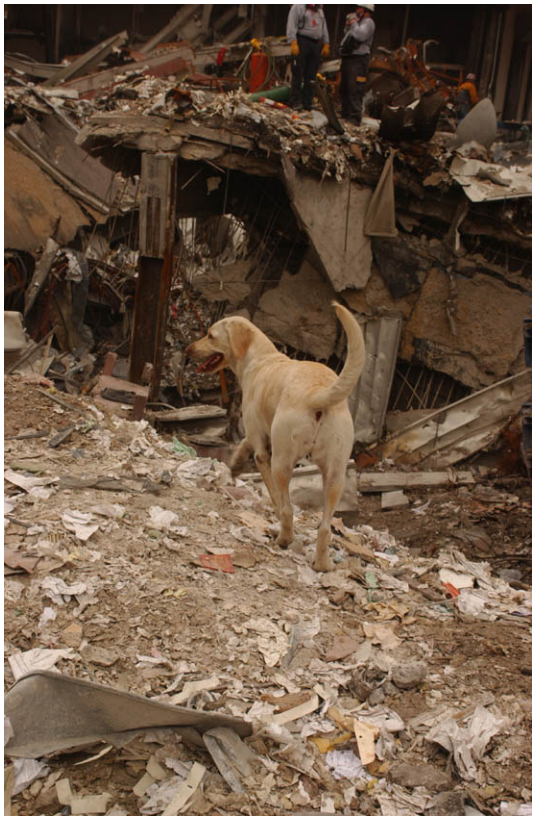
ALABAMA A&M AND AUBURN UNIVERSITIES

UNP-0066

The Dog's Sense of Smell

Introduction

Olfaction, the act or process of smelling, is a dog's primary special sense. A dog's sense of smell is said to be a thousand times more sensitive than that of humans. In fact, a dog has more than 220 million olfactory receptors in its nose, while humans have only 5 million. Because of this keen sense of smell, dogs are able to locate everything from forensic cadaver material to disaster survivors as demonstrated during the terrorist attack on the World Trade Center on September 11, 2001.



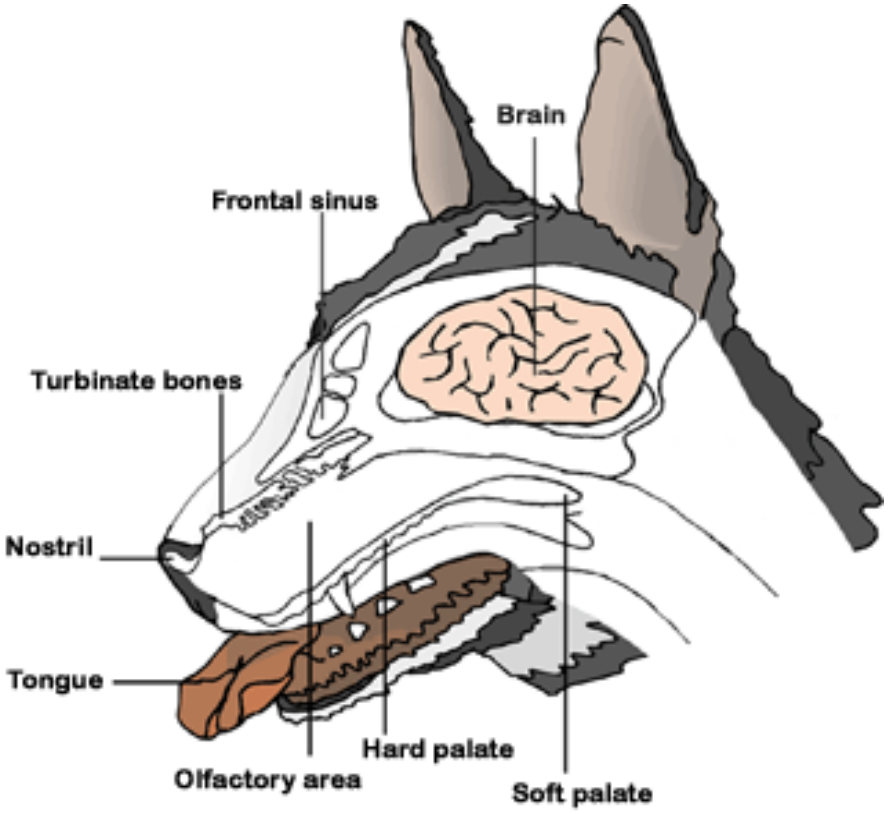
Member of the Federal Emergency Management Agency Task Force searching for victims of the World Trade Center attack. (Photo courtesy of FEMA)

Anatomy

A dog's nose consists of a pair of nostrils (nares) for inhaling air and odors and a nasal cavity. The olfactory receptor cells in a dog's nose extend throughout the entire layer of specialized olfactory epithelium found on the ethmo-turbinate bones of the nasal cavity. The olfactory portion of the nasal mucous membrane contains a rich supply of olfactory nerves that ultimately connect with the highly developed olfactory lobe in the dog's brain.

Dogs possess an additional olfactory chamber called the vomeronasal organ that also contains olfactory epithelium. The vomeronasal organ, known as Jacobson's organ, consists of a pair of elongated, fluid-filled sacs that open into either the mouth or the nose. It is located above the roof of the mouth and behind the upper incisors.

