

1. Learning to Smell

Did you know that nobody is born with a particularly acute sense of smell? Of course there are some differences in the way people smell. The way in which you perceive an odor depends on your genome, your culture, how much attention you pay to it, your psychological state, and on whether you previously encountered it or not. But unless you suffer from specific disorders or lesions, the more you pay attention to smell, the more you can smell. The human nose is believed to be able to discriminate between several millions of different smells, even at very low concentrations. Some people—notably perfumers—are even able to imagine smells, or combinations of smells, much in the same way you can picture a color with your eyes closed. On a brain scan, their orbitofrontal cortex appears thicker than average: it's all about training!

2. Ancient Origins

Did you know that perfumery was born in the Bronze age in Egypt and Mesopotamia, along with the sacred dimension of perfumes, which would later be a part of many ancient civilizations? From the 8th century onwards, scents accompanied the settlement of the Greeks on the Mediterranean rim before being democratized in the Hellenistic period when new sources of raw materials opened thanks to the conquests of Alexander. The Roman peace then allowed a wide circulation of perfumes and an increasingly rich range of techniques and products. Written sources and archaeological findings—vessels used as containers and dispensers, but also actual organic residues—provide important data on what ancient aromatic compositions were—resins, plants, spices, oils, animal secretions—and how they were used. Some were worn by men and women for cosmetic or therapeutic purposes, others were offered to the gods, burnt in cults, public ceremonies, and integrated in funeral rituals.

3. Scents in the Modern Age

Did you know that after centuries of Western philosophers undermining the sense of smell, a renewed interest in odorous matters emerged in 19th-century Europe? People started to concern themselves with eradicating bad odors—or 'miasmas'—from outdoor and indoor spaces on the one hand, and with creating the most beautiful and sophisticated scents ever smelled on the other. Perfumery was indeed entering the industrial era thanks to the discovery of synthetic chemistry. Researchers started to produce in-lab synthetic molecules, either molecules preexisting in nature or completely new ones, which cheapened production, made fragrant products available to a larger audience, but also widened creative possibilities for perfumers, turning their craft into an art. This new-found fascination for the sense of smell in modern life then transpired in literature, art, and entertainment.

4. Smelling the World

Did you know that in some parts of the world—especially in tropical regions, where odors are stronger and more diverse—smells have significant sociocultural and cosmological roles? In some societies, aromas are cultural signifiers, neither subjective nor arbitrary, but learned as shared social constructs. Researchers in sensory anthropology have uncovered many examples of people for whom odors play a major structural role, such as the Ongees of Little Andaman Island, the Batek Negritos of the Malaysian peninsula, or the Sereer Ndut in Senegal. In these foreign cosmologies, smells can determine religious, natural and political orders, enforce social structures, orient human sociability, participate in human-to-spirit communication, organize the physical and ideological space, embody concepts such as time, life or death, and carry many other symbolic meanings. These people not only share world-views but also 'world-smells'!

1. Crossmodal Perceptions

Did you know that congruent experiences between different types of stimuli can affect overall perception? For instance, it's been shown that the brain response of three-month-old infants to seeing faces is altered when maternal odors are simultaneously presented. Conversely, our experience of a smell is influenced by congruent touch, sound and visual stimuli, whether we realize it or not. The hedonic response to a similar smell will differ whether the person is presented with a picture of cheese or of dirty socks, and white wine surreptitiously colored with odorless red dye will almost always be described with red wine terms. Research in the field of crossmodal perception have also shown that even non-synaesthetic individuals tend to associate smells with certain pitches, brightness, colors, tastes, and shapes. Citrus smells for instance tend to evoke angular, pointy shapes and high-pitched sounds. A better understanding of such crossmodal correspondences could lead to better-designed products, interfaces, environments, and improved non-verbal communication.

2. The Smell of the Rain

Did you know that the smell exhaled by the earth when it rains bears a poetic Greek name? The term Petrichor—from the Greek words *petra*, "rocks", and *ichor*, "blood of the gods"—was coined by Australian researchers Isabel Bear and Dick Thomas in 1964. This distinctive smell is made up of volatile oils exuded by certain plants during dry periods and absorbed by soils and rocks, and of geosmin, a metabolic by-product of certain bacteria found in soil that smells like beets. When raindrops hit a porous surface such as soil or rough concrete, they trap tiny bubbles which then shoot upward and burst, ejecting aerosols which release the odorous compounds, a phenomenon which can be an inspiration for artists and scientists alike. The human nose is extremely sensitive to the sedimentary, earthy scent of geosmin, even at very low concentrations, possibly because our ancestors relied on rainy weather for survival.

