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Modern understandings of DNA have evolved from the discovery of nucleic acid to the development of the double-helix model. In the 1860s, Friedrich Miescher, a physician by profession, was the first person to isolate phosphate-rich chemicals from white blood cells or leukocytes. He named these chemicals (which would eventually be known as RNA and DNA) nuclein because they were isolated from the nuclei of the cells. If DNA of a particular species was analyzed and it was found that it contains 27 percent A, what would be the percentage of C? 27 percent 30 percent 23 percent 54 percent Explain Griffith's transformation experiments. What did he conclude from them? Answer Live R cells acquired genetic information from the heat-killed S cells that "transformed" the R cells into S cells. Why were radioactive sulfur and phosphorous used to label bacteriophage in Hershey and Chase's experiments? Answer Sulfur is an element found in proteins and phosphorus is a component of nucleic acids. The building blocks of DNA are nucleotides. The important components of the nucleotide are a nitrogenous base, deoxyribose (5-carbon sugar), and a phosphate group. The nucleotide is named depending on the nitrogenous base. The nitrogenous base can be a purine such as adenine (A) and guanine (G), or a pyrimidine such as cytosine (C) and thymine (T). DNA double helix does not have which of the following? antiparallel configuration complementary base pairing major and minor grooves uracil In eukaryotes, what is the DNA wrapped around? single-stranded binding proteins sliding clamp polymerase histones Provide a brief summary of the Sanger sequencing method. Answer The template DNA strand is mixed with a DNA polymerase, a primer, the 4 deoxynucleotides, and a limiting concentration of 4 dideoxynucleotides. DNA polymerase synthesizes a strand complementary to the template. Incorporation of ddNTPs at different locations results in DNA fragments that have terminated at every possible base in the template. These fragments are separated by gel electrophoresis and visualized by a laser detector to determine the sequence of bases. Describe the structure and complementary base pairing of DNA. Answer DNA has two strands in anti-parallel orientation. The sugar-phosphate linkages form a backbone on the outside, and the bases are paired on the inside. A with T, and G with C, like rungs on a spiral ladder. The elucidation of the structure of the double helix provided a hint as to how DNA divides and makes copies of itself. This model suggests that the two strands of the double helix separate during replication, and each strand serves as a template from which the new complementary strand is copied. What was not clear was how the replication took place. There were three models suggested: conservative, semi-conservative, and dispersive. Meselson and Stahl's experiments proved that DNA replicates by which mode? conservative semi-conservative dispersive none of the above If the sequence of the 5'-3' strand is AATGCTAC, then the complementary sequence has the following sequence: 3'-AATGCTAC-5' 3'-CATCGTAA-5' 3'-TTACGATG-5' 3'-GTAGCATT-5' How did the scientific community learn that DNA replication takes place in a semi-conservative fashion? Answer Meselson's experiments with E. coli grown in <sup>15</sup>N deduced this finding. DNA replication has been extremely well studied in prokaryotes primarily because of the small size of the genome and the mutants that are available. E. coli has 4.6 million base pairs in a single circular chromosome and all of it gets replicated in approximately 42 minutes, starting from a single origin of replication and proceeding around the circle in both directions. This means that approximately 1000 nucleotides are added per second. The process is quite rapid and occurs without many mistakes Which of the following components is not involved during the formation of the replication fork? single-strand binding proteins helicase origin of replication ligase Which of the following does the enzyme primase synthesize? DNA primer RNA primer Okazaki fragments phosphodiester linkage In which direction does DNA replication take place? DNA replication is bidirectional and discontinuous; explain your understanding of those concepts. Answer At an origin of replication, two replication forks are formed that are extended in two directions. On the lagging strand, Okazaki fragments are formed in a discontinuous manner. What are Okazaki fragments and how they are formed? Answer Short DNA fragments are formed on the lagging strand synthesized in a direction away from the replication fork. These are synthesized by DNA pol. If the rate of replication in a particular prokaryote is 900 nucleotides per second, how long would it take 1.2 million base pair genomes to make two copies? Answer 1333 seconds or 22.2 minutes. Explain the events taking place at the replication fork. If the gene for helicase is mutated, what part of replication will be affected? Answer At the replication fork, the events taking place are helicase action, binding of single-strand binding proteins, primer synthesis, and synthesis of new strands. If there is a mutated helicase gene, the replication fork will not be extended. What is the role of a primer in DNA replication? What would happen if you forgot to add a primer in a tube containing the reaction mix for a DNA sequencing reaction? Answer Primer provides a 3'-OH group for DNA pol to start adding nucleotides. There would be no reaction in the tube without a primer, and no bands would be visible on the electrophoresis. Eukaryotic genomes are much more complex and larger in size than prokaryotic genomes. The human genome has three billion base pairs per haploid set of chromosomes, and 6 billion base pairs are replicated during the S phase of the cell cycle. There are multiple origins of replication on the eukaryotic chromosome; humans can have up to 100,000 origins of replication The ends of the linear chromosomes are maintained by helicase primase DNA pol telomerase How do the linear chromosomes in eukaryotes ensure that its ends are replicated completely? Answer Telomerase has an inbuilt RNA template that extends the 3' end, so primer is synthesized and extended. Thus, the ends are protected. DNA replication is a highly accurate process, but mistakes can occasionally occur, such as a DNA polymerase inserting a wrong base. Uncorrected mistakes may sometimes lead to serious consequences, such as cancer. Repair mechanisms correct the mistakes. In rare cases, mistakes are not corrected, leading to mutations; in other cases, repair enzymes are themselves mutated or defective. During proofreading, which of the following enzymes reads the DNA? primase topoisomerase DNA pol helicase The initial mechanism for repairing nucleotide errors in DNA is \_\_\_\_\_. mismatch repair DNA polymerase proofreading nucleotide excision repair thymine dimers What is the consequence of mutation of a mismatch repair enzyme? How will this affect the function of a gene? Answer Mutations are not repaired, as in the case of xeroderma pigmentosa. Gene function may be affected or it may not be expressed.

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