

Biology Class 05

5th June, 2023 at 9:00 AM

ANALYSIS OF PREVIOUS YEAR QUESTION(9:00 AM):

Which of the following statements best describes the role of the B cells and T cells in the human body?**Prelims 2022**

- (a) They protect the body from environmental allergens.
- (b) They alleviate the body's pain and inflammation.
- (c) They act as immunosuppressants in the body.
- (d) They protect the body from diseases caused by pathogens.

• **Answer: (d)**

• **Approach:**

- B cells will protect us through the production of antibodies.
- T cells will protect us through cell-mediated immune response.

Blood:

- Blood is a fluid body tissue that transports vital materials to different parts of the body.
- The major components are plasma, red blood cells, white blood cells, and platelets.
- Blood plasma is a yellowish liquid that contains plasma proteins.

Plasma Proteins:

- They are functional/globular proteins and not fibrous/structural proteins.
- Types of plasma proteins:
 - **I. Globulin:** For the Defence mechanism of the body.
 - **II. Albumin:** To maintain blood pressure.
 - **III. Fibrinogen:** Clotting of blood.

Platelets:

- Their technical name is **thrombocytes**.
- They initiate the process of clotting blood.
- Other components needed for blood clotting are Vitamin K, Fibrinogen, etc.

Red Blood Cells(RBCs):

- Their technical name is **Erythrocyte**.
- They contain the protein **hemoglobin**.
- Haemoglobin contains **iron** which gives the reddish color to blood.
- The primary purpose of the hemoglobin is to transport oxygen to all cells.
- All cells need oxygen to obtain energy.
- **Adenosine Triphosphate (ATP)** is the "energy currency" of the cells.

White Blood Cells (WBCs):

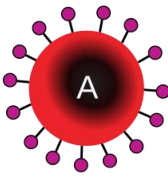
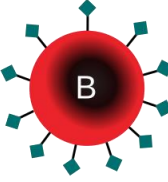
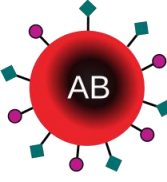
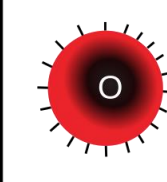


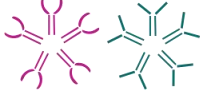



- Their technical name is **leucocytes**.
- Two main types of WBCs are:
 - **I. Agranulocytes:** They do not contain granules in their cytoplasm.
 - **For example:**
 - **Monocytes** which give innate immunity.
 - **Lymphocytes-** B cells(antibody-mediated immune response) & T cells (Cell-mediated immune response).

II. Granulocytes:Granules present in the cytoplasm

- They can be classified into:
 - Neutrophils- Effects innate immunity.
 - Basophils- Involved in causing inflammation.
 - Eosinophils- involved in allergic reactions.

BLOOD GROUP (9:30 AM):

- A blood group is a classification of blood that is based on the presence and absence of antibodies and inherited antigenic substances on the surface of red blood cells.
- An **Antigen** is an entity that causes the body to initiate an immune response against it.
- This is present on the surface of the red blood cells.
- An **Antibody** is a substance that is produced by the plasma white blood cells in response to certain antigens.

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in red blood cell	 A antigen	 B antigen	 A and B antigens	None

Rhesus(Rh) Factor:

- This refers to a certain type of protein present at the surface of the RBCs.

Blood Transfusion:

- Blood transfusion is simply the process under which the blood loss due to surgery or accident is replaced.
- Blood transfusion considers the concerned blood groups, Rh factor, and the associated antigens & antibodies that can be produced.
- We will try to avoid transfusion so that the antibody and antigen of any single group get into a single body.
- We need to focus on the antigen of the blood donor and the antibody produced in the recipient.

-
- **Practice question:**
- A man whose blood group is not known meets with a serious accident and needs a blood transfusion. Which one of the blood groups mentioned below will be safe for transfusion (**prelims 2001**)?:
- (a) O, Rh -
- (b) O, Rh +
- (c) AB, Rh -
- (d) AB, Rh +
- **Answer :(a)**
- **Approach:**
- O - is the universal donor because it has no antigens.
- The universal recipient is AB + because it has no antibodies.

