THE NUCLEIC ACIDS

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Friedrich Miescher in 1869

- isolated what he called **nuclein** from the nuclei of pus cells
- Nuclein was shown to have acidic properties, hence it became called **nucleic acid**

Two types of nucleic acid are found

- Deoxyribonucleic acid (DNA)
- Ribonucleic acid (RNA)

The distribution of nucleic acids in the eukaryotic cell

- DNA is found in the nucleus
  with small amounts in mitochondria and chloroplasts
- RNA is found throughout the cell

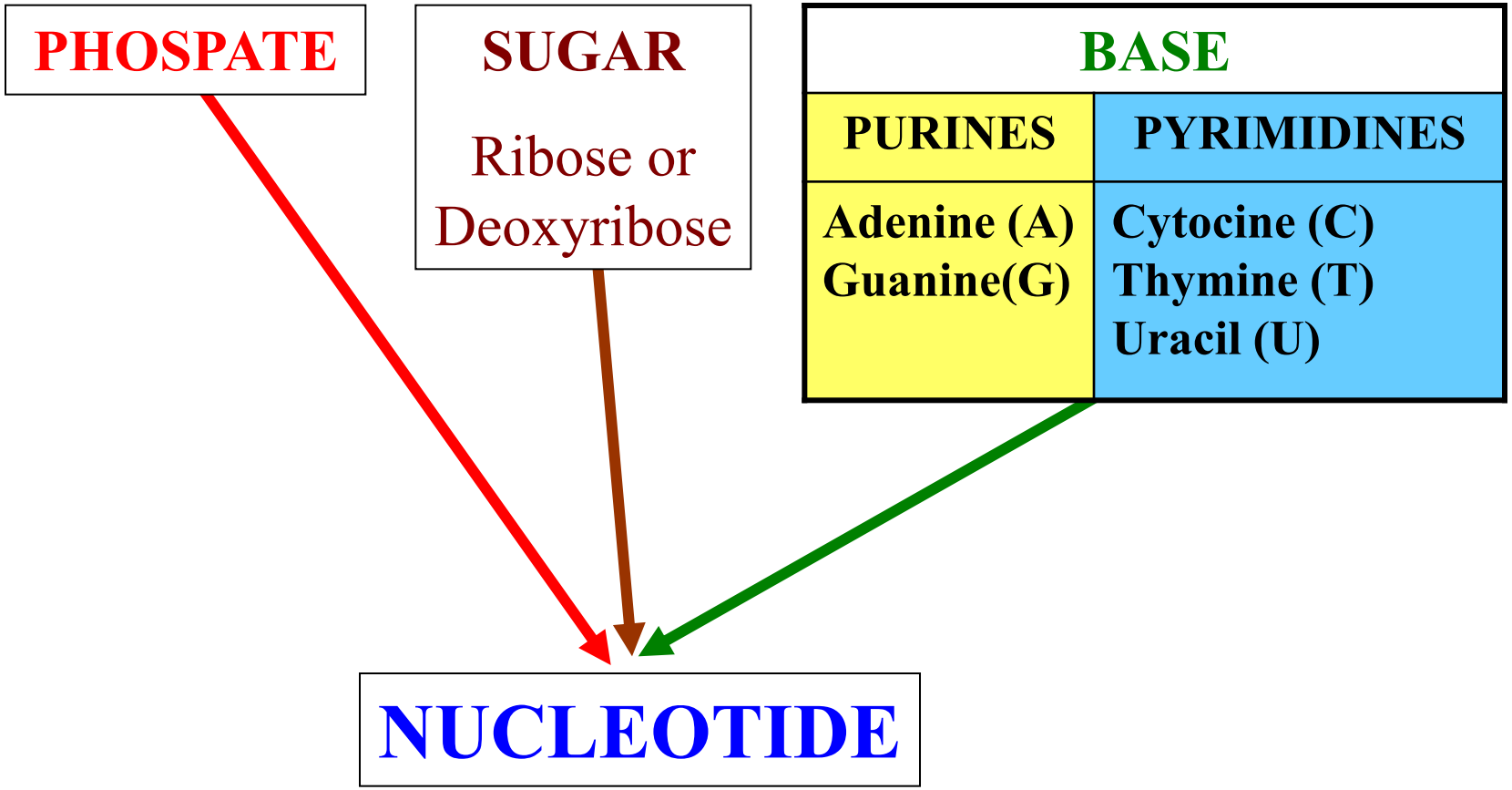
DNA as genetic material: The circumstantial evidence

