The modulation of behavior by internal physiological states is essential for animal survival. Like many other animals, hungry fruit flies exhibit different food searching behaviors. We have identified key olfactory sensory neurons for innate odor preference and discovered that nutrient sensors in these neurons play an important role in appetitive decisions. Our studies indicate that two neuropeptides short neuropeptide F (sNPF) and tachykinin causes presynaptic facilitation and inhibition, respectively, in specific neurons, and the concerted effect controls appetitive behavior in the fruit fly. The DM1 and DM5 glomeruli are genetically hardwired for attraction and aversion behavior, respectively. At low odor concentrations, sNPF sensitizes DM1, while at high odor concentrations tachykinin suppresses activity of DM5. Insulin is a metabolic signal that negatively regulates the expression of the neuropeptide receptor genes to modify neuronal excitability. Thus, starvation does not simply scale up or down global activity in the antennal lobe. Rather, it upregulates activity in certain sensory channels and downregulate it in others towards a concerted modulation of appetitive behaviors.