GENETICS(10:00 AM):

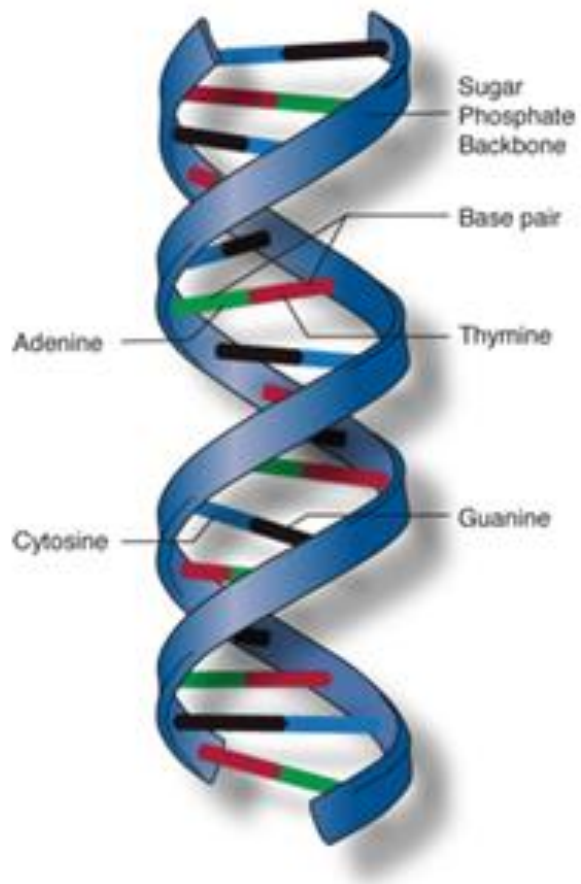
- **Nucleic Acids:**
- They form the genetic material of all life forms.
- They are responsible for the transfer of characters from parents to offspring.

It is made up of three parts:

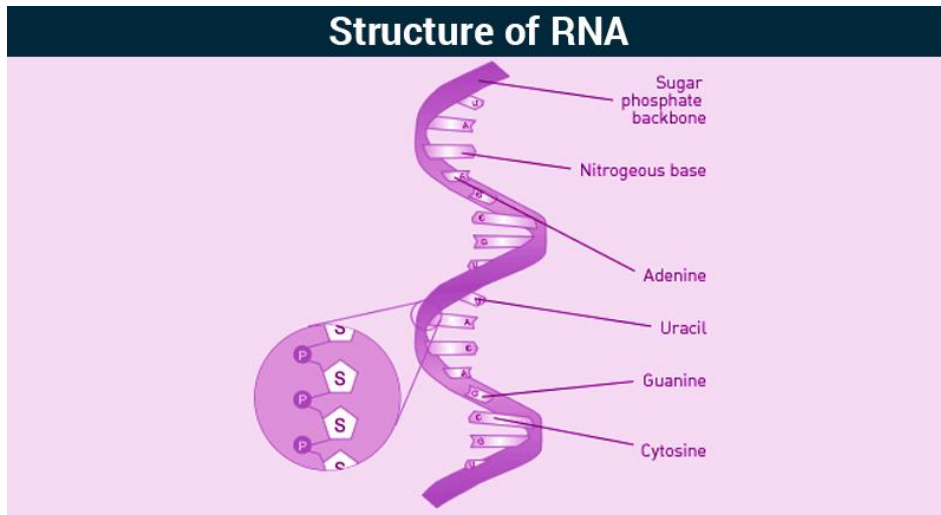
- Phosphate group.
- Pentose sugar- Ribose and Deoxyribose.
- Nitrogenous base- **Purines** (Adenine **A**, and Guanine **G**), and **Pyrimidines** (Cytosine **C**, Thymine **T**, Uracil **U**)

DNA:

- It mostly has a double-stranded helix structure.
- It consists of Adenine, Guanine, Thymine, and Cytosine.



-
- **RNA:**
- It mostly has a single-stranded structure helix structure.
- It consists of Adenine, Guanine, Cytosine, and Uracil.



Complementary Base Pairing:

- Complementary base pairing allows the base pairs to be arranged in a more energetically favorable way.
- It is essential in forming the double-helical structure of DNA.

Structure of DNA:

- The structure of DNA contains two strands formed by the sugar and phosphate backbone.
- Between these, nitrogenous bases are present which pair up using complementary base pairing in which Adenine joins to Thymine by a double bond and cytosine joins to guanine by a triple bond.
- The two strands then twist together into a spiral structure called the double helix DNA.

GENE EXPRESSION(10:25 AM):

- Gene expression is the process the cell uses to produce the molecule it needs by reading the genetic code written in the DNA.
- Simply speaking, gene expression is the process by which the instructions in our DNA are converted into a functional product, such as a protein.
- Gene is a unit of DNA.
- The segments of DNA tell individual cells how to produce specific proteins.
- These segments are called genes.
- It is the presence or absence of specific proteins that gives an organism its characteristics.
- **Transcription** of a segment of DNA to messenger- RNA takes place in the cell nucleus.
- **Translation** of messenger RNA into specific proteins takes place in the ribosomes present in the cytoplasm.

VACCINE PRODUCTION (10:50 AM):

- The purpose of a vaccine is to make the B cells recognize the antigens which will produce an **immune memory** in the body against the disease.

