Abstract: Through photosynthesis, marine algae convert gigatonnes of carbon dioxide into carbohydrates every year. In the form of algal polysaccharides, these structurally complex biomolecules determine to a large extent how much carbon is stored in the oceans. Specialised marine bacteria unlock this carbon energy by breaking down the polysaccharides through the action of carbohydrate-active enzymes (CAZymes) and releasing the carbon dioxide back into the atmosphere. However, some of the polysaccharides are not recycled quickly, but sink into the deep sea and sediments, where they can store carbon for millennia. To better understand these processes, great efforts are needed to further explore the marine carbon cycle. The same advances are also important to support emerging efforts to use algal biomass as a new sustainable resource for the bioeconomy. The enzymatic machinery responsible for the degradation of polysaccharides by marine bacteria has remained largely unexplored because of the size and heterogeneity of algal polysaccharides. Pure and defined oligosaccharides needed for systematic screenings of marine CAZymes are currently not available. Since conventional chemical synthesis is time-consuming and often not general enough, ASAP aims to obtain collections of oligosaccharides related to different classes of algal polysaccharides by using automated glycan assembly (AGA) technology. Oligosaccharides with many different sequences and sulfation patterns will be prepared from small sets of monosaccharide building blocks. Incubation of the synthetic oligosaccharides with samples containing carbohydrate-degrading activity and subsequent HPLC-MS analysis of the degradation products will provide information on: 1) the collective enzyme activities of a bacterial community in seawater and sediment samples; 2) the abilities of individual bacterial strains to degrade specific polysaccharides; 3) the substrate specificities of purified CAZymes.