

Scratch and Sniff

Help! Danger! Stay away! These are all messages that can be sent through pheromones- silent sirens used by animals to transmit messages of all kinds. Insects, plants, and mammals use chemicals in their bodies called pheromones that, when released, react with the bodily chemicals in other organisms, creating a message board in the air. The word pheromone comes from the combination of the Greek words *pherein*, meaning to transfer or carry, and *hormōn*, meaning to excite or stimulate (Wyatt). Contrary to hormones, which occur inside an organism, pheromones occur outside an organism and react with other organisms (Wyatt). Several types of pheromones exist including alarm pheromones, food trail pheromones, territorial pheromones, and sex pheromones. The form of chemical communication has been found in insects, mammals, and plants. Scientists and researchers have discovered uses of pheromones outside of their natural roles.

WHAT ARE PHEROMONES?

Pheromones are chemicals in an organism's body that are used to transmit messages and signals to members of the same species and were originally defined as "substances secreted to the outside by an individual and received by a second individual of the same species" (Wyatt). Pheromones are found in insect, plant, and mammal species. Figure 1 shows how some of the same chemicals are found in both insects and mammals, but double or triple as different types pheromones depending on the genus. Studies show that pheromones are present in humans, but not much is known about them. The majority of pheromones have two or more chemicals that when combined only in certain proportions at a certain time,

Compound	Function	Family	Genus
Benzaldehyde	Trail pheromone	Bee, Apidae	<i>Trigona</i>
	Defence pheromone	Ant, Formicidae	<i>Veromessor</i>
	Male sex pheromone	Moth, Amphipyridae	<i>Pseudaletia</i>
2-Tridecanone	Alarm pheromone	Ant, Formicidae	<i>Acanthomyops</i>
	Defence pheromone	Termite, Rhinotermitidae	<i>Schedorhinotermes</i>
Dehydro-exo-brevicomin	Male sex pheromone	Mammal	Mouse, <i>Mus</i>
Exo-brevicomin	Aggregation pheromone	Insect	Bark beetle, <i>Dendroctonus</i>
(Z)-7-Dodecen-1-yl acetate	Female sex pheromone	Mammal	Asian elephant <i>Elephas maximus</i>
		Insect	140 species of moth (as one component of a multi-component pheromone)

Figure 1: Several types of chemical compounds cause the same pheromones in different animals or different pheromones in different animals.

become biologically active. Animals of like species use sensory organs to receive pheromones emitted by each other. Pheromones can be used to transmit signals about danger, a food trail, territory, and sex. Some pheromones, known as releaser pheromones, result in an immediate response. Others, primer pheromones, have a more gradual response (Jacob).

ALARM PHEROMONES

An alarm pheromone is released by an animal that feels threatened or is under attack and can tell other animals to flee or fight back. This type of pheromone has been discovered in bees and aphids. The chemicals in different pheromones vary greatly from type of pheromone and differ amongst species. The adult leaf footed bug has an alarm pheromone that consists of hexyl acetate, hexanol, hexanal, and hexanoic acid (Leal). In bees, fighting is caused by a pheromone consisting of Benzyl acetate. But flight behavior is signaled by a pheromone with 1- butanol, 1- octanol, and hexyl acetate (Leal).

Alarm pheromones are released by some plants that cause surrounding plants to produce a polyphenol called tannin when animals are grazing on the plants (“Pheromone” [Wikipedia](#)). When a hungry herbivore is near, the plant being grazed upon releases the alarm pheromone, which triggers the surrounding plants of the same species to release tannin. This bitter substance repels the animal away from the previously appetizing plants (“Tannin” [Wikipedia](#)). There is no evidence of alarm pheromones in humans, but research continues in this area.

FOOD TRAIL PHEROMONES

Some are perplexed at an ant colonies’ ability to maintain a line between a food source and a nest. Ants, along with other social insects, use a non-volatile pheromone to mark the trail (“Pheromone” [Wikipedia](#)). In the case of ants, this trail of “bread crumbs” is made of various types of hydrocarbons. Hydrocarbons are and compounds containing only hydrogen and carbon (“Hydrocarbon” [Wikipedia](#)). An initial few ants find a source of food and mark the trail on the way back to the nest. The chemical trail that has been left behind evaporates quickly, and therefore must be restored quickly by other ants that are to follow the trail. Once the food source is depleted, some ants release another pheromone to deter ants from following a trail that leads to a dead end. Autotrophic plants have no need for food trail pheromones since they are organisms that produce their own food. Although humans are heterotrophic, the human brain has developed past the need for a food trail pheromone in the human body.

TERRITORIAL PHEROMONES

When dogs urinate in public places, they are doing more than relieving themselves. A territorial pheromone is contained in canine urine. They release this pheromone along the borders of their territories to tell other dogs to stay away. The territorial pheromone is also common in felines. They also release territorial pheromones through urine. Also, when a cat rubs its face or body against an owner, it emits a facial pheromone. This pheromone has a calming effect on the cat and gives it a sense of security. It is also another way the cat marks its territory (Wolff). Eepideictic pheromones are similar to territorial pheromones, but are only present in female insects and released only in the places that female insects have laid their eggs (“Pheromone” [Wikipedia](#)). Neither plants nor humans contain territorial pheromones.

