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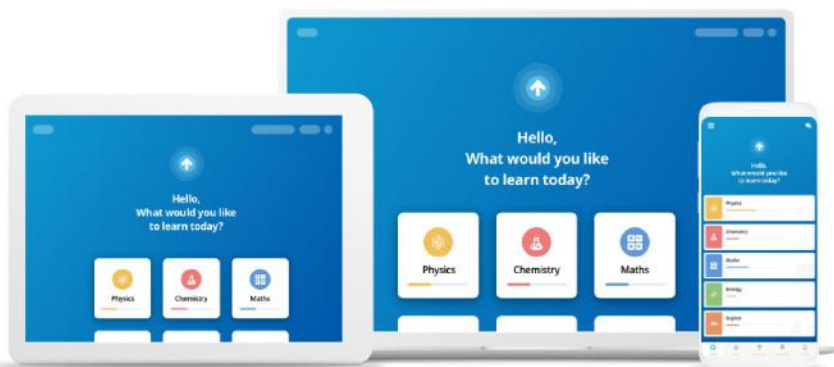
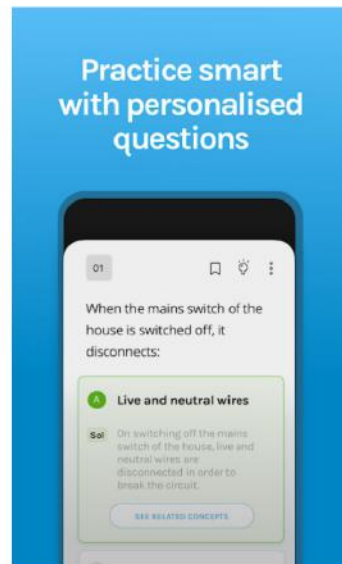
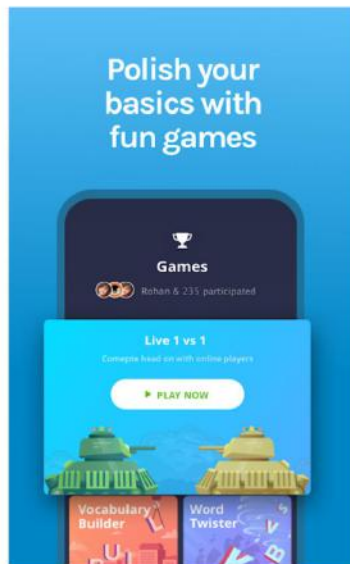
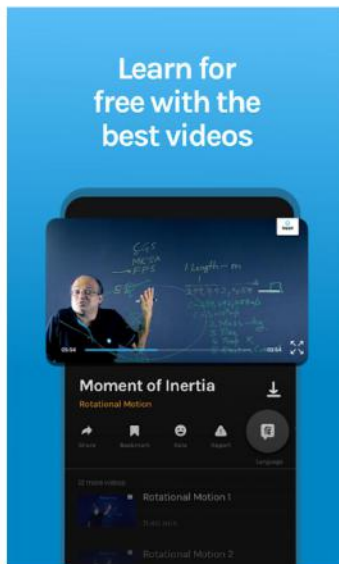
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## **NCERT Solutions for Class 12 Subject-wise**

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- [Class 12 Biology](#)
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- [Class 12 Business Studies](#)
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#526151

Topic: Genetic material

What would be the molar concentration of human DNA in a human cell? Consult your teacher.

Solution

The average molecular weight of a single base pair in a double-stranded DNA is 650 daltons

1 Dalton is equal to one-twelfth of the mass of a carbon-12 atom which is  $1.66 \times 10^{-24}$  grams.

Human DNA has  $3.3 \times 10^9$  base pairs.

The molecular weight of a DNA = Number of base pairs  $\times$  650 Daltons

So, the molecular weight of Human DNA is

$$(3.3 \times 10^9) \times 650 = 2.15 \times 10^{12} \text{ daltons}$$

which is equivalent to  $3.59 \times 10^{-12}$  grams or 3.5 picograms.

Avogadro number of molecules is one mole. Next step is converting the amount of DNA into moles. Now in Human DNA,  $3.3 \times 10^9$  base pairs of nucleotides are present.

