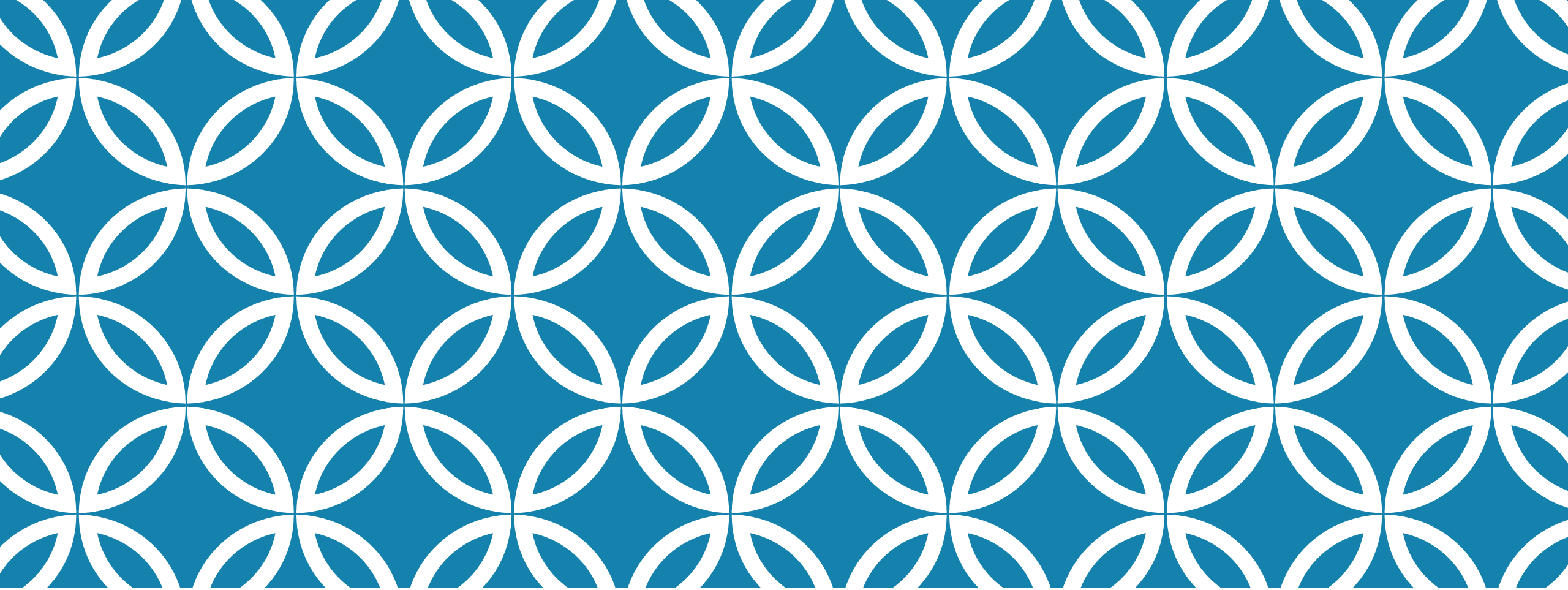


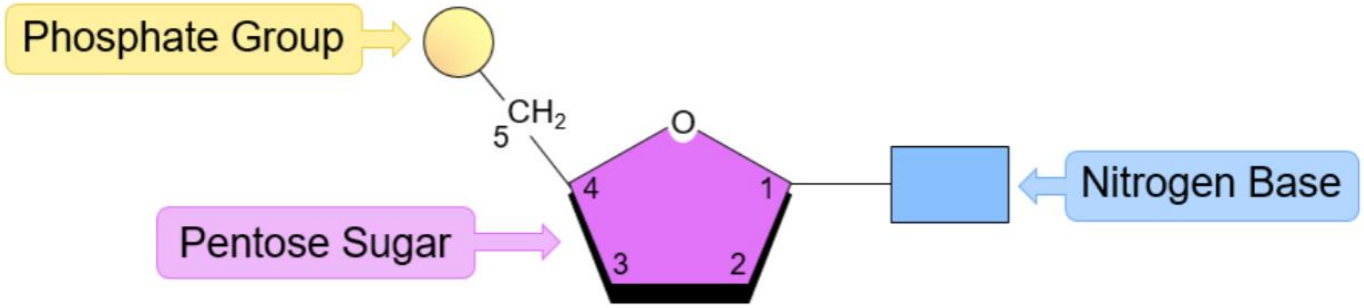
CHAPTER 2.6.

