DAY THIRTY THREE

Biology and Human Welfare

Learning & Revision for the Day

- Health
- Diseases
- AIDS
- Cancer
- Basic Concepts of Immunology
- Adolescence
- Drugs and Alcohol Abuse
- Strategies for Enhancement in Food Production
- Biofortification
- Single Cell Proteins
- Tissue Culture
- Microbes in Human Welfare

Health

Health is defined as a state of complete physical, mental and social well-being and is not merely the absence of disease or infirmity. Balanced or good health is a state of optimum physical fitness, mental maturity, alertness, freedom from anxiety and social well-being with freedom from social tensions. Health can be affected by the following factors

1. **Lifestyle related problems** The habit and food related problems affect our health reversibly, e.g. diabetes, obesity, etc.
2. **Infections** Health gets affected by infections caused by various pathogens, e.g. eye flu.
3. **Genetic disorders** These include defects or deficiencies inherited by child from his parents, e.g. haemophilia.

Diseases

Any deviation from normal state of health is called a disease, in which the normal functioning of body or any organ gets disturbed or deranged. Diseases can be classified as given below

Congenital Diseases

These diseases are present in human, since birth and caused due to mutation, chromosomal aberration or environmental factors, e.g. alkaptonuria, sickle-cell anaemia, cleft palate, etc.

Acquired Diseases

These diseases are developed after birth and are not transferred from parents to offspring.

(i) **Communicable or infectious diseanes** It spreads from one person to other.

(a) **Contagious diseases** spread by direct contact, e.g. ringworm, leprosy, etc.

(b) **Non-contagious diseases** spread through indirect contact, e.g. cholera, typhoid, etc.

(ii) **Non-communicable diseases** do not spread from one person to other, e.g. arthritis, diabetes, etc.

Communicable or Infectious Diseases

Various microorganisms responsible for infectious disease are bacteria, viruses, fungi, protozoans, worm, etc. These are disease causing organisms called as **pathogens**. The pathogens can enter our body by various ways, multiply and disturb the normal metabolic activities thus, shattering the major organ systems.

Depending upon the causative organism/pathogen communicable diseases are of following types

Some Human Diseases Caused by Viruses

Disease	Pathogen	Epidemiology	Incubation	Symptoms	Prophylaxis	Therapy
• Common cold	Rhinovirus	Droptet infection	—	Nasal congestion, sore throat, cough, headache and tiredness.	Avoid contact with infected articles and patient	
• Chicken pox (Varicella)	Herpes zoster virus	Contagious	12-20 days	High faver with dark red coloured rash or pox changing into vesicles, crusts and falling.	Avoid contact with patient	Zoster Immuno Globulins (ZIG), Varicella vaccine
• Smallpox	Variola virus	Contagious and droplet infection	12 days	Appearance of rash changing into pustules, scaps and falling, pockmarks are left.	Smallpox vaccine	No case reported after 1978
• Poliomyelitis	Polio virus (Picornavirus)	Direct and oral	7-14 days	Damages motor neurons causing stiffness of neck, convulsion and paralysis of generally legs.	Salk vaccine and Oral (sabin vaccine) Polio Vaccine (OPV)	Physiotherapy
• Measles (Rubella disease)	Rubella virus	Contagious and droplet infection	10 days	Rubella (skin eruptions), coughing, sneezing, etc.	Edmonston B-vaccine and isolation	Antibiotic and sulpha drugs
• Mumps	Mumps virus	Contagious and droplet infection	12-26 days	Painful enlargement of parotid and salivary glands.	Mumps vaccine and isolation	Antibiotics
• Rabies (Hydrophobia)	Rabies virus	Indirect and inoculative (vectors are rabid animals especially dogs)	10 days to 1-3 months	Spasm of throat and chest muscles, fear from water, paralysis and death.	Immunisation of dogs	Pasteur-treatment

Some Human Diseases Caused by Bacteria

Disease	Pathogen	Epidemiology	Incubation Period	Symptoms	Prophylaxis	Therapy
• Tuberculosis	*Mycobacterium tuberculosis*	Air-borne and droplet infection	2-10 weeks	Coughing, chest pain and bloody sputum with tuberculin.	BCG vaccine	Streptomycin, para-amino salicylic acid rifampicin, etc.
• Diphtheria	*Corynebacterium diphtheriae*	Air-borne and droplet infection	2-6 days	Inflammation of mucosa of nasal chamber, throat, etc., respiratory tract blocked.	DPT vaccine	Diphtheria antitoxins, penicillin and erythromycin.
• Cholera	*Vibrio cholerae*	Direct and oral (with contaminated foods and water)	6 hours to 2-3 days	Acute diarrhoea and dehydration.	Sanitation, boiling of water and cholera vaccine	Oral rehydration therapy and tetracycline

Disease	Pathogen	Epidemiology	Incubation Period	Symptoms	Prophylaxis	Therapy
• Leprosy	*Mycobacterium leprae*	Slowest infectious and contagious	2-5 years	Skin hypopigmentation, nodulated skin, deformity of fingers and toes. Lepromin in skin tests.	Isolation	Dapsone, rifampicin and clofazimine
• Pertussis	*Bordetella pertussis*	Contagious and droplet infection	7-14 days	Whoops during inspiration.	DPT vaccine	Erythromycin
• Tetanus (lockjaw)	*Clostridium tetani*	Throat injury	3-21 days	Degeneration of motor neurons, rigid jaw muscles, spasm and paralysis.	ATS and DPT vaccines	Tetanus antitoxins
• Typhoid	*Salmonella typhi*	Direct and oral	1-3 weeks	Classic typhoid fever and widal test.	TAB-vaccine and screening of food and water	Chloramphenicol
• Plague	*Pasteurella pestis*	Indirect and inoculative (vector is rat flea)	2-6 days	Bubonic plague affects lymph nodes; pneumonic plague affects lungs and septicemic plague causes anaemia.	Killing of rats and rat fleas, plague vaccine	Tetracyline, streptomycin and chloromycetin.
• Gonorrhoea	*Neisseria gonorrhoeae*	Sexual transmission	2-10 days	Inflammation of urinogenital tract.	Avoid multiple sex partners	Penicillin and ampicillin
• Syphilis	*Treponema pallidum*	Sexual transmission	3 weeks	Painless lesions orogenital warty growth.	Avoid multiple sex partners	Tetracycline and penicillin
• Pneumonia	*Diplococcus pneumoniae*	Air-borne	1-3 days	Decrease in respiratory efficiency.	Isolation	Penicillin and flucloxacillin
• Salmonellosis	*Salmonella enteritidis*	Direct and oral	48 hours	Diarrhoea	Isolation	Oral dehydration therapy and tetracycline

Some Pathogens and their Symptoms

Diseases	Causative organisms	Mode of infection	Symptoms and sign	Diagnostic test/technique/ treatments
Protozoan Diseases (caused by Protozoa)				
Amoebic dysentery	*Entamoeba histolytica*	By contaminated food and water	• Pathogen enters human intestine causing disease. Passing of blood along with the faeces and pain in abdomen.	• Stool test for diagnosis Drug-metronidazole
Malaria fever	*Plasmodium vivax* (benign tertiary malaria), *Plasmodium falciparum* (malignant malaria) and *Plasmodium malariae* (quartan malaria)	By the bite of female *Anopheles* mosquito	• RBCs and liver of the host are on the target • Fever at intervals, restlessness, less appetite, slight sleeplessness, muscular pain, headache and a feeling of chilliness.	• Blood test, drug-quinine, paludrine, primaquin
African sleeping sickness	*Trypanosoma brucei*	By the bite of the tse-tse fly *(Glossina palpalis*)	• Swelling of lymphatic glands, fever, weakness, loss of weight, anaemia, increase in pulse rate.	• Blood test
Kala azar (dum-dum fever)	*Leishmania donovani*	By bite of sandfly	• Protozoa infects liver, lymph glands and WBCs of man, dog and cat. • Swelling, high fever and enlargement of spleen and liver, weakness and anaemia	• Blood test

