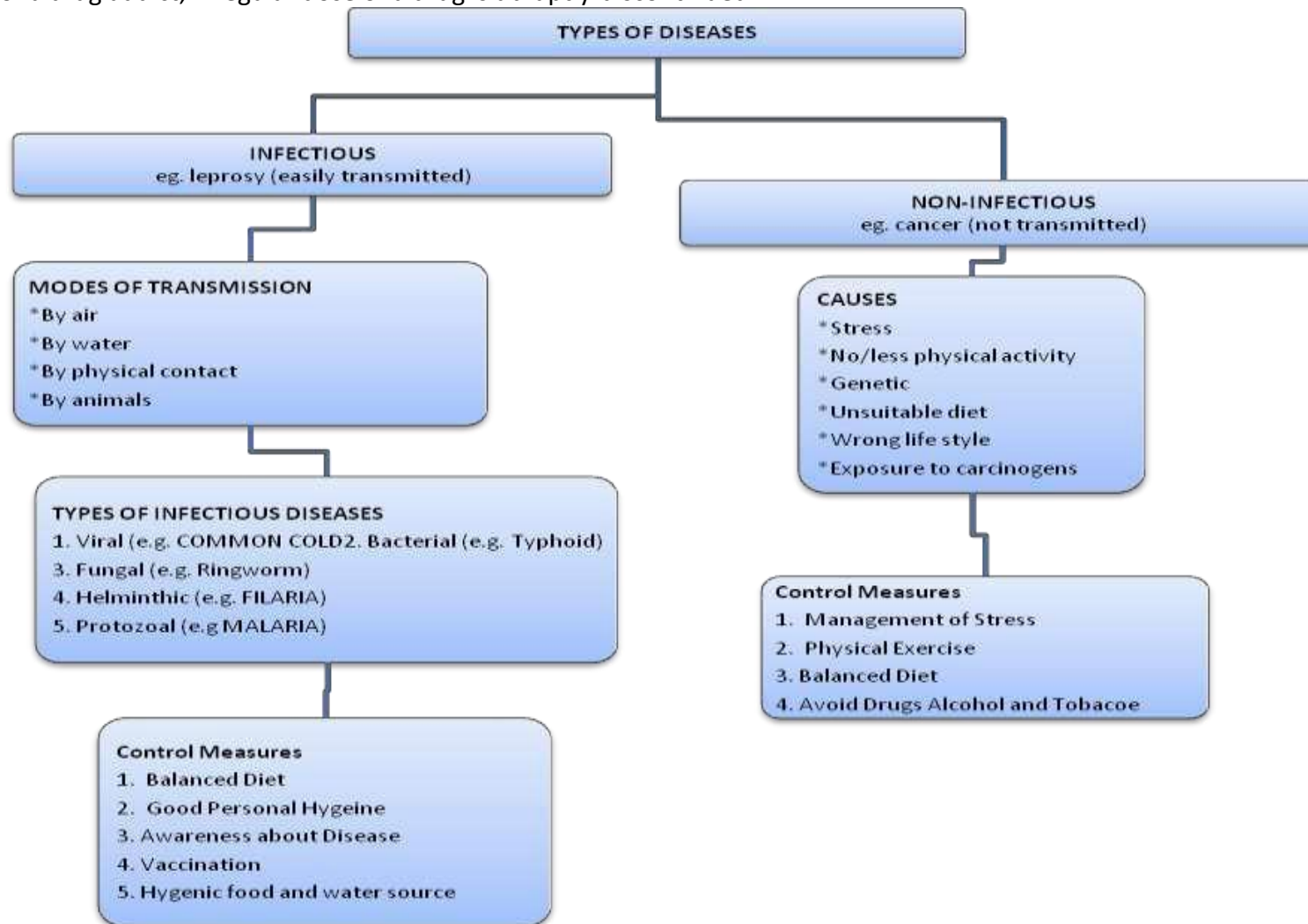
(CHAPTER 8) HUMAN HEALTH AND DISEASE

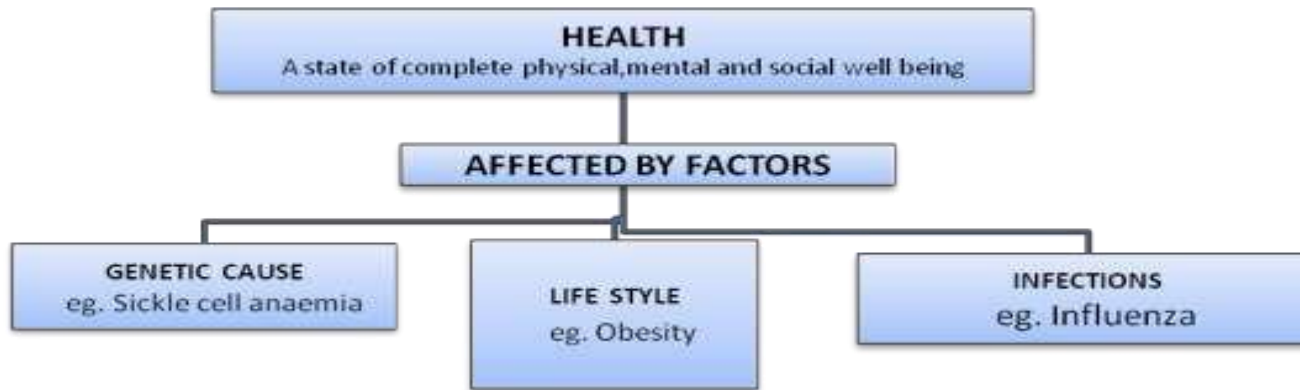
KEYWORDS:

1. **Health**:- Health is defined as a state of complete physical, mental and social well being.
2. **Disease**:- Disease is the condition when the functioning of one or more organ(s) or system(s) of the body is/are adversely affected and characterised by various symptoms.
3. **Pathogens**:- Pathogens are those organisms which causes diseases.
4. **Vectors**: Vectors are those organisms which spread the pathogens.
5. **Immunity**:- Immunity refers to the overall ability of a living body to fight against diseases.
6. **Incubation period**:- Incubation period is the time period between infection and the appearance of symptoms.
7. **Interferons**:- Interferons are the glycoproteins produced by our body cells in response to a viral infection.
8. **Antigens**:- Antigens are the large and complex foreign molecules that activate the specific immune system to generate antibodies.
9. **Antibodies**:- antibodies are the protein molecules produced in response to the antigens.
10. **Vaccination**:- Vaccination is the process of introducing a preparation of antigenic proteins of pathogens or killed or inactivated/ attenuated pathogens into the body, to generate the immune response/antibody.
11. **Cancer**:- Cancer refers to the uncontrolled proliferation of cells, that results from the breakdown of regulatory mechanisms which govern the normal cell behaviour.
12. **Metastasis**:- Metastasis is the phenomenon in which cancer cells spread to different sites through the body fluids and develop secondary tumours.
13. **Tumours**:- Tumours are the masses of cells produced by the uncontrolled proliferation of cancerous cells.
14. **Retroviruses**:- Retroviruses are those viruses which have RNA as the genetic material, but can synthesise DNA on RNA-template by reverse transcription.
15. **Drug Abuse**:- When drugs are taken for a purpose other than their normal clinical use in amounts/concentration or frequency that impair one's physical, physiological and psychological functions, it constitutes drug abuse.
16. **Adolescence**:- Adolescence refers to the period and process of rapid growth and physical and mental development (attitudes and beliefs) from childhood to adulthood.
17. **Addiction**:- Addiction refers to the physical and psychological attachment/ dependence to certain effects of the drugs/ alcohol.

18. **Syndrome**:- Syndrome refers to a group of symptoms.

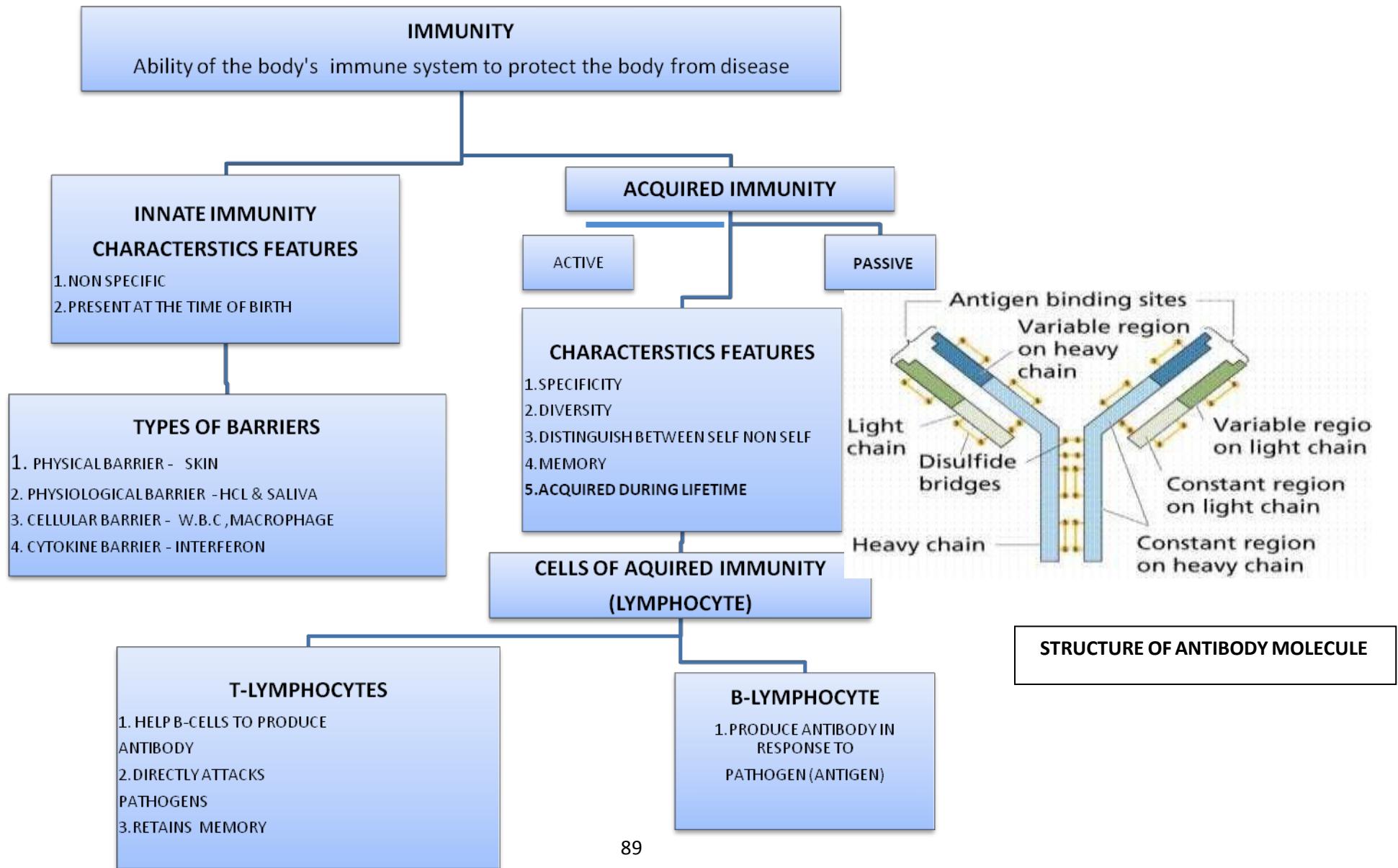
19. **Withdrawal syndrome**:- Withdrawl syndrome refers to the characteristic unpleasent symptoms manifested by the body of a drug addict, if regular dose of a drug is abruptly discontinued.





COMMON INFECTIOUS DISEASES

Ringworms	<i>Microsporium, Trichophyton, Epidermo phyton.</i>	Dry scaly lesions on skin, scalp, nail. Intense itching.	From soil, by using clothes, towels, comb of infected person.
Name of disease	<i>Causal organism</i>	<i>Symptoms</i>	<i>Transmission</i>
Common cold	Rhino virus	Nasal congestion & discharge, sore throat, cough, headache for 3 to 7 days	By droplet infection
Pneumonia	Bacteria- <i>Streptococcus pneumoniae</i>	Alveoli get filled with fluid, problem in respiration, fever, chill, cough.	By inhaling droplets/aerosols released by infected persons, sharing utensil.
Malaria	Protozoa- <i>Plasmodium vivax</i>	Chill, high fever recurring every 3-4 days due to rupture of RBC. Haemozoin released in blood	By female <i>Anopheles</i> mosquito bite.
Filaria	Helminthic worm- <i>Wuchereria bancrofti, W. malayi</i>	Chronic inflammation of organs, specially lower limbs, genital organs affected	By bite of female culex mosquito



Major functional properties of antibodies

Antibody class	Major Functional properties
IgM	complement activation; antigen trapping; antigen receptor of naïve B cells
IgG	complement activation, phagocytosis, ADCC, transfer of adaptive immunity to offspring, regulation of antibody production
IgA	mucosal immunity, phagocytosis
IgE	activation of mast cells, basophils, eosinophils
IgD	antigen receptor on naïve B cells

LYMPHOID ORGANS

Primary Lymphoid Organ

- 1. Bone Marrow

2. Thymus

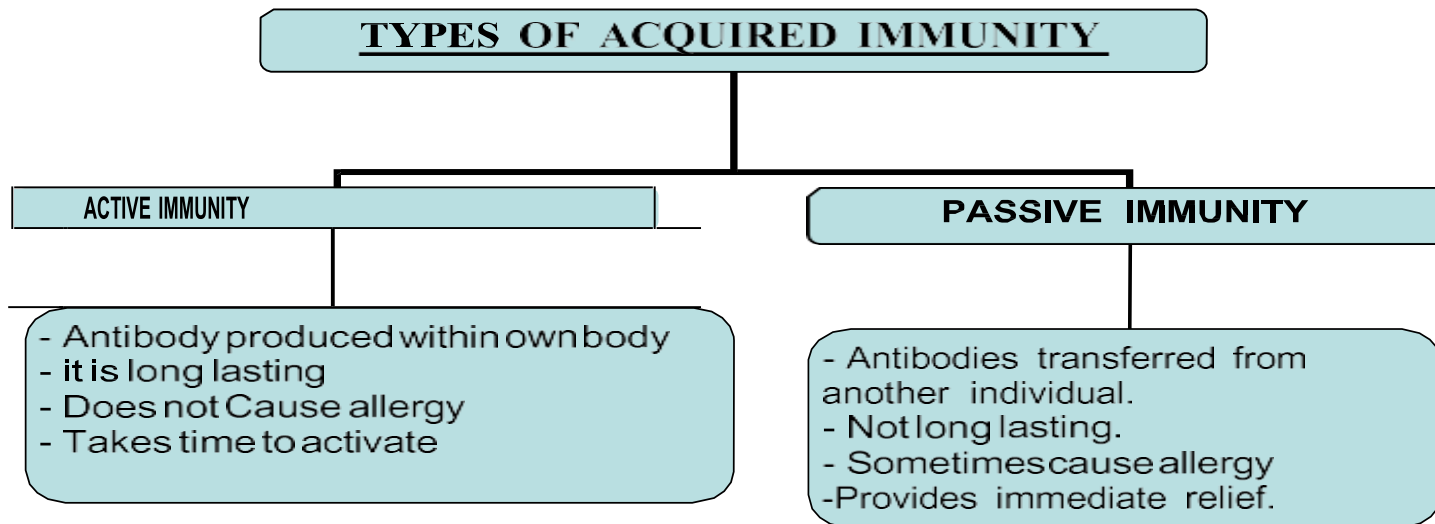
Function:
Provide microenvironment or the development and Maturation of lymphocyte

Secondary Lymphoid Organ

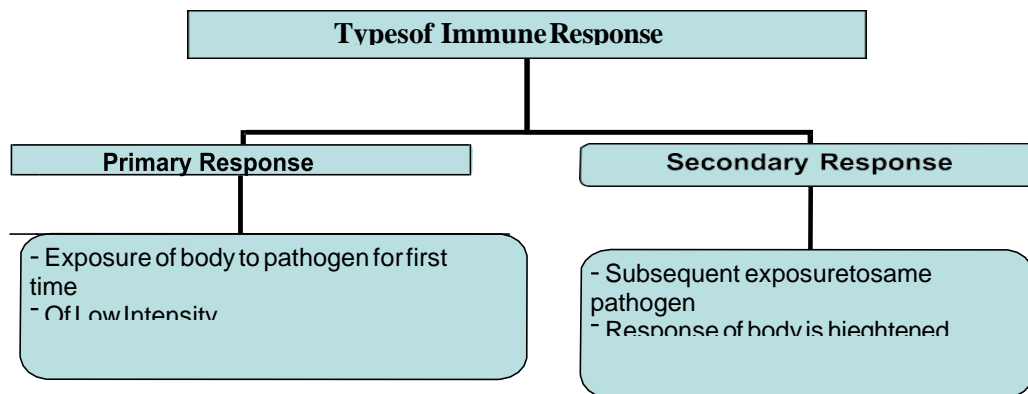
- 1. Spleen
- 2. Lymph Nodes
- 3. Peyer's Patch
- 4. Tonsils
- 5. Mucosal associated lymphoid tissue (MALT)

Function:

- 1. Spleen: Filter the microbes from blood
- 2. Lymph Nodes: Trap the microorganisms
- 3. Peyer's Patch: Present in small intestine and help in the formation of effector cells
- 4. Tonsils: Trap microbes entering through Mouth
- 5. MALT: Traps Microbes



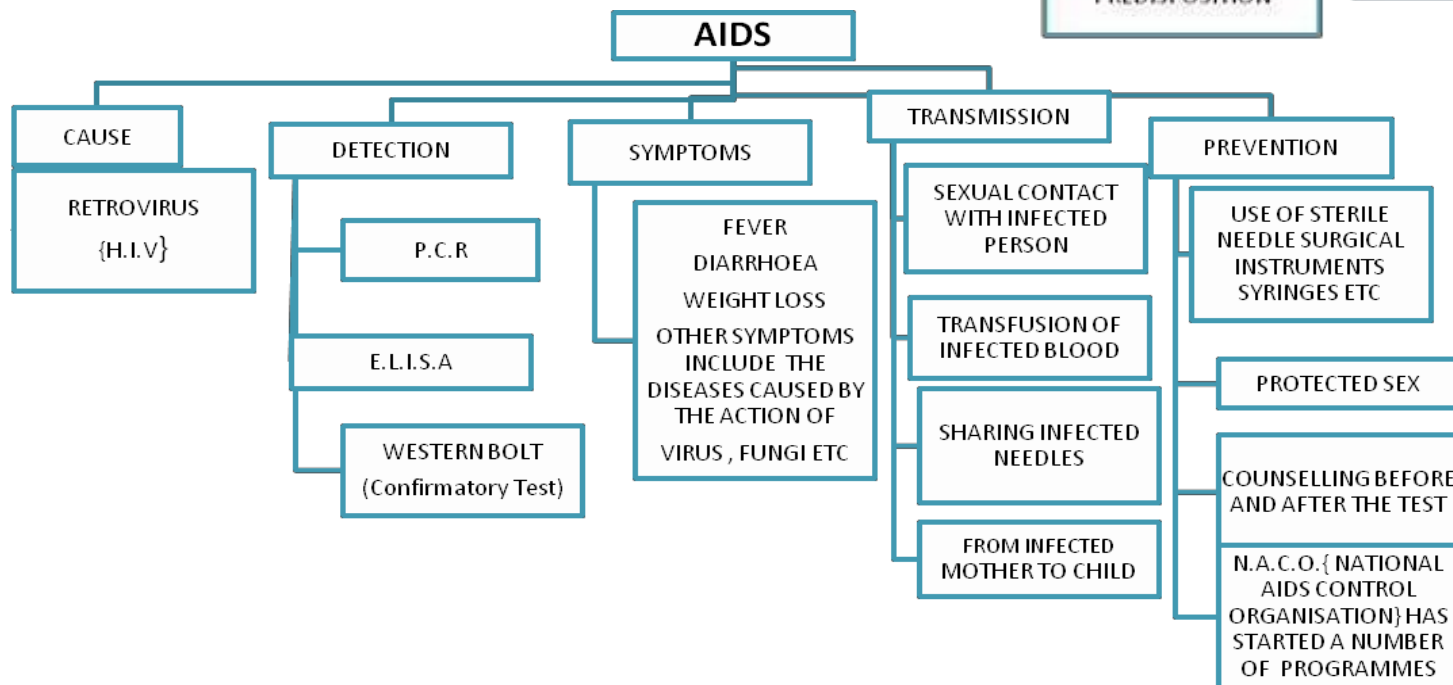
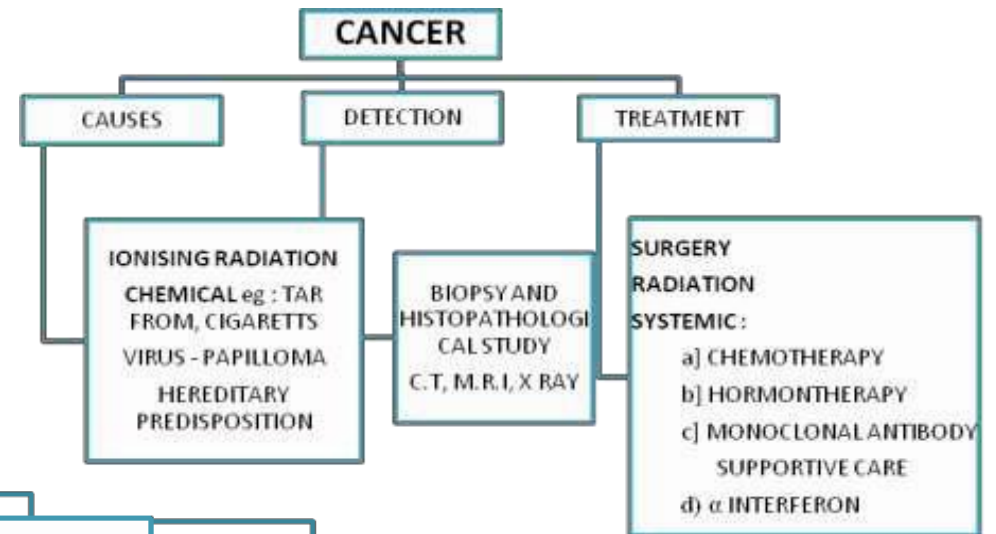
Types of Immune Response:



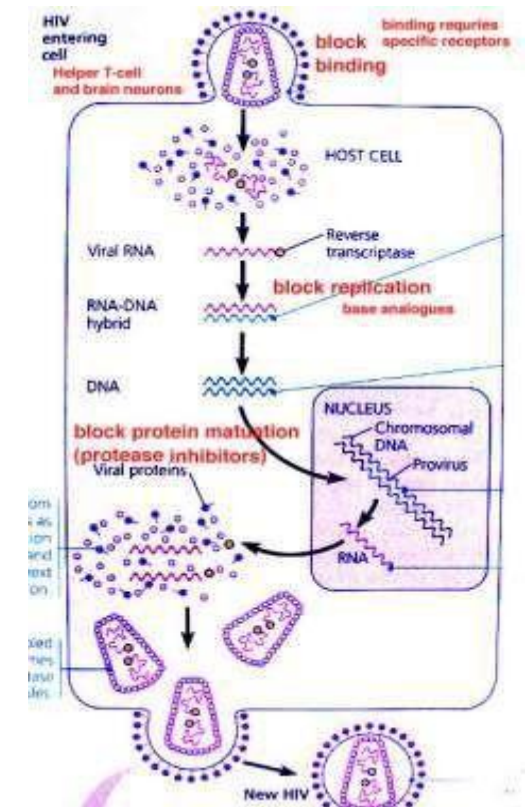
Vaccination and Immunization Vaccination refers to the administration of any vaccine. Immunization is the process by which the body produces antibodies in response to the vaccine to fight infections. Vaccine is a preparation of antigenic proteins of pathogens or inactivated/weakened pathogen. It is introduced into the body to generate antibodies which can neutralize the pathogens during actual infection. Vaccines also generate memory B & T cells that recognize the pathogens quickly. Vaccines that contain preformed antibodies produce quick immune response and provide Passive Immunity e.g. vaccines against tetanus & snakebite. Other vaccines provide Active Immunity e.g. oral polio vaccine, BCG, cholera vaccine.

Allergies The exaggerated response/hypersensitiveness of the immune system of a person to certain antigens coming in contact with or entering into the body is called allergy.

Auto-immunity It is a condition when structural & functional damage is caused due to the attack of the self cells of the body by its own immune cells. Examples : Rheumatoid arthritis, Insulin- dependent diabetes.

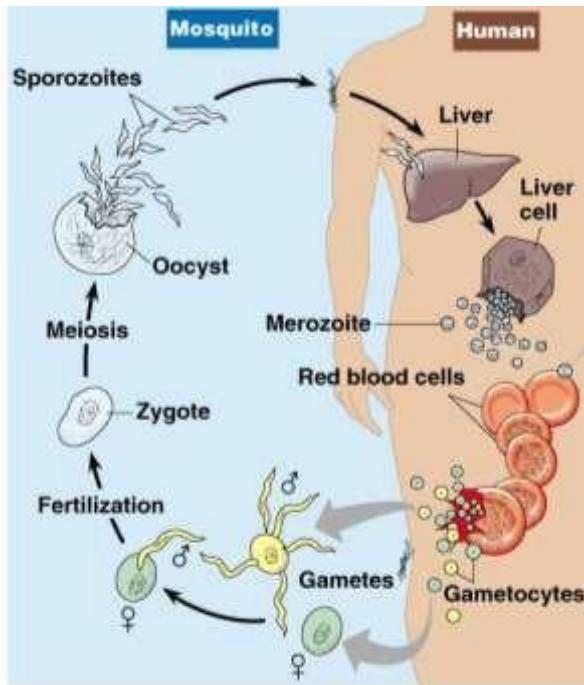


Refer Fig 8.6 replication of retrovirus page 155 NCERT



CBSE/XII/BIOLOGY/HUMAN HEALTH & DISEASES/DRUGS & ALCOHOL ABUSE

Name of Drug	Plant source	Part of plant	Binds with	Effects on human body	Common name & mode of abuse
1. Opioid <u>diacetylmorphine</u>	<u>Papaver somniferum</u>	<u>latex of plant</u>	<u>opioid receptors present in central nervous system & GI</u>	<u>acts as depressant & slows down body function</u>	<u>Heroin, smack</u> <u>taken by snorting or injection</u>
2. Cannabinoid	<u>Cannabis sativa</u>	<u>inflorescence also flower top, leaves, resin</u>	<u>receptors are present in brain</u>	<u>cardiovascular system</u>	<u>Marijuana, Ganga, charas, hashish etc</u> <u>taken by inhalation or oral ingestion</u>
3. Cocoa alkaloid	<u>Erythroxylum coca</u>		<u>interferes with action of neurotransmitter dopamine</u>	<u>CNS by causing euphoria & increase in energy.</u>	<u>Cocaine, coke or crack</u> <u>Excess causes hallucination</u>



LIFE CYCLE OF PLASMODIUM

Sporozoites are injected into the body by female anopheles mosquito

Sporozoites reach the liver through blood

Parasite reproduces asexually in the liver and comes out in the blood by bursting the liver cells
They enter the RBC

PARASITE REPRODUCE ASEXYUALLY IN RBC and by bursting them releases haemozoin which
causes cycles of fever

Parasite starts the sexual stage and forms gametocytes in RBC

Female anopheles mosquito takes up gametocytes

Fertilization of gametes and development takes place in the mosquito's intestine

Mature infective sporozoites escape from the intestine and migrate to the salivary glands of mosquito

Mosquito bites again and injects the sporozoites into human body

IMPORTANT QUESTION FOR SELF ASSESSMENT

1) Why do children of metro cities of India suffer from allergies and asthma?

Ans (Hint.-Pollution)

2) A patient has lost his immunity. 1.How does saliva and tear help to prevent bacterial infection?

Ans: -saliva and tear contain lysozymes.

-Lysozymes enzymes which digest the cell wall of bacteria

-By lysing the cell wall, they kill bacteria and prevent their infection.

2. What is vaccination ?How does it help to produce immunity?

Ans:- Vaccination process of introducing a preparation of antigenic protein of the pathogens or weakened or killed pathogen in to the body.

-The vaccines include quick multiplication of B and T-lymphocytes; some of them are stored as memory cells

-The B-lymphocytes quickly produce antibodies, which neutralize the antigen during infection.

3. Write the full form of ELISA. Give an example of the clinical application of ELISA?

Ans:--Enzyme Linked Immune Sorbent Assay.

-ELISA test is used in the diagnosis of AIDS, hepatitis-B and other STD's

4 .What are the advantages of people being healthy?

Ans-When people are healthy,

A)They are efficient at work which consequently increases productivity and brings economic prosperity

B)Health increases longevity.

C)It reduces infant and maternal mortality

5 .A) Name the respective forms in which the malarial parasite gains entry into

I) Human body and

ii) Body of female Anopheles

B) Name the hosts where the sexual and the asexual reproduction of malarial parasite occur respectively.

C) Name the toxin responsible for the appearance of symptoms of malaria in humans. Why do these symptoms occur periodically ?

Ans-(A) (i)-Sporozoite

(ii)Gametocyte

(B)-sexual reproduction in mosquito

-asexual reproduction in human body.

(C) Haemozoin

- Haemozoin is released when the RBC's rupture and release the pathogen

-some cells of pathogen enter fresh RBC's and reproduce asexually and repeat the cycle; hence the symptoms appear periodically .

6. Define innate immunity. Name and explain the category of barrier which involves macrophages.

7. What is meant by writing H2L2 for an antibody? Name any four types of antibodies produced in our/human body?

Ans. - Each antibody molecule has four peptide chains. - Of them, two are small and called light chains (L) and two of them are longer and called heavy chains (H); hence written as H₂L₂. The four types of antibodies are iga, ige, igg and igm.

8. How do normal cells get transformed into cancerous neoplastic cells? Mention the differences between viral oncogenes and cellular oncogenes. Ans. The transformation of normal cells into cancerous neoplastic cells is induced by physical, chemical and biological agents collectively called carcinogens; they lose the property of contact inhibition.

Difference: Viral Oncogenes	Cellular Oncogenes
- These are the genes present in the oncogenic viruses, which effect oncogenic transformation of the cells they infect.	- These are the genes present in normal cells and code for growth factors; when activated under certain conditions, can cause oncogenic transformation of the cell.

9(i) Explain metastasis. Why is it fatal?

Ans. (i) Metastasis is the property of tumor cells, which get separated from a tumor, spread to different sites in the body through body fluids and produce secondary tumors wherever they are lodged. Since secondary tumors are formed at several parts of the body, it is difficult to be diagnosed and treated; hence it is fatal.

10 (1) Lymphocytes are of two types why are they called so?

A person was injured in a road accident and required an urgent immune response. What should be done?

(ii) The lymphocytes are of two types B and T-cells. Why are they called so?

(iii) A person has injured on a road accident and required an urgent immune response.

Ans: (i) Those lymphocytes which undergo maturation in the bone marrow are called B-cells while those which undergo maturation in the thymus are called T-cells.

(ii) Those lymphocytes which undergo maturation in the bone marrow are called B-cells while those which undergo maturation in the thymus are called T-cells.

(iii) Vaccine against Tetanus.

HOTS

1 The immune system of a person is suppressed . In ELIZA test he tested positive

i) Name the diseases associated with it.

iii) Why did he loose his immunity.

Ans (Hint:-AIDS)

2 Which organ can trap the microbes in the body fluid ?

Lymph

3) A person claimed that he has seen sounds, heard colours and smelt light. I) What could be the possible reason?

li) Name two chemicles responsible for this conditions. lii)

Mention any one source for these chemicals.

Ans (Hint:- Drug Abuse)

CBSE QUESTIONS

1. (a) Name the agent that causes amoebiasis and the human body organ that it infects.
(b) Write the symptoms and the mode of transmission of the disease. (2013) (3)
2. List the symptoms of Ascariasis. How does a healthy person acquire this infection? (2014) (3)
3. Community service department of your school plans a visit to a slum area near the school with an Objective to educate the slum dwellers with respect to health and hygiene. (2014) (4)
(a) Why is there a need to organize such visits?
(b) Write the steps you will highlight, as a member of this department, in your interaction with them to enable them to lead a healthy life
4. Expand ELISA and LSD? (2)
5. What is the source of cocaine?

SOLUTIONS OF CBSE QUESTIONS

- Ans. 1 Entamoeba histolytica and it infects large intestine of human beings. Ref.p.148 NCERT para1.
- Ans. 2 The symptoms of Ascariasis are (i) internal bleeding (ii) muscular pain (iii) fever. A healthy person acquires this infection through contaminated water, vegetables and fruits.
- Ans. 3 (a) Because there is dirty condition of the slum dwellers and lack of education.
(b) I will highlight the followings steps: (i) suggest them to wash their hands before eating. (ii) Keep their surroundings neat and clean.
- Ans. 4 (i) Enzyme linked immune sorbant assay
(ii) Lysergic acid diethyl amides.
- Ans. 5 The source of cocaine is Coca plant – Erythroxyllum coca. It is an alkaloid.