Structure of DNA and RNA

NUCLEOTIDES

DNA and RNA are composed of monomers (=single units that act as building blocks), which contain:

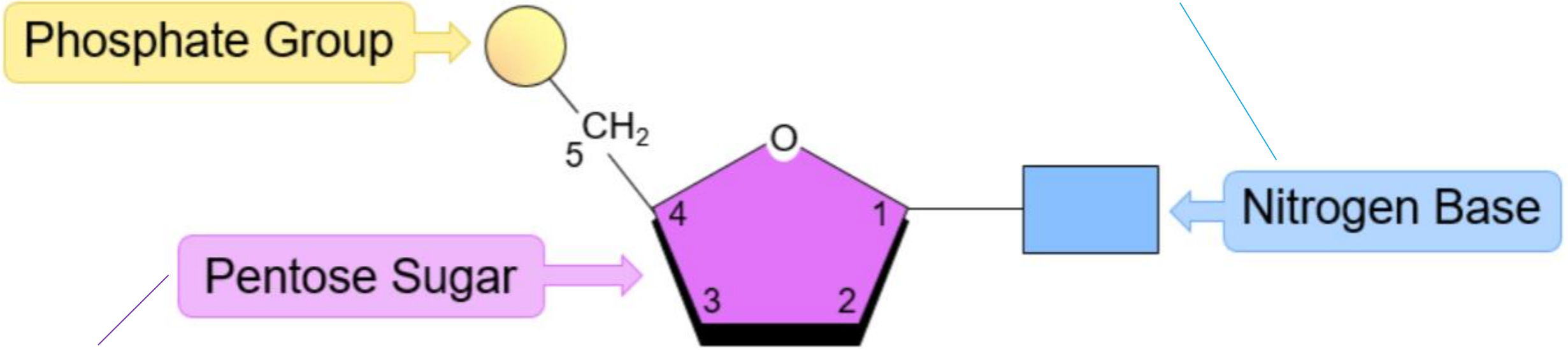
- Pentose (5C) sugar,
- a phosphate group
- a nitrogenous base (A, C, G, T/U)



