

# Science at St. Kate's Paper Abstract

## Connections between Mathematics and Music: Change Ringing

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Many people have played an instrument in a band, learned piano or have sung. But if one were to ask whether music is connected to mathematics, he or she would get several puzzled looks pondering if it really is rational to try to connect the emotionally charged art of music with the steely logic of mathematics. However, some would wonder why mathematics is considered all cold logic and music all emotion as they would assert that the two are intimately connected. In this project, I investigated the latter's opinion by exploring in detail music's dependency on the games of symmetry, focusing specifically on change ringing.

Change ringing is an art of ringing a set of tuned bells, founded in seventeenth century England which uses all the bells in a church tower in a series of mathematical patterns called changes. The bells are typically large, weighing between 100 and 3600 pounds and are usually hung in rings of 8 to 12. They are rung in rounds, that is, in descending order of pitch, from the high pitched lighter bells to the low pitched heavier bells. Every bell in the tower is rung in these rounds and the order in which they must be rung must never be repeated; there must be constant variation in the order of the rounds.

Although the bells are a type of musical instrument, the change ringing form is related to complicated forms of mathematical patterns of permutations. It is this that makes for interesting mathematics!