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Drosophila Odorant Receptors Identified

Image Title: - John Kachik

The discovery of odor-detecting receptors in the fruit fly *Drosophila* may help scientists better understand how insectsand eventually other animalsprocess olfactory information and how odors influence insect behavior.

The group, led by HHMI investigator Richard Axel at Columbia University, reported its findings in the March 5, 1999, issue of the journal *Cell*. Last week, an independent research team from Yale University published similar findings in the journal *Neuron.*

Researchers had identified odor receptors in mammals years ago, so one might ask, Why bother to search for similar sensors in fruit flies? Axel's group and others had good reasonfruit fly genes are easy to manipulate, and *Drosophila* is an ideal model for studying the function of genes. Moreover, *Drosophila's* sophisticated scent-sniffing organs and large repertoire of recognized aromas make it well suited for studies of neural pathways of odor recognition.

Fruit flies gather information about their surroundings and social interactions from scents, and research has shown that odors exert a strong influence on fruit fly behavior. Certain odors, for example, play a crucial role in fruit fly mating behavior. By studying how fruit flies process olfactory cues and subsequently translate those cues into behavioral responses, Axel's group hopes to gain a better grasp on the neural circuitry involved in these complex activities.

To find *Drosophila's* odor receptors, Axel's team combined molecular biology and genomics. First, the researchers probed for genes expressed exclusively in the fly's olfactory organs, the antennae and a baton-shaped bulge on the head called the maxillary palp. The scientists narrowed their search to a small subset of genes. Further testing showed that a gene called *dor104* is active only in the sensory nerve cells of the olfactory organs, implicating it in odor detection.

Once they had *dor104*, the researchers compared its sequence to those in a database containing all of the *Drosophila* genome sequenced to datesome 15 percent of *Drosophila*'s total genome. Using a sophisticated sequence-matching algorithm, this search identified 11 related genes that encode *Drosophila* odor receptors.

"Our success was in large part dependent on the large amount of *Drosophila* sequence that was available from researchers at the University of California at Berkeley," Axel says. He adds, though, that the 12 genes discovered so far are "only a small part of a larger puzzle." Since the known genes were gleaned from a search of only 10 percent of the *Drosophila* genome, Axel reasons that 100-200 genes are probably involved in odor recognition.

Now that they've found the odorant receptor genes in *Drosophila*, Axel's group plans to use them to study how odors influence behavior. "We're ultimately after a mechanistic link between specific odors and specific behaviors," Axel says. By identifying the receptors activated by odors that induce mating behavior, for example, the researchers may be able to map the neural circuitry of this behavior.

The findings may have more practical applications. One obvious application, Axel says, is the development of new insecticides. By pinning down the scents involved in the mating behavior of crop-eating insects, researchers could then devise ways of blocking the receptors for these odors, thus halting the insects' reproduction.

For now, Axel's group plans to focus on how neurons respond to odors. "We'd like to know how the *Drosophila* brain knows which receptors have been activated by a particular odor," Axel says. "Once we understand how the brain knows what the antennae are smelling, we can then ask how that knowledge can explain behavior. Our current work is merely the first step in this endeavor."