NUCLEOTIDES

Acidic
negatively charged

contains nitrogen
has one or two rings in its structure

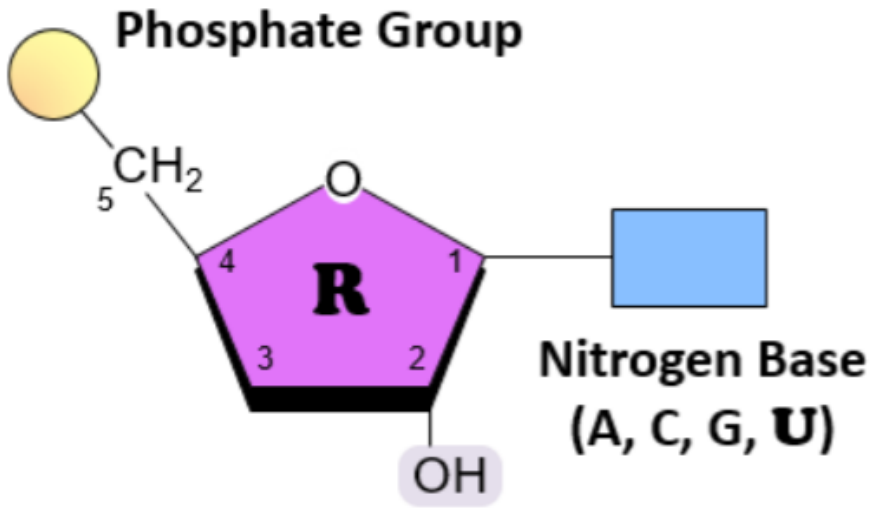


five carbon atoms = pentose sugar

DNA VS RNA

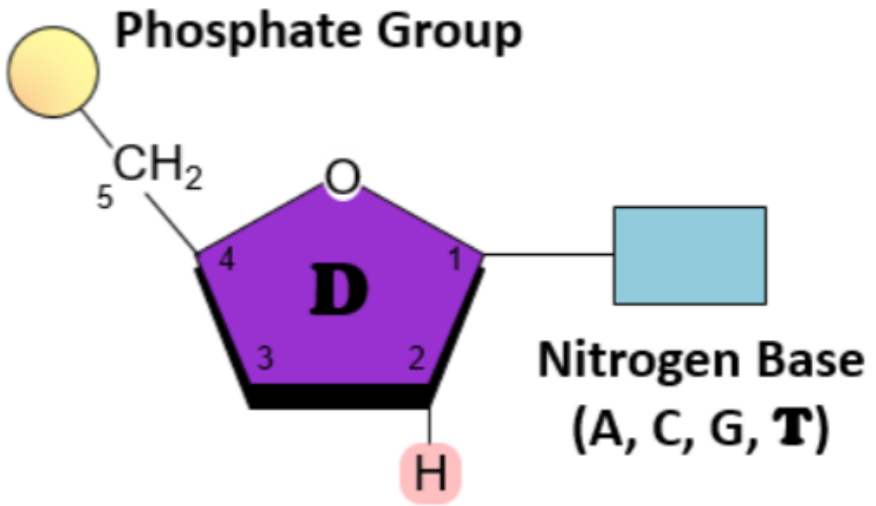
	DNA	RNA
Pentose Sugar	Deoxyribose	Ribose
Nitrogenous Bases	Has Thymine (T)	Has Uracil (U)
Number of Strands	Double stranded (double helix)	Single stranded
Basic Function	Master copy of genetic instructions	Temporary copy of a specific instruction

NUCLEIC ACID COMPARISON



Ribose Sugar

RNA Nucleotide



Deoxyribose Sugar

DNA Nucleotide

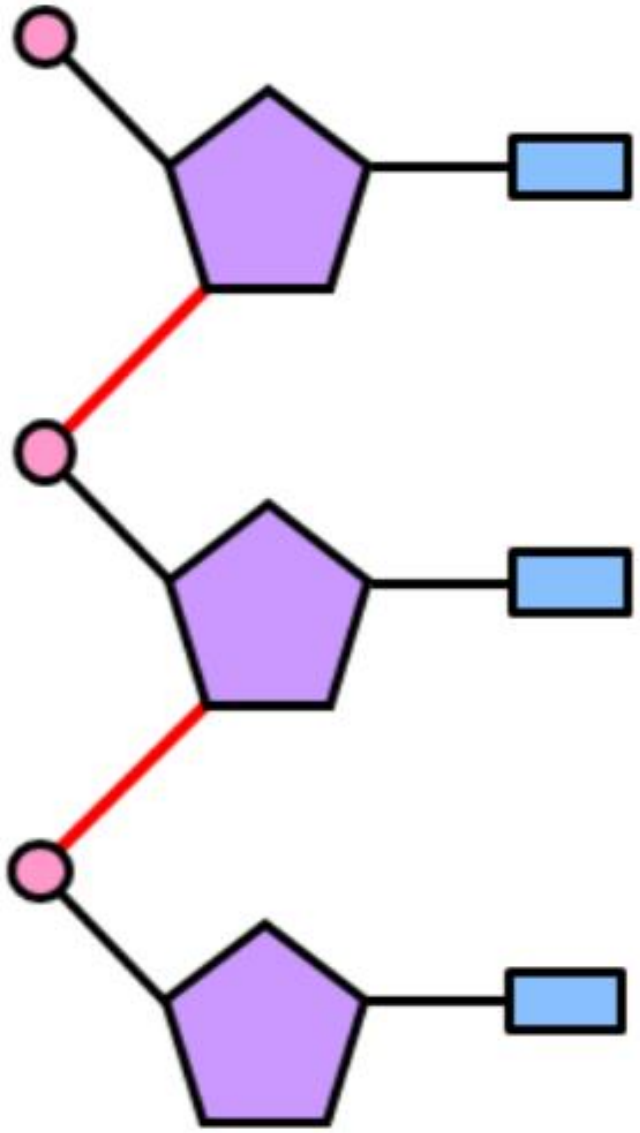
POLYNUCLEOTIDE FORMATION

Nucleotides – linked to form a polynucleotide strand via condensation reactions (water produced)

