

SMELL ING THE BOU QUET


MISSOURI
BOTANICAL
GARDEN

Plants & Scents in the Garden



On view May 2, 2025 – March 31, 2026 ————— **Stephen and Peter Sachs Museum**

BERGAMOT
CAMPANITA
WITCH HAZEL
BITTER ORANGE
IXORA
OAK MOSS
TUBEROSE
GARDENIA
VANILLA
JASMINE
WATER LILY
BAOBAB
LAVENDER
ROSE
IRIS
CARRION FLOWER
PERU BALSAM
ROCK ROSE



Smelling the Bouquet
Plants & Scents in the Garden

On view May 2, 2025 – March 31, 2026

STEPHEN AND PETER SACHS
MUSEUM

Plants and scents are inseparable in our experience and our imagination. Our daily lives are influenced by aromas and scents from morning to night—many of them coming from plants. Whether it is the tea or coffee we start our day with, or the perfume we wear, it is the volatile compounds plants create that attract us to enjoy them and to harness them for their special smells. Plants fragrance our world and may we savor every sniff.

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Museum at Missouri Botanical Garden.
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SMELL ING THE BOU QUET

Plants & Scents in the Garden

On view May 2, 2025 – March 31, 2026

Scent is an essential part of life. It is especially important to plants, as they use the chemistry of scent to communicate with the world around them, attracting pollinators with their intoxicating smells and repelling herbivores with pungent odors. These different scents attract and repel humans as well, evidenced by the archaeological remains of plants and tools used for incense and perfume in ancient cultures. Every part of a plant—from flower to root—contains volatile organic compounds (VOCs) that can be harvested and extracted through different processes, with the art and science of perfumery combining these elements in new and exciting compositions for our noses to enjoy.

The *Smelling the Bouquet* exhibition explores the spectrum of scents plants create, inspired by the diverse live and scientific collections at the Missouri Botanical Garden. The gardens outdoors offer renowned fragrant plants that have been a part of human culture for millennia, such as roses, jasmine, and water lilies. The Garden's conservatories

protect and display unique and rare plants from around the globe that provide new opportunities for Garden botanists and horticulturists to study and analyze their scents to understand pollinator interactions and what VOCs they may create and emit. Garden botanists carry out this scent research on plants in Madagascar, which is today also the center of production for one of the most famous and identifiable scents in the world, Madagascar vanilla. The Garden's Herbarium specimens, together with scent-related objects, intersect the artistry and the botany behind the human culture of scent.

The highlight of the exhibition is the opportunity to sniff over two dozen scents that include several interpretive fragrances of the Garden's live plants as well as botanical compounds renowned for use in perfumery. Artisan perfumers Shawn Maher and Weston Adam—both based in the St. Louis region—created these interpretive fragrances and provided these compounds in the Main and Lower Level galleries. In the Museum's South gallery, olfactory artist Gayil Nalls, PhD features her botanical scent artwork, *World Sensorium*, that offers a unique sensory encounter with the importance of aromatic plants to the collective human experience.

Explore the world of plants and scents in the Sachs Museum, and then head outside to the various gardens to sniff and enjoy the fragrances offered by the plants around you.

—Nezka Pfeifer, Museum Curator,
Stephen and Peter Sachs Museum

#SmellingTheBouquet
@mobotmuseum


MISSOURI
BOTANICAL
GARDEN



Photo: Virginia Harold

Gayil Nalls

World Sensorium, The World Social Olfactory Sculpture

World Sensorium is a living artwork that exists not only as a sensory experience but as a far-reaching inquiry into humanity's connection with the natural world. It aligns art and science to immerse individuals in the neuroaesthetic experience of olfaction by exploring the biological and cultural foundations of olfactory aesthetics. Like the first edition, through its composition, *World Sensorium 2025* transcends geographic and linguistic barriers to evoke memory, identity, and our collective human experience.