Chapter 9 (STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION)

Important Terminologies

1. **Animal Husbandary**:- Animal husbandary is the agricultural practices of breeding and raising livestock that are useful to humans.
2. **Dairying**:- Dairying is the mangement of animals for milk and milk products for human consumption.
3. **Poultry**:- Poultry is the class of domesticated fowl used for food (their meat) or for their eggs.
4. **Breed**:- Breed is a group of animals of the same species related by descent and are similar in most of their characters.
5. **Inbreeding**:- Inbreeding refers to the mating of more closely related individuals within the same breed.
6. **Inbreeding Depression** :- Inbreeding depression is defined as the loss in vigour and fertility associated with inbreeding.
7. **Outbreeding**:- Outbreeding is the breeding of unrelated animals, either of the same breed or of different or even different speices.
8. **Outcrossing**:- Outcrossing is the practice of mating of animals within the same breed, but having no common ancestors on either side of their pedigree up to 4-6 generations.
9. **Cross-breeding**:- Cross-breeding is the method of out breeding in which superior males of one breed are mated with the superior females of another breed of the same species.
10. **Interspecific hybridisation**:- It is the method of outbreeding in which male and female animals of the different species are crossed.
11. **Apiculture**:- Apiculture is the maintanance of hives of honeybees for the production of honey.
12. **Fishery**:- Fishery is an industry dealing with catching rearing processing and selling of fishes, molluscs, crustaceans, etc. or their product.
13. **Plant Breeding**:- Plant breeding is the purposful manipulation of plant species in order to create desired plant types that are better suited for cultivation, give better yeilds and are disease- resistant.
14. **Germplasm**:- Germplasm refers to the sum totle of all the alleles of the genes present in an individual organism and its related species.
15. **Biofortification**:- Biofortification refers to breeding of crops to produce varities with higher levels of nutrients like vitamins and minerals or higher proteins and healthier fats.
16. **Plant Tissue Culture**:- Plant tissue culture refers to the regeneration of whole plants from any cell or tissue or organ of a plant on a suitable synthetic medium in vitro.
17. **Explant**:- An explant is the plant part excised from a specific location in a plant to be used for initiating a culture.
18. **Micropropagation**:- The method of producing thousands of plants through tissue culture is called micropropagation.
19. **Somaclones**:- These are the genetically identical plants developed from any part of plant by tissue culture/micropropagation.
20. **Somatic Hybridisation**:- Somatic hybridisation is the process of fusing protoplasts of somatic cells derived from two different varieties or species of plants, on suitable nutrient culture medium.

Animal Breeding- objectives:

1. Improved growth rate.
2. Increased production
3. Improve desirable qualities.
4. Improved resistance to diseases
5. Improved resistance to adverse environmental conditions

Methods: i). **Inbreeding**-Breeding between same breed for 4-6 generations. Eg.- cows, buffaloes, poultry . (Advantage: Increases homozygosity and develops pure line, removes less desirable genes)

In breeding depression- continued in breeding reduces fertility even productivity. A single outcross often helps to overcome inbreeding depression

ii) **Outbreeding**- breeding between unrelated animals. It is of two types –

1.) **Out crossing**- mating within the same breed but not having ancestors.

2.) **Crossbreeding**- superior males of one breed are mated with superior females of another breed to get better progeny.e.g.- cows of inferior breed with superior bull.

Hisardale- is a new breed of sheep developed in Punjab by crossing Bikaneri Ewes and Marino Rams.

3) **Interspecific hybridization**- male and female animals of two different species are mated.

E.g.- mule is crossbreed of male donkey and female horse.

4.) Control breeding- it is done by artificial insemination and multiple ovulation embryo transfer technology (MOET)

(a)Artificial insemination- semen of superior male is collected and injected into the reproductive tract of the selected female. The spread of certain diseases can be controlled by this method.

(b) MOET- Technique for herd improvement by successful production of hybrids.

i) Hormone(FSH) are administered to the cow for inducing follicular maturation and super ovulation. ii) Cow produces 6-8 eggs instead of one egg & is either mated with elite bull or artificially inseminated. iii) Fertilised egg at 8-32 cell stage are recovered non-surgically & transferred to surrogate mother. iv) Done in cattle, sheep, rabbits etc.

Steps in Plant breeding:-

1 **Collection of variability**-Collection and preservation of all different wild varieties, species, relatives of cultivated species etc. are also called germplasm collection.

2.**Evaluation and selection of parents**-Germplasm is evaluated to identify plants with desirable traits.

3.**Cross hybridization among the selected parents**-Two plants having two desired characters are hybridized to get new hybrid having two desired characters.

4.**Selection and testing of superior recombinants**-Selection of the plants having desired character combinations.

5.**Testing, release and commercialization of new cultivars**-Newly selected lines are evaluated for their yield, agronomic traits, disease resistance etc. and released into the market.

Green revolution - Crop production.

White revolution - Milk production

Blue revolution - Fish production

Biofortification-Breeding crops with higher levels of proteins, vitamins and minerals eg. Vitamin C rich bitter melon, mustard, tomato; protein rich beans lablab French in Garden peas.Vitamin A rich carrots, Spinach, pumpkin, iron and calcium rich spinach and bathua etc. to improve public health.

SCP (Single cell protein)-

Protein rich cell biomass from microbes such as bacteria, yeast, algae are used as alternative food.

Eg-Spirulina can be grown in waste water (from potato processing plant) to produce protein rich biomass treated as food.

Advantages : i) Provides protein rich food supplement in human diet ii) Reduces pressure of conventional agricultural production iii) Use of Waste water reduces pollution level iv) High rate of biomass production in large amount in short period.

Methylophilus methylotrophus (250 gm) can be expected to produce 25 tonnes of protein due to its high rate of biomass production and growth

Tissue culture-

Technique of in vitro regeneration of whole plant by growing any plant part called **explant** in culture medium under aseptic condition. includes following methods:

1. **Callus culture:** Cell division in explant form an unorganized mass of cell called callus.

2. **Suspension culture:** Involves small group of cells suspended in a liquid media.

3. **Meristem Culture** –Apical shoot meristem is used as explant & support multiple shoot development.

4. **Embryo Culture:** Excision of young embryos from developing seeds & culture in nutritional media.

5. **Anther culture:** Production of haploid plant species by desired anther cultured in suitable medium.

6. **Protoplast culture and somatic hybridization-**

In this method, hybridization of different species could produce variants of economic value as follows:

i) Isolation of desired single cells ii) Digestion of cell wall by pectinase & cellulase enzyme for exposure of protoplast iii) Fusion of protoplast by Polyethylene glycol(PEG) iv) Hybrid protoplast culture resulting in desired variety of plant eg., Pomato is obtained by somatic hybrid of potato and tomato.

7. **Micropropagation-**

Tissue culture technique used for rapid vegetative multiplication of ornamental plants and fruit trees by using small explants. Micropropagation is done by shoot meristem culture & somatic embryogeny. It results in genetically identical plants & used widely in forestry & floriculture.

8. **Somaclonal variation-**Genetic variation in plants regenerated from a single culture is used to develop several useful varieties eg., Short duration sugarcane, Rust resistant wheat.

Uses: a)Rapid clonal multiplication

b)Production of virus free plants

c)Production of transgenic plants

d)Germplasm collection

Test Questions

1 MARK

* Q1. Name two techniques involved in controlled breeding experiments.

Q2. What is blue and green revolution?

* Q3. What is inbreeding depression?

* Q4. What is 'Heterosis' or hybrid vigour?

Q5. Name the Indian variety of rice patented by an American company.

Q6. What is Pomato?

* Q7. Name the algae used as protein rich food.

* Q8. Expand- MOET and SCP.

* Q9. What is quarantine?

Q10. What is cultivar?

Q.11 State the importance of biofortification.

(CBSE 2012)

Q.12 Name any two diseases the — Himgiri — variety of wheat is resistant to.

(CBSE-2013)

2 MARKS

**Q1. What is Biofortification?

**Q2. Which part of the plant is best suited for making virus free plants?

Q3. What is breed? What are the objectives of animal breeding?

**Q4. Define out-crossing? Suggest an advantage.

**Q5. What is artificial insemination? What is its importance?

Q6. What are the differences between aqua and pisciculture?

Q7. What is animal husbandry?

Q8. What is bird flu?

**Q9. Name the most common species of honey bees of India? What are the products from the honey bees?

**Q10. What is germplasm? How it is maintained?

3 MARKS QUESTIONS

**Q1. What does inbreeding mean? Suggest its advantages. What is the danger of inbreeding?

**Q2. Name the methods employed in animal breeding. Which method is the best? Why?

*Q3. Explain the procedure of MOET technique in cattle.

Hints: High milk yielding cow administered with FSH → 6-8 eggs produced → inseminated artificially → fertilized eggs at 8-32 cell stages are recovered non-surgically → transferred to surrogate mother for further growth.

Q4. What is interspecific hybridization? Give one example of crop in which it is practiced and mention one advantage.

Q5. What is cross-breeding? What advantages does it have? Give an example

5 MARKS QUESTIONS

Q1. Explain the points that have to be considered for successful bee-keeping?

Q2. Write the scientific name of sugarcane grown in north and south India respectively. Mention their characteristic features. Mention the characteristic of the hybrid produced by crossing these two varieties.
.Hint :North – Saccharum barberi. South – Saccharum officinarum. High yield, thick stems, higher sugar content, ability to grow in both North and South India

Q3. Describe various steps involved in plant breeding.

Hint: Collection of variability, Evaluation and selection of parents, Cross hybridisation among the selected parents, Selection of testing of superior Recombinants, Testing, release and commercialization of new cultivars

LIST OF HIGH YIELD VARIETIES OF ANIMALS OF IMPORTANCE

Sl. No.	Animal	Name of breed	Distribution
01.	Cattle	Gir	Gujrat
		Malvi	Rajasthan
		Tharparkar	Andhra Pradesh
2.	Buffaloes	Murrah	Punjab
		Bhadawari	Uttar Pradesh
3.	Sheep	Nali	Jammu & Kashmin
		Shahabadi	Bihar
4.	Chicken	Aseel	India
		Rhode Island Red	USA
05.	Honey Bee	<i>Apis indica</i>	India
		<i>Apis mellifera</i>	Italy

LIST OF HIGH YIELD VARIETIES OF PLANTS OF IMPORTANCE

Sl. No.	Plants	Name of breed	Distribution	Type of varieties
01.	Rice	IR-8	Philippines	Semi-dwarf
		Taichung Native-1	Taiwan	Semi-dwarf
		Jaya	India	Semi-dwarf
		Ratna	India	Semi-dwarf
02.	Wheat	Sonalika	India	High yield
		Kalyan sona	India	Disease resistant

PREVIOUS YEARS CBSE QUESTIONS

- (a) Mention the property of plant cells that has helped in growing crops by tissue culture. (2013) (3 Marks)
 (b) Explain how it is possible to grow on a commercial scale:
 - Banana crop
 - Virus free crop plants from virus infected good quality crop plants
- Define inbreeding depression. (2 Marks)
- Expand MOET. (1 Marks)
- Name any two diseases the 'Himgiri' variety of wheat is resistant to. (2 Marks)
- Explain SCP and its importance. (2014) (3 Marks)

Solutions

Ans. 1 (a) These plants cells are Totipotent that is capable of giving rise to a whole plant.

(b) (i) Banana crops can be grown on a commercial scale by Somaclones.

(ii) The virus free crop plants can be grown from virus infected good quality crop by Meristem Culture.

Ans. 2 The inbreeding depression is the reduction in fertility and even productivity. The mating of more closely related individual within the same breed for 4-6 generations is called inbreeding.

Ans. 3 Multiple ovulation embryo transfer technology.

Ans. 4 The two diseases the 'Himgiri' variety of wheat is resistant to

(a) Hill bunt

(b) Leaf and stripe rust.

Ans. 5 Use of Microbes like Spirulina to get large quantities of protein is called single cell protein.

There is a high rate of biomass production and growth. 250g of Methylophilus can produce 25 tonnes of protein as compared to 200g of protein from 250kg cow. **Ref.p.176.NCERT.**

Chapter – 10: Microbes in Human Welfare

Points to be remember:-

- **Activated sludge.** The sediment formed in the settling tank, mainly consists of bacterial flocs is called activated sludge.
- **Antibiotics.** Organic substances produced by certain microorganisms that can kill or retard the growth of other (such as disease causing) microorganism.
- **Baculoviruses.** These are viral pathogens that attack insects and arthropods.
- **Biofertilisers.** These are the organisms that enrich nutrient quality of the soil.
- **Biogas.** A mixture of gases containing predominantly methane produced by the microbial activity and which be used as fuel.
- **Biological control of pests.** A method of controlling pests in agriculture that relies on natural predation rather than the chemical pesticides.
- **BOD (Biochemical Oxygen Demand).** The amount of the oxygen that would be consumed if all the organic matter in one litre of water/ sewage oxidized by bacteria.
- **Fermentors.** Very large vessels used for growing microbes on the industrial/ commercial scale.
- **Flocs.** The masses of bacteria which grow anaerobically on cellulosic material and produce large amount of methane along with CO_2 and H_2
- **Primary sludge.** All solids that settle during the primary treatment of sewage.
- **Prions.** Tiny proteinaceous infectious agents.
- **Thermal vents.** The sites, where the temperature may be as high as $100^\circ C$.
- **Viroids.** A new infectious agent that are smaller than viruses and are composed of free RNA.

Microbes are present everywhere.

E.g.- Thermal vents of geyser (Temp. above $100^\circ C$)

-Deep in soil.

-Under snow.

-**Diverse.** Protozoa, Bacteria, Fungi, Virus, Viroids, Prions (Proteinaceous infectious agents)

-**Useful :** Antibiotics.

-**Harmful:** cause diseases.

In Household Products:

-Everyday : Lactobacillus (LAB) Lactic acid Bacteria - form curd from milk.

-Increase Vit . B12

- Check disease causing microbes in our stomach.
- Fermentation of dough for dosa, idli (CO₂ produced)
- Making bread -Baker's yeast. *Saccharomyces cerevisiae*.
- Toddy made from sap of palm.
- Cheese making (eg. Swiss cheese by *Propionibacterium sharmanii*, Roquefort cheese by fungi.)

In Industrial Products :

- Beverages and antibiotics.
- Fermentors : Large vessels for growing microbes.

Fermented Beverages :

- Beverages like wine, beer, whisky, Brandy, Rum (*Saccharomyces cerevisiae*)
- Malted cereals and fruit juices used to produce ethanol, wine and beer produced without distillation. Whisky, brandy, rum produced after distillation.

Antibiotics : (Against life)

- Penicillin produced by Alexander Fleming from *Penicillium notatum* while working with *Staphylococci* Earnest Chain and Howard Florey awarded Nobel Prize in 1945 for establishing Penicillin as an effective antibiotic.
- Uses : Treat diseases like plague, whooping cough, diphtheria, leprosy.

Chemicals: Enzymes and other Bioactivities Molecules:

Uses:

- Aspergillus niger* for production of Citric Acid.
- Acetobacter aceti* for production of Acetic Acid.
- Clostridium butylicum* for production of Butyric Acid.
- Lactobacillus for production of Lactic acid.
- Lipases used in detergents to remove oil stains from Laundry.
- Pectinases and Proteases to clarify bottled juices.
- Streptokinase** (from *Streptococcus*) as clot buster in patients with myocardial infraction (heart attack).
- Cyclosporin A**- an immunosuppressant used in organ transplant patients (produced by *Trichoderma polysporum*)
- Statins** produced by yeast *Monascus purpureus* used as blood, cholesterol lowering agent.

Microbes in sewage Treatment:

Why treatment necessary?

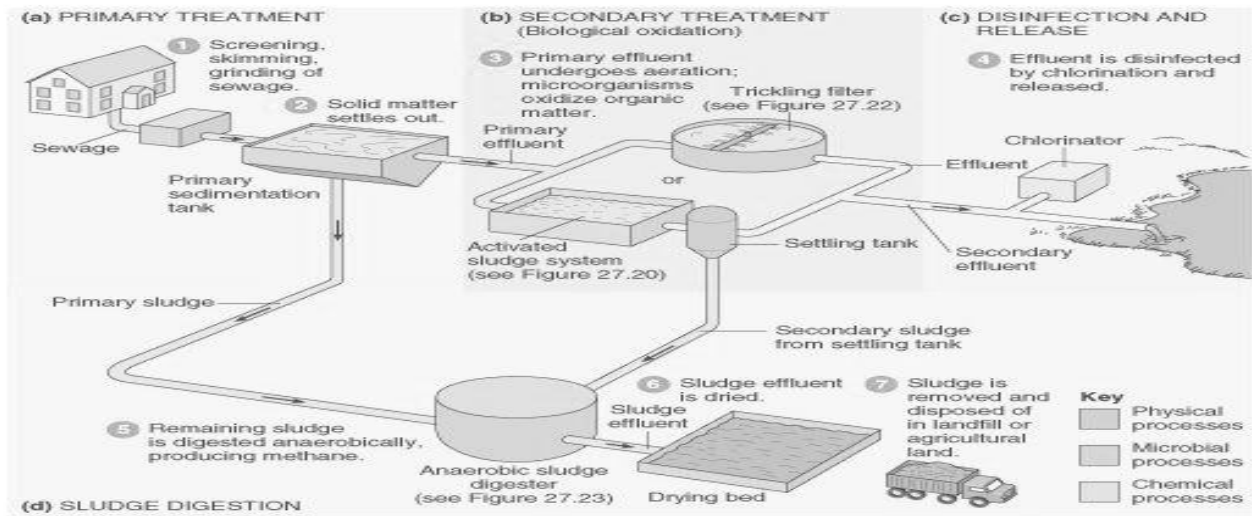
- Major component of waste water, human excreta.
- Waste water sewage.
- Cannot be disposed directly into rivers and streams.

Where & how?

- Before disposal sewage treated in sewage treatment plants (STPs) -
- Treatment done in two stages.
- Primary : Physical removal of particles large and small by filtration and sedimentation.

Solids - primary sludge.

- Supernatant - effluent.
- Secondary: Primary effluent taken to large aeration tanks.
- Agitated mechanically and air pumped into it.
- Aerobic microbes form masses with fungal filaments flocs.
- Microbes consume organic matter in effluent for growth.
- BOD (Biological oxygen demand) reduced.
- Passed into settling tank.
- Bacterial flocs sedimented (activated sludge)
- Small part of activated sludge used as inoculums in aeration tank.
- Major part pumped into large anaerobic sludge digesters.
- Anaerobic bacteria digest bacteria and fungi.
- Bacteria produce gases such as methane, hydrogen sulphide and CO₂ - Biogas.
- Secondary effluent released into rivers and streams.
- No man made technology available till date.
- Untreated sewage if released into rivers causes pollution.
- Ministry of environment and Forests initiated, Ganga Action Plan and Yamuna Action Plan.



Biogas plant:

- Concrete tank 10- 15 mts deep, slurry or dung fed.
- Floating cover placed above rises as biogas content rises.
- Connecting pipe for supply of biogas.
- Used for cooking and lighting.
- Development by IARI :- Indian Agriculture Research institute & KVIC:-Khadi and village Industries Commission.

Microbes as Biocontrol Agents :

- Insecticides and Pesticides toxic, harmful & are pollutants.
- Natural predation better method.
- No of pests kept in check, not totally eradicated.
- Food chains not disturbed
- Eg. Ladybird and Dragon flies useful to get rid of aphids and mosquitoes.
- Bacillus thuringiensis*** (Bt) used to control butterfly caterpillar.
- Mode of spores operation.
 - o Available is sachets, mixed with water and sprayed on plants.
 - o Eaten by insect larva
 - o Toxin released in gut kills larvae.
- Now Bt toxin genes introduced into plants - resistant to insect pests. e.g. Bt cotton.
- Tungus trichoderma*** now being developed.
- Nucleo polyhedrovirus***- good for narrow spectrum insecticide applications.

Advantages :-

- No negative impacts on plants, mammals, birds, fish or target insects.
- For overall IMP (Intergrated pest Management) programme.
- For ecologically sensitive areas.

As Biofertilizers:

-Chemical fertilizers major pollutant.

-Switch to organic farming and use of biofertilizers need of the time.

-Main sources of biofertilizers. **Bacteria, Fungi & Cyanobacteria.**

Eg Rhizobium present in roots of leguminous plants fix atmospheric nitrogen into usable organic form. **Azospirillum** and **Azotobacter** - free living bacteria - fix atmospheric Nitrogen.

-Symbiotic Associations

Eg. Genus **Glomus sp.** form **mycorrhiza**

-Fungal symbiont absorbs phosphorus from soil and passes it to plant.

-Plants show

- resistance to root - borne pathogens.
- Tolerance to salinity and drought
- Increase in growth and development.

-*Cyanobacteria*- autotrophic - fix atmospheric nitrogen

-Imp. biofertilizer.

e.g. *Anabaena, Nostoc, Oscillatoria.*

-**Blue green algae** - increase fertility by adding organic matter. -No. of biofertilizers are commercially available.

For production of biodegradable plastics:

-biodegradable plastic, e.g. polyhydroxybutyrate (PHB) is being produced commercially by fermentation with the bacterium *Alcaligenes eutrophus*.

-Production of PHB may be easily achieved in tree plants like populus, where PHB can be extracted from leaves.

-Other main drawback of bacterial PHB is its high production cost, making it substantially very expensive than synthetic plastics.

As edible vaccines:

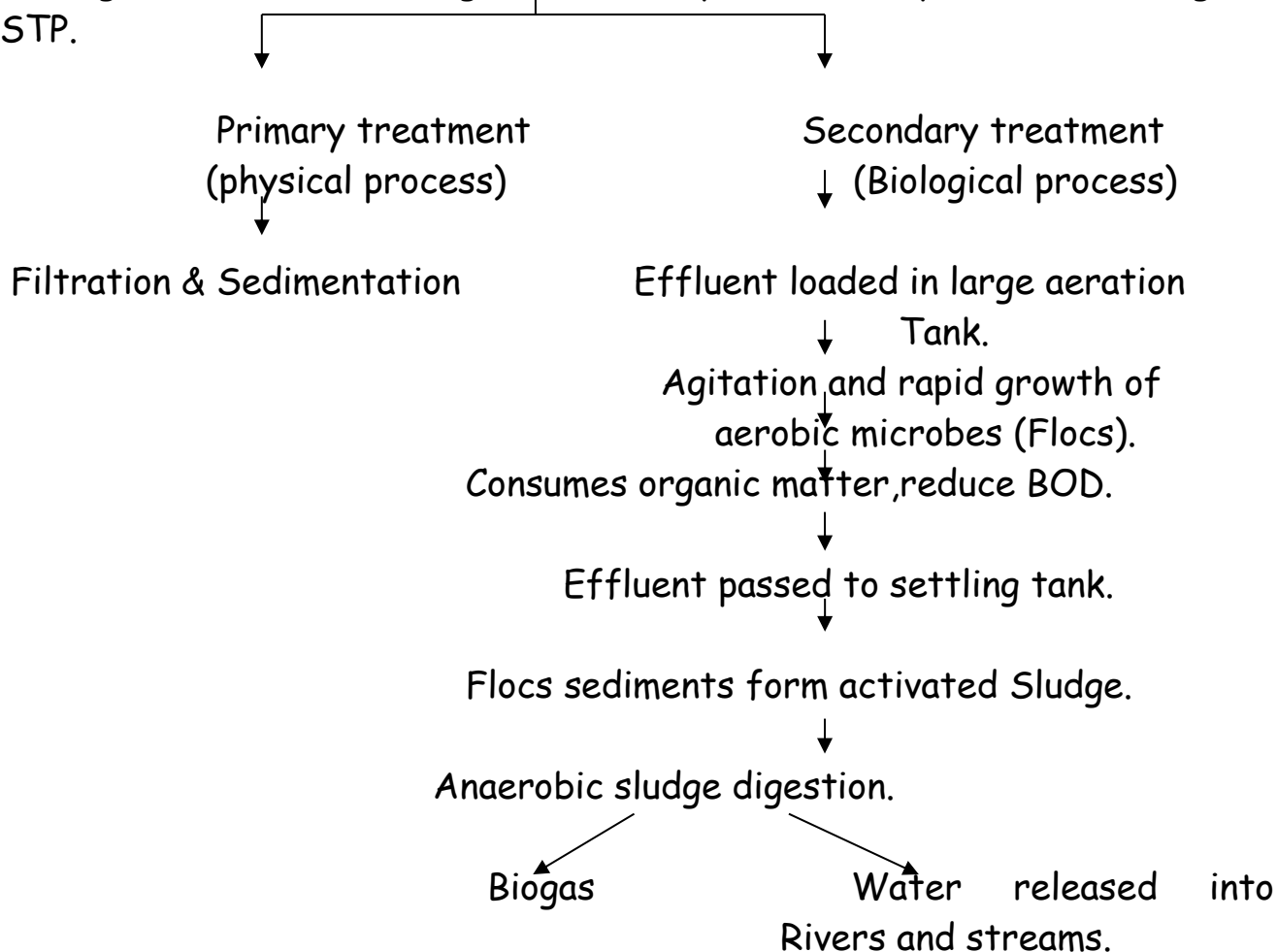
-the genes encoding the antigenic proteins of virus and bacteria can be isolated from the pathogens and expressed in plants.

-such transgenic plants or their tissues producing antigens can be eaten for vaccination/immunization (edible vaccines).

-the expression of such antigenic proteins in crops like banana and tomato are useful for immunization of humans since banana and tomato fruits can be eaten raw. Example: cholera and hepatitis B vaccine.

Microbes in sewage treatment:

Sewage is treated in sewage treatment plant(STPS) process of sewage in STP.



CBSE Questions and Test Questions

Q1 Milk start to coagulate when Lactic Acid Bacteria (LAB) is added to warm milk as a starter. Mention any other two benefits that LAB provides.

Ans.(1) It increase nutritional quality of and by increasing Vit. B 12 content.

(2) It checks the growth of pathogens in gut.

Q2 Name the Organism commercially used for the production of single cell protein.

Ans. Spirulina.

Q3 which of the following cyanobacterium that can fix atmospheric nitrogen?

Azospirillum, Oscillatoria, Spirulina.

Ans. Oscillatoria.

Q4. Mention the role of cyanobacteria as a biofertilizer.

Ans. They fix atmospheric nitrogen.

Q5 Name the baker yeast used in fermentation.

Ans. *Saccharomyces cerevisiae*.

Q6 Name the bacterium responsible for the large holes seen in "Swiss Cheese". What are these holes due to?

Ans. Propionic bacterium *sharnanii*.

They holes are due to production of large amount CO_2 .

Q7. Mention the product produced and its use by each of the microbes listed below.

(i) *Streptococcus cerevisiae* (ii) *Lactobacillus* (iii) *Saccharomyces cerevisiae*

Ans.	Microbes	-	Product	-	Use
	<i>Streptococcus</i>	-	Streptokinase	-	Use to remove blood clot
	<i>Lactobacillus</i>	-	lactic acid	-	Coagulates & partially digests milk protein & form curd
	<i>Saccharomyces cerevisiae</i>	-	Ethanol	-	Bread making, fermenting malted cereals & fruit juices

Q8 Name the source of cyclosporine-A how does this bioactive molecule function in our body?

Ans. *Trichoberma polysporum*.

It acts as an immuno – suppressant and is used in organ transplant patient.

Q9 Name the enzyme produced by streptococcus bacterium. Explain its importance in medical sciences.

Ans. *Streptococcus* bacteria produces streptokinase. It is used to remove blood clots from the blood vessels in a patient suffering from myocardial infarction or in heart patient.

Q10 Why are some molecules called bioactive molecules? Give two example of such molecules.

Ans. Some molecules are called bioactive molecules because microbes like bacteria or fungi are used in their production.

Example: - Citric acid – Acetic acid
Ethanol - Lipase
Streptokinase- Cyclosporine A

Q11 Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming.

Ans. Baculoviruses are pathogens that attack insects and other arthropods. Baculoviruses of genus Nucleopolyhedrovirus are used as biological control agent. They control only species – specific pest, do not affect non-target organism and beneficial insect are conserved. Therefore, they are used as biological control agents.

It is used to conserve beneficial insects and kills harmful ones.

Q12 Describe how biogas is generated from activated sludge. List the components of biogas.

Ans. The activated sludge is pumped into large tanks called anaerobic sludge digesters. Here, bacteria which grow and aerobically digest the bacteria and fungi in the sludge. During this digestion, bacteria produce a mixture of gases which form biogas. Biogas is made up of methane, hydrogen sulphide

Q13 How do methanogens help in producing biogas?

Ans. Methanogens produce biogas by anaerobic decomposition of cellulosic material (excreta of cattle dung).

Q14 Name the genus to which baculoviruses belong. Describe their role in the integrated pest management programmes.

Ans. Baculoviruses belong to the genus Nucleopolyhedrovirus. They control only species-specific pest, do not affect non-target organisms and beneficial insects are conserved. They aid in IPM problems and there is no negative impact on plants or other animals.

Q15 Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential?

Ans. Sewage water treatment is carried out in two stages.

- (1) Primary treatment – it involves physical removal of particles from the sewage through filtration and sedimentation. The settled solid forms the primary sludge and the supernatant forms the effluent.
- (2) Secondary treatment – it is biological treatment. Effluent is passed in aeration tanks and constantly agitated mechanically. Air is pumped into it. This allows growth of useful aerobic microbes which consume

organic matter in the effluent. This significantly reduces BOD of the effluent.

Q16 Name the blank spaces a,b,c and d given in the following table:

Type of microbe	Name	Commercial product
Bacterium	a	Lactic Acid
Fungus	b	Cyclosporin A
c	Monascus purpureus	Statins
Fungus	Penicillium notatum	d

- Ans. a) Lactobacillus
 b) Trichoderma polysporum.
 c) Fungus
 d) Penicillin

Q17 Name the blank spaces a,b,c and d given in the following table:

Type of microbe	Name	Commercial product
Bacterium	a	Clot buster enzyme
b	Aspergillus niger	Citric Acid
Fungus	Trichoderma polysporum	c
Bacterium	d	Butyric acid

- Ans. a) Streptococcus
 b) Fungus
 c) Cyclosporine A
 d) Clostridium butylicum

Q18 Name the blank spaces a,b,c and d from the table given below:

Type of microbe	Scientific Name	Product	Commercial product
(i) Fungus	a	Cyclosporin	b
(ii) c	Monascus purpureus	Statin	d

- Ans. a) Trichoderma polysporum
 b) Immuno – suppressive agent
 c) Fungus
 d) Blood cholesterol lowering agent.

Q19 (a) How is activated sludge produced during sewage treatment?

(b) Explain how this sludge is used in biogas production.

Ans. a) Once the BOD of sewage water is reduced significantly, the effluent is passed into a settling tank where the bacterial flocs undergo sedimentation and the sediment is thus called activated sludge.

b) A small part of activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining part of activated sludge is pumped into large digesters where the bacteria and fungi in the sludge produce a mixture of gases called biogas.

Q20 River Ganga has become very polluted. It is considered to be a sacred river, which people believe purifies itself. Just because of this reason, the pollution in it has increased as people throw many things in it in the name of religion.

Answer the following questions based on the above information:

- (i) What has government done to check the pollution here?
- (ii) How can you play a role in saving the river?
- (iii) How is the pollution in water checked?