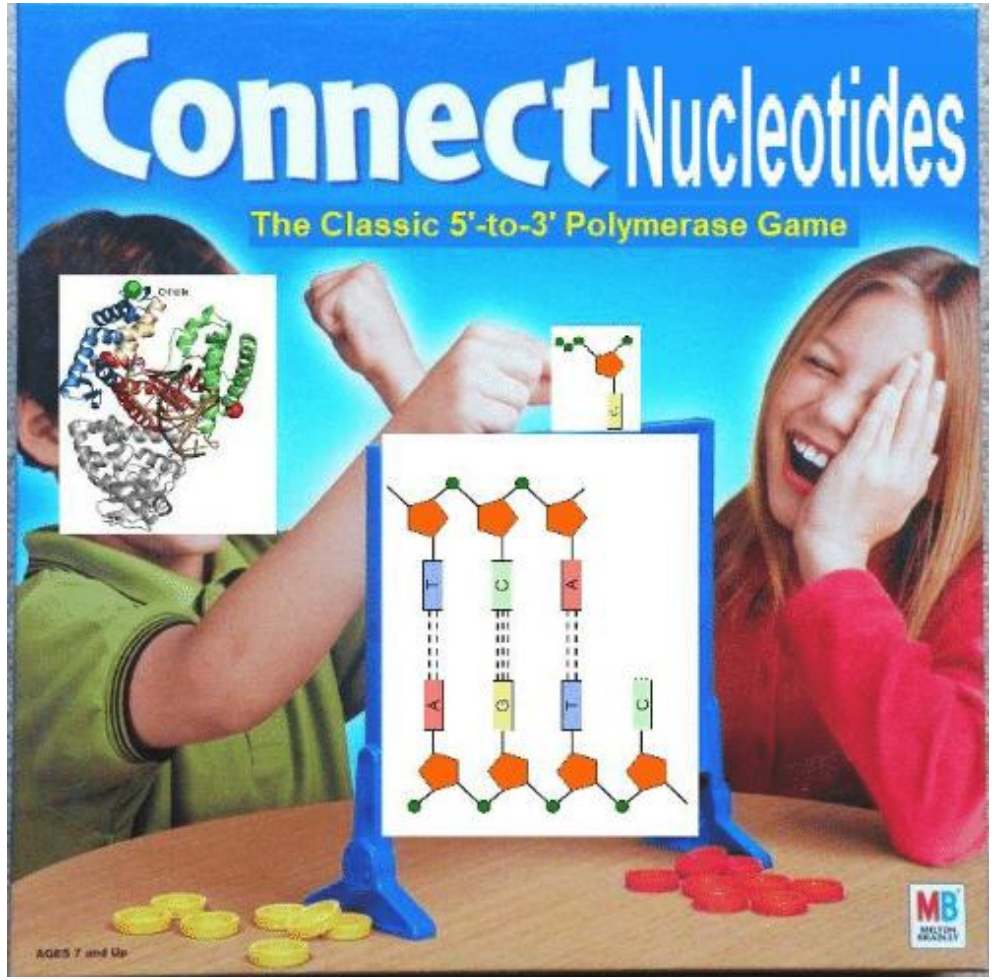
5‘-phosphate group of one nucleotide attaches to sugar of another nucleotide (*at 3‘ hydroxyl group*)

→ nucleotide strands run in a 5‘ → 3‘ direction

The bond between two nucletoides is a covalent **phosphodiester bond** (shown as red line)



POLYNUCLEOTIDE FORMATION

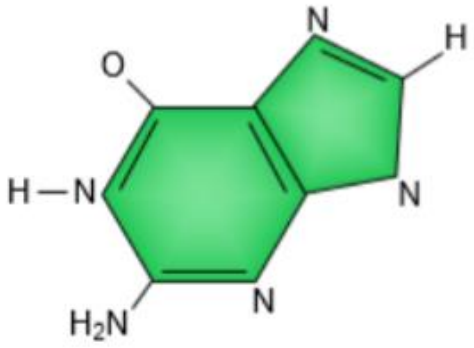


NITROGENOUS BASES

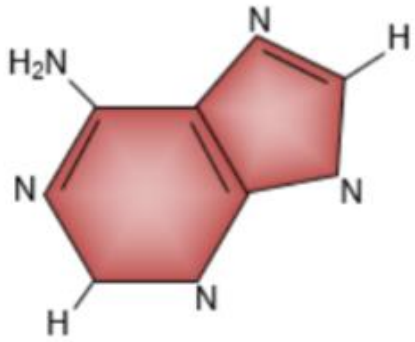
DNA and RNA nucleotides are each composed of one of four nitrogenous bases

- Adenine and Guanine are double ringed purines

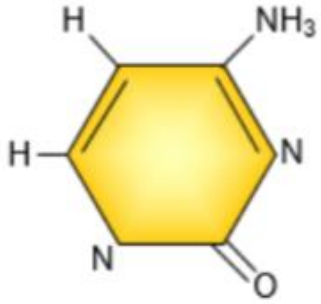
- Cytosine and Thymine / Uracil are single-ringed pyrimidines