Right now, people around the world are experiencing profound emotional responses—interactions between the brain and body—that are stimulated by breathing molecular compounds of aromatic plants released from the landscape and transported through the air. Culture emerged, in part, through an evolutionary process as humans became conscious of the feelings and thoughts, or qualia, evoked by these sensory encounters, which led our ancestors to integrate specific plants into their lives for repeated and intentional uses. These iconic aromatic plants hold special meanings in different regions and were identified through a global survey with country representatives. They were formulated into a one-world scent based on each country's population percentage. These plants are used in our daily lives for medicine, rituals, and cultural practices. They form the foundation of *World Sensorium*.
—Gayil Nalls



Santalum album
Santalaceae;
Bernhardi herbarium;
no location or date
Courtesy of the
Missouri Botanical Garden
Herbarium, 3538562

World Sensorium/ Conservancy

(WS/C) is a multidisciplinary organization dedicated to research, conservation, and plant advocacy at the intersection of olfactory heritage and environmental sustainability. The mission of WS/C is to safeguard the world's diverse olfactory landscapes by preserving and revitalizing aromatic plants and their cultural significance. WS/C collaborates with botanists, ecologists, historians, artists, local communities, and international organizations to document and protect endangered aromatic plant species and olfactory traditions.
worldsensorium.com



The World Social Olfactory Sculpture, 2025, Courtesy of the artist; Photo: Virginia Harold



Vanilla planifolia by chomplearn



Rosa x damascena by RaDoll



Jasminum sambac by iman satria



Santalum album by DSLucas



Plumeria sp. by Rofidd



Pinus sylvestris by Robert Schneider

The Art & Science of the Natural & Synthetic in Perfumery



Everything about scents is rooted in chemistry—the odorants we smell are volatile molecules detected by our olfactory system that sends signals to our brains, which interprets these signals as different scents. The complexity of scents comes from the diverse combination of these volatile molecules, which are a stable arrangement of carbon, hydrogen, helium, and oxygen atoms (aromatic rings). Depending on the combination, these atoms form aromatic compounds found in many plants, such as terpenes (citrus fruits, pine trees, lavender), esters (fruity and sweet scents like apples, bananas, strawberries), amines (rotting smells), lactones (creamy, coconut), aldehydes (includes vanillin) and ketones (fruity, berry, musky).

The art and science of perfumery harnesses these volatiles and combines them to create the fragrances that delight us and mark some of our special moments and memories. Historically, wearable perfumery began as an art enjoyed by the elite that was crafted from dear and precious materials—both botanical and animalic—and focused on the beauty of these ephemeral fragrances in and of themselves, such as roses, jasmines, and musk. Increased demand for these components tested production to the limits, particularly with ingredients that have limited supply, such as ambergris and animal musks.

Late 19th-century advancements in organic chemistry, distillation, and extraction techniques allowed chemists to isolate specific volatiles from different items occurring in nature, thereby enabling their reproduction and mass production. Synthesizing these new compounds gave perfumers the freedom to create scents that went beyond just replicating nature, while also making perfume more affordable and accessible to a wider segment of the population.

**Sampling table with
interactive scented cloches**
Lower level gallery
2025
Photos: Virginia Harold

Synthetic Compounds

The public often conflates the use of synthetic compounds with toxicity. However, with the professionalization of perfumery and the development of knowledge about natural ingredients used in perfumes, international bodies such as the International Fragrance Association (IFRA) were created to promote the safe use of fragrances through regulation, as well as represent perfumers collectively. There are several natural extractions that have been used in perfume for generations that are now known to cause irritations or sensitivities, such as oak moss and coumarin, so today these are synthesized in a lab for the protection of perfume wearers. Lastly, for the plants represented here in the exhibition that are in danger of extinction (especially the species of oud), using synthetic compounds is less expensive and does not stress the natural populations of the plant in question so that we do not extirpate the species in our drive to enjoy their fragrance.



Indigenous oak moss was a component of historic perfumery. Chypre scents—a blend of dry and warm citrus, woody, and mossy notes, with the inclusion of compounds from bergamot, oakmoss, and labdanum—had been known for millennia in fragrance usage. The fragrance that gave birth to the contemporary family of Chypre perfumes was François Coty's Chypre in 1917.

**Oak moss,
Antlered perfume lichen
*Evernia prunastri***
Josephine County, Oregon, USA
Parmeliaceae; C.M. Wetmore;
August 16, 1975
Courtesy of Lichenes Exsiccati
Minnesota 38

Chypre de Coty
Vintage Coty Chypre
Eau de Toilette Spray
French, ca. 20th century
Courtesy of
Missouri Botanical Garden

Photos: Virginia Harold

Image composition
created with photos by
iStock, Liudmyla Liudmyla

Perfume, Perfumers & Perfumery

Today's perfumers are at the forefront of exploring new frontiers in scent and creating fragrant narratives that embody the past, present, and future. The word "perfume" has its origins in the burning of incense, which was used to scent the air but also to scent one's body and clothing. Coming from the Latin *per fumum*, meaning "through smoke," the craft of perfumery is believed to have originated in ancient Mesopotamia 7,000 years ago. Despite this long history, fragrance development—what we consider to be contemporary perfumery—did not become a formalized discipline until the late 1800s.

