

Adenosine Triphosphate

ATP is the molecular currency of the cell and is present in high concentrations ($\sim 6\text{mM}$). Biosynthesis of ATP is achieved through oxidative phosphorylation, photophosphorylation, and substrate-level phosphorylation. Hydrolysis of ATP to ADP or AMP yields energy and is sufficient to drive many unfavorable processes in the direction required by the cell. It is a small packet of energy used by the cell. An active person (12-MJ diet) turns over about 75 k of ATP every day, so **a typical ATP molecule is broken down into ADP and resynthesized 1000 times each day.** In rapidly metabolizing tissues, the lifetime of each ATP molecule is only a few seconds. The concentration of free ADP is normally lower than that of ATP in the cytosol of eukaryotic cells (about 200 times lower). This situation is clouded by large amounts of bound ADP permanently attached to the actin cytoskeleton. A low concentration of free cytosolic ADP is essential for metabolism to work properly. The diffusion rate is proportional to the concentration, which makes it difficult to recycle ADP quickly in rapidly metabolizing tissues such as cardiac muscle. Shuttle systems have evolved that accelerate ADP transport within cells. Coenzymes [such as ATP, nicotinamide adenine dinucleotide and hydrogen, nicotinamide adenine dinucleotide phosphate (NADPH), and coenzyme A (CoASH)] do not move easily between cell compartments and allow cells to keep their cytosol more oxidizing than their mitochondria, which suppresses lactate production under aerobic conditions. There