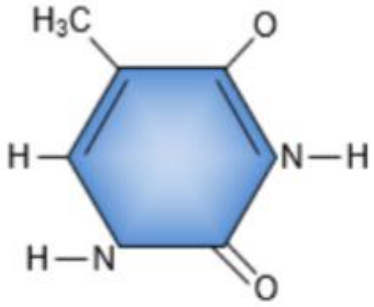
Guanine



Adenine

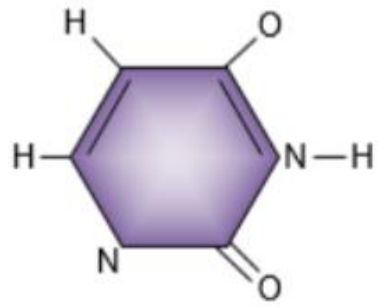


Cytosine



Thymine

(DNA only)



Uracil

(RNA only)

DNA STRUCTURE: COMPLEMENTARY BASE PAIRING

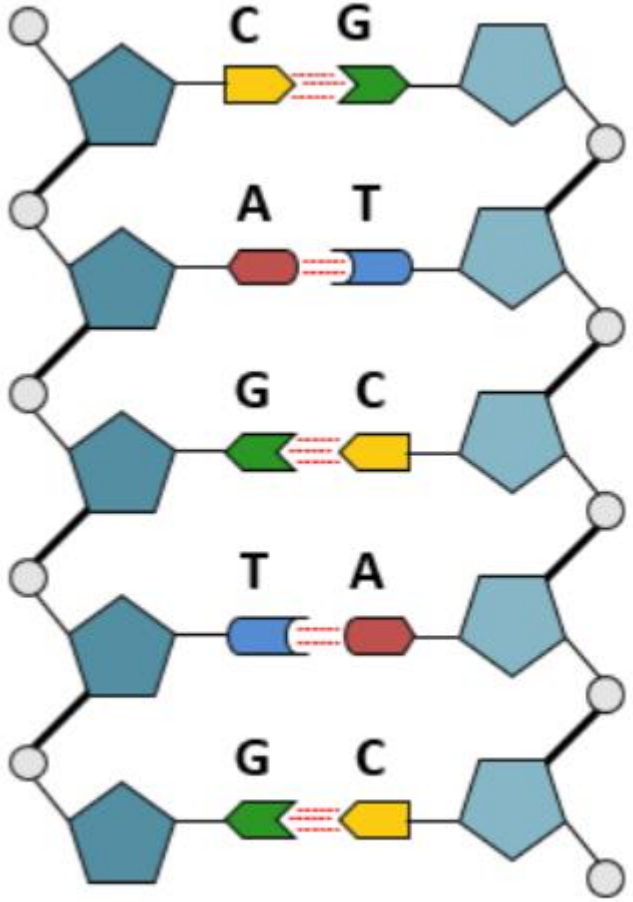
DNA molecules form a double-stranded structure (ladder)

- Sugar-phosphate backbones are connected by bases

The nitrogenouse bases from each strand → form complementary pairing connected by hydrogen bonds

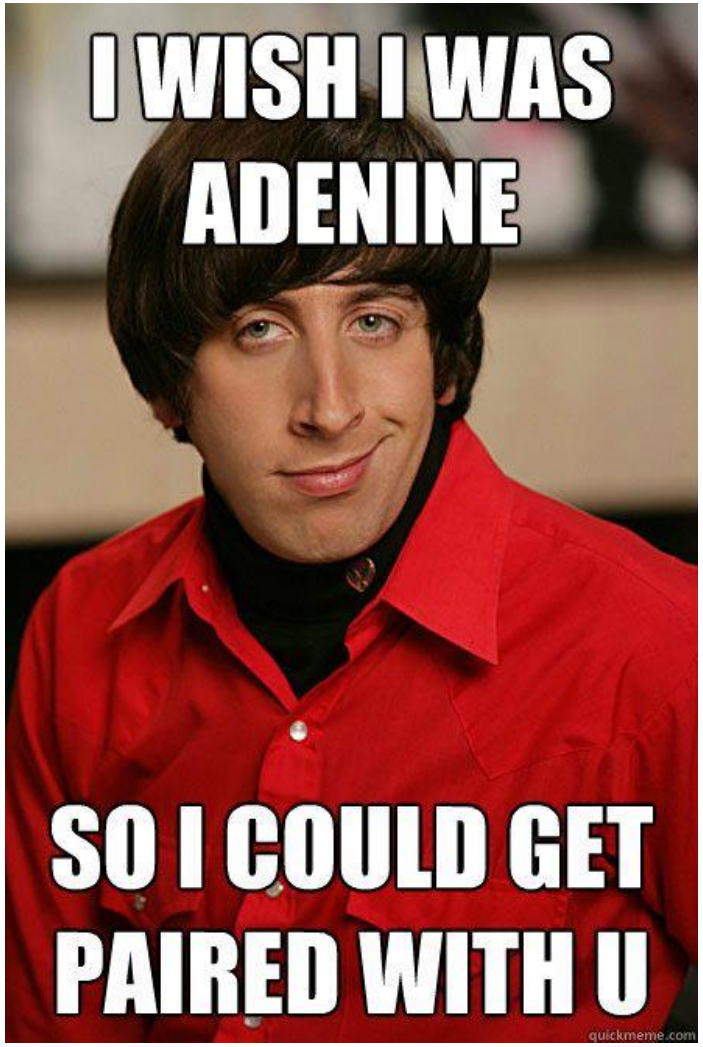
- Cytosine (C) pairs with Guanine (G) → three H-bonds
- Adenine (A) pairs with Thymine (T) → two H-bonds

