EV SSC BIOLOGY

Chapter-12: Heredity in organisms and evolution

Ques. ▶ 1 In the biology class the teacher said that in 1953 two scientists describe the model of a double stranded molecule. It formed of some chemical substances. He also said that this molecule can increase its number by a special type of process. *[R.B.-17]*

a. What is CysE? 1
b. What do you mean by tissue culture? 2
c. Explain the structure of the above mentioned molecule. 3
d. Analyze the significance of the last line of the stem. 4

Answer to the question no. 1

a CysE is a bacterial gene which is transferred to the genome of sheeps in order to improve the quality and increase the amount of sheep's fur.

b Generally, one or a group of cells of the same type is called tissue. The process of growing a tissue on a nourishing and sterilized medium is tissue culture.
Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs (like pollen, apical or lateral bud, node, root) under sterile conditions on a nutrient culture medium of known composition.

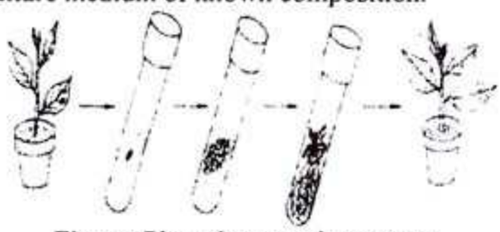


Figure: Plant tissure culture steps

c A DNA molecule is illustrated in the stem.
The main component of chromosome is deoxyribonucleic acid. It is usually a double stranded spiral structure of polynucleotides. A strand is complementary to the other. There are sugar (five carbon), nitrogen bases (adenine, guanine, cytosine, thymine) and inorganic phosphate involved in giving DNA its distinct structure.Nitrogen bases are of two types, such as- purines [adenine (A), guanine (G)] are purines and pyrimidines[cytosine (C) and thymine (T)]. Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds [A=T] and guanine of a helix connects with a cytosine of opposite helix by three hydrogen bonds[G≡C] This bond is always developed in between a purine and a pyrimidine. So a strand of DNA is complementary to another strand.. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So the length between the two adjacent nucleotides is $3.4A^0$ in average.

d By the phrase "special type of process"- it is meant that DNA molecule is replicated via a unique process named as semi-conservative process.
In this process, the hydrogen bonds between nitrogenous bases of opposite helices get denatured and hence the two strands of DNA become separated. Each strand works as a template for synthesizing new DNA strand. By the end of DNA replication, hydrogen bonds between new DNA and old template strand are formed again.
The replication of one helix results in two daughter helices- each of which contains one of the original parental helical strands. It is called semi- conservative because half of each parent helix is conserved in each daughter helix.

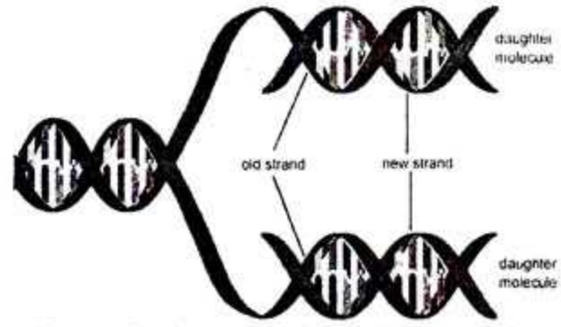


Figure: Semi-conservative replication of DNA

Ques. ▶ 2 Sifat is impressed by observing different incidents of biodiversity. These kind of two incidents are given below :
Incident-1 : Though a fish lays a lot of eggs, the number of fish becomes less in the river.
Incident-2 : Many dogs are transferred to Nijhum Island from the main central part of Bangladesh through fishermen. The dogs of Nijhum Island have become much wilder than the dogs of central part. *[C'tg.B.-17]*

a. What is gene? 1
b. Why DNA test is required? Explain. 2
c. Explain the cause of Incident-1 in the light of the theory of evolution. 3
d. Evaluate the incident-2 according to the organic evolution. 4

Answer to the question no. 2

a Gene is the unit of all visible and invisible characteristics of an animal.

b DNA testing is the scientific analysis and application of DNA collected and extracted from some biological samples. DNA testing is done to identify a criminal, treating a genetic disorder, paternity testing etc. DNA testing gives very accurate results.

c The incident-1 could be explained by Darwin's theory on natural selection. Nowadays, the rivers are being more and more polluted than ever. As a results the fishes are dying, and not all fishes can survive the harsh condition of the water after being hatched from the egg. Only the fittest ones survive. This why a fish may lay lots of eggs but only a few fishes survive. This phenomenone is an example of natural selection theory.

d The environment of Nijhumisland and central part of Bangladesh are completely different. The dogs have been transferred to a new place. To be adapted with this changed environment, the dogs' behavior have changed. They have evolved to survive the different surroundings. And for ensuring their existence, they have become wilder and ferocious, as they had to fight for food competing with the resident dogs of Nijhumisland.
And so evolution made the dogs much wilder.

Ques. ▶ 3 'X' is a component of heredity there is Nitrogen base thymine. 'Y' is another component of heredity which is called 'Factor" by Mandel. *[S.B.-17]*

a. What is colourblind? 1
b. What is meant by thalassemia of Khuli? 2
c. Describe the structure of X of the stem. 3
d. 'Y' is the controller of heredity. — Analyze it with logic. 4

Answer to the question no. 3

a Color blindness is the inability to distinguish one or several chromatic colors.

b Thalassemia is the name of a disease of acquiring abnormal state of red blood cells. Because of this disease, red blood cells are disintegrated. β thalassemia is caused when the gene for the production of the protein globulin is disintegrated. Bthalassemia is also called Thalassemia of Kuli.

c X in the stem is DNA, which is the unit of heredity. DNA contains nitrogenous base thiamine.
The main component of chromosome is deoxyribonucleic acid. It is usually a double
stranded spiral structure of polynucleotides. A strand is complementary to the other. There are sugar (five carbon), nitrogen bases (adenine, guanine, cytosine, thymine) and inorganic phosphate involved in giving DNA its distinct structure.Nitrogen bases are of two types, such as- purines [adenine (A), guanine (G)] are purines and pyrimidines[cytosine (C) and thymine (T)]. Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds [A=T] and guanine of a helix connects with a cytosine of opposite helix by three hydrogen bonds[G≡C] This bond is always developed in between a purine and a pyrimidine. So a strand of DNA is complementary to another strand.. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So the length between the two adjacent nucleotides is $3.4A^0$ in average.

d Y in the stem is gene, which is the controller of all visible and invisible characteristics of an organism.
The factor, which Gregor Johan Mendel mentioned in his work concerning heredity in plants, takes the presently glamorous known as gene. Gene is located in the chromosomes. For each characteristic of an organism, at leat one gene is responsible. For each genes, there are two copies present in the two sister chromosomes. Sometimes a group of genes collectively express one single characteristic. Different experiments proved that gene is the controller of heredity. Species wise gene number varies, but within a specieis the genes are more or less constant in number. Traits of the parents pass through the offsprings via genes. And that is why Y is called the controller of heredity.

Ques. ▶4 Many lives are lost when the boiler of a Tampaco company bursts. As the dead bodies become ablazed, DNAs were collected for the identification of the persons demised. *[J.B.-17]*

a. What is a locus? 1
b. What do you understand by evolution? 2
c. Describe the structure of the component being used to identify the dead persons. 3
d. Besides identifying the dead persons, the component being used plays an important role in ensuring justice. — Explain it. 4

Answer to the question no. 4

a A locus (plural loci) in genetics is a fixed position onachromosome, like the position of a gene.

b Evolution is change in the heritable characteristics
of biological populations over successive generations. Evolutionary processes give rise to biodiversity at every level of biological organisation, including the levels of species, individual organisms. From the very early stages of life, some of the organisms got became extinct, on the other hand some persisted because they could adapt with the environment. It has become possible for evolution.

c DNA was used to identify the dead bodies.
The main component of chromosome is deoxyribonucleic acid. It is usually a double stranded spiral structure of polynucleotides. A strand is complementary to the other. There are sugar (five carbon), nitrogen bases (adenine, guanine, cytosine, thymine) and inorganic phosphate involved in giving DNA its distinct structure.Nitrogen bases are of two types, such as- purines [adenine (A), guanine (G)] are purines and pyrimidines[cytosine (C) and thymine (T)]. Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds [A=T] and guanine of a helix connects with a cytosine of opposite helix by three hydrogen bonds[G≡C] This bond is always developed in between a purine and a pyrimidine. So a strand of DNA is complementary to another strand.. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So the length between the two adjacent nucleotides is $3.4A^0$ in average.

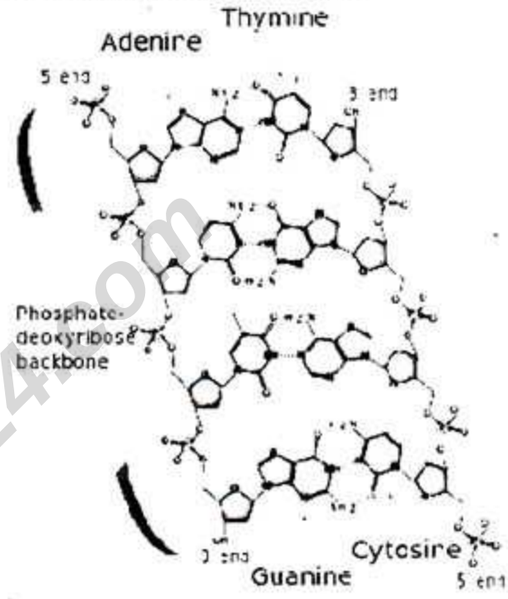


Figure: Structure of DNA

d The way DNA plays anplays an important role in ensuring justice is explained below-

- **Paternity testing:** Sometimes disputes arise regarding the birth identity of a child. In that case DNA testing provides accurate results and identifies the actual parents as parents share similar genetic profile with their offspring.
- **Criminal identification:** Biological samples from crime sites are collected and DNA is extracted from them. The test result is compared with the genetic profiles of the suspects and if any match is found, further investigation is allowed to identify the real culprit.

Thus DNA resting helps establish justice in the society.

