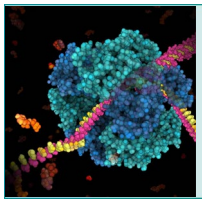

ATP in Use

hhmi | BioInteractive

Animation Transcript

Adenosine triphosphate, or ATP, is the molecule that powers all life on Earth. Energy from ATP is required for essential activity, including pumping ions across membranes and pulling apart the DNA helix.

The ATP molecule is made of three main structures: an adenine nucleobase, a ribose sugar, and three phosphates. Energy is released when the bond holding the end phosphate group is broken, converting ATP to ADP through a water-consuming hydrolysis reaction.

To stay alive, your cells depend on enzyme pumps to maintain differences in ion concentration across membranes. The flow of calcium ions controls muscle contraction, nerve transmission, gene regulation, and cell death. Because of enzyme pumps, the concentration of calcium ions inside your living cells is 10,000 times lower than outside.

The ATP hydrolysis reaction breaks the end phosphate bond, releasing energy driving atoms to rearrange inside the enzyme, transforming its shape. With each transformation, channels inside the enzyme open and close, sending ions in opposite directions: hydrogen in and calcium out of the cell.

DNA helicase is another type of ATP-powered enzyme. This mechanism is so critical for life that 1% of your genetic code is for helicase enzymes.

Helicase enzymes are motor proteins that move along the DNA double helix, mechanically separating strands powered by energy from ATP. The ring-shaped enzyme uses ATP hydrolysis to provide energy for the mechanical separation of strands of the DNA helix. With each step of the enzyme, two pairs of DNA bases are separated, requiring energy from two ATP molecules around the ring.