So number of moles =  $3.3 \times 10^9$  molecules / Avagadro number

$$= (3.3 \times 10^9) \times (6 \times 10^{23})$$

$$= 5.5 \times 10^{-15}$$

$$= 5.5 \text{ femtomoles of DNA}$$

Now, by definition molarity is defined as the number of moles of solute per liter of solution

therefore, the molar concentration of human DNA can be calculated by knowing the volume of water/liquid in the cell. The volume varies in different cells. The average volume is 5 picoliter ( $5 \times 10^{-12}$  )

So, molarity of DNA in a human cell can be calculated as follows

$$(5.5 \times 10^{-15}) / (5 \times 10^{-12}) = 0.0011 \text{ M}$$

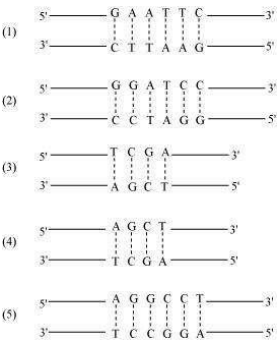
#526157

Topic: Genetic material

Collect 5 examples of palindromic sequence by consulting your teacher. Better try to create a palindromic sequence by following base-pair rules.

Solution

The palindromic sequence is a sequence of the DNA that reads the same whether read from 5' → 3' direction or from 3' → 5' direction.



#526176

Topic: Genetic material

Discuss with your teacher and find out how to distinguish between.

- (a) Plasmid DNA and Chromosomal DNA
- (b) RNA and DNA
- (c) Exonuclease and Endonuclease

Solution

- (a) Chromosomal DNA refers to the entire genome of an organism and depends on the genome for replication. It may be single stranded or double stranded and linear or circular. While plasmid DNA is extrachromosomal DNA that can replicate itself independently and always double-stranded circular DNA.
- (b) DNA has deoxyribose pentose sugar and adenine and thymine as purines. It is found in the nucleus, mitochondria, and chloroplast only. While RNA has ribose pentose sugar and adenine and uracil as purines and found in nucleus and cytoplasm only. DNA replicates to form DNA and transfers genetic information from one generation to next whereas RNA is formed by DNA when required and directs the synthesis of protein in the body.
- (c) Exonucleases are the enzymes that remove nucleotides from 5' or 3' end of DNA while endonucleases make cut within the DNA sequence by breaking the phosphodiester bond, not from its one of the end.

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**#526179**

**Topic:** Genetic material

Group the following as nitrogenous bases and nucleosides:

Adenine, Cytidine, Thymine, Guanosine, Uracil and Cytosine.

**Solution**

DNA is a polymer of nucleotides which are made up of sugar, a nitrogenous base and a phosphate moiety. DNA has four bases; two purines and two pyrimidines. The two purines are namely adenine and guanine and two pyrimidines are cytosine, thymine. A nucleotide unit without phosphate group is called nucleoside. Nitrogenous bases = Adenine, thymine, uracil and cytosine. Cytidine and Guanosine are the nucleosides.

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**#526181**

**Topic:** Genetic material

If a double stranded DNA has 20 percent of cytosine, calculate the percent of adenine in the DNA.

**Solution**

According to Chargaff's rule all cellular DNAs, regardless of the species, number of adenosine residues is equal to number of thymidine residues which means that  $A=T$ ; and the number of guanosine residues is equal to the number of cytidine residues;  $G=C$ . If there is 20% cytosine which means guanine percentage is also 20%. Thus, the percent of  $A+T=100-(G+C)$

$A+T=100-40=60$ , Adenine percent =  $60/2=30$ .

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**#526183**

**Topic:** Replication, transcription, translation

If the sequence of one strand of DNA is written as follows:

5'-ATGCATGCATGCATGCATGCATGC-3'

Write down the sequence of complementary strand in 5'→3' direction.

**Solution**

According to complementary base pairing, A pairs with T and C with G. For the given sequence, the complementary strand will be 3'-TACGTACGTACGTACGTACGTACG-5'. So, the sequence of the complementary strand in 5' to 3' direction is 5'-GCATGCATGCATGCATGCATGCAT-3'.

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**#526184**

**Topic:** Replication, transcription, translation

If the sequence of the coding strand in a transcription unit is written as follows:

5'-ATGCATGCATGCATGCATGCATGC-3'

Write down the sequence of mRNA.

**Solution**

The template strand serves in mRNA synthesis while the other strand is called coding strand as its base sequence is same as that of newly synthesized mRNA. So, the sequence of mRNA will be identical to the given sequence of coding strand except for the presence of uracil in place of thymine in mRNA. Sequence of mRNA is 5'-AUGCAUGCAUGCAUGCAUGCAUGCAUGC-3'

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**#526185**

**Topic:** Genetic material

Which property of DNA double helix led Watson and Crick to hypothesise semi-conservative mode of DNA replication? Explain.

