The discovery of thousands of planets around stars other than our Sun has revived age-old questions on how these exo-planets form and which chemical ingredients are available to build them. Star formation and chemistry start in the cold and tenuous clouds between the stars. In spite of the extremely low temperatures and densities, these clouds contain a surprisingly rich and interesting chemistry, as evidenced by the detection of nearly 200 different molecules, from simple to complex. New facilities such as ALMA allow us to zoom in on dense cloud cores and planetary system construction sites with unprecedented sharpness and sensitivity. Spectral scans of young disks contain tens of thousands of rotational lines, revealing water and a surprisingly rich variety of organic materials, including simple sugars and high abundances of deuterated species. How are these molecules formed and what chemical processes play a role? How common are they?