Helminthic Diseases (caused by Helminths)				
Filariasis (elephantiasis)	*Wuchereria bancrofti* and *W. malayi*	By bites of *Culex* mosquitoes	• Swelling of the legs and scrotum as lymphatic tissues are targetted.	• Blood test, drugs - albendazole, diethylcarba-mazine
Ascariasis	*Ascaris lumbricoides*	By contaminated food and water	• It enters small intestine causing chronic pain, indigestion, diarroehea and vomiting	• Stool test, drugs- chenopodium, alcopar, bendex, mebendazole, etc
Ancylostomiasis (hookworm disease)	*Ancylostoma duodenale*	By boring through the skin and feet	• Worm infects small intestine causing blood dysentery, loss of weight and anaemia	• Stool test
Fungal Diseases (caused by fungi)				
Ringworm or Tinea pedes	Trichophyton, Epidermophyton and Microsporum	Acquired from infected person by using his towels/clothes	• Dry. scaly lesions on skin, nails and scalp.	• Sign and symptoms help in diagnosis.
Dandruff	*Malassezia globoca*	By using of contaminated clothes, combs, etc.	• Dry skin, flakes of skin that range from small and white to large, greasy and yellow, itchy flaking that appears on the scalp or eyebrow or around the hairline, ears or nose.	• Sign and symptoms help in diagnosis.

Non-Communicable Diseases

These can be categorised as follows:

(i) **Hormonal diseases** Diseases due to defects in the production of hormones. Examples of these are

(a) **Cretinism** (due to the deficiency of thyroxine)

(b) **Diabetes** (due to the deficiency of insulin).

(ii) **Cancer** It is caused due to uncontrolled cellular growth in certain tissues, e.g. breast cancer.

(iii) **Allergic diseases** They occur due to overactive response of immune system towards certain things like dust, serum, drugs, fabric, pollen, etc., e.g. sneezing, irritation, itching, rashes.

(iv) **Ageing and degenerative diseases** Degeneration of body tissue result in this disease, e.g. weakening of eye muscles, arteriosclerosis and arthritis (joint and bone diseases).

(v) **Deficiency diseases** These occur due to the deficiency of nutrients in diet. These are

(a) **Protein deficiency** Kwashiorkor, marasmus, etc.

(b) **Vitamin deficiency** Pellagra, scurvy, etc.

(vi) **Mental disorders** These occur due to depression, anxiety, etc., e.g. schizophrenia.

(vii) **Disease caused by addictive substances** like alcohol, narcotic drugs, tobacco and certain psychological factors, cause liver damage, reduced alertness, etc.

(viii) **Diseases of malfunctioning** These diseases are caused by malfunctioning of organs, e.g cardiac failure, kidney failure, osteoporosis, myopia, cataract.

AIDS

- Acquired Immuno Deficiency Syndrome or AIDS is caused by the Human Immunodeficiency Virus (HIV), a member of a group of viruses called **retrovirus,** which have the envelope enclosing the RNA genome.
- **Transmission** of HIV-infection occurs by
  - Sexual contact with infected person.
  - By transmission of contaminated blood and blood products.
  - By sharing infected needles in case of intravenous drugs.
  - From infected mother to her child through placenta.
- The **prevention** measures of AIDS are listed below
  - Use of disposable needles and syringes.
  - Checking blood for HIV.
  - Free distribution of condoms and advocating safe sex.
  - Control of drug abuse.
  - Promoting regular check-up for HIV in susceptible population, etc.
- AIDS is diagnosed by **ELISA** (Enzyme Linked Immuno Sorbent Assay) test. Treatment with anti-retroviral drugs is only partially effective as they can delay but cannot prevent the death of patient.

Cancer

In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms.

Normal cells show a property of cell **contact inhibition** through which their uncontrolled growth is inhibited. Cancer cells lack this property.

As a result, cancer cells continue to divide and give rise to masses of cells called **tumours**, which are mainly of two types

- **Benign tumour**s remain confined to their original location and do not spread to other parts.
- **Malignant tumours** are masses of neoplasmic/proliferating cells, which exhibit metastasis, i.e. grow rapidly, invade and damage the surrounding normal tissue/cells.

- Cancer can be detected by
  - Biopsy and histopathological studies of the tissue.
  - Use of techniques like radiography, Magnetic Resonance Imaging (MRI) and Computed Tomography (CT).
  - Use of antibodies against cancer-specific antigens.
- Cancer can be treated by
  - Surgery
  - Radiotherapy
  - Chemotherapy
  - Immunotherapy

Basic Concepts of Immunology

The ability of the host to fight against the disease causing organisms is called **immunity** and the cells, molecules, proteins, etc. which play role in the phenomenon constitute a system known as **immune system**.

Few important points related to immunology are

- The immune system of our body consists of lymphoid organs, tissues, cells and soluble molecules like antibodies.
- The primary lymphoid organs are bone marrow and thymus. The secondary lymphoid organs are spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix.
- The bone marrow is the main lymphoid organ, where all blood cells including lymphocytes are produced. The thymus is a lobed organ, located near the heart and beneath the breastbone.
- Both bone marrow and thymus provide micro, environments for the development and maturation of B and T-lymphocytes. The spleen is a large bean-shaped organ. It mainly contains lymphocytes and phagocytes. It also has large reservoir of erythrocytes.
- The lymph nodes are located at different points along the lymphatic system. They trap the microbes or antigens. These antigens are responsible for the activation of lymphocytes causing the immune response.
- A lymphoid tissue is also located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called **Mucosal Associated Lymphoid Tissue** (MALT). It constitutes about 50% of the lymphoid tissue in human body.

Types of Immunity

Immunity is of two types

1. **Innate immunity** is non-specific and present since the time of birth. It can be accomplished by providing different types of barriers to the entry of microbes which are

   (i) Physical barriers (ii) Physiological barriers
   (iii) Cellular barriers (iv) Cytokine barriers

2. **Acquired immunity** is pathogen specific and characterised by memory.
   - B and T-lymphocytes produce primary and secondary responses.
   - B-lymphocytes produce antibodies and T-cells help them in this process.
   - The response provided by antibodies IgA, IgM, IgE, IgG and IgD present in blood is called **humoral** immune response (antibody-mediated).
   - The second type is called **cell-mediated** immune response or Cell-Mediated Immunity (CMI). The T-cells mediate CMI.

Acquired immunity can be classified as

(i) **Active immunity** is acquired when the host is exposed to antigen. It can further be classified into
- **Naturally acquired** immunity involves natural infection by a pathogen which generates antibodies and specialised lymphocytes.
- **Artificially acquired** immunity is comprised by vaccines that are introduced in body to generate antibodies and specialised lymphocytes.

(ii) **Passive immunity** is acquired when ready-made antibodies are given to the body. It can be further classified into
- **Natural antibodies** pass passively from mother to child *via* placenta and milk.
- **Artificial antibodies** are formed within organisms are introduced through injection for defensive purpose against the pathogen.

Vaccination

It is the introduction of antigenic proteins of pathogen or inactivated weakened pathogens into the body, to trigger the immune system for the formation of antibodies, during the natural infection of the introduced pathogen.

Vaccines can be classified as

(i) **First generation vaccines** In preparation of these vaccines, whole microorganisms are used. These are not of uniform quality and produce side effects.

(ii) **Second generation vaccines** These vaccines are produced by recombinant DNA technique/genetic engineering, e.g. Hepatitis-B virus vaccine, herpes virus vaccine, pneumonia vaccine.

(iii) **Third generation vaccines** These are chemically synthesised multivalent vaccines. These vaccines have high purity.

Allergies

- The are the exaggerated response of the immune system to certain antigens present in the environment.
- The substances to which such an immune response is produced are called **allergens.**
- Symptoms of allergy are sneezing, watery eyes, running nose and difficulty in breathing.
- Allergy occurs due to the release of chemicals like histamine and serotonin from the mast cells. The use of drugs like anti-histamine, adrenaline and steroids quickly reduce the symptoms of allergy.

