2.1 Nucleic Acids

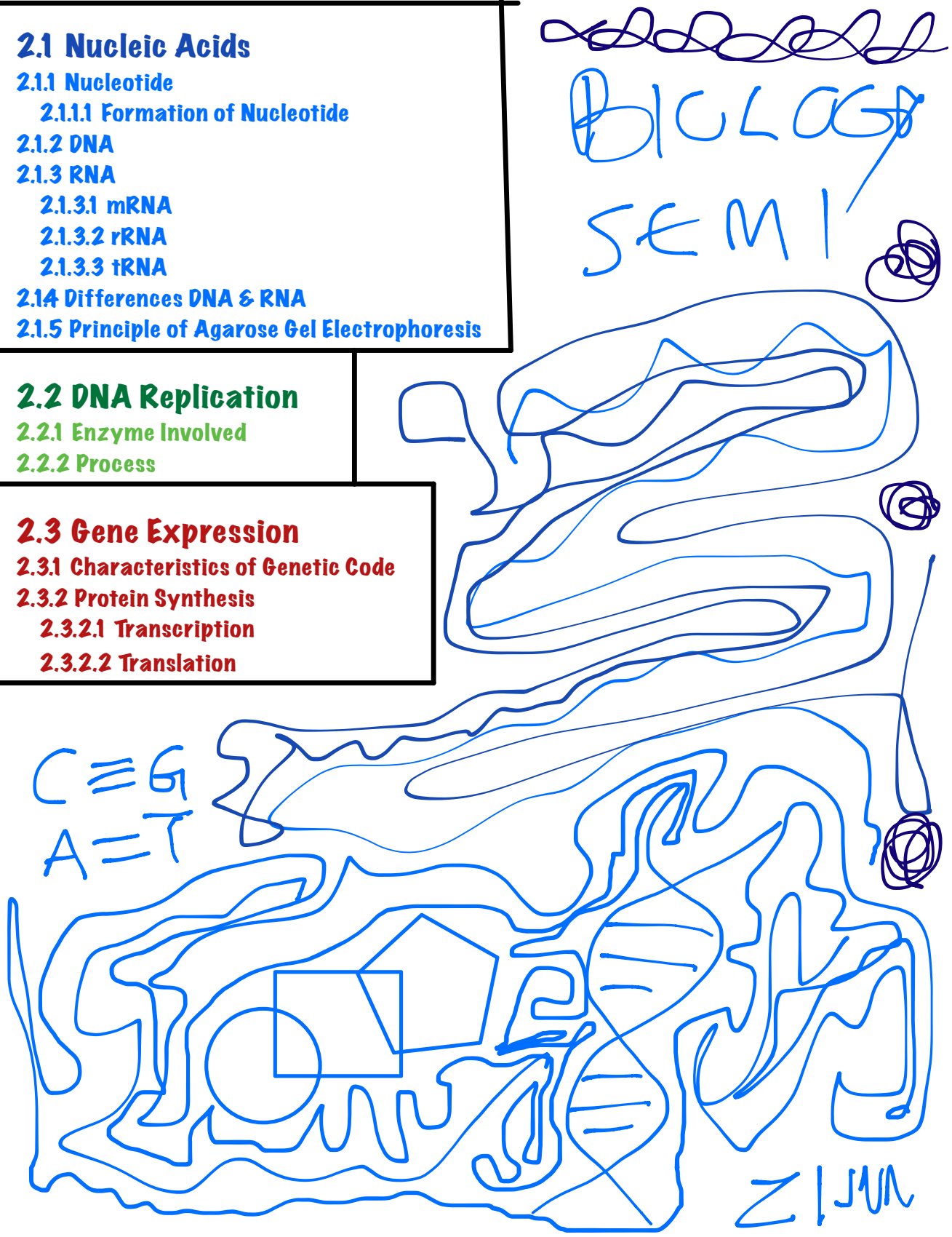
- 2.1.1 Nucleotide
  - 2.1.1.1 Formation of Nucleotide
- 2.1.2 DNA
- 2.1.3 RNA
  - 2.1.3.1 mRNA
  - 2.1.3.2 rRNA
  - 2.1.3.3 tRNA
- 2.14 Differences DNA & RNA
- 2.1.5 Principle of Agarose Gel Electrophoresis

