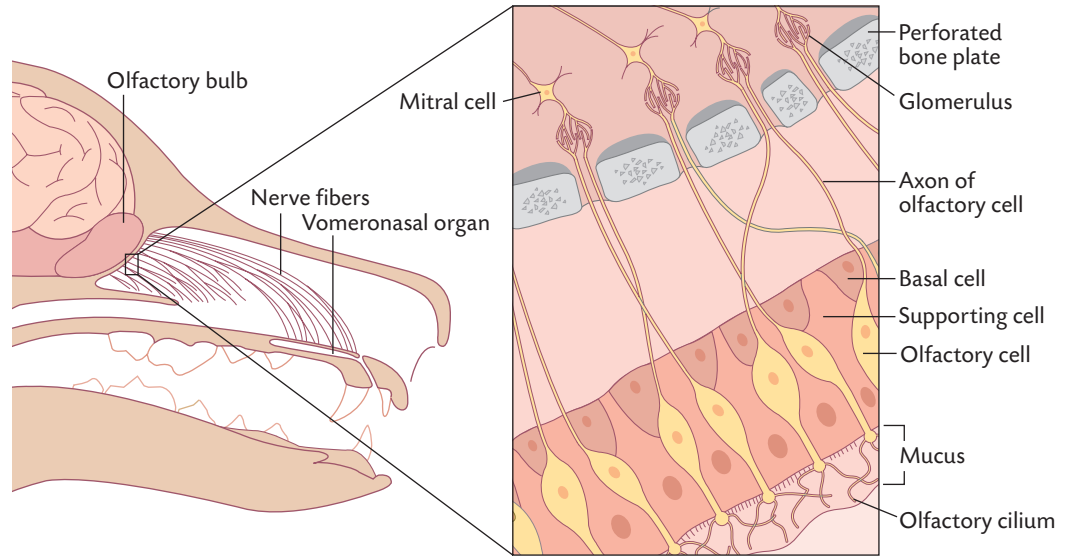


**Figure 5.12** The location of olfactory cells in the nasal cavity in a dog. Olfactory cells are primary sensory cells equipped with axons forming synapses with neurons (mitral cells) in the olfactory lobe. A large number of olfactory cells form synapses with a single mitral cell in a tuft of nerve endings and dendrites called a glomerulus. The vomeronasal organ is located ventrally in the nasal septum in the front of the nasal cavity. The organ communicates with the oral cavity via the incisive duct.



with 10–20 long cilia, which provide the cells with a large contact surface with the surroundings. The membranes of these cilia contain the receptor molecules that bind the odor molecules. The cilia extend into a layer of mucus produced by special glands in the epithelium, and the odor molecules must first be dissolved in this mucous layer in order to come into contact with the receptor molecules. The glands produce mucus continuously, and the mucous layer slides slowly over the olfactory epithelium and is drained into the nasopharynx. This keeps the epithelium moist and clean. It also prevents accumulation of odor molecules in the mucous layer, facilitating the response of the olfactory cells to changes in composition or concentration of odor molecules in the inhaled air.

The unmyelinated axons of olfactory cells conduct nerve impulses to synapses with neurons called mitral cells in the olfactory bulb, which is a part of the cerebrum (Fig. 5.12). The axons are gathered in a series of bundles extending from the nasal cavity to the olfactory lobe through tiny holes in the bony plate separating the olfactory mucosa from the brain. These nerve fibers represent the olfactory nerve (cranial nerve I). On average, each mitral cell forms synapses with about 1000 olfactory cells. The olfactory cells are the most exposed of the body's neurons, and are also the only neurons that are replaced by mitosis after birth. The lifespan of olfactory cells is about 2 months, and dead cells are replaced by mitosis and differentiation of basal cells in the olfactory epithelium.

### Stimulation of olfactory cells

Air has primarily three passageways through the nasal cavity of a mammal. The upper passage leads the air above the heat exchanger and to the olfactory epithelium, and then further on to the nasopharynx. The middle passage leads the air through the heat exchanger and to the anterior part of the olfactory epithelium, before the air enters the nasopharynx. The lowest passage is a shortcut beneath the heat exchanger leading directly to the nasopharynx. During breathing at rest, the air flows mainly through the two lower passages, and only a very small portion of the inhaled air reaches the olfactory epithelium (Fig. 5.13).

When an animal sniffs, much of the air passes through the upper passageway, which leads to the olfactory epithelium. During sniffing, the airflow through the nasal cavity becomes turbulent, which increases the proportion of inhaled air coming in direct contact with the olfactory epithelium. Exhalation through the nose occurs mainly through the lower passage. When a dog seeks scents on the ground, for instance when tracking, it might sniff up to 200 times per min. However, when a running dog seeks odor substances in the air, it exhales through the mouth. The head is then turned towards the wind and there is a continual inward flow of air through the nose for long periods of time. The ability to maintain a continuous inward airflow through the nose even during exhalation through the mouth is due to the high speed of the exhaled air. When the speed of flow of a gas or liquid increases, the pressure in the flow decreases (the

Each mitral cell forms synapses with about 1000 olfactory cells

Olfactory cells live for about 2 months before they are replaced

Sniffing increases the proportion of inhaled air reaching the olfactory epithelium