SEX PHEROMONES

The most widely known pheromones are those pertaining to mating. Sex pheromones were among the first discovered when bombykol, a sex pheromone in female silk moths, was synthesized by scientists in 1959. These pheromones can indicate many things, such as the availability of an organism of the opposite sex, or the arousal of the opposite sex. These types of pheromones are usually released by a

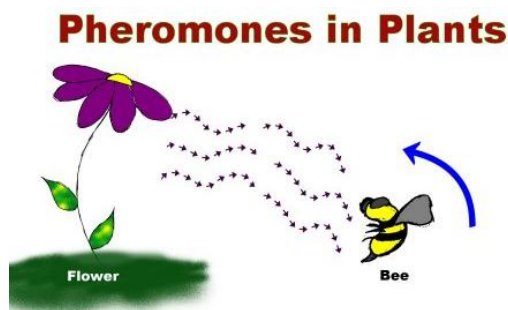


Figure 2: This plant is releasing what the bee thinks are female bee pheromones.

female to attract a male. Lepidopterans, which include butterflies and moths, emit sex pheromones that can be detected up to 10 kilometers away by other lepidopteron of the same species (“Pheromone” [Wikipedia](#)). In an effort to attract more male bees for pollination, about

50% of orchid species (Bernklau) have been found to imitate female bee pheromones as shown in Figure 2.

The chemicals that the plant releases are similar enough to the sex pheromones of female bees that a male bee will get closer to the plant for further examination. In the midst of this exploration, “pollinaria are inadvertently attached to the head or abdomen of the male insect that then pollinates the next flower that he visits.” (Bernklau)

Animals also have aggression pheromones, which are similar to sex pheromones, in that they attract members of the opposite sex, but they can also attract members of the same sex. In addition, many male organisms emit these pheromones to warn other males to stay away from their mate.

UNCLASSIFIED PHEROMONES

Bees are responsible for producing a few unclassified pheromones. When one pheromone, Nasonov, is released, it is almost as if a bee is saying, "Right Here!" This pheromone transmits a scent to signal returning bees to the hive. It is used at the entrance of the hive and is also left on flowers to signal which flowers have nectar. Nasonov, also called Nasonov, is made up of geraniol, nerolic acid, citral and geranic acid, among other terpenoids.

The queen bee also releases a slightly altered sex pheromone. Not only does the Queen Mandibular Pheromone serve as an attractant for the drone bees, but it also stifles the reproductive systems of the other female worker bees in the hive. The QMP ensures that the queen is the only reproductive female in the hive or colony. Chemicals in QMP include 9-oxodec-(E)-2-enoic acid, enantiomers of 9-hydroxydec-(E)-2-enoic acid, methyl *para*-hydroxybenzoate and 2-(4-hydroxy-3-methoxyphenyl) ethanol ("The Wonder Chemical").

Studies show evidence of human pheromones, particularly in females. Many have heard that when a group of females live together for extended periods of time, their menstrual cycles begin to occur simultaneously. In 1971 Martha McClintock, a researcher from Harvard University, tested this concept. After her observation that women living in college dormitory arrived with scattered menstrual cycles but left with the same menstrual cycles as others, she tested the theory on female rats. McClintock released chemical signals to the rats that shortened their estrous cycles and others that lengthened them. With this experiment, it is believed that the same can be applied to human females. It is believed that human females release pheromones upon that start of their menstrual cycles that could effect the time of occurrence and length of the menstrual cycles of other women. The concept of pheromones in humans is controversial and still researched in depth. There is limited research on the pheromones in plants, but the few pheromones that have been found were able be classified with other pheromones existent in mammals and insects.

Pheromones are a major form of communication for insects and mammals, but also exist in plants and humans. Insects, plants, and mammals all have alarm and sex pheromones. Territorial pheromones are limited to insects and mammals. Food trail pheromones are found in insects alone. Humans contain pheromones that are still being studied and not yet classified. Insect also have some unclassified pheromones. Though the chemicals and purposes greatly vary from pheromone to pheromone, insects,

plants, and mammals (humans included), all share the same thing- chemical communication through pheromones.

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IMAGES

Figure 1

"Table 1.1." Chart. Pheromones and Animal Behaviour: communication by smell and taste. By Tristram D. Wyatt. Cambridge, UK: Cambridge UP, 2003. 5. Cambridge University Press. Cambridge U. 7 Dec. 2006 <http://assets.cambridge.org/052148/068X/excerpt/052148068X_excerpt.pdf>

Figure 2

"Pheromones in Plants." Chart. Skin Biology. 7 Dec. 2006 <<http://www.calypsos-oil.com/ScienceOfBodyPerfumes.html>>.