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Q.No 1 :Differences in DNA replication in Prokaryotes and Eukaryotes :

i) There is only one point of origin in Prokaryotic cells and replication occurs in two opposite direction, while in Eukaryotic cells have multiple points of origin and replication takes place in unidirection within the nucleus.

ii) Prokaryotic cells have one or two types of polymerases, on the other hand Eukaryotic have four or more .

iii) Replication in Prokaryotic cells occurs at much faster speed than in Eukaryotic cells .

iv) Prokaryotic cells undergo replication continuously while replication in Eukaryotic cells occurs amid S-phase of cell cycle.

Differences between prokaryotic and Eukaryotic transcription :

i) Transcription and translation both occur simultaneously in cytoplasm of Prokaryotic cells , they both take place separately and transcription happens in the nucleus of Eukaryotic cells.

ii) Transcription initiation machinery is simple since DNA is not associated with any histone proteins , contrary it is very complex since the genetic material is associated with proteins.

iii) There is no modification of the primary transcript after transcription in Prokaryotic cells, while primary transcript undergo post transcriptional modification.

iv) Only one type of RNA polymerase enzyme, which synthesize all type of RNA in the cell , on the other hand, three types of RNA polymerase in Eukaryotic cells.

v) Promoter region always located upstream to the start site in the Prokaryotic however , it is usually located upstream to the start site , but rarely as in the case of RNA polymerase III, promoter is located downstream to start site in the Eukaryotic cells.

vi) Termination of transcription in prokaryotic is either done by rho dependent mechanism or rho independent mechanism , while termination mechanism of transcription in Eukaryotic cells is still unknown.

Differences in DNA translation in Prokaryotic and Eukaryotic cells :

i) Translation in prokaryotic cells occurs synchronously while Eukaryotic translation occurs asynchronously with its transcription.

ii) 5’ end of mRNA is immediately available for translation in prokaryotic cells, while in Eukaryotic cells the primary transcript is processed after transcription and then it is

migrated to the cytoplasm, where only cytoplasmic ribosomes can initiate translation.

iii) In Prokaryotic cells Ribosome 705 type is used in translation, while in Eukaryotic cells ribosome 805 type is used .

iv) Prokaryotic mRNAs occur in the cytoplasm while Eukaryotic occur in the nucleus.

v) mRNAs in prokaryotic are unstable and live for five seconds, while mRNAs in Eukaryotic are stable and may live for about few hours to days.

vi) Prokaryotic translation has no definite phase for happening, on the other hand , Eukaryotic translation take place during G1 and G2 phases in the cell cycle .

Q.No 3(a) : Relationship between mutation & human diseases

There is a deep relationship between mutation and human diseases. Human body is made up of million of cells each is responsible for particular function. Each cell contains chromosomes, which are made up of DNA . Mutation is an alteration in the sequence of DNA . This mutation is responsible for human diseases. Following are the diseases that are caused by mutation in human body.

i) Chromosomal diseases : happen when the entire chromosome or large segment of chromosome is missed, copied or changed .e.g Dawn syndrome

ii) Single –gene disorders : It is produced when a change in a gene results in stop working of gene. e.g Sickle cell anemia

iii) Multifunctional disorder : it results because of mutation in multiple genes, mostly coupled with environmental causes. E.g diabetes

iv) Mitochondrial disease : Theses are rare diseases caused by mutation in non-chromosomal DNA located within the mitochondria. These disorders can effect any part of the body including brain and muscle .

v) Mutation can also cause some infectious disease like T.B and AIDS .

Q.No. 3 (b) : Sickle cell Anemia & its treatment

This is a disease which effects the red blood cells of a person. The cells become long and bent like a sickle because of mutation. The cells are stuck in blood vessels because of the odd shape which results in decrease in blood flow and circulation .

Treatment with advanced techniques :

Sickle cell disease can be treated with antibiotics, pain management, blood transfusion , hydroxyl urea and surgery . However the most advance technique currently used for the treatment of this disease, is gene therapy. In this technique, stem cell is taken from the liquid bone marrow and using the lentiviral vector transfer the functioning gene into DNA of stem cell. Inside the body chemotherapy will be used to remove existing stem cells and the modified stem cells will be returned to the body that can produce normal hemoglobin.

Q.No 2: Basic steps in gene transferring technique :

These are the following basic steps which are followed in gene transferring.

i) 1^{st} gene of the interest is cut out from the DNA sequence restriction enzyme . If there is no suitable restriction enzyme recognition site around the gene, then 1^{st} PCR reaction is carried out to create new recognition site.

ii) 2^{nd} , A cut is made in the circular DNA sequence of the vector. The same enzyme is used as used in the 1^{st} step .This changes the vector into a linear molecule and makes it ready to accept the new piece of DNA.

iii) In the 3^{rd} step, the vector and the gene are added together. The gene and the opened vector are mixed up with bacterial enzyme called DNA ligase. The ligase sticks DNA ends together to form a single circular molecule which includes both vector and gene .It is repeated and passed to daughter cells in the same way as the bacterium own DNA.

Example : Horizontal gene transfer both in Prokaryote & Eukaryote

Applications of R-plasmid, transposable element & gene cloning :

i) The gens on R-Plasmids give resistance to antibiotics or to other bacterial growth places.

ii) A bacterium with an R-plasmid for penicillin resistance is able to survive treatment by that antibiotic.

iii) R-plasmid can also carry the tra genes that permit the plasmid to be spread from cell to cell .

iv) Transposable elements can be used in insertional mutagenesis .

v) Transposable elements can also be used for gene mapping .

vi) Transposable elements can be used in gene cloning as well .

vii) Cloning ensures the continuity of of hereditary from the parents to the their off springs .

viii) Cloning increases the rate of production and the quality of product is improved .

ix) Good qualities of the plants and animals can be maintained through cloning .