Autoimmunity

- It is memory-based acquired immunity evolved in higher vertebrates. Sometimes, due to the genetical and other reasons, the body attacks self-cells. When the body attacks self cells, this results in damage to the body and is called **autoimmune disease**, e.g. rheumatoid arthritis, Grave's disease, etc.

Adolescence

The World Health Organisation (WHO) defines adolescence as the period of life between 12 and 19 yrs of age. Adolescence is the formative period of both physical and psychological health and is the preparatory phase for the adult life.

That's why a healthy adolescence is a critical juncture for a healthy adulthood.

Characteristics of Adolescence

(i) **Imaginary audience** False belief in adolescents that other are intensely interested in their appearance and judge their every move.

(ii) **Metacognition** Also called **introspection**. It is the capacity to reflect on our own thoughts and behaviour.

(iii) **Personal fables** Beliefs in adolescents that they are highly special and destined to live a heroic or legendary life.

(iv) **Egocentrism** Lack of differentiation between some aspects of self and other, unpleasant behaviours.

- Adolescence is accompanied by several biological and behavioural changes. Curiosity, need for adventure, excitement and experimentation may constitute the common causes, which motivate adolescents to start taking drugs and alcohol. Other causes include peer pressure, family history, media, etc.

Drugs and Alcohol Abuse

Drugs are psychoactive substances which are ingested for recreational use, often is illegal and addictive. The commonly abused drugs are

(i) **Opioids** are drugs which bind to opioid receptors in the central nervous system and gastrointestinal tract, e.g. morphine and heroin.

(ii) **Cannabinoids** are a group of chemicals, which interact with cannabinoid receptors present mainly in the brain (CNS).

(iii) **Cocaine** is obtained from *Erythroxylum coca,* it interferes with the transport of neurotransmitter and dopamine.

(iv) **Hallucinogens** are products obtained from *Atropa belladona* and *Datura* species which are hallucinogenic. LSD is obtained from a fungus.

(v) **Tobacco** contains mainly nicotine, which is a stimulant and toxin. Nicotine stimulates the adrenal gland to release adrenaline and nor-adrenaline, which increase the blood pressure and heart rate and also causes oral cancer on chewing.

(vi) **Alcohol** is a depressant. It affects the central nervous system. Alcohol acts as a sedative, analgesic and anesthetic.

- **Addiction** is a psychological attachment to certain effects such as *Euphorbia* and a temporary feeling of well-being associated with drugs and alcohol.
- **Dependence** is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome, if the regular dose of drugs/alcohol is abruptly discontinued.

Effects of Drug/Alcohol Abuse

The common warning signals of drug/alcohol addiction are

- Drop in academic performance.
- Isolation from family and friends.
- Lack of interest in personal hygiene.
- Aggressive and rebellious behaviour.
- Reckless behaviour, vandalism and violence.

Prevention and Control

The preventive measures are

- Avoid undue peer pressure.
- Accept failures and disappointments as part of life.
- Seek help from parents and peers.
- Seek professional and medical help for deaddiction.
- Look for danger signs.

Strategies for Improvement in Food Production

With the ever increasing world population, the demand for food is also increasing. As the cropping area is not increasing significantly, the search for alternate food resources and strategies for enhancement in food production plays an important role. The two important techniques involved in enhancement of food production are **plant breeding** and **animal husbandry.**

Plant Breeding

It is the purposeful manipulation of plant species in order to create desired plant types that are better suited for cultivation, give better yields and are disease resistant. The first and foremost aim in plant breeding is to create useful variation in the crop plant. The main steps in breeding a new genetic variety of a crop are

Step I Collection of variability For effective exploitation of natural genes available in the population, the collection and preservation of all the different wild varieties, species and relatives of the cultivated species takes place. The collection is called **germplasm collection.**

Step II Evaluation and selection of parents The germplasm is evaluted to identify the parent with desirable characters, which is further used in the process of fertilisation.

Step III Cross hybridisation among the selected parents The set of different desired characters can be combined through hybridising these parents. It is very time consuming and tedious process. One among several progeny individual is true hybrid.

Step IV Screening and testing of superior recombinants It is the process of selection of hybrid with desired character combination. It is crucial process and requires careful scientific evaluation of the progeny.

Step V Testing, release and commercialisation of new cultivers The newly selected variety is evaluated on the basis of various performance parameters in varied conditions. Later these are released as the product in market for commercial purpose.

- Plant breeding is useful in improvement of nutritional quality by genetic engineering, e.g. fortified rice, iron rich rice and carotene rich rice and development of disease, drought and environmental stress resistant varieties.

Selection in Plant Breeding

Selection is the oldest method of plant breeding in which individual plant or group of plants are sorted out from mixed population, thus eliminating undesirable ones. The selection methods include

(i) In **mass selection** method, plants are selected based on their desirable morphological characters (phenotype).

Some crop varieties developed by mass selection are as follows

Crop	Variety
Cotton	Dharwar American, Dodahati local and Cambodias
Groundnut	TMU-1, TMU-2, AK-10 and K-122

(ii) A **pureline** is a collection of plants obtained as a result of repeated self-pollination from a single homozygous individual. Hence, a variety formed by this method shows more homozygosity with respect to all genes.

Some crop varieties developed by pureline selection are

Crop	Variety
Wheat	NP-4, NP-6, K-13, Kalyan Sona and Sonalika
Rice	CO-4, CO-10 and MU-3
Cotton	CO-2, RC-50, Gourani, Nandyala-14 and Coconanda-1
Tobacco	NP-28 and T-59
Groundnut	TMV-3
Castor	HC-1 and HC-b

(iii) **Progeny selection** is mainly employed in cross-pollinated crops and it overcomes some of the demerits of mass selection. It is based on the principle of testing the progenies of selected plants, and the final selection is based on this test. The most common method used in maize is **ear-to-row** method, developed by Hopkins in 1908.

(iv) **Clonal selection** method is used for crops like sugarcane, potato, tea, banana and certain species of grasses which are asexually propagated and produce very poor seeds.

Some crop varieties developed by clonal selection are

Crop	Variety
Potato	Kufri Red and Kufri Safed
Mango	Mundapa, Padma and Neelam
Banana	Bombay Green and High Gate
Orange	Yuvraj and Blood Red

Hybridisation

- It is the method of producing new crop varieties in which two or more plants of unlike genotype (genetically dissimilar) are crossed.
- **Hybrid** is an offspring of a cross between two genetically unlike individuals.
- The first natural hybridisation was reported in corn (maize) by **Mather**, whereas the first artificial hybrid was

obtained by **Thomas Fairchild**, which is known as **Fairchild Mule.**

- Hybridisation can be **intravarietal** (i.e. cross between two plants of the same variety having different genotypes), **intervarietal** (i.e. cross between the plants of different varieties of the same species), **interspecific** or **intrageneric** (i.e. cross between two different species of the same genus) and **intergeneric hybridisation** (i.e. cross between the plants belonging to different genera of the same family).

Some crop varieties developed by hybridisation are

Crop	Variety
Varieties Developed by Intervarietal Hybridisation	
Wheat	NP 52 × NP 165 → NP 170
Cotton	Malvi 8 × Jarlia → Maljari
	Grade 1 × CO-2 → Laxmi
Tomato	Sioux × Meeruti → Pusa Ruby
Varieties Developed by Interspecific Hybridisation	
Cotton	*Gossypium hirsutum* × *Gossypium arboreum* → Deviraj
	G. hirsutum × *G. herbaceum*→ Devitej
Potato	*Solanum eurtilobatum* × *Solanum andigenum* × *Solanum tuberosum* → Kufri Kuber
Tomato	*Lycopersicon esculentum* × *Lycopersicon pimpinellifolium* → Pusa Red Plum

Intergeneric Crop Varieties

Crop	Developed by the Cross Between
Triticale	*Triticum aestivum* × *Secale cereale*
Rabbage	Radish × Cabbage
Raphanobrassica	*Raphanus sativus* × *Brassica oleracea*
Bromato	Brinjal × Tomato
Sugarcane and *Sorghum*	Sugarcane × *Sorghum*

NOTE

- Inbreeding is the mating between individuals related by descent or ancestry. The main effect of inbreeding is an increase in **homozygosity** in the progeny, but it also causes inbreeding depression. Inbreeding depression is the reduction or loss in vigour and fertility as a result of inbreeding.
- **Emasculation** is the removal of anthers or male reproductive part from flowers of female parents before maturity or before anthesis (i.e. first opening of flower) or before bursting of anthers. Emasculation is a step in hybridisation.

