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Editorial

Recent developments in olfaction

Virtually all animal species have evolved sophisticated olfactory systems to analyze the chemical world and extract essential information from the environment. How this astounding feat is accomplished by the nose and the brain is an intriguing question with a long history in science. A major breakthrough has been made in 1991, when Linda Buck and Richard Axel discovered a large gene superfamily encoding G-protein-coupled, seven-transmembrane odorant receptor proteins. These and further findings were not only rewarded with the Nobel prize for Buck and Axel in 2004 but also kindled the interest of a wide range of scientists, seniors and students alike. Today, olfaction is a highly dynamic field encompassing disciplines from chemistry to behavioral sciences. Because odorant receptors and associated cell biological issues have been the topic of many excellent reviews, this issue of *Seminars in Cell and Developmental Biology* concentrates on areas beyond the nose, with an emphasis on the development of olfactory circuits and the processing of olfactory information in the brain.

Olfactory sensory neurons project from the nose to the first processing center in the brain, the olfactory bulb, where they terminate in anatomically discrete microcircuits, the glomeruli. *Strotmann* and *Breer* review current knowledge about the mechanisms by which axons of olfactory sensory neurons navigate to the olfactory bulb and find their appropriate target glomerulus based on the odorant receptor they express. *Wachowiak* and *Shipley* discuss the functions of glomeruli in representating and processing odor information as it enters the brain. Further aspects of the olfactory bulb are discussed in four other articles: *Egger* and *Urban* focus on inhibitory interneurons and the way they are thought to shape odor representations in the olfactory bulb. *Kay* and *Stopfer* take a computational viewpoint and compare the vertebrate olfactory bulb to the analogous structure in insects, the antennal lobe. *Lledo* and *Lagier* review synchronized firing in the olfactory bulb and the underlying cellular mechanisms, an issue that also comes up in other articles. In addition, *Lledo* and *Lagier* discuss the continuous turnover of olfactory bulb interneurons during adult life and its functional implications. *Rinberg* and *Gelperin* then review the long history of experiments in the olfactory bulb of awake animals, reminding us of the need to study intact systems. Information is conveyed from the olfactory bulb to a variety of higher brain areas, as reviewed by *Wilson et al*. These authors also summarize current knowledge about the integration of odor information by neurons in the most prominent olfactory bulb target, the piriform cortex. Finally, *Boehm* discusses exciting recent results from the vomeronasal system, a second olfactory pathway in terrestrial vertebrates. This article covers the full range of topics from molecular biology to behavior and explains why traditional views of the vomeronasal system are now being challenged. Together, the articles in this issue intend to elucidate progress at all levels of the olfactory pathway and illustrate why olfaction has become such a popular multidisciplinary field.

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