Genetic material vaccines:

- **DNA vaccine:**
- It is the introduction of the DNA sequence coding for the antigen, against which an immune response is needed.
- The production of the target antigen takes place within the body of the organism.

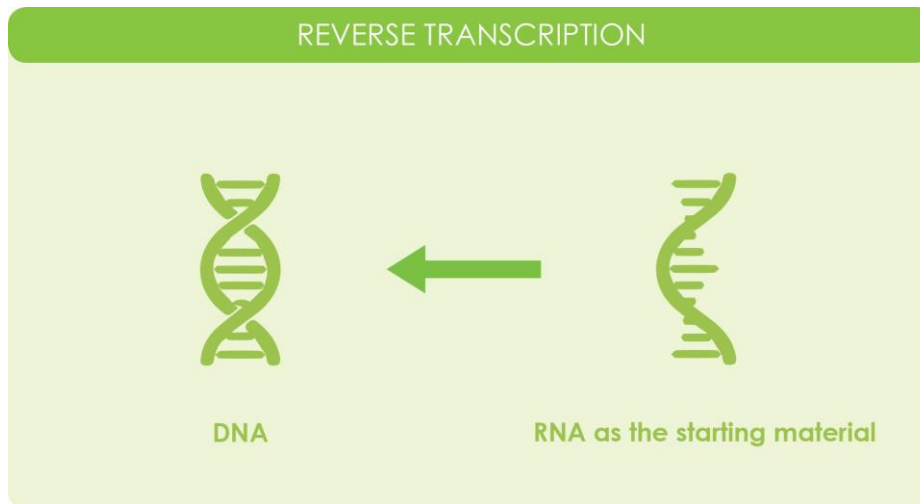
For example - Zycov vaccine for Covid 19

mRNA Vaccine:

- It works by introducing an mRNA sequence that is coding for the disease-specific antigen.
- **For example- Pfizer, and Moderna** vaccines for Covid 19.
- As vaccine also follows the transcription-translation stages, mRNA vaccines will follow one less step as they won't have to do the transcription.

Genetics of diseases:

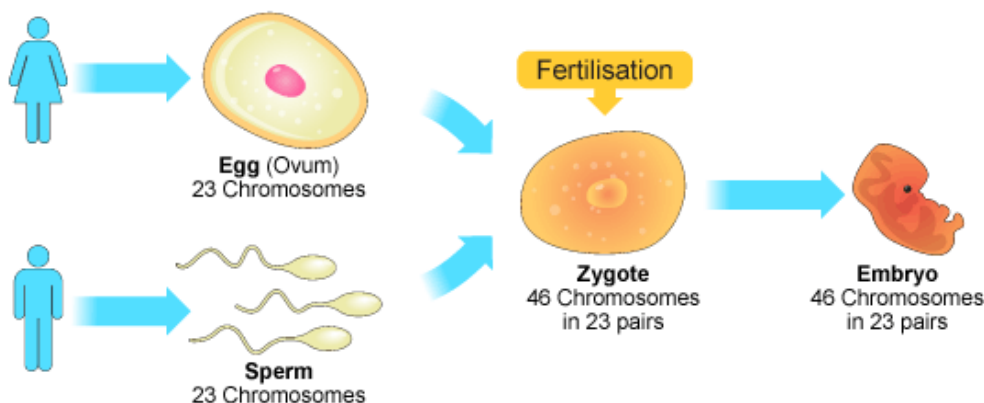
- **DNA virus-** Adenovirus, herpes, chicken pox, etc.
- **RNA virus-** Retrovirus and Non- Retrovirus. (Covid-19, Dengue).
- In retroviruses, the RNA will first convert into DNA by reverse transcription.



-
- **For example-** the HIV virus.
- For non-retroviruses, the RNA will directly create protein.
- When we mention that DNA is the main genetic material, it means that the genetic information would be present in the DNA of the cell.
- It does not mean that only that specific material is present.

Chromosomes:

- Every species has a fixed number of chromosomes, like 46 in humans.
- Eggs from the mother and sperm from the father together make the zygote.