Methods of Breeding for Disease Resistance

It is carried out by either of the following two breeding methods

1. Conventional Breeding

Conventional plant breeding has been going on for hundreds of years, and is still commonly used today. It is known as the breeding or planting, which uses chemical ways like chemical fertilisers or synthetic components.

Some Important Diseases Resistant Varieties

Crops	Varieties	Resistance to diseases
Wheat	Himgiri	Leaf and stripe rust and hill bunt
Brassica	Pusa Swarnim (Karan rai)	White rust
Cauliflower	Pusa Shubhra, Pusa Snowball K-1	Black rot and curl blight black rot
Cowpea	Pusa Komal	Bacterial blight
Chilli	Pusa Sadabahar	Chilli mosaic virus, tobacco mosaic virus and leaf curl

2. Mutation Breeding

- Mutations are sudden heritable changes in the characteristics of an organism. The improvement of crops by changing the genotype of plants through induced mutations is called mutation breeding, e.g. Sharbati Sonora was produced from Sonora-64 by mutation breeding using gamma-rays.
- Mutation breeding involves both physical and chemical mutagens. It can be done on both somatic and germ cells.
- Some other new varieties of crops developed by mutation breeding are NP 386 (wheat), Jagannath (rice), Aruna (castor), MU-7 and Indore-2 (cotton), etc.

NOTE

- **Polyploid breeding** is done to produce plants with extra set of chromosomes. Polyploid individuals carry more than two sets of genome such as *3n* (triploid), *4n* (tetraploid), 5*n* (pentaploid), etc. *Triticum aestivum* (wheat) is a natural hexaploid (2*n* = 42).
- ***Triticale*** is the first man-made allopolyploid cereal crop.

Biofortification

The breeding of crops with the higher levels of vitamins and minerals or higher proteins and healthier fats is called biofortification. Wheat variety Atlas-66 having a high protein content has been used as a donor for improving cultivated wheat.

Other examples of biofortified crops are iron fortified rice, vitamin-A enriched carrots, spinach, pumpkin and protein enriched beans and peas, etc.

Single Cell Proteins (SCPs)

Single cell protein is protein rich biomass produced by unicellular and multicellular organisms like bacteria, fungi, yeast, algae, etc. These organisms are processed and used as human food.

Some Microorganisms Used for SCP Production

Microorganism	Substrate for Growing	Countries, where these are Used Commercially
Yeast		
Candida utilis (torula yeast)	Confectionery effluents, ethanol and sulphite liquor	UK, USA, Russia and Europe
Fungi		
Chaetomium cellulolytium	Cellulosic wastes	UK and Finland
Fusarium graminearium	Starch hydrolysates	
Bacteria		
Brevibacterium sp.	$C_1 - C_4$ hydrocarbons	UK
Methylophylus methylotrophus	Methanol	

- SCP is advantageous in following ways
  - High quality protein and less fat content.
  - Reduces pressure on agricultural production systems.
  - Minimises the use of environment hazardous insecticides and fertilizers that cause pollution.
  - Can be produced throughout the year.

Tissue Culture

- This technique is based on the totipotency (i.e. ability of a cell to give rise to whole plant) of plant cell.
- The concept of totipotency was given by **Haberlandt** (1902) and detailed practical applications of totipotency was shown by **Steward** (1932), who developed a complete carrot plant from a root cell.
- Applications of plant tissue culture are as follows
  - A plant breeder may use tissue culture to screen cells rather than plants for advantageous characters, e.g. herbicide resistance/ tolerance against insect or pest, disease resistance.
  - Large scale growth of plant cells in liquid culture in bioreactors is used for the production of valuable compounds like plant derived secondary metabolites and recombinant proteins used in biopharmaceuticals.
  - To cross distantly related species, culturing the tissue of resulting embryo can be done for its growth, which would otherwise normally die (embryo rescue).
  - For rapid production of doubled monoploid (dihaploid) plants from haploid cultures to achieve homozygous lines, in breeding programmes, the haploid plants are treated with colchicine, to double the chromosome number.

Somatic Hybridisation

It involves the fusion of protoplasts of two different species, which resulted into hybrid formation. The fusion of protoplasts from two different varieties can be enhanced by treating them with the chemical called **Polyethylene Glycol** (PEG) in the presence of high voltage electric current on a suitable medium. This method in plant breeding is called **protoplasmic fusion.**

Green Revolution

- **NE Borlaug,** a famous Mexican plant breeder, was awarded by a **Nobel Peace Prize** (1970) for developing high yielding dwarf varieties such as Sonora-64 and Lerma Rojo-64. He is also known as **Father of Green Revolution.**
- NE Borlaug developed semi-dwarf wheat varieties by using Norin-10 gene (dwarfing gene) from a Japanese variety and semi-dwarf rice varieties.
- **Dr. MS Swaminathan** is the pioneer in mutation breeding. He is also known as founder of Radiation Genetics and Father of Green Revolution in India.
- India received semi-dwarf wheat material from Mexico and introduced Lerma Rojo and Sonora-64 varieties.
- **IR-36** is a rice variety, developed by a team of IRRI (Philippines) scientists led by **Dr. Gurudev S Khush.** It is the most widely planted variety in history.

Animal Husbandry

- The science of rearing, caring, feeding, breeding, improvement and utilisation of domesticated animals is called **animal husbandry**.
- The domesticated animals kept for use or profit are collectively called **livestock**. The livestock of India can be categorised into milk yielding animals, meat and egg yielding animals utilised as motive power and wool yielding animals.
- **Dairying** is the management of animals for milk and its products for human consumption. Milk yield is dependent primarily on the quality of breeds.
- The following are requirements for good dairy management
  (i) Sufficient and nutrient-rich fodder; clean water and proper shelter.
  (ii) Disease-free conditions and proper hygiene should be maintained.

1. Poultry Culture

- It involves rearing of fowls, ducks, geese, turkeys and some varieties of pigeons but more often is used for fowl rearing.
- Fowls are reared for food or for their eggs. The poultry birds reared for meat are called **broilers**.

- Layers are the female fowls reared for egg production.
- Cockerel is a young male fowl. Rooster is the mature male fowl.
- The hens normally start egg laying from February and continue till August with some intervals.
- The average production of an Indian breed is about 60 eggs per annum.
- The important points of poultry management are
  - Selection of disease-free and suitable breeds.
  - Proper feed and water.
  - Safe and hygienic shelter.
- The most common disease amongst fowls is **Ranikhet disease** or **new castle disease**, which is caused by a virus. In this disease, bird opens the beak, becomes thirsty and suffers from fever and yellowish white diarrhoea.

2. Pisciculture

- It is the rearing and breeding of fishes in ponds and artificial water reservoirs.
- Fisheries are the place where aquatic animals are reared.
- Some freshwater fishes found in India are as follows

Common Name	Zoological Name
Catla	*Catla catla*
Singhi	*Heteropneustes heteropneustes*
Rohu	*Labeo rohita*
Singhara	*Mystus singhara*

- Some marine fishes found in India are as follows

Common Name	Zoological Name
Sardine	*Sardinella*
Pomfret	*Stromateus*
Eel	*Anguilla*
Salmon	*Aluitheronema*
Bombay duck	*Harpodom*
Hilsa	*Tenualosa ilisha*

3. Sericulture

- It is the production of raw silk from the silkworm by practicing the rearing of silkworm on commercial scale.
- Silk is obtained from six species of silkworm, i.e. mulberry silkworm (*Bombyx mori*), tasar silkworm (*Antheraea paphia*), muga silkworm (*Antheraea assama*), eri silkworm (*Attacus ricinni*), oak silkworm (*Antherae pernyi*) and giant silkworm (*Attacus altas*).