Ques. ▶5

DNA	Recombinant DNA
X	Y

[B.B.-17]

a. What is an explant? 1
b. What do you understand by natural selection? 2
c. Describe how X plays a role in ensuring justice? 3
d. It is possible by the process mentioned in the figure Y to introduce new and qualitative features n plants and animals. — Explain it. 4

Answer to the question no. 5

a Explants are small pieces of plant parts or tissues that are aseptically cut and used to initiate a culture in nutrient medium.

b Natural selection is the process whereby organisms that get better adapted to their environment tend to survive and produce more offspring.
In the process of evolution, the surrounding environment of an organism is always changing. To be adapted with this change, some organism's physical characteristics get changed, but not all of them make it to the end. The ones which earn the most suitable characteristics to survive in the hostile environment are naturally selected and pass these features into their offsprings to be saved from extinction.

c "X" is the DNA, which is the main component of chromosome. Using the information of DNA, justice can be ensured.
DNA testing is a powerful tool for identification and has many practical applications. DNA test is done after collecting biological samples from individuals. Biological samples include bones, teeth, hair, blood, saliva, semen etc. When a crime ocurrs, evidences including biological samples are collected from the crime scene and crime suspects. DNA testing is done for the biological speciments and the results are compared. If any match is found, the suspect is convicted as the criminal. Again, DNA testing is an important tool in paternity testing. Usually, father's DNA profile matches exactly with the child's DNA profile. Thus justice is ensured as DNA testing helps identify the criminal and solves social disputes like paternity controversies.

d "Y" represents the process of creating recombinant DNA. Using this technology, it is possible to add new features to animals and plants.
Recombinant DNA technology is the method where DNA molecules from two different species are inserted into a host organism to produce new genetic combinations that are of value to science. Followings are the results of recombinant DNA technology-
In plants-

- Creating pest resistant variety of different agricultural crops. For example- BT maize, BT rice etc. are immune to the harms caused by insects from the orders lepidoptera and coleoptera.
- It is possible to create virus resistant plant variety. For example transferring coat protein gene of tobacco mosaic virus (TMV) to tobacco plants gave rise to virus resistant plant variety.
- Varieties of corn and cotton tolerant to herbicides have been produced by genetic modification.
- Through genetic engineering more than one trait can be inserted in the same plant. For example, genetically modefied cotton and corn plants are able to resist weeds and pests at the same time.
- Through genetic change, nutrition value of some crops has been improved. For example, vitamin A i.e. beta-carotene gene has been transferred into rice.

In animals-

- In livestock, for example transfer of protein C gene has been done to increase protein in cow-milk though still it is in research level.
- Through genetic modification, genetic changes have been accomplished in sheep by transferring the human growth hormone producing gene to serve the purpose of increasing its size and meat production. To improve the amount and quality of the fur, 2 bacterial genes, such as CysE and CysM have been transferred to the genome of sheep.

It was possible to increase the growth of some fishes (common carp, bombay duck, tilapia, catfish etc.) upto 60% by introducing salmon growth hormone gene to those fishes.

Ques. ▶6

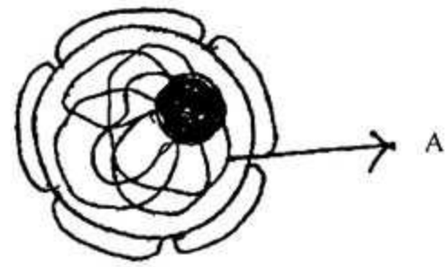


Fig: 'X' *[Dj.B.-16]*

a. What is dominant character? 1
b. What do you mean by RNA? 2
c. Describe the structure of the Fig. X. 3
d. The labelling part 'A' is very important for sex determination. Analyze it with your logic. 4

Answer to the question no. 6

a The paternal and maternal character that is exposed in the first filial generation is known as the dominant character.

b RNA is the abbreviated form of Ribo Nucleic Acid. They are made up of a poly-nucleotide chain. It contains a pentose sugar, Ribose with inorganic phosphate and a nitrogen base. The nitrogen bases can be Adenine (A), Guanine (G), Cytosine (C) or Uracil (U). The viri, which are not made up of DNA, have an RNA as their nucleic acid.

c The 'X' in the stem is the Nucleus. A well-formed nucleus contains the following parts:
Nuclear membrane: The membrane that encircles the nucleus is known as the nuclear membrane. It is a double-layered membrane made up of protein and lipid. There are pores in this membrane, which are known as Nuclear pores.
Nucleoplasm: The jelly-like material found within the nucleus is known as nucleoplasm. It contains nucleic acid, protein, enzymes and a few mineral salts.
Nucleolus: Within the nucleus, there is a tiny spherical shiny structure, which is the nucleolus. It is made up of RNA and protein.
Chromatin network: The fine thread-like part within the nucleus is the chromatin network. It is divided into short and thick parts during a cell division, which are known as chromosomes.

d The 'A' part of the stem is the chromatin fibre. During a cell division, it divides into a number of thick and short structures known as chromosomes. So, 'A' is indirectly a chromosome. It plays an important role in the determination of sex in organisms. In case of humans, the significance of 'A' can easily be understood through the discussion of chromosome.
There are 46 (23 pairs) chromosomes in a human. Of those, 22 pairs are called Autosomes and one pair is called the Sex chromosomes. The two sex chromosomes are – X and Y, which play a vital role in the determination of sex. In a diploid cell of a female the sex chromosomes are two X, i.e., XX. But, in a diploid cell of male the sex chromosomes are X and Y, i.e., XY. During meiosis in female each ovum gets one X chromosome along with other chromosomes. On the other hand, half of the sperms get X and another half get Y chromosome after meiosis. So, during fertilization the X and Y of the male will combine the X of the female to form a zygote. When it is XX, it is a female child and when it is XY, it is a male child. So, it has been clear that 'A', especially the sex chromosome plays a vital role in the determination of sex.

Ques. ▶ 7 Limon is suffering from anemia after one year of his birth. Limon receives blood every two months as per the doctor's advice. But, doctor advised not to give him any iron mixed food. *[Ctg.B.-16]*

a. Write the elaboration of DNA. 1
b. Why the gene in called the carrier of heredity? 2
c. Explain the cause of the disease of Limon. 3
d. Father and Mother is responsible for the disease of Limon— Analyse this comment. 4

Answer to the question no. 7

a The full form of DNA is Deoxyribo Nucleic Acid.

b Gene is the controller of all visual and inherent characters of an organism. Gene hold all the characteristics of an organism and transmits those to the descendants through gametes. So, gene is called the carrier and transmitter of all characteristics of an organism, which exists in chromosomes.

c From the symptoms of disease and the doctor's identification, Limon has been suffering from thalassemia. It is a disease of an abnormal condition of the Red blood corpuscle of blood. It happens by the destruction of the RBC. The patient suffers from anemia due to this disease. RBC is formed by two types of proteins, α-Globulin and β-Globulin. When these two are destroyed, thalassemia occurs. The disease is of two types, α-Thalassemia and β-Thalassemia. α-Thalassemia occurs when the gene responsible for α-Globulin is absent. Similarly, when the gene for β-Globulin is absent β-Thalassemia occurs. So, from the discussion, it has been obvious that thalassemia occurs mainly due to the malformation of Red blood corpuscle.

d Limon's disease is Thalassemia. It is a blood-related disease, which can be transmitted from generation to generation. The logic in favour of this idea is –
It is a disease caused due to the abnormality of red blood corpuscle (RBC) of the blood. RBC is formed with two proteins - α-Globulin and β-Globulin. Thalassemia is caused when the two genes responsible for these two proteins are destroyed. The RBC is malformed due to the lack of these two genes. As a result, the patient suffers from severe anemia, which is thalassemia. The disease is classified in two categories based on the availability of gene. In Thalassemia Major, the child receives the defective gene from their parents. But, in Thalassemia Minor, the child receives it from either father or mother. These children act as carriers of thalassemia gene. So, it is clear from the above discussion that, the disease can only be transmitted from the parents. Therefore, in the stem, Limon's parents are responsible for his disease.

Ques. ▶ 8

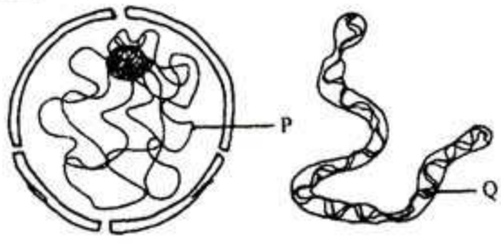


Fig : X Fig : Y

[S.B.-16]

a. What is prokaryotic cell? 1
b. What do you understand by Bionomial Nomenclature? 2
c. Describe the chemical structure of 'Q' in Fig : Y. 3
d. Analyze the role of 'P' component determine of human sex. 4

Answer to the question no. 8

a The cell, which is devoid of a well-formed nucleus, is called a Prokaryotic cell.

b The scientific name of an organism is composed of two parts. The first part is its Genus name, while the second part is its Species name. In this way, when a name is formed with two parts (names) it is termed as a Binomial name. All living organisms today are named in this way maintaining some internationally recognized rules. The plants are named by ICBN, while the animals are named by ICZN, following those rules.

c The 'Q' of 'Y' in the stem is the DNA. Its structure is described below –
DNA is double-helicalled in structure. The two poly-nucleotide chains are attached to each other and arranged in the form of a dextrally twisted iron staircase, which forms a double-helix. The banister of this staircase is made up of pentose sugar, nitrogen base and inorganic phosphates. The nitrogen bases of DNA are – Adenine, Guanine, Cytosine and Thymine. The Adenine of one helix is attached with the Thymine of the other through two hydrogen bonds (A = T), while the Guanine of this helix is attached with the Cytosine of the other through three hydrogen bonds (G ≡ C). There are ten nucleotides in a complete twist of the helix. The two helixes exist at the two opposite margins of the DNA molecule keeping hydrogen bonds in between.

d The 'P' part of the stem is the chromatin fibre. During a cell division, it divides into a number of thick and short structures known as chromosomes. So, 'P' is indirectly a chromosome. It plays an important role in the determination of sex in organisms. In case of humans, the significance of 'P' can easily be understood through the discussion of chromosome.
There are 46 (23 pairs) chromosomes in a human. Of those, 22 pairs are called Autosomes and one pair is called the Sex chromosomes. The two sex chromosomes are – X and Y, which play a vital role in the determination of sex. In a diploid cell of a female the sex chromosomes are two X, i.e., XX. But, in a diploid cell of male the sex chromosomes are X and Y, i.e., XY. During meiosis in female each ovum gets one X chromosome along with other chromosomes. On the other hand, half of the sperms get X and another half get Y chromosome after meiosis. So, during fertilization the X and Y of the male will combine the X of the female to form a zygote. When it is XX, it is a female child and when it is XY, it is a male child. So, it has been clear that 'P', especially the sex chromosome plays a vital role in the determination of sex.