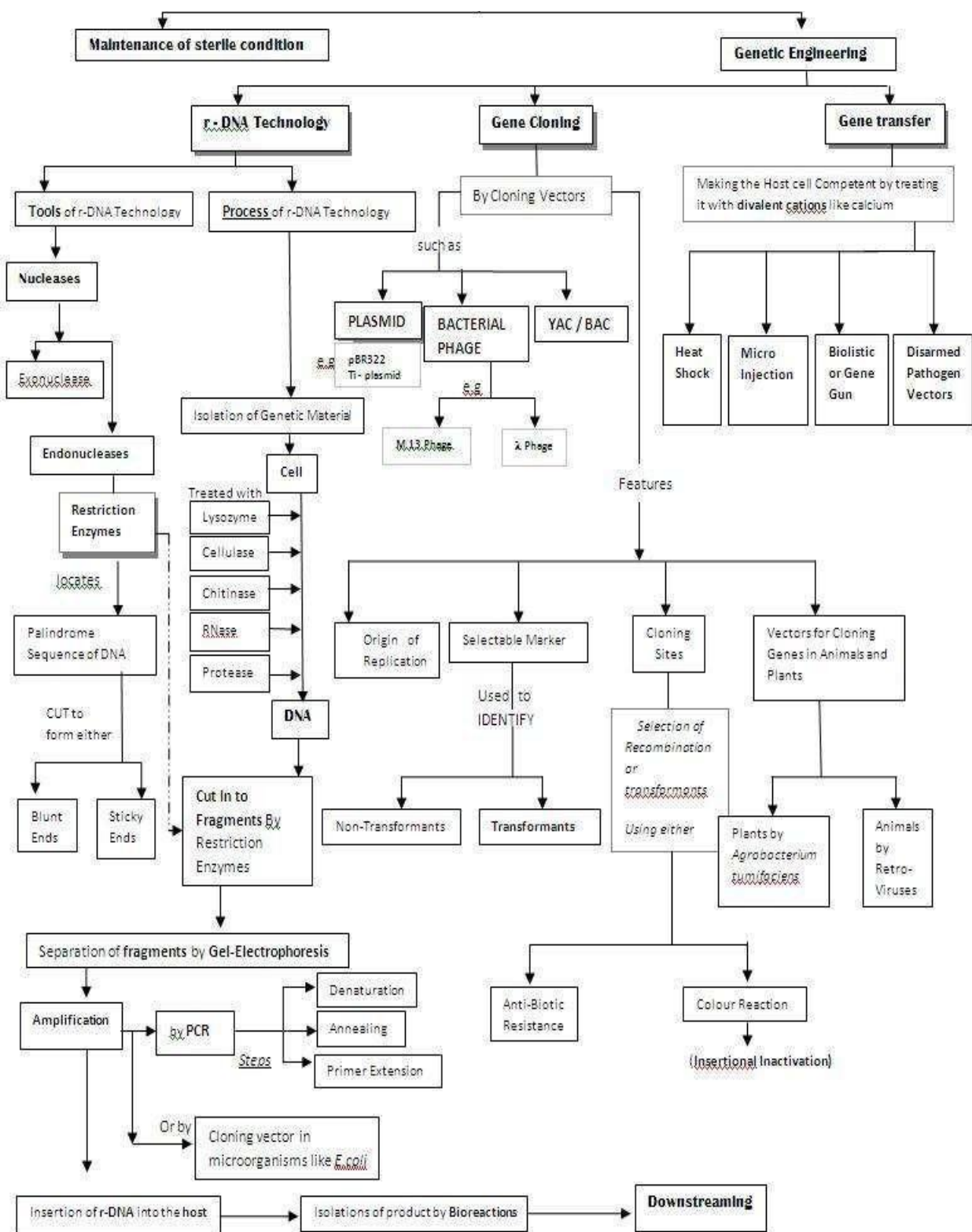
Ans. (1) Government has started "Ganga Action Plan" to clean the river. Government is also spreading awareness among the citizens through advertisement.

(2) We can make a propaganda in our locality and inform people of their actions and its effect.

(3) Pollution in water is checked by measuring its

Chapter-11: BIOTECHNOLOGY: PRINCIPLES AND PROCESSES

CONCEPT MAP :-



Biotechnology is a broad area of science involving multiple disciplines designed to use living organisms or their products to perform valuable industrial or manufacturing processes or applications pertaining to human benefit.

Recombinant DNA technology:

An organism's genome contains virtually all the information necessary for its growth and development

Steps in producing recombinant DNA

1. The required gene is cut from a DNA molecule using a restriction enzyme.
2. A bacterial plasmid is isolated and cut with the same restriction enzyme. This ensures cut ends are complementary (same base sequence) to the ends of the required gene.
3. The required gene is joined to the plasmid using the enzyme DNA ligase in a process called ligation.
4. The resulting recombinant plasmid is returned to the bacterial cell.
5. The bacteria reproduce and the required gene is cloned.

How do we obtain DNA and how do we manipulate DNA? Quite straight forward to isolate DNA

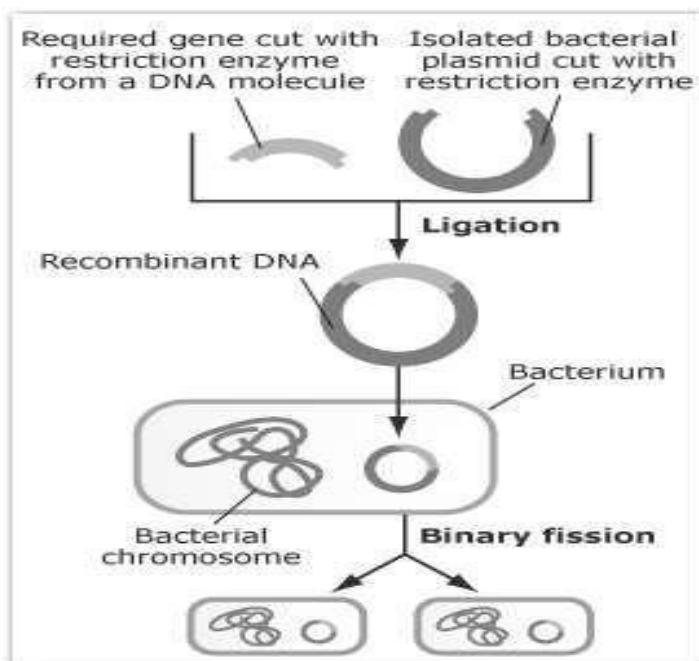
For instance, to isolate genomic DNA

1. Remove tissue from organism
2. Homogenize in lysis buffer containing guanidine thiocyanate (denatures proteins)
3. Mix with phenol/chloroform - removes proteins
4. Keep aqueous phase (contains DNA)
5. Add alcohol (ethanol or isopropanol) to precipitate DNA from solution
6. Collect DNA pellet by centrifugation
7. Dry DNA pellet and resuspend in buffer Store at 4°C

Each cell (with a few exceptions) carries a copy of the DNA sequences which make up the organism's genome.

How do we manipulate DNA?

It used to be difficult to isolate enough of a particular DNA sequence to carry out further manipulation and/or characterization of its molecular sequence



Recombinant DNA Technology

Isolation Digestion

- (Lysozyme(Bacteria),
- cellulase(Plant cell)
- Chitinase(Fungus)
- Fractionation

Purification of the TARGET
 fragment Cloning into vectors
 Transformation of host cell and
 selection Replication
 Analysis

Introduction of recombinant DNA into host cells:

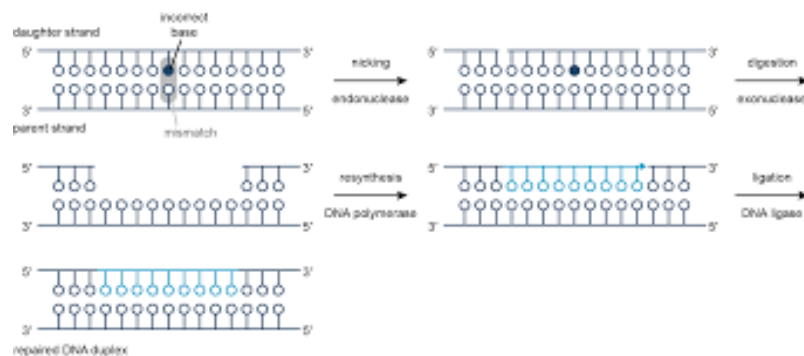
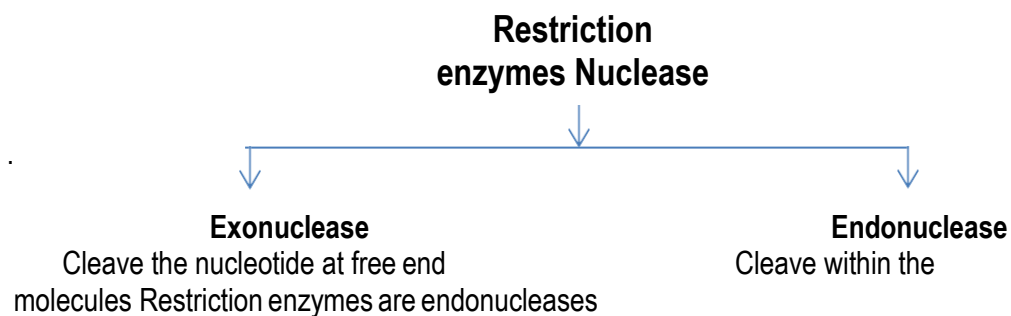
Some commonly used procedures:

1. Transformation
2. Transfection
3. Electroporation
4. Biolistics
5. *Agrobacterium* mediated gene transfer

DNA is manipulated using various enzymes that modify and/or synthesise it. Until 1970 there were no convenient methods available for cutting DNA into discrete, manageable fragments.

1970 - The Beginning of the Revolution

Discovery of a **restriction enzyme** in the bacterium *Haemophilus influenzae*



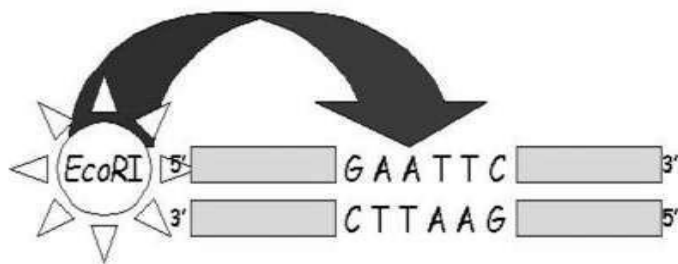
- Bacterial enzymes.
- Different bacterial strains express different restriction enzymes.
- The names of restriction enzymes are derived from the name of the bacterial strain they are isolated from.
- Cut (hydrolyse) DNA into defined and **REPRODUCIBLE** fragments.
- **Basic tools of gene cloning.**

Names of restriction endonucleases

Titles of restriction enzymes are derived from the first letter of the genus + the first two letters of the species of organism from which they were isolated.

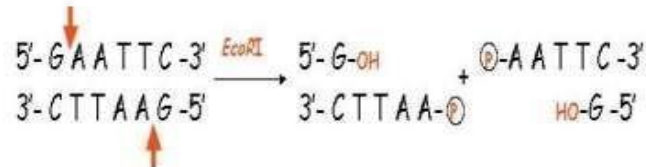
Source microorganism	Enzyme	Recognition	Ends produced
<i>Arthrobacter luteus</i>	<i>Alu</i> I	AGCT [↓]	Blunt
<i>Bacillus amyloiquefaciens</i> H	<i>Bam</i> HI	G GATCC	Sticky
<i>Escherichia coli</i>	<i>Eco</i> RI	G AATTC	Sticky
<i>Haemophilus gallinarum</i>	<i>Hga</i> I	GACGC(N) ₅	Sticky
<i>Haemophilus influenzae</i>	<i>Hind</i> III	↓ A AGCTT	Sticky
<i>Providencia stuartii</i> 164	<i>Pst</i> I	CTGCA G	Sticky
<i>Nocardia otitiscaviarum</i> s	<i>Not</i> I	GC GGCCGC	Sticky
<i>Staphylococcus aureus</i> 3A	<i>Sau</i> 3A	↓ GATC	Sticky
<i>Serratia marcesans</i>	<i>Sma</i> I	CCC GGG	Blunt
<i>Thermus aquaticus</i>	<i>Taq</i> I	↓ T CGA	Sticky

Restriction enzymes recognise a specific short nucleotide sequence



This is known as a Restriction Site

The phosphodiester bond is cleaved between specific bases, one on each DNA strand



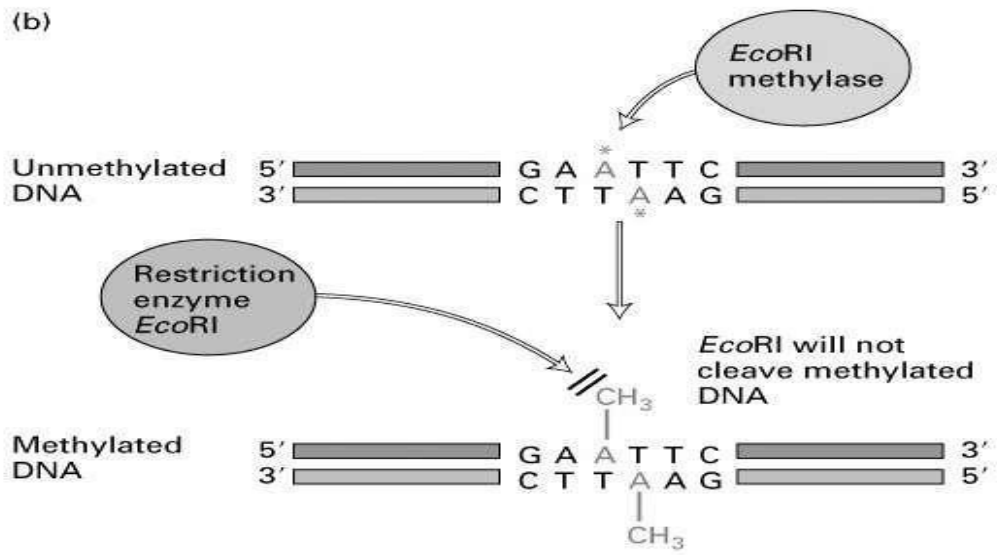
The product of each reaction is two double stranded DNA fragments

Restriction enzymes do not discriminate between DNA from different organisms

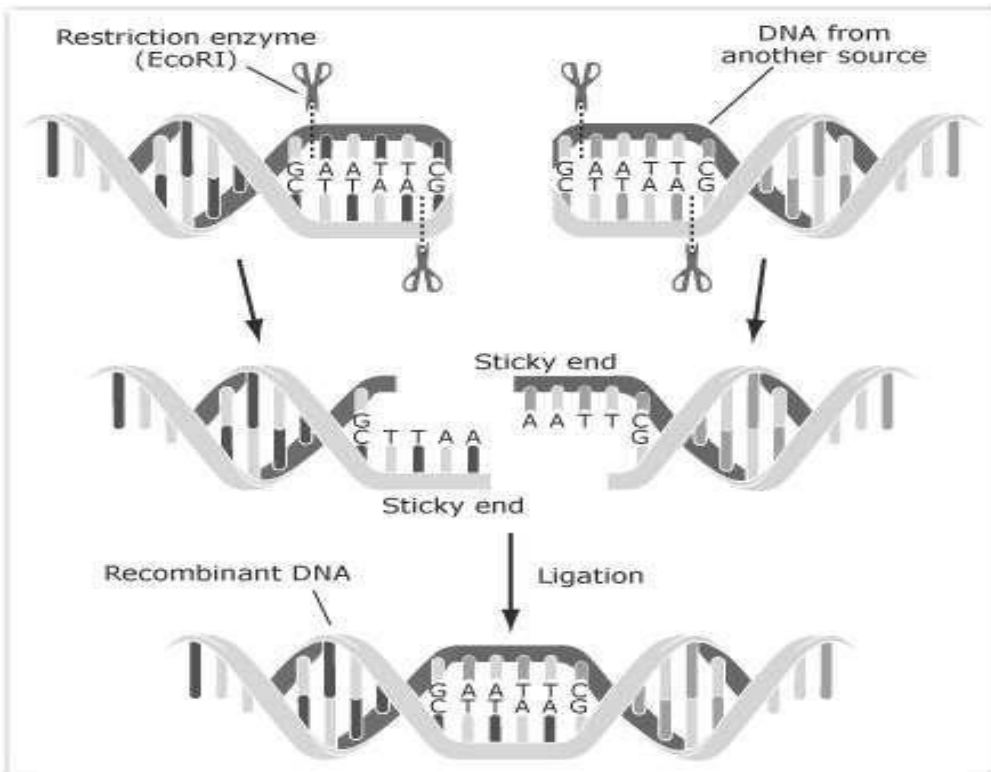
Restriction endonucleases are a natural part of the bacterial defence system

- Part of the restriction/modification system found in many bacteria
- These enzymes **RESTRICT** the ability of foreign DNA (such as bacteriophage DNA) to infect/invade the host bacterial cell by cutting it up (degrading it)
- The host DNA is **MODIFIED** by **METHYLATION** of the sequences these enzymes recognise
 - Methyl groups are added to C or A nucleotides in order to protect the bacterial host DNA from degradation by its own enzymes

(b)



Types of restriction enzymes



ACTION OF RESTRICTION ENZYME *ECO RI*

- Type I Recognise specific sequences but then track along DNA (~1000-5000bases) before cutting one of the strands and releasing a number of nucleotides (~75) where the cut is made. A second molecule of the endonuclease is required to cut the 2nd strand of the DNA
 - e.g. *EcoK*.
 - Require Mg^{2+} , ATP and SAM (S-adenosyl methionine) cofactors for function

Type II Recognise a specific target sequence in DNA, and then break the DNA (both strands), within or close to, the recognition site. Only they are used in rDNA technology as they recognize and cut DNA within a specific sequence typically consisting of 4-8 bp.

- e.g. *EcoRI*
- Usually require Mg^{2+}
- Type III Intermediate properties between type I and type II. Break both DNA strands at a defined distance from a recognition site
 - e.g. *HgaI*
 - Require Mg^{2+} and ATP

Hundreds of restriction enzymes have been isolated and characterised

- Enables DNA to be cut into discrete, manageable fragments
- Type II enzymes are those used in the vast majority of molecular biology techniques
- Many are now commercially available

Many Type II restriction endonucleases recognise PALINDROMIC sequences (From Greek palindromos, *running back again, recurring: palin, again*)

A segment of double-stranded DNA in which the nucleotide sequence of one strand reads in reverse order to that of the complementary strand. (Always read from the same direction)

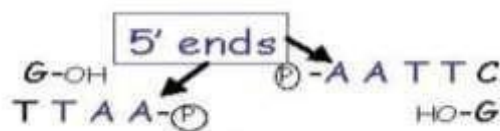
For example, *EcoRI* recognises the sequence

5'-G A A T T C-3'

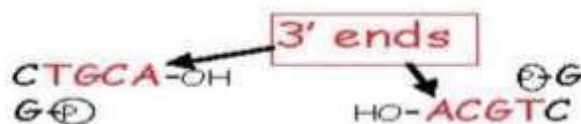
3'-C T T A A G-5'

Different enzymes cut at different positions and can create single stranded ends ('sticky ends')

- Some generate 5' overhangs - eg: *EcoRI*



- Some generate 3' overhangs - eg: *PstI*



Some generate blunt ends- eg: *SmaI*



Examples of restriction enzymes and the sequences they cleave

The 'sticky' overhangs are known as **COHESIVE ENDS**

- The single stranded termini (or ends) can base pair (**ANNEAL**) with any complementary single stranded termini

This is the basis for **RECOMBINANT DNA TECHNOLOGY**

- Inserting foreign DNA into a cloning vector

Restriction enzymes are a useful tool for analysing Recombinant DNA

After ligating a particular DNA sequence into a cloning vector, it is necessary to check that the correct fragment has been taken up. Sometimes it is also necessary to ensure that the foreign DNA sequence is in a certain orientation relative to sequences present in the cloning vector.

- Checking the size of the insert
- Checking the orientation of the insert
- Determining pattern of restriction sites within insert DNA

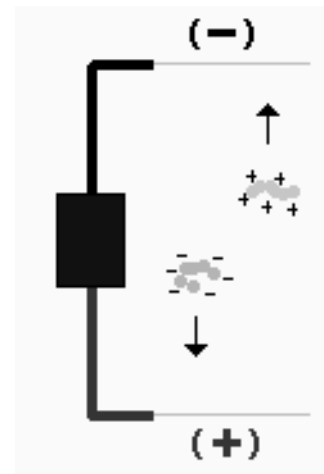
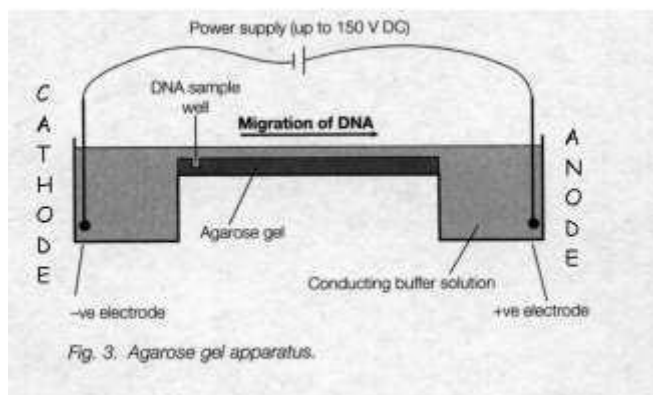
DNA fractionation

Separation of DNA fragments in order to isolate and analyse DNA cut by restriction enzymes

Electrophoresis

Electrophoresis is a technique used to separate and sometimes purify macromolecules - especially proteins and nucleic acids - that differ in size, charge or conformation. When charged molecules are placed in an electric field, they migrate toward either the positive or negative pole according to their charge.

DNA is electrophoresed through the agarose gel from the **cathode** (negative) to the **anode**(positive) when a voltage is applied, due to the net negative charge carried on DNA.



When the DNA has been electrophoresed, the gel is stained in a solution containing the chemical **ethidium bromide**. This compound binds tightly to DNA and fluoresces strongly under UV light - allowing the visualisation and detection of the DNA.

Recombinant DNA technology:

Recombinant DNA: Plasmids, cloning

What is DNA cloning?

DNA cloning is the isolation of a fragment or fragments of DNA from an organism and placing in a VECTOR that replicates independently of chromosomal DNA. The RECOMBINANT DNA is propagated

in a host organism; the resulting CLONES are a set of genetically identical organisms which contain the recombinant DNA

Three main purposes for cloning DNA

- 1) DNA sequencing
- 2) Protein production
- 3) Engineering animals/plants/proteins

Cloning and Expression Vectors

Isolated DNA is cloned into **VECTORS** for long term storage, propagation of the DNA and for production of protein from gene(s) encoded in the DNA

What are cloning vectors?

Cloning vectors are extra-chromosomal 'replicons' of DNA which can be isolated and can replicate independently of the chromosome. Vectors usually contain a **selectable marker** - a gene that allows selection of cells carrying the vector e.g. by conferring resistance to a toxin. DNA of interest can be cloned into the vector and replicated in host cells, usually one which has been well characterised.

Commonly used vectorsystems

- Bacterial plasmids
- Bacteriophages
- Cosmids
- Yeast artificial chromosomes (YACs)
- Ti plasmid (plants)
- Eukaryotic viruses such as baculovirus (insect cells), SV40 virus and retroviruses.

Characteristics of a Cloning Vector

❖ Origin of replication(ORI)

This process marks autonomous replication in vector. ORI is a specific sequence of nucleotide in DNA from where replication starts. When foreign DNA is linked to this sequence then along with vector replication, foreign (desirable) DNA also starts replicating within host cell.

❖ Selectable Marker

Characteristics of Selectable marker:

A gene whose expression allows one to identify cells that have been transformed or transfected with a vector containing the marker gene.

A **marker gene** is used to determine if a piece of DNA has been successfully inserted into the host organism. Gene usually encoding resistance to an antibiotic. A **selectable marker** will protect the organism from a **selective agent** that would normally kill it or prevent its growth.

❖ Restriction sites

Allow cleavage of specific sequence by specific Restriction Endonuclease. Restriction sites in E.coli cloning vector pBR322 include HindIII , EcoRI , BamHI , Sall, PvuI, PstI, ClaI etc.

Refer NCERT text book diagram of pBR322

A Cloning Vector that Works with Plant Cells

Most commonly used plant cloning vector "**Ti**" **plasmid**, or tumor-inducing plasmid. Found in cells of the bacterium known as **Agrobacterium tumefaciens**, normally lives in soil. Bacterium has ability to infect plants and cause a **crown gall**, or tumorous lump, to form at the site of infection.

*Ti plasmid - called T DNA - separates from the plasmid and incorporates into the host cell genome. This aspect of Ti plasmid function has made it useful as a **plant cloning vector (natural genetic engineer).***

Plasmids are the most commonly used vector system. Several types available for cloning of foreign DNA in the host organism *Escherichia coli*. Many *E. coli* plasmids allow the expression of proteins encoded by the cloned DNA

Bacteriophage another common vector system used for cloning DNA. These are viruses which 'infect' *E. coli*. The M13 bacteriophage is a single-stranded DNA virus which replicates in *E. coli* in a double-stranded form that can be manipulated like a plasmid. It can be used to produce single-stranded DNA copies which are useful for **DNA sequencing**.

Bacteriophage common vector system used to make DNA libraries. It allows the cloning of larger fragments of DNA than can be incorporated into plasmids.

Transformation is the process by which plasmids (or other DNA) can be introduced into a cell. For *E. coli* transformation with plasmids is quite straightforward. Plasmids can be introduced by electroporation or by incubation in the presence of divalent cations (usually Ca^{2+}) and a brief heat shock (42°C) which induces the *E. coli* cells to take up the foreign DNA

1. Two antibiotic selection and replica plating
2. Color selection: blue/white selection using the lacz gene

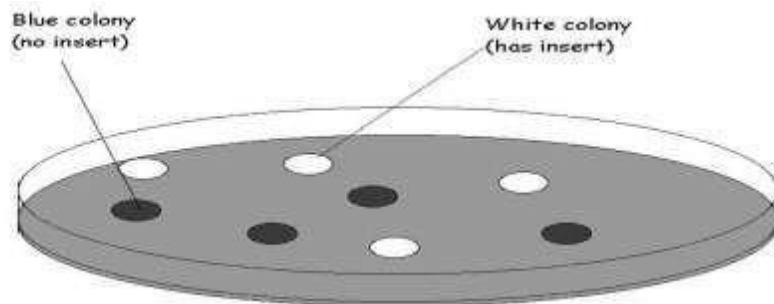
Insertional inactivation -

Subcloning a DNA fragment into an active gene (usually a marker gene whose function can be easily detected) will disrupt the function of that gene. This can be detected by looking for colonies that no longer display that phenotype.

Colour selection

A more common method to determine which transformants contain plasmids with inserts is to use **colour selection**. For *E. coli*, this involves the **lac complex** and **blue/white screening**.

Colonies carrying plasmid with no insert will be coloured **blue** whereas colonies carrying recombinant plasmid will be **white**.



For plasmids such as pBR322, which contains two antibiotic resistance genes, cloning an insert into one of these will disrupt that gene and inactivate the resistance to that antibiotic.

Southern/Northern Blotting Analysis

Analysing complex nucleic acid mixtures (DNA or RNA)

The total cellular DNA of an organism (genome) or the cellular content of RNA are complex mixtures of different nucleic acid sequences. Restriction digest of a complex genome can generate millions of specific restriction fragments and there can be several fragments of exactly the same size which will not be separated from each other by electrophoresis.

Techniques have been devised to identify specific nucleic acids in these complex mixtures

- **Southern blotting** - DNA
- **Northern blotting** - RNA

Southern blotting

Technique devised by Ed Southern in 1975, is a commonly used method for the identification of DNA fragments that are complementary to a known DNA sequence. Allows a comparison between the genome of a particular organism and that of an available gene or gene fragment (**probe**). It can tell us whether an organism contains a particular gene (DNA fragment) or not

In Southern blotting,

1. Chromosomal DNA is isolated from the organism of interest, and digested to completion with a restriction endonuclease enzyme.
2. The restriction fragments are then subjected to electrophoresis on an agarose gel, which separates the fragments on the basis of size.
3. DNA fragments in the gel are denatured (i.e. separated into single strands) using an alkaline solution.
4. Transfer fragments from the gel onto nitrocellulose filter or nylon membrane.

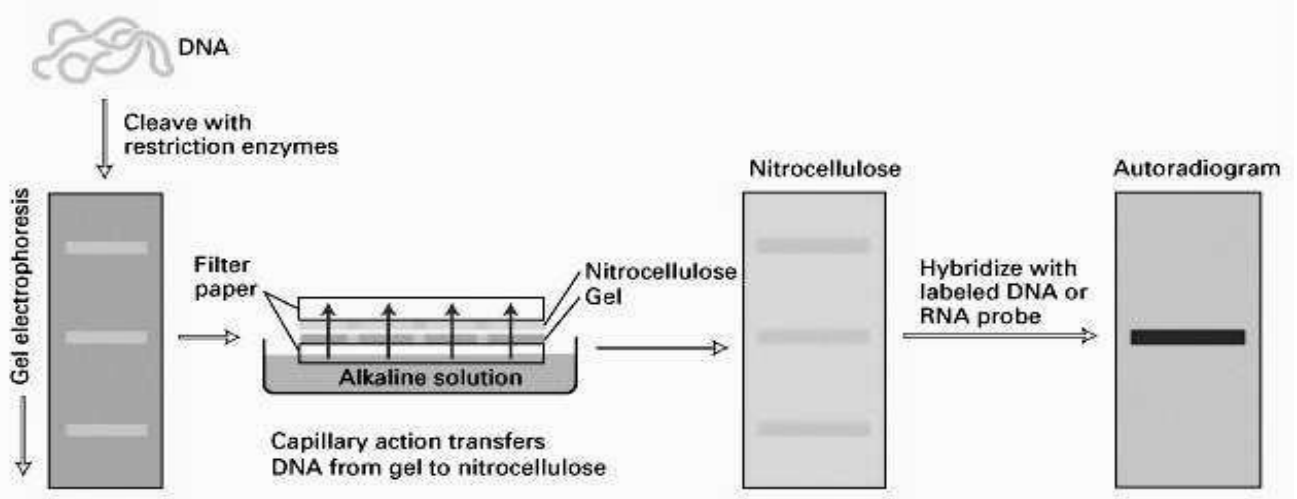
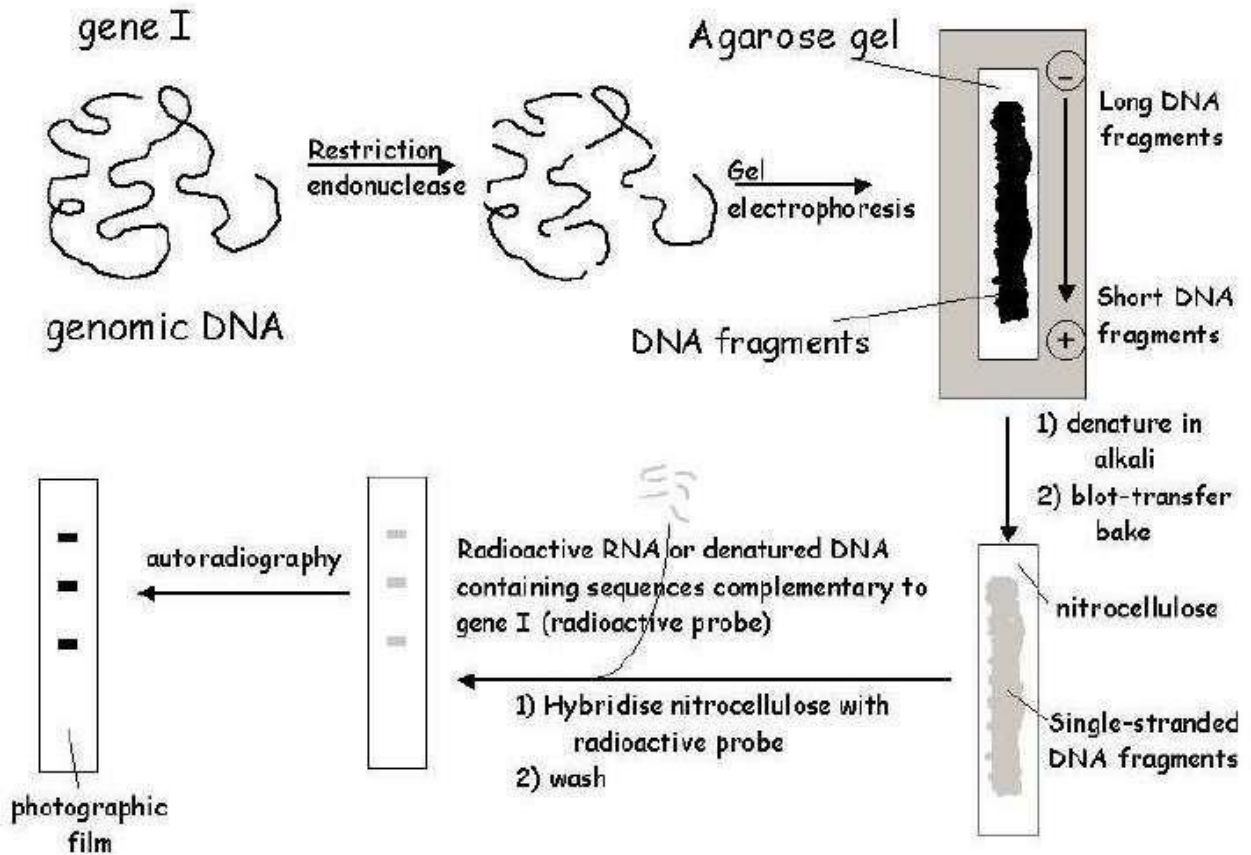


Fig 7-32, Lodish et al (4th ed.)

DNA is bound irreversibly to the filter/membrane by baking at high temperature (nitrocellulose) or cross-linking through exposure to UV light (nylon).

