Much of our current understanding of photosynthetic charge separation has been derived from studies of the bacterial reaction center (BRC) from purple bacteria. I will present two-dimensional electronic spectroscopy (2DES) experiments on the BRC that reveal previously hidden excitonic and vibronic structure. Through analysis of the coherent dynamics of the BRC we assign the upper exciton energy of the “special pair” and identify resonances between a number of key intramolecular pigment vibrations and electronic energy gaps in the BRC. Such resonances have been proposed to play a functional role in photosynthetic energy transfer and charge separation. I will also discuss our recent progress towards implementing fluorescence-detected 2D spectroscopy (FD-2D), which offers high sensitivity and the potential for spatially-resolved and sub-ensemble measurements.