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Cayley maps are orientable embeddings of Cayley graphs that admit a group of orientation preserving automorphisms acting regularly on the vertices of the map. They proved repeatedly useful and constitute a large part of the class of orientably regular maps (orientable maps that admit a group of orientation preserving automorphisms acting regularly on the darts of the map). It is therefore natural to try to generalize this concept. We propose a generalization that requires the existence of an automorphism group acting regularly on the vertices, while dropping the requirement for this group to be orientation preserving. Namely, a generalized Cayley map is an orientable or non-orientable map that admits a group of automorphisms acting regularly on its vertices (in case of orientable maps, the automorphisms are allowed to include the orientation reversing reflections). We investigate this new class of highly symmetric maps, and show a surprising connection to the concept of Petrie duality. (Received September 26, 2017)