3. Inspired by Nature

Did you know that the art of perfumery itself finds its origin in the products of nature? Since the dawn of civilization, mankind has found ways to extract the precious fragrances of flowers, trees, aromatic plants, roots, spices, and even animals. Techniques to obtain natural raw materials have evolved and multiplied over time, from maceration, enfleurage, and expression, to distillation, solvent extraction, and, most recently, supercritical CO₂ extraction. However, some fabulously fragrant blooms, such as lilies, carnations, peonies, honeysuckles and many others, do not store their essential oils and consequently resist extraction. Perfumers have thus found ways to imitate the scents of these elusive 'mute flowers' by associating other natural ingredients and synthetic molecules. Since the 1980s, headspace technology, gas chromatography and mass spectrometry can help perfumers by analyzing the composition of the VOCs emitted by plants and translating it into a graph that they can then interpret, each with their own sensibility.

1. In Utero Olfaction

Did you know that the sense of smell is one of the first senses to be fully functional in the fetus? The nose starts to form early in the first trimester and from the 6th or 7th month of pregnancy we start learning smells through the amniotic fluid. Our mother's diet thus influences our olfactory and gustatory preferences before even being born—but also after, through breastfeeding. Olfactory responsiveness was for example assessed in neonates born to mothers who had or had not consumed anise flavor during their pregnancy. Both groups of infants were then followed-up for behavioral markers of attraction and aversion when exposed to anise odor and infants born to anise-consuming mothers showed a stable preference for anise odor in the first few days of their lives. Newborn babies are also able to recognize their mother by the smell of their skin and breast milk way before they can fully recognize their face.

2. Why Mammals Smell

Did you know that the mammals sense of smell dictates many of their most important behaviors? It plays an essential role in alimentation (finding food, identifying what's edible, regulating the appetite), in sociability (recognizing kin, sensing emotional states, finding mates), in avoiding dangers (detecting toxic substances, fires, or predators), as well as in orientation (to follow a track, identify a territory or a migratory route). Olfactory information travels particularly fast in the brain because the sense of smell is designed to trigger quick responses. Which also explains why the most immediate reaction to a smell is to classify it as good or bad: immediate attraction or rejection is an evolutionary necessity for survival. When confronted to a smell judged disgusting, the insular cortex can even trigger involuntary defense mechanisms, such as frowning the nose, coughing, sneezing or vomiting. Olfactory judgements are made all the time without us always realizing it and guide our everyday behaviors just as they guide animals.

3. Life Without Smell

Did you know that before Covid-19 the loss of the sense of smell was a rare and rather unknown condition? When it does not result from a birth defect, anosmia is often caused by damage to the olfactory nerve which can occur after a head trauma, a viral infection, certain allergies and upper respiratory tract infections, or as a consequence of chronic inflammatory diseases and neurological disorders. Although the sense of smell may return after a while, in some situations it may also never return. The consequences of such loss are not to be treated lightly. They encompass loss of appetite and of sexual drive, anxiety, depression, and a strong feeling of isolation, confusion, and frustration. Living without smell can also turn out to be dangerous because of an inability to detect smoke or gas leaks. Since the beginning of the Covid-19 pandemic, smell training protocols have flourished to help people regain their sense of smell and, with it, their sense of being fully alive.

4. Perfume as Medicine

Did you know that since its origins, perfume has been used for its therapeutic virtues? Many fragrant materials were used as antiseptics—such as myrrh, lavender or rosemary—or for their healing effects—such as benzoin. From the Middle Ages to the 19th century, numerous perfumes became renowned for their medical properties, like Carmelite Water and the Queen of Hungary's Water in the 14th century, the Four Thieves vinegar supposed to protect against the plague, and even the famous Eau de Cologne, invented in the 17th century by Jean-Paul Féminis and long-considered a true panacea. Many objects have been designed through the ages to cleverly carry and use these miraculous scents, such as plague doctors' beak masks in which aromatic plants filtered and purified the air breathed in. For protection, people from the upper class also carried *vinaigrettes*, small boxes to keep sponges soaked in scented vinegar, as well as *pomanders*, hollowed chiseled jewels filled with aromatic materials.

