Unit 6 Content

1. DNA Structure

a. Discovery

(1) Avery-MacLeod- Marty- 1944 isolated DNA from Griffith’s transformation experiment

(2) Hershey-Chase- 1952 elegant experiment with virus and bacteria showing DNA was injected not protein

(3) Watson, Crick, Wilkins, and Franklin- 1953 W and C published work showing structure of DNA (used Wilkins and Franklins work to do so)

b. Structure of DNA

(1) Deoxyribose nucleic acid

(2) Double helix (two twisted strands) made of nucleotides (monomers)

(3) Nucleotide = phosphate + 5C deoxyribose sugar + nitrogen base

(4) Antiparallel strands- one runs 3’ to 5’ the other runs 5’ to 3’, sides of phosphates and sugars (backbone), rungs of paired bases with hydrogen bonds in between

(5) Purines (adenine, guanine; double rings) pair with Pyrimidines (cytosine, uracil, thymine; single ring)

(6) A - T- double H bond

(7) C – G- triple H bond

c. Location

(1) In eukaryotes DNA is found in nucleus on multiple linear chromosomes (a chromosome IS a strand of DNA with proteins etc. associated).

(2) In prokaryotes DNA is not in a nucleus and is usually a single circular chromosome

(3) Prokaryotes, viruses, and eukaryotes (yeast) can contain plasmids (small extrachromosomal DNA that is double stranded DNA)

2. DNA replication

a. Process of making exact copies of DNA (i.e. for mitosis or meiosis)

b. Process is semi conservative (original strand is copied)

c. Steps

(1) Enzyme (helicase) unzip strands by breaking hydrogen bonds

(2) “Spare” nucleotides are added bidirectionally to bond complementarily with use of DNA polymerases (DNA pol)

(3) DNA pol only can add to the 3’ to 5’ side and new DNA is made in the 5’ to 3’direction

(4) Replication bubbles open up and a replication fork is created because bubble is in half and it has one side 3/5 and one 5/3

(5) RNA primers must be laid down to start process (RNA primase makes primers)

(6) Leading strand makes DNA continuously (3/5)

(7) Lagging strand makes DNA discontinuously (5/3), Okazaki fragments

(8) Lagging strand requires enzyme (ligase) to fuse fragments

3. RNA

(1) Ribonucleic acid

(2) Single stranded, different sugar called ribose; different base called uracil INSTEAD of thymine

(3) Base pair rules in RNA, A-U and C-G

(4) messenger RNA or mRNA carries information from DNA to the ribosome

(5) transfer RNA or tRNA bind amino acids and are used in translation at ribosome

(6) ribosomal RNA or rRNA are part of ribosomes that have catalytic function

(7) RNAi are molucules that are used for regulation of gene expression (turn on or off)

4. Transcription

a. making mRNA in nucleus

b. enzyme RNA pol reads the DNA in 3’ to 5’ direction and synthesizes complementary mRNA

c. Ex. 3’ to 5’ DNA is ATG CAT then the 5’ to 3’ mRNA made will be UAC GUA

d. Steps

(1) TATA Box where RNA pol binds and begins

(2) Transcription Factors (proteins that enhance transcription and help RNA pol into correct shape)

(3) Elongation (adding of RNA nucleotides- does not stay attached to DNA)

(4) Termination, ends when RNA pol reaches a termination sequence

5. mRNA editing

a. introns are excised (cut out)

b. exons are left and spliced together using spliceosomes (snRNP’s)

c. add polyA tail to 3’

d. add GTP cap to 5’

e. each 3 are called a codon

f. go to ribosome (free or in RER)

6. Translation

a. mRNA code is read and matched with tRNA (brings amino acids) to construct a polypeptide using the ribosome

b. Ex. mRNA codon is AAA then tRNA anticodon will be UUU and will have a corresponding amino acid for that codon of mRNA

c. Initiation: 5’ end of mRNA attaches to small ribosome, tRNA with anticodon UAC attaches to start codon AUG; large ribosomal subunit binds and tRNA is in P site

d. Elongation: new tRNA enters A site; peptide bond forms when amino acid is transferred from tRNA in P site to A site; translocation occurs and tRNA in A site moves to P

e. Termination: Ribosome encounters stop codon (UAA, UAG, UGA)

f. If in ER then: polypeptide is released into ER, then to Golgi complex, vesicle to cell membrane, then exocytosis (may be given signals for exit/destination)

g. Free ribosomes typically make products for the cell and are not exported

7. Mutations

a. any change of DNA sequence, can be inheritable if it is in egg or sperm

b. point mutations- one nucleotide error; substitutions (i.e. A instead of G)

c. frame shift mutations- one or more bases deleted or inserted

d. silent mutations can occur, i.e. substitution codes for same amino acid or deletion/insertion is of three nucleotides