1. Present in all cells and virtually restricted to the nucleus
2. The amount of DNA in somatic cells (body cells) of any given species is constant (like the number of chromosomes)
3. The DNA content of gametes (sex cells) is half that of somatic cells.
   In cases of polyploidy (multiple sets of chromosomes) the DNA content increases by a proportional factor
4. The mutagenic effect of UV light peaks at 253.7nm. The peak for the absorption of UV light by DNA

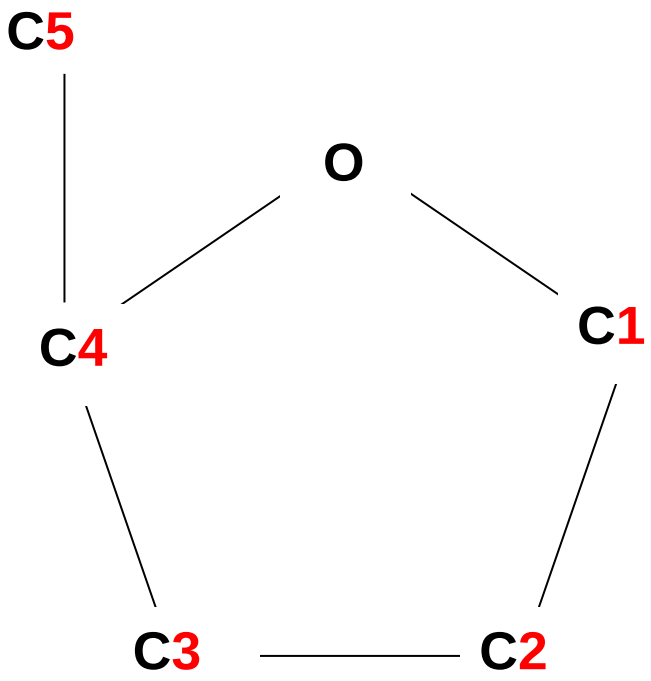
NUCLEIC ACID STRUCTURE

- Nucleic acids are **polynucleotides**
- Their building blocks are **nucleotides**