1. Taste is Smell

Do you know that about 80% of what we deem as taste is actually smell, both categorized as forms of chemoreception? The gustatory receptors, or taste buds, located on the tongue and palate can only detect basic flavors: sweet, salty, sour, bitter, umami (or savory), and, debatably, fat. Concurrently, the volatile molecules emanating from what we are eating or sipping activate our sense of smell by traveling from our mouth to our olfactory receptors. Odors are indeed perceived through two main pathways: orthonasal (the nostrils) and retronasal (the back of our mouth). It's the combination of information from the tongue, the nose, but also from other sensory cells such as the trigeminal nerve (responsible for sensations of spiciness, cooling, and astringency), that allows us to perceive the qualities of food and drinks as one sensation that we commonly call "taste".

2. A Sense of Time

Do you know that humans can tell time through their sense of smell? Odors can indeed provide temporal landmarks: for example, the calendar of the Onge people from the Andaman Islands in India is based on the scent cycles of a flower while that of the Dassanetch people of South-West Ethiopia is based on the characteristic aromas of seasons. In China, incense clocks appeared in the Song dynasty and were used to tell the time by burning aromatic materials, a tradition which eventually spread to nearby countries such as Japan. The clocks were designed to hold incense sticks or powdered incense made and calibrated to a known rate of combustion to measure time in minutes, hours, or days. Another way, more subjective, to estimate the time thanks to incense, consisted in sniffing the evolution of the smell hanging in the air, and to, quite literally, breathe in the passing of time.

1. La Madeleine de Proust

Do you know why smells can recall such vivid memories? Olfactory information has a special relationship with the limbic system of the brain where it simultaneously goes through the piriform cortex; the amygdala, in charge of emotions; and the hippocampus, working as a library of memories. We thus memorize a smell according to the emotional context in which we smelled it for the first time. When we encounter it again, it activates the same parts of the brain and revives, unblemished, the emotions and memories. In psychology, this phenomenon of powerful yet involuntary recollection is sometimes called “Proustian memory,” in reference to French novelist Marcel Proust’s masterpiece, *In Search of Lost Time*. In one famous passage, the narrator is suddenly brought back to his childhood by the flavor of a madeleine dipped in tea: “when from a long distant past nothing subsists, [...] still, alone, more fragile, but with more vitality, [...] the smell and taste of things remain poised a long time, like souls, ready to remind us, waiting and hoping for their moment, amid the ruins of all the rest;”

3. Volatile Communication

Did you know that, even more so than animals, plants communicate through volatile organic compounds, including smells? There are tens of thousands of VOC’s synthesized by plants: they are the words by which the vegetal world communicates. Through them, plants beckon pollinators, fend off herbivores and micro-organisms such as pathogens, summon helpful insect predators, and alert other plants to the presence of danger. Plants that are damaged by herbivores emit complex blends of volatile compounds that can cause neighboring branches to induce resistance. The smell of fresh-cut grass for instance is actually a cry of warning sent by the damaged blades to their congeners. Because, yes, plants can indeed “smell” using odor receptors functioning on a molecular level, although the process happens much slower than in animals. If plants and other mammals can do it, why couldn’t humans learn to communicate with smells just as well?

3. An Olfactory Heritage

Did you know that there is such thing as an olfactory heritage? Based in Versailles, France, stands the Osmothèque, the only perfume conservatory in the world. Much more than a simple database of formulas, it is a repository of perfumes, whether still on store shelves or long gone. There, they are preserved for posterity, fragments of a collective history and identity, as much as of personal ones. But olfactory heritage has also been embraced in other ways. Many researchers and artists are working to identify, preserve, and recreate culturally and historically significant smells, sensory remnants and meaningful constituents of human civilizations. In 2001, Japan listed and labeled 100 olfactory landscapes worth being preserved. In 2016, the Koç University’s Research Center for Anatolian Civilization in Istanbul exhibited scents having had a particular significance in Anatolia. Most recently, the Odeuropa project started to assemble a database of what one could have smelled in Europe between 1500 and 1900. Albeit fleeting, scents definitely leave their mark on the world.