The artisan perfumers who are integral collaborators in this exhibition—Shawn Maher and Weston Adam—created nine interpretive fragrances that are unique to the exhibition: water lily, gardenia, tuberose, ixora, cubanola, baobab, carrion flower, witch hazel, and woolly lavender. Each of these scents captures the fragrance notes of live plants in the Missouri Botanical Garden conservatories and gardens.

For months, Shawn and Weston worked with Museum Curator Nezka Pfeifer in sniffing and reviewing many fragrant plants at the Garden, eventually selecting these nine to interpret through the art and science of perfumery. Some plants were unable to be physically rendered into perfume or are listed as threatened or endangered. Others have unique olfactory profiles not well known in fragrance, nor does the public have access to sniff them; some bloom in the evening (after admission hours at the Garden) or they are physically separated from the public in difficult to reach locations. These were also offered as limited edition perfumes for sale to the public during the exhibition.

Perfume blotters, clip stands, pipettes, and vials

China
paper, metal, plastic, glass
ca. 2024
Courtesy of Missouri Botanical Garden
Photo: Virginia Harold

Photo background:
iStock, guarosh

Perfumers: Shawn Maher (left),
and Weston Adam (right)

MaherOlfactive.com

 **MaherOlfactive**

ChatillonLux.com

 **ChatillonLux**

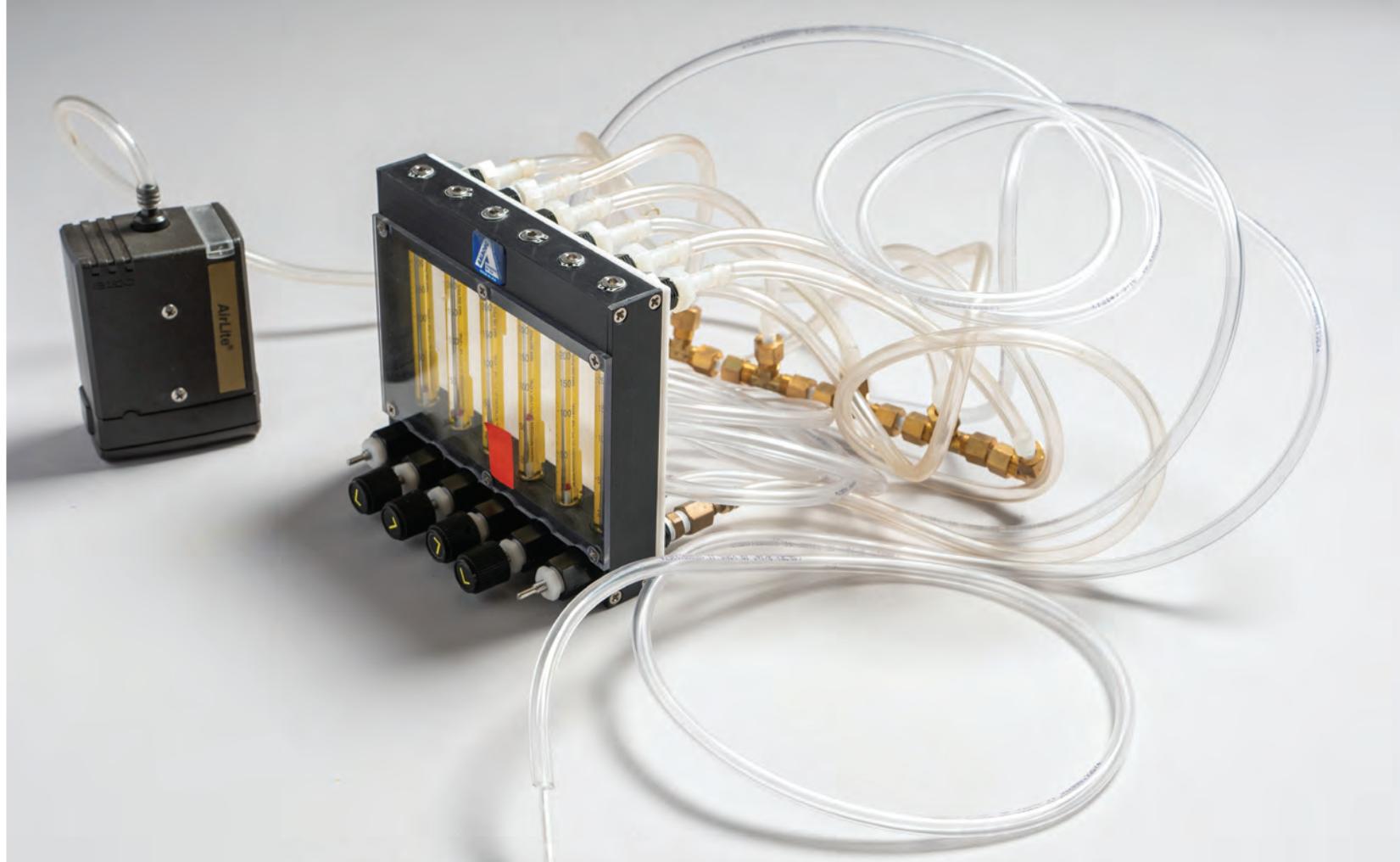
**westonadam.art/
phronema-perfumes**

 **phronema_perfumes**



Researching Plant Scents

The Garden's live collections offer myriad opportunities to learn more about plants. Dr. Mónica Carlsen, one of the Garden's scientists, shared her botanical scent research with this exhibition. She conducted headspace/scent trapping to gather data on tropical plants in the Climatron and other conservatories, several of which are interpreted as fragrances by the exhibition's perfumers. Samples were analyzed at the Danforth Plant Science Center, Bioanalytical Chemistry Facility, using gas chromatography–mass spectrometry (GC-MS) to identify complex scent components. Dr. Carlsen is also working on the first comprehensive characterization of floral scent diversity and variation across the genus *Anthurium*. Results will help elucidate the role of floral scent molecules in attracting, maintaining fidelity, and ensuring specificity of insect pollinators among co-existing *Anthurium* species, and could potentially lead to fragrance innovation in the perfume industry.