Final step is to immerse the membrane in a solution containing the **probe** - either a DNA (cDNA clone, genomic fragment, oligonucleotide or RNA) can be used. This is **DNA hybridisation**. The membrane is washed to remove non-specifically bound probe, and is then exposed to X-ray film - a process called **autoradiography**. **The principle of Southern blotting**



PCR(Polymerase Chain Reaction):

PCR is a technique for the *in vitro* amplification of a desired sequence of DNA. PCR allows the generation of a large quantity of DNA product (up to several μ g) from only a few starting copies. It has

been shown that PCR can be used to generate a detectable quantity of DNA from only one starting **target** (or **template**) molecule.

PCR developed in the mid-1980, has found multiple applications, such as:

1. Rapid amplification of intact genes or gene fragments
2. Generation of large amounts of DNA for sequencing
3. Generation of probes specific for uncloned genes by selective amplification of a specific segment of cDNA
4. Analysis of mutations for medical applications
5. Detection of minute amounts of DNA for forensic purposes
6. Amplification of chromosomal regions adjacent to genes of known sequence and many more

Development of PCR won the Nobel prize for Kary Mullis and co-workers.

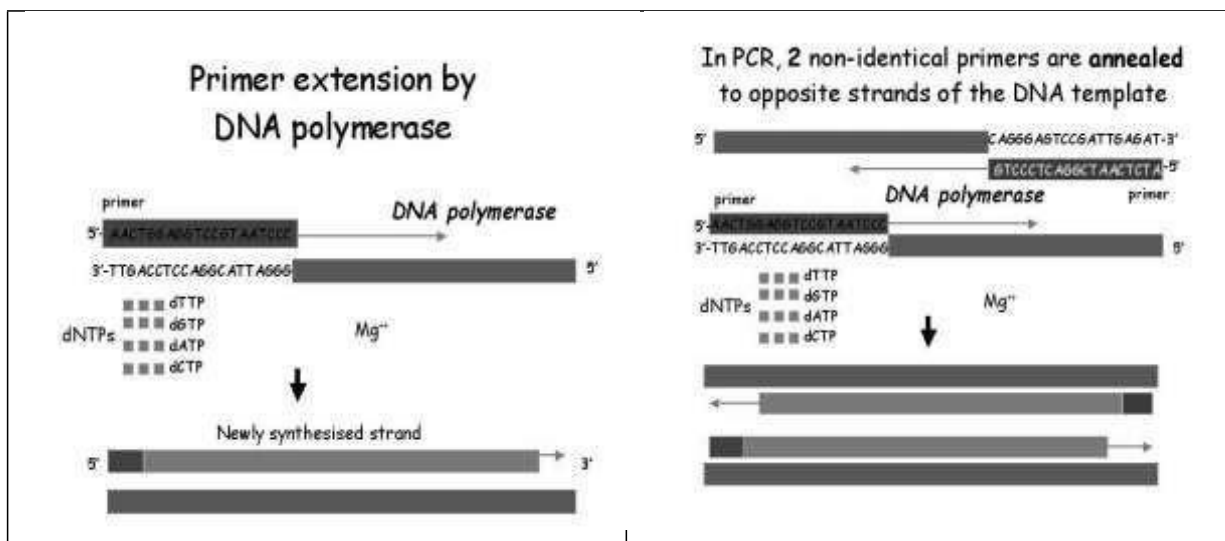
PCR principle

PCR reaction is a DNA synthesis reaction that depends on the **extension** of primers **annealed** to opposite strands of a dsDNA template that has been denatured (**melted apart**) at temperatures near boiling. By repeating the **melting**, **annealing** and **extension** steps, several copies of the original template DNA can be generated.

The amount of starting material (target) needed is very small

Not necessary to isolate the desired sequence, because it will be defined by the **primers** that are used in the reaction. The **primers** are oligonucleotides **complementary** to different regions on the 2 strands of DNA template (**flanking** the region to be amplified).

The **primer** acts as a starting point for DNA synthesis. The oligo is **extended** from its 3' end by **DNA polymerase**.



Primer design

The stages of a PCR reaction

PCR is a **cycle** of three steps:

1. **DENATURATION** - the strands of the DNA are **melted apart** by heating to 95°C
2. **ANNEALING** - the temperature is reduced to ~ 55°C to allow the primers to **anneal** to the target DNA
3. **POLYMERISATION / EXTENSION** - the temperature is changed to the optimum temperature for the DNA polymerase to catalyse **extension** of the primers, *i.e.* to copy the DNA between the primers.

The **cycle** is repeated over and over again - as many times as needed to produce a detectable amount of product.

Discovery of a thermostable DNA polymerase

The **breakthrough** came with the discovery of the thermostable DNA polymerase *Taq* polymerase, from the thermophilic bacterium, *Thermus aquaticus*, which lives in hot springs.

Taq polymerase enzyme can resist **high temperatures** required to melt the template DNA apart without denaturation (loss of activity) and works best at **high temperatures (72°C)**. This led to improved specificity & sensitivity. Annealing of primers to sites other than the target sequence is significantly reduced at the higher temperatures used for *Taq* polymerase.

Applications of PCR

- 1) Cloning a gene encoding a known protein
- 2) Amplifying 'old DNA'
- 3) Amplifying cloned DNA from vectors
- 4) Creating mutations in cloned genes

5) Rapid amplification of cDNA ends - RACE

6) Detecting bacterial or viral infection

- * AIDS infection
- * Tuberculosis (*Mycobacterium tuberculosis*)

7) Cancer

Detecting mutations that occur in cancer and monitoring cancer therapy. Determining if a patient is free of malignant cells

8) Genetic diagnosis

a. Diagnosing inherited disorders

- * Cystic fibrosis
- * Muscular dystrophy
- * Haemophilia A and B
- * Sickle cell anemia

b. Diagnosing cancer - certain cancers are caused by specific and reproducible mutations: eg. Retinoblastoma - childhood cancer of the eye. The heritable form (germ line mutation of one of the two retinoblastoma alleles): mutation is detected in all cells. Spontaneous form: only detected in tumour tissue.

c. Blood group typing

d. Prenatal diagnosis – eg determining the sex of foetus for those at risk of X-linked disorders

PCR is one of the most versatile techniques invented, and has so many applications that this list could go on for quite some time.

Downstream processing

It refers to the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissue or fermentation broth

Stages in Downstream Processing

A widely recognized heuristic for categorizing downstream processing operations divides them into four groups which are applied in order to bring a product from its natural state as a component of a tissue, cell or fermentation broth through progressive improvements in purity and concentration.

Removal of insoluble Product Isolation Product Purification Product Polishing

GLOSSARY:

Adult stem cells

The stem cells found in a developed organism and have the twin properties of self-renewal and differentiation. These can be obtained from fetal cord blood and bone marrow. They are multipotent in nature.

Amplification

An increase in the number of copies of a specific DNA fragment; can be in vivo or in vitro.

See also :cloning, polymerase chain reaction

Annotation

Adding pertinent information such as gene coded for, amino acid sequence, or other complementary to the database entry of raw sequence of DNA bases.

Antisense

Nucleic acid that has a sequence exactly opposite to an mRNA molecule made by the body; binds to the mRNA molecule to prevent a protein from being made.

Antisense RNA technology

An RNA molecule that is the reverse complement of a naturally occurring mRNA, and which can be used to prevent translation of that mRNA in a transformed cell.

Autoradiography

A technique that uses X-ray film to visualize radioactively labeled molecules or fragments of molecules; used in analyzing length and number of DNA fragments after they are separated by gel electrophoresis.

Bacterial artificial chromosome (BAC)

A vector used to clone DNA fragments (100 to 300 kb insert size; average, 150 kb) in *Escherichia coli* cells. Based on naturally occurring F-factor plasmid found in the bacterium *E. coli*.

Base sequence

The order of nucleotide bases in a DNA molecule; determines structure of proteins encoded by that DNA.

-

Bioinformatics

The science of managing and analyzing biological data using advanced computing techniques. Especially important in analyzing genomic research data.

Biolistics

Remarkable method developed to introduce foreign DNA into mainly plant cells is by using a gene or particle gun. Microscopic particles of gold or tungsten are coated with the DNA of interest and bombarded onto cells with a device much like a particle gun. Hence the term **biolistics** is used.

Biotechnology

Set of biological techniques developed through basic research and now applied to research and product development. In particular, biotechnology refers to the use by industry of recombinant DNA, cell fusion, and new bioprocessing techniques.

Cancer

Diseases in which abnormal cells divide and grow unchecked. Cancer can spread from its original site to other parts of the body and can be fatal.

See *also*: [hereditary cancer](#), [sporadic cancer](#)

Carcinogen

Something which causes cancer to occur by causing changes in a cell's DNA.

See *also*: [mutagen](#)

Carrier

An individual who possesses an unexpressed recessive trait.

cDNA library

A collection of DNA sequences that code for genes. The sequences are generated in the laboratory from mRNA sequences.

See *also*: [messenger RNA](#)

Clone

An exact copy made of biological material such as a DNA segment (eg. a gene or other region), a whole cell, or complete organism.

Cloning

Using specialized DNA technology to produce multiple, exact copies of a single gene or other segment of DNA to obtain enough material for further study. Process, used by researchers in the Human Genome Project, referred to as cloning DNA. Resulting cloned (copied) collections of DNA molecules constitute clone libraries. Second type of cloning exploits the natural process of cell division to make many copies of an entire cell. The genetic makeup of these cloned cells, called cell line, is identical to the original cell. Third type of cloning produces complete, genetically identical animals such as the famous Scottish sheep, Dolly.

Cloning vector

DNA molecule originating from a virus, a plasmid, or the cell of a higher organism into which another DNA fragment of appropriate size can be integrated without loss of the vector's capacity for self-replication; vectors introduce foreign DNA into host cells, where the DNA can be reproduced in large quantities. Examples are plasmids, cosmids, and yeast artificial chromosomes; vectors are often recombinant molecules containing DNA sequences from several sources.

Complementary DNA (cDNA)

DNA that is synthesized in the laboratory from a messenger RNA template.

Complementary sequence

Nucleic acid base sequence that can form a double-stranded structure with another DNA fragment by following base-pairing rules (A pairs with T and C with G). The complementary sequence to GTAC for example, is CATG.

Cosmid

Artificially constructed cloning vector containing the cos gene of phage lambda. Cosmids can be packaged in lambda phage particles for infection into *E. coli*; Permits cloning of larger DNA fragments (up to 45kb) than can be introduced into bacterial hosts in plasmid vectors.

DNA bank

A service that stores DNA extracted from blood samples or other human tissue.

DNA profiling

A PCR technique that determines the alleles present at different STR (short tandem repeat) loci within a genome in order to use DNA information to identify individuals.

DNA repair genes

Genes encoding proteins that correct errors in DNA sequencing.

DNA replication

The use of existing DNA as a template for the synthesis of new DNA strands. In humans and other eukaryotes, replication occurs in the cell nucleus.

DNA sequence

The relative order of base pairs, whether in a DNA fragment, gene, chromosome, or an entire genome. See *also*: base sequence analysis

Double helix

The twisted-ladder shape that two linear strands of DNA assume when complementary nucleotides on opposing strands bond together.

Electrophoresis

A method of separating large molecules (such as DNA fragments or proteins) from a mixture of similar molecules. An electric current is passed through a medium containing the mixture, and each kind of molecule travels through the medium at a different rate, depending on its electrical charge and size. Agarose and acryl amide gels are the media commonly used for electrophoresis of proteins and nucleic acids.

Electroporation

A process using high-voltage current to make cell membranes permeable to allow the introduction of new DNA; commonly used in recombinant DNA technology.

See *also*: transfection

Embryonic stem (ES) cells

An embryonic cell having totipotency that can replicate indefinitely, transform into other types of cells, and serve as a continuous source of new cells. These cells are derived from inner cell mass of the blastocyst or the 4-8 cell stage of embryo.

Endonuclease

See: restriction enzyme

Escherichia coli

Common bacterium that has been studied intensively by geneticists because of its small genome size, normal lack of pathogenicity, and ease of growth in the laboratory.

Exogenous DNA

DNA originating outside an organism that has been introduced into the organism.

Exon

The protein-coding DNA sequence of a gene.

See also: [intron](#)

Exonuclease

An enzyme that cleaves nucleotides sequentially from free ends of a linear nucleic acid substrate.

Expressed sequence tag (EST)

A short strand of DNA that is part of cDNA molecule and can act as identifier of a gene. Used in locating and mapping genes.

See also: [cDNA](#), [sequence tagged site](#)

Fingerprinting

In genetics, the identification of multiple specific alleles on a person's DNA to produce a unique identifier for that person.

See also: [forensics](#)

Fluorescence in situ hybridization (FISH)

A Physical mapping approach that uses fluorescein tags to detect hybridization of probes with metaphase chromosomes and with the less-condensed somatic interphase chromatin.

Forensics

Use of DNA for identification. Some examples of DNA use are to establish paternity in child support cases; establish the presence of a suspect at a crime scene, and identify accident victims.

Functional genomics

Study of genes, their resulting proteins, the role played by proteins in the body's biochemical processes.

Gel electrophoresis

See: [electrophoresis](#)

Gene gun or particle gun: a popular and widely used direct gene transfer method for delivering foreign genes into virtually any tissues and cells or even intact seedlings.

- The foreign DNA is coated or precipitated onto the surface of minute gold or tungsten particles (1-3 μm).
- It is bombarded or shot onto the target tissue or cells using the gene gun or microprojectile gun or shot gun.
- The bombarded cells or tissues are cultured on selection medium to regenerate plants from the transformed cells.

Gene library

See: [genomic library](#)

Gene mapping

Determination of the relative positions of genes on a DNA molecule (chromosome or plasmid) and of the distance, in linkage units or physical units, between them.

Gene pool

All the variations of genes in a species.

See also: [allele](#), [gene polymorphism](#)

Gene therapy

Experimental procedure aimed at replacing, manipulating, or supplementing nonfunctional or malfunctioning genes with healthy genes.

See *also*: [gene](#), [inherit](#), [somatic cell gene therapy](#), [germ line gene therapy](#)

Gene transfer

Incorporation of new DNA into an organism's cells, usually by a vector such as a modified virus. Used in gene therapy.

See *also*: [mutation](#), [gene therapy](#), [vector](#)

Genetic engineering

Altering the genetic material of cells or organisms to enable them to make new substances or perform new functions.

Genetic engineering technology

See: [recombinant DNA technology](#)

Genetic marker

A gene or other identifiable portion of DNA whose inheritance can be followed.

See *also*: [chromosome](#), [DNA](#), [gene](#), [inherit](#)

Genetic material

See: [genome](#)

Genetic polymorphism

Difference in DNA sequence among individuals, groups, or populations (e.g., genes for blue eyes versus brown eyes).

Genetic screening

Testing a group of people to identify individuals at high risk of having or passing on a specific genetic disorder.

Genetic testing

Analyzing an individual's genetic material to determine predisposition to a particular health condition or to confirm a diagnosis of genetic disease.

Genome

All the genetic material in the chromosomes of a particular organism; its size is generally given as its total number of base pairs.

Genome project

Research and technology-development effort aimed at mapping and sequencing the genome of human beings and certain model organisms.

See *also*: [Human Genome Initiative](#)

Genomic library

A collection of clones made from a set of randomly generated overlapping DNA fragments that represent the entire genome of an organism.

Human Genome Project (HGP)

Formerly titled Human Genome Initiative.

See *also*: [Human Genome Initiative](#)

In vitro

Studies performed outside a living organism such as in a laboratory.

In vivo

Studies carried out in living organisms.

Marker

See: genetic marker

Microinjection

A technique for introducing a solution of DNA into a cell using a fine microcapillary pipette or microsyringe under a phase contrast microscope to aid vision.

Microsatellite DNA

Polymorphism comprising tandem copies of usually, two-, three-, four- or five-nucleotide repeat units, also called a short tandem repeat (STR).

Mutation

It is an alteration in any of the base of a DNA sequence sometime's leading to a defective protein or prematurely terminated non-functional protein. Mutations are spontaneous in nature although rare. Example-Sickle cell haemoglobin has amino acid mutation of valine to glutamine in its beta chain.

Northern blot-A gel-based laboratory procedure that locates mRNA sequences on a gel that are complementary to a piece of DNA used as a probe.

Phage

A virus for which the natural host is a bacterial cell.

Plasmid

Autonomously replicating extra-chromosomal circular DNA molecules, distinct from the normal bacterial genome and non essential for cell survival under nonselective conditions. Some plasmids are capable of integrating into the host genome. Number of artificially constructed plasmids are used as cloning vectors.

Polymerase, DNA or RNA

Enzyme that catalyzes the synthesis of nucleic acids on preexisting nucleic acid templates, assembling RNA from ribonucleotides or DNA from deoxyribonucleotides.

Primer

Short preexisting polynucleotide chain (generally from 17-30 nucleotides in length) to which new deoxyribonucleotides can be added by DNA polymerase.

Probe

Single-stranded DNA or RNA molecules of specific base sequence, labeled either radioactively or immunologically. Used to detect the complementary base sequence by hybridization.

Promoter

The nucleotide sequence upstream of a gene that acts as a signal for RNA polymerase binding.

Restriction enzyme, endonuclease

Protein that recognizes specific, short nucleotide sequences and cuts DNA at those sites. Bacteria contain over 400 such enzymes that recognize and cut more than 100 different DNA sequences.

See *also*: restriction enzyme cutting site

Restriction fragment length polymorphism (RFLP)

Variation between individuals in DNA fragment sizes cut by specific restriction enzymes; polymorphic sequences that result in RFLPs are used as markers on both physical maps and genetic linkage maps. RFLPs are usually caused by mutation at a cutting site.

See also: [marker](#), [polymorphism](#)

Retroviral infection

Presence of retroviral vectors, such as some viruses, which use their recombinant DNA to insert their genetic material into the chromosomes of the host's cells. The virus is then propagated by the host cell.

Sanger sequencing

- A widely used method of determining the order of bases in DNA.
- The classical chain-termination method requires a single-stranded DNA template, a DNA primer, a DNA polymerase, normal deoxynucleotide triphosphates (dNTPs), and modified nucleotides (dideoxy NTPs) that terminate DNA strand elongation.
- These ddNTPs will also be radioactively or fluorescently labelled for detection in automated sequencing machines. The DNA sample is divided into four separate sequencing reactions, containing all four of the standard deoxynucleotides (dATP, dGTP, dCTP and dTTP) and the DNA polymerase.
- To each reaction is added only one of the four dideoxynucleotides (ddATP, ddGTP, ddCTP, or ddTTP) which are the chain-terminating nucleotides, lacking a 3'-OH group required for the formation of a phosphodiester bond between two nucleotides, thus terminating DNA strand extension and resulting in DNA fragments of varying length.

See also: [sequencing](#), [shotgun sequencing](#)

Satellite

Chromosomal segment that branches off from the rest of the chromosome but is still connected by a thin filament or stalk.

Sequencing

Determination of order of nucleotides (base sequences) in a DNA or RNA molecule or the order of amino acids in a protein.

The X or Y chromosome in human beings that determines the sex of an individual. Females have two X chromosomes in diploid cells; males have an X and a Y chromosome. The sex chromosomes comprise the 23rd chromosome pair in a karyotype.

Shotgun method

Sequencing method that involves randomly sequenced cloned pieces of the genome, with no foreknowledge of where the piece originally came from. This can be contrasted with "directed" strategies, in which pieces of DNA from known chromosomal locations are sequenced. Because there are advantages to both strategies, researchers use both random (or shotgun) and directed strategies in combination to sequence the human genome.

Shuttle vector

A vector that can replicate in the cells of more than one organism (e.g. YAC vector in *E.coli* and in yeast).

Single nucleotide polymorphism (SNP)

DNA sequence variations that occur when a single nucleotide (A, T, C, or G) in the genome sequence is altered.

Single-gene disorder

Hereditary disorder caused by a mutant allele of a single gene (e.g., Duchenne muscular dystrophy, retinoblastoma, sickle cell disease).

See also: polygenic disorders

Site-directed mutagenesis

Technique Biotechnologist use to create mutation selectively, rather than that which occurs randomly in nature. Using this technique amino acids can be substituted in the expressed proteins making them more stable or functionally better.

Somatic cell

Any cell in the body except gametes and their precursors.

Southern blotting

Transfer by absorption of DNA fragments separated in electrophoretic gels to membrane filters for detection of specific base sequences by radio-labeled complementary probes.

Transgenic

An experimentally produced organism in which DNA has been artificially introduced and incorporated into the organism's germline.

See also: cell, DNA, gene, nucleus, germ line

Transposable element

A class of DNA sequences that can move from one chromosomal site to another.

Transformation

Most common method to introduce rDNA into living cells. In this procedure, bacterial cells take up DNA from the surrounding environment. Many host cell organisms such as *E. coli*, yeast and mammalian cells do not readily take up foreign DNA and have to be chemically treated to become competent to do so. In 1970, Mandel and Higa found that *E. coli* cells become markedly competent to take up external DNA when suspended briefly in cold calcium chloride solution.

CaCl_2 known to increase the efficiency of DNA uptake to produce transformed bacterial cells. The divalent Ca^{2+} ions supposedly create transient pores on the bacterial cell wall by which the entry of foreign DNA is facilitated into the bacterial cells.

Transfection

Another method to transfer rDNA into host cells involves mixing the foreign DNA with charged substances like calcium phosphate, cationic liposomes or DEAE dextran and overlaying on recipient animal cells.

Vector

DNA molecule, capable of replication in a host organism, into which a gene is inserted to construct a recombinant DNA molecule.

Western blot

A technique used to identify and locate proteins based on their ability to bind to specific antibodies.

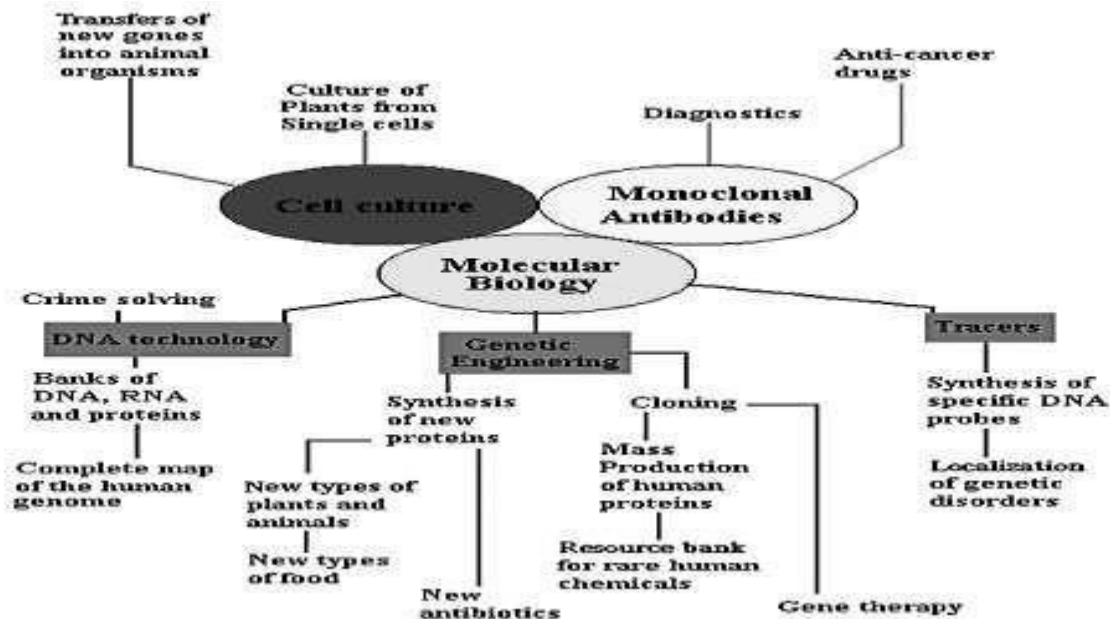
See also: DNA, Northern blot, protein, RNA, Southern blotting

Yeast artificial chromosome (YAC)

Constructed from yeast DNA, it is a vector used to clone large DNA fragments.

See also: cloning vector, cosmid

Outline of molecularbiology



Test Questions

1 Mark Questions

- 1) What is biotechnology?
- *2) Define plasmid.
- *3) What are molecular scissors?
- *4) What do you mean by recognition sequence?
- *5) Which enzymes act as molecular glue?
- *6) What is elusion?
- 7) What are cloning vectors?
- 8) Name the sequence within a cloning vector from where the replication commences.
- *9) Mention the bacteria that acts as natural genetic engineer.
- 10) Name any two processes by which alien DNA is introduced into the host cell.
- 11) Expand the term PCR.
- *12) Name the microorganism from which the thermostable DNA polymerase required for PCR is obtained?
- 13) What is a bioreactor?
- *14) What are the two main processes involved in downstream processing?
- 15) Do eukaryotic cells have restriction endonucleases? Justify your answer.

HINTS:

- 1) Large scale production and marketing of products and processes using living organisms, cells or enzymes.
- 2) Autonomously replicating circular , extra-chromosomal bacterial DNA used in gene manipulation.
- 3) Restriction enzymes.
- 4) Restriction endonucleases always cut DNA at a specific point by recognizing a specific sequences of base pair known as recognition sequence.
- 5) DNA ligases
- 6) The ultimate step in the separation and isolation of DNA fragments through gel electrophoresis in which separated bands of DNAs are cut out from the gel and extracted from the gel piece.

7) Cloning vectors are extra-chromosomal 'replicons' of DNA which can be isolated and can replicate independently of the chromosome. DNA of interest can be cloned into the vector and replicated in host cells

8) ORI point

9) *Agrobacterium tumefaciens*

10) Microinjection, biolistics (gene gun)

11) Polymerase Chain Reaction 12) *Thermus aquaticus*

13) Large scale biotechnological product involves the use of bioreactor.

14) Separation and purification

15) Eukaryotic cells have no restriction enzyme. It is present in prokaryotic cell (like bacteria)

where

these act as defense

2-Marks Questions

1) Enlist the core techniques that pave the way for modern biotechnology.

*2) What is gene cloning?

**3) Mention the three steps involved in genetically modifying an organism.

4) Why do bacteria possess restriction enzyme?

**5) Mention one basic difference between restriction endonucleases and exonucleases.

3Marks Questions:

*1) Enlist the major steps in recombinant DNA technology.

2) Mention the steps involved in the separation and isolation of DNA fragments through agarose gel electrophoresis.

***3) Describe in brief the principle of DNA isolation through gel electrophoresis.

4) Highlight the salient features that are required to facilitate cloning into a vector.

**5) Enumerate the major steps for isolation of DNA.

*6) Draw a neat, labeled diagram of (a) simple stirred tank bioreactor/ (b) sparged tank bioreactor. 7) What do you mean by replica plating?

8) What are the uses of embryonic stem cells?

Answers:

1) R-DNA Technology:

Restriction enzyme cuts double stranded DNA at its particular recognition sequence. The cuts produce DNA fragments with cohesive ends

DNA from a plasmid was also cut by the same restriction enzyme

When two of the above mentioned DNA come together they can join by base pairing.

DNA ligase enzyme used to unite the backbones of the two DNA fragments, producing R-DNA

2) Agarose gelelectrophoresis:

3) DNA When charged molecules are placed in an electric field, they migrate toward either the positive or negative pole according to their charge. In contrast to proteins, which can have either a net positive or net negative charge, nucleic acids have a consistent negative charge imparted by their phosphate backbone, and migrate toward the anode DNA is electrophoresed through the agarose gel from the cathode (negative) to the anode (positive) when a voltage is applied, due to the net negative charge carried on DNA

4) Salient features of a DNA cloning Vectors:

|| Size: small enough to be easily separated from the chromosomal DNA of the host bacteria.

|| Ori site; must have the site for DNA replication that allows the plasmid to replicate separately from the

host cell's chromosome.

Multiple Cloning sites: a stretch of DNA with recognition sequence for many different common restriction enzymes.

Selectable marker genes

RNA polymerase promoter sequence

5) Major steps for isolation of DNA: Cell containing DNA is treated with lysozyme/cellulose/chitinase
DNA along with RNA, Protein, lipid are released

Treatment with RNAase, protease to remove RNA and Protein

Appropriate treatment to remove other impurities

Addition of chilled ethanol to get precipitation of purified DNA

6) Consult NCERT Textbook page number 204

5-Marks Questions:

1) ***What do you mean by PCR? Briefly enumerate the major steps of PCR. Mention the utility of PCR.

2) What are the problems of using prokaryotic host like *E.coli* for production of eukaryotic proteins?

Previous years CBSE Questions-Solved

1. Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally? (CBSE 2014,)

Ans. - Alien DNA must be linked to *ori* or origin of replication site to start replication.

1. Name the source of the DNA polymerase used in PCR technique. Mention why it is used. (CBSE 2013,)

Ans. - The source is the bacterium *Thermus aquaticus*. It is used because it is thermostable and do not denature at high temperatures.

2. Write any four ways used to introduce a desired DNA segment into a bacterial cell in recombinant technology experiments. (CBSE 2013)

Ans. - (i) The desired DNA segment is inserted into a cloning vector and the bacterial cell can be made to

take it up after making them competent by treating them with specific concentration of divalent cations such as calcium.

(ii) Microinjection

(iii) Biolistics

(iv) Disarmed pathogen vector

1. What is cistron? (CBSE 2015)

Ans. - A segment of DNA, Coding for polypeptide.

2. Why do children cured by enzyme-replacement therapy for adenosine deaminase deficiency need periodic treatment? (CBSE 2015)

Ans. - As this therapy does not cure the disease completely.

Additional Test Questions

1. Describe the role of CaCl_2 in the preparation of competent cells?

Ans. - Increases the permeability of cell membrane.

2. For selection of recombinants, insertional inactivation of antibiotic marker has been superseded by insertional inactivation of a marker gene coding for a chromogenic substrate. Give reasons.

Ans. - Helps in the selection of recombinants from non-recombinants

3. Illustrate the design of a bioreactor. Highlight the difference between a flask in your laboratory and a bioreactor which allows cells to grow in a continuous culture system.

Ans. - Design of Bio-reactor.

It has more controlled conditions.

Chapter-12 BIOTECHNOLOGY & ITS APPLICATION

Biotechnology is making Genetically modified organisms-microbes, plants, animals for industrial production of Bio-Pharmaceuticals and other useful products.

Applications –

- i) Diagnostic & therapeutic
- ii) Genetically modified crops
- iii) Waste treatment
- iv) Energy production
- v) Food processing
- vi) Bioremediation

Application in agriculture

Genetically modified organisms (GMO)-Plants, bacteria, fungi, animals.whose genes are altered by manipulation.

Transgenic crops(GMO) -Crops contain or express one or more useful foreign genes.

Advantages -i) More tolerant to stresses (heat, cold, draught).

ii) Pest resistant GM crops, reduce the use of Chemical pesticides. Eg-BT-Cotton

iii) Reduced post harvest losses. Eg- Flavr savrtomato.

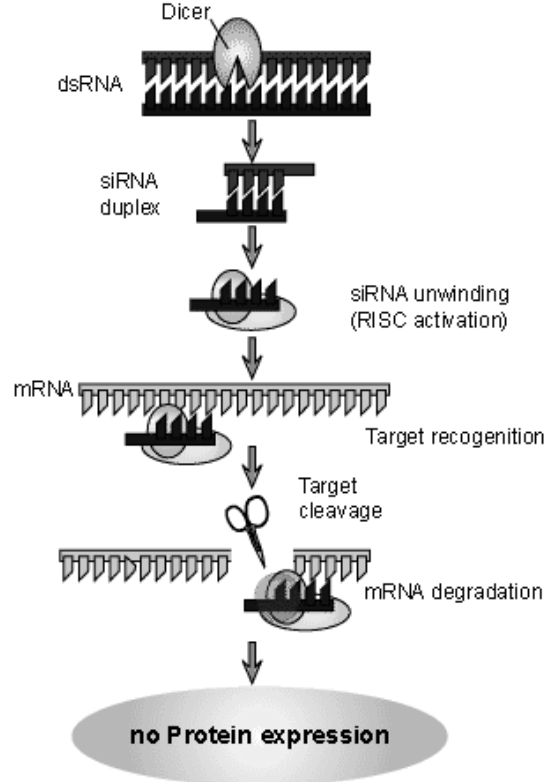
iv) Enhance nutritional value of food. eg.- Golden Rice (Vitamin A enriched).

v) Increased efficiency of mineral use.

PEST RESISTANT PLANTS

Bt- cotton -- BT stands for *Bacillus thuringiensis* (Soil Bacteria). Bacterium produces proteins (Crystal Protein-*cry* I AC, *cry* II AB). A crystalline insecticidal protein that kills the insects.Hence *cry*-Genes have been introduced in plants to produce crystal proteins as Protoxin (inactive toxin), which is converted to toxins in alkaline medium (i.e. in the gut of insects) and cause death of the insect larva.