**Solution**

Watson and Crick observed that the two DNA strands are antiparallel, and have opposite polarity. This means that 5' phosphate of one strand faces the 3' hydroxyl group of the other strand and that the 5' phosphate groups of two strands are present in opposite position. The antiparallel arrangement of two helices allows hydrogen bonding between amino and carbonyl group of complementary base pairs. This led them to the hypothesis of the semiconservative mode of DNA replication wherein two strands of DNA first separate from each other followed by copying of each template strand to form two DNA molecules each carrying one parental strand and one newly synthesized strand.

#526186

**Topic:** Replication, transcription, translation

Depending upon the chemical nature of the template (DNA or RNA) and the nature of nucleic acids synthesised from it (DNA or RNA), list the types of nucleic acid polymerases

**Solution**

There are two types of nucleic acid polymerase

- 1) DNA-dependent DNA polymerase: DNA polymerase enzyme adds deoxyribonucleotides to synthesize DNA using the base sequence of parental DNA strand by the process of DNA replication.
- 2) DNA-dependent RNA polymerase: It adds ribonucleotides primer strand to synthesize RNA using the base sequence of template DNA strand.

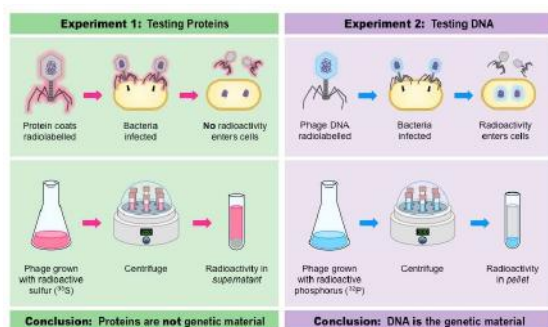
#526188

**Topic:** Genetic material

How did Hershey and Chase differentiate between DNA and protein in their experiment while proving that DNA is the genetic material?

**Solution**

Alfred D. Hershey and Martha Chase cultured bacteriophage in 2 different media one containing radioactive phosphorus ( $^{32}\text{P}$ ) and the other media containing radioactive sulfur ( $^{35}\text{S}$ ). Phosphorus is a component of the nucleotides which form the nucleic acid while sulfur is a component of amino acids methionine and cysteine which are among the 20 amino acids that form the protein. Now the two samples of bacteriophage were allowed to infect its host cell i.e., *Escherichia coli*. After infection, the samples were analyzed for the radioactivity in the host cells. For analysis, virus and bacteria were separated via centrifugation. Since the bacteria are large they form a solid pellet at the bottom after centrifugation and the smaller viruses remained in the supernatant. The bacterial pellet was found to be radioactive when infected by the  $^{32}\text{P}$ -viruses. While no radioactivity was found in the bacterial pellet when infected by the  $^{35}\text{S}$ -viruses. Thus, proving DNA is the genetic material.



#526191

**Topic:** Genetic material

Differentiate between the followings:

- (a) Repetitive DNA and Satellite DNA
- (b) mRNA and tRNA
- (c) Template strand and Coding strand

**Solution**

- (a) The non-coding sequence of DNA that are repeated several times in the genome of an individual are termed as repetitive DNA sequences. Whereas satellite DNA is one of the various categories of repetitive DNA sequences that contain highly repetitive DNA. Depending upon the number of repeats, satellite DNA is grouped as minisatellites, microsatellites, and minivariant repeats.
- (b) Messenger RNAs (mRNAs) specify the amino acid sequence of one or more polypeptides, thus it transfers genetic information from DNA to ribosomes. Whereas transfer RNAs (tRNAs) read the genetic information present in form of triplets in the mRNA and transfer the appropriate amino acid from amino acid pool of cytoplasm to a growing polypeptide chain during protein synthesis.
- (c) The template DNA strand serves in RNA synthesis during transcription while the other strand is called coding strand as its base sequence is same as that of newly synthesized mRNA but do not code for anything.

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**#526192**

**Topic:** Replication, transcription, translation

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List two essential roles of ribosome during translation.

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**Solution**

The role of the ribosome during translation are as follows:

- a) Ribosome serves as a site for protein synthesis.
- b) Bacteria have 70S ribosome. The 30S subunit has 16S rRNA and 50S subunit has 23S and 5S rRNA. 23S rRNA has peptidyl transferase activity and catalyzes the synthesis of peptide bond formation between amino acids in bacteria.

