



## Synthetic lectins: Progress in biomimetic carbohydrate recognition

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Carbohydrate recognition is a difficult task, even for natural receptors such as lectins. The problems are two-fold. Firstly, saccharides are coated with hydroxyl groups and are therefore hydromimetic, being difficult to distinguish from a background of water molecules. Secondly they are structurally complex, and often differ only subtly from each other. It is not surprising, therefore, that lectins show notoriously weak affinities and often quite modest selectivities. If proteins perform moderately, one might expect that synthetic receptors would fail completely. However surprisingly good results have been achieved for one family of carbohydrate substrates, those with all-equatorial arrays of functionality ( $\beta$ -glucosyl,  $\beta$ -GlcNAc etc.). The key to success is the provision of cavities which complement both apolar and polar moieties. For allequatorial saccharides, this implies parallel apolar surfaces separated by polar spacers, as illustrated in the cartoon below and exemplified by prototype 1.<sup>[1]</sup> This lecture will discuss the chemistry and binding properties of 1 and, especially, more recent systems based on similar principles.<sup>[2]</sup> At their best, these "synthetic lectins" come close to matching the affinities of some lectin-carbohydrate interactions, while showing selectivities which are arguably superior. Given such performance, the prospects for applications may soon be realistic. For example, further development could lead to tools for studying the O-GlcNAc protein modification, and to molecular components for glucose sensors.



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- [2] For example: Y. Ferrand, M. P. Crump and A. P. Davis, *Science*, 2007, **318**, 619-622. N. P. Barwell, M. P. Crump and A. P. Davis, *Angew. Chem., Int. Ed.*, 2009, **48**, 7673-7676. B. Sookcharoenpinyo, E. Klein, Y. Ferrand, D. B. Walker, P. R. Brotherhood, C. F. Ke, M. P. Crump and A. P. Davis, *Angew. Chem., Int. Ed.*, 2012, **51**, 4586-4590. C. Ke, H. Destecroix, M. P. Crump and A. P. Davis, *Nature Chem.*, 2012, **4**, 718-723.