NUCLEOTIDE STRUCTURE

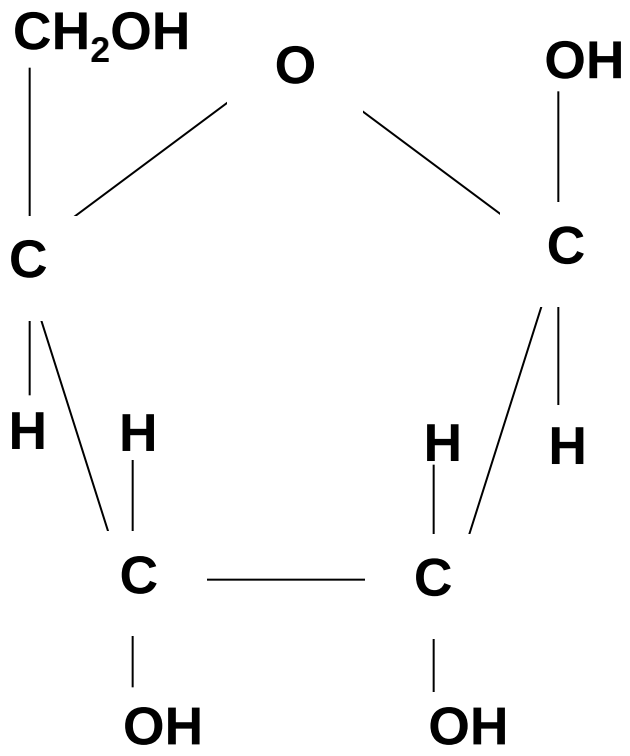


Ribose is a pentose

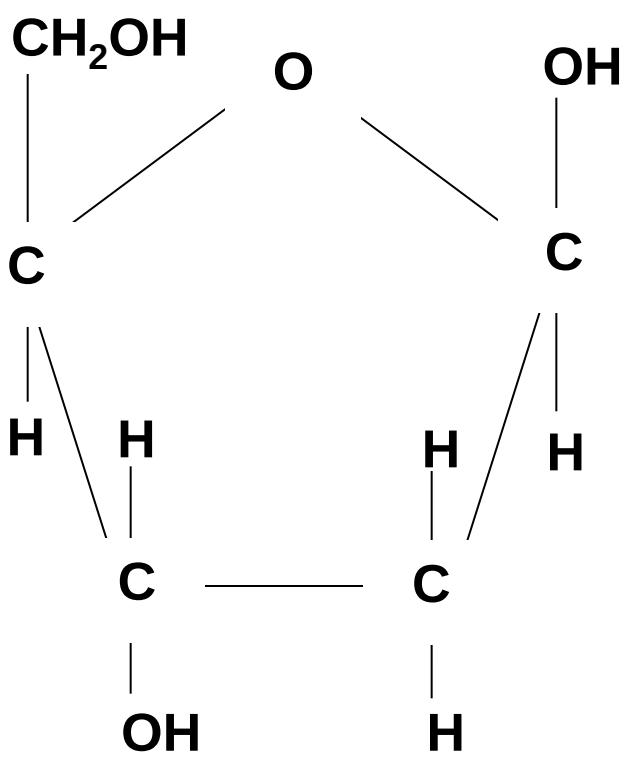


Spot the difference

RIBOSE

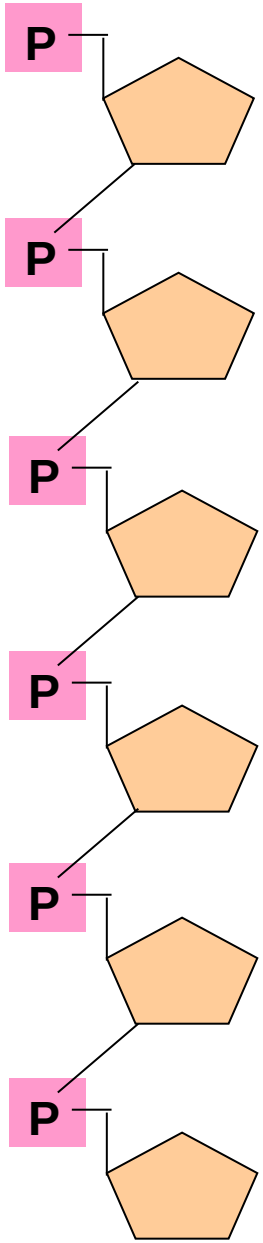


DEOXYRIBOSE



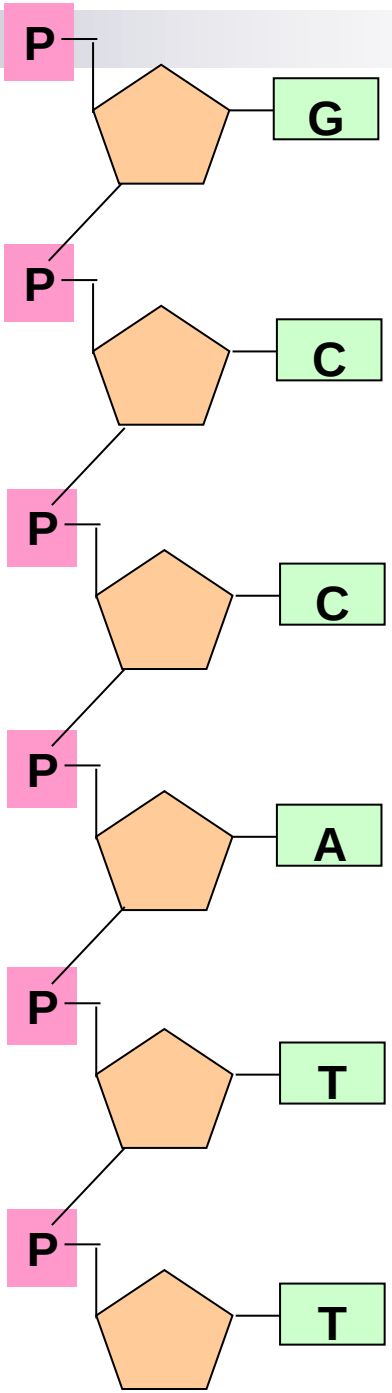
THE SUGAR-PHOSPHATE BACKBONE