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**#526193**

**Topic:** Genes, mutation, genetic expression

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In the medium where *E. coli* was growing, lactose was added, which induced the lac operon. Then, why does lac operon shut down sometime after addition of lactose in the medium?

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**Solution**

Lac operon is a group of genes that are related to the metabolism of lactose in the medium. The operon consists of 2 types of genes; the regulatory genes which control the expression of the structural genes and the structural genes which express the proteins like beta-galactosidase required for the breakdown of lactose to galactose and glucose. As long as the lactose is present in the medium the regulatory genes allow the expression of the structural genes (i.e. the production of beta-galactosidase enzyme). The moment lactose in the medium is exhausted, a protein called repressor protein binds to a region called the operator and blocks the expression of the structural genes (beta-galactosidase enzyme). So, with time, lactose in the medium is completely digested by the beta-galactosidase enzyme and absence of lactose in the medium blocks the expression of beta-galactosidase enzyme after sometime.

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**#526195**

**Topic:** Genetic material

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Explain (in one or two lines) the function of the following:

- (a) Promoter
- (b) tRNA
- (c) Exons

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**Solution**

- (a) The promoter is a cis-acting site present physically continuous with transcription unit and provides a binding site for RNA polymerase enzyme.
- (b) Transfer RNAs (tRNAs) read the genetic information present in the form of triplets in the mRNA and transfer the appropriate amino acid from amino acid pool of cytoplasm to growing polypeptide chain during protein synthesis.
- (c) Exons are the protein-coding sequences of RNA that serve to carry genetic information from DNA to proteins.

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**#526196**

**Topic:** Human genome project, DNA fingerprinting

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Why is the Human Genome project called a mega project?

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**Solution**

The human genome project is called as a mega project because there was the sequencing of each and every nucleotide base pair present in the human genome which took around 13 years for its completion. The aim of this project was to develop new technology and new information in the field of genomic studies. It was a large scale project and provide the opportunity in the field of genetics, biotechnology, and medical sciences. It provided clues regarding the understanding of human biology.

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**#526197**

**Topic:** Human genome project, DNA fingerprinting

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What is DNA fingerprinting? Mention its application.

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**Solution**

The technique which is used to identify and analyze the variation on the basis of variation and polymorphism in DNA sequence is called as DNA fingerprinting.

Application of DNA fingerprinting are as follows:

- a) Used to identify crime suspect
- b) Paternity testing
- c) Used to find out evolutionary history of an organism

#526198

**Topic:** Replication, transcription, translation

Briefly describe the following:

- (a) Transcription
- (b) Polymorphism
- (c) Translation
- (d) Bioinformatics

**Solution**

a) Transcription is the process in which RNA is synthesized from DNA.

Transcription is a 3 step process-

- 1) Initiation- RNA polymerase binds to DNA sequence called the promoter and providing the single-stranded template for transcription process.
- 2) Elongation- RNA polymerase reads the template strand and adds bases leading to elongation of the chain.
- 3) Termination- In this step terminator sequences mark the end of transcription.

b) Polymorphism is a form of genetic variation resulting in the formation of several different types of individuals among the members of one particular species. The varying sequences of nucleotides are located at different positions in a DNA helix resulting in variation and hence polymorphism in the population. Polymorphism is responsible for speciation and evolution.

c) Translation is the process in which protein is synthesized from RNA.

Translation is a 3 step process-

- 1) Initiation- In initiation, the ribosome assembles around the mRNA that has to be read and the first tRNA carrying the amino acid methionine
- 2) Elongation- In this stage the amino acid chain is elongated
- 3) Termination- In this stage, the synthesized polypeptide chain is released.

d) Bioinformatics is the use of information technology for collecting and analyzing complex biological data such as genetic codes, protein sequences, etc. using databases. There has been an advancement in the field of molecular biology, there is the invention of computers, scientific techniques, and instrumentation at the nano level, etc. These have helped in the development and progress in the field of bioinformatics.

#526205

**Topic:** Genes, mutation, genetic expressionDiagrammatically represent the experimental steps in cloning and expressing a human gene (say the gene for growth hormone) in a bacteria like *E. coli*?**Solution**

Cloning is the process of introducing a desired gene into a host like *E. coli*. The desired gene is inserted into a vector (plasmid) which basically acts as a vehicle to carry the desired gene into an organism in which we intend to express the gene of our interest.