Dr. Mónica Carlsen

Scientist and Education Program
Manager, Latin America
Department of the Science and
Conservation Division of the
Missouri Botanical Garden
Photo: Dr. Mónica Carlsen

Russell B. Williams, PhD

(not pictured)
Director,
Bioanalytical Chemistry
Facility at the Donald
Danforth Plant Science Center

Flow meter, air pump

Metal, plastic, PVC, glass
Ca. 21st century
Courtesy of
Dr. Nisa Karimi Collection
Photo: Virginia Harold

Headspace technology is a gas-extraction technique allowing for the direct sampling of volatile odor compounds present in the air surrounding an object without the use of solvents or damaging the object (i.e., plants, flowers, and foods). The volatile compounds from the headspace are usually captured on traps packed with adsorbent materials, then desorbed and injected into a Gas Chromatograph and Mass Spectroscopy (GCMS) to identify the molecules present. Headspace techniques have been used extensively to sample *in vivo* (from a living organism) the floral headspace of a large variety of taxa and their aromatic compounds as well as for the analysis of volatile compounds in environmental, toxicological, and food applications.



ANDRE MICHAUX. 1810.

DR. JNO. LINDLEY 1848.

Photo: Virginia Harold

ROSE

Perfumery Plant Species

Rose, the Queen of Flowers

The fossil record establishes the origins of the rose at 40 million years ago, whereas the oldest known written record of the flower is from Assyrian cuneiform tablets, ca. 4,200 BCE. *R. damascena* has come to be synonymous with the scent of rose (along with *R. centifolia*), yet there are as many variations of the fragrance as there are rose varieties.

Damask rose is the result of natural hybridization of three species native to Europe and the near East: *Rosa gallica*, *Rosa moschata*, and *Rosa fedschenkoana*. The scent among *Rosa* has been in decline since the proliferation of Chinese roses in the 18th century, which were hardy and unique in color, but low in fragrance. A further decrease occurred when 19th-century French breeders crossed the

Chinese tea rose with European roses. In the 1960s, English rose breeder David Austin worked to bring back the flower's much loved and characteristic scent, but ongoing crossbreeding for the cut-flower industry that devalues scent—emphasizing color and shape—contributes to continued decline in fragrance levels.