Mismatches would destabilise the DNA molecule

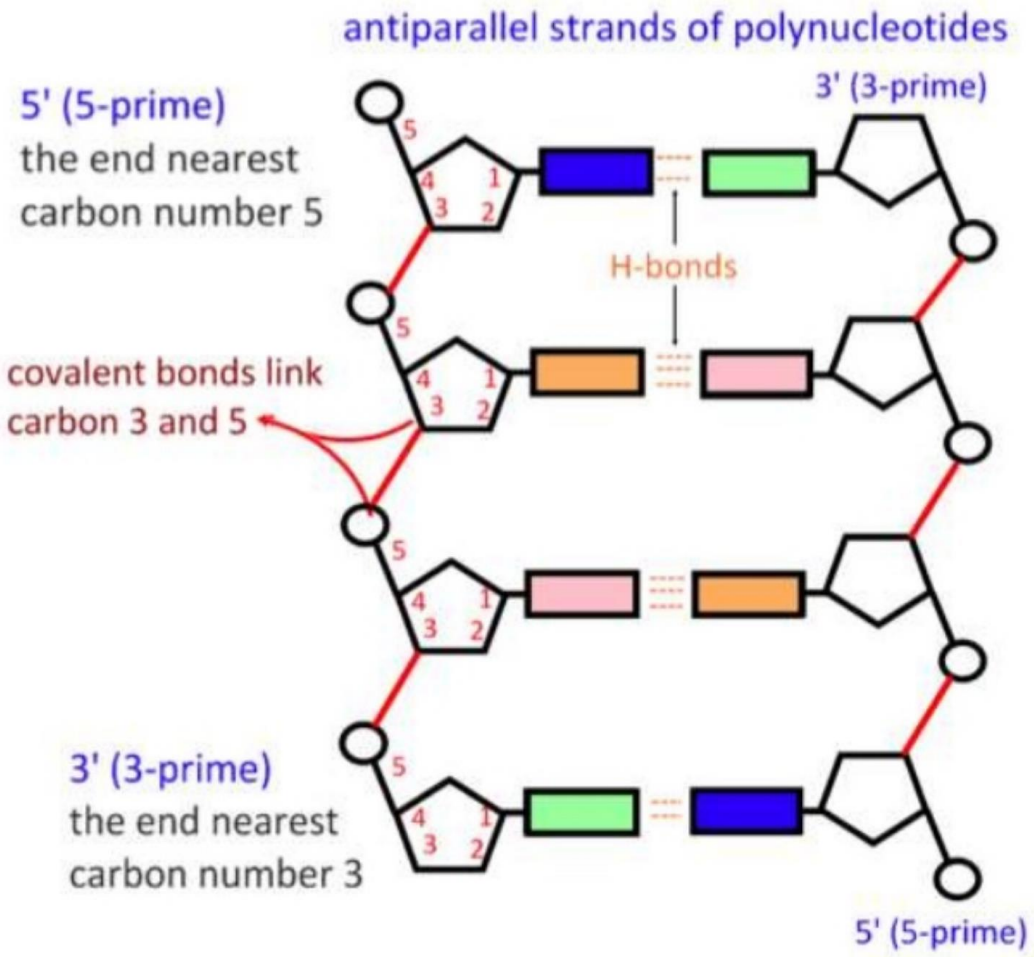


DNA 'Ladder'