Protection of plants against nematodes –Nematode, *Meloidogyne incognita* infects tobacco plants & reduces yield. Specific genes (DNA) from nematodes introduced into the plants using *Agrobacterium tumifecians* (soil bacteria). Genes produce sense and antisense complementary RNA. Act as dsRNA and initiates RNAi (RNA interference) and silences the specific mRNA. Complementary RNA neutralizes the specific RNA of nematodes by a process called RNA Interference and parasite cannot live in transgenic host.



In medicine- genetically engineered insulin—

rDNA technology was applied in therapeutic application by generating genetically engineered insulin for man. In 1983, Eli Lilly, an American company prepared 2 DNA sequences coding for chains A & B.

Human insulin consists of two short Polypeptide chains A & B being linked by disulphide bridges. In man, Insulin secreted as Prohormone containing C peptides that is removed during maturation.

In rDNA technique, insulin could be generated by preparing two separate DNA sequences of A & B chain which are incorporated into plasmids of E. coli to produce insulin chains.

Gene therapy

- Gene therapy involves correction of the gene defects in child or embryo.
- Adenosine deaminase deficiency is a kind of immuno-disorder caused by deletion of gene coding for ADA.
- It can be cured by bone marrow transplantation or enzyme replacement therapy.
- A functional ADA-cDNA (through Retrovirus) is introduced in lymphocyte culture for genetic infusion and transferred to the patient body for normal functioning.

Molecular diagnosis --

Early & accurate detection of diseases substituting conventional diagnostic techniques may be done by following methods:

PCR (Polymerase chain reaction): Short stretches of pathogenic genome is amplified for detection of suspected AIDS, Cancer or genetic disorder.

ELISA (Enzyme Linked Immunosorbent Assay) used to detect AIDS based on detection of antibodies produced against antigen of pathogen.

Transgenic Animals

Animals with manipulated genes or a foreign gene to be expressed are called as transgenic animals.

They are useful-

1. To know how genes contribute to development of disease.

2. To use proteins for treatment of disease.
3. To verify vaccine and chemical safety.

Biopiracy -- Some organizations and multinational companies exploit or patent bioresources of other nations without proper authorization. Indian patent bill is there to prevent such unauthorized exploitation.

GEAC- For validity of GM research and the safety of introducing GM organism

Three mark question

1) What is the main advantage of producing genetically engineered insulin?

Ans- i) Produces only A&B peptides ii) No C-Peptides produced iii) No need to remove C-Peptides during maturation.

2) What are the advantages of Molecular diagnosis technique?

Ans- i) Accurate ii) disease can be detected at very early stage iii) Can be diagnosed even if the number of pathogens is very low.

3) What are the potential risks (Three) of using GM food?

Ans – Potential risks- i) Products of transgene - allergic or toxic ii) Cause damage to natural environment iii) Weeds also become resistant iv) Can endanger native species

4) What is hirudin? How do you get it?

Ans- Anti coagulant obtained from transgenic Brassica napus.

5) How does agro bacterium help to increase Tobacco production?

Ans – i) Introduction of Nematode specific gene. ii) Production of dsRNA (Sense and anti-Sense)

iii) Silence specific mRNA.

6) Why do farmers face the problems in Agro chemical based farming?

Ans – i) Too expensive ii) Conventional breeding procedure do not ensure increased production.

7) Why should farmers in India cultivate GM crops?

Ans - Tolerant to stress, pest resistant, less post-harvest losses, increased mineral use efficiency.

Five mark question

***1) Explain the steps involved in the production of genetically engineered insulin?

Ans- i) Human insulin consists of 51 amino acids arranged in chains of A and B bearing 21 and 30 a. a respectively interconnected by disulphide bridges.

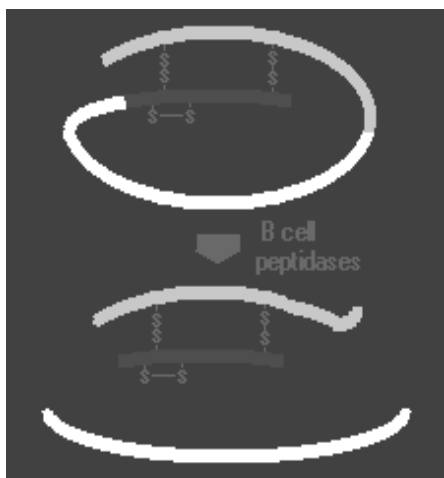


Diagram- Maturation of proinsulin into insulin after removal of c- peptide

- ii) Insulin synthesized as prohormone has extra c -peptide which is removed during maturation.
- iii) In 1983 , Eli Lilly, American company prepared two DNA sequences similar to A and B chains of human insulin(humulin).
- iv) Chain A and B extracted and combined by creating disulphide bonds.

Keywords of the chapter

Genetically Modified Organism(GMO), Bt cotton, insecticidal proteins, cry genes, pest resistant plants, RNA interference(RNAi)/RNAsilencing, dsRNA, Genetically engineered insulin, gene therapy, ADA deficiency , c DNA, Molecular diagnosis, transgenic animals, Bio ethics, Genetic Engineering Approval Committee(GEAC), Bio piracy, Indian patent bill.

CHAPTER 12: (HOTS QUESTIONS)

*1.Name the disease in plants caused by Ti Plasmid?

Crown gall disease.

2. What is the main objective of Gene therapy in biotechnological techniques?

Gene therapy involves replacement of defective genes by normal genes.

3.Which organism is considered as Natural genetic engineer?

Agrobacterium tumefaciens.

**4.Which kind of bioweapon is most widely used ?

Bacillus anthracis.

**5.What is the main objective of herbicide resistant GM crop ?

It effectively eliminates the weeds without involving manual labour .

6. From which species is human insulin commercially produced?

Escherichia coli

7.Gene medicine refers to use of gene manipulation technology to ameliorate or even permanently cure diseases in human. Name the technique.

Gene therapy

8.The bacterium *Bacillus thuringiensis* provides the major source of insect resistant gene-clarify.

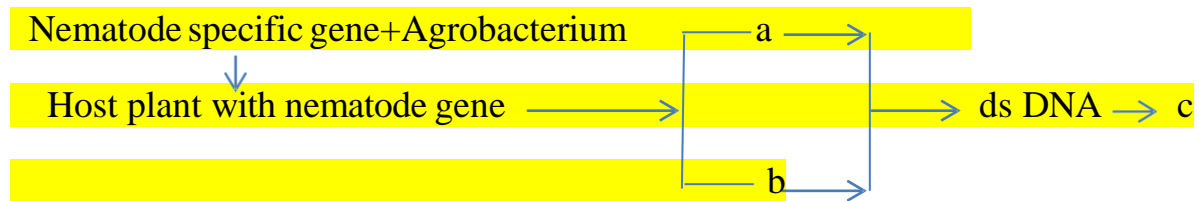
Produces insecticidal protein i.e. 'cry protein' that kills certain insect pests.

The gene encoding for ' cry protein' is isolated from bacteria & incorporated in major crop plants as bio-pesticides.

9.'RNAsilencing is a form of genomic defense'. Elucidate the statement taking *M. incognitia* as an example.

RNA-interference technique is adopted to prevent infestation of nematode *M. incognitia* in the roots of Tobacco plants .Nematode specific genes introduced into host plants by complementary ds RNA developed through ‘transposons’ .

10. Identify a, b, c from the table given below:



a)sense RNA b) Anti sense RNA c)silencing mRNA

LIST OF TRANSGENIC PLANTS & ITS USES

Sl. No.	Transgenic plants	Application
01.	Bt Cotton	Pest resistant(Cotton bollworm) , Herbicide tolerant, High yield
02.	Flavr Savr Tomato	Improved nutrient quality(Increased solid nutrient)
03.	Potato	Increased nutritional quantity(Starch content)
04.	Brassica napus	Hirudin protein prevents blood clotting
05.	Golden Rice	Enriched in Vitamin-A(B-carotene)
06.	Wheat	Herbicide resistant
07.	Maize	Herbicide resistant
08.	Corn	Insecticide resistant

LIST OF TRANSGENIC MICROORGANISMS & ITS USES

Sl. No.	Transgenic microorganisms	Application
01.	<i>Bacillus thuringiensis</i>	Produces cry protein as plant insecticide
02.	<i>Escherichia coli</i>	Produces human insulin, interferons, interleukin
03.	<i>Pseudomonas fluorescens</i>	Prevents frost damage of fruits
04.	<i>Pseudomonas putida</i>	Scavenging of oil spillage.
05.	<i>Rhizobium meliloti</i>	Nitrogen fixation by Nif gene
06.	<i>Trichoderma</i>	Biocontrol of fungal diseases in plants.
07.	<i>Trametes</i>	Removal of lignin from wood pulp.

PREVIOUS YEARS CBSE QUESTIONS

1. State the role of C peptide in human insulin. (CBSE 2014)

Ans. - C-peptide (extra stretch of polypeptide) makes the insulin inactive.

- 2 . How have transgenic animals proved to be beneficial in:

(a) Production of biological products

(b) Chemical safety testing

(CBSE 2014)

Ans. - (a) Rosie—the transgenic cow, produced human proteins containing human α -lactalbumin

Transgenic animals have been made to produce 2- 1-antitrypsin used to treat emphysema.

(b) Toxicity testing – Transgenic animals are more sensitive to toxic substances, so the results are obtained in less time.

3. State the role of transposons in silencing of mRNA in eukaryotic cells. (CBSE 2013)

Ans. - Transposons or mobile genetic elements in viruses are the sources of the

complementary dsRNA,

which in turn bind to specific mRNA and cause RNA interference of the parasite.

4. Name the pest that destroys the cotton bolls. Explain the role of *Bacillus thuringiensis* in protecting the cotton crop against the pest to increase the yield. (CBSE 2013,)

Ans. - Cotton bollworms destroy the cotton bolls. *Bacillus thuringiensis* has Bt toxin genes. These genes produce toxic proteins that kill the pests. Bt toxins are initially inactive protoxins but after ingestion by the insect their inactive toxin becomes active due to the alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells thus killing the insects. Specific Bt toxins were isolated from *Bacillus thuringiensis* and incorporated into the cotton plants to make them pest resistant.

3. How did an American company, Eli Lilly use the knowledge of r-DNA technology to produce human insulin? (CBSE 2015)

Ans. - Two chains of DNA sequence corresponding to A & B chains of human insulin prepared, introduced them into plasmids of E. coli to produce separate A & B chains, A & B chains extracted combined by creating disulphide bonds.

5. Why is proinsulin so called? How is insulin different from it? (CBSE 2013)

Ans. - Proinsulin is called so because it is an inactive form of insulin.

Insulin	Proinsulin
1. It is made up of two short polypeptide chains A and B linked by disulphide bridges.	1. Along with the two polypeptide chains in insulin. It contains an extra stretch called C peptide.
2. It is functional.	2. It is non-functional.

Additional Test Questions

1. Discuss the advantages of GMO.

Ans. - It helps to produce plants resistant to Biotic and Abiotic agents.

2. Ignoring our traditional knowledge can we prove costly in the area of biological patenting? Justify.

Ans. - Patenting helps in making biological experiments regulated.

3. When a foreign DNA is introduced into an organism, how is it maintained in the host and how is it transferred to the progeny of the organism?

Ans. - The ori helps to do so.

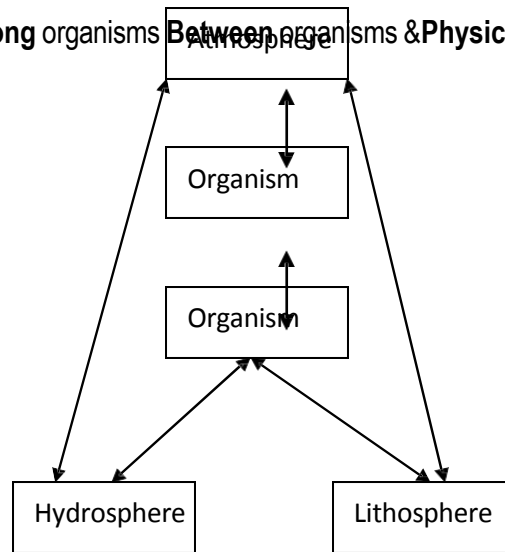
4. List the disadvantages of insulin obtained from the pancreas of slaughtered cows and pigs.

Ans. - Causes allergic reactions.

Chapter 13 ORGANISMS AND POPULATIONS

Ecology

It deals with the interaction **Among** organisms **Between** organisms & **Physical** environment.

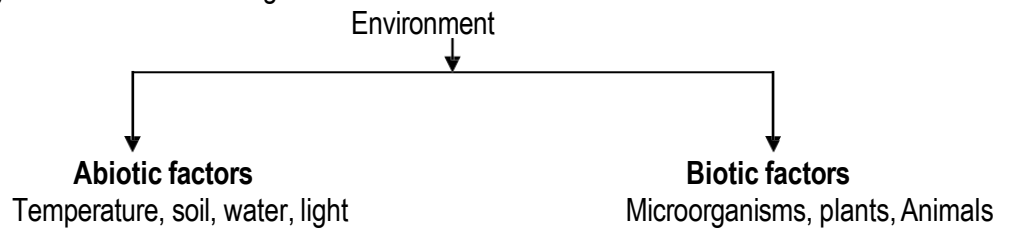


Biome

Biome: the largest ecological regions distinguishable by characteristic plants and animals.

There are six Biomes : tundra, conifer, deciduous forest, grassland, tropical, and desert. Biomes are subdivided into associations made up of societies.

Environment simply means the surrounding



Temperature

Average temperature varies seasonally

Organisms may be Eurythermal or Stenothermal

Eurythermal- **wide range** of temperature tolerance

Stenothermal- **Narrow range** of temperature tolerance

Water

Influences life of organisms. No life without water.

Productivity and distribution of plants are water dependent.

Organisms may be Euryhaline or Stenohaline.

Euryhaline- **Wide range** of salinity tolerance

Stenohaline- **Narrow range** of salinity tolerance.

Light

Photosynthesis and release of oxygen light dependent.

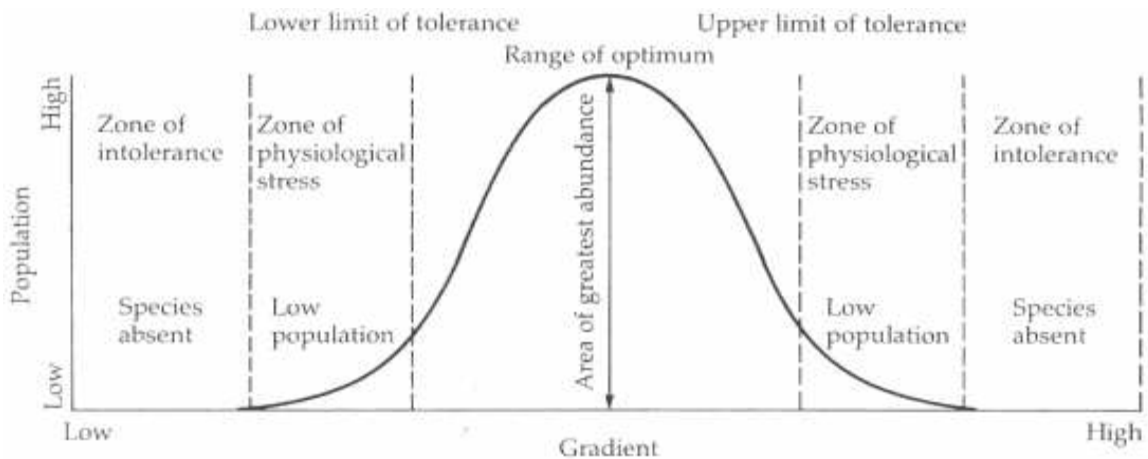
Sciophytes need to use diurnal and seasonal light intensity of forage, migration and reproduction.

Soil

Nature and proportion of soil in a place depends on climate, weathering process and types of soil.

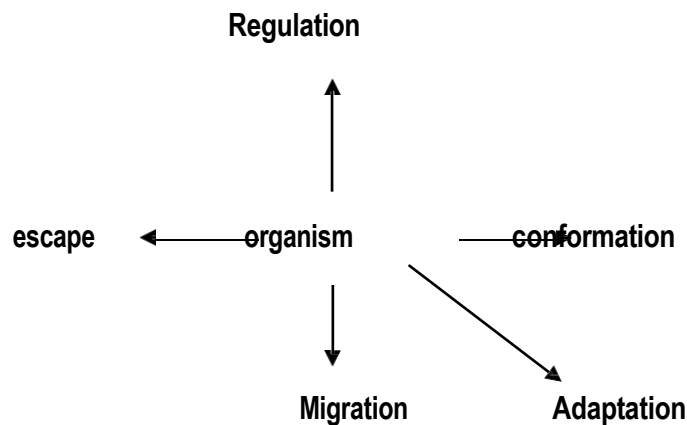
Soil composition, grain size and aggregation determine percolation and water holding capacity of soil.

Physical and chemical properties determine type of plants and Animals that survive in a habitat.



Graph showing abundance of species w.r.t. low and high limits of abiotic factor e.g. temperature or salinity etc.

Response to environmental condition



Regulation

Organisms maintain homeostasis achieved by physiological and behavioral means

Thermo regulation and osmoregulation.

Conformation

Cannot maintain constant internal Environment

Body temperature and osmotic concentration of body changes with ambient temperature and concentration of medium.-Thermo conformer and osmo conformer

Migration

Organism moves away temporarily to another habitat in stressful condition.

e.g. - Migratory birds like Siberian crane

Suspension

Organisms suspend their metabolic activities during stressful condition

Resume their function at the return of favorable conditions.

E.g. **Hibernation** (winter sleep) of Frog, Reptiles, Polar Bear etc

Aestivation (summer sleep) in Snail and Fish.

Seed dormancy.

Adaptation

Morphological, physiological and behavioral changes that enable organisms to adjust to the ever changing environment .

Kangaroo rat survives in desert conditions through internal oxidation of fat, removing concentrated urine of limited quantity.

Allen's rule-cold climate mammals have shorter ears and limbs to minimize heat loss.

Polar mammals like seals have **blubber** to prevent heat loss.

Burrowing habit to escape from heat

Higher count of RBC, Hb (haemoglobin) at high altitudes.

Population attributes

*Birth Rate – Number of individuals born per thousand per year.

*Death Rate – Number of individuals die per thousand per year.

*Sex Ratio – Ratio of male-female in the population.

*Population density. - the number of individual organisms per unit area (appropriate measure – total number-sometimes difficult to determine or meaningless because 4 factors **N+I-M+E** are concerned w.r.t habitat concerned)

Age pyramids

Three ecological ages:

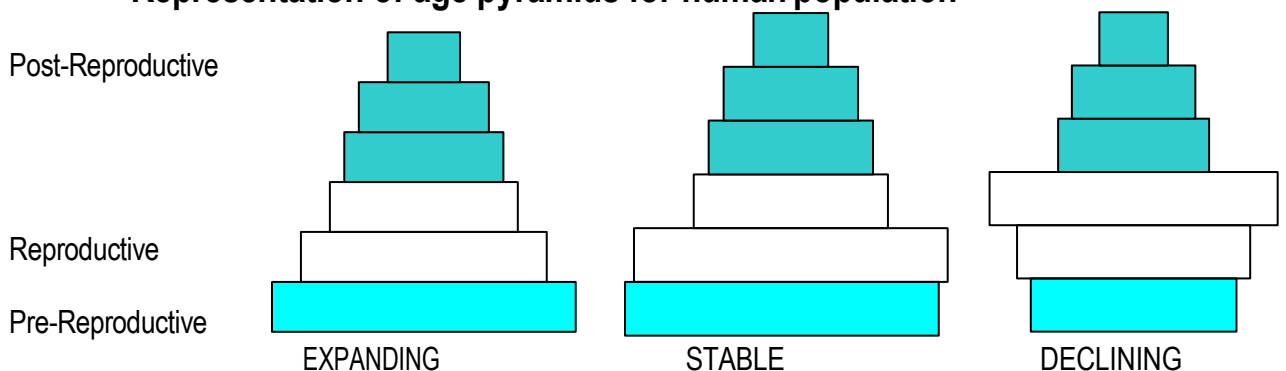
Pre-reproductive, Reproductive and Post-Reproductive

High proportion pre-reproductive individuals occur in **Expanding** population

Pre-reproductive individuals are uniform in **Stable** population.

Pre-reproductive individuals are less in **Declining** population.

Representation of age pyramids for human population



Population growth

Factors that affect the size of population

Food availability

Weather

Predation pressure

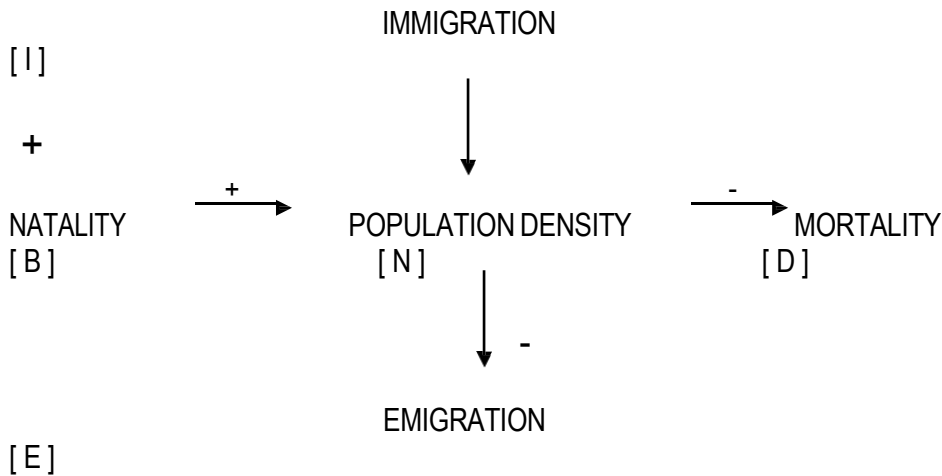
Competition

Density of population at any time at a given place depends on

Natality, Mortality, Emigration Immigration

Population growth models

Factors that affect population density



The characteristics of populations are shaped by the interactions between individuals and their environment

- Populations have size and geographical boundaries.
 - The **Density** of a population is measured as the number of individuals per unit area.
 - The **Dispersion** of a population is the pattern of spacing among individuals within the geographic boundaries.
- **MEASURING DENSITY**
- **Density – Number of individuals per unit of area.**
- **Population will grow if $B+I > D+E$**
- **Population will shrink if $B+I < D+E$**
- **Population will be in equilibrium if $B+I=D+E$**

(1) Population

- (a) A population in an ecological sense is **a group of organisms, of the same species**, which roughly occupy the **same geographical area** at the **same time**

(2) Population size

- (a) A population's size depends on how the population is defined
- (b) If a population is defined in terms of some degree of reproductive isolation, then that population's size is the **size of its gene pool**

- (c) If a population is defined in terms of some geographical range, then that population's size is the **number of individuals living in the defined area**

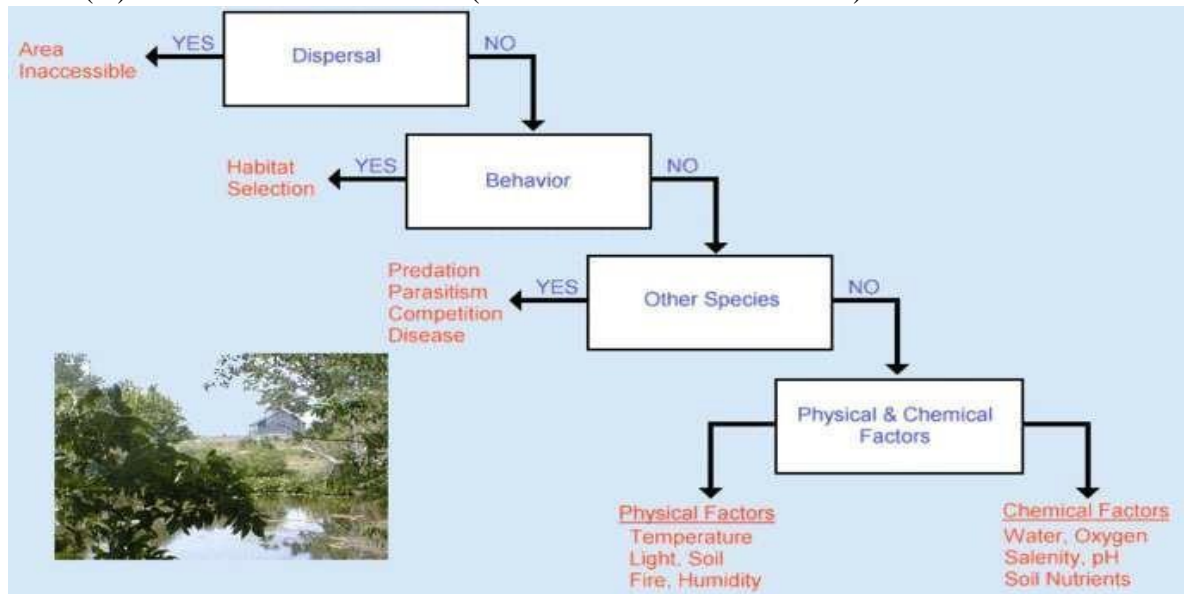
(3) Population density

- (a) Given that a population is defined in terms of some natural or arbitrarily defined geographical range, then population density may be defined as simply **the number of individual organisms per unit area**

(b)

(4) Patterns of dispersion

- (a) Individual members of populations may be distributed over a geographical area in a number of different ways including
- (i) Clumped distribution (attraction)
 - (ii) Uniform distribution (repulsion)
 - (iii) Random distribution (minimal interaction/influence)



Types of population interactions

INTERACTION	SPECIES – all	SPECIES – bII
Mutualism	+	+
Predation	+	-
Parasitism	+	-
Commensalism	+	0
Competition	-	-
Ammensalism ↓	-	0

Mutualism Both species benefited.

Lichens Relationship between Non-photosynthetic Fungi and photosynthetic Algae or Cyanobacteria.

Mycorrhiza Association between Fungi and Higher Plants like Pinus.

Plants and insects for pollination

Orchid ophrys and male bee a good example for co-evolution of plants and animals.

PREDATION

One species gets benefited and the other harmed.

Tiger and Deer

Snake and Frog
Herbivores and plants

Competition

Both the species are harmed.

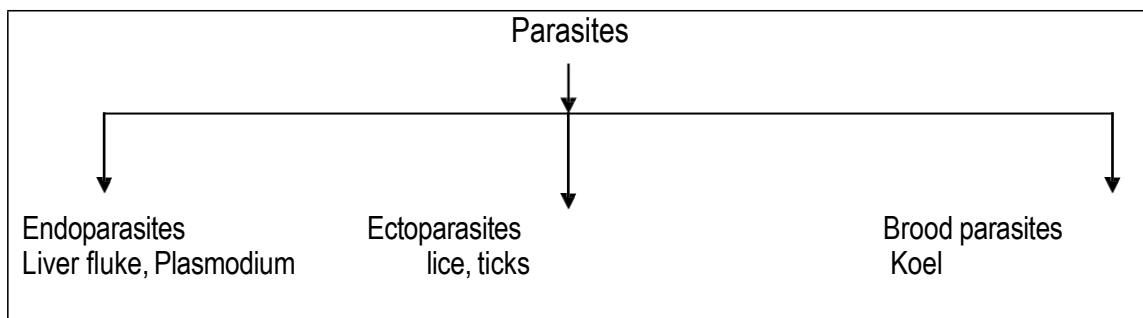
Flamingoes and resident fishes compete for the common food zooplankton in South American lakes.

Abington Tortoise and goats in Galapagos Islands for food.

Gause's Competitive Exclusion Principle -Two closely related species competing for the same resource cannot co-exist indefinitely and the competitively inferior one will be eventually eliminated.

Parasitism

One species gets benefit and the other is harmed.



Adaptations of parasites

- # Loss of sense organs
- # Presence of adhesive organs or suckers
- # Loss of digestive system
- # High reproductive capacity.

Ammensalism

One species hurts the other but the other is not affected.

Penicillium secretes Penicillin and kill Bacteria but by this Penicillium does not benefit.

Algal bloom leads to death of fishes, but the death of fishes is of no use to the algal bloom.

Commensalism

One species benefits and the other neither harmed nor benefited.

The cattle egret catches the insects disturbed by moving cattle, but the cattle neither harmed nor benefited.

Another example

Clown fish gets protection from predators by close association with sea anemone, but the sea anemone is not affected.

SHORT TEST QUESTIONS (HOTS)

1. Why is temperature considered to be the most relevant abiotic factor that influences the life of organisms?

- Because it affects the enzyme activity.

2. During global warming which type of organism can cope up better – Eurythermal or stenothermal? Why?

- Eurythermal as it can tolerate wide range of temperature.

3. Why does the logistic growth curve becomes S shaped?

- Sigmoid curve, population becomes stable due to environmental resistance.

Short answer type questions (3 marks)

*1. What is brood parasitism? Give an example. What adaptation has evolved in this phenomenon?

Ans. One species lays eggs in the nest of another bird, lets the host incubate them. e.g. Cuckoo lays eggs in the nest of a crow.

The Eggs of the parasite resemble the eggs of the host in colour, size. Reduce chances of the host bird detecting the foreign eggs and ejecting them from nest.

**2. Name and explain the kind of interaction in the following.

Ans. 1. Algae and Fungi in Lichens

2. Head Louse Humans

3. Hermit Crab and Sea Anemone

(i) Interaction of mutualism where the two species are equally benefited. Fungus provides protection, helps in absorption of water and minerals, Algae provide food for the Fungus.

(ii) This is case of Parasitism where the louse is an ectoparasite. Parasite takes shelter on humans and also derives nutrition.

(iii) It is commensalisms where one species is benefited and the other is neither benefited nor affected. Sea Anemone is benefited as it does not have to move to places rich in nutrients, while hermit crab is neither benefited nor harmed.

***3. How does Ophrys get pollinated by bees?

Ans. 1. Sexual deceit.

2. One petal resembles female.

3. Male pseudocouplates with the flower.

4. Pollen grain transferred from one flower to another.

4. Biomass is a more meaningful measure of population size. Explain with an example.

Ans. (i) Population large Total number is not an easily adoptable measure. Counting takes long time or practically impossible

(ii) There is no need to know the absolute population size for some investigations.

(iii) Number may sometimes be misleading eg. In a given area there are 200 *Parthenium* plants and a single banyan tree. Here biomass size of the banyan tree is much more than those of 200 *Parthenium* plants.

**5. Give example of how plant protects themselves from the predators.

Ans. (i) Thorns.eg. – Rose, babool etc.

(ii) Chemicals that can kill the animals. eg.- Calotropis etc.

*6. What is interference competition? Define competitive exclusion principles.

Ans. (i) Feeding efficiency may be reduced due to interference of another species. eg. –Tiger and deer.

(ii) Two closely related species need same resource cannot co-exist indefinitely.

(5 Marks) Questions:

***1. What are the different types of population growth pattern? Mention their differences.

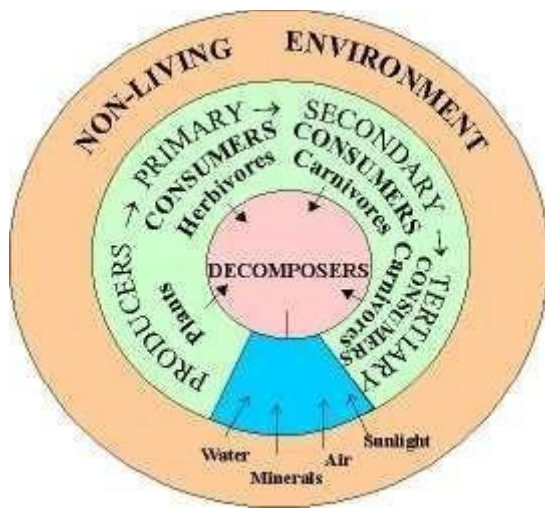
Ans: a. Logistic and Exponential growth

b. S Shaped curve, J shaped curve. Limiting Factors, No-limiting Factors

***2. With the help of age pyramids explain the nature of a population.

Ans: a. Pre-reproductive/ re-productive/ post-reproductive

b. increasing population/ stable population/ declining population



The country has 10 different biogeographic zones and 26 biotic provinces.

o. Biogeographic zones

Biotic provinces

- | | |
|---------------------|--|
| 1. Trans-Himalaya | Ladakh mountains, Tibetan plateau |
| 2. Himalaya | Northwest, West, Central and East Himalayas |
| 3. Desert | Thar, Kutch |
| 4. Semi-arid | Punjab plains, Gujarat Rajputana |
| 5. Western Ghats | Malabar plains, Western Ghats |
| 6. Deccan Peninsula | Central highlands, Chotta-Nagpur, Eastern highlands, Central Plateau, Deccan South |
| 7. Gangetic plains | Upper and Lower Gangetic plains |
| 8. Coast | West and East coast, Lakshadweep |
| 9. North-East | Brahmaputra valley, Northeast hills |
| 10. Islands | Andaman and Nicobar |

Source: Wildlife Protected Area Network in India: A Review, Wildlife Institute of India, 2000.