4. Apiculture

- It is the rearing of honeybees on commercial scale. Four species of honeybees are reported in different parts of India, i.e. *Apis florea* (little bee), *Apis indica* (Indian bee), *Apis dorsata* (rock bee) and *Apis mellifera* (European bee).
- European bee is the best species from commercial point of view.
- Bees communicate with one another by dance language. Round dance indicates the closeness of food source from hive, while tail wagging dance indicates distance and direction of food source.
- **Prof. K von Fritsch** succeeded in recording honeybee dance and was honoured by Nobel Prize.
- Nosema disease is caused by protozoan *Nosema apis*.
- The chemical composition of honey is

Component of Honey	Amount in Percentage
Ash	1.00%
Enzymes and pigments	2.21%
Maltose	8.81%
Water	17.20%
Dextrose	21.28%
Laevulose	38.9%

Microbes in Human Welfare

Microbes are microscopic organisms, i.e. can be seen only under a microscope. The diverse microbes are viruses, viroids, bacteria, fungi, protozoans and certain algae. These microbes like bacteria and fungi can be cultured on nutritive media to form colonies in the laboratory. Microbes can be useful and harmful as well.

The useful aspects of microbes are given below

1. Microbes in Household Food Processing

- **Curd** is produced by *Lactobacillus* and other Lactic Acid Bacteria (LAB) , which grow in milk and convert it into curd.
- **Dough** is a fermented product obtained from bacteria. The puffed up appearance is due to the CO_2 produced during fermentation.
- **Toddy** is produced by fermenting coconut water and sap from plants.
- **Cheese** differs in texture, flavour and taste, depending on the microbe used for its fermentation, e.g. Swiss cheese and Roquefort cheese.

2. Microbes in Industrial Products

- **Beverages** like whisky, rum and brandy, wine and beer are made by fermenting different types of raw materials using yeast, *Saccharomyces cerevisiae*.
- **Antibiotics** like penicillin is obtained from the fungus *Penicillium notatum*.
- **Enzymes** produced by various microbes are lipases, proteases and pectinases.

Enzymes Synthesised by Various Microbes

Enzyme	Microorganism
Amylase	Bacteria—*Bacillus subtilis*, *B. mecarans* and *B. diastoticus*. Fungi—*Aspergillus oryzae*, *A. niger* and *Rhizopus oryzae*.
Protease	Bacteria— *Bacillus subtilis* and *B. licheniformis*. Fungi—*Aspergillus oryzae*, *Penicillium roqueforti* and *Mortieralla reinspora*.
Pectinase	Fungi—*Aspergillus niger* and *Byssochlamys fulvo*.
Lipase	Fungi—*Candida lipolytica, Geotrichum candidum, Aspergillus niger* and *Mucor javanicus*.
Invertase (sucrase)	Fungi—*Saccharomyces cerevisiae*.
Renin/Rennet	Fungi—*Mucor pusilus* and *Endothia parasitica*.

- **Bioactive molecules** like cyclosporin (Immuno Suppressive Agent) statins (lowers blood cholesterol levels) are prepared using a fungus *Trichoderma polysporum* and a type of yeast *Monascus purpureus,* respectively.
- **Organic acids** are made by using different microbes, e.g. citric acid (*Aspergillus niger*– fungus), acetic acid (*Acetobacter aceti*–bacterium), lactic acid (*Lactobacillus delbrueckii* – bacterium), etc.

Organic Acids Synthesised by Various Microbes

Organic Acid	Microorganism
Lactic acid	*Lactobacillus delbreuki, L. bulgaricus, Streptococcus lactis* and *Rhizopus* species
Acetic acid (vinegar)	*Acetobactor aceti*
Citric acid	*Aspergillus niger, Penicillium* sp. and *Mucor* sp.
Gluconic acid	*Acetobacter aceti, Aspergillus niger, Penicillium* and *Chrysogenum*
Butyric acid	*Clostridium acetobutyricum*
Oxalic acid	*Aspergillus* sp.
Gallic acid	*Aspergillus niger*

3. Microbes in Sewage Treatment

- Sewage contains a large amount of organic matter and microbes. This cannot be discharged directly into natural water bodies like rivers. Treatment of sewage is done by the heterotrophic microbes naturally present in sewage.
- This treatment is carried out in two stages
  1. **Primary treatment** basically involves physical removal of large and small particles and debris from the sewage through filtration and sedimentation.
  2. **Secondary treatment** or **Biological treatment** is basically done to significantly reduce the Biochemical Oxygen Demand (BOD) of the primary effluent.
- The primary effluent is passed into large aeration tanks, where it is constantly agitated mechanically and air is pumped into it.
- This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh-like structures). While growing, these microbes consume the major part of the organic matter in the effluent.

4. Microbes in Energy Generation (Biogas Production)

- Biogas is a mixture of gases (mainly methane) produced by the microbial activity and is used as fuel.
- Methanogens like *Methanobacterium* produce large quantities of methane along with carbon dioxide and hydrogen by acting on cellulosic compound. Cattle dung is used for the production of biogas as it contains cellulosic material as well as methanogens.

5. Microbes as Biocontrol Agents

- Biocontrol refers to the use of biological methods for controlling plant diseases and pests.
- *Bacillus thuringiensis* is the most widely applied species of bacteria used for biological control of following three sub-species of insect pests namely, lepidopteran (moth, butterfly), coleopteran (beetle) and dipteran (true flies).
- Doom is another bacterial pesticide, which is a mixture of *Bacillus papillae* and *Bacillus lentimorbus*. It is commercially used for controlling Japanese beetle Popilliae. *Bacillus sphaericus* is toxic to larvae of *Anopheles* mosquito.
- The first bioherbicide was a mycoherbicide, which was based on a fungus *Phytophthora palmivora.* It was used in 1981 to control the growth of milk weed in *Citrus* orchards.
- Fungi that cause diseases in insects are known as **entomopathogenic fungi**. It includes at least fourteen species of entomophthoraceous fungi which attack aphids.
- *Beauveria bassiana* is used to manage different types of pests such as white flies, thrips, aphidss and weevils.

6. Microbes as Biofertilisers

The two groups of organisms used as biofertilisers are bacteria and cyanobacteria.

- **Bacteria** fix atmospheric nitrogen and enrich soil nutrients. *Rhizobium* is symbiotic and others free-living are *Azospirillum* and *Azotobacter.*
- **Cyanobacteria** function as biofertilisers by fixing atmospheric nitrogen and also increase organic matter of the soil through the photosynthetic activity, e.g. *Anabaena, Nostoc, Oscillatoria,* etc.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 When an apparently healthy person is diagnosed as unhealthy by a psychiatrist, the reason could be that
(a) the patient was not efficient at his work
(b) the patient was not economically prosperous
(c) the patient shows behavioural and social maladjustment
(d) he does not take interest in sports

2 Both sickle-cell anaemia and Huntington's chorea are
(a) bacteria related diseases
(b) congenital diseases
(c) pollutant- induced diseases
(d) virus related diseases

3 Which of the following diseases is caused by a protozoan? → CBSE-AIPMT, 2015
(a) Syphilis (b) Influenza
(c) Babesiosis (d) Blastomycosis

4 Quinine is an antimalarial drug, which is obtained from the bark of
(a) *Papaver somniferum* (b) *Cinchona officinale*
(c) *Plantago ovata* (d) *Atropa belladonna*

5 Cerebral malaria is caused by
(a) *Plasmodium vivax*
(b) *Plasmodium ovale*
(c) *Plasmodium malariae*
(d) *Plasmodium falciparum*

6 Chaga's disease is caused by
(a) *Trypanosoma gambiense* (b) *Leishmania donovani*
(c) *Trypanosoma cruzi* (d) *Trichinella spiralis*

7 Which of the following is not a viral disease?
(a) Polio (b) Rabies
(c) Smallpox (d) Plague

8. Diphtheria is caused by
(a) poisons released by living bacterial cells into the host tissue
(b) poisons released from dead bacterial cells into the host tissue
(c) poisons released by virus into the host tissues
(d) excessive immune response by the host's body