- The nucleotides are all orientated in the same direction
- The phosphate group joins the 3rd Carbon of one sugar to the 5th Carbon of the next in line.

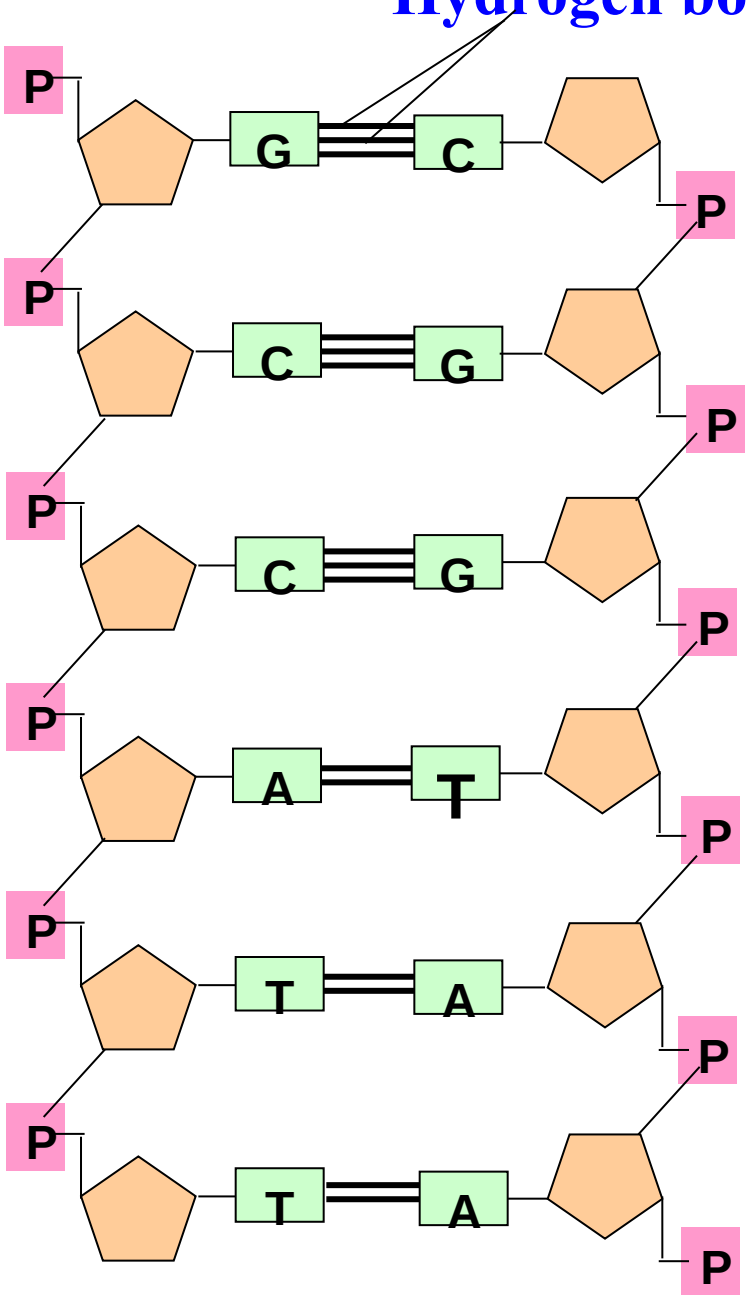


ADDING IN THE BASES

- The bases are attached to the 1st Carbon
- Their order is important It determines the genetic information of the molecule