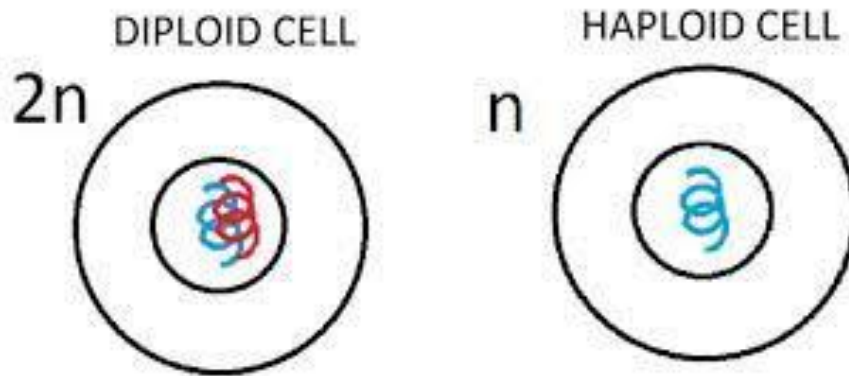
-
- The number of chromosomes in every nucleus of every cell of the body is fixed for all living organisms.
- All the cells of our body have 46 chromosomes, except the reproductive/sex cells/gametes which have only 23 pairs, so the resultant zygote continues with 46 chromosomes.

Haploid cell:

- Haploid refers to the presence of a single set of chromosomes in an organism's cells.
- Sexually reproducing organisms are diploid (having two sets of chromosomes, one from each parent).
- They contain n half the number of chromosomes.
- They are represented as n .
- In humans, only the egg and sperm cells(gametes/sex cells) are haploid.

Diploid cells:

- They contain two sets of chromosomes or the complete set of chromosomes of an organism.
- **Somatic cells-** all the cells of organisms other than the gametes are diploid.
- They are represented as $2n$.



-
- Diploid is a term that refers to the presence of two complete sets of chromosomes in an organism's cells, with each parent contributing a chromosome to each pair.
- Humans are diploid, and most of the body's cells contain 23 chromosome pairs.
- One copy of each chromosome pair came from the individual's mother and the other from the individual's father.
- Since we have two copies of each chromosome, we also have two copies of every gene.

Homologous chromosomes:

- They are a pair of chromosomes that are similar in length, structure, and gene position.
- One comes from the father and one from the mother.
- **For example-** Both parents will give the genes for a characteristic, say eye color.
- But we will not have two-colored(one each of father and mother) eyes normally.

INHERITANCE OF CHARACTERISTICS THROUGH MENDEL'S EXPERIMENTS (11:30 AM):

- Mendel began a series of experiments to find out how traits are passed from generation to generation.
- At the time, it was thought that parents' traits were blended together in their progeny.
- All the characteristics in organisms are manifested in two factors/traits:
 - I. Dominant Trait
 - II. Recessive Trait.
- These factors or genes are the units of inheritance.
- The dominant trait overrides the impact of the recessive traits.
- The recessive trait cannot express itself in the presence of the dominant trait.
- **For example-** in the garden pea, the green color of the pod is dominant over the yellow color pod.
- We can get a yellow color offspring pod only if both parents are yellow.
- The traits which are dominant and which traits are recessive are determined by nature as per natural selection based on evolution.

•

Homozygous:

- When both the genes are the same for a particular trait, for example- GG, YY.
- Where G is green and Y is yellow.

Heterozygous:-





- When both genes are different. for a particular trait, for example- GY.

Phenotype:

- The sum of an organism's observable characteristics is its phenotype.
- While genotype is inherited from an organism's parents, the phenotype is not.
- Environmental factors that may influence the phenotype include nutrition, temperature, humidity, and stress.
- **For example-** Flamingos are naturally white in color, it is only the pigments in the organisms that they eat that cause them to turn vibrantly pink.

Genotype:

- It is the subsequent combination of genes that an individual possesses for a specific gene.
- For example-** A gene encodes eye color.
- In this example, the allele is either brown, or blue, with one inherited from the mother, and the other inherited from the father.
- The brown gene is dominant (B), and the blue allele is recessive (b).
- If the child inherits two different genes (heterozygous) then they will have brown eyes.
- For the child to have blue eyes, they must be homozygous for the blue-eye gene.

Phenotype		Genotype	
Purple		PP (homozygous)	1
Purple		Pp (heterozygous)	2
Purple		Pp (heterozygous)	
White		pp (homozygous)	1
Ratio 3:1		Ratio 1:2:1	

- Utility for Blood Group inheritance:**

Phenotype	Genotype
A	AA, AO
B	BB, BO
O	OO
AB	AB- Codominance
- Both A and B are dominant over O.
- If both parents have the blood group A, the child can be O only if both the parents have AO AO, heterozygous groups.
- Such a correlation cannot be told for the Rhesus factor as per this concept.

Question 2: A married couple adopted a male child.

A few years later, twin boys were born to them. The blood group of the couple is AB positive and O negative. The blood group of the three sons is A positive, B positive, and O positive. The blood group of the adopted son is:

- O Positive
- A Positive
- B Positive
- Cannot be determined by the given data

Answer- (a)

As both A and B are dominant over O, their child cannot have an O blood group

NCERTs to be referred:

- 6th chapter of class 8.

The topics for the next class are Genetics and biotech