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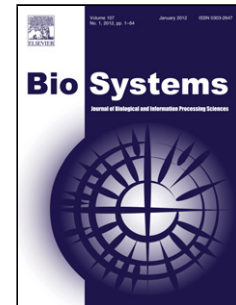
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Fundamental principles of the olfactory code

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Abstract

Sensory coding represents a basic principle of all phyla in nature: species attempt to perceive their natural surroundings and to make sense of them. Ultimately, sensory coding is the only way to allow a species to make the kinds of crucial decisions that lead to a behavioral response. In this manner, animals are able to detect numerous parameters, ranging from temperature and humidity to light and sound to volatile or non-volatile chemicals. Most of these environmental cues represent a clearly defined stimulus array that can be described along a single physical parameter, such as wavelength or frequency; odorants, in contrast, cannot. The odor space encompasses an enormous and nearly infinite number of diverse stimuli that cannot be classified according to their positions along a single dimension. Hence, the olfactory system has to encode and translate the vast odor array into an accurate neural map in the brain. In this review, we will outline the relevant steps of the olfactory code and describe its progress along the olfactory pathway, i.e., from the peripheral olfactory organs to the first olfactory center in the brain and then to the higher processing areas where the odor perception takes place, enabling an organism to make odor-guided decisions. We will focus mainly on studies from the vinegar fly *Drosophila melanogaster*, but we will also indicate similarities to and differences from the olfactory system of other invertebrate species as well as of the vertebrate world.

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