The discovery of neutrino oscillations, rewarded with the 2015 nobel prize in physics, showed conclusively that neutrinos have mass and mix non-trivially. Since this discovery a wide range of oscillation experiments have measured parameters of the massive neutrino standard model. In most cases the model reproduces experimental data extremely well. However, intriguing anomalies in short baseline experiments have indicated that the 3-neutrino picture may be incomplete. One hypothetical explanation of the anomalies is that an additional, sterile neutrino exists, with a corresponding heavier mass state mixed into the active neutrino flavors. In this talk I will discuss a search for sterile neutrinos with the IceCube neutrino telescope, a detector made from a billion tons of glacial ice at the South Pole. In the energy range where this experiment is sensitive, sterile neutrinos would introduce MSW resonant oscillations, providing a dramatic experimental signature. I will review the physics of sterile neutrinos and the MSW resonance, before presenting the first experimental results from the IceCube sterile neutrino search.