Ques. ▶ 9

Fig-X

[J.B.-16]

a. What is cell? 1
b. What do you mean by power house of cell? 2
c. Why figure 'X' is called physical basis of heredity? Explain. 3
d. How it is possible to find out any criminal correctly with the help of main component of figure "X"? 4

Answer to the question no. 9

a A cell is the structural and functional unit of a living body.

b By the term Power-house of a cell, we mean the Mitochondrion (*pl.* Mitochondria). At different stages of

respiratory process, like the Krebs's cycle, Electron transport system, and Oxidative phosphorylation takes place in the mitochondrion to produce energy or ATP. So, it is named like this, as it produces all the energy needed for all physiological functions of a living body.

c The 'X' in the stem is a Chromosome. It is the main organelle of heredity, which contains a number of genes, the carrier and transmitter of hereditary characters. The genes are responsible for exposing all the characteristics of a living organism. Each chromosome is formed by fibre-like chromatins. The function of chromosome is to transmit genes from parents to offspring. So, the eye-colour, hair style and skin configuration etc. are carried and transmitted by chromosome for the consistence of the race. That's why scientists have termed the chromosome as the physical basis of heredity.

d The 'X' in the stem signifies the Chromosome, the main configuration of which is DNA. The scientific study of DNA is termed as DNA-test. In identifying a criminal correctly this test has been proved to be the most reliable today. To complete the test first an organic sample is needed. The bone, blood, tooth, hair, saliva or semen can be such a sample. The sample collected from the site of crime or the victim is compared to the DNA map of the organic sample. If the victim's sample matches with the person's one, he is proved to be the criminal, otherwise he is not guilty. In this way now a day, criminal investigation is underway with DNA test to identify and confirm a criminal.

Ques. ▶ 10 Abir is a foregin worker. He has two daughters. The elder daughter is like her father but the younger one looks like her mother concerning hair, complexion etc. Recently, as he has given birth of a baby daughter, he has become aggrieved with his wife. He could know that he was responsible in determining the sex of his offspring with the help of health workers of his village. *[Mirzapur Cadet College, Tangail]*

a. What is colour blindness? 1
b. Why DNA test is necessary to determine paternity of a child? 2
c. Explain the causes of difference found between the offspring of Abir? 3
d. Explain why only Abir is responsible for the determination of sex of his child. 4

Answer to the question no. 10

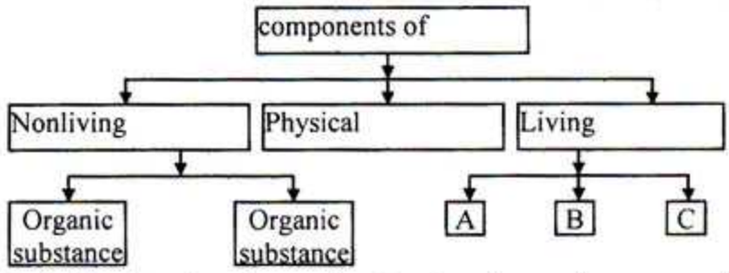
a Color blindness is a vision defect wherein the eye perceives some colors differently than others.

b DNA testing is currently the most advanced and accurate technology to determine parentage. In a DNA parentage test, the result (called the 'probability of parentage)is 0% when the alleged parent is not biologically related to the child and the probability of parentage is typically 99.99% when the alleged parent is biologically related to the child.

c The difference between the offsprings of Abir are given below —
In case of his elder daughter, she looks like abir because in her abir's gene is manifested and her mother's gene is dominated. But in case of second daughter, the girl looks like her mother because her mother's gene is manifested in her.

d Why Abir is responsible for the determination of sex of his child is explained below —
Sex is determined by two chromosomes, X and Y. A female is XX, a male is XY. Since women completely lack the Y chromosome, they always contribute an X chromosome to the baby. The sex is determined by whether the sperm that fertilizes the egg is carrying another X or a Y.
That is why Abir is responsible for the determination of sex of his child.

Ques. ▶ 11 Stem 1 : *[Joypurhat Girls' Cadet College, Joypurhat]*



Evolution is the change in the hereditary characters of population that passes generation to generation. Charles Darwn first disclosed about natural selection.
Stem 2 :

a. What is osmoregulation? 1
b. Nerve cell is different from other cell. Why? 2
c. Give the difference between stem 1 and RNA. 3
d. How do the organism is being adapted in the nature? 4

Answer to the question no. 11

a Osmoregulation is the process of regulating water potential in order to keep fluid and electrolyte balance within a cell or organism relative to the surrounding.

b The nerve cell is different from other cells because there is no active centriole in the cytoplasm of neuron, so the neuron cannot divide, whereas other cells have the capability to divide. As a result no regeneration of neuron occurs. It receives stimulus from the environment, such as: heat, touch, pressure etc. the nervous tissue can transmit it within the body and according to that can make the appropriate response.

c The figure mentioned in the stem is DNA. The difference between DNA and RNA is given below:

Topic	DNA	RNA
1. Full form	De-oxy ribonucleic acid	Ribonucleic acid
2. Strands	Double-stranded	Single-stranded; sometimes for secondary loops within the strand
3. Nitrogenous bases	adenine, cytosine, guanine and thymine	adenine, cytosine, guanine and uracil
4. Function	DNA is the genetic material	RNA is the genetic material only in some viruses
5. Types	DNA has no types	RNAs can be of many types- tRNA, mRNA, rRNA etc.
6. Significance	DNA codes for RNA	Some RNA codes for protein
7. Location	In bacteria, DNA is located in the cytoplasm. In eukaryotic organisms, DNA is located inside the nucleus. Chloroplasts and mitochondria have DNA.	RNA can be present in both nucleus and cytoplasm.

d The organism is being adapted in the nature in the following way:

According to Darwin, the organisms which gain success in struggling by being changed in physical characters have won the fight. By their excellence in modification and in inheritance of characters developed through adaptations from generation to generations, make the win in the competition in evolution to survive. The characters, nature and the trends in organisms and in their offspring are the diversity expressing favor and make the organisms to cope up with the environment. These positive characteristics are inherited through generations. Conversely, the organisms, with adverse diversity in the struggling with the passage of time ultimately, are destroyed. Darwin mentioned that this type of adaptation is the first solution to win the struggle against the nature.

Through evolution at the emergence of new species, many other species are lost in the passage of time. It has been found that the species which possess the more ability to adapt through the way of evolution can go far. So, those who will attain the more ability to adapt with the environmental flow of life and population demography will be surviving for longer period of time. In this way an organism adapts.

Ques. ▶ 12 Dr. Mahmuda produced a huge amount of disease free varieties of strawberry plant not by traditional process but by a special process in his Genetic lab. On the other hand Dr. Akkas produced insulin in his lab by following another special technology in his Genetic engineering lab. *[Pabna Cadet College, Pabna]*

a. What is Nucleotide? 1
b. What do you mean by DNA replication? 2
c. Describe the procedure of Dr. Akkas. 3
d. Describe the procedure of Dr. Mahmuda. 4

Answer to the question no. 12

a A nucleotide is an organic molecule made up of a nucleotide base (adenine, guanine, cytosine, thymine, uracil), a five-carbon sugar and at least one inorganic phosphate group. Nucleotides make up the basic units of DNA and RNA molecules.

b DNA replication is the process by which a double-stranded DNA molecule is copied to produce two identical DNA molecules. Replication is an essential process because, whenever a cell divides, the two new daughter cells must contain the same genetic information, or DNA, as the parent cell.

c The procedure process mentioned in the stem that is done by Dr. Akkas is genetic engineering or recombinant DNA technology. The process is described below —

1. DNA with desired gene is separated from donor organism. Then plasmid DNA is separated from a bacteria to use it as a carrier of the gene. Plasmid is an individual DNA besides the chromosome in bacteria cell, which is able to divide or able in self-division.
2. In this step plasmid DNA and donor DNA are divided by a special enzyme. Desired gene is present in any of the part (location) of the donor DNA.
3. Then donor DNA is placed in between the two terminal parts of a plasmid by lipase enzyme. Lipase here act as adhesive. As a result DNA recombinant forms with the specific desired gene. This recombinant plasmid now carries the desired part of donor DNA.
4. In this stage the bacteria recombinant DNA emerges into receiver bacteria. The method of emergence of donor's chopped DNA pait into bacteria is called transgenic organism. A new species of bacteria or organism created due to transformation is called transgenic organism.

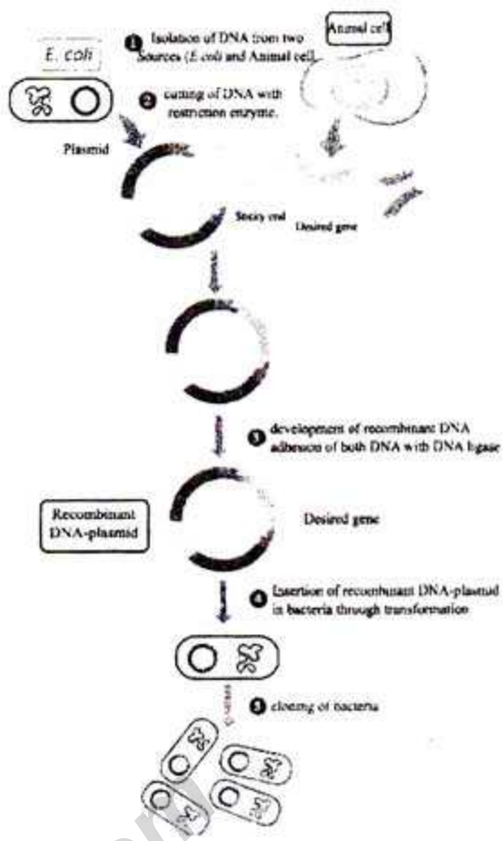


Fig: Recombinant DNA technology

5. In this stage bacteria with recombinant plasmid are identified and then separated. Bacteria with desired genes are then made reproduce rapidly. Now each of these reproduced bacteria contain the desired gene. The process by which gene is reproduced is called gene cloning. To use the gene, plasmid is separated again.

d The procedure process mentioned in the stem that is done by Dr. Mahmuda is tissue culture technology. The process is described below —

The process of separating a tissue from a plant and allow it to grow in a nutlient medium is called tissue culture. Tissue culture is comparatively a new branch of botany. In plant tissue culture, any detached part of a plant or any part (pollen grain, terminal or lateral bud, part of root) is cultured in any nourishing and sterilized medium. All the elements for the nutrition and growth of tissue are supplied with the sterilized medium. The part of a plant being separated for tissue culture is called 'explants'.

Steps of tissue culture:

1. Selection of mother plant: The healthy, disease resistant plant with high quality is selected for plant tissue culture.
2. Preparation of culture medium: For the growth of the plant culture, culture media are made by mixing proper amount of essential mineral nutrients, vitamins, phytohormones, sucrose and condensing substance agar to bring the medium to a semisolid state.

