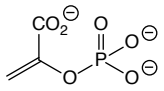
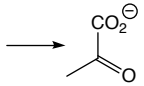
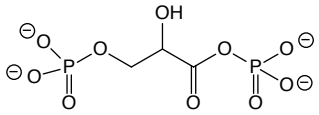
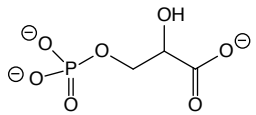
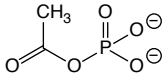
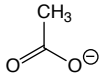
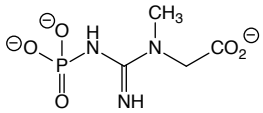
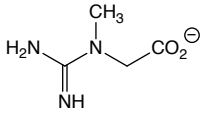
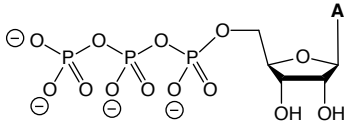
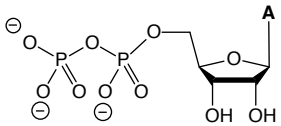
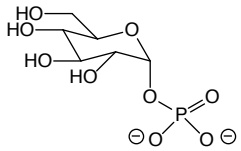
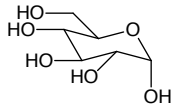
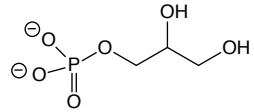
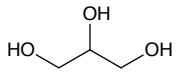
Phosphorylated Biological Energy Carriers. . . The Myth of ATP Revealed!

Or, How the chemist analyzes the energy carrying capacity of molecules: *It's the leaving group man!*

compound Free energy of hydrolysis type of phosphate group	**structure**	**leaving group**	**additional chemistry**
phosphoenol pyruvate -14.8 kcal/mole phospho-enol ester			
1,3-diphosphoglycerate -11.8 kcal/mole mixed anhydride			
acetyl phosphate -11.3 kcal/mole mixed anhydride			
phosphocreatine -10.3 kcal/mole phosphoramide			
ATP -7.5 kcal/mole phosphoric anhydride			ATP $\rightarrow$ ADP & ADP $\rightarrow$ AMP are similar, but AMP $\nrightarrow$ adenosine (why?)
glucose-1-phosphate -5.0 kcal/mole phosphate ester + acetal			
glycerol-3-phosphate -2.2 kcal/mole phosphate ester			

Note: The leaving group leaves from a phosphate group in which the P=O is analogous to a C=O in the carboxylic acid family. The free energy of hydrolysis is ΔG° for the reaction of each molecule with water under standard conditions, which facilitates comparison. None of these molecules would by hydrolyzed directly *in vivo* but would trade phosphate groups with each other or other molecules not listed here. The entries at the top of the table have the greatest ability to donate phosphate.