The exponential model of population describes an idealized population in an unlimited environment

- We define a change in population size based on the following verbal equation.

Change in population size during time interval = Births during time interval – Deaths during time interval

- Using mathematical notation we can express this relationship as follows:
 - If **N** represents **population size**, and **t** represents **time**, then ΔN is the **change in population size** and Δt represents the **change in time**, then:
 - $\Delta N/\Delta t = B-D$
 - Where **B** is the **number of births** and **D** is the **number of deaths**
 - We can simplify the equation and use **r** to represent the difference in per capita birth and death rates.
 - $\Delta N/\Delta t = rN$ OR $dN/dt = rN$
 - If **B = D** then there is **zero population growth (ZPG)**.
 - Under ideal conditions, a population grows rapidly.

- **Exponential population growth** is said to be happening
- Under these conditions, we may assume the maximum growth rate for the population (r_{max}) to give us the following exponential growth
- $dN/dt = r_{max}N$

The logistic model of population growth incorporates the concept of carrying capacity

- Typically, unlimited resources are **rare**.
 - Population growth is therefore regulated by **carrying capacity** (K), which is the maximum stable population size a particular environment can support.

POPULATION GROWTH RATE

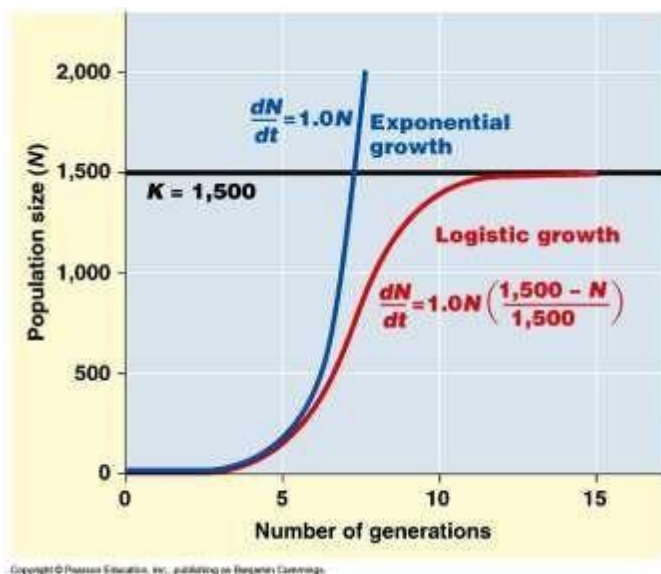
LOGISTIC GROWTH RATE

Assumes that the rate of population growth slows as the population size approaches carrying capacity, leveling to a constant level.

S-shaped curve

CARRYING CAPACITY

The maximum sustainable population a particular environment can support over a long period of time.



Population growth

- The simplest case of population growth is that which occurs when there exists no limitations on growth within the environment
- In such situations two things occur
 - The population displays its **intrinsic rate of increase**
 - The population experiences **exponential growth**

Intrinsic rate of population increase (r_{max})

- Intrinsic rate of **population** increase is the rate of growth of a population when that population is growing under ideal conditions and without limits, ie.as fast as it possibly can
- This rate of growth implies that the difference between the **birth rate** and **death rate** experienced by a population is maximized

- (e) However, a population that is not growing maximally can still experience **exponential growth**
- (f) "A population with a higher intrinsic rate of increase will grow faster than one with a lower rate of increase. The value of r_{max} for a population is influenced by life history features, such as age at the beginning of reproduction, the number of young produced, and how well the young survive."

(24) Exponential growth

- (a) Exponential growth simply means that a population's size at a given time is equal to the population's size at an earlier time, times some greater-than-one number
- (b) For example, if a population increased in size per unit time in the following manner: 1, 2, 4, 8, 16, 32, 64, 128, etc.
- (b) "It has been difficult to demonstrate a direct relationship between population growth rate and specific life history characteristics. Increasingly, ecologists are recognizing that most populations show a mix of the traditional r -selected and K -selected characteristics; life history evolves in the context of a complex interplay of factors."

	r Unstable environment, density independent	K Stable environment, density dependent interactions
Organism size	Small Variabl	Large constan
Energy used to make each individual	Low	High
# Offspring produced	Many	Few
Timing of maturation	Early	Late (with much parental care)
Life expectancy	Short(i.e. high mortality)	Long
Lifetime reproductive events	One	More than one
Environment	Variable and unpredictable	Constant or variable but predictable

**Model Questions with Answer
Very Short Answer – 1 Mark**

- Which are the factors responsible for the wide variety of habitat formed within each biome?
- Fresh water animals are unable to survive for long in sea water. Give reason.
- With which population growth model is the Verhulst Pearl equation associated?
- Define diapause. Which organisms exhibit it?
- Calculate the death rate if 6 individuals in a laboratory population of 60 fruitflies died during a particular week.
- In biological control method, one living organism is used against another to check its uncontrolled growth. Which kind of population interaction is involved in this?
- An organism has to overcome stressful condition for a limited period of time. Which strategies can it adopt to do so?
- What do phytophagous insects feed on?

Short Answer Type I Questions(2 Marks)

9. What are the four levels of biological organisation with which ecology basically deals?
10. Differentiate between stenohaline and euryhaline organisms.
11. List four features which enable the Xeric plants to survive in the desert conditions.
12. Mention the attributes which a population has but not an individual organism.
13. How do stenothermal organisms differ from eurythermal organisms?
14. What are the four ways through which the living organisms respond to abiotic factors?
15. Why do clown fish and sea anemone pair up? What is this relationship called?

Short Answer Type II(3 Marks Questions)

16. How does the shape of age pyramid reflect the growth status of a population.
17. Darwin showed that even a slow growing animal like elephant could reach enormous number in absence of checks. With the help of your understanding of growth models, explain when is this possible? Why is this notion unrealistic?
18. How will you measure population density in following cases?
 - (i) fish in a lake
 - (ii) tiger census in a national park
 - (iii) single huge banyan tree with large canopy.
19. Species facing competition might evolve mechanism that promotes coexistence rather than exclusion. Justify this statement in light of Gause's competitive exclusion principle, citing suitable examples.

Long Answer Type (5 Marks Questions)

20. What is altitude sickness? What its causes and symptoms? How does human body try to overcome altitude sickness?
21. Orchid flower, Ophrys co-evolves to maintain resemblance of its petal to female bee. Explain how and why does it do so?

Answer to the Questions

Very Short Answers

1. Regional and local variations
2. Due to osmotic problems.
3. Logistic Growth.
4. A stage of suspended development, zooplanktons.
5. $6/60 = 0.1$ individuals per fruitfly per week.
6. Predation.
7. (i) Migration
(ii) Suspension of active life by hibernation/aestivation/spore formation.
8. Plant sap and other parts of the plant.

Short Answers I

9. Organisms, population, communities and biomes.
10. **Euryhaline** : Organisms tolerant in wide range of salinities.
Stenohaline : Organisms tolerant to narrow range of salinities.
11. (i) thick cuticle
(ii) Stomata in deep pits
(iii) Stomata closed during day time
(iv) leaves reduced to spines (CAM photosynthetic pathway).

12. Birth rate, Death rate, Sex ratio, age groups.
13. **Eurythermal** : Organisms that can tolerate and thrive in wide range of temperatures
- Stenothermal** : Organisms restricted to a narrow range of temperature.
14. (i) Regulate (ii) Conform (iii) Migrate
(iv) Suspend
15. Clown fish lives in tentacles of sea Anemone and gets protection from predators.
Interaction - commensalism.

Short Answers II

16. Shape of pyramids reflects growth status of the population (a) growing (b) Stable (c) declining.
Refer page 227, Fig. 13.4, NCERT book, Biology - XII
17. Possible if the growth model is Exponential, *i.e.*, having unlimited resources. Its an unrealistic situation because resources are limited. Hence, it follows logistic growth model.
18. (a) fish caught per trap.
(b) number per unit area
(c) percentage cover in biomass.
19. State Gause's competitive exclusion principle. Mechanisms is resource partitioning. *E.g.*, experiment of Mac Arthur on Warblers (Refer page 325, NCERT book, Biology - XII).

Long Answers

20. Breathlessness at high attitudes.
Cause : Low atmospheric pressure at high altitudes due to which body does not get enough oxygen.
Symptoms : Nausea, fatigue and heart palpitations. Body adapts by :
(a) increasing red blood cell production
(b) decreasing binding affinity of haemoglobin
(c) by increasing breathing rate.
21. employs 'sexual deceit'
 one petal bears uncanny resemblance to female of the bee.
 Male bee is attracted to what it perceives as a female 'pseudocopulates,' during which pollen dusted on male bee's body.
 Male bee transfers pollen to another flower when the same bee pseudocopulates with another flower.
 Ophrys does so because pollination success will be reduced unless it co-evolves with female bee.

PREVIOUS YEARS CBSE QUESTIONS

1. Where would you expect more species biodiversity— in tropics or in polar regions? Give reasons in support of your answer. **(CBSE 2013, Chap. 13)**
Ans. - More biodiversity is found in the tropics. This is because tropical regions remain undisturbed from frequent glaciations as in polar regions. Also, the tropics are less seasonal/more constant.
2. "It is possible that a species may occupy more than one trophic level in the same ecosystem at the same time." Explain with the help of one example. **(CBSE 2013, Chap. 13)**
Ans. - For example, sparrow is an omnivore. When it eats seeds, fruits or any other

plant product, it occupies the primary trophic level. Whereas, when it eats worms and any other insect, it occupies the secondary trophic level. Thus, it occupies more than one trophic level in the same ecosystem.

3. (a) Write the importance of measuring the size of a population in a habitat or an ecosystem.

(b) Explain with the help of an example how the percentage cover is a more meaningful measure of population size than mere numbers.

(CBSE 2013, Chap. 13)

Ans. - (a) By measuring the size of a population, following can be predicted:

- (i) Status of the population in a habitat
- (ii) Outcome of competition with other species
- (iii) Impact of predator or pesticides
- (iv) Increase or decrease of population size. (Any two)

(b) Example: Banyan tree and *Parthenium* plants.

When 1 banyan tree is compared with 100 *Parthenium* plants, the population of banyan in terms of number is very much low as compared to *Parthenium*. But in terms of percentage cover or biomass, the banyan provides a much larger cover in comparison to 100 *Parthenium* plants. Thus, the percentage cover or biomass is a more meaningful measure of population size.

4. Differentiate between two different types of pyramids of biomass with the help of one example of each.

(CBSE 2013, Chap. 13)

Ans. -

Upright pyramid of biomass	Inverted pyramid of biomass
1. The biomass of producers is more than that of consumers.	1. The biomass of the producers (phytoplankton) is less than that of consumers (fish).
2. For example, forest ecosystem.	2. For example, aquatic ecosystem.

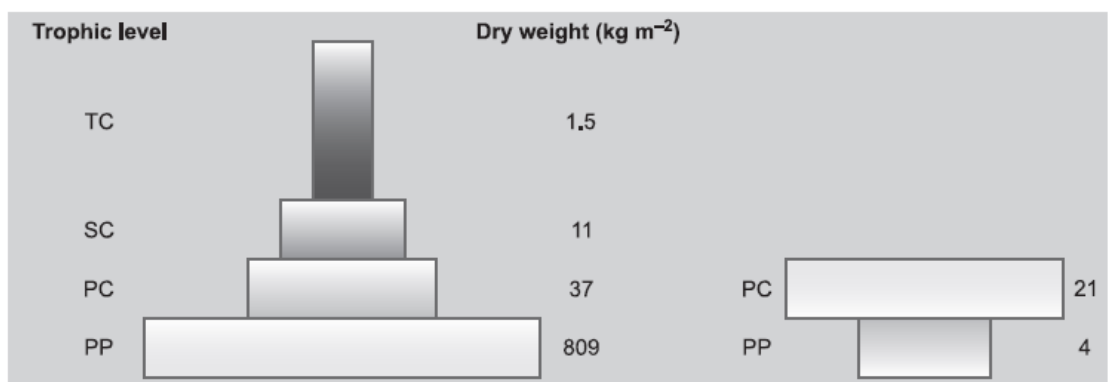


Fig. Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels

Fig. Inverted pyramid of biomass: Small standing crop of phytoplankton supports large standing crop of zooplankton

5. What is mutualism? Mention any two examples where the organisms involved are commercially exploited in agriculture. (CBSE 2015, Chap.13)

Ans. - Interaction between two species in which both are benefitted.

- (i) Rhizobium in the roots (nodules) of legumes
- (ii) Mycorrhiza / Glomus with the roots of higher plants

6. How snails, seeds, bears, zooplanktons, fungi and bacteria adapt to condition unfavorable for their survival? (CBSE 2015, Chap.13)

Ans. - Sanil-aestivation

Seeds – dormancy

Bear-Hibernation

Zooplankton -

diapause/suspended development

Fungi-Spore/Zygospore

Bacteria-Cyst/spore

7. (a) List the different attributes that a population has and not an individual organism.

(b) What is population density? Explain any three different ways the population density

can be measured, with the help of an example each. (CBSE 2015, Chap.13)

Ans. - (a) Attributes of population Birth rate, Death Rate, sex ratio, age pyramids/age distribution

(b) Population density-

Number of individuals per unit area at a given time/ period

- 1. Biomass/ %Cover, e.g Hundred Parthenium plants and 1 huge banayan tree
- 2. Relative Density, e.g Number of fish caught per trap from a lake
- 3. Number, e.g Human population
- 4. Indirect estimation, e.g without actually counting/seeing them e.g tiger census based on pugmarks and fecal pellets

Additional Questions (Chapter 13)

1. What would be the growth rate pattern, when the resources are unlimited?

Ans. - Exponential

2. What is brood parasitism? Explain with the help of an example.

Ans. - Cuckoos laying eggs in crows nest.

3. List any four characters that are employed in human population census.

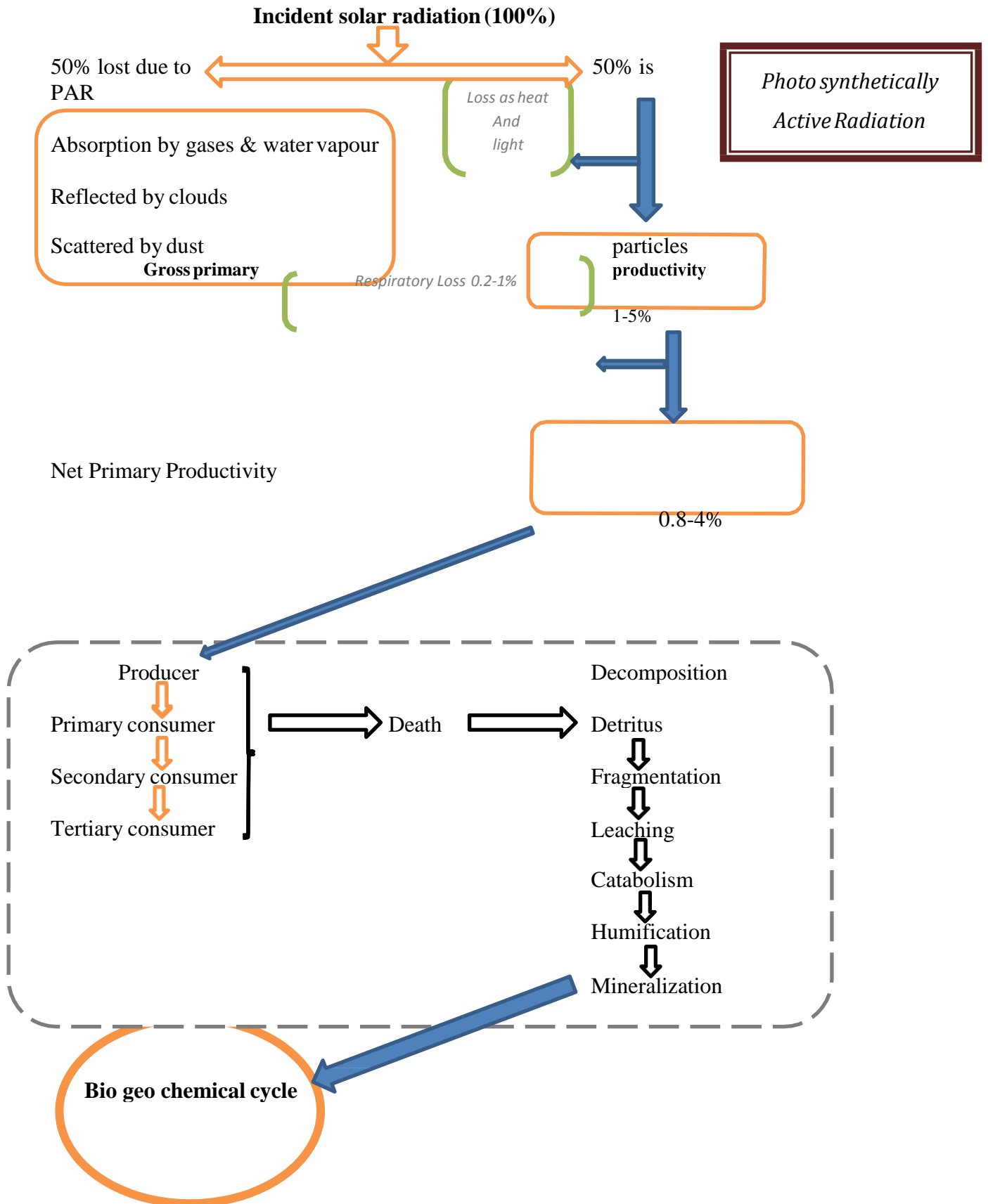
Ans. - Sex ratio, growth rate, birth rate, death rate.

Chapter-14: ECOSYSTEM

Ecology [Greek: *oikos*; home and *logos*; the study of] – First coined by **Ernest Haeckel** (1869). Ecology therefore - study of an organism in its natural home.

Odum (1963) defined ecology as the study of structure and function of nature or the study of inter-relationships between organisms and their environment.

Inter relationship between components of ecosystem



Vocabulary:

- **Habitat:** Environment in which a species normally lives or the location of a living organism.
- **Ecology:** The Scientific Study of the Interactions between organisms and the environment
- **Abiotic:** Non-living (ex. Temp, light, water, nutrients)
- **Biotic:** Living organisms (called biota)
- **Population:** A group of individuals of the same species living in a particular geographic area.
- **Population ecology:** Concentrates mainly on factors that affect how many individuals of a particular species live in an area.
- **Community:** Consists of all the organisms of all the species that inhabit a particular area; it is an assemblage of populations of many different species.
- **Community ecology:** The whole array of interacting species in a community. This area of research focuses on how interactions such as predation, competition, and disease, as well as abiotic factors such as disturbance, affect community structure and organization.
- **Ecosystem:** Consists of all the abiotic factors in addition to the entire community of species that exist in a certain area. An ecosystem—a lake, for example—may contain many different communities.
- **Ecosystem ecology:** The emphasis is on energy flow and chemical cycling among the various biotic and abiotic components.
- **Biome:** Any of the world's major ecosystems, classified according to the predominant vegetation and characterized by adaptations of organisms to that environment. Terrestrial regions inhabited by certain types of life, especially vegetation. eg. Deserts, grassland and forests.
 - **Biological diversity** - variety of different species (species diversity), genetic variability among individuals within each species (genetic diversity), and variety of ecosystems (ecological diversity).
- **Biotic potential** - maximum rate at which the population of a given species can increase when there are no limits of any sort on its rate of growth.
- **Carrying capacity (K)** - maximum population of a particular species that a given habitat can support over a given period of time.
- **Competition** - two or more individual organisms of a single species (intraspecific competition) or two or more individuals of different species (interspecific competition) attempting to use the same scarce resources in the same ecosystem.
- **Consumer** - organism that cannot synthesize the organic nutrients it needs and gets its organic nutrients by feeding on the tissues of producers or of other consumers; generally divided into primary consumers (herbivores), secondary consumers (carnivores), tertiary (higher-level) consumers, omnivores, and detritivores (decomposers and detritus feeders).
- **Deforestation** - removal of trees from a forested area without adequate replanting.
- **Desert** - biome where evaporation exceeds precipitation and the average amount of precipitation is less than 25 centimeters (10 inches) a year. Such areas have little vegetation or have widely spaced, mostly low vegetation.
- **Desertification** - conversion of rangeland, rain-fed cropland, or irrigated cropland to desert like land, with a drop in agricultural productivity of 10% or more. It is usually caused by a combination of overgrazing, soil erosion, prolonged drought, and climate change.
- **Ecological diversity** - the variety of forests, deserts, grasslands, oceans, streams, lakes, and other biological communities interacting with one another and with their nonliving environment.

Ecological niche - total way of life or role of a species in an ecosystem. It includes all physical, chemical, and biological conditions a species needs to live and reproduce in an ecosystem.

Ecology - study of the interactions of living organisms with one another and with their nonliving environment of matter and energy. Study of the structure and function of nature.

Environmental degradation - depletion or destruction of a potentially renewable resource such as soil, grassland, forest, or wildlife by using it at a faster rate than it is naturally replenished. If such use continues, the resource can become nonrenewable on a human time scale or nonexistent (extinct).

Extinction - complete disappearance of a species from the earth. This happens when a species cannot adapt and successfully reproduce under new environmental conditions or when it evolves into one or more new species (speciation).

Food web - complex network of many interconnected food chains and feeding relationships.

Forest - biome with enough average annual precipitation (at least 76 centimeters, or 30 inches) to support growth of various species of trees and smaller forms of vegetation.

Grassland - biome found in regions where moderate annual average precipitation (25 to 76 centimeters, or 10 to 30 inches) is enough to support the growth of grass and small plants, but not enough to support large stands of trees.

Habitat - place or type of place where an organism or a population of organisms lives.

Immature community - community at an early stage of ecological succession. It usually has a low number of species and ecological niches and cannot capture and use energy and cycle critical nutrients as efficiently as more complex, mature ecosystems.

Keystone species - species that play roles affecting many other organisms in an ecosystem.

Limiting factor - single factor that limits the growth, abundance, or distribution of the population of a species in an ecosystem.

Mature community - fairly stable, self-sustaining community in an advanced stage of ecological succession; usually has a diverse array of species and ecological niches; captures and uses energy and cycles critical chemicals more efficiently than simpler, immature communities.

Native species - species that normally live and thrive in a particular ecosystem.

Pioneer community - first integrated set of plants, animals, and decomposers found in an area undergoing primary ecological succession.

Pioneer species - first hardy species, often microbes, mosses, and lichens, that begin colonizing a site as the first stage of ecological succession.

Primary succession - sequential development of communities in a bare area that has never been occupied by a community of organisms.

Secondary succession - sequential development of communities in an area in which natural vegetation has been removed or destroyed but the soil is not destroyed.

IMPORTANT QUESTION (C.B.S.E)

Q.1. List two factors that determine the vegetation and soil type of an ecosystem.

Ans. (i) Precipitation

(ii) Temperature

Q.2. Name the dominant producers in a deep aquatic ecosystem. what other name could you give to a primary consumer .

Ans. Phytoplankton-herbivores.

Q.3.state what does (standing crop)of a trophic level represent.

Ans. Standing crop represents the mass of living material(biomass) at the particular time.

Q.4.What is the starting point of a grazing food chain and detritus food chain, respectively?

Ans. GFS start with producers while DFC start with decomposers.

Q.5.Mention any two significant roles predation plays in nature.

Important roles of predation in nature.

(i) They keep the prey population under control.

(ii) They act as conduits for energy transfer across trophic

Q.6.What is meant by saying that the energy flow in an ecosystem is unidirectional?

Ans. The sun is an ultimate source of all energy. The energy passes from producers to consumers in one direction i.e. energy cannot pass back in a reverse direction.

Q.7.What is a detritus food chain made up of how do they meet their energy and nutritional requirements?

Ans. DFC is made up of dead plant and animal remains and their fecal matter. They obtain energy by decomposing the dead materials.

Q.8. It is possible that a species may occupy more than one trophic level in the same ecosystem at the same time Explain with the help of one example.

Ans. For example, Sparrow is an omnivore. When it eats seeds, fruits or any other plant production, it occupies the primary trophic level. Whereas, when it eats worms and other insect, it occupies the secondary level. Thus, it occupies more than one trophic level in the same ecosystem.

Q.9.List the three parameters used for constructing ecological pyramids. Describe any one instance where the pyramid may look inverted.

Ans. Three parameters used are:-

(i) Number of individuals in a trophic level.

(ii) Biomass of individuals in a trophic level.

(iii) Rate of flow of energy in a trophic level.

The pyramid may look inverted in a tree ecosystem where the number of consumers are numerous depending on a single producer.

Q.10.(a)What is meant by ecological succession ? Explain how it occurs from a climax community?

(b)What properties distinguish a pioneer community from a climax community?

Ans.(a) Refer to basic concept of Ecological succession in study material.

(b) Pioneer community Climax community

(i) The species which invade a (i) The last or final stage in a Bare area to
initiate succession in termed climaxes

Succession is called pioneer community.

Community.

(ii) Its species have reproduction (ii) Its species have low

- | | |
|---|--|
| rate. | reproduction rate |
| (iii) Its species have short life span. | (iii) Its species have long life span. |
| (iv) they are replaceable. | (iv) They are stable and not replaced |

Q.11. Name the kind of organism which constitute the pioneer community of xerarch and hydrarch succession, respectively.

Ans. Xerarch succession- Lichens.

Hydrarch succession- phytoplankton.

Q.12. Name the pioneer and the climax species in a water body. Mention the changes observed in the biomass and the biodiversity of the successive seral communities developing in the water body.

Ans. Pioneer species- phytoplankton.

Climaxes species- Forest/ Trees.

Biomass will be gradually increased and phytoplankton are replaced by tree - floating angiosperm then by rooted hydrophytes followed by different seral communities. Thus, biodiversity also increase.

Q.13. What is primary productivity how is it different from net primary productivity?

Ans. Primary production is referred to as amount of biomass or organic matter produced per unit area, over a time period by the plants during photosynthesis net primary productivity is equal to the rate of organic matter produced by photosynthesis minus rate of respiration and other losses.

Q.14. Explain the difference between first trophic levels of detritus food chain and grazing food chain.

Ans. First trophic level DFC

(i) Decomposers are the 1st trophic level.

(ii) They decomposes organic complex matter into simple

First trophic level of GFC

(i) Producers are the first trophic

level .

(ii) They prepare complex organic molecules from the help sun light.

Chapter-15: BIODIVERSITY AND CONSERVATION

Biodiversity is defined as the totality of genes, species and ecosystems of a given region, It is the variety and variability of life form (all animals, plants and microbes on earth) and the ecological complexes in which they occur. The term was first coined by **Walter G. Rosen(1985)**, however the term was popularized by the American sociobiologist **Edward Wilson(1988)**

Hierarchical levels of Biodiversity:

- 1) **Species Diversity**: Varieties in the number and richness of the species of a region.
- 2) **Genetic Diversity** : Diversity in the number and types of genes, as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. It helps in speciation.
- 3) **Ecosystem/Community/Habitat Diversity**: Variety in the types of ecosystems.

Patterns of Biodiversity:

- 1) **Latitudinal gradients** – species diversity decreases, from equator to poles. Tropics (23.50N -23.50S) show richest species diversity. Speciation is generally a function of time. Temperate region is subjected to glaciations. Tropical regions remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification. Tropical environments are less seasonal, relatively more constant and predictable. Constant environment facilitates niche specialisation and lead to greater species diversity. Tropical latitudes also get huge solar radiations which promote higher productivity.

Reasons for greater biological diversity in tropics

- (a) Tropical latitudes have remained relatively undisturbed for millions of years and thus had a long evolutionary time for species diversification.
- (b) Tropical environments are less seasonal, relatively more constant and predictable which promote niche specialisation and lead to greater species diversity.
- (c) There is more solar energy available in the tropics, which contributes to higher productivity and indirectly leads to greater biological diversity.

The importance of species diversity to the ecosystem

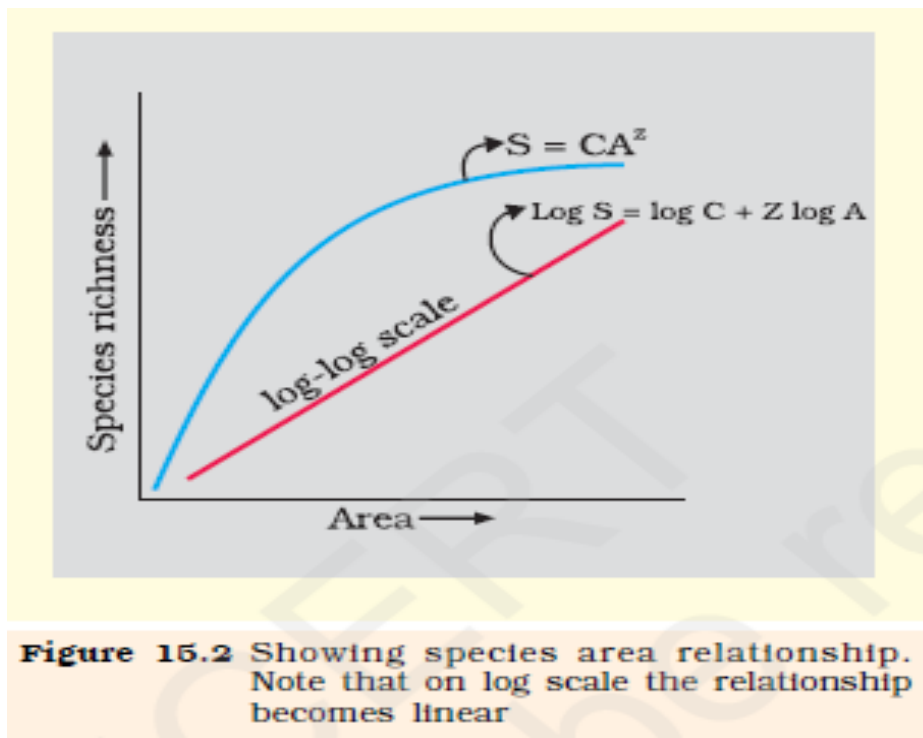
- (1) Ecosystems with higher diversity are more productive than ecosystems with lower biodiversity. David Tilman showed in his experiments that increased diversity contributes to higher productivity.
- (2) Biodiversity is essential for the stability of an ecosystem. Communities with more species are more stable than those with less species.
- (3) Rich biodiversity is also essential to make an ecosystem more functional and survival of the human race on the earth.

(Rivet popper hypothesis proposed by Paul Ehrlich).

SPECIES – AREA RELATIONSHIPS :

Arrhenius (1921) concluded that the number of **species** increases continuously less as the **area** increases.

This phenomenon is known as **the species/area relationship (SAR)**. This is reflected in the quantitative formula $S = cA^z$, in which **S** represents the number of **species** and **A** the size of the **area**. The constant **c** is an empirically determined multiplier that varies among taxa and **areas**. The exponent **z** varies according to the topographic diversity, the isolation of the **area** and the mobility of the taxon. It is usually higher* for islands (around 0.3) than for the mainland (commonly assumed less than 0.2). (* the lower **z**, the less space is needed to capture a greater number of species.)



ALEXANDER VON HUMBOLDT observed within a region species richness increased with increasing explored area but only up to a limit. The relation between species richness and area for a wide variety of taxa turns out to be a **rectangular hyperbola**. On a logarithmic scale the relationship is a straight line described by the equation

$\text{Log } S = \text{log } C + Z \text{ log } A$ Where S = species richness, A = Area, Z = slope of the line (regression coefficient), C = Y- intercept. It has been noted that regardless of the **taxonomic group** or **region** the **slope of the regression line are amazingly similar**. However, for a very **large area** like the entire continent the **slope of the line is steeper**.

Loss of biodiversity:

Loss of biodiversity in a region may lead to

- 1) decline in plant production
- 2) lowered resistance to environmental changes such as drought.
- 3) increased variability in certain ecosystem processes such as plant productivity, water use, pest & disease cycles.

Major causes of biodiversity loss:

- i) Habitat loss and fragmentation
- ii) Over exploitation
- iii) Alien species invasions
- iv) Co-extinctions and mass extinctions, ,
- v) Overexploitation ,
- vi) Urbanization,
- vii) Pollution
- viii) Global climate change

Biodiversity conservation

Reasons for conservation can be grouped into three categories:

- a) narrow utilitarian- for deriving direct economic benefit from nature.
- b) broad utilitarian- as biodiversity plays a major role in many ecosystem services.
- c) ethical- we need to realise that every species has an intrinsic value and we need to pass on our biological legacy to future generations.

How to conserve biodiversity:

In-situ Conservation– Threatened /endangered plants and animals are provided with urgent

measures to save from extinction **within their natural habitat**(in wildlife sanctuaries, national parks &

biosphere reserves, sacred groves /lakes-i.e. in **protected areas**)

Biodiversity hotspots – regions with very high levels of species richness and endemism. Norman Myers developed the concept of hotspots in 1998 to designate priority areas for *insitu* conservation. They are the most threatened reservoir of biodiversity on earth. In India 2 hotspots are there, eg. Western ghats, and the Eastern Himalayas.

