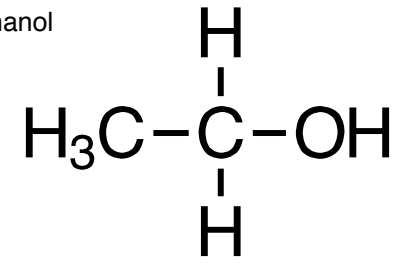
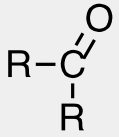
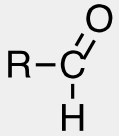
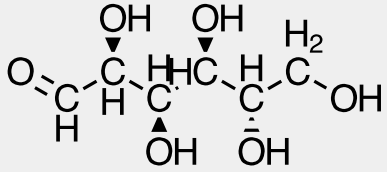
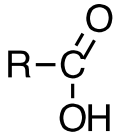
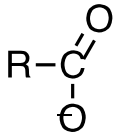
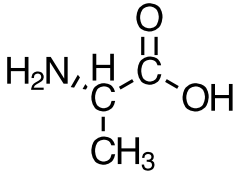
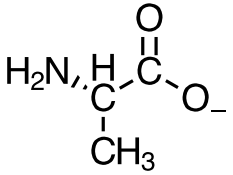
Functional Groups in Biology

not at all complete!

Name	prefix or suffix	Structure	Found in	What's it good for?	Example
Hydroxyl or alcohol	"-ol"		Almost everything: Sugars and other carbohydrates. Important in DNA. Can be important in proteins.	Good H-bond donor. The O can be an acceptor. **Attacks and reacts with Phosphate!!!!! (did I emphasize that enough?)**	Ethanol 
Carbonyl	Aldo or aldehyde if at end of carbon chain, Keto or Ketone if not at end	Keto:  Aldo 	Almost everything. DNA Base pairs, all sugars, Proteins.	Great H-bond acceptor. Important intermediate in some chemical reactions.	Glucose: Note the hydroxyls too 
Carboxyl or organic acid (sometimes simply "acid")	Carboxyl or "acid." When deprotonated: "-ate"	Protonated (acid)  Deprotonated (conjugate base) 	All Amino Acids (as well as additional sites in some amino acids) Important reactive intermediates in metabolism. **NOT in DNA** (I know…it's called an acid for a different reason).	Can be very good H-bond acceptor. **NOT** an H-bond donor under most circumstances because the H comes off. Important reactive group.	Amino acid "Alanine" This is protonated  De-protonated: 

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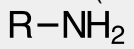
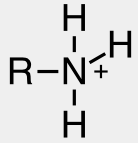
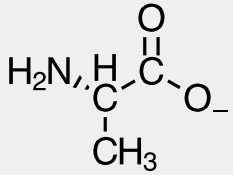
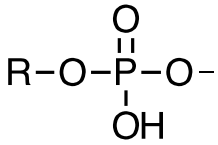
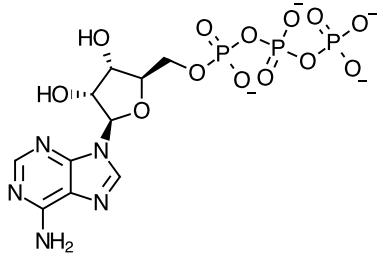
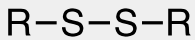
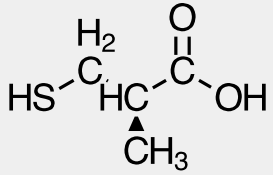
Amine	amino-	Neutral (base)  Conjugate acid 	All Amino acids (as well as additional sites in some amino acids) DNA "bases" Derivatives of sugars	Excellent H-bond donor. Can act as a base. Important in DNA -base-pairing and in many chemical reactions.	Alanine (other end) 
Phosphate	Phospho- or just -phosphate as ending.	In the single de-protonated form: 	DNA and it's components. ATP. Added to many things to modify shape or chemistry	The other half of the most fundamental chemistry with hydroxyls. Used to make high-energy intermediates and to regulate shape of proteins	Adenosine triphosphate (ATP)  Mn
Thiol or sulfhydryl	thio-	Single  "Disulfide" 	Lots of enzyme cofactors (help with the chemistry of reactions) in proteins to hold structure tightly together (disulfide).	Good for reversible redox reactions. Can be a reactive group in some proteins, or used for structure.	The amino acid cysteine 

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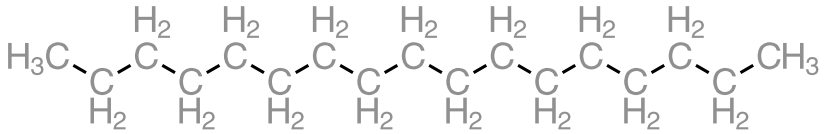
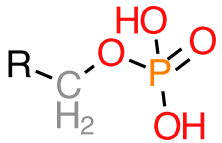
Some Additional Groups:

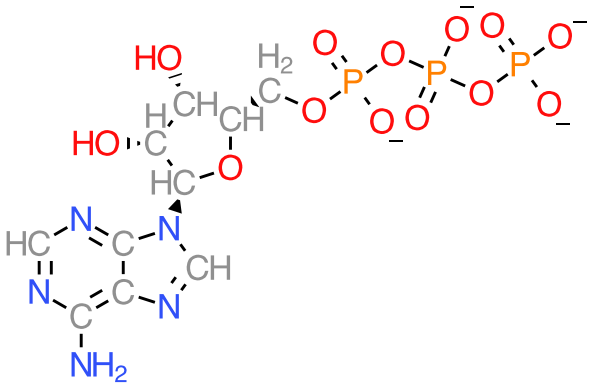


This would be called an "aliphatic" chain. It's very hydrophobic. We will learn some organic chemistry names as we go. For now, a CH_3, is called a "methyl group." It's hydrophobic. But one methyl group alone is not enough to make an otherwise hydrophilic molecule very hydrophobic. **THE HYDROGENS NEVER MAKE H-bonds.** This gets it's own page because chains of carbon are the building blocks of lipid chains. Chains longer than this make up the water-insoluble part of your body.

R-S-H Thiol or Sulfhydryl. Often forms covalent bonds with other sulfhydryls in proteins. Oxidation/Reduction chemistry.



This is a phosphate. It can also be drawn having lost one or two of the red hydrogens, as below (so, it is an acid). How many protons are missing will depend on the surrounding pH. Usually, phosphates carry negative charges.
It is the "acid" in deoxyribonucleic acid (DNA) or ribonucleic acid (RNA).
The chemistry of the interaction of phosphates with hydroxyls and how it can be affected by water and ions forms the most basic reactions of life. The transfer of phosphates provides the negative ΔG needed to push otherwise unfavorable reactions to happen. You've hear of ATP? (picture at right) Life transfers one or two of those phosphates as the source of free energy needed to drive reactions.



Mn