2.2 DNA Replication

- 2.2.1 Enzyme Involved
- 2.2.2 Process

2.3 Gene Expression

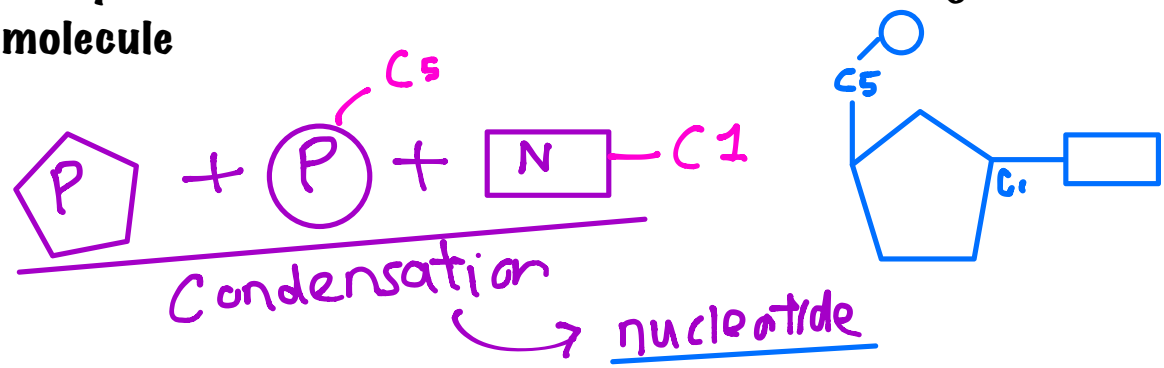
- 2.3.1 Characteristics of Genetic Code
- 2.3.2 Protein Synthesis
  - 2.3.2.1 Transcription
  - 2.3.2.2 Translation



2.1.1 Formation of Nucleotide

Condensation 1 , 2 , Polymerisation

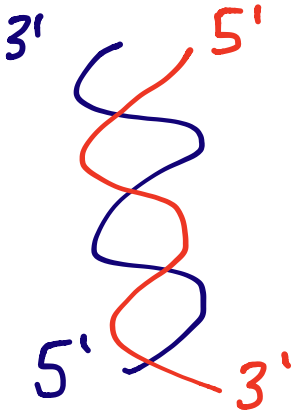
1. Pentose , Phosphate acid , Nitrogenous base link up form nucleotide via condensation
2. Nitrogenous base joined to carbon atom 1 of sugar molecule
3. Phosphoric acid attached to carbon atom 5 of sugar molecule

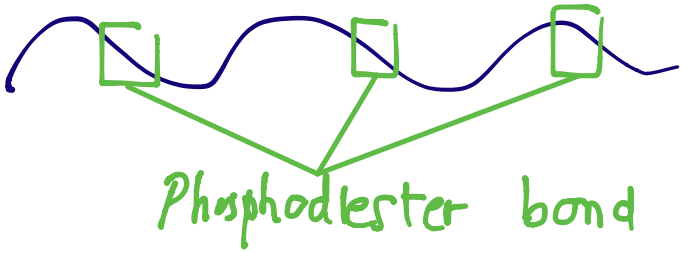


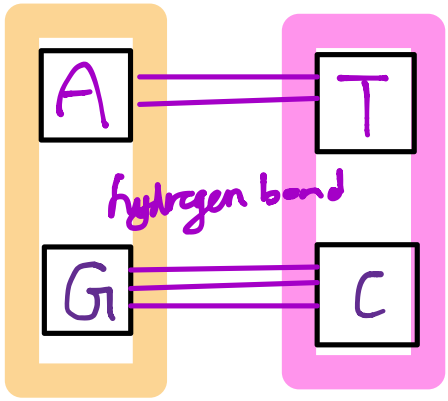
1. 2 nucleotides bound together form dinucleotide through condensation
2. Covalent bond form between -OH group of carbon atom 3 and phosphate group of another is referred to phosphodiester bond
3. Polymerisation repeat few million times form long polynucleotide chain
4. 5' end of (PC) ends with Phosphate group attached to C5
   3' end of (PC) ends with -OH group on C3

2.1.2 DNA

1. Polymer consisting of 2 polynucleotide strands
2. (2PS) coiled in right-handle spiral helix & around each other form double helix
3. (2PS) run in opposite directions (Antiparallel)
4. Each (PS) consists of sequence of nucleotides linked together by (phosphodiester.b)
5. Each DNA nucleotide strand contains 1 of 4 bases A G C T
6. 2 (PS) held together by hydrogen bond
7. Purine always bond with Pyrimidine
8. A pair with T and form 2 hydrogen bond , C-G 3hb.







