Sniff a Snack

Exhibit message

Wolves have a powerful sense of smell that they use to track prey.

Quick fact

Humans use the dog's excellent sense of smell to sniff out bombs, illegal cargo and people trapped in rubble.

It has been reported anecdotally that several dogs have:

1. sniffed out human skin cancer/melanoma cells or
2. notified their owners of upcoming epileptic fits by paying constant attention to their owners, or acting in an unusual way.

Scientists are unsure whether dogs can detect these things through smell, human body language or electrosensory changes.

Graphic panel text

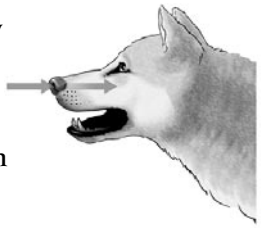
Dogs have a better sense of smell than humans, because:

- they have one hundred times more receptors to detect smells and
- the area of their brain controlling smell (olfaction) is fifteen times larger.

Predators like wolves sweep their heads side to side to pick up a chemical scent.

Scents become harder to detect the longer they are exposed to wind, water and sunlight.

The dog's nose shape may also help. When a dog exhales, air is pushed through side slits so it flows back and away from incoming scented air.



Want to know more about wolves and olfaction?

Olfaction (the sense of smell) is important, but not essential to wolf survival.

Many animals have an excellent sense of smell. While it is commonly reported in Nature documentaries that polar bears can smell prey many kilometres away, this has not been measured by scientists. The silkworm moth appears to have the most sensitive sense of smell, being able to detect female moths more than 10 kilometres away.

Wolves use sight, hearing and their sense of smell to track prey, find a mate and check out their surroundings for competitors.

In wolves (and humans), the nose is lined with olfactory receptors or nerves. These nerves are covered by a layer of mucous. Scent molecules dissolve in the mucous and bond with receptors on the nerves. These receptors will bond with a few different molecules that match the shape of the receptor.

Once the scent molecules bond with particular receptors, it triggers an electric impulse in the olfactory nerve. This impulse travels along the nerve to the olfactory bulb in the brain. This is where the smell is interpreted and the human or dog knows what the smell is.

Dogs (and other mammals) also have a cigar-shaped organ in the roof of their mouth called the vomeronasal organ. This organ seems to pick up scent called pheromones excreted by other dogs, so they can recognise other dogs and potential mates.

The ability of animals to detect scent also depends on temperature, wind direction and dryness. If the temperature is cool and the predator is upwind from a scent, they will be less able to detect any scent molecules. Water also washes away or dilutes scent, making it difficult to detect.

When a dog sniffs, it changes the shape of its nose to draw in large volumes of air. When a dog exhales, it moves its nose so air is deflected out and back through slits on the side. The exhaled air flows away from the smell and prevents any incoming scent mixing with exhaled air. This also sets up an air current that pulls air across the scent trail and draws scent molecules into the air.

Extra for experts

Research on German shepherds shows that dogs go through three phases to search, decide on and follow a scent trail. During all phases, the dogs were measured taking six sniffs per second (6 Hz), but the number of sniffs between each breath (number of sniffs per period) became longer or shorter.

1. Search phase

Dogs move quickly, but sniff less between breaths to pick up any scent molecules.

2. Deciding phase

This where dogs have found a scent and need to work out which direction the trail should be followed (i.e., towards the freshest scent). Dogs take fewer steps and more sniffs between breaths after detecting a track. This helps them compare scent concentration and decide which direction they should be following.

3.Tracking phase

The dog has decided which direction it will follow and speeds up the number of steps they take but reduce the number of sniffs between each breath (similar to the sniff rate during the search phase).

Wolves mostly hunt large prey such as deer, moose and elk, but they also eat hare, beaver, badger, dog, pig, cattle, birds, small rodents, berries, insects, fishes… even goose eggs! Scientists study the poo or scats of wolves to work out what they have eaten. If the scats contain teeth, bones, feathers, and scales or hair, these can be weighed and classified to show what the wolf ate.

Sometimes wolf packs are seasonal in the prey that they hunt, with some packs hunting hare more during summer months. The number of wolves in a pack varies from 2 up to 23 (the largest number of wolves recorded in a pack). Pack size and prey size are not tightly related.

