Let the function describing the density of particles be . The density per unit volume per unit time is then proportional to the probability to find a particle given by equation . Thus, and obey the same equation. We find this equation by focusing on an individual walker. We also assume that the walker is confined to a cubic lattice making steps along the edges of the lattice.

The probability to find the walker at the site at time is . The walker has six neighboring nodes that it can arrive from to the site each of which have a 1/6 chance to make a step into the node.

Therefore, the following equation is derived:

Rearranging the equation, we get:

We then notice that the equation is in the form of a second order symmetric derivative, and, upon taking the limit, we arrive to the diffusion equation.