

## Math, Music and Contra Dance

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by Lena Erickson



I first heard about contra dance at a small math conference in Northfield, Minnesota during the summer of 2013 when a graduate student described the connection between contra dance and permutation groups. Contra dance, a type of partnered folk dance, involves people dancing in two lines facing each other or in groups of four. If the participants of a contra dance are each labeled with a number, with  $n$  being the total number of dancers, then their most basic interactions during the contra dance can be represented as permutations on the set of numbers one through  $n$ .



*Norman, OK, contra dance, December 2014 (Miranda Arana)*

A permutation, put simply, means a reordering of members of a set, so a permutation of the dancers is a function that moves the dancers to other dancers' positions, like two people swapping places (e.g. gents' allemande), a group of four people circularly moving in a full rotation (e.g. circle left), or no one changing position (i.e. the identity permutation). If you combine these functions, adding one small dance step to another, you're composing permutations, which is the operation that defines the algebraic structure known as a permutation group.

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This link to mathematics brings something special to contra dance: it evokes a feeling of connection to the universe at large. Permutation groups themselves are only yet a subset of the set of reflection symmetries, which has applications anywhere symmetry is present: in the structure of a snowflake, in the arrangement of atoms in a molecule, and even in the transpositions and inversions in Bach's Art of Fugue, which are precisely the symmetries of a dodecagon. Math is deeply and richly tied to music and dance, and my knowing that the movement of our bodies in

dance symbolized a greater relationship between elements brought an almost spiritual aspect to my experience of contra dance. While the mechanics of the dance were explainable by the mathematical structures I'd previously come to understand, the experience itself involved so much more: a sense of community, an interaction with people normally distanced, and the exhilarating act of applying these abstract concepts I'd learned to movement in the physical world, with music playing and bodies moving all around me.

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*Our thanks to CDSS member Miranda Arana who sent us Lena's essay. She teaches Introduction to World Music for non-music majors at OU.*