DNA IS MADE OF TWO STRANDS OF POLYNUCLEOTIDE



DNA IS MADE OF TWO STRANDS OF POLYNUCLEOTIDE

- The sister strands of the DNA molecule run in opposite directions (**antiparallel**)
- They are joined by the bases
- Each base is paired with a specific partner:

A is always paired with **T**

G is always paired with **C**

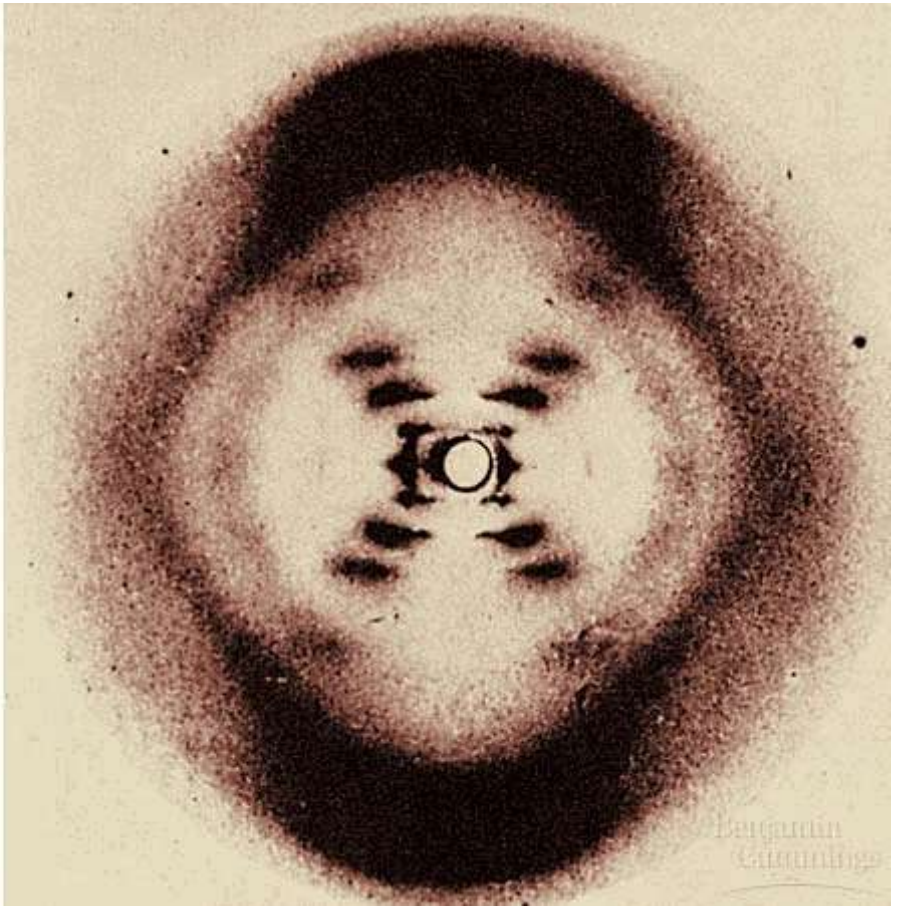
Purine with Pyrimidine

- This the sister strands are **complementary** but **not** identical
- The bases are joined by **hydrogen bonds**, individually weak but collectively strong

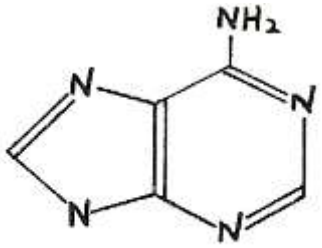
Erwin Chargaff's Data (1950-51)