9 Which of the following sets of diseases is caused by bacteria? → NEET-II 2016
(a) Cholera and tetanus
(b) Typhoid and smallpox
(c) Tetanus and mumps
(d) Herpes and influenza

10 Gonorrhoea is a STD caused by
(a) *Mycobacterium tuberculosis*
(b) *Corynebacterium diphtheriae*
(c) *Neisseria gonorrhoeae*
(d) *Clostridium tetani*

11 Which one of the following correctly matches the Sexually Transmitted Disease (STD) with its pathogen?
(a) AIDS — *Bacillus anthracis*
(b) Syphilis — *Treponema pallidum*
(c) Urethritis — *Entamoeba gingivalis*
(d) Gonorrhoea — *Leishmania donovani*

12 Infection of *Ascaris* usually occurs by → NEET 2013
(a) drinking water containing eggs of *Ascaris*
(b) eating imperfectly cooked pork
(a) tse-tse fly
(c) mosquito bite

13 In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels? → NEET 2018
(a) Ringworm disease (b) Ascariasis
(c) Elephantiasis (d) Amoebiasis

14 Ringworm is due to the infection of
(a) algae (b) fungi (c) bacteria (d) viruses

15 Which one of the following fungi contains hallucinogens? → CBSE-AIPMT 2014
(a) *Morchella esculenta* (b) *Amanita muscaria*
(c) *Neurospora* sp. (d) *Ustilago* sp.

16 HIV that causes AIDS, first starts destroying
(a) B-lymphocytes (b) leucocytes
(c) thrombocytes (d) helper T-lymphocytes

17 Which of the following is correct regarding AIDS causative agent HIV? → NEET-II 2016
(a) HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase
(b) HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase
(c) HIV is unenveloped retrovirus
(d) HIV does not escape but attacks the acquired immune response

18 In malignant tumours, the cells proliferate, grow rapidly and move to other parts of the body to form new tumours. This stage of disease is called
(a) metagenesis (b) metastasis
(c) teratogenesis (d) mitosis

19 Which of the following statements is not true for cancer cells in relation to mutations? → NEET-I 2016
(a) Mutations destroy telomerase inhibitor
(b) Mutations inactivate the cell control
(c) Mutations inhibit production of telomerase
(d) Mutations in proto-oncogenes accelerate the cell cycle

20 MALT constitutes about ..... per cent of the lymphoid tissue in human body. → NEET 2017

(a) 50 (b) 20
(c) 70 (d) 10

21 Immunodeficiency makes a person highly susceptible to infection. It is caused by

(a) lack of B-cells (b) lack of T-cells
(c) Both (a) and (b) (d) None of these

22 The cell-mediated immunity inside the human body is carried out by → NEET 2013

(a) T-lymphocytes (b) B-lymphocytes
(c) thrombocytes (d) erythrocytes

23 If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidence? → CBSE-AIPMT 2015

(a) Fibrinogen in plasma
(b) Serum albumins
(c) Haemocytes
(d) Serum globulins

24 Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections? → NEET 2017

(a) Autoimmune response
(b) Cell-mediated immune response
(c) Hormonal immune response
(d) Physiological immune response

25 Which of the following immunoglobulins does constitute the largest percentage in human milk? → CBSE-AIPMT 2015

(a) IgD (b) IgM
(c) IgA (d) IgG

26 Increased asthmatic attacks in certain seasons are related to

(a) hot and humid environment
(b) eating fruits preserved in tin containers
(c) inhalation of seasonal pollen
(d) low temperature

27 Which of the following is not an autoimmune disease? → NEET 2018

(a) Alzheimer's disease (b) Rheumatoid arthritis
(c) Psoriasis (d) Vitiligo

28 Asthma may be attributed to → NEET-I 2016

(a) allergic reaction of the mast cells in the lungs
(b) inflammation of the trachea
(c) accumulation of fluid in the lungs
(d) bacterial infection of the lungs

29 BCG vaccine is used against

(a) TB (b) leprosy
(c) food poisoning (d) None of these

30 Mild hypertension is caused due to the excess secretion of

(a) renin (b) epinephrine
(c) aldosterone (d) All of these

31 Name the chronic respiratory disorder caused mainly by cigarette smoking. → NEET-I 2016

(a) Asthma (b) Respiratory acidosis
(c) Respiratory alkalosis (d) Emphysema

32 Cirrhosis of liver is caused by

(a) cocaine (b) alcohol (c) LSD (d) morphine

33 Which part of poppy plant is used to obtain the drug smack? → NEET 2018

(a) Root (b) Latex (c) Flowers (d) Leaves

34 Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown below? → CBSE-AIPMT 2014

(a) Hallucinogen (b) Depressant
(c) Stimulant (d) Pain-killer

35 A person showing unpredictable moods, outbursts of emotion, quarrelsome behaviour and conflicts with others is suffering from

(a) schizophrenia
(b) Borderline Personality Disorder (BPD)
(c) mood disorders
(d) addictive disorders

36 Which one of the following depresses brain activity and produces feelings of calmness, relaxation and drowsiness?

(a) *Valium* (b) Morphine
(c) Hashish (d) Amphetamines

37 Bombay green banana is a result of

(a) hybridisation (b) pureline selection
(c) mass selection (d) clonal selection

38 Clonal cell lines are obtained from

(a) tissue culture
(b) tissue fractionation
(c) tissue homogenisation
(d) tissue system

39 In tissue culture, shoot formation in callus can be induced by

(a) IAA_3 (b) ABA
(c) GA_3 (d) kinetin

40 A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called → NEET-I 2016

(a) contour farming (b) strip farming
(c) shifting agriculture (d) ley farming

41 In plant breeding programmes, the entrire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called → NEET 2013

(a) selection of superior recombinants
(b) cross-hybridisation among the selected parents
(c) evaluation and selection of parents
(d) germplasm collection

42 A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to → NEET 2018

(a) Lerma Rojo
(b) Sharbati Sonora
(c) Co-667
(d) Basmati

43 Interspecific hybridisation is the mating of → NEET-II 2016

(a) animals within same breed without having common ancestors
(b) two different related species
(c) superior males and females of different breeds
(d) more closely related individuals within same breed for 4-6 generations

44 NE Borlaug, who is known as 'Father of Green Revolution' as he developed

(a) high yielding semi-dwarf varieties like Sonora-64, Lerma Rojo, etc
(b) Sharbati Sonora and Pusa Lerma varieties of wheat by mutation
(c) Aruna variety of castor
(d) Penicillin from *Penicillium notatum* and *Penicillium chrysogenum*

45 Which of the following is not a harmful effect of pesticides?

(a) The mode of action of pesticides is non-selective
(b) Non-biodegradable pesticides cause biological magnification
(c) Excessive and prolonged use of pesticides lead to pesticide treadmill
(d) Pesticides control vectors or carriers of different disease producing organisms

46 Highest milk-yielding breed of cattle in the world is

(a) Brown Jersey (b) Ongole
(c) Holstein-Friesian (d) Hallikar

47 The world's highly prized wool yielding 'Pashmina' breed is

(a) sheep
(b) goat
(c) goat and sheep cross
(d) Kashmir sheep and Afghan sheep cross

48 Which one of the following is a viral disease of poultry?

(a) Salmonellosis
(b) Coryza
(c) New castle disease
(d) Pasteurellosis

49 Eri silkworm feeds on

(a) mulberry leaf (b) neem leaf
(c) khaira leaf (d) castor leaf

50 *Apis dorsata* is commonly known as

(a) rock bee (b) little bee
(c) Indian bee (d) European bee

51 Conversion of milk to curd improves its nutritional value by increasing the amount of

(a) vitamin-B_{12} (b) vitamin-A
(c) vitamin-D (d) vitamin-E

52 In yoghurt making, pasteurised homogenised milk is inoculated with

(a) *Streptococcus thermophilus*
(b) *Lactobacillus bulgaricus*
(c) Both (a) and (b)
(d) None of the above

53 Among the following edible fishes, which one is a marine fish having rich source of omega-3 fatty acids? → NEET-II 2016