A rose's characteristic scent comes primarily from 2-phenyl-ethanol, rose oxide, beta-damascenone, beta-ionone, also geraniol and citronellol. The scent is sweet, floral, fruity and slightly animalic, or spicy, but individual facets depend on the distillation process.

ORANGE

The Fruitful Scents of Bitter Orange

Known as bitter orange (also Seville orange), the fruit of *Citrus x aurantium* is not particularly palatable, but the flowers are much more fragrant than other *Citrus* varieties.

Originally from East Asia, the bitter orange was first introduced to the Mediterranean by the Romans, who were believed to have eaten the fruit, despite its sour quality. This plant is grown around the globe, but the trees cultivated for perfumery are localized to areas with distillation facilities because orange blossoms need to be processed as soon as possible after harvest.

The fragrance of extracts from the genus *Citrus* differs by distillation process and according to origin. *Citrus aurantium* (bitter) flower yields neroli oil by steam distillation,

which has delicate tones marked by a sharp slightly terpenic top note that is pleasantly bitter, floral, fresh, citrusy, and herbal. Volatile solvent extraction yields orange blossom concrete and absolute (also orange flower water), which is more rounded than neroli, with a headier floral sweetness and warm, honeyed, tenacious olfactory profile. The rind of *Citrus aurantium* (bitter) is expressed, yielding oils that are true to the fruit itself. Petitgrain, obtained by crushing the leaves, has a more woody, herbal scent, with floral and citrus undertones. The blending possibilities are quite wide-ranging.

BERGAMOT

Bergamot, the “Green Gold” of Calabria

Unlike many plants from the genus *Citrus* whose parts (flowers, fruit, leaves) undergo a variety of distillation and extraction processes to yield different aromatic compounds, bergamot essential oil from *Citrus x bergamia* has been produced by cold expression of the fruit rind since the early 19th century. Its first recorded use in perfumery in the late 17th century was, however, a steam distillation process. Despite this relatively simple extraction method, its fragrance is highly nuanced, influenced by season, terroir, and hand of the producer. Part of the citrus olfactory family, bergamot essential oil has aspects of sweet orange peel combined with floral notes, lavender, and woody terpenoids. Its zesty citrusy side is complemented by its bitter, green, spicy-balsamic

undertones. And it is the aromatic that gives Earl Grey tea its unmistakable scent.

Although cultivation is concentrated to a small area spanning circa 140 kilometers from Italy’s Strait of Messina to the Ionian coast (the tip of the Italian “boot”), each plot of land brings unique qualities to the fragrant oil. *Citrus bergamia* as we know it today is cultivated, almost exclusively, in the Calabria region, where it is presumed to have originated as a seedling in the 17th century.

ORRIS

Iris—Orris Root—the Blue Gold of Perfumery

The iris rhizome is the source of orris root, which is cultivated and aged for years before use in perfumery. The sweet, earthy, woody quality comes from triterpenoid breakdown into irones, which are close in structure and aroma to violet ionones, and responsible for the characteristic scent of the dried, aged root. The older the rhizomes of this underground aromatic, the more pungent the scent. Orris can range from powdery, and violet-like, to woody, green, with waxy tones, and a touch of fruit, cocoa, or leather. Orris butter takes on a slightly more earthy note, whereas the absolute is the most powdery and longest lasting. The name and the scent of orris are synonymous with luxury.

Orris root powder and concrete have historically

been used in violet powders, hair and wig powders, pomanders, soaps, cosmetics, toothpaste and breath freshener, alcohol, tobacco, perfumed gloves, scented linens and as a fixative for potpourris. Used by medieval monks as an aromatic flavoring in wines, elixirs and liquers, today it is experiencing a revival in craft spirits. Orris root derived from *Iris florentina* is incorporated as a flavoring during the distillation of gin. Orris absolute—due to its rarity, price, and quality—is reserved for perfumery.

