nucleic acids & protein synthesis

GENETIC MOLECULES

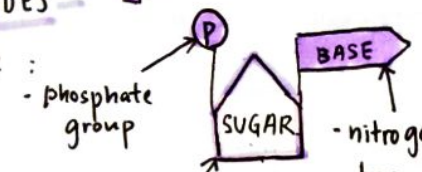
- macromolecules
- polymers
  - ↳ polynucleotides

DNA
- deoxyribonucleic acid
- pentose sugar
  - ↳ deoxyribose
- 2 polynucleotide strands
  - ↳ made of nucleotides
- ATGC

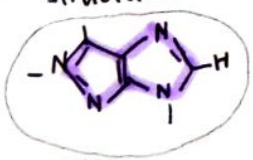
RNA
- ribonucleic acid
- pentose sugar
  - ↳ ribose
- 1 polynucleotide strands.
  - ↳ made of nucleotides
- AUGC

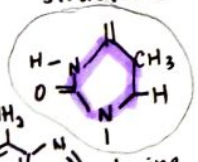
NUCLEOTIDES

- made of :
  - phosphate group
  - pentose sugar (ribose / deoxyribose)
  - nitrogen containing base

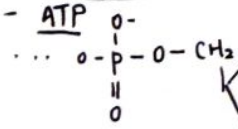


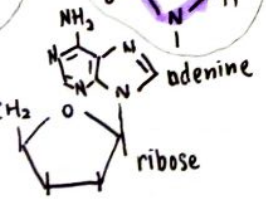
- BASES
  - ↳ PURINES
    - adenine
    - guanine
    - ↳ double ring structure
  - ↳ PYRIMIDINES
    - thymine
    - cytosine
    - uracil
    - ↳ single ring structure





- ATP





adenosine

DNA REPLICATION

- 2 strands of DNA molecule split apart.
- New nucleotides line up along each half strand
- DNA molecules just like original, each base only pairs with complementary one
- called → semi-conservative replication

(continued from DNA replication)

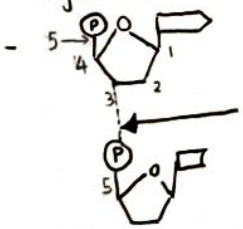
Basic idea → "formal"

1. The DNA double helix unwinds and unzips as the Hydrogen bonds between bases break.
2. In nucleus, there are nucleotides with two extra phosphates. Nucleotides are activated.
3. Each of the bases of activated nucleotides pair up with its complementary base on the old DNA strands.
   - DNA polymerase
   - checks if nucleotides are complementary
4. DNA polymerase links the sugar and innermost phosphate groups of next-door nucleotides together.
5. The two extra phosphates are broken off and released into the nucleus.
6. Two complete new molecules are formed, each containing one new and one old strand.

DNA polymerase will only link an incoming nucleotide to the growing new chain IF it is complementary to the old strand

POLYNUCLEOTIDES

- many nucleotides linked together
- takes place during interphase
- 5 carbon links to 3 carbon of next sugar molecule.



- In DNA :
  - ↳ two polynucleotides
  - ↳ running in opposite directions
    - ↳ antiparallel
  - ↳ two polynucleotides held by H-bonds → can be broken easily during DNA replication → protein synthesis

(continued from DNA)
- ↳ AT, GC
  - ↳ complementary base pairing
- ↳ double helix

GENE

- a part of DNA molecule, where the nucleotide sequence codes for just one polypeptide.
- ALLELES → different variants of genes.

MUTATION

- A change in the nucleotide sequence of a gene, which may then result in an altered polypeptide.

DNA
* ↳ Triplet code

mRNA
↳ codon

tRNA
↳ anticodon

TRIPLET CODE

- read from the sense strand.
- 3 bases stand for one amino acid.
- START CODON (methionine) → AUG (mRNA), TAC (DNA)
- STOP CODON → UAA, UGA, UAG (mRNA)

PROTEIN SYNTHESIS

TRANSCRIPTION

(gene)

- In the nucleus, part of the DNA molecule unwinds and unzips as the H- bonds between bases break.
- Free activated RNA nucleotides pair up with exposed bases of one DNA strand (sense strand).
- RNA polymerase bonds sugar-phosphate groups of RNA nucleotides to form a sugar phosphate backbone.
- mRNA is formed, leaves nucleus through pore in nuclear envelope.

RNA polymerase
- reads DNA sequence
- in transcription

} Transcription begins when RNA polymerase binds to promoter sequence of DNA, stops at terminator sequence (ATT, ATC, ACT)

TRANSLATION

- mRNA attached to a ribosome in the cytoplasm
- In cytoplasm, there are tRNA molecules, they have an anticodon on one end and a specific amino acid on the other.
- tRNA molecules pick up their specific amino acids from the cytoplasm. The anticodon of tRNA links up with a codon on the mRNA molecule on the ribosome.
- ✱ Two tRNA molecules fit onto the ribosome at one time. This brings two amino acids side by side. A peptide bond is formed between them. This is catalysed by enzyme peptidyl transferase, found in the small subunit of the ribosome.
- Ribosome moves along the mRNA, 'reading' the next three bases on the mRNA. A third tRNA links up and brings third amino acid, forming a peptide bond with the second one. First tRNA leaves.
- Polypeptide chain continues to grow until a 'STOP' codon is exposed on the ribosome.

Ribosomes
- reads codons (on mRNA)
-

} several ribosomes can work at the same time. (polyribosomes.

- primary structure of protein.

} NOT protein yet!
Polypeptide chain! ← most general name

USEFUL ANSWER

↳ Base sequence on DNA molecules determines the base sequence on mRNA which determines which tRNA molecules can link up with them. Since each type of tRNA is specific for one amino acid, this determines the sequence in which the amino acids are linked together.

↳ How does deletion of one nucleotide affect ... ?
- changes triplet code
- different amino acid is coded for
- all subsequent amino acids affected.

- ENZYMES -

DNA Replication → DNA polymerase

Protein Synthesis (transcription) → RNA polymerase

Protein Synthesis (translation) → peptidyl transferase