Although wolves are thought to greatly reduce the number of deer, bison and elk in a forest, human hunters actually kill more of these prey animals. In Poland, wolves annually removed up to:

- 105 red deer
- 38 wild boar
- 25 roe deer and
- 2 moose per 100 km^2.

Human hunters annually harvested up to:

- 140 red deer
- 142 wild boar
- 114 roe deer
- 7 moose per 100 km^2.

Olfactory receptor genes in the dog are found on the same chromosomes as human chromosomes 7, 11, and 19, with some changes in the number of genes. This is useful for studying the evolution of mammals. This genetic similarity is evidence for the evolutionary divergence of humans and other carnivores 60–100 million years ago.

Further information

Natural History Museum of Los Angeles County Dogs Experience the World Nose-first http://www.nhm.org/exhibitions/dogs/formfunction/smell.html

Sniffing danger. Mark Schrope. *New Scientist* 26 August 2000

The ChemoReception Web http://md1.csa.com/crw/abstract.html

Dogs—it's a stinky job, but someone's got to do it! http://www.exn.ca/dogs/nose.cfm

Smell (Olfaction) http://www.inb.uni-luebeck.de/~madany/diplom/diplomarbeit/node8.html

Olfaction—A Review http://www.leffingwell.com/olfaction.htm

The Vomeronasal Organ (Mammalian) http://athena.neuro.fsu.edu/research/vomeronasal/

Aerodynamic Sampling for Landmine Detection http://www.mne.psu.edu/psgdl/Aerosampling.pdf

Gary S. Settles, Douglas A. Kester Gas Dynamics Lab, Mechanical and Nuclear Engineering Dept., Penn State University. SPIE Aerosense, April 2001. Vol 4394 (108).

CANINE DETECTION CAPABILITIES: OPERATIONAL IMPLICATIONS OF RECENT R & D FINDINGS J. M. Johnston, Institute for Biological Detection Systems Auburn University June 1999

http://www.vetmed.auburn.edu/cdri/pdf/k-9_det_capabilities.pdf

The Olfactory System: Anatomy and Physiology http://www.macalester.edu/~psych/whathap/UBNRP/Smell/nasal.html

Dogs have a nose for it http://www.eurekalert.org/pub_releases/2000-08/NS-Dhan-2208100.php

Another sniffer dog for the clinic? John Church, Hywell Williams. 15 September 2001. *The Lancet.* Vol 358.

Wolf Pack Territory Marking in the Bialowieza Primeval Forest (Poland). Behaviour. K. Zub, J. Theuerkauf, W. Jedrzejewski, B. Jedrzejewska, K. Schmidt, R. Kowalczyk. Vol 140 (5): 635–648.

Diet composition of wolves Canis lupus in east-central Finland. Gade-Jorgensen Inge, Stagegaard Rie. *Acta Theriologica.* [print] December, 2000. Vol 45 (4): 537–547.

Observer bias and analysis of gray wolf diets from scats. Spaulding Rick, Krausman Paul R, Ballard Warren B. *Wildlife Society Bulletin.* [print] Winter, 2000. Vol 28 (4): 947–950.

Dietary overlap between wolves and coyotes in northwestern Montana. Arjo Wendy M [a]; Pletscher Daniel H; Ream Robert R. *Journal of Mammalogy.* August, 2002. Vol 83: 754–766.

A record large Wolf, Canis lupus, pack in Minnesota. Mech L David. *Canadian Field-Naturalist.* [print] July–September, 2000. Vol 14 (3): 504–505.

Observer bias and analysis of gray wolf diets from scats. Spaulding Rick [a]; Krausman Paul R; Ballard Warren B. *Wildlife Society Bulletin.* [print] Winter, 2000. Vol 28 (4): 947–950.

Wolf Pack Size and Food Acquisition. Paul A. Schmidt, L. David Mech. Oct 1997. *American Naturalist.* Vol 150 (4): 513–517.

Coyote senses in predation: environmental influences on their relative use. Wells, Michael C. 1978. *Behavioural Processes,* Vol 3: 149–158.