Scent Families in Perfumery

Pale iris, Orris root violet, powdery, floral, earthy	Palermo violet violet, dry, vegetal	Blue water lily, BluBop passion fruit, pineapple, fruity jasmine	Arabian jasmine floral, musky, sweet, spicy	Tuberose floral, heady, indolic, white flower, creamy	Gardenia, Cape jasmine creamy, intoxicating, rich, white floral
Anisic aldehyde floral, anise, vanilla	Ixora tropical white floral with spicy and indolic undertones	Portlandia creamy, cocoa butter, vanilla, floral	Campanita sweet, green, creamy, chocolatey with a hint of jasmine	Cabbage rose sweet, floral, fruity, powdery, honey, green	P-dimethoxybenzene floral, sweet, clover

Floral

Floral represents the largest olfactory group used in perfumery and is also the most readily recognized. The olfactory range is vast and can be reminiscent of freshly picked flowers or exhibit powdery nuances and fruity gourmand hints.

Aromatic

While not regarded as a traditional scent group, the aromatic family is characterized by plants or trees with grassy, vegetal herbaceous notes and an "outdoorsy" aroma.

Cineole, Eucalyptol eucalyptus, camphor, mint, herbal	Woolly lavender lavender, creamy, spicy, and camphor	Witch hazel silky floral with citrus and terpenic notes	Beta-pinene piney, woody, turpentine	Myrcene earthy, musky, green
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Chypre

Chypre fragrances are an alchemy of contrasts, tying citrusy bergamot notes together with a woody resinous cistus labdanum and mossy animalic notes.

Citrus

The Hesperide (Citrus) family is one of the oldest elements in perfumery. It is characterized as fresh and invigorating, with bright acidity.

Oak moss, Antlered perfume lichen green, earthy, woody, musky, smoky, ambery, forest-like	Rock rose, Gum cistus, Labdanum resinous, amber, woody, vegetal	Limonene citrus, lemon, fresh	Bergamot citrus, lime, tea, spicy, woody	Bitter orange (neroli) floral, green, zesty, citrus, honey, spice
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Amber

Amber fragrances are characterized by rich, heady notes, warm and powdery qualities, and are often described as sensual.

Madagascar vanilla vanilla, caramel, cocoa, butter, woody	Vanillin vanilla, creamy, syrupy	Gaiacol smoky, sweet, coffee	Peru balsam smoky, balsamic, vanilla, clove	Benzyl cinnamate cinnamon, balsamic	Eugenol clove	Ethyl cinnamate cinnamon, honey, plum
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Stinky

While humans tend to harness plant scents they find appealing to use for incense and perfumery, there are plants that also make very strong unappealing smells that would never be inspirations for perfumes or commercial fragrances. The volatile compounds in these plants emit scents that are akin to rotten fish, fermented food, decayed meats, or rotting garbage, all of which are attractive to carrion flies or beetles who act as these plants' pollinators.

Baobab fermented, green pineapple, banana, musky	Carrion flower rotten, sweet, musky, unsettlingly meaty	Para-Cresol floral, bitter, crushed pill
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CHYPRE

Chypre Scent Family Inspired by the Island of Cyprus

Chypre fragrances are an alchemy of contrasts, tying citrusy bergamot notes together with a woody resinous cistus labdanum and mossy animalic notes at the base. They are often described as evoking an earthy and damp forest floor.

Pronounced SHEEP-ruh, chypre scents are named after the French word for Cyprus, an island nation in the eastern Mediterranean Sea with a millennia-long history of scent making and perfume production. Historic Cypriot scents were renowned for using the indigenous oak moss, citrusy bergamot, or labdanum (also known as rock rose) and today perfumes which include these scents or compounds usually are characterized as chypre perfumes. Today, chypre perfumes continue to be classified with these notes, but have

also been expanded to include notes of patchouli, water, animalic musks, leather, and amber.

Cistus ladanifer, commonly called rock rose, is a resinous, flowering shrub native to the western Mediterranean region. A historic plant used in perfumery, the scent from *C. ladanifer* does not come from the distinctive white blooms with maroon blotches, but from the fragrant resin exuded from the woody stems and leaves, known as labdanum. Used by ancient Mesopotamians and Egyptians in perfume and incense.