(a) *Mystus* (b) Mangur
(c) Mrigala (d) Mackerel

54 Outbreeding is an important strategy of animal husbandry because it → CBSE-AIPMT 2015

(a) helps in accumulation of superior genes
(b) is useful in producing purelines of animals
(c) is useful in overcoming inbreeding depression
(d) exposes harmful recessive genes that are eliminated by selection

55 Artificial selection to obtain cows yielding high milk output represents → NEET 2017

(a) stabilising selection as it stabilises this character in the population
(b) directional as it pushes the mean of the character in one direction
(c) disruptive as it splits the population into two, one yielding higher output and the other lower output
(d) stabilising followed by disruptive as stabilises

56 Homozygous purelines in cattle can be obtained by → NEET 2017

(a) mating of related individuals of same breed
(b) mating of unrelated individuals of same breed
(c) mating of individuals of different breeds
(d) mating of individuals of different species

57 Penicillin was the first antibiotic made by Alexander Fleming from

(a) *Penicillium chrysogenum* (b) *Penicillium notatum*
(c) *Streptococcus thermophilus* (d) *Penicillium roqueforti*

58 An antibiotic that acts on a variety of pathogenic organisms is called

(a) broad spectrum antibiotic
(b) narrow spectrum antibiotic
(c) Gram positive antibiotic
(d) Gram negative antibiotic

59 Gallic acid used in ink making is obtained with the help of
(a) *Aspergillus niger* (b) *Acetobacter aceti*
(c) *Ashbya gossypii* (d) *Rhizopus stolonifer*

60 The enzyme, which is used in cheese making is
(a) lactase (b) protease
(c) rennin (d) pepsin

61 Which of the following crops is being grown in India for biodiesel?
(a) *Chlamydomonas* (b) *Jatropha*
(c) *Euphorbia* (d) *Capaifera*

62 Which one of the following is a neem product used as insect repellant?
(a) Rotenone (b) Azadirachtin
(c) Parathion (d) Endrin

63 The free-living fungus *Trichoderma* can be used for
(a) killing insects
(b) biological control of plant diseases
(c) controlling butterfly caterpillars
(d) producing antibiotics

64 Mycorrhiza does not help the host plant in
(a) enhancing its phosphorus uptake capacity
(b) increasig its tolerance to drought
(c) enhancing its resistance to root pathogens
(d) increasing its resistance to insects

65 Which of the following is correctly matched for the product produced by them? → NEET 2017
(a) *Acetobacter aceti* – Antibiotics
(b) *Methanobacterium* – Lactic acid
(c) *Penicillium notatum* – Acetic acid
(d) *Saccharomyces cerevisiae* – Ethanol

66 Which of the following in sewage treatment removes suspended solids? → NEET 2017
(a) Tertiary treatment (b) Secondary treatment
(c) Primary treatment (d) Sludge treatment

67 Activated sludge should have the ability to settle quickly so that it can
(a) be readily pumped back from sedimentation tank to aeration
(b) absorb pathogenic bacteria present in water while sinking to the bottom of the settling tank
(c) be discarded and anaerobically digested
(d) absorb colloidal organic matter

68 The biofertiliser, which is inoculated in rice fields in South-Eastern Asia, which is found to increase yield up to 50%, is
(a) *Anabaena cycadaceae* present symbiotically in *Cycas* roots
(b) *Nostoc punctaeformae* found symbiotically in *Anthoceros* thallus
(c) *Anabaena azollae* present symbiotically in the leaves of water fern *Azolla*
(d) Symbiotic association between roots of higher plants and fungal hyphae

69 Match the following columns. → CBSE-AIPMT 2015

	Column I		Column II
A.	*Aspergillus niger*	1.	*Lactic acid*
B.	*Acetobacter aceti*	2.	*Butyric acid*
C.	*Clostridium butylicum*	3.	*Acetic acid*
D.	*Lactobacillus*	4.	*Citric acid*

Codes

	A	B	C	D
(a)	2	3	4	1
(b)	2	4	3	1
(c)	4	3	2	1
(d)	4	1	3	2

Directions (Q. Nos. 70-71) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true but Reason is not the corret explanation of Assertion
(c) If Assertion is true but Reason is false
(d) If both Assertion and Reason are false

70 **Assertion** Interferons are a type of antibodies produced by body cells infected by bacteria.

Reason Interferons stimulate inflammation at the site of injury.

71 **Assertion** In plant tissue culture, somatic embryos can be induced from any plant cell.

Reason Any viable plant cell can differentiate into somatic embryos.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Green manure plant belongs to
(a) Compositae (b) Solanaceae
(c) Poaceae (d) Leguminosae

2 Flit is used on large scale for control of malaria. The main constituent of flit is
(a) malathion (b) atrazine (c) aldrin (d) dialdrin

3 Herbicides act usually by
(a) blocking photosystem-I (b) blocking photosystem-II
(c) blocking xylem vessels (d) blocking phloem channels

4 Which of the following is not an organophosphate?
(a) Aldrin (b) Parathion
(c) Fenitrothion (d) Trithion

5 Hypophysation is done in fishes to
(a) increase size (b) increase their growth
(c) cause breeding in fisheries (d) increase their palatibility

6 Which of the following reasons written below is not a cause of cancer?
(a) Ionising radiations (b) Altered oncogenes
(c) Chemical carcinogens (d) None of these

7 In honeybee, royal jelly is secreted from
(a) crop gland (b) wax gland
(c) hypopharyngeal gland (d) salivary gland

8 Norin 10 produced by crossing between
(a) Daruma × Fultz
(b) Fultz-Daruma × Turkey Red
(c) Gainess × Locals of Japan
(d) Locals × Gainess

9 Transient ischaemic attack is characterised by
(a) loss of consciousness (b) low blood pressure
(c) retinoblastoma (d) skin cancer

10 Haemozoin is
(a) a precursor of haemoglobin
(b) a toxin from *Streptococcus*
(c) a toxin from *Plasmodium* species
(d) a toxin from *Haemophilus* species

11 Which one of the following pairs is mismatched?
(a) *Pila globosa* – Pearl
(b) *Apis indica* – Honey
(c) *Kenia lacca* – Lac
(d) *Bombyx mori* – Silk

12 Grafted kidney may be rejected in a patient due to
(a) humoral immune response
(b) cell-mediated immune response
(c) passive immune response
(d) innate immune response

13 Bordeaux mixture ($CuSO_4 + Ca(OH)_2 + H_2O$) is a fungicide. It was discovered by
(a) Dr. BP Pal (b) MS Swaminathan
(c) Millardet (d) Pushkar Nath

14 The sporozoites that cause infection when a female *Anopheles* mosquito bites a human being are formed in
(a) liver of human
(b) RBCs of mosquito
(c) salivary glands of mosquito
(d) intestine of human

15 Which gases are produced in anaerobic sludge digesters?
(a) Methane and CO_2
(b) Methane, hydrogen sulphide and CO_2
(c) Methane, hydrogen sulphide and O_2
(d) Hydrogen sulphide and CO_2

16 Vitamin-B_2 (riboflavin) is obtained on large scale from the fungus
(a) *Saccharomyces cerevisiae*
(b) *Ashbya gossypii*
(c) *Rhizopus stolonifer*
(d) *Penicillium purpurogenum*

17 Big holes in Swiss cheese are made by a
(a) machine
(b) bacterium that produces methane gas
(c) bacterium that produces large amount of carbon dioxide
(d) fungus that releases a lot of gases during its metabolic activities

18 Carbamate pesticides act by combining with acetylcholine esterase enzyme. Which one of the following is a carbamate?
(a) Propoxur (baygon) (b) Aldicarb (temik)
(c) Carbofuran (furadan) (d) All of these

19 Women who consumed the drug thalidomide for relief from vomiting during early months of pregnancy gave birth to children with
(a) no spleen
(b) hare-lip
(c) extra fingers and toes
(d) underdeveloped limbs

20 To obtain virus-free healthy plants from a diseased plant by tissue culture technique, which part/parts of the diseased plant will be taken?
(a) Apical meristem only
(b) Palisade parenchyma
(c) Both apical and axillary meristems
(d) Epidermis only

