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We investigate the ways in which fundamental properties of the weak Bruhat order on a Weyl group can be lifted (or not) to a corresponding highest weight crystal graph, viewed as a partially ordered set. The latter projects to the weak order via the so-called key (poset) map, defined based on the Demazure crystal structure. We work mostly in symmetrizable Kac-Moody generality, and first give positive results for lower intervals in a crystal poset. The main ones are: the analogue of the word property, the fact that the Möbius function is always 0 or ± 1 , and that the corresponding order complexes are homotopy equivalent to balls or spheres. Then we show that these results fail for arbitrary intervals, even in type A . (Received August 21, 2016)