**Rock Rose, Gum cistus,
Labdanum**
Cistus ladanifer
Valencia, Spain
Cistaceae; J. Riera,
April 15, 1999
Courtesy of Missouri Botanical
Garden Herbarium; 6946326

Incense, the Ascending Perfume of Sweet Savor

Incense, a biological material that releases fragrant smoke when burned, is one of the most ancient forms of scenting the air or perfuming oneself. Dating back thousands of years—and used around the world—the ancient peoples of Egypt, China, and India were renowned for their use of incense to fragrance their spiritual and living spaces. As fire is viewed as a purifying force, the act of burning incense is thought to cleanse the air of malevolent energies and is often connected to meditative or religious practice.

Incense is burned in various forms, including resin granules, woods, herbs, sticks, cones, and can be burned directly or use a separate heat source. Cultures around the world use different types of burners as functional objects and because they hold deep symbolic meanings, representing a bridge between the physical and spiritual realms. Several species of plants are capable of producing resinous sap, that when hardened, becomes able to be burned as incense. One of these plant families, Burseraceae, has so many of these incense species that the family is called the torchwood family.

Different grades of luban, frankincense resin

Boswellia sacra

Dhofar Province, Oman
Courtesy of
Missouri Botanical Garden,
William L. Brown Center
Biocultural Collection; 02096
Gift of Dr. Elizabeth Horton



Palo santo
Clusia pachamamae (below)
Resin incense
Courtesy of
Carmen Ulloa Ulloa Collection
and Alfredo Fuentes Collection



Photos: Virginia Harold



Oud, Agarwood, Aloeswood (above)
Assam, India
Courtesy of
Missouri Botanical Garden

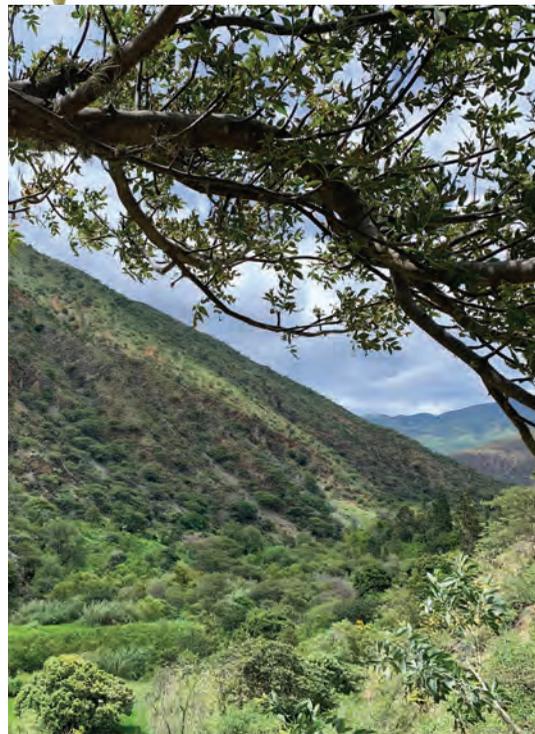


Bhutanese incense (left)
Thimpu, Bhutan
Juniper, rhododendron, safflower, pine, and other plants
ca. 2021
Courtesy of
Missouri Botanical Garden,
William L. Brown Center
Biocultural Collection; 07725

Restoring Palo Santo, the Holy Wood of the Tropical Dry Forest

Palo santo
Bursera graveolens
 La Libertad, Peru
 Burseraceae; J.L. Marcelo-Peña;
 February 13, 2020
 Courtesy of Missouri Botanical
 Garden Herbarium; 7020460

Conservationists' decades-long focus on preserving the tropical rainforest has resulted in their largely ignoring one of the most endangered ecosystems—the seasonally dry tropical forest (SDTF), only about 10% of the original extent of which remains intact, and little of which is protected. Elizabeth Collins, of George Mason University, conducted research on palo santo (*Bursera graveolens*), an economically, ecologically, and culturally important tree species found only in the American SDTF. Her work assessing the population's genetic diversity and evolutionary history has led to updating the description of *Bursera graveolens* and describing two new species of palo santo, each endemic to separate areas and considered threatened. The findings have been translated into recommendations for ongoing palo santo reforestation projects.