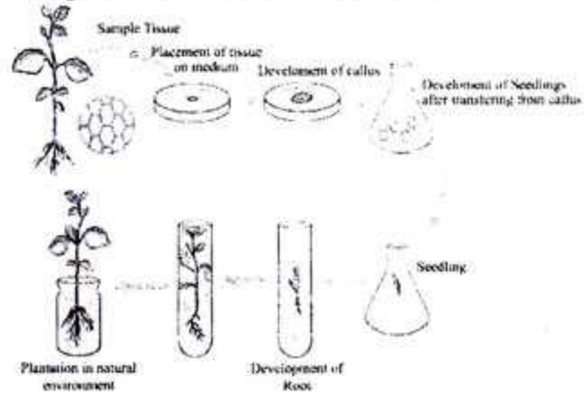


Fig: Steps of tissue culture

3. Establishment of sterilized medium: Taking the culture medium in a glass container (test tube, conical flask), its opening is usually closed with a cotton plaque. Later in an autoclave machine, keeping it at the temperature of 121°C under 15-1b/sq. inch pressure for 20 minutes, the medium is sterilized. Then again after closing the mouth or opening the glass container, it is kept in a room with the controlling of light and temperature (25+2° C) for the growth of the explants. After the turning of the medium into a cold and semisolid state, explants are inoculated on it. In this stage, the tissue placed on the medium through repeated cell division turns directly into a plantlet or callus or a cluster of cells without differentiation.
4. Transfer in root developing medium: If no root is developed in the plantlets by this time, then after attaining a definite height, shoots are cut and again placed in the root developing medium.
5. Transfer to natural environment or to field level: After washing with water and putting them outside the room on the tubs, the plantlets are allowed to adapt with the external environment. When the grown up plantlets become fresh and strong, they are once planted in soil in natural environment.

Ques. ▶ 13 Observe the following stem & answer the qustions below :

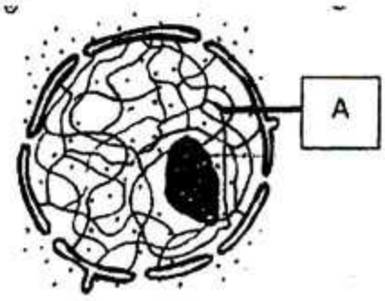


Fig. X

[Faujdarhat Cadet College, Chattogram]

a. What is umblical cord? 1
b. Why RNA is recognized as a nucleic acid? 2
c. Describe the structure of X, which mentioned to the above stem. 3
d. The A is very important for heredity-analyze it with your logic. 4

Answer to the question no. 13

a The umbilical cord is a tube-like structure that connects a fetus to the mother's placenta, providing oxygen and nutrient-rich blood and removing waste.

b RNA or ribonucleic acid is one kind of nucleic acid. Most of the RNAs are single-stranded. It is composed of 5 carbon ribose sugar, inorganic phosphate, and nitrogen bases (adenine, guanine, cytosine and uracil).

c Fig- "X" mentioned in the stem is nucleus. The structure of nucleus is given below —
A structured nucleus has the following parts:
Nuclear membrane: The membrane that encloses the nucleus is called nu- clear membrane. It is a double-layered membrane and is composed of lipids and proteins.
Nucleoplasm: The jelly-like fluid enveloped by the nuclear membrane is called the nucleoplasm. It is a viscous fluid which contains nucleic acids, proteins, enzymes, and some other substances.

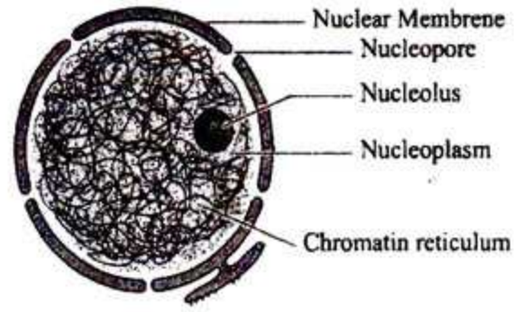


Fig: Nucleus

Nucleolus: In a nucleus, the round structure attached to a chromosome is called the nucleolus. Its main function is to store nucleic acid and synthesis protein.
Chromatin reticulum: A threadlike reticulate body which is found in the nucleoplasm which is called chromatin reticulum. Chromatin fibers become coiled during cell division and become more condensed, and then they are called chromosomes.

d "A" mentioned in the stem is chromosome which is very important for heredity. This is analyzed below —
Chromosomes are important because they contain the entire genetic information for an organism. An organism's DNA is contained within the chromosome as a long series of nucleotides that are organized into genes. Each chromosome has thousands of gene DNA sequences that are organized into chromosomal structures through the help of different proteins. Chromosomes are organized by these proteins into very compact structures called chromatin that can fit into the nucleus of a cell. These chromosomal proteins also help aid the DNA of the cell undergo different functions such as replication for cell division and unwinding different genes for use in protein synthesis.

Ques. ▶ 14 Kamal does not able to differentiate the green and red colour. Jamal is suffering from hemoglobin related genetic disease. This disease has different types.

[Cumilla Cadet College, Cumilla]

a. What is gene? 1
b. Describe about DNA test. 2
c. Why do females are less suffering from the Kamal's disease? Discuss the reason. 3
d. Analyze the types of Jamal's disease and comment which type is more fatal for human beings. 4

Answer to the question no. 14

a The unit of controlling all the visible and invisible signs and characters of organisms is gene.

b DNA test is a DNA-based test which looks at specific locations of a person's genome in order to determine ancestral ethnicity and genealogical relationships. There are three major types of genealogical DNA tests: Autosomal and X-DNA, Y-DNA and mtDNA.

c The name Kamal's disease is color blindness. Females are less suffering from color blindness because the genes responsible for the most common, inherited color blindness are on the X chromosome. Males only have one X chromosome, while females have two X chromosomes. In females, a functional gene on only one of the X chromosomes is enough to compensate for the loss on the other. This kind of inheritance pattern is called X-linked, and primarily affects males. Inherited color blindness can be present at birth, begin in childhood, or not appear until the adult years.

d Jamal is suffering from thalassemia disease. There are two types of thalassemia- alpha thalassemia and beta thalassemia. Jamal is suffering from beta type thalassemia. Beta thalassemia is caused when gene for the production of protein beta globulin is disintegrated. Beta thalassemia also called thalassemia of a khuli. Alpha thalassemia is more fatal for human than beta thalassemia, in which severe anemia begins even before birth. Pregnant women carrying affected fetuses are themselves at risk for serious pregnancy and delivery complications. Normally, each person has four genes for alpha globin. Alpha thalassemia happens when one or more of the genes that control the making of alpha globulins is absent or defective. It can cause anemia ranging from mild to severe and is most commonly found in people of African, Middle Eastern, Chinese, Southeast Asian, and, occasionally, Mediterranean descent.

Ques. ▶ 15 Living cell contain two types of organic acid. One of them carreis hereditary characters in a double helix condition, the other one is single helix and related with protein synthesis. *[Sylhet Cadet College, Sylhet]*

a. What is Locus? 1
b. Why Gene and DNA are same? 2
c. Explain the structure of first mentioned organic acid in your body. 3
d. Make a comparative discussion between the mentioned two types of acid. 4

Answer to the question no. 15

a The location of a gene throughout a chromosome as called locus.

b DNA is the complete molecule that holds all our genetic information. Segments of that DNA molecule that specifically encode proteins are the genes. As genes are made of DNA, are part of the DNA molecule, we can say that gene and DNA are same.

c The first type of organic acid that mentioned in the stem is DNA or deoxyribonucleic acid. The structure of DNA is explained below —
The main component of chromosome is deoxyribonucleic acid or DNA. It is usually a double stranded spiral structure of polynucleotides. A strand is complementary to the other.

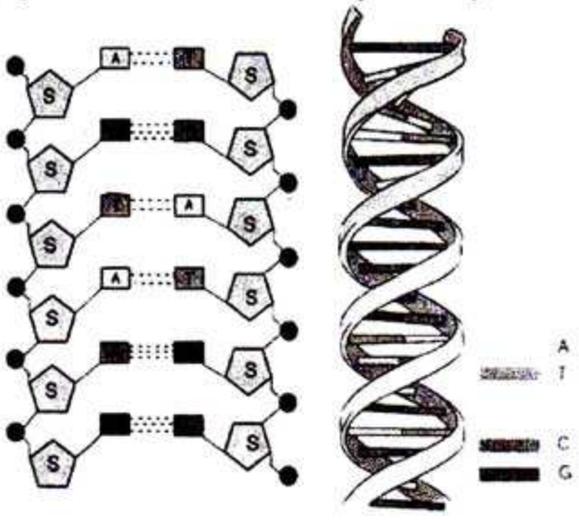


Fig: DNA

In it there are five carbon sugars, nitrogen bases (adenine, guanine, cytosine, thymine), inorganic phosphate. These three components collectively are called a nucleotide. DNA is a stable substance in a chromosome. Nitrogen bases are of two types, a purine and a pyrimidine. Adenine (A), guanine (G) are purines and cytosine (C) and thymine (T) are pyrimidines. The Adenine of one strand bonds with the thymine of another strand by two hydrogen bonds, and guanine of a helix connects with a cytosine of another helix by three hydrogen bonds. This bond is always developed between a purine and pyrimidine. So, a strand of DNA is complementary to another strand but not identical to it.

d The two types of acid mentioned in the stem are DNA or deoxyribonucleic acid and RNA or ribonucleic acid. A comparative discussion between them is given below —
- DNA contains the sugar deoxyribose, while RNA contains the sugar ribose.
- DNA is a double-stranded molecule while RNA is a single-stranded molecule.
- DNA is stable under alkaline conditions while RNA is not stable.
- DNA is responsible for storing and transferring genetic information while RNA directly codes for amino acids and as acts as a messenger between DNA and ribosomes to make proteins.
- DNA and RNA base pairing is slightly different since DNA uses the bases adenine, thymine, cytosine, and guanine; RNA uses adenine, uracil, cytosine, and guanine. Uracil differs from thymine in that it lacks a methyl group on its ring.