Interestingly, the olfactory receptors in the nasal cavity are anatomically distinct from those in the vomeronasal organ. Each receptor neuron (nerve cell) in the olfactory epithelium of the nasal cavity has a dendrite that ends in a knob with several thin cilia covered by mucus. Receptor neurons in the vomeronasal organ typically lack cilia but have microvilli on the cell surface.



Anatomy of a dog's nose.

Physiology

A dog's nose is normally cool and moist. The moisture secreted by mucous glands in the nasal cavity captures and dissolves molecules in the air and brings them into contact with the specialized olfactory epithelium inside the nose.

Dogs use sniffing to maximize detection of odors. The sniff is actually a disruption of the normal breathing pattern. Sniffing is accomplished through a series of rapid, short inhalations and exhalations. A bony subethmoidal shelf, which is found below the ethmoturbinate bones of the nasal cavity, forces inhaled air into the olfactory epithelium. Washing out of the region upon exhalation does not occur due to the nasal pocket created by the bony subethmoidal shelf. The nasal pocket permits the odor molecules that are unrecognizable in a single sniff to accumulate and interact with olfactory receptors. Odor molecules in the olfactory epithelium of the nasal cavity are absorbed into the mucous layer and diffuse to the cilia of receptor neurons. This interaction generates nerve impulses that are transmitted by the olfactory nerves to the dog's brain, which has a well-developed olfactory lobe. This allows the dog to recognize a scent and follow a trail.

Olfactory receptor cells in the vomeronasal organ also send impulses to the region of the hypothalamus associated with sexual and social behaviors. This organ is believed to be important in the detection of pheromones (body scents). This theory could account for the dog's ability to identify and recognize other animals and people.

Utility

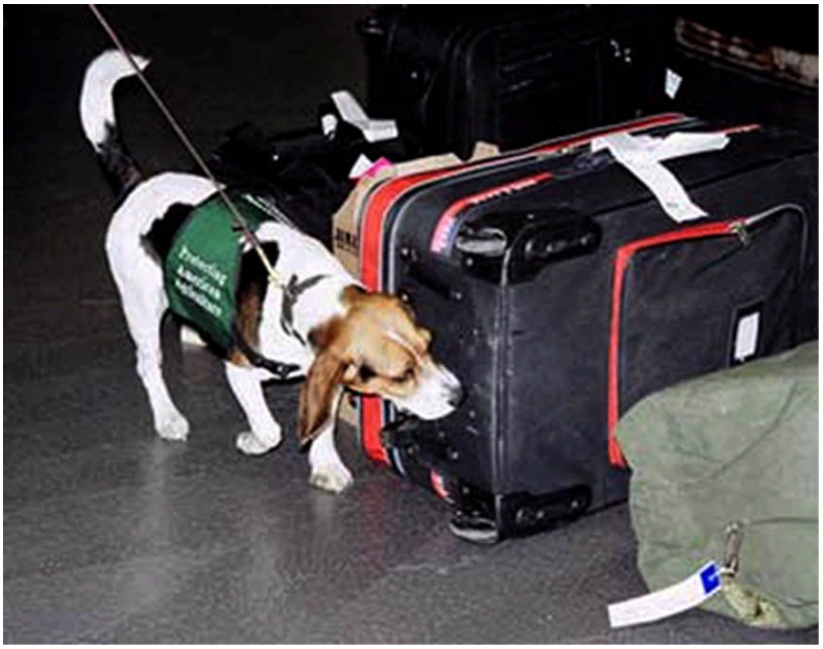
Today, people use a dog's keen sense of smell in many ways. Federal, state, and local government agencies employ specially trained dogs in search and rescue missions and in the detection of narcotics and contraband agriculture products. The Federal Emergency Management Agency has national dog-handler teams that respond to disasters worldwide. State and local law enforcement agencies in the United States (U.S.) have canine units trained to detect drugs and search for lost individuals, homicide victims, and forensic cadaver materials.

U.S. Customs and Border Protection has more than 800 canine teams that work with the U.S. Department of Homeland Security to combat terrorist threats, stop the flow of illegal narcotics, and detect unreported currency, concealed humans, or smuggled agriculture products. Its Canine Enforcement Program (CEP) uses a variety of dogs including Labrador retrievers, golden retrievers, German

shepherds, Belgian Malinois, and many mixed breeds.

The CEP uses beagles to detect agriculture contraband. The passively trained Beagle Brigade dogs detect prohibited fruits, plants, and meats in baggage and vehicles of international travelers as they go through Federal Inspection Service areas. Beagle Brigade teams work at several major border-crossing stations in the United States as well as many international airports that are ports of entry into this country.

Medical tests have recently shown that specially trained dogs are capable of detecting certain types of tumors in humans.



Member of the U.S. Customs & Border Protection Beagle Brigade inspecting luggage for agriculture contraband. (Photo courtesy of Customs & Border Protection)

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Special thanks to **Jean Hall Dwyer,** *Extension Communications Specialist,* for the drawing "Anatomy of a dog's nose."

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Revised February 2016; UNP-0066

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