21 An insect bite may result in inflammation of that spot. This is triggered by the alarm chemicals such as
(a) histamine and dopamine
(b) histamine and kinins
(c) interferons and opsonin
(d) interferons and histones

22 Which one of the following statements is correct?
(a) Benign tumours show the property of metastasis
(b) Heroin accelerates body functions
(c) Malignant tumor exhibits metastasis
(d) Patients who have undergone surgery are given cannabinoids

23 Antivenom injection contains preformed antibodies while drops that are administered into the body contain
(a) harvested antibodies (b) gammaglobulin
(c) attenuated pathogens (d) activated pathogens

24 Which of the following enhance or induce fusion of protoplasts?
(a) Sodium chloride and potassium chloride
(b) Polyethylene glycol and sodium nitrate
(c) IAA and kinetin
(d) IAA and gibberellins

25 Which one of the following bioherbicides is being used to control milk weed vines in *Citrus* orchards?
(a) *Phytophthora palmivora*
(b) *Morrenia odorata*
(c) *Colletotrichum gloeosporioides*
(d) *Bacillus thuringiensis*

26. In which one of the following combinations (a-d) of the number of the chromosomes correctly represents the present day hexaploid wheat?

Combination	Monosomic	Haploid	Nullisomic	Trisomic
(a)	21	28	42	43
(b)	7	28	40	42
(c)	21	7	42	43
(d)	41	21	40	43

27. Which of the following is not a natural insecticide?
(a) Rotenone obtained from roots of *Derris* sp.
(b) Azadirachtin obtained from neem
(c) Cinerin obtained from *Chrysanthemum*
(d) Devine obtained from *Phytophthora palmivora*

28. Parthenocarpic tomato fruits can be produced by
(a) removing androecium of flowers before pollen grains are released
(b) treating the plants with low concentrations of gibberellic acid and auxins
(c) raising the plants from vernalised seeds
(d) treating the plants with phenylmercuric acetate

29 A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in
(a) polyploidy (b) somaclonal variation
(c) polyteny (d) aneuploidy

30 Common cold differs from pneumonia as
(a) pneumonia is a communicable disease, whereas the common cold is a nutritional deficiency disease
(b) pneumonia can be prevented by a live attenuated bacterial vaccine, whereas the common cold has no effective vaccine
(c) pneumonia is caused by a virus, while the common cold is caused by the bactreium *Haemophilus influenzae*
(d) pneumonia pathogen infects alveoil whereas the common cold pathogen affects nose and respiratory passage but not the lungs

31 In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to
(a) graft rejection (b) autoimmune disease
(a) active immunity (c) allergic response

32 The group of pesticides that is derived from urea is
(a) carbamates such as carbafuron, aldicrab, propoxur, etc
(b) triazines such as atrazine, simazine, etc
(c) organophosphates such as malathion, parathion, etc
(d) organochlorines such as BHC, DDT, etc

33 At which stage of HIV infection does one usually show symptoms of AIDS?
(a) Within 15 days of sexual contact with an infected person
(b) When the infected retrovirus enters host cells
(c) When HIV damages large number of helper T-lymphocytes
(d) When the viral DNA is produced by reverse transcriptase

34 Prickly pear cactus (*Opuntia*) in Australia and India was effectively controlled by the larvae of
(a) cochineal insect (*Cactoblastis cactorum*)
(b) screw worm (*Cochlimyia hominivorax*)
(c) fluted scale insect (*Icerya purchasi*)
(d) *Gambusia* fish

35 In which one of the following options the two examples are correctly matched with their particular type of immunity?

	Examples		Type of immunity
(a)	Polymorphonuclear leucocytes and monocytes	–	Cellular barriers
(b)	Anti-tetanus and anti-snake bite injections	–	Active immunity
(c)	Saliva in mounth and tears in eyes	–	Physical barriers
(d)	Mucous coating of epithelium lining the urinogenital tract and the HCl in stomach	–	Physiological barriers

36 Match the following columns.

	Column I		Column II
A.	Citric acid	1.	*Trichoderma*
B.	Cyclosporin	2.	*Clostridium*
C.	Statins	3.	*Aspergillus*
D.	Butyric acid	4.	*Monascus*

Codes

	A	B	C	D		A	B	C	D
(a)	3	1	2	4	(b)	3	1	4	2
(c)	1	4	2	3	(d)	3	4	1	3

37 Match the following columns.

	Column I (Bioactive substance)		Column II (Role)
A.	Statin	1.	Removal of oil strains
B.	Cyclosporin-A	2.	Removal of clots from blood vessels
C.	Streptokinase	3.	Lowering of blood cholesterol
D.	Lipase	4.	Immuno-suppressive agent

Codes

	A	B	C	D		A	B	C	D
(a)	2	3	1	4	(b)	4	2	1	3
(c)	4	1	4	3	(d)	3	4	2	1

38 Which of the following options are correct?

I.	Heroin	–	Stimulant
II.	Marijuana	–	Cardiovascular
III.	Cocaine	–	Hallucination
IV.	Morphine	–	Sedative

(a) I, II and III
(b) I, III and IV
(c) II, III and IV
(d) I, II and IV

39 Which of the following is incorrectly matched in the given table?

	Microbe	Product	Application
(a)	*Monascus purpureus*	Statins	Lowering of blood cholesterol
(b)	*Streptococcus*	Streptokinase	Removal of clot from blood vessel
(c)	*Clostridium butylicum*	Lipase	Removal of oil stains
(d)	*Trichoderma polysporum*	Cyclosporin A	Immunosuppressive drug

Directions (Q. Nos. 40-41) *In each of the following questions a statement of Assertion is given followed by the corresponding statement of Reason. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion
(c) If Assertion is true but Reason is false
(d) Both Assertion and Reason are false

40 **Assertion** Techniques called superovulation and embryo transplantation are used for cattle improvement.

Reason Gonadotropin injection releases more than one ovum (superovulation) in high yielding cows.

41 **Assertion** Invertase is manufactured from *Aspergillus oryzae*.

Reason Amylase is produced by *Saccharomyces cerevisiae*.

ANSWERS

SESSION 1

1 (c)	**2** (b)	**3** (c)	**4** (b)	**5** (d)	**6** (c)	**7** (d)	**8** (a)	**9** (a)	**10** (c)
11 (b)	**12** (a)	**13** (c)	**14** (b)	**15** (b)	**16** (d)	**17** (b)	**18** (b)	**19** (c)	**20** (a)
21 (c)	**22** (a)	**23** (d)	**24** (b)	**25** (c)	**26** (c)	**27** (a)	**28** (a)	**29** (a)	**30** (d)
31 (d)	**32** (b)	**33** (b)	**34** (a)	**35** (d)	**36** (a)	**37** (d)	**38** (a)	**39** (d)	**40** (d)
41 (d)	**42** (d)	**43** (b)	**44** (a)	**45** (d)	**46** (c)	**47** (b)	**48** (c)	**49** (d)	**50** (a)
51 (a)	**52** (c)	**53** (d)	**54** (c)	**55** (b)	**56** (a)	**57** (b)	**58** (a)	**59** (a)	**60** (c)
61 (b)	**62** (b)	**63** (b)	**64** (d)	**65** (d)	**66** (c)	**67** (a)	**68** (c)	**69** (c)	**70** (d)
71 (a)									

SESSION 2

1 (d)	**2** (a)	**3** (b)	**4** (a)	**5** (c)	**6** (d)	**7** (c)	**8** (b)	**9** (a)	**10** (c)
11 (a)	**12** (b)	**13** (c)	**14** (c)	**15** (b)	**16** (b)	**17** (c)	**18** (d)	**19** (b)	**20** (c)
21 (b)	**22** (c)	**23** (c)	**24** (b)	**25** (a)	**26** (d)	**27** (d)	**28** (b)	**29** (a)	**30** (d)
31 (b)	**32** (b)	**33** (c)	**34** (a)	**35** (a)	**36** (b)	**37** (d)	**38** (c)	**39** (c)	**40** (b)
41 (d)									