Ques. ▶ 16

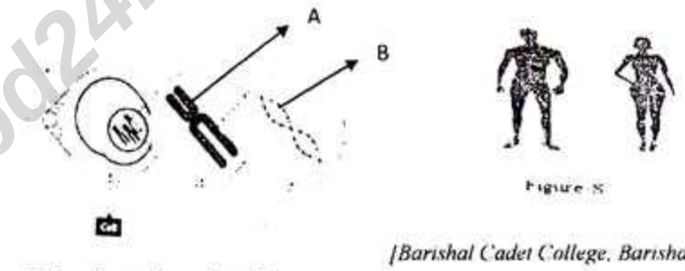


Figure-S

[Barishal Cadet College, Barishal]

a. What is peritendium? 1
b. Why is E. coli used as plasmid? Explain. 2
c. Explain the structure of B-marked part of mentioned figure. 3
d. Analyze the relationship between A-marked part and Figure-S. 4

Answer to the question no. 16

a Peritendium is one of the fibrous sheaths surrounding the primary bundles of fibers in a tendon.

b E. coli is used as plasmid because of its genetical simplicity, growth Rate, foreign DNA hosting etc. When recombinant plasmids are incubated with E. coli cells first treated with a high concentration of divalent cations, a very small fraction of the cells take up a single recombinant plasmid.

c "B" marked part mentioned in the figure is DNA. The structure of DNA is explained below —
The main component of the chromosome is deoxyribonucleic acid or DNA. It is usually a double-stranded spiral structure of polynucleotides. A strand is complementary to the other. In it there are five-carbon sugars, nitrogen bases (adenine, guanine, cytosine, thymine), inorganic phosphate. These three components collectively are called a nucleotide. The Adenine of one strand bonds with the thymine of another strand by two hydrogen bonds, and guanine of a helix connects with a cytosine of another helix by three hydrogen bonds.

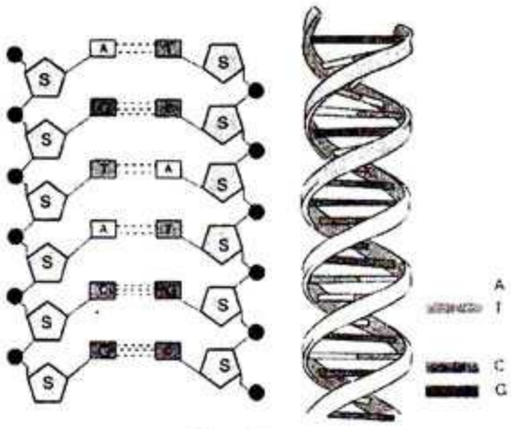


Fig: DNA

This bond is always developed between a purine and pyrimidine. So, a strand of DNA is complementary to another strand but not identical to it. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So, the length between the two adjacent nucleotides is $3.4A^O$ (from top to bottom). The two strands of polynucleotides in DNA are positioned antiparallelly. It looks like rungs in a twisted ladder. The bases are connected flatly and horizontally in position from the main axis. The external two strands or two axes of DNA are composed of consecutive arrangements of sugar and phosphate, and internal nitrogen bases are plainly aligned.

d "A" marked part mentioned in the figure is chromosome and fig- "S" mentioned in the stem is The is figure of a male and a female. The relationship between chromosome and gender of human is analyzed below —

The chromosome holds not only the genetic code, but many of the proteins responsible for helping express it. All animals have a set of DNA coding for genes present on chromosomes. In humans, most mammals, and some other species, two of the chromosomes, called the X chromosome and Y chromosome, code for sex. In these species, one or more genes are present on their Y chromosome that determines maleness. In this process, an X chromosome and a Y chromosome act to determine the sex of offspring, often due to genes located on the Y chromosome that code for maleness. Offspring have two sex chromosomes: an offspring with two X chromosomes will develop female characteristics, and an offspring with an X and a Y chromosome will develop male characteristics.

Ques. ▶ 17

fig-X

fig-Y

[RAJUK Uttara Model College, Dhaka]

a. What is locus? 1
b. Why chromosomes are considered as physical basis of heredity. 2
c. Explain the differences of the molecules expressed in the fig-X and Fig-Y. 3
d. Structure of Y is very complex-analyze the statement. 4

Answer to the question no. 17

a The location of a gene throughout a chromosome is called locus.

b The function of chromosomes is to carry genes (which control the characteristics of organism) to the offspring from parents. Colors of human eyes, nature of hair, compositions of skin etc. continue intact through the flow of heredity carried by chromosomes. This is why chromosome are considered as physical basis of heredity.

c Fig "X" mentioned in the stem is RNA and Fig "Y" mentioned in the stem is DNA. The differences between DNA and RNA are explained below —

1. DNA contains the sugar deoxyribose, while RNA contains the sugar ribose. The only difference between ribose and deoxyribose is that ribose has one more -OH group than deoxyribose, which has -H attached to the second (2') carbon in the ring.
2. DNA is a double-stranded molecule while RNA is a single-stranded molecule.
3. DNA is stable under alkaline conditions while RNA is not stable.
4. DNA and RNA perform different functions in humans. DNA is responsible for storing and transferring genetic information while RNA directly codes for amino acids and as acts as a messenger between DNA and ribosomes to make proteins.
5. DNA and RNA base pairing is slightly different since DNA uses the bases adenine, thymine, cytosine, and guanine; RNA uses adenine, uracil, cytosine, and guanine. Uracil differs from thymine in that it lacks a methyl group on its ring.

d Fig "Y" mentioned in the stem is DNA which structure is very complex. This analyzed below —

DNA is a complex molecule that consists of many components, a portion of which are passed from parent organisms to their offspring during the process of reproduction. Although each organism's DNA is unique, all DNA is composed of the same nitrogen-based molecules. The structure of DNA is a double-helix polymer, a spiral consisting of two DNA strands wound around each other. Each strand of a DNA molecule is composed of a long chain of monomer nucleotides. The nucleotides of DNA consist of a deoxyribose sugar molecule to which is attached a phosphate group and one of four nitrogenous bases: two purines (adenine and guanine) and two pyrimidines (cytosine and thymine). The nucleotides are joined together by covalent bonds between the phosphate of one nucleotide and the sugar of the next, forming a phosphate-sugar backbone from which the nitrogenous bases protrude. One strand is held to another by hydrogen bonds between the bases; the sequencing of this bonding is specific– i.e., adenine bonds only with thymine, and cytosine only with guanine. The configuration of the DNA molecule is highly stable, allowing it to act as a template for the replication of new DNA molecules.

Ques. ▶ 18

Topics-01	Sample 'X' is collected from deformed dead body of Road accident.
Topics-02	Transfer of gene by the process of 'Y' for the development o f high quality crops.

[Viqarunnisa Noon School and College, Dhaka]

a. What is Explant? 1
b. Why 'O' blood group is called unviersal donar? 2
c. Explain the role of 'X' for the indentification of unknown dead body. 3
d. New character can be developed in the plant and animal by the process of 'Y'. 4

Answer to the question no. 18

a Explant is a portion of plant parts or tissues that are aseptically cut and used to initiate a culture in a nutrient medium.

b Type O blood is the called the universal donor because it has neither A nor B surface antigens on the red blood cells. Antigens are proteins that are capable of evoking an allergic response in someone whose body does not have the antigen. At any emergency situation, individual with "O" blood group can donate blood to patient with any blood group.

c DNA is denoted as "X" in the stem and DNA test is done to identify dead bodies.
DNA testing is a powerful tool for identification of dead bodies. DNA test is done after collecting biological samples from individuals. Biological samples include bones, teeth, hair, blood, saliva, semen etc. For this purpose, evidences including biological samples are collected from the dead body. Also, close family person of the person who died or belongings of that person are useful because biological samples can be collected from them. DNA testing is done for the biological specimens and the results are compared. If any match is found, the person dead is identified.

d The process "Y" which is mentioned in the stem is called genetic engineering by which new traits can be introduced to both plant and animal. In this process, recombinant DNA technology is applied.
Recombinant DNA technology is the method where DNA molecules from two different species are inserted into a host organism to produce new genetic combinations that are of value to science.
Followings are the results of recombinant DNA technology —
In plants:

- Creating pest resistant variety of different agricultural crops. For example- BT maize, BT rice etc. are immune to the harms caused by insects from the orders lepidoptera and coleoptera.
- It is possible to create virus resistant plant variety. For example, transferring coat protein gene of tobacco mosaic virus (TMV) to tobacco plants gave rise to virus resistant plant variety.
- Varieties of corn and cotton tolerant to herbicides have been produced by genetic modification.
- Through genetic engineering more than one trait can be inserted in the same plant. For example. genetically modified cotton and corn plants are able to resist weeds and pests at the same time.
- Through genetic change, nutrition value of some crops has been improved. For example, vitamin A i.e. beta-carotene gene has been transferred into rice.

In animals:

- In livestock, for example transfer of protein C gene has been done to increase protein in cow-milk though still it is in research level.
- Through genetic modification, genetic changes have been accomplished in sheep by transferring the human growth hormone producing gene to serve the purpose of increasing its size and meat production. To improve the amount and quality of the fur, 2 bacterial genes, such as CysE and CysM have been transferred to the genome of sheep.

It was possible to increase the growth of some fishes (common carp, bombay duck. tilapia, catfish etc.) up to 60% by introducing salmon growth hormone gene to those fishes.

Ques. ▶ 19

[Dnaka Residential Model College, Dhaka]

a. What is imbibition? 1
b. What do you understand by biodiversity? 2
c. Describe the molecular structure of 'P'. 3
d. Analyze the fole of 'X' component determine of human sex. 4

Answer to the question no. 19

a The special process of absorbing liquid by dry or half-dry colloidal substance is known as imbibition. Seeds absorb water before germination in imbibition process.

b Biodiversity is the abundance and variability among organisms existing on the earth. Biodiversity encompasses all living species on Earth and their relationships to each other.

c From the figure of the stem, is it understood that "P" represents a chromosome.
The main component of chromosome is deoxyribonucleic acid. It is usually a double-stranded spiral structure of polynucleotides. A strand is complementary to the other. There is sugar (five-carbon), nitrogen bases (adenine, guanine, cytosine, thymine) and inorganic phosphate involved in giving DNA its distinct structure. Nitrogen bases are of two types, such as- purines [adenine (A), guanine (G)] are purines and pyrimidines[cytosine (C) and thymine (T)]. Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds [A=T] and guanine of a helix connects with a cytosine of opposite helix by three hydrogen bonds [G≡C] This bond is always developed in between a purine and a pyrimidine. So a strand of DNA is complementary to another strand. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So the length between the two adjacent nucleotides is $3.4A^0$ in average.