	Base composition, mole percent				Base ratios			Asymmetry ratio
	A	G	C	T	A/T	G/C	Pu/Py	$\frac{A+T}{G+C}$
Animals								
Man	30.9	19.9	19.8	29.4	1.05	1.00	1.04	1.52
Sheep	29.3	21.4	21.0	28.3	1.03	1.02	1.03	1.36
Hen	28.8	20.5	21.5	29.2	1.02	0.95	0.97	1.38
Turtle	29.7	22.0	21.3	27.9	1.05	1.03	1.00	1.31
Salmon	29.7	20.8	20.4	29.1	1.02	1.02	1.02	1.43
Sea urchin	32.8	17.7	17.3	32.1	1.02	1.02	1.02	1.58
Locust	29.3	20.5	20.7	29.3	1.00	1.00	1.00	1.41
Plants								
Wheat germ	27.3	22.7	22.8	27.1	1.01	1.00	1.00	1.19
Yeast	31.3	18.7	17.1	32.9	0.95	1.09	1.00	1.79
Aspergillus niger (mold)	25.0	25.1	25.0	24.9	1.00	1.00	1.00	1.00
Bacteria								
E. coli	24.7	26.0	25.7	23.6	1.04	1.01	1.03	0.93
Staphylococcus aureus	30.8	21.0	19.0	29.2	1.05	1.11	1.07	1.50
Clostridium perfringens	36.9	14.0	12.8	36.3	1.01	1.09	1.04	2.70
Brucella abortus	21.0	29.0	28.9	21.1	1.00	1.00	1.00	0.72
Sarcina lutea	13.4	37.1	37.1	12.4	1.08	1.00	1.04	0.35
Bacteriophages								
T7	26.0	24.0	24.0	26.0	1.00	1.00	1.00	1.08
λ	21.3	28.6	27.2	22.9	0.92	1.05	1.00	0.79
ϕX174, viral	24.6	24.1	18.5	32.7	0.75	1.30	0.95	1.34
ϕX174, replicative	26.3	22.3	22.3	26.4	1.00	1.00	1.00	1.18

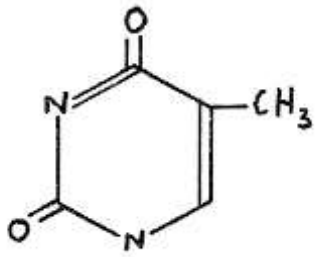
Wilkins & Franklin (1952): X-ray crystallography