Ex-situ Conservation –Threatened animals& plants are **taken out from their natural habitat**& placed in a setting where they can be protected and given care as in botanical gardens, zoological gardens, seed/pollen/gene banks etc.

Efforts to conserve biodiversity:

Convention on Biological

Diversity(CBD) The three main goals of CBD are 1)Conservation of biological diversity 2)Sustainable use of components and 3)Fair and equitable sharing of benefits **Indian efforts:**

Taking cognizance of the provisions of the CBD,India has enacted an umbrella legislation called the Biological Diversity Act,2002 and also notified the Biological Diversity Rulkes,2004.Its primary aim is to endorse the main goals of CBD suiting to India's national needs and circumstances. India will host the 11th Conference of Parties(COP) (known as RIO+20)in October2012.

Drivers of biodiversity loss-

The main threats to biodiversity are one or more of the following developments:

Causes of biodiversity loss:

□ There are four major causes “**The Evil Quartet**” are as follows:

1) Habitat loss and fragmentation:

- a. •**Human population growth-** means growing demands for space and food.
- b. •**Intensive agriculture -** encroach on habitats.
- c. •**Extension of road, rail and electricity networks -** fragments habitats and scares away some species.

2) Over-exploitation: *we consume too much of a species or goods that ecosystems provide. includes excessive hunting, collecting and trade in species and parts of species.*

3) Alien species invasion: Nile perch introduced into Lake Victoria in east Africa led to extinction of 200 species of **cichlid fish** in the lake.

□ **Parthenium**, (carrot grass), **Lantana**, and water hyacinth (**Eichornia**) posed a thread to indigenous species.

□ African cat fish **Clarias gariepinus** for aquaculture purposed is posing a threat to indigenous catfishes in our rivers.

4) Co-extinction

Other reasons

•**Pollution**- affects the health of animals and plants as much as human health. *Environmental disasters* such as oil spills have devastating consequences for birds and the marine fauna and flora.

•**Climate change** - global rise in temperature between 1.4° and 5.8° Celsius and the sea level by between 9 and 88 cm. *Many species will not be able to adapt or move to other regions in next century.*

Endangered species a species that is in danger of extinction throughout all or a significant portion of its range.

Ex situ conservation- removal of germplasm resources (seed, pollen, sperm, individual organisms), from their original habitat or natural environment. Keeping components of biodiversity alive outside of their original habitat or natural environment.

Extinction-termination of a species caused by the failure to reproduce and the death of all remaining members of the species; the natural failure to adapt to environmental change.

Fauna-All of the animals found in a given area.

Flora-All of the plants found in a given area.

Gene bank- A facility established for the *ex situ* conservation of individuals (seeds), tissues, or reproductive cells of plants or animals.

Genetic diversity-The variety of genes within a particular population, species, variety, or breed. **Hotspot**-An area on earth with an unusual concentration of species, many of which are endemic to the area, and which is under serious threat by people.

Red List-The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated are Near Threatened).

Species diversity-The number and variety of species found in a given area in a region.

RAMSAR AND ITS IMPORTANCE

Ramsar Convention, is an intergovernmental treaty or convention on Wetlands that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Wetlands are vital for human survival. They are among the world's most productive environments; cradles of biological diversity that provide the water and productivity upon which countless species of plants and animals depend for survival.

List of Ramsar sites in India

According to WWF-India, wetlands are one of the most threatened of all ecosystems in India. Loss of vegetation, salinization, excessive inundation, water pollution, invasive species, excessive development and road building, have all damaged the country's wetlands. Some common Ramsar site in India are Chilka lake in Orissa, Karike Wetland in Punjab, East Kolkata Wetlands in West Bengal, Bhoj Wetland in Madhya Pradesh, etc.

Table 1. Comparison Between the Number of Species in India and the World.

Group	Number of species in India (SI)	Number of species in the world (SW)	SI/SW (%)
Mammals	350 (1)	4,629 (7)	7.6
Birds	1224 (2)	9,702 (8)	12.6
Reptiles	408 (3)	6,550 (9)	6.2
Amphibians	197 (4)	4,522 (10)	4.4
Fishes	2546 (5)	21,730 (11)	11.7
Flowering Plants	15,000 (6)	250,000 (12)	6.0

Table 2. Globally Threatened Animals Occurring in India by Status Category.

Group	Endangered	1994 IUCN Red List Vulnerable	Rare	Threat Category Indeterminate	Insufficiently	T
Mammals	13	20	2	5	13	53
Birds	6	20	25	13	5	69
Reptiles	6	6	4	5	2	23
Amphibians	0	0	0	3	0	3
Fishes	0	0	2	0	0	2
Invertebrates	1	3	12	2	4	22
TOTAL	26	49	45	28	24	172

Source: Groombridge, B. (ed). 1993. *The 1994 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK. lvi+

Table 3. Summary of Plant Conservation Status Information at WCMC.

IUCN Threat category	Number of
species Extinct	19
Extinct/Endangered	43
Endangered	149
Endangered/Vulnerable	2
Vulnerable	108
Rare	256
Indeterminate	719
Insufficiently Known	9
No information	1441
Not threatened	374
TOTAL	3120

Source: WCMC Species Unit.\

TEST QUESTIONS WITH SOLUTIONS

Q.1.What is the result obtained when we compare the relationship between species richness and area for wide variety of taxa?

Ans: Rectangular hyperbolic function .

Q.2.Which region is considered as the one with highest biodiversity on earth ?
What is the name given to such region forests?

Ans: Amazonian rainforest . They are also called the “ Lungs of the planet “ .

Q.3. Enlist the three biological diversity with the help of suitable examples

Ans: The three levels of biological diversity are

- Genetic diversity : It exists in number , type of years, alleles as well as chromosome present in a species. India has about 50,000 type of rice and 1,000 type of varieties of mango
- Species diversity : Exist in richness of different species. Ex – Amphibian species are rich in number in western ghats than in the eastern ghats.
- Ecological diversity : Exists in the variety of ecosystems present in large landscape of geographical area viz. deserts, rainforests, wetlands, etc.

Q 4.Mention the 3 important features that make a stable biological community.

Ans: Features that make a stable biological community are:

- (i) Communities should have greater biodiversity for greater stability
- (ii)It should be able to prevent invasion by alien species
- (iii) It should be able to restore itself in a short period of time

Q 5. Write Evil Quartet biodiversity.

Ans: The four major causes of biodiversity losses are known as the Evil Quartet.

They are

- (i)Habitat loss and fragmentation –When large habitats are broken into smaller fragments due to various human activities, animals are badly affected and their populations decline.

(ii)Over exploitation –When need of a resource become grid .ex – over – exploitation of passenger pigeon led to its extinction

(iii)Alien species invasion – International and non-international introduction of a species to a nearly area may disturb the harmony of existing species.ex- Eichhornia after introduction posed a big threat to the native species.

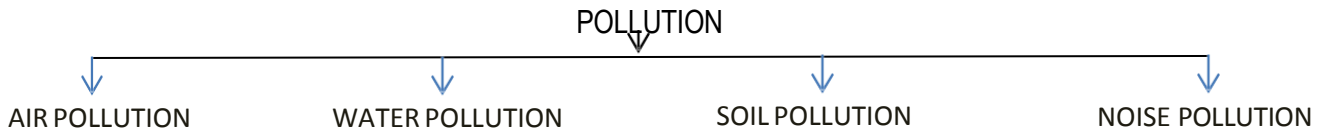
(iv)Co extinctions- Extinction of one species invariably leads to extinction of another when they are associated with each other in an obligatory way. Ex- when host species is extinct, obligate parasites dependent on it also die.

Q 6. Explain ‘rivet popper’ hypothesis. Name the ecologist who proposed it.

Ans: Stanford ecologist Paul Ehrlich, in an airplane (ecosystem) all parts are joined together using thousands of rivets (species). If every passenger travelling in it starts popping a rivet to take home (causing a species to become extinct), it may not affect flight safety (proper functioning of the ecosystem) initially, but as more and more rivets are removed, the plane becomes dangerously weak over a period of time. Furthermore, which rivet is removed may also be critical. Loss of rivets on the wings (key species that drive major ecosystem functions) is obviously a more serious threat to flight safety than loss of a few rivets on the seats or windows inside the plane.

Chapter – 16: Environmental Issues

Pollution: Any undesirable change in physical, chemical or biological characteristics of air, land, water or soil which harms the human beings.



Pollutants: Agents that bring about pollution eg. smoke, dust, pollen, chemical pollutants, wastes from hospitals, E-wastes etc.

Biodegradable and non-biodegradable pollutants

Slash and Burn Agriculture (Jhum Cultivation) : Farmers cut down trees and burn the plant remains. Ash is used as a fertilizer and the land is then used for farming or cattle grazing.

Reforestation : Process of restoring a forest that was removed at some point of time in the past.

Effluents : Something flowing over a large body of water (may be sewage or industrial effluents).

CPCB : Central Pollution Control Board

FOAM : Friends of Arcata Marsh

JFM (Joint Forest Management.) : Introduced by the Government of India in 1980s to work closely with local communities for protecting and managing forests

Ways of removing particulate matter

1. Electrostatic Precipitator

Electrical device to remove 99% particulate matter. Electrode wires produce a corona that releases electrons. Negatively charged dust particles get attached with electrons & are collected in plates.

2. Scrubber

Used to remove gases from industrial exhaust by spraying water or lime. Gases get dissolved in water while lime reacts to form precipitation of substances.

3. Proper maintenance of Automobiles

Reference Fig 16.1 NCERT

Advantage of CNG over diesel

- CNG burns most efficiently.
- Cheaper cannot be siphoned.
- Cannot be adulterated.

Problems in use of CNG

- Difficulty in laying down pipelines. Non-assurance of uninterrupted supply

Steps taken in Delhi to reduce pollution.

- Phasing out old vehicles.
- Use of unleaded petrol.
- Use of low sulphur Petrol and Diesel.
- Use of catalytic converters in vehicles Application of stringent pollution level norms for vehicles.

Noise pollution

- It is undesirable high level of sound.

Harmful effects of noise pollution

- Psychological and Physiological disorders
- Damage of eardrums and hearing ability
- Cause sleeplessness, increased heartbeat altered breathing pattern, stress etc.

Steps to be taken to control noise pollution

- Use of sound absorbent materials or by muffling noise in industries
- Demarcation of horn free zones around hospitals and schools.
- Permissible sound levels of crackers,
- Timings after which Loudspeakers cannot be played

Water pollution

Deterioration in water quality due to physical, chemical or biological factor.

Sources of water pollution

a) **Domestic sewage:** Includes waste water from residential & public sewage system & contains suspended solids(sand, silt & clay), colloids(faecal matter, microbes, paper & cloth fibres), dissolved materials(Nitrates, Ammonium phosphate, sodium and calcium salts) & biodegradable organic wastes.

b) Industrial wastes

Includes heavy metals released along with waste water eg., Mercury, DDT which increases toxicity level of water affecting living bodies and results in biomagnification.

BOD

Biological Oxygen Demand (BOD) indicates the amount of dissolved oxygen utilised by the microorganisms for oxidising the organic matter present in the water body. Greater the organics, greater would be the pollution and lesser the dissolved oxygen.

Effects of BOD

Algal bloom

- It is free floating (Planktonic) Algae.
- Imparts a distinct colour to water bodies
- Cause deterioration of water quality and fish mortality.
- Some blooms are toxic to humans and Animals.

Water hyacinth (*Eichornia crassipes*)

World's most problematic aquatic weed

Called as 'Bengal Terror' Grows faster than our ability to remove.

Biomagnification

Increase in concentration of the toxicant at successive trophic levels

Biomagnification of DDT in Aquatic food chain

Water \longrightarrow Zooplankton \longrightarrow Small Fish \longrightarrow Large Fish \longrightarrow Fish-eating Birds
0.0003 ppm 0.04 ppm 0.5 ppm 2 ppm 5 ppm

Eutrophication

Defined as Natural ageing of lake by biological enrichment of its water. Life supportive water in young lakes encourage growth of aquatic life & simultaneously deposition of organic remains at the bottom. Eventually floating plants grow in raised water temperature resulting in blockade of surface water that accelerates ageing called as eutrophication.

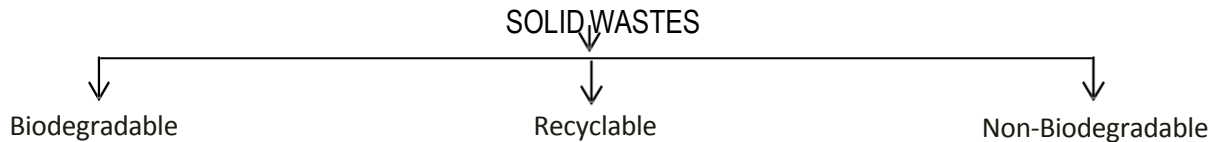
Cultural or accelerated eutrophication

Acceleration of ageing process of a lake by effluents from industries and homes.

Integrated waste water treatment in arcata

It consist of two steps

- a) Conventional sedimentation, filtering and chlorine treatment,
- b) Passing this water through marshes for neutralization absorption and assimilation of pollutants.
- c) Upkeep of this project by FOAM (Friends of Arcata Marsh).



Ecological sanitation (Ecosan)

A sustainable system for handling human excreta without using water but with composting method. **Advantages of ecosan**

- a) Wastage of water is reduced
- b) Practical and efficient
- c) Hygienic and cheap
- d) Excreta can be recycled and used as natural fertilizer.

Hospital wastes

Syringes, discarded medicines, Used gloves, Post-operative materials etc. Should be treated before disposing off.

E-wastes

- Unused or damaged computers, calculators, mobile phones etc.
- Developed countries have plants for recycling e-wastes for recycling of metals.
- In developing countries e-wastes are buried in landfills or incinerated.

Agro chemicals

- Chemicals used in agricultural fields, Fertilizers, pesticides, weedicides etc.
- They are toxic to even non target organisms.
- Excess fertilizers cause Eutrophication.
- They cause soil pollution

Advantages of organic farming

- Economical Wastes do not get accumulated but recycled
- Does not cause Eutrophication

Radioactive wastes

- Emit radiations and damage biological organisms.
- Nuclear wastes are called potent pollutants, as they are lethal even in lower doses.

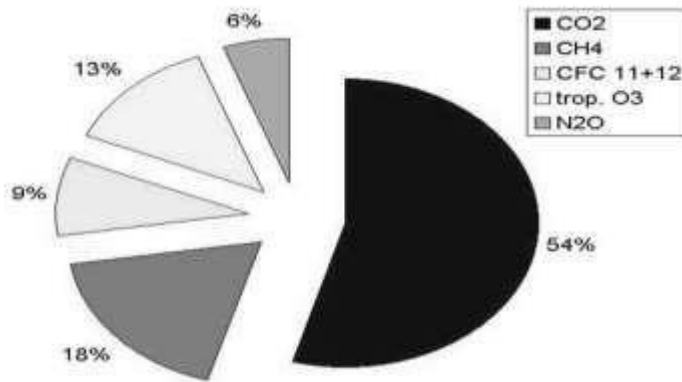
Disadvantages of nuclear plants

- Accidental leakages may happen
- Unsafe disposal of radioactive wastes
- Radiation emitted cause mutations in organisms
- Radiation causes genetic disorders

Greenhouse effect

Atmospheric cover around earth does not allow substantial amount of long wave radiation emitted by earth to escape in space. Infrared radiation is absorbed by greenhouse gases in atmosphere which is further returned as downward flux of radiation for keeping earth warm. Thus, greenhouse gases control of escape of heat from earth surface to outer space. Green House Gases:-Carbon dioxide, methane, Chlorofluorocarbon (CFC), Perfluoromethane(CF₄), Nitrous oxide(N₂O) etc.

Harmful effect is global warming, increase in sea level etc.



Ozone depletion

Ozonosphere protects earth from harmful radiation. In stratosphere, photodissociation results in ozone formation that dissipates the energy of UV radiation.



UV

CFC produces active chlorine in presence of UV radiation & depletes ozone layer

UV-C



UV-C



Triatomic molecule of oxygen.

- Found in stratosphere of atmosphere.
- CFCs discharged from lower atmosphere move upward.
- UV rays act on these CFCs and release chlorine atoms.
- Chlorine degrades ozone and release molecular oxygen.
- This process is irreversible and thus ozone is depleted.

OZONE HOLE

Reference Fig 16.8 NCERT

Soil erosion

The removal of top fertile layer due to human activities

Reasons: -

- Over cultivation
- Over grazing
- Deforestation
- Improper irrigation practices

Water logging

- The crops may droop
- Leads to salinity of the soil.

Slash and burn agriculture/jhum cultivation

- Farmers cut down the trees of the forest and burn the plant remains.
- Ash is used as fertilizer and land is used for farming or cattle grazing
- Later, Land is left uncultivated for several years for replenishment of minerals

Effects of deforestation

- Leads to global warming due to excess carbon-dioxide
- Loss of biodiversity
- Damage to hydrological cycle

- Leads to soil erosion
- Desertification of land

Reforestation

- Restoring forest that was existing earlier
- E.g. Observing Van-Mahotsavas
- It also occurs naturally

Afforestation

- Developing a forest in a new area where no such forest existed in that area.

A case study of people's participation in forest conservation

A king of Jodhpur wanted to arrange wood for his new palace in 1731.

Few Bishnois hugged the trees and asked to cut them first rather than cutting trees.

365 persons lost their lives in this act

A small temple is now present there in remembrance of this act

Amrita Devi Bishnoi Wild Life Protection Award is instituted for individuals of rural areas who take keen interest in protecting wild life.

Chipko movement

It was started by local women of Garhwal, They hugged the trees to protect them from the axes of contractors.

Joint forest management (jfm)

- Strategy Government of India in 1980
- Local communities worked with the government to save the forest.
- Communities get forest products for encouragement.

Environmental issues

Very short answer type questions (1mark)

1. What is meant by algal blooms? What is its significance?

Ans. Excess growth of certain phytoplankton due to excess nutrients in water causes Deteriorates water quality, leads to fish mortality.

2. Define eutrophication.

Ans. Nutrient enrichment in water bodies leading to depletion of oxygen and loss of life supporting Environment.

3. What is biomagnification?

Ans. Increase in the concentration of certain toxic chemicals at successive trophic levels.

4. What is BOD?

Ans. Biological Oxygen Demand is the measure of organic matter in any water sample.

5. What is the effect of DDT in birds?

Ans. DDT disturbs calcium metabolism in birds, thinning of egg shell and premature breaking of Eggs lead to decline in bird population.

6. What do you understand by Ecosan?

Ans. Ecosan are the toilets which use composting method for ecological sanitation.

7. Why are nuclear wastes called potent pollutants?

Ans. Are lethal even at lower doses and cause damaging disorders.

8. What is Jhum cultivation?

Ans. Farmers cut down the trees, burn, use cattle for grazing and then allow the land to recover.

9. Mention two problems that have arisen due to green revolution.

Ans. Water logging and soil salinity.

10. What is snow blindness?

Ans. Inflammation of cornea caused by a high dose of UV-B radiation.

11. Which is the world's most problematic weed, also known as —terror of Bengal?

Ans. *Eichornia crassipes* (Water hyacinth).

12. What is the effect of DDT in birds?

Ans. Disturbs Calcium metabolism Thinning of egg shells and premature breakage of eggs, Decline of bird population.

Short answer type questions (2 marks)

1. Mention the harm caused by fine particulate matter to human beings?

- Ans. (i) Cause respiratory problems
 (ii) Irritation of eyes
 (iii) Inflammation of lungs
 (iv) Premature death.

2. Differentiate between biodegradable and non-biodegradable wastes.

Biodegradable wastes	Non-Biodegradable wastes
*Can be broken down into harmless simple Compounds by the action of decomposers.	*Cannot be broken down by microbes and get accumulated in the biosphere
*Can be used as manure	*Enter the food chain
*Cause little pollution	*Cause biomagnifications

3. Describe Chipko Movement.

Ans. It was launched in Garwhal, Himalayas by Shri Sunder LalBahuguna in 1974.

Local women showed enormous bravery in protecting the trees from the axes of the contractors by hugging them.

4. What are the advantages of Organic farming?

Ans. Economical procedure as recycling takes place.

Waste not accumulated butrecycled

Efficiency and utilization of resources increased

Does not lead toeutrophication.

5. Write an account on Ecological sanitation (Ecosan).

Ans.A sustainable system for handling human excreta, using dry composting toilets. Practical,

Hygienic, efficient and cost-effective solution to human waste disposal Human excreta can be Recycled into manure Used in Kerala and Sri Lanka.

6. How do radioactive wastes cause damage to living organism?

Ans. Cause mutations in living organisms at a very high rate. Lethal in high doses Causes cancer and other disorders.Reduces the vegetation cover.

7. What is ecological sanitation? What are its advantages?

Ans. It is sustainable system for handling human excreta without using water but by composting Method.

Advantages

Hygienic, practical and efficient, Conserves water can be recycled and, Acts as a natural fertilizer.

Short answer type questions (3 marks)

1. Mention harmful effects of noise pollution on human health.

- Ans. Stress Altered breathing pattern
 Increased heart beating and blood pressure
 Sleeplessness and headache
 Hearing impairment.

2. What measures should be taken to reduce global warming?

- Ans. Reduce use of fossil fuel
 Efficient use ofenergy.
 Avoid deforestation
 Reduce human population Control greenhouse gases.

3. How can we reduce automobile pollution?

- Ans. Un-Leaded Petrol- Reduces lead pollution in air.
 Low Sulphur Diesel- Reduces sulphur pollution in air
 Four stroke engines to reduce emission of unburnt hydrocarbons.

Tube-Ups to increase air-fuel ratio and help in better combustion.
Catalytic Converters to reduce pollution.
CNG to reduce pollution and conserve fossil fuels.

4. Mention the adverse effects agrochemicals.

Ans. They are toxic to non-target organisms. They cause soil pollution Excess fertilizers cause eutrophication.

5. Write a short note on ozone depletion.

Ans. Ozone found in stratosphere. CFCs discharged from lower atmosphere move upward. In stratosphere UV rays act on these CFCs release chlorine atoms. Chlorine degrades ozone and release molecular oxygen (O_3O_2). In this reaction chlorine acts, as catalyst and loss ozone is irreversible.

6. Mention the Supreme Court directions to the Government to reduce pollution.

Ans. Switch over to CNG in public transport system

Enforcement of Euro II norms for vehicles.

Compulsory periodic check-up of pollution.

Use of unleaded petrol Low sulphur petrol and diesel

Catalytic converters in vehicles

Phasing out of old vehicles.

Long answer type questions (5marks)

1. a) Explain the functioning of electrostatic precipitator with the help of a diagram.

b) Mention the consequence if the electrostatic precipitator does not work in a power plant.

Ans. Used for removing particulate air pollutants.

Removes about 99 of the particulate pollutants from the exhaust of thermal power plants.

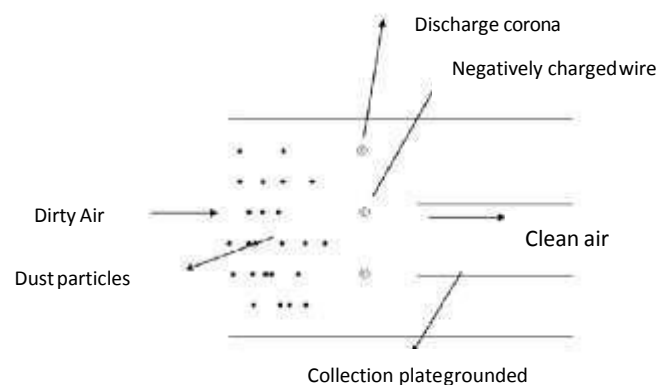
Electrode wires that are maintained at several thousand volts, which release electrons.

Electrons become attached to dust particles giving a net negative charge.

Collecting plates are grounded and attract the charged dust particles.

Velocity of air between the plates must be low enough to allow the dust particles to fall.

If electrostatic precipitator of a thermal plant stops working, all the particulate pollutants get released and pollute the air.



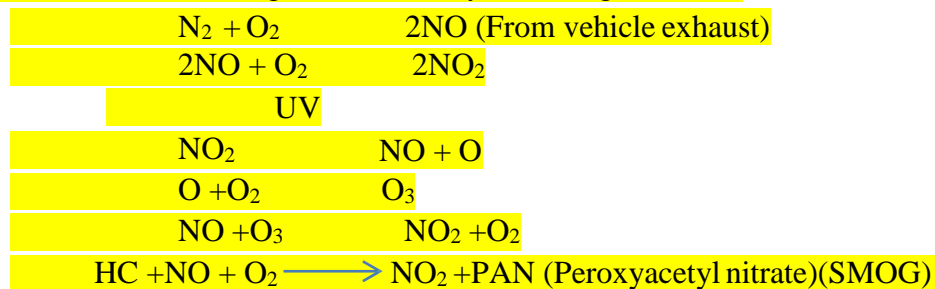
ELECTROSTATIC PRECIPITATOR

IMPORTANT LEGISLATIONS FOR ENVIRONMENTAL PROTECTION

Sl. No.	Environmental Act	Application
1.	The Environment Protection Act, 1986	Protect & control the quality of environment
2.	The Air (Prevention & control) Act, 1981	Protect & control of air pollution
3.	The Water (Prevention & control) Act, 1974	Protect & control of water pollution to safe guard water resources
4.	The Insecticide Act, 1968	Control & regulation of safe distribution & use of insecticides
5.	Montreal Protocol	Control on emission of ozone depleting substances
6.	National Forest Policy, 1988	Restriction of forest cover for plain land & hills
7.	Kyoto Protocol, 1977	Reducing overall greenhouse gas emission

Photochemical oxidation (SMOG):

- Secondary air pollutants are produced from primary pollutants by photochemical oxidation . eg., Olefins, aldehydes, Peroxyacetyl Nitrate(PAN)
- Photochemical Smogs are formed by following reactions:



TEST QUESTIONS WITH SOLUTION

Q.1. Name the two gases mainly responsible for the green house effect.

Ans : Carbon dioxide and methane

Q. 2. What is the unit for measuring thickness of ozone?

Ans: Dobson unit.

Q.3. A radiation causes aging of skin, skin cancer and inflammation of cornea called snow blindness, it also damages DNA . Name the radiation.

Ans: Ultraviolet B rays.

Q.4. Mention the six harmful effects of noise on human health.

Ans: Six harmful effects of noise on human population are:

- (i) Stress
- (ii) Sleeplessness
- (iii) Increased rate of heart beat
- (iv) Altered berating patterns
- (v) Damage of eardrum if sound levels are very high
- (vi) Damage of hearing abilities at low level noise

Q 5. What is eutrophication? Explain its consequences on the life of plants and animals in such water bodies.

Ans: Eutrophication is the natural aging of a lake by biological enrichment of its water. In a young lake the water is cold and clear, supporting little life. With time, streams draining into the lake introduce nutrients such as nitrogen and phosphorus, which encourage the growth of aquatic organisms. Consequences of eutrophication on the life of plants and animals in such a water bodies are as follows:

- (i) Presence of large amount of nutrient in such water bodies causes excessive growth of planktonic (free-floating) algae leading to algal bloom. Algal bloom causes deterioration of water quality and fish mortality. Some of them are toxic to human beings and animals.
- (ii) Growth of water hyacinth leads to imbalance in the aquatic ecosystem.

Q 6. Explain accelerated eutrophication. Mention any two consequences of this phenomenon.

Ans: Accelerated eutrophication is nutrient enrichment of water bodies due to human activities like passage of sewage.

Consequences are:

- (i) Large amounts of nutrients in water causes excessive growth of planktonic algae which impart characteristics color to water bodies
- (ii) Depletion of oxygen content of water leading to the death of the aquatic organisms.

Q. 7. What is global warming? List four strategies for reducing global warming.

Ans: The Greenhouse gases in the atmosphere causes the rise in global mean temperature called global warming. Four strategies for reducing global warming are:

- (i) Reducing deforestation
- (ii) Planting trees
- (iii) Slowing down the growth of human population
- (iv) Reduction in the emission of greenhouse gases.

Q 8. (a) Mention the causes of depletion of ozone layer in the stratosphere? How does this affect the human life?

(b) Explain biomagnification of DDT in an aquatic food chain. How does it affect the bird population.

OR

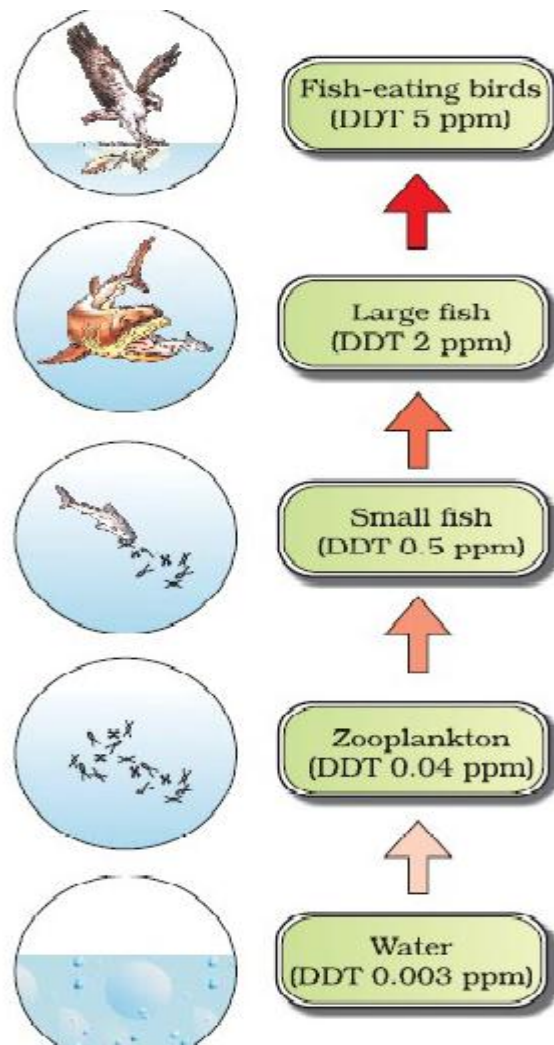
DDT content in the water of a lake that supplies drinking water to the nearby villages is found to be 0.003ppm. The kingfishers of that area were reported to have 2ppm of DDT. Why has the concentration increased in these birds? What harm will this cause to the bird population? Name the phenomenon.

Ans: (a) Chlorofluorocarbons (CFCs) deplete ozone in the stratosphere. UV (B) damages DNA causing mutation, skin cancer, inflammation of cornea, cataract, aging of skin, snow blinders.

(b) If DDT leaches from the agricultural field, it gets into the water body and enters the food chain: zooplanktons->small fish->large fish->any fish eating bird. Concentration of DDT increases along resulting in decline in bird population.

The DDT being a toxic substance gets accumulated in the organism and passes to the next higher trophic level because it cannot be metabolized or excreted. Thus, concentration of DDT has increased in the birds. The high concentration of DDT disturbs the calcium metabolism in birds and causes thinning of eggshell and their premature breaking and eventually causes a decline in the bird population.

The phenomenon is called biomagnification.