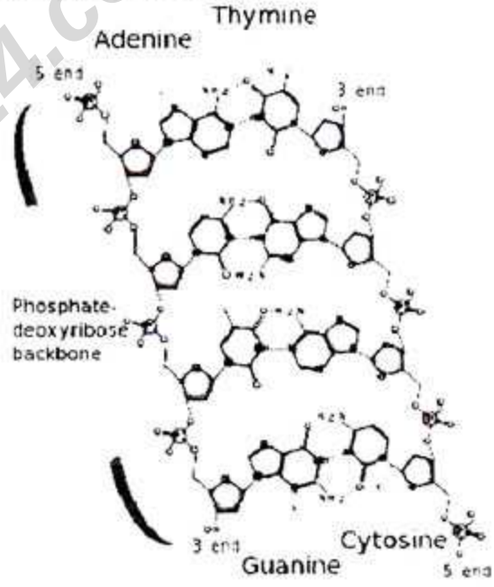


Fig: Structure of DNA

d The two sex chromosomes are marked with X and Y. They play significant role in determining sex. In women, in the diploid cells both sex chromosomes are X i.e. XX. But in case of men of the two chromosomes one is X and the other is Y. Both the chromosomes are long in structure, rod shaped but chromosome Y is little shorter than the chromosome X. At the time of development of egg, meiosis occurs, and every egg possesses a chromosome. But in case of a man at the time of the formation of sperms, half number of sperms contain X chromosome and other half number of sperms contain Y chromosome. An egg can be fertilized with either one of the sperm type X or Y. So, zygote can be having both the chromosomes as type X, or can be having one X and the other one Y. The baby, which is born having both the chromosomes as X i.e. XX, will be a baby girl and the baby, who is born with a chromosome of type X and the other one is of Y, will be a baby boy. So, it means that X chromosome have direct influence on determining the sex of a human child.

Ques. ▶ 20

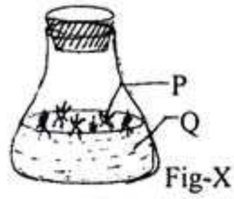


Fig-X

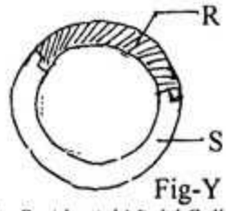


Fig-Y

[Dhaka Residential Model College, Dhaka]

a. What is marked 'P'? 1
b. Mention the sterilization process of marked — Q of above stem? 2
c. Describe the process of production of fig-Y? 3
d. Analyse the significance of fig-X for producing modern crops. 4

Answer to the question no. 20

a Small plantlets are marked as "P" in the stem grown by tissue culture.

b A medium for plant tissue culture is labeled as "Q" in the stem. Culture medium is sterilized in autoclave machine at 121°C temperature, at 15-lb pressure per square inch for 20 minutes. Sterilization is done so that the medium is contamination and germ free.

c Figure "Y" of the stem represents a recombinant DNA. The process of creating a recombinant DNA is listed below —

- A DNA molecule of interest is selected.
- A carrier is selected so that the transfer of desired segment of DNA becomes possible.
- Selection of necessary restriction enzyme (special type of enzyme to cut DNA) to chop the DNA molecule at a particular locus
- Ligase enzyme ligates the two separate segments of DNA
- Recombinant DNA is prepared now.

d Significance of tissue culture to create modern crops are explained below-

- Disease-free plants can be created
- A good number of plants can be produced within a relatively short period
- The problem regarding storing seeds can be avoided
- The plants, which do not produce endosperm, can be developed directly by culturing their embryo
- The rapid multiplication of the plants, which do not reproduce through sexual reproduction or of which rate of natural reproduction is low, can be done by culturing their embryo
- Plants with new characteristics can be developed
- Good yield of crops is ensured

Ques. ▶ 21 Look at the figure below and Answer to the questions:

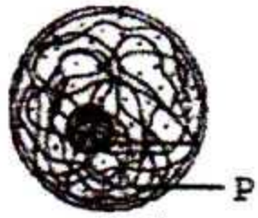


Fig-X

[Milestone College, Dhaka]

a. What is Nucleotide? 1
b. Why DNA replication is called the semi conservative way? 2
c. Explain the abnormalities that occur due to problems in the 'P' part as mentioned in the stem. 3
d. "Fig 'X' as mentioned in the stem is known as the center of a cell"-Analyze. 4

Answer to the question no. 21

a A nucleotide is an organic molecule made up of a nucleotide base (adenine, guanine, cytosine, thymine, uracil), a five-carbon sugar and at least one inorganic phosphate group. Nucleotides make up the basic units of DNA and RNA molecules.

b DNA replication is called semiconservative because an existing DNA strand is used to create a new strand. DNA is a double stranded molecule. When DNA is copied the two strand of DNA (old strands) separate and new nucleotides match up with the two separated strands. This process creates two identical double stranded DNA molecules are formed. Each DNA molecule contains one strand of the original DNA molecule and one newly synthesised strand.

c The "P" part mentioned in the stem is chromosome. The abnormalities that occur due to problems in the chromosomes are given below-

Colour blindness: Colour blindness is a condition when someone cannot properly identify any colour. To identify colour we have pigments in our optical nerve cells. Being colour blind, the patient is deficient of colour identifying pigments in their optical nerve and suffers from colour blindness. If someone lacks a single pigment then he would not be able to differentiate colour red and green. It is the universal problem of colour blindness. For lacking of more than one pigment besides red and green, the patient cannot differentiate the colour blue and yellow. One man out of ten is seen as colour blind. In comparison, very few numbers of women suffer from this problem.

Thalassemia: Thalassemia is a genetic blood disorder in which the body makes an abnormal form of hemoglobin. Hemoglobin is the protein molecule in red blood cells that carries oxygen. The disorder results in excessive destruction of red blood cells, which leads to anemia. Anemia is a condition in which your body does not have enough normal, healthy red blood cells. There are two primary types of thalassemia disease: Alpha thalassemia disease and Beta thalassemia disease. Beta thalassemia major (also called Cooley's Anemia) is a serious illness. Symptoms appear in the first two years of life and include paleness of the skin, poor appetite, irritability, and failure to grow. Proper treatment includes routine blood transfusions and other therapies. There are two main types of alpha thalassemia disease. Alpha thalassemia major is a very serious disease in which severe anemia begins even before birth. Pregnant women carrying affected fetuses are themselves at risk for serious pregnancy and delivery complications. Another type of alpha thalassemia is Hemoglobin H disease. There are varying degrees of Hemoglobin H disease. Thalassemia genetically passes from generation to generation. In Bangladesh, thalassemia is an important hereditary blood concerning problem.

d "Fig- X" mentioned in the stem is the figure of nucleus which is known as the center of a cell. This is analysed below —

The nucleus can be thought of as the center of a eukaryotic cell because it contains most of the genetic material that carries the instructions for the cell's operations. Inside the nucleus, DNA directs the sequence of chemical steps needed for the synthesis of proteins and, by way of the proteins' action, it controls the metabolism of the rest of the cell. Inside the cell's nucleus rests a long molecule called

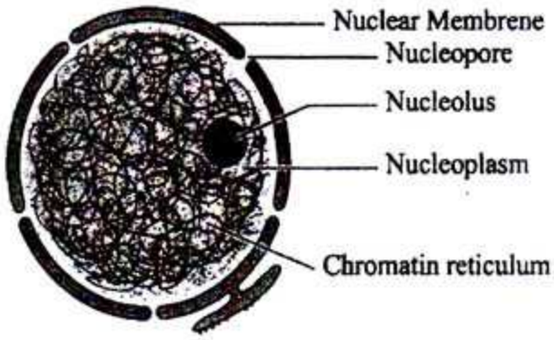


Fig- Nucleus.

DNA. This strand of genetic material contains the instructions needed to build a body, influence its behaviour and drive the chemistry of the cell itself. These instructions are coded as a sequence of nucleotides called genes that can be read by single strands of nucleotides called messenger RNA. Messenger RNA reads off the sequence of instructions coded in the DNA, alters its shape in response to the exact sequence it has read and passes out of the nucleus to instruct the cell's internal machinery in the steps needed to synthesise proteins. Some of these proteins help digest food, some build or destroy other proteins and some are useful in transporting chemicals through the wall of the cell. Very nearly every action the cell takes is in some way influenced by the DNA of the nucleus. That is why nucleus is called the center of a cell.

Ques. ▶ 22

P Q

[Adamjee Cantonment Public School, Dhaka]

a. What is diaphragm? 1
b. What is meant by DNA replication? 2
c. Describe the preparatory step of "Fig Q", in above stem. 3
d. What type of problem may occur in the body if "Fig P" is destroyed in above stem.– Write the recovery process from this situation. 4

Answer to the question no. 22

a Diaphragm is muscular sheet which separates the thoracic cavity from the abdominal cavity in humans. It looks like a spreading or stretching umbrella.

b DNA replication is the biological process of producing two identical replicas of DNA from one original DNA molecule. This process occurs in all living organisms and is the basis for biological inheritance. It is a semi-conservative process which means the newly replicated DNA molecule has an old strand and a newly synthesized strand.

c Figure Q represents a bacterium which contains a recombinant DNA. The preparatory stages of recombinant DNA production are mentioned below-

a. Selection of target DNA.
b. Selection of a carrier to transfer the target DNA
c. Selection of appropriate restriction enzyme to cut the DNA at a particular region
d. Selection of DNA ligase enzyme to join the segments of DNA chopped
e. Selection of a host for the replication of the carrier DNA which now contains the segment of desired DNA
f. Evaluation of the expression of recombinant DNA prepared with the desired DNA segment

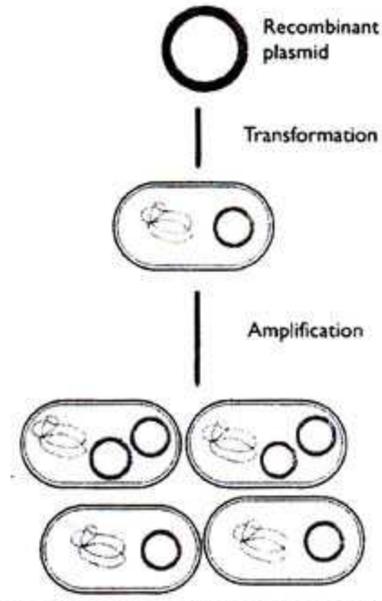


Fig: Formation of recombinant DNA

d Figure P of the stem represents human red blood cell or red blood corpuscle. These cells carry and supply oxygen to each of the living cells of the body.

If red blood cells are destroyed, then the following conditions may arise —

- Anemia: Anemia is a decrease in the total amount of red blood cells (RBCs) or hemoglobin in the blood, or a lowered ability of the blood to carry oxygen. When anemia comes on slowly, the symptoms are often vague and may include feeling tired, weakness, shortness of breath or a poor ability to exercise.
- Thalassemia: Disintegrated and abnormal state of red blood cells are known as thalassemia which leads to anemia. It is hereditary genetic disease.

Treatment:

- Transfusion of blood at regular intervals in thalassemia patients.
- Intake of iron rich fruits in anemia and thalassemia patients.
- Medicines to reduce the complications prescribed by doctors.

Ques. ▶ 23 $\frac{3}{4}$ th of earth is water and ¼ th is land area which are inbibited by a large no of biodiversified organisms and they have different types of interaction. Different regions of people are also suffering from different types of diseases. Some of the diseases are prevalent in Middle East and Chaina.

