Study guide of biology: genetics

Education

Study guide for Ch 16-18 Chapter 16 • Alfred Hershey and Martha chase answered the question whether protein or DNA was the genetic material by using Bacteriophages (viruses that infect bacteria). o Bacteriaphages were good for the experiment because they only contain 2 organic compounds, DNA and protein. • James Watson and Francis Crick were the first to solve the structure (structure= function) of DNA. • X-ray crystallography(process used to visualize molecules in 3-D. • DNA is a double helix- structure • The nitrogenous bases of DNA are(adenine (A), thymine (T), guanine (G), and cytosine (C). The 2 strands (the leading and the lagging strand) are antiparallel. o The leading strand goes in direction 5’ to 3’. o Lagging strand goes 3’ to 5’. Takes longer to replicate cause it’s built in fragments. • Tip from the book(know these enzymes for replication: DNA polymerase, ligase, helicase, and topoisomerase. Know this enzyme for transcription(the role of RNA polymerase. • Replication(making DNA from already existing DNA strand. DNA replication is semiconservative (1/2 of original DNA and the other ? is from new DNA strand). This is used by humans! A group of enzymes called DNA polymerases catalyzes the elongation of new DNA at replication fork. The overall direction of DNA replication goes from the origin to the fork. o DNA polymerase adds nucleotides to the growing chain one by one; working in a 5’ to 3’ (DNA build strand (“ new”) or RNA polymerase go 5’(3’ in the build strand). Parent strand DNA and RNA polymerase is 3’ to 5’. o DNA polymerase matches adenine with thymine and guanine with cytosine o The lagging strand is synthesized in separate pieces called Okazaki fragments (which segments in 3’(5’), which are then sealed together by DNA Ligase.

Forming a continuous DNA strand. • Many factors in replication: o Base pairing in DNA replication(A= T/ G= C. o Mismatch repair(special repair enzymes fix incorrectly paired nucleotides o Nucleotide excision repair. • Tip****(know the difference between replication (DNA to DNA), transcription (DNA to RNA), and translation (RNA to protein). • In Eukaryotic cells, DNA and protein are packed together as chromatin. o Heterochromatin(very condensed chromatin. o Euchromatin(loosely condensed chromatin. Telemer region(small fragment of DNA that is lost during replication due to enzyme's inability to attach the fragment on to the end of the DNA helix. (This is our biological clock). Chapter 17 • Gene expression(the process by which DNA directs the synthesis of proteins (or sometimes RNA). • Transcription= DNA(RNA o Takes place in the nucleus in eukaryotic cells. • Messenger RNA (mRNA) produced during transcription. It carries the genetic message of DNA to the protein making machinery of the cell in the cytoplasm, ie the ribosome. The mRNA triplets are called codons (a codon is a mRNA triplet). o mRNA is read codon by codon. ? Start codons and stop codons are used in the build strand the protein coding segment is between the start codon and stop codon in the build strand. • They are written in the 5' to 3' direction. • More than one codon codes for each of the 20 amino acids. Genetic code includes 64 codons (4 x 4 x 4). o The group must be read in the correct groupings in order for translation to be successful o 3 codons act as signal terminators (UAA, UAG, UGA) o AUG always has to be start codon. RNA polymerase(enzyme that separates the 2 DNA strands and connects the RNA nucleotides as they base-pair along the DNA template strand. o RNA pol. Can add RNA nucleotides only to the 3' end of the strand. REMEMBER… uracil replaces thymine when base pairing to adenine. ==> difference betw DNA

and RNA. o The DNA sequence at which RNA pol. Attaches is called the Promoter. o The DNA sequence that signals the end of transcription= Terminator. • Transcription unit(the entire stretch of DNA that is transcribed into an RNA molecule. • 3 main stages of transcription: from the book. Initiation (RNA polymerase that transcribes mRNA cannot bind to the promoter region without supporting help from proteins known as transcription factors. transcription factors assist the binding of RNA polymerase to the promoter, thus the initiation of transcription) Notes: o Elongation (RNA polymerase moves along the DNA, continuing to untwist the double helix. RNA nucleotides are continually added to the 3’ end. As this happens, the double helix re-forms. Notes: • Termination (RNA polymerase transcribes a terminator sequence in the DNA, the RNA transcript is released, and the polymerase detaches. There a couple of key post-transcriptional modifications to RNA(the addition of a 5’ cap and the addition of a poly A Tail (3’). • RNA splicing also takes place in eukaryotic cells. Large portions of the newly synthesized RNA strand are removed. This is the parent strand. o The sections of the mRNA that are spliced out are called introns. o Sections that are spliced together by a spliceosome(exons. ? The new strand containing the exons is called the build strand, which runs in a direction of 5’ to 3’.

