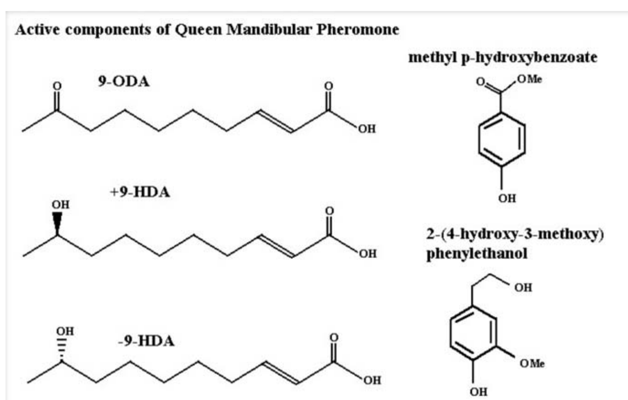
scent

From the earliest days of unicellular life, ability to detect and identify specific chemicals in the world outside the cell membrane has been vital to survival. *Chemotaxis*, sensing a certain compound and moving along its concentration gradient, allows a one-cell organism to find food and to avoid danger. Billions of years later, as the biosphere unfolded, diverse multicellular organisms *organized* groups of cells - specially differentiated to detect specific outside chemicals – into sense organs. *They could smell*.

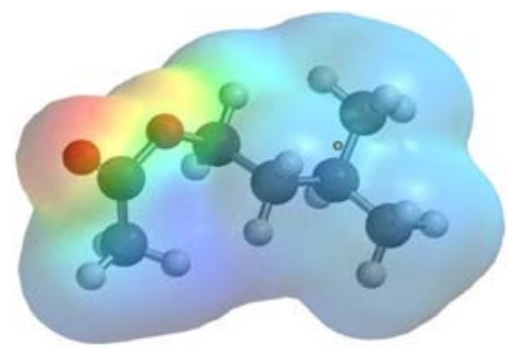
In humans, the primal state of the sense of smell is right there in our anatomy**:** neurons extend directly from the frontal olfactory lobe of our brains and actually touch moistened air. We can't easily see this, even though it's right in front of us in our nasal membranes. We are able to detect single airborne molecules with such specificity that over 1 trillion separate odors can be recognized. Of course, humans have some difficulty comprehending the informational potential of the scent environment, overwhelmed as we are by the powerful input of our visual cortex and our highly developed language use, with its roots in the auditory cortex.

With honeybees, the scent detectors are right there for all to see. Two antennae lead the way as each bee moves along. It is useful to reflect on the *two worlds* in which each honeybee must live. Born into darkness, she lives over half her existence in the dark, moving along the comb surfaces among tens of thousands of sisters. As she tends to the young and receives and stores material brought in from afar, information about local and regional conditions in the hive must be communicated, so that activity in the crowded halls can be coordinated. In the darkness, use of chemical signals - scents, *pheromones* - have developed to a high degree**:** *specific glands* producing *specific chemicals* in one individual can be received by *specific antennae receptors* on other individuals. From the standpoint of the individuals receiving the message, the *meaning of that chemical signal must be understood* in the context of each individual's current role in the colony. Neural processing and brain power, of course, is needed to deliver this understanding.



An important value of this form of communication is the ability of a simple chemical to be spread among tens of thousands of bees that move about in a hive and for the message to be unambiguous to all, even as it is passed from one individual to the next. The queen mandibular pheromone (QMP), includes 9-oxo-2-decenoic acid and is produced by the queen and spread among the colony, messaging that the queen is present and accounted for. This elicits many forms of response among colony members**:** suppress ovary activity, maintain a retinue to tend to the queen, construct worker comb cells.


Brood pheromone (BP) is a collection of chemicals (methyl palmitate, methyl oleate, methyl stearate, methyl linoleate, methyl linolenate, ethyl palmitate, ethyl oleate, ethyl stearate, ethyl linoleate and ethyl linolenate) produced in varying proportions by developing larvae and signal to the nurse bees specific nutritional needs of the developing brood. These requirements change daily**;** specific brood pheromones communicate these needs and the nurse bees respond. Furthermore, brood demand for more protein (messaged by BP) has been shown to significantly increase pollen foraging activity of the colony.

isopentyl acetate

Bees know the scent of alarm – *isopentyl acetate* – and when guard bees alert the colony that action in defense of the hive is needed, that is the signal they use to communicate. Beekeepers also know this **…** and they know that a little smoke masks the ability of a honeybee to sense the alarm message. Thus can they work so peacefully within the hive.