[Bangladesh International School & College, Dhaka]

a. What is is Biodiversity? 1
b. What is meant by mutualism? 2
c. Explain what is the effect of biodiversity on the maintenance of stability in an ecosystem. 3
d. Describe the last line mentioned in the stem and justify if it is life threatening. 4

Answer to the question no. 23

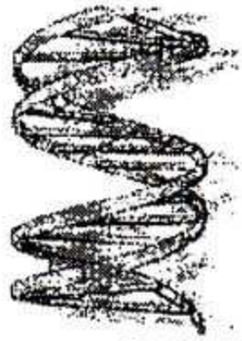
a Biodiversity is the abundance and variability among organisms existing on the earth.

b Mutualism is the relationship among animals or plants when in the association both the organisms become benefited. Such as bee, fly, worm and insect etc. fly around from flower to flower to attain the nectar and as a result the pollination is accomplished.

c **Effect of biodiversity on the maintenance of stability in an ecosystem:** For maintaining the balance in the environment, a complex relationship has been developed. With the activities of a large number of organisms, the balance is maintained. Only the extinction of a species in an environment may cause a large catastrophe. So, for the stability of the environment biodiversity is especially important. For example, once, there were innumerable oysters in the coast of Check Pick. They could purify the water of the total locality by only three days. But now 99% of those oysters have been extinct. As a result, purification of the water is affected.

d Thalassemia is the name of a disease of acquiring abnormal state of red blood cells. Because of this disease, red blood cells are disintegrated. So, the patient suffers from anemia. This disease genetically passes from generation to generation. This disease is prevalent in Middle East and China. Thalassemia is caused for the disintegration of the two genes related to the α globulin and β globulin. proteins. Consequently, defective red blood cells are usually found α Thalassemia is caused if the gene for α globulin production is absent or changed. Without red blood cell oxygen cannot be transported so it is a life-threatening disease.

Ques. ▶24



[BIAM Model School and College, Dhaka]

a. Write the formula of pyruvic acid? 1
b. Why artery is different from vein? 2
c. Describe the process of replication of above mentioned figure? 3
d. The above mentioned figure is different from RNA, why? Explain it. 4

Answer to the question no. 24

a Pyruvic acid ($C_3H_4O_3$) is the compound formed from breaking down a molecule of glucose (C6H12O6) through many chemical reactions at first stage of glycolysis.

b Artery is different from vein in many ways. But the most significant one is that artery carries oxygenated blood away from the heart to different organs of the body. On the other hand, vein carries carbon enriched blood from the body towards heart.

c Mentioned figure in the stem is a DNA double strand. Replication process of DNA is given below,
1. DNA replicates in a half-conservative way.
2. The double stranded DNA becomes single stranded by breaking hydrogen bonds in between them.
3. Each stand causes the emergence of a new strand.
4. At the end, a new strand, combining with another old strand, forms the structure of a molecule of DNA.
This principle is known as semi-conservative method.

d Mentioned figure in the stem is a DNA double strand. There is significant difference between DNA and RNA. Differences are given below,

Feature	DNA	RNA
Structure	DNA is double stranded structure	RNA is single structured
Composition	It is composed of 5 carbon deoxyribose sugar, inorganic phosphate and nitrogen bases (adenine, thymine, cytosine and uracil).	It is composed of 5 carbon ribose sugar, inorganic phosphate and nitrogen bases (adenine, guanine, cytosine and uracil).
Heredity	DNA is the main component and chemical carrier of heredity.	The viruses which are not composed of DNA possess RNA as their nucleic acid. In this situation, RNA serves itself as the hereditary material.

Ques. ▶25 In biology class teacher said that, in 1953 two scientists described about a double halix molecule structure. It is made of some chemical compounds. He also said, that, this molecule replicate itself by a special process.

[Rajshahi Cantonment Public School and College, Rajshahi]

a. What is phenotype? 1
b. What is meant by herbicide tolerant gene? 2
c. Explain the structure of the mentioned molecule. 3
d. Analyze the significance of the last line of the stem. 4

Answer to the question no. 25

a **Not found in the textbook**: Phenotype is the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment.

b Herbicide tolerant genes are genetically modified genes that are designed to tolerate specific broad-spectrum herbicides, which kill the surrounding weeds, but leave the cultivated crop intact.

c The mentioned molecule is **DNA**. **Structure of DNA:** DNA is usually a double stranded spiral structure of polynucleotide. In it there are five carbon sugars, nitrogen bases (adenine, guanine, cytosine, thymine) inorganic phosphate. Adenine bonds with a thymine by two hydrogen bonds, and guanine connects with a cytosine by three hydrogen bonds. Two strands of polynucleotides in DNA are positioned antiparallelly. Bases are connected flatly and horizontally in the position from the main axis. External two strands of DNA are composed of consecutive arrangement of sugar and phosphate, and internal nitrogen bases are plainly aligned.

d DNA replication takes place in **semi-conservative method**. Through this process,
- The double stranded DNA becomes single stranded by breaking hydrogen bonds in between them
- Each stand causes the emergence of a new strand.
- At the end, a new strand, combining with another old strand, forms the structure of a molecule of DNA.

As the new DNA emerges, it has a new and an old strand.

Ques. ▶26 M ⟶ Adenine, Guanine, Cytosine, Thymine
N ⟶ Tall pea plant, Short pea plant

[Chattogram Cantonment Public College, Chattogram]

a. What is organic evolution? 1
b. Explain the functions of bicuspid and tricuspid valve of the heart. 2

c. Describe the component of chromosome which is formed by the parts of 'M' mentioned in the stem. 3

d. Using the plants of 'N' mentioned in the stem, Mendel proved that, Tall plant: Short plant = 3 : 1– Analyze the statement. 4

Answer to the question no. 26

a Organisms continuously go through changes to survive in the changing environment. In the span of some thousand years of time, species of organisms accepted new changes within them for their survival, it is called organic evolution.

b Bicuspid valve:

- Situated at the aperture between left atrium and left ventricle
- Allows the flow of blood from left atrium to left ventricle
- Prevents the oxygenated blood from flowing back to the left atrium

Tricuspid valve:

- Situated at the aperture between right atrium and right ventricle
- Allows the flow of blood from right atrium to right ventricle
- Prevents the de-oxygenated blood from flowing back to the right atrium

c Chromosome is made of DNA. DNA stands for deoxyribonucleic acid. Description of DNA is given below-

- DNA is a double-stranded spiral polynucleotide structure where one strand is complementary to the other. Polynucleotide chains are composed of small structural units called nucleotide.
- One nucleotide is composed of one nitrogen base, one phosphate group and one deoxyribonucleic acid.
- Purine nucleotides (Adenosine, Guanosine) and Pyrimidine nucleotide (Thymine, Cytosine) make up DNA strand.
- Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds, and guanine of a helix connects with a cytosine of another helix by three hydrogen bonds. This bond is always developed in between a purine and pyrimidine
- The length between the two adjacent nucleotides is $3.4A^0$
- DNA is the carrier of the hereditary traits

d Gregor Johann Mendel, the father of genetics, proposed laws of inheritance based on his work on pea plants. He crossed pea plants over and over and grouped the offspring based on the physical traits they expressed. When pure tall plants (plants that contained dominant traits for tallness in both their alleles, TT), were crossed with pure short plants (plants that contained recessive traits for tallness in both their alleles, tt), all the daughter plants, called the F1 generation, were tall. the next round of experiment, Mendel used the F1 generation as parents (both tall plants, Tt) and crossed them. The phenotypic ratio between tall and short pea plants was 3:1 where the genotype was 1:2:1 in F2 generation. When plants with pure contrasting traits (homozygous, TT or tt) are crossed, the dominant trait is expressed in the next generation. In other words, all offspring (heterozygous, Tt) of pure parents express the dominant trait, although they contain the recessive allele in their genetic makeup.

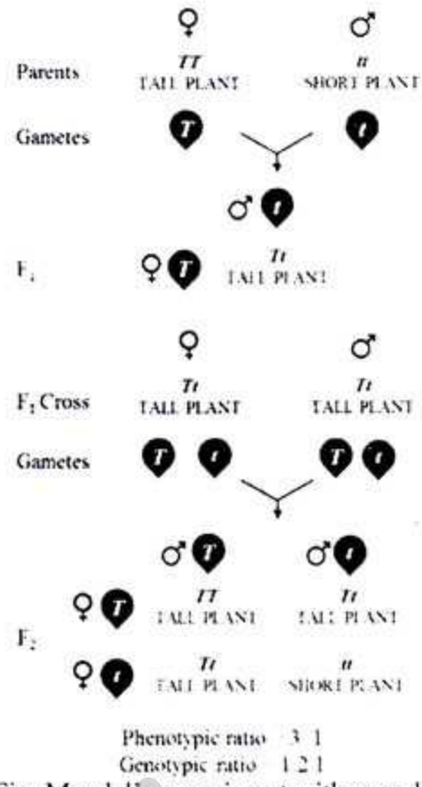


Fig: Mendel's experiment with pea plant

Ques. ▶27 Watson and Crick propagated the theory of X-Ray Difraction of a structure of a winding stair case.

[Cantonment English School and College, Chattogram]

a. What is pyrimidine? 1

b. How does Ligase work? 2

c. How does the structure replicate? 3

d. The revolutionary discovery of the above is a gift of modern science-explain. 4

Answer to the question no. 27

a Pyrimidine is a type of nitrogen base that constitute both DNA and RNA. Adenine and guanine are pyrimidine nitrogen bases.

b Ligase is an enzyme which can join two DNA fragments. It facilitates the joining of DNA strands together by catalyzing the formation of a phosphodiester bond which is considered as the backbone of DNA. Ligase enzyme is a very important tool in genetic engineering.

c The structure mentioned in the stem is DNA. At each cell division event, DNA replication takes place and two identical DNA copies are created. DNA replication is semi or half conservative, meaning that each strand in the DNA double helix acts as a template for the synthesis of a new, complementary strand. This process takes us from one starting molecule to two "daughter" molecules, with each newly formed double helix containing one new and one old strand. At first, the hydrogen bond between nucleotides of the two opposite strands gets disrupted and the strands separate from each other. Each strand works as a template for synthesizing new strand. After that, hydrogen bond between the newly synthesized strands re-emerges and thus two complete DNA molecules are formed. An enzyme named DNA polymerase works in synthesizing new strands in DNA replication.

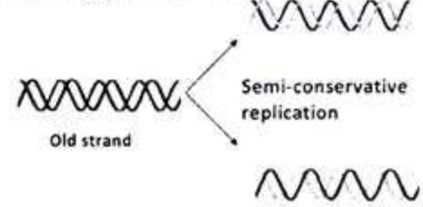


Fig: DNA replication process

d Discovery of DNA led to a whole new era of scientific research in terms of modern science where DNA has been using as a tool, as an identification marker and many more. Truly, the discovery of DNA has been a gift to the scientific community for the betterment of humankind. Application of DNA in various fields like crime solving, paternity testing etc. had been a blessing till today.

