Galaxies live in a range of environments, characterized by their volume density. For example, the densest regions of the Universe are in galaxy clusters, which contain hundreds to thousands of galaxies all in pseudo gravitational virial equilibrium. These dense environments can in turn alter the properties of the galaxies themselves in striking ways via a variety of gravitational and hydrodynamic processes. The result of these processes alter galaxy shapes, their internal dynamics, and shuts off the formation of new stars. I will present work I have been doing to characterize the evolution of galaxies in clusters over the past 10 billion years as a way of understanding how the environment can affect galaxies.

I will describe how we have used extensive multi-wavelength data sets on distant clusters to form a picture in which infalling cluster galaxies likely have their gas supplies cut off, their morphologies transformed, and may even experience epochs of very frequent mergers. I will then describe new results from a large program called Gemini Observations of Galaxies in Rich Environments (GOGREEN) which is the premier spectroscopic survey of distant clusters. With the GOGREEN data, we are finding that the quenching of galaxies in dense environments at high redshift may proceed very differently from that at redshifts less than one, requiring a revision of our thoughts on how environment affects galaxy evolution at large lookback times.