Pyrimidine Purine

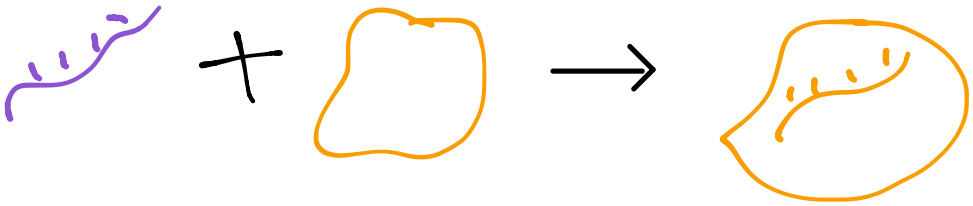
2.1.3 RNA

2.1.3.1 mRNA

1. 3-5% of total mRNA
2. made up of single-stranded polynucleotide
3. carries nucleotide sequence transcribed from triplet code of DNA in nucleus to ribosome in cytoplasm

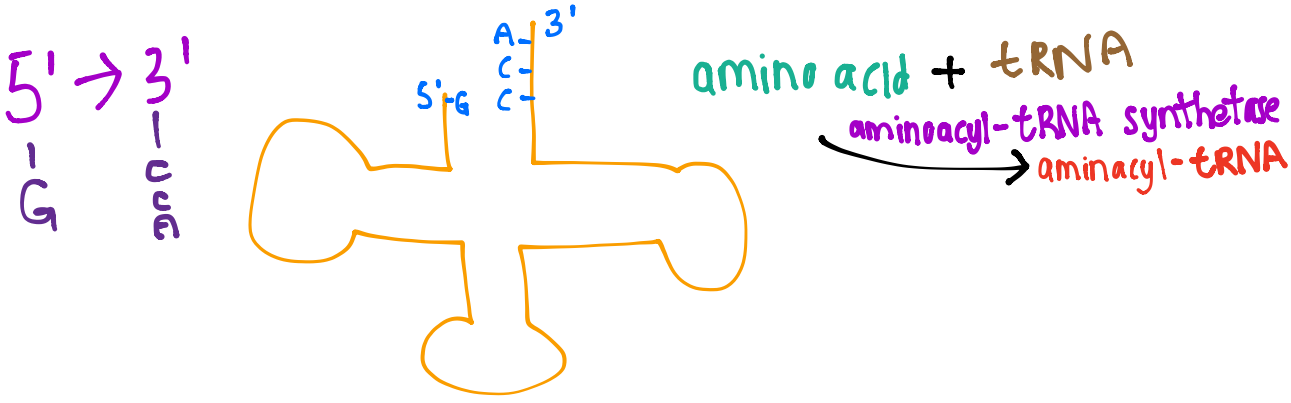
2.1.3.2 rRNA

1. most abundant RNA , 80% of total RNA
2. combined with protein in cytoplasm to form ribosomes



2.1.3.3 tRNA

1. 15% of total RNA
2. 5' end ends in G
3. 3' end ends in base sequence CCA
4. each amino acid attached to its specific tRNA by Enzyme aminoacyl-tRNA synthetase to produce anion acid-tRNA complex

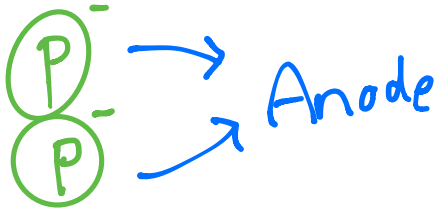


2.14 Difference of DNA & RNA

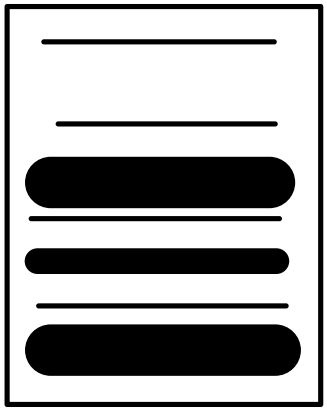
DNA	RNA
double strands arranged antiparallel & coil to form double helix	single polynucleotide strand
deoxyribose H at C_2	ribose -OH group at C_2
NB: A, T, G, C	NB: A, U, G, C
Only 1 type DNA	3 type RNA : - mRNA - rRNA - tRNA

