

Title: Behavioral and Neural Mechanisms of Olfactory Learning

Background: Insects and mammals have remarkably similar senses of smell. Most insects have to use their sense of smell to solve ecological problems that are similar to problems faced by mammals. For example, honey bees have to learn about the association of floral odors with carbohydrate (nectar) and protein (pollen) rewards that honeybees need for survival. Yet the association can change from hour to hour and day to day, which is well within the 10-20 day foraging lifespan of a bee. Therefore, bees cannot come into the world automatically ³knowing² which flowers they need to visit. Instead, honey bees must be prepared to rapidly learn the associations and then forget them when they are no longer relevant.

Perhaps because of the similar ecological contexts, insects and mammals have evolved a similar genetic and physiological means for detecting, discriminating and learning about odors. This similarity extends into several layers of processing in the brain. For this reason insects such as honey bees can be used as basic research models for understanding the neural and molecular bases that underlie the sense of smell.

Objectives: The projects involve studying odor-guided behavior in honeybees in support of two NIH-funded research projects. The first task for students will be to learn how to condition honeybees to respond to floral odors. These bees will then be tested to evaluate how well they detect these odors and discriminate them from other odors. Subsequent behavioral tests will involve analysis of behavioral responses both in real time and on videotape. These data will be collated for presentation during meetings and for publication, and statistical analyses will be performed to evaluate specific hypotheses. Further work could take either of two paths depending on the student's interest. One path would involve molecular and/or pharmacological treatment of brain regions about which there are specific hypotheses as to how those regions are involved in olfactory behaviors. The other path would involve field studies of learning in freely flying bees.

This work will involve regular participation in laboratory meetings, interactions with other laboratory personnel, and regular (weekly or biweekly) meetings with the research supervisor.

Qualifications: Students should have completed initial coursework in Biology and Chemistry. They should also have remaining at least one academic year, and preferably two or three, for work on this project. The amount of time per week will depend on how long they have been involved in this project and the need to balance research with course loads.

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