Remember parent strand runs in 3’ to 5’. • Small nuclear RNA (snRNA)(plays a major role in catalyzing the excision of the introns and joining of exons. o Ribozyme is when RNA serves a catalytic role. • Translation: o 2 additional types of RNA play important roles in translation besides mRNA: ? Transfer RNA (tRNA) and ribosomal RNA (rRNA). • tRNA functions in transferring

amino acids from a pool of amino acids located in cytoplasm to a ribosome. These amino acids are incorporated into a growing polypeptide chain. At one end of a tRNA it loosely binds the amino acid, and at the other end it has a nucleotide triplet called an anticodon (allows it to pair specifically with a complementary codon on the mRNA). • rRNA complexes with proteins to form the 2 sub units that form ribosomes. o Translation can be divided into 3 steps ? Initiation, Elongation, and Termination (descriptions of these steps can be found on pg 129-130 I got lazy so fuck off) • The review guide goes into mutations on pg 130 but I think that you're better off reading the guide than reading my description. Chapter 18 In bacteria, genes are often clustered into units called operons. • Operon consists of 3 parts: o Operator: controls the access of RNA polymerase to the genes, it's found within the promoter region. ? Normally in on position. In a repressible operon. o Promoter: where RNA polymerase attaches. o Genes of the operon: the entire stretch of DNA required for all the enzymes produced by the operon. • Regulatory Genes(produce repressor proteins that may bind to the operator site. When a regulatory protein occupies the operator site, RNA pol. Is blocked from the genes of the operon. Repressible operon(normally on. It can be inhibited. This type of operon is normally anabolic. o The repressor protein produced by the regulatory gene is inactive. o If the organic molecule being produced by the operon is provided to the cell, the molecule can act as a corepressor, and bind to the repressor protein(this activates it. ? The activated repressor protein binds to the operator site, shutting down the operon. • The lac operon is inducible o Controls the production of B-galactosidase an enzyme that catalyzes the hydrolysis (break down) of lactose into glucose and galactose ?

Inducible operon(gene expression B-galactosidase is stimulated by the presence of a co inducer, lactose. • Turns the repressor gene switch off. o This is notes on gene expression on tryptophan. Next stuff is from book. ? Inducible operon(normally off but can be activated. This type of operon is catabolic, breaking downfoodmolecules for energy. The repressor protein produced by the regulatory gene is active. • To turn the inducible operon on, a specific small molecule, called an inducer, binds to an inactivates the repressor protein.

With the repressor out of the operator site, RNA polymerase can access the genes of the operon. o 2 regulatory mechanisms used to turn on lac operon ? Presence of lactose as co inducer ? Low amounts of glucose. • These 2 are the only way for this shit to work yo! • Differential gene expression in eukaryotic cell gene expression o The expression of different genes by cells with the same genome. • Histone acetylation(acetyl groups are added to amino acids of histone proteins, thus making the chromatin less tightly packed and encouraging transcription. DNA methylation(the addition of methyl groups to DNA it causes chromatin to condense, thus reducing gene expression. o With the help of phosphorylation next to a methylated amino acid, chromatin becomes loosened and thus encouraging transcription. • Epigenic inheritance(the inheritance of traits transmitted by mechanisms not directly involving the nucleotide sequence. • Transcription initiation is where DNA control elements that bind transcription factors are involved in regulation. Control elements(multiple control elements(segments of non coding DNA that serve as binding sites for transcription factors that help regulate transcription. o This is necessary for the precise regulation of gene

expression in diff cell types. o Proximal and Distal control elements. ? Proximal control element has to be right next to promoter anything else is distal. • Transcription factors(o Enhancer regions are bound to the promoter region by proteins called activators. o Some transcription factors function as repressors, others function as activators. Extra stuff • TATA box is at the beginning of promoter region.