- Paternity testing: Sometimes disputes arise regarding the birth identity of a child. In that case DNA testing provides accurate results and identifies the actual parents as parents share similar genetic profile with their offspring.
- Criminal identification: Biological samples from crime sites are collected and DNA is extracted from them. The test result is compared with the genetic profiles of the suspects and if any match is found, further investigation is allowed to identify the real culprit.
- Identification of deceased person: In similar ways, biological samples from a deceased body and the relatives to be in question can be confirmed via DNA testing which could help identify the person's identity.
- Genetic engineering: Modern science uses recombinant DNA technology to improve the yield of crops, crop quality, production of medicine etc.

Ques. ▶28 Karib and Karina are siblings. Karib cannot distinguish red-green colours but Karina does not have this disorder. Their mother also has got the Same problem.

[Cantonment English School and College, Chattogram]

a. What is gene? 1
b. What do you mean by sex linked inheritance? 2
c. State the characteristics of the disorder. 3
d. Evaluate that Karibs disorder is inherited. 4

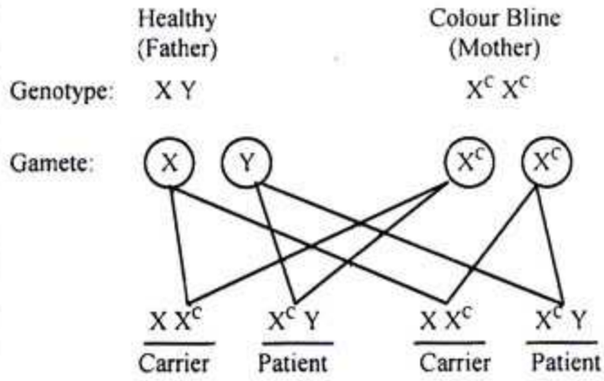
Answer to the question no. 28

a A gene is the basic physical and functional unit of heredity. It refers to the unit of controlling all the visible and the invisible signs and characters of organisms.

b Sex linked inheritance means the traits conferred to the offspring of an individual by its sex chromosomes. X and Y chromosomes are sex chromosomes of human and genes associated with these chromosomes are called sex linkage genes. For example, hemophilia is an X- chromosome linked disorder which is inherited in the next generation.

c The disorder mentioned in the stem is called colour blindness which is an X-linked disorder. It is a condition where a person cannot properly identify any colour. We have pigments in our optical nerve cells which help us to differentiate between different colours. A colour blind patient lacks colour identifying pigments in his optical nerve and suffers from colour blindness. If someone lacks only a single pigment even then he would not be able to differentiate colour red and green. For lacking of more than one pigment, the patient cannot differentiate between blue and yellow colours. One man out of ten suffer from colour blindness. In comparison, very few numbers of women suffer from this problem.

D. Being an X-linked disorder, colour blindness affect males more than it affects females. Karib and Karina's mother has the disease, but Karina not having this disorder implies that their father is a healthy individual and Karina herself is a carrier.



Karina = Female carrier of colour blindness
Karib = Male colour blind patient
X = Healthy chromosome
Y = Healthy chromosome
X^C = Defective chromosome

Since, one X chromosome in Karina is defective and the other one is healthy, so she is not showing any disease characteristics. But Karib has only one X chromosome and that too is defective, thus he developed colour blindness.

Ques. ▶29 In the biology class; teacher discussed about the structure of DNA molecule. He also informed to the students that this molecule also help to detect the criminal.

[Bangladesh Elementary School, Chattogram]

a. What is CAM? 1
b. What do you mean by determination of sex? 2
c. Explain the structure of mentioned molecule of the stem. 3
d. Analyze and evaluate the last statement of the stem. 4

Answer to the question no. 29

a Crassulacean acid metabolism, also known as CAM photosynthesis, is a carbon fixation pathway that evolved in some plants as an adaptation to arid conditions. In a CAM plant, the stomata in the leaves remain shut during the day to reduce evapotranspiration but open at night to collect carbon dioxide.

b A sex-determination system is a biological system that determines the development of sexual characteristics in an organism. Most organisms that create their offspring using sexual reproduction have two sexes, male and female. The males have XY sex chromosome and the females have XX sex chromosome.

c The main component of the chromosome is deoxyribonucleic acid. It is usually a double-stranded spiral structure of polynucleotides. A strand is complementary to the other. There are sugar (five carbon), nitrogen bases (adenine, guanine, cytosine, thymine) and inorganic phosphate involved in giving DNA its distinct structure. Nitrogen bases are of two types, such as- purines [adenine (A), guanine (G)] are purines and pyrimidines [cytosine (C) and thymine (T)]. Adenine of a strand bonds with a thymine of another strand by two hydrogen bonds [A=T] and guanine of a helix connects with a cytosine of opposite helix by three hydrogen bonds[G≡C] This bond is always developed in between a purine and a pyrimidine. So, a strand of DNA is complementary to another strand. A complete twist in a helix is $34A^0$ long and in a complete twist, there are

ten nucleotides. So, the length between the two adjacent nucleotides is $3.4A^0$ in average.

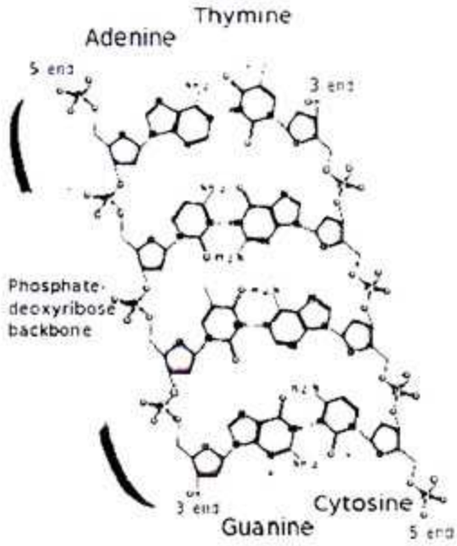


Fig: Structure of DNA

d To detect the criminal, DNA testing can be done.
Biological samples from crime sites are collected and DNA is extracted from them. The test result is compared with the genetic profiles of the suspects and if any match is found, further investigation is allowed to identify the real culprit.
DNA profiling and matching of physical data, such as fingerprints, are used in solving all crime types. The forensic scientists will look for suitable samples at a crime scene, examining such items as weapons, clothing, hair or anything else from which they can obtain body cells for DNA profiling, or fingerprints or "marks" for use in fingerprint matching. The DNA database can help to solve undetected cases where there is no suspect. DNA profiling can also be used to identify a body formally. This is achieved by obtaining DNA profiles from both the mother and father or by relating personal effects to a body. DNA profiling is used in such cases after all other means of identifying a body have been carried out.The details of a person's fingerprints are distinctive to them and only them. Even identical twins do not have identical fingerprints.
Thus DNA resting helps establish justice in the society. In Bangladesh, along with evidence, witness, eyewitness dependent judiciary system,
DNA has opened a new window of ensuring true justice.

Ques. ▶30 Answer the questions based on the following stem.

Figure-A

[SCHOLARSHOME, Sylhet]

a. What is double fertilization? 1
b. What is meant by Nit ogen-Base? 2
c. Describe the structure Figure:A. 3
d. What are the roles of Figure 'A' in heredity?-Explain. 4

Answer to the question no. 30

a The two fusions, mixing of a male gamete with an egg and mixing of another male gamete with secondary nuclei, take place at about the same time. This phenomenon is called double fertilization.

b A nitrogenous base is simply a nitrogen-containing molecule that has the same chemical properties as a base. They are particularly important since they make up the building blocks of DNA and RNA: adenine, guanine, cytosine, thymine and uracil.

c Fig- "A" mentioned in the stem is DNA. The structure of DNA is given below —
The main component of chromosome is deoxyribonucleic acid or DNA. It is usually a double stranded spiral structure of polynucleotides. A strand is complementary to the other. In it there are five carbon sugars, nitrogen bases (adenine, guanine, cytosine, thymine), inorganic phosphate. These three components collectively are called a nucleotide.
DNA is a stable substance in a chromosome. Nitrogen bases are of two types, a purine and a pyrimidine. Adenine (A), guanine (G) are purines and cytosine (C) and thymine (T) are pyrimidines. The Adenine of one strand bonds with the thymine of another strand by two hydrogen bonds, and guanine of a helix connects with a cytosine of another helix by three hydrogen bonds. This bond is always developed between a purine and pyrimidine.

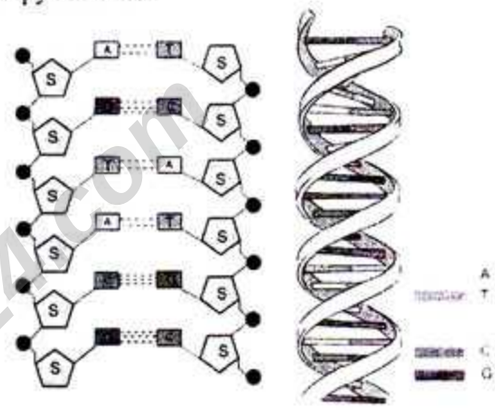


Fig: DNA

So, a strand of DNA is complementary to another strand but not identical to it. A complete twist in a helix is $34A^0$ long and in a complete twist, there are ten nucleotides. So, the length between the two adjacent nucleotides is $3.4A^O$ (from top to bottom). The two strands of polynucleotides in DNA are positioned antiparallelly. It looks like rungs in a twisted ladder. The bases are connected flatly and horizontally in position from the main axis. The external two strands or two axes of DNA are composed of consecutive arrangements of sugar and phosphate, and internal nitrogen bases are plainly aligned. In fact, DNA is a precise thread, but in a prokaryotic cell DNA is usually circular and the surface area would be a few microns to centimeters.

d Fig- "A" mentioned in the stem is DNA which has an important role in heredity. This is explained below —
DNA can replicate itself in a semi-conservative fashion, through a process known as Replication. This process on the one hand allows for the transmission of the parental cell information to the off-spring. So this guarantees the heredity. DNA makes up heredity. Without DNA there wouldn't be characteristics of an individual or heredity. We know, gene is the segment of DNA which contain genetic data. The function of chromosomes is to carry genes (which control the characteristics of organism) to the offspring from parents. Colors of human eyes, nature of hair, compositions of skin etc. continue intact through the flow of heredity carried by chromosomes. This is why chromosome are considered as physical basis of heredity. So, DNA is the true structure and earlier of the behavioural characters of organisms, and it directly carries the characteristics of parents to their offspring from generation to generation.