DNA STRUCTURE: COMPLEMENTARY BASE PAIRING



DNA STRUCTURE: ANTIPARALLEL STRANDS



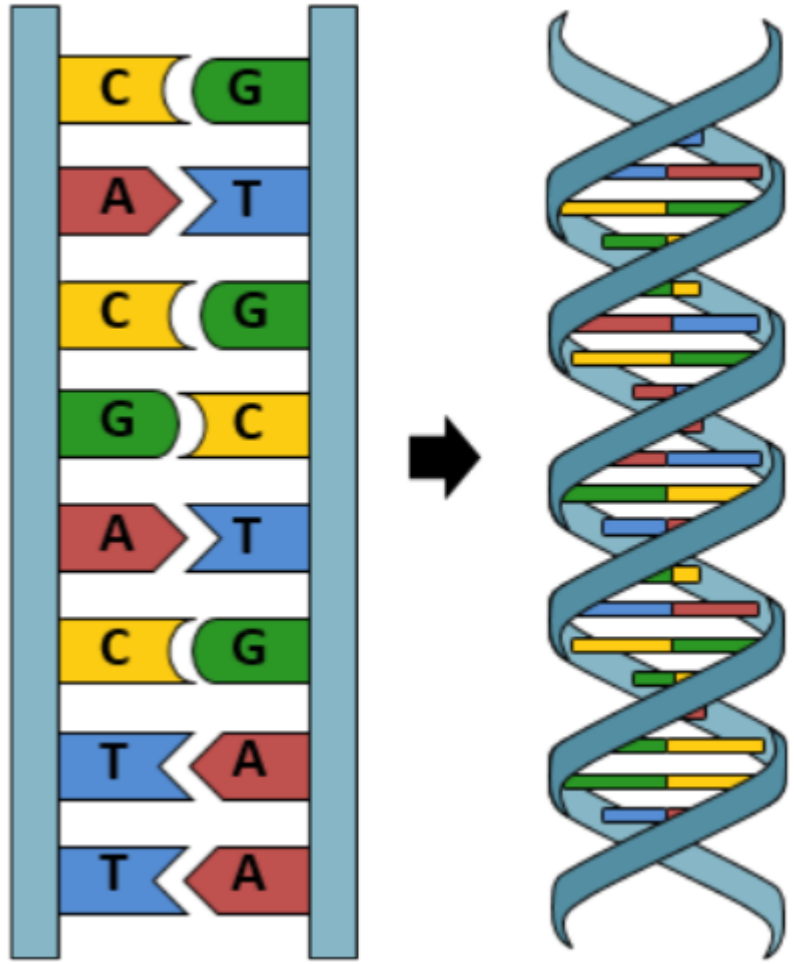
DNA STRUCTURE: DOUBLE HELIX

Strands must run **antiparallel** in order for two sets of bases to pair

(“*pentose sugars ‘point’ in opposite directions*”)

Double stranded molecule twists → most stable energy configuration

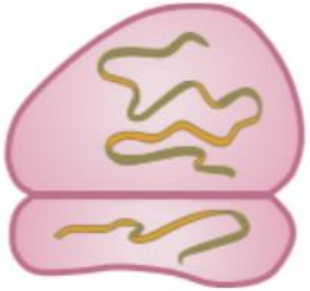
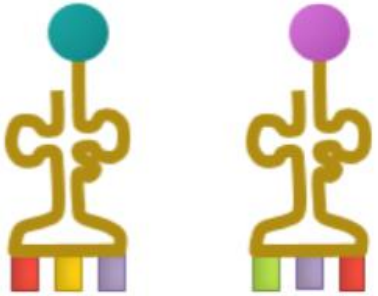
DNA forms stable **double helix** (10 – 15 bases per rotation)



RNA STRUCTURE AND TYPES

- RNA is usually single-stranded

- Three main types of RNA:

Messenger RNA	Ribosomal RNA	TRANSFER RNA
		
mRNA is a transcript copy of a gene (*codes for protein*)	rRNA is the catalytic component of ribosomes	tRNA transports amino acids to the ribosome

DNA ELUCIDATION: WATSON & CRICK

James Watson and Francis first elucidated DNA structure in 1953

Their efforts were guided by the contributions of other scientists:

- Pauling – Molecular distances and bond angles
- Levene – Nucleotide composition (*sugar, phosphate, base*)
- Chargaff – Base composition (*equal purine / pyrimidine number*)