2.1.5 Principle of Agarose Gel Electrophoresis

1. used to separate DNA fragments
2. separation based on charges on DNA fragments
3. Phosphate backbone of DNA molecule is negatively charged
4. When placed in electric field , fragments move to positively charged anode
5. Movement of DNA fragments based on size of DNA molecule
6. Bigger DNA molecule move slower , Smaller - faster
7. Movement of DNA fragments based on conc. & pore size of gel
8. Bigger pore size cause DNA molecule move faster , Smaller - slower



size DNA , conc & Pore size



2.2.1 Enzyme Involved

1. Helicase
2. Single-stranded DNA binding protein
3. Topoisomerase
4. Primase
5. DNA Polymerase III
6. DNA polymerase I
7. DNA Ligase

Proses DNA Replication

1. **Helicase** unwinds DNA double helix , break down hydrogen bonds between bases at replication fork
2. **Single-stranded DNA binding protein** binds to and stabilizes single-stranded DNA formed by the action of helicase so that unwound region can serve as template
3. **Topoisomerase** relieves overwinding strain ahead of replication fork by breaking , swivelling , rejoining DNA strand
4. **Primase** synthesis RNA primer at 5' end of the leading strand and 5' end of each Okazaki fragment of the lagging strand
5. **DNA polymerase III** synthesises new DNA strand using parental DNA as template
6. **DNA polymerase I** removes RNA nucleotides of RNA primer & replaces them with DNA nucleotides
7. **DNA Ligase** joins Okazaki fragments of lagging strand ; On leading strand , joins the end of DNA that replaces the RNA primer to the rest of leading strand

2.3 Genetic Code

Code for sequence of amino acids in a protein

2.3.1 Characteristic of Genetic Code

1. **Triplet Code**
   - A. Every (aa) in a protein is coded for by a sequence of 3 bases along DNA molecule
   - B. Triplets of bases on mRNA called codons
2. **Degenerate**
   - A. More than one codon can code for same (aa)
3. **Non-Overlapping**
   - A. Each nucleotide in a triplet code is used only once
4. **Punctuated**
   - A. There are code for initiation and termination of translation
     - a. AUG = start codon
     - b. UGA , UAG , UAA = stop codons
       1. Signal the initiation/termination of translation
5. **Universal**
   - A. Same triplets code for same (aa) in all organisms

2.3.2 Protein Synthesis

1. synthesis of polypeptide chains which than produce specific protein based on genetic code in DNA
2. Occur in 2 stages

2.3.2.1 Transcription

1. Process of synthesising mRNA using informations from DNA represented as cistron
2. Helicase unwind the double-stranded DNA by breaking the hydrogen bonds between complementary base pairs in DNA
3. Exposed part of DNA strand called sense strand , is the part that forms cistron
4. Expose base sequence on the sense strand acts as template for transcription
5. RNA Polymerase binds to cistron on DNA
6. Initiation transcription in the 5' to 3' direction on mRNA strand
7. RNA Polymerase moves along the sense strand until reaches the termination codon on cistron
8. RNA Polymerase is released

2.3.2.2 Translation

1. Process which the codons on mRNA are used to assemble a sequence of (aa) in polypeptides
2. 5' end of mRNA binds to small ribosomal subunit to begin the translation process
3. Activation of (aa) by aminoacyl-tRNA synthetase occurs when (aa) attached to its specific tRNA to produce specific aminoacyl-tRNA complex
4. This process uses energy supplied by ATP
5. Initiation occurs when tRNA with anticodon UAC that carries (aa) methionine binds to start codon AUG on mRNA
6. Large ribosomal subunit binds to small ribosomal subunit to from functional ribosome with A site and P site