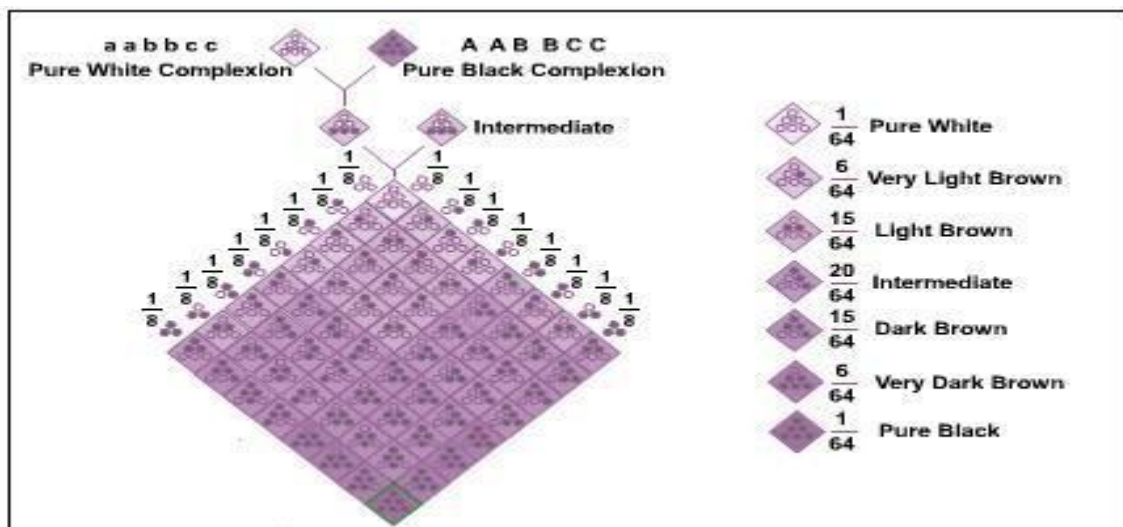


Annexure –I

SUPPLEMENTRY MATERIAL CHAPTER-5

Polygenic Inheritance:-

- the inheritance of quantitative traits, traits which are influenced by multiple genes, not just one
- may be influenced by ENVIRONMENT also
- Eg.- **Height**. People are not just short or tall; they have a variety of heights which run along a spectrum. Furthermore, height is also influenced by environment; someone born with tall genes could become short due to malnutrition or illness
- **Skin color**-The three "dominant" genes A, B and C are supposed to control dark pigmentation because they can produce melanin. Whereas, their corresponding "recessive" alleles a, b & c are responsible for light pigmentation



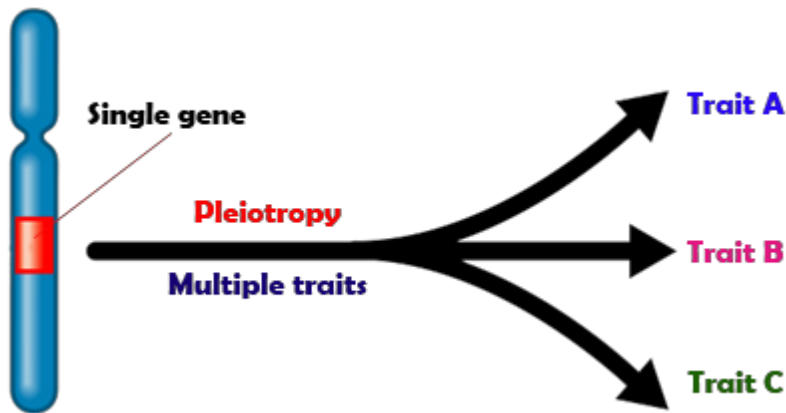
PLEIOTROPY

pleio-many

trepein –influencing

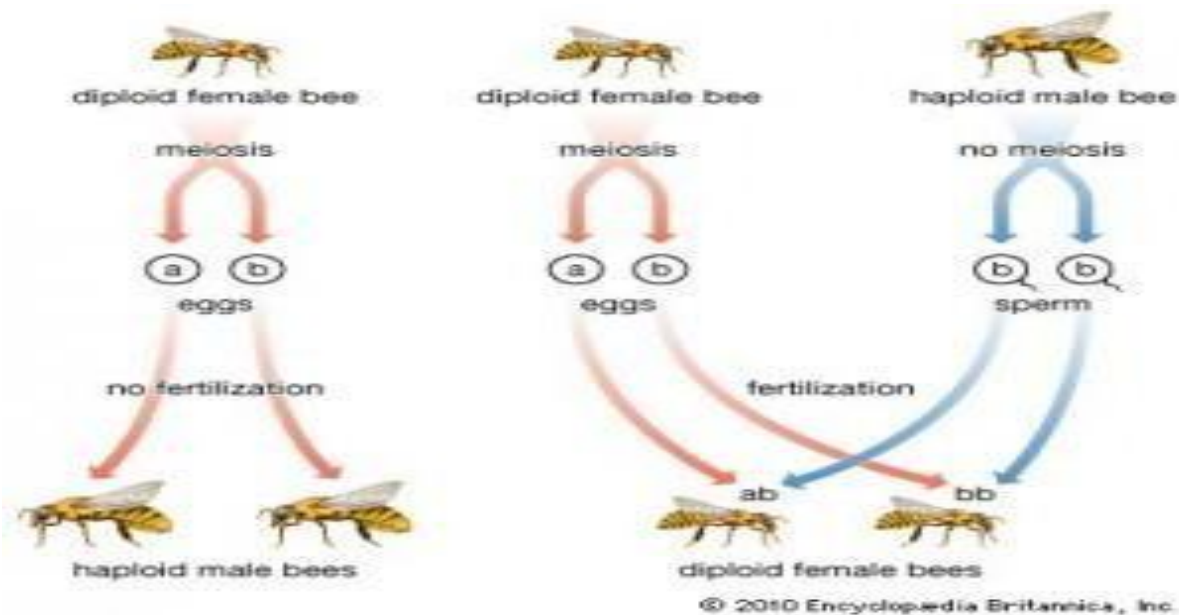
Pleiotropy is the event during which a gene can have more than one

phenotypic effect



E.g.- Phenylketonuria (PKU)- caused by a deficiency of the enzyme phenylalanine hydroxylase, which is necessary to convert the essential amino acid phenylalanine to tyrosine. A defect in the single gene that codes for this enzyme therefore results in the multiple phenotypes associated with PKU, including mental retardation, eczema, and pigment defects that make affected individuals lighter skinned.

sex determination in honey bee



Color-Blindness

-Color-blindness is the inability to distinguish the differences between red and blue colors.

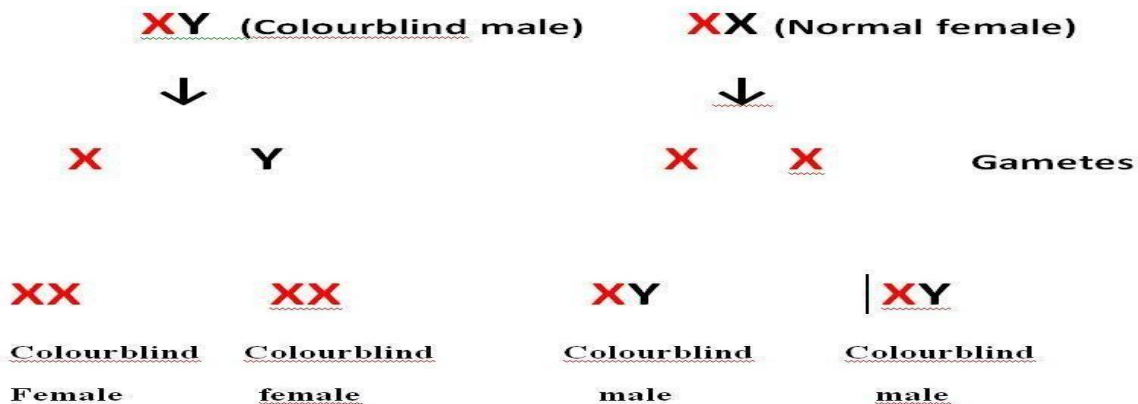
-X-linked recessive disorders

-The colour blind gene is carried on one of the X chromosomes. Since men have only one X chromosome, if his X chromosome carries the colour blind gene (X) he will be colour blind (XY). A woman can have either:-

(i) two normal X chromosomes, so that she will not be colour blind or be a carrier (XX),

(ii) or, one normal X and one colour blind carrying X chromosome, in which case she will be a carrier (XX), or rarely

(iii) he will inherit a colour blind X from her father and a colour blind X from her mother and be colour blind herself (XX). She will pass on colour blindness to all of her sons if this is the case.



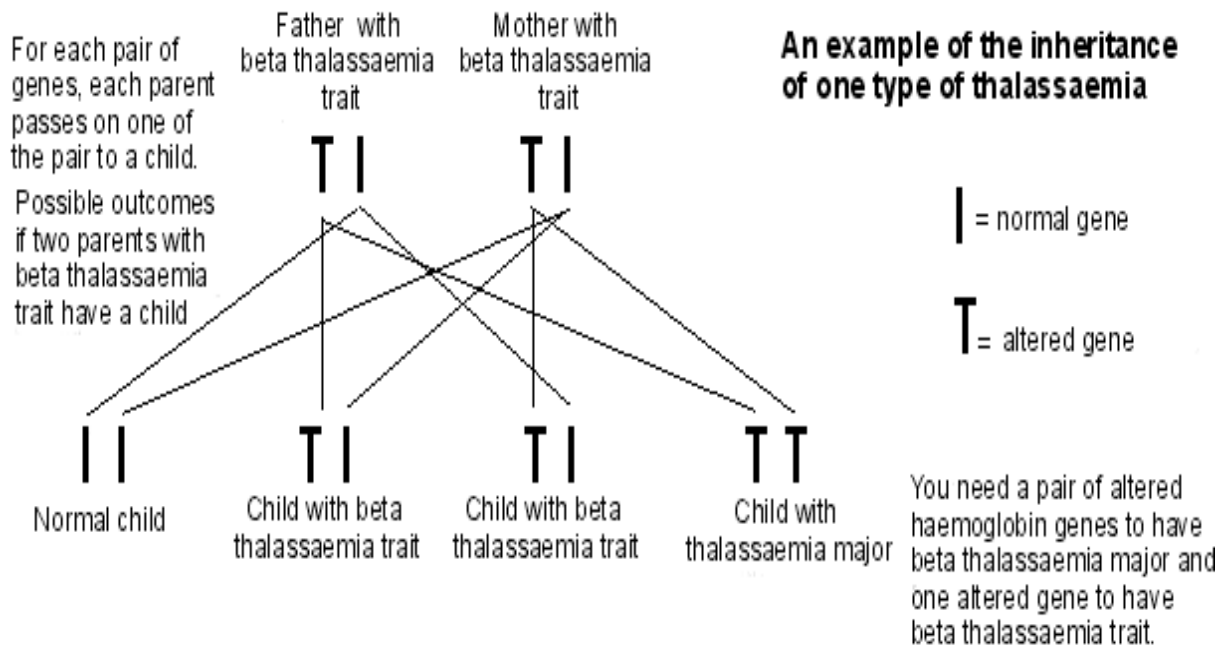
Thalassemia

-Autosome linked recessive disease

-inherited diseases of the blood that affect a person's ability to

produce hemoglobin, resulting in anemia.

-The two main types of thalassaemia are called "alpha" and "beta"



Annexure-II

Example of Value based Questions (Either 3 or 5 marks questions)

1. Rohit meets an accident. Iqbal his schoolmate takes him to hospital where Rohit (AB blood group) needs blood transfusion. Iqbal also has AB blood group and is willing to donate his blood but Rohit's mother object by saying "Iqbal belongs to different community so has different type of blood."

In your opinion

- Rohit's mother is wrong or right?
- Give your opinion by explaining the allelic composition of blood group AB.

2. During a visit to Kedarnath, Mohan came across a young couple staying in the adjacent room in the hotel. He learnt that the couple had been visiting different temples and performing rituals to get a child. Mohan was astonished and explained to them about ART which he had recently studied in Biology. The couple was happy and understood their wrong approach and thanked Mohan.

- Identify the values which Mohan has shown.
- What is ART? What are the various method included in ART?
- What are the limitations for which ART is not commonly accepted?

3. Rahul and his friends are having discussion about a recently released movie in which hero is a sperm donor. His friends say that sperm donation is a means to earn money. Rahul explains that sperm donation can help infertile couples.

- Whom do you think is right?
- In which type of infertile cases such sperm donation is helpful.
- Draw a neat and labeled diagram of a sperm.

4. Release of numerous pest and disease resistant crops have been done in the recent years. They also account for adverse side effects. It has led to the development of 'super pests' and 'super weeds' which requires more scientific inputs to control them. Considering the above answer the questions given below:

- What values have been neglected in the above case?
- Should we allow the continuation of such practices? Justify your answer.
- What steps should be taken to safeguard the natural genes?

5. *Gautam was a sincere and studious boy. But recently he has been under lot of stress due to continuous nagging and undue pressure to excel by his parents. He met some notorious kids of his school who forced him to take drugs to distress himself. After little resistance, he took to drugs and became addicted. After finding about this, Gautam's parents put him in a rehabilitation centre. When Gautam returned from the centre after few months, he became his earlier self and his parents also became supportive.*

Answer the following questions based on the above information:

- (i) What values are being promoted in the above case?*
- (ii) Suggest some ways by which Gautam can avoid turning to drug abuse again?*
- (iii) How would the relation between Gautam and his parents improve after this incident?*

6. *A group of scientists are working on creating transgenic cows to produce milk with medicinal properties. But there are adverse side-effects on the cows due to this procedure. Their life span shortens; they become prone to diseases and die very early.*

Answer the following questions based on the above information:

- (i) What values are being neglected by the scientists in the above situation?*
- (ii) Should they continue with their production of transgenic cows? Give reason.*
- (iii) What has been the reaction of different communities and various organizations to such acts?*

7. *Consider the following two cases:*

(i) A forest that is rich in biodiversity sees a decline in the animal population and clearing of a large part of the forest. The Government declared it as a biodiversity hotspot and the forest regained its species richness in few years.

(ii) A lake that is rich in marine fishes sees a decline in its species population due to over harvesting. The people living in the area made the lake a sacred grove and started worshipping it. The species population of the lake again became normal.

Answer the following questions based on the above information:

- (i) Which values are being promoted in the above cases?*
- (ii) Suggest some ways in which you can contribute to this concern.*
- (iii) What would have been the effect if the forest was not declared a biodiversity hotspot?*

8. Harman was going home from school. On his way he saw a pani puri vendor cleaning the dishes with bare hands and then serving the customers with the same hands without washing hands with a soap or wearing plastic gloves. Harman went to the vendor and told him the need for washing hands before touching any eatable. The vendor hushes him away and tells him there is no harm as he has rinsed his hands with water.

Answer the following questions based on the above information:

(i) In the given situation, who do you think has the correct perspective?

Justify your answer giving reasons.

(ii) Suggest few ways by which cleanliness can be promoted.

9. Anita was happy when she gave birth to her first child. Her in-laws were dissatisfied at her not giving birth to a male child and blamed Anita. Anita tried to convince her in-laws that she had no role in the child's gender. They understood the biological reason but were yet to be satisfied. Anita's husband took up the matter and convinced the parents.

a) What values did Anita's husband show in the above situation?

b) What governs sex determination in humans? How is it different from birds?

c) Why can't Anita be blamed for not giving birth to a male child?

10. Some parents wrote a complaint letter to the local municipality to remove all hoardings in the city advertising the use of condoms and matters relating to AIDS prevention. The children of these parents came to know about the matter and raised their voice against removal of those hoardings. The parents were convinced by the awareness level of their children and withdrew the complaint.

a) Parents considered the hoarding as sight pollution. Why do you disagree?

b) What value is promoted by the children protesting against their parents?

c) What are the methods by which AIDS spreads?

BIOLOGY (044)

AISSCE 2016

QUESTION PAPER SOLVED

SECTION-A

1. **A male honeybee has 16 chromosomes whereas its female has 32 chromosomes. Give one reason.**

Ans Male Honey bee develops from unfertilized female gamete / unfertilised egg / Parthenogenesis of female gamete (16 chromosomes), female develops by fertilization / fertilised egg (32 chromosomes) = $\frac{1}{2} + \frac{1}{2}$

[1 Mark]

2. **Mention the role of 'genetic mother' in MOET.**

Ans Genetic mother is used to produce many eggs / for superovulation // 6-8 eggs (under the influence of FSH)

[1 Mark]

3. **What is biopiracy ?**

Ans Biopiracy is the use of bioresources by multinational companies and other organization without proper authorization/compensation payment to the concern country /organisation.

[1 Mark]

4. **Mention two advantages for preferring CNG over diesel as an automobile fuel.**

Ans Advantages of CNG-

- i) burns efficiently / less unburnt residues.
- ii) Cheaper than petrol / diesel.
- iii) Causes less pollution.
- iv) cannot be adulterated.
- v) cannot be siphoned by thieves. (any two) = $\frac{1}{2} \times 2$

[1 Mark]

5. **Write the probable differences in eating habits of *Homo habilis* and *Homo erectus*.**

Ans *Homo habilis* did not eat meat / vegetarian

Homo erectus ate meat (meat eater) = $\frac{1}{2} \times 2$

[1 Mark]

SECTION - B

Q Nos. 6-10 are of two marks each

6. **A single pea plant in your kitchen garden produces pods with viable seeds, but the individual papaya plant does not. Explain.**

Ans Pea- flowers of pea plants are bisexual , monoecious / self pollinated (to produce pods with viable seeds) = $\frac{1}{2} + \frac{1}{2}$

Papaya-Dioecious plant / unisexual plant bearing male and female flowers on seperate plants, unable to produce viable seeds as there is no cross pollination / it could be a male plant which is unable to produce fruit and seeds = $\frac{1}{2} + \frac{1}{2}$

[1+1=2 Marks]

7. Following are the features of genetic codes. What does each one indicate ?

Stop codon; Unambiguous codon; Degenerate codon; Universal codon.

Ans Stop codon - does not code for any amino acid / terminates the synthesis of polypeptide chain

Unambiguous codon - one codon codes for one amino acid only

Degenerate codon - some amino acid are coded by more than one codon

Universal codon - genetic code is same for all organisms (bacteria to humans) = $\frac{1}{2} \times 4$

[2 Marks]

8. Suggest four important steps to produce a disease resistant plant through conventional plant breeding technology.

Ans Steps for producing disease resistant plants-

i) Screening of germplasm (for resistance sources)

ii) Hybridization of selected parents

iii) Selection and evaluation of hybrids

iv) Testing and release of new varieties = $\frac{1}{2} \times 4$

[2 Marks]

9. Name a genus of baculovirus. Why are they considered good biocontrol agents ?

Ans Nucleopolyhedrovirus = $\frac{1}{2}$

Species specific, narrow spectrum insecticidal application , no negative impact on non target organisms = $\frac{1}{2} \times 3$

[$\frac{1}{2} + 1\frac{1}{2} = 2$ Marks]

10. Explain the relationship between CFC's and Ozone in the stratosphere.

Ans UV rays act on CFC's , release Cl atom ,which act on ozone to release O_2 , resulting in ozone layer depletion / causing ozone hole = $\frac{1}{2} \times 4$

[2 Marks]

OR

Why are sacred groves highly protected ?

Ans Sacred groves are highly protected - because of religious and cultural traditions , refuges for large number of rare and threatened plants / ecologically unique and biodiversity rich regions = 1+1

[2 Marks]

SECTION - C

Q Nos. 11-22 are of three marks each

11. (a) Name the organic material exine of the pollen grain is made up of. How is this material advantageous to pollen grain ?
- (b) Still it is observed that it does not form a continuous layer around the pollen grain. Give reason.
- (c) How are 'pollen banks' useful ?

Ans (a) Sporopollenin = $\frac{1}{2}$

Most resistant to high temperature / strong acids / alkali / no enzymes can degrade it (**any one**) = $\frac{1}{2}$

(b) (Germs pores) to allow pollen tube to emerge out / pollen germination = 1

(c) Helps in storing pollen grains for years / for crop breeding programmes = 1

[3 Marks]

OR

(a) **Mention the problems that are taken care of by Reproduction and Child Health Care programme.**

(b) **What is amniocentesis and why there is a statutory ban on it ?**

Ans (a) Uncontrolled population growth / social evil like sex abuse / sex related crime / STDs (**any two**) = $\frac{1}{2} \times 2$

(b) Foetal sex determination tests based on chromosomal pattern in the amniotic fluid / to study chromosomal abnormalities in the foetus = 1

Banned to legally check female foeticide = 1

[3 Marks]

12. What is a test cross ? How can it decipher the heterozygosity of a plant ?

Ans. - A cross to analyse whether genotype of dominant individual is homozygous or heterozygous = 1

- On crossing with a recessive parent , if 50% of progeny have dominant trait and 50% have recessive trait then the plant is said to be heterozygous = 1+1

//

The above value points can be considered with the help of a test cross = 1 + 1

[3 Marks]

13. (a) What do 'Y and 'B' stand for in 'YAC' and 'BAC' used in Human Genome Project (HGP). Mention their role in the project.

(b) **Write the percentage of the total human genome that codes for proteins and the percentage of discovered genes whose functions are known as observed during HGP.**

(c) **Expand 'SNPs' identified by scientists in HGP.**

Ans. (a) - Y = Yeast = $\frac{1}{2}$

B = Bacterial = $\frac{1}{2}$

- Used as vector for cloning foreign DNA = $\frac{1}{2}$

(b) (<) 2% , (<) 50% = $\frac{1}{2} + \frac{1}{2}$

(c) Single Nucleotide Polymorphism = $\frac{1}{2}$

[3 Marks]

14. Differentiate between homology and analogy. Give one example of each.

Ans.	Homology	Analogy
	<ul style="list-style-type: none">- Organisms having the same structure developed along different directions due to adaptations / different functions- Result of divergent evolution- Indicates common ancestry- Anatomically same structures	<ul style="list-style-type: none">- Different structures having the same function (in different organisms)- Result of convergent evolution- Does not indicate common ancestry- Anatomically different structures
	Example Forelimbs of whale - bats - cheetah - human // Thorns of Bougainvillea - tendrils of cucurbits	(<i>Any two difference</i>) = 1 + 1 Example Wings of butterfly and birds // Sweet potato and potato (<i>Any other correct example</i>) = $\frac{1}{2} \times 2$ [3 Marks]

15. (a) It is generally observed that the children who had suffered from chicken - pox in their childhood may not contract the same disease in their adulthood. Explain giving reasons the basis of such an immunity in an individual. Name this kind of immunity.

(b) What are interferons ? Mention their role.

Ans. (a) The first infection of chicken pox produce a primary response and antibodies are generated against chicken pox virus , subsequent encounter with the same virus elicits a highly intensified secondary response , due to the memory cells formed during the first encounter , active immunity = $\frac{1}{2} \times 4$

(b) Proteins secreted by viral infected cells , which protects non infected cells from viral infection / when α - interferon is given to cancer patient (it activates immune system) , destroys tumour = $\frac{1}{2} \times 2$

[3 Marks]

16. (a) Write the two limitations of traditional breeding technique that led to promotion of micro propagation.

(b) Mention two advantages of micro propagation.

(c) Give two examples where it is commercially adopted.

Ans. (a) Failed to keep pace with demand , failed to provide fast and efficient system of crop improvement = $\frac{1}{2} \times 2$

(b) Large number of plants can be developed in a short duration / production of genetically identical plants / somaclones / healthy plants can be recovered from diseased plants

(*Any two*) = $\frac{1}{2} \times 2$

(c) Tomato / banana / apple (*Any two*) = $\frac{1}{2} \times 2$

[3 Marks]

17. (a) How do organic farmers control pests ? Give two examples.

(b) State the difference in their approach from that of conventional pest control methods.

Ans. (a) Natural predation / biological control = 1

Examples - lady bird used to kill aphids // dragon flies used to kill mosquitoes // *Bacillus thuringiensis* used to kill cotton bollworm / caterpillar / butterfly caterpillar

(Any two) = $\frac{1}{2} + \frac{1}{2}$

(b) **Conventional Pest Control**

- use of chemical insecticides & pesticides
- Harmful to non target organisms
- Cause environmental pollution

Organic farming based pest control

- No chemical used.
- Not harmful to non target organisms
- No adverse impact on environment

(Any two) = $\frac{1}{2} \times 2$

[3 Marks]

18. (a) Name the selectable markers in the cloning vector pBR322 ? Mention the role they play.

(b) Why is the coding sequence of an enzyme (β -galactosidase) a preferred selectable marker in comparison to the ones named above ?

Ans. (a) amp^R / ampicillin resistance genes , tet^R/ tetracycline resistance gene = $\frac{1}{2} \times 2$

They help in identifying and eliminating non-transformants / non recombinants and selectively permitting the growth of the transformants / recombinants = 1

(b) Simpler process / less cumbersome , in the presence of chromogenic substrate recombinants are colourless and non recombinants are blue in colour = $\frac{1}{2} \times 2$

[3 Marks]

19. (a) Why must a cell be made 'competent' in biotechnology experiments ? How does calcium ion help in doing so ?

(b) State the role of 'biolistic gun' in biotechnology experiments.

Ans. (a) - To take up the (hydrophilic) DNA from the external medium = 1

- Divalent calcium ions increase the efficiency of DNA entering the cell through pores in the cell wall = 1

(b) To introduce alien DNA into the plant cell by bombarding them with high velocity microparticles (gold or tungsten coated with DNA) = 1

[3 Marks]

20. Explain enzyme-replacement therapy to treat adenosine deaminase deficiency. Mention two disadvantages of this procedure.

Ans. Functional adenosine deaminase is given to the patient by injection = 1

Disadvantages

- Therapy is not completely curative , periodic infusion of enzyme required = 1 + 1

[3 Marks]

21. Name and explain the type of interaction that exists in mycorrhizae and between cattle egret and cattle.

Ans. - Mutualism = $\frac{1}{2}$

Association between fungi and the root of higher plants, fungus absorbs essential nutrients from the soil and plant provides the fungi with energy yielding carbohydrates (both benefitted) = $\frac{1}{2} \times 2$

- Commensalism = $\frac{1}{2}$

Cattle stir up and flush out insects from the vegetation on which the egret feed, cattle is neither harmed nor benefitted / not effected = $\frac{1}{2} \times 2$

[3 Marks]

22. Differentiate between primary and secondary succession. Provide one example of each.

Ans. Primary Succession

- It begins with areas where no living organisms ever existed

- Establishment of a biotic community is very slow

Example

Newly cooled lava / bare rocks / newly created ponds or reservoir

Secondary Succession

- It begins in areas where natural

biotic communities have been destroyed

- Establishment of a biotic community is faster = 1×2

Example

- Abandoned farm lands / burnt or cut forests / lands that have been flooded = $\frac{1}{2} \times 2$

[3 Marks]

SECTION - D

Q No. 23 is of four mark

23. A large number of married couples the world over are childless. It is shocking to know that in India the female partner is often blamed for the couple being childless.

(a) Why in your opinion the female partner is often blamed for such situations in India? Mention any two values that you as a biology student can promote to check this social evil.

(b) State any two reasons responsible for the cause of infertility.

(c) Suggest a technique that can help the couple to have a child where the problem is with the male partner.

Ans. (a) Female partner is blamed due to social mind set / inequality of sexes / lack of awareness / male dominated society / any other relevant point (*Any two*) = $\frac{1}{2} \times 2$

- Awareness to be created that abnormality can occur in both male and females and infertility issues with suitable examples

- Mutual respect towards both the partners in case of the problem and to find the remedy from medical experts instead of visiting quacks

- Educate them to find the reason and not believe in superstitions (*Any two*) = $\frac{1}{2} \times 2$

(b) Physical (abnormality in reproductive system), congenital, immunological or psychological (*Any two*) = $\frac{1}{2} \times 2$

- (c) Intra cytoplasmic sperm injection (ICSI) / artificial insemination (AI) / Intra uterine insemination (IUI) = 1 [4 Marks]

SECTION - E

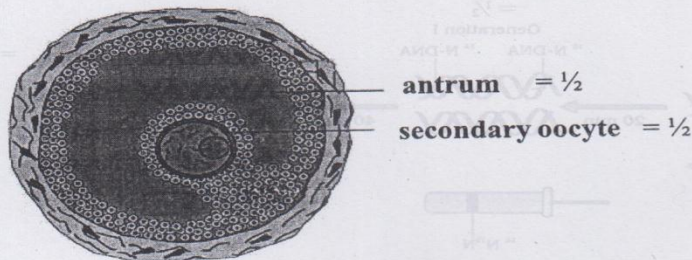
Q Nos. 24-26 are of five marks each

24. (a) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.
 (b) Why is follicular phase in the menstrual cycle also referred as proliferative phase? Explain.
 (c) Explain the events that occur in a graafian follicle at the time of ovulation and thereafter.
 (d) Draw a graafian follicle and label antrum and secondary oocyte.

Ans. (a) Menstrual phase occurs when released ovum not fertilised, break down of endometrial lining (of the uterus) and its blood vessel form the liquid that comes out through the vagina, lasts for 3 to 5 days = $\frac{1}{2} \times 3$
 Level of ovarian and pituitary hormones fall = $\frac{1}{2}$

// graphically represented

- (b) Primary follicle grows into graafian follicle under the influence of LH & FSH, regeneration of endometrium (under the influence of estrogen) = $\frac{1}{2} \times 2$
 (c) Graafian follicle ruptures to release the ovum (secondary oocyte), remaining parts of the Graafian follicle transform into corpus luteum = $\frac{1}{2} \times 2$
 (d)



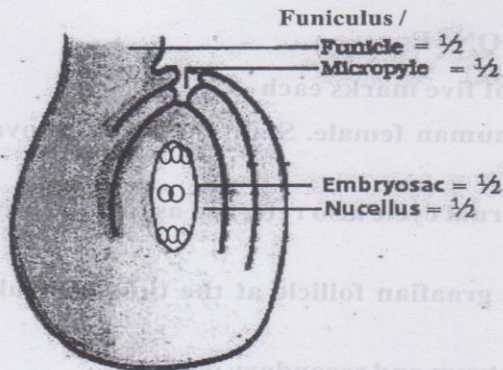
[5 Marks]

OR

- (a) As a senior biology student you have been asked to demonstrate to the students of secondary level in your school, the procedure(s) that shall ensure cross-pollination in a hermaphrodite flower. List the different steps that you would suggest and provide reasons for each one of them.
 (b) Draw a diagram of a section of a megasporangium of an angiosperm and label funiculus, micropyle, embryo sac and nucellus.

Ans. (a) Emasculation, removal of anthers from the flower bud before the anther dehisce to avoid self pollination = $\frac{1}{2} + \frac{1}{2}$
 Bagging, to prevent contamination of its stigma with unwanted pollen grains = $\frac{1}{2} + \frac{1}{2}$
 Rebagging, the stigma of the mature ovary are dusted with desired pollen grains and rebagged

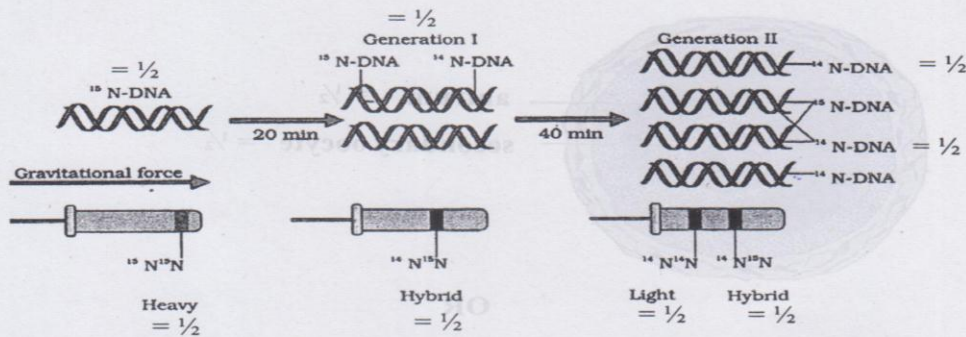
(b)



[5 Marks]

5. Describe Meselson and Stahl's experiment that was carried in 1958 on *E. Coli*. Write the conclusion they arrived at after the experiment.

They grew *E. coli*, in $^{15}\text{NH}_4\text{Cl}$ for many generations to get ^{15}N incorporated into DNA, then the cells are transferred into $^{14}\text{NH}_4\text{Cl}$, the extracted DNA are centrifuged in CsCl and measured to get their densities, DNA extracted from the culture after one generation (20 minutes), showed intermediate hybrid density, DNA extracted after two generations (40 minutes) showed light DNA, and hybrid DNA = $\frac{1}{2} \times 8 = 4$



A correctly labelled diagrammatic representation in lieu of the explanation of experiment = $\frac{1}{2} \times 8$
DNA replication is semi conservative in nature = 1

OR

- (a) Describe the process of transcription in bacteria.
(b) Explain the processing the hnRNA needs to undergo before becoming functional mRNA in eukaryotes.

(a) Initiation: Enzyme(DNA dependent RNA polymerase)RNA polymerase binds with sigma factor (σ) and attaches to the promoter site ie 5' site of the DNA = 1

Elongation: When RNA polymerase moves from promoter to the terminator site it causes the polymerisation of nucleoside triphosphates / Nucleotides resulting in the formation of RNA (in

BIOLOGY (Code No. 044)
QUESTION PAPER DESIGN

Class - XII (2016-17)

Time 3 Hours

Max. Marks: 70

S. No.	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer-I (SA-I) (2 marks)	Short Answer -II (SA-II) (3 marks)	Value based question (VBQ) (4 marks)	Long Answer (LA) (5 marks)	Total Marks	% Weightage
1.	Remembering- (Knowledge based Simple recall questions, to know specific facts, terms, concepts, principles, or theories, Identify, define, or recite, information)	2	1	1	-	-	7	10%
2	Understanding- (Comprehension -To be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	-	2	4	-	1	21	30%
3	Application (Use abstract information in concrete situation, to apply knowledge to new situations, use given content to interpret a situation, provide an example, or solve a problem)	-	2	4	-	1	21	30%
4	High Order Thinking Skills (Analysis & Synthesis- Classify, compare, contrast, or differentiate between different pieces of information, Organize and/or integrate unique pieces of information from a variety of sources)	2	-	1	-	1	10	14%
5	Evaluation- (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	1	-	2	1	-	11	16%
TOTAL		5x1=5	5x2=10	12x3=36	1x4=4	3x5=15	70(26)	100%