Watson

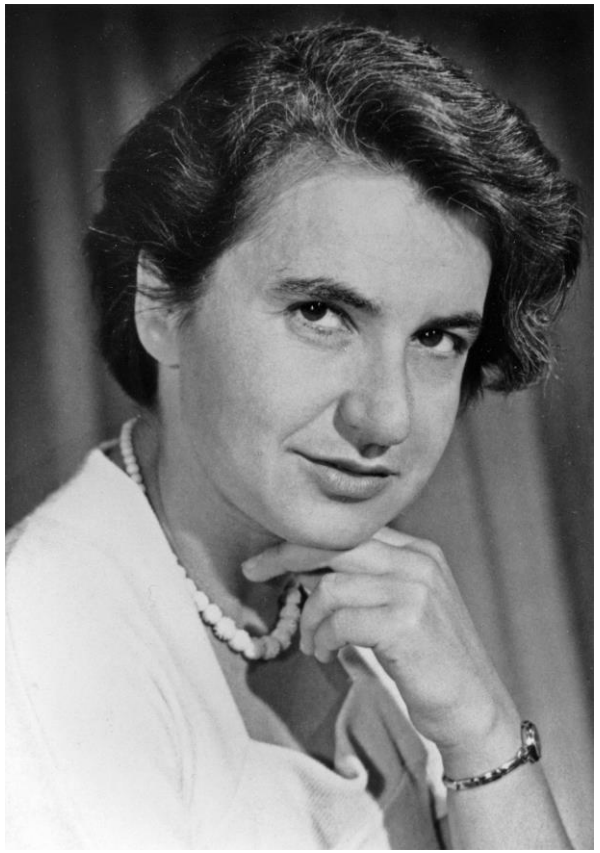
Crick

OFTEN FORGOTTEN: ROSALIND FRANKLIN

- she is the main reason we know of the double helix

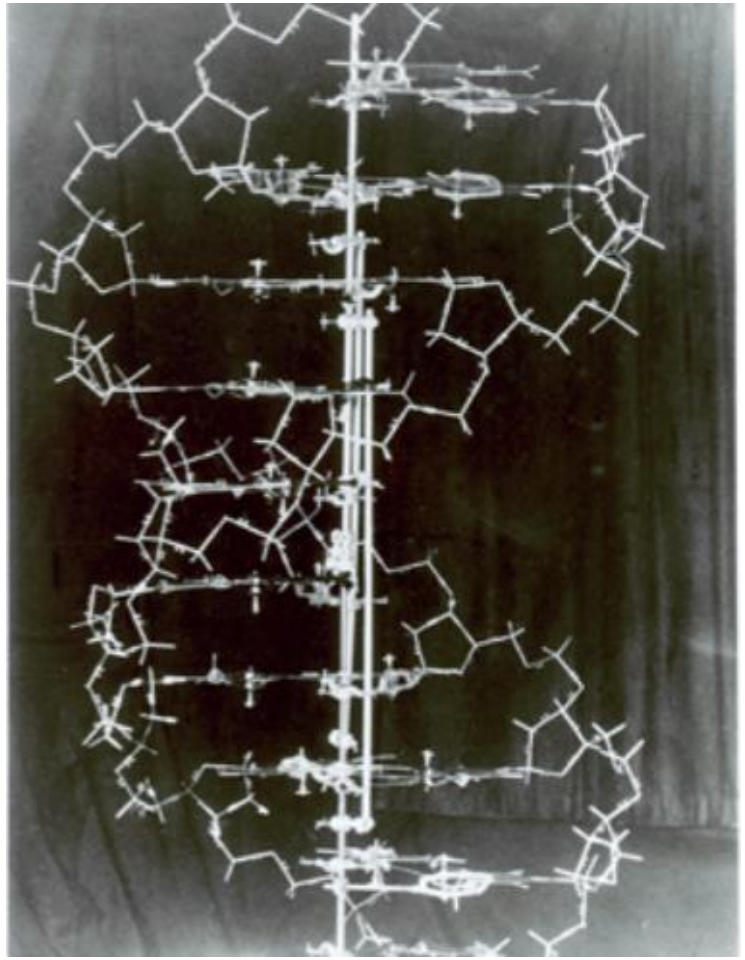
- published a paper at the same time

- Watson & Crick received nobel prize → they used Franklin‘s data without her knowledge or approval



DNA ELUCIDATION: MODEL MAKING

Watson & Crick built models (*trial and error*) to assess viability of potential structures



They assembled a DNA model that demonstrated:

- Anti parallel DNA strands
- Outer sugar-phosphate backbone
- Inner base pairing (complementary)
- Overall shape of a double helix

DATA BASED QUESTIONS

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