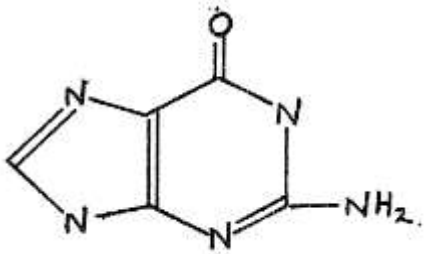
Purines & Pyrimidines



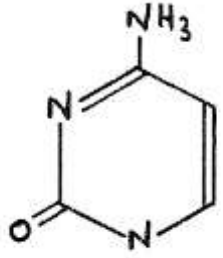
Adenine



Thymine

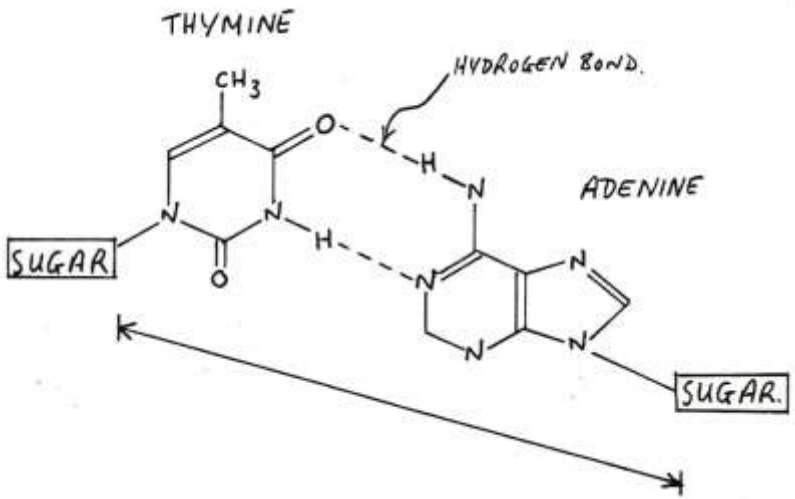


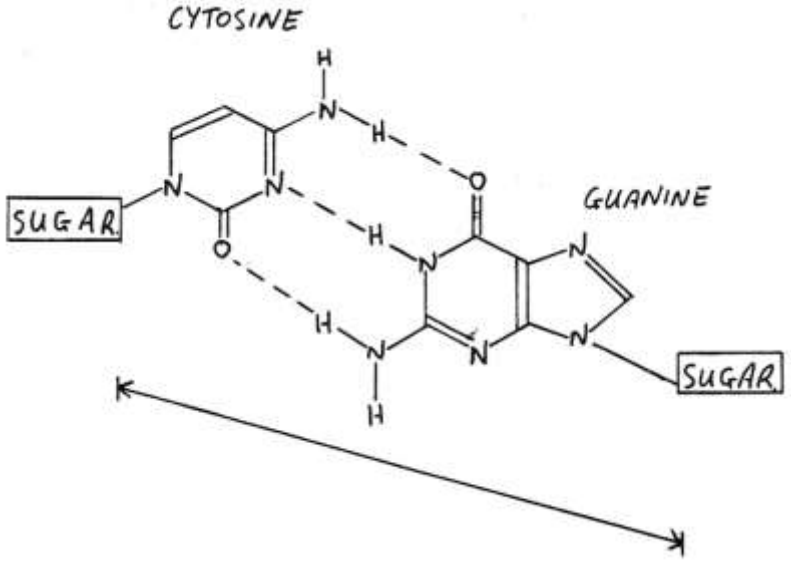
Guanine



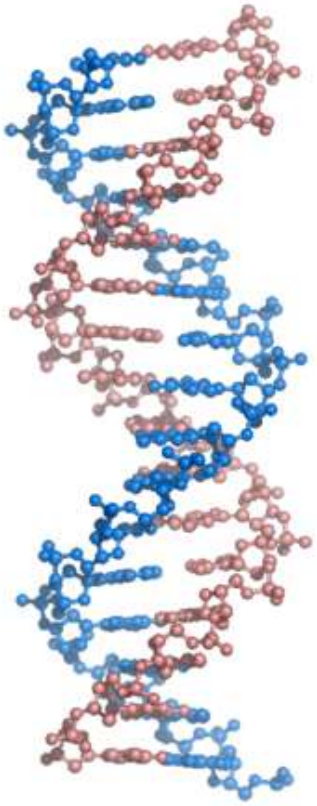
Cytosine

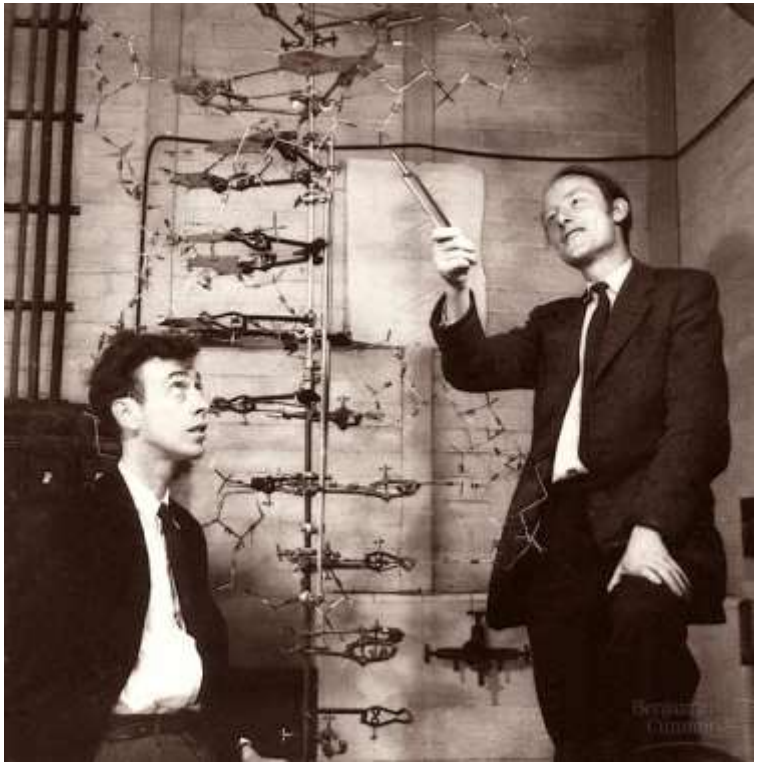
Watson & Crick Base pairing





The Double Helix (1953)





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