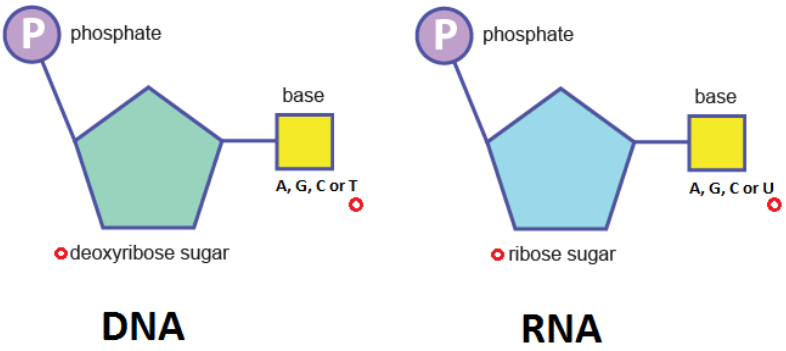
Nucleic acids: important information-carrying molecules

Structure of DNA and RNA

DNA

A nucleotide has 3 components:

- A pentose (5-carbon sugar) called deoxyribose
- A phosphate group
- A nitrogen-containing organic base, which can be adenine, guanine, cytosine or thymine



Two nucleotides join together by a condensation reaction, forming a phosphodiester bond. More nucleotides join on to this to form a polynucleotide strand.

RNA

Contain 3 nitrogen-containing organic bases adenine, cytosine and guanine but not thymine. They have uracil instead. It stays as a single polynucleotide strand rather than forming a double helix.

RNA molecules are relatively short. RNA transfers genetic information from the DNA in the chromosomes to the ribosomes. Ribosomes are made of RNA and protein.

DNA replication

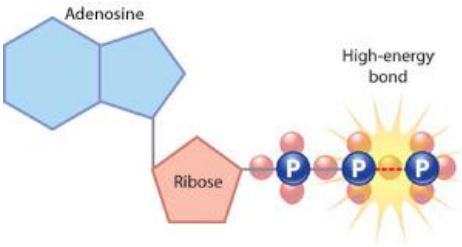
DNA replication is described as semi-conservative because one strand of the old molecule remains intact and a new strand is synthesised following base pairing rules.

- The DNA helicase causes the double helix to unwind.
- The DNA molecules 'unzips'. This happens because the DNA helicase causes the hydrogen bonds between the two polynucleotide strands to break.
- New DNA nucleotides join on to the exposed template strand of DNA by complementary base-pairing. A always pairs with T and C always pairs with G
- DNA polymerase joins the new nucleotides together by a condensation reaction

ATP

It contains:

- A molecule of adenine (nitrogen-containing organic base)
- A molecule of ribose (5-carbon sugar found in RNA)
- 3 phosphate groups



The third phosphate group can be hydrolysed from the rest of the molecule, releasing energy that can be used for energy-requiring processes in the cell. We can say the hydrolysis of ATP is COUPLED to energy-requiring processes in cells. When this third phosphate group is split off, it leaves adenosine diphosphate (ADP) and an inorganic phosphate (which biochemists write as Pi). This reaction is catalysed by the enzyme ATP hydrolase.

The inorganic phosphate released can be used to add a phosphate group to another molecule making it more reactive

ADP and Pi can be joined together again, by a condensation reaction, to make ATP. This requires an input of energy.

The energy required to synthesise ATP from ADP and Pi can come from cellular respiration or photosynthesis. The reaction is catalysed by the enzyme ATP synthase.