Goldfish offer an excellent model in which to study immediate behavioral changes in response to rapid steroid fluctuations because changes in steroid levels have been found to affect social behavior rapidly in this species. In the Thompson lab at Bowdoin College, Lord et al. (2009) recently investigated whether testosterone injections could induce rapid changes in the behavioral responses of male goldfish when exposed to female stimuli. Lord et al. (2009) showed that testosterone injections stimulated male approach toward female visual cues, and that an aromatase inhibitor blocked the effects of testosterone. These studies indicated that testosterone elevations can rapidly modulate behavior and identified the biochemical pathway through which this process occurs. It has been suggested that such mechanisms may allow socially induced fluctuation of testosterone to rapidly influence behavior in this species. (Lord et al., 2009).

In female goldfish, chemicals released into the water called pheromones are used as social cues; specifically, pheromones secreted by females elicit behavioral and endocrine changes related to mating in males (Zheng et al, 1997). For example, 4-pregnen-17α, 20β-diol-3-one (17,20βP) is a preovulatory pheromone that is secreted by females into the water several hours before they ovulate, which induces increased concentrations of serum gonadotropin II (GtH II), a hormone that ultimately leads to increased levels of testosterone, as well as the volume of sperm and seminal fluid in male goldfish. Furthermore, Kobayashi et al. (1986) showed that exposure to preovulatory females (and thus, 17,20βP) induced a surge in testosterone levels in male goldfish. The increased testosterone may be the cause of the behavioral changes, thus providing a social context in which testosterone rapidly affects behavior.

As it has been inferred that the presence of 17,20βP secreted by a female goldfish drives the spike in testosterone in males exhibited after exposure to a preovulatory female and as Lord et al. effectively outlined the biochemical mechanism involved in testosterone’s rapid behavioral effects, the current study examined the social context for those effects. I investigated whether exposure to 17,20βP, like injections of testosterone, rapidly influence social approach behavior. Adult male comet goldfish, Carassius auratus, were used to test the behavioral effects in males of exposure to 17,20βP. This experiment determined whether the pheromone would, like testosterone, stimulate approach responses to the visual cues of females. 17,20βP was added to the water in the male goldfish housing and the approach response to the visual cues of a female were measured. Each fish in the experimental group was tested twice, once after exposure to the pheromone and once after an equal volume of fluid not containing 17,20βP was deposited into the tank.

No significant difference was found between the behaviors of the pheromone exposed males and the control fish. The work of a fellow research student, however, suggested an explanation for these negative results, as her research suggested that the goldfish may require the presence of specific wavelengths of UV light in order to correctly identify a potential mate. It is important to note that the lights used during my experimental trials only had a slight UV spike and not a broad emission. Moreover, I have not yet been able to confirm whether the pheromone exposure had the intended effective of increasing testosterone levels in male goldfish. Hormone assays will be performed in the fall in order to determine if testosterone levels were actually increased.

Following my behavioral experiments, I spent the duration of the summer doing a preliminary investigation of GPR-30, a g-protein coupled estrogen receptor, in preparation for my work in the fall, which will be to localize the receptor in the goldfish brain using either insitu hybridization or immunohistochemistry. References