1 # The Central Dogma of Molecular Biology

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2 # The Central Dogma of Molecular Biology

3 # Importance of Proteins

- There are three main kinds:
  - structural - make up most body parts
  - hormone - chemical that controls the body
  - enzyme - catalyst - speeds up chemical reactions

4 # Importance of Proteins

- Without proteins there would be no life
- All cells make proteins
- Proteins in your body make up your:
  - Hair
  - Nails
  - Muscles
  - Skin
  - Cartilage

5 # Discovery of DNA (deoxyribonucleic acid)

- 1953 Watson, Crick and Wilkins determined the structure of DNA to be a double helix
- They won a Nobel Prize for their work

6 # Structure of the DNA molecule

- DNA is shaped like a double helix
- It is like a spiral staircase
- Another way to think of it is a twisted ladder

7 # Connecting the DNA molecule

- Rails* of the DNA ladder are alternating sugar & phosphates
- Rungs* are composed of pairs of bases
  - A bonds with T*
  - G bonds with C*

8 # Connecting the DNA Molecule

- The DNA Ladder*

9 # Connecting the DNA molecule

- The two strands of DNA are different
- One is called the sense strand and it is the plan to make a protein
- The other strand is the antisense strand and it is only used for protection of the

sense strand

10 ## Connecting the DNA molecule

- The two strands of DNA are said to be antiparallel*
- One strand is oriented in a 5' to 3' direction*
- The other strand is oriented in the opposite 3' to 5' direction*

11 ## Connecting the DNA molecule

- Nucleotides are units composed of a base, phosphate and a sugar

12 ## Connecting the DNA molecule

- The two strands of DNA bases are connected by weak forces called hydrogen bonds*

13 ## Components of DNA

- Phosphate

14 ## Components of DNA

- Deoxyribose (sugar)

15 ## Components of DNA

- DNA bases
  (4 different types)
  - Adenine
  - Thymine*
  - Guanine
  - Cytosine

16 ## Components of DNA

- Proteins are attached to the DNA helix in cells
- These proteins are known as histones
- They assist in DNA storage

17 ## DNA and RNA Compared

1
- DNA
  - Found only in nucleus*
  - Double stranded helix
  - Bases = ATGC*
  - Sugar = Deoxyribose

2
- RNA
  - Found in ribosomes, nucleolus*
  - Single stranded helix *
  - Bases = AUGC (URACIL) *
  - Sugar = Ribose

18 ## Replication of DNA

- Replication - the making of an exact copy of the DNA molecule
  - Replication occurs whenever a cell divides
  - The copy must be 100% accurate
    (errors = death possibly)

- Replication practice (find the complimentary bases or base sequence)*
  - **A – pairs with ?**
  - **T – pairs with ?**
  - **G – pairs with ?**
  - **C – pairs with ?**

19 ## Replication of DNA

20 ## Stages in replication (basic)

- DNA molecule is split in two at the end by the work of enzymes *****
- DNA unzips slightly and the two strands unwind *****
- new nucleotides attach to the free ends *****
  (A-T, G-C)
- more DNA unzips
- more nucleotides attach *****
- process continues until completed
- result is two (2) double strands of DNA
- each strand is 50% new and 50% old DNA

21 ## Stages in replication

22 ## Stages in replication

- DNA replication is different on the leading and lagging strands *****

23 ## Enzymes * Involved in DNA Replication

- DNA polymerase – adds nucleotides in a 5' to 3' direction
- Topoisomerase
- Gyrase
- RNA primase
- DNA ligase – connects the gaps in the lagging strand

24 ## DNA Replication in Motion

25 ## Introns and Exons

- Introns – sequences in the DNA that are NOT used to make mRNA or to make a protein. They are NOT transcribed *****
- Exons – sequences in the DNA that are expressed or used to make mRNA and ultimately are used to make a protein

26 ## Introns and Exons

27 ## Restriction Enzymes

- Restriction enzymes (also known as restriction endonucleases) recognize specific DNA sequences and CLEAVE or cut the DNA into pieces *****
- Generally these cuts occur in a manner which leaves a sticky end of single strand DNA
- These pieces can be separated by using gel electrophoresis (this is like electronic chromatography)
- We use restriction enzymes for cutting bacterial, viral or even human DNA and later insertion of the desired DNA fragments – called gene splicing *****

28 ▨ Restriction Enzymes

29 ▨ Restriction Enzymes

30 ▨ Ribonucleic Acid (RNA)

- Three types of RNA:
  - rRNA = ribosomal RNA - makes up the ribosome
  - mRNA = messenger RNA - is the message from DNA for the construction of the new protein molecule *
  - tRNA = transfer RNA - carries amino acids to ribosomes

31 ▨ Ribonucleic Acid (RNA)

- Ribosomal RNA is used to make a ribosome
- The ribosome "reads" the mRNA plan for the new protein
- mRNA is the set of directions for a new protein*

32 ▨ Ribonucleic Acid (RNA)

- Messenger RNA

33 ▨ Ribonucleic Acid (RNA)

- Transfer RNA
  - Each tRNA holds one amino acid
  - Every tRNA has a special region called the anti-codon (3 bases)
  - An tRNA anti-codon "mates" with codon on the mRNA molecule
  - There are 61 different tRNA molecules, yet only about 20 amino acids (hint: 3 stop codons)

34 ▨ Ribonucleic Acid (RNA)

- Transfer RNA

35 ▨ Transcription

- Transcription is the special copying of one side of the DNA molecule (the sense strand) that results in the production of a single strand of RNA *
- The original DNA is not changed
- This process can be repeated
- The amount of DNA that is transcribed is usually one gene

36 ▨ Transcription

- Process of Transcription
  - DNA is unzipped by an enzyme
  - Only one side fills with RNA nucleotides by the action of another enzyme RNA polymerase
    A-U, G-C (NO THYMINE = T)
  - As the RNA strand separates the DNA strands reattach as before the process started
  - 4. The result is the original DNA plus a new RNA strand

37 ▨ Transcription

38 ▧ Transcription

- Uracil – a base only found in RNA

39 ▧ Transcription

- Transcription Practice *
  - A (in DNA) pairs with ___ in RNA
  - T (in DNA) pairs with ___ in RNA
  - G (in DNA) pairs with ___ in RNA
  - C (in DNA) pairs with ___ in RNA

40 ▧ Transcription

41 ▧ Transcription

42 ▧ Translation

- Translation * is the reading of the RNA code, by ribosomes, to make proteins * or polypeptides
- Translation is often called protein synthesis

43 ▧ Translation

- mRNA is the message (the plan for the protein)
- rRNA "reads" the mRNA (the ribosome) *
- tRNA molecules carry amino acids to the ribosome for assembly into proteins
- The ribosome allows only the correct tRNA to add its amino acid – others are rejected

44 ▧ Translation *

45 ▧ Translation

46 ▧ Translation

- Triplet codons -groups of three bases on mRNA that code for specific amino acids *

47 ▧ Translation

- The function of special stop codons is to terminate* or end the translation process*
  - The stop codons are: UAA, UAG and UGA
- The function of the start codon is to serve as a place for the ribosome to begin translation
  - The only start codon is AUG

48 ▧ Translation

- 9 bases would give __?__ amino acids *
- 27 bases would give __?__ amino acids *

49 Translation

- Anticodon practice *

codon	anticodon
AAA	UUU
CCC	?
UUU	?
UCG	?

NEVER look up the anticodon in the chart or table!

Look the CODON in the table or chart

50 Translation