

SYMMETRY AND ORDER IN THE KINDERGARTEN METHOD; THE COLOR SYMMETRIES OF THE THREE-DIMENSIONAL FROEBEL GIFTS 3-6

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The symmetry properties of Froebel's building gifts are discussed in detail. The symmetry groups of all blocks are classified and presented within the wider taxonomy of the Gij symmetry groups. The subgroups of each individual block are identified and tabulated by conjugacy classes. The complete catalogue consisting of 5 symmetry subgroups of the half-cube and the quarter-cube, 16 subgroups of the oblong, 35 subgroups of the pillar and the square, and 98 subgroups of the cube is presented. The complete catalogue consisting of 4 conjugacy subgroups of the half-cube and the quarter-cube, 8 conjugacy subgroups of the oblong, 23 conjugacy subgroups of the pillar and the square, and 33 conjugacy subgroups of the cube is presented as well. The partial order of all symmetry subgroups are shown in lattice diagrams embedded within the complete lattice of the 98 subgroups of the octahedral group.

The cycle indices of the permutation groups of the vertices, edges and faces are given for each building block. The use of the cycle indices is discussed within the context of Polya's theorem of counting, that is, the theory of counting configurations non-equivalent with respect to a given permutation group. A special emphasis is given in the cycle indices of the faces for they can be used in the enumeration of n^4 color assignments on the faces of the building blocks. Some applications of this analysis in formal systems in architectural design and music composition are suggested in the end.