Barlow (1961) proposed one of the most successful theories in neuroscience, which states that sensory neurons should be organized to optimize the information they process with limited energy. This theory has repeatedly been validated in the early visual system by making testable predictions that have been confirmed experimentally. For example, efficient coding explains why retinal ganglion cells (RGCs) have center-surround receptive fields and why firing rates follow a power-law output nonlinearity.

Our lab previously

**Aim 1:** Determine whether retinal ganglion cells process colors information efficiently.

Information in natural images is mostly achromatic, and differences between shades of red and green represent very little of the information. However, how the retina works seems to contradict that principle: Midget cells consist most (80%) of RGCs and encode red/green opponency, while parasol cells, which encode achromatic information, only represent a small fraction (10%) of RGCs. *My working hypothesis is that we can reconcile these two principles and show that encoding visual information with a high proportion of midget cells is efficient.* To do so, I will apply the efficient model previously built by our lab (Jun, Field and Pearson, 2021) to chromatic natural images. Because my preliminary results suggest that having more parasol than midget cells is efficient, I will need to make biologically realistic modifications to the model to replicate previous empirical findings. By doing so, I aim to uncover the minimal conditions that make midget cells the most efficient subtype of RGCs to encode natural images. Such modifications include non-overlapping photoreceptors, increasing the proportion of RGCs relative to photoreceptors, as well as introducing inhibition into the network.

**Aim 2:** Determine the computational benefits of inhibitory interneurons to make encoding more efficient

Amacrine cells are inhibitory interneurons that receive inputs from RGCs and inhibit them in return. These cells are responsible for multiple phenomena, such as contrast gain control and motion selectivity.