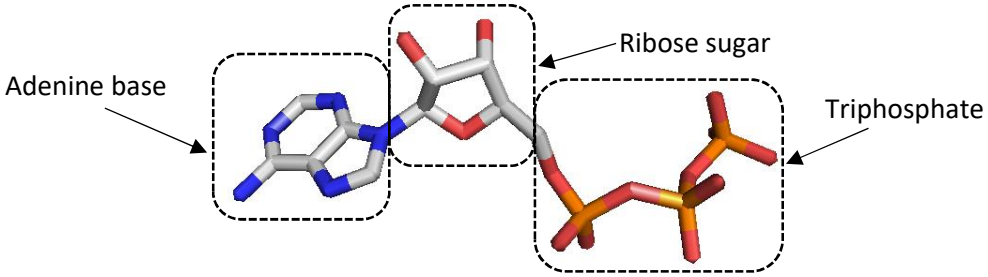
TB7 - ATP

Adenosine triphosphate is a small molecule which acts as an **energy carrie**r in all organisms.

THE STRUCTURE OF ATP

ATP is a nucleotide derivative – it has a similar structure to a nucleotide.

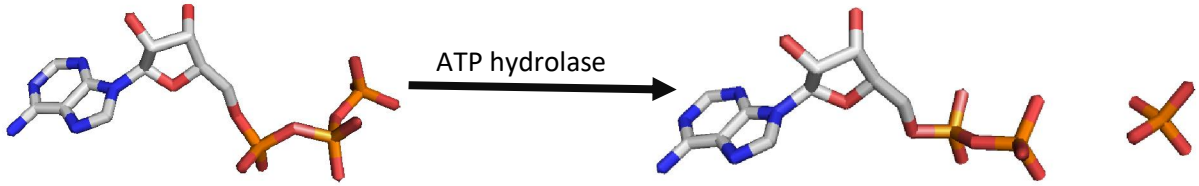


The **triphosphate** group is simply three phosphates which have condensed together. Compare this structure with the structure of a nucleotide in resource TB6 – Nucleic Acids.

ATP AS AN ENERGY CARRIER

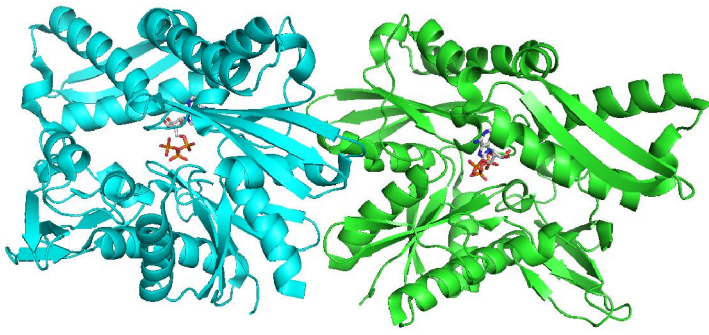
Organisms rely on being able to access energy to survive. To do this, they utilise ATP, as a source of chemical energy. ATP stores chemical energy in its **covalent bonds**. When bonds are broken, energy is released. It is necessary to use a carrier molecule such as ATP, so that energy can be temporarily stored and used within cells where needed.

Adenosine triphosphate is **hydrolysed** to **adenosine diphosphate** and a free **inorganic phosphate** group. This is done by enzymes such as ATP hydrolase, which breaks the final phosphate-phosphate bond, triggering series of reactions which release chemical energy. This energy is used to power other, unfavourable reactions



$$ATP \rightarrow ADP + P_i$$

As you can see, one of the phosphate groups has been cleaved from the end of adenosine triphosphate, turning it into adenosine diphosphate.



ATP molecules bound to the ATP hydrolase enzyme.

ATP can be hydrolysed in cells depending on the energy requirement of the reactions which are occurring. For example, when you are exercising, you need to contract your muscles frequently, this uses up energy. The energy for this comes from ATP, so when you are exercising, ATP is hydrolysed more readily, releasing the energy needed.

Produced by Adam Stubbs at Newcastle University as part of a summer outreach project.

As well as releasing energy, when ATP is hydrolysed it releases a molecule of **inorganic phosphate**. This can be particularly useful, as it can be used to **phosphorylate** other compounds, and lead to other reactions within a cell. When a compound is phosphorylated, it usually becomes more reactive, and can trigger further reactions. One example of this is seen during glycolysis, which is an essential part of respiration. The first step in glycolysis involved glucose being phosphorylated into glucose 6-phosphate by ATP

$$glucose + ATP \rightarrow glucose\ 6\ phosphate + ADP$$

RESYNTHESISING ATP

When cells have hydrolysed their ATP into ADP, they need to remake ATP quickly, so that they have a ready supply of energy should they need it. To do this, the reverse reaction occurs, this is a **condensation reaction** which combines ADP and P_i. The energy for this process comes from either **photosynthesis** or **respiration**.