Palo Santo dry forest (left)
Peru

Palo Santo factory (right)
Ecuador

***Bursera graveolens* (far right)**
Overall range

Photos: Betsy Collins





From top left to right:

Pomander
Courtesy Anonymous

Lucien Lelong "N" Parfum bottle
René Lalique (1860-1945)
Courtesy of The Richard H. Driehaus Collection

Collection of 16 Venetian scent bottles
Courtesy of The Richard H. Driehaus Collection

Perfume bottle w/ dragonfly casing
Courtesy of Éliane Thomas Collection

Trésor perfume bottle, Lancôme
Courtesy of Éliane Thomas Collection

Perfume flask and cover,
Thomas Webb & Sons
Courtesy of The Richard H. Driehaus Collection

Jade scent or snuff bottle
Courtesy of Eric Hoffman Collection

Vinaigrette
Courtesy of Missouri Botanical Garden

Jade pomander or sachet
Courtesy of Eric Hoffman Collection

Photos: Virginia Harold





Scent bottle
Paulding Farnham
Tiffany & Co., New York, NY
(1902-1932)
Glass, enameled gold,
diamonds, peridot
Ca. 1900
Courtesy of The Richard H.
Driehaus Collection
Photo: Virginia Harold

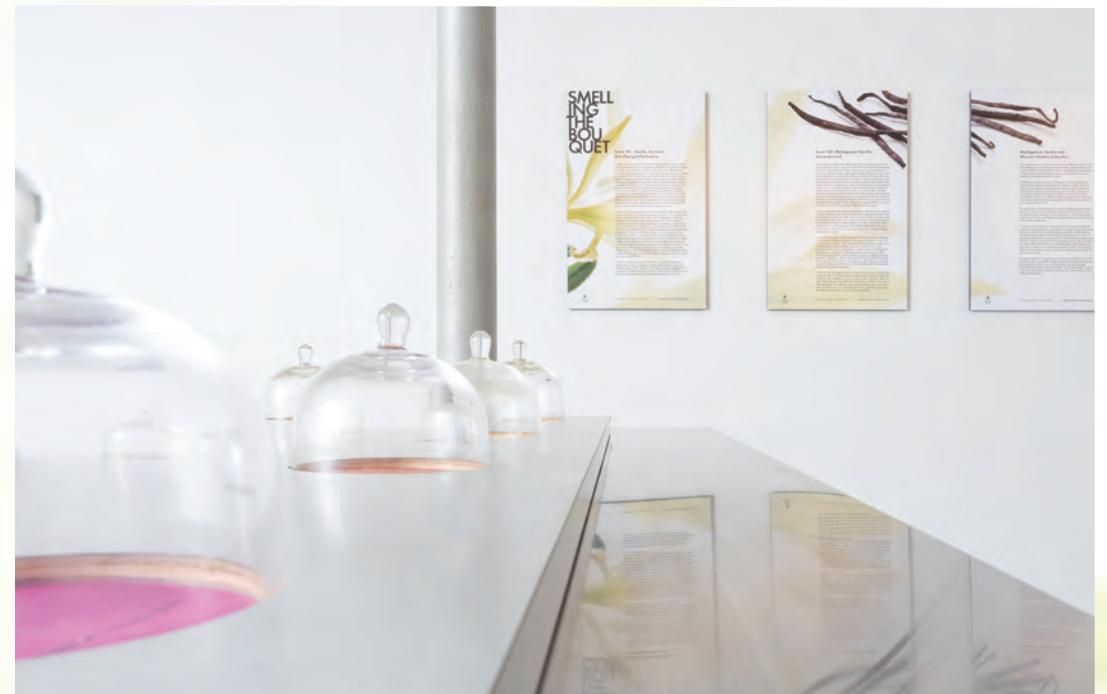
Madagascar Vanilla and Missouri Botanical Garden

Vanilla comes from the fruit of the orchid *Vanilla planifolia*. Its creamy, sweet, spicy, sometimes smoky scent is recognized as one of the most distinct gourmand notes in perfumery and cuisine. The history of vanilla's fragrant interactions with people dates to more than 600 years ago, when it was integral to the culture of the Totonac, Mayan, and Aztec people in the plant's native region of Mesoamerica. Only much later—in the late 18th – early 19th centuries—was vanilla introduced to other tropical climates, including Madagascar, Comoros, and Réunion Island, which today account for 85% of global vanilla bean production. Because the tiny *Euglossa* orchid bees that pollinate *V. planifolia* in Mesoamerica are absent in this island region, the hermaphroditic flowers must be hand-pollinated, one blossom at a time, by so-called *marieuses* (matchmakers). Today, Madagascar vanilla is considered among the best in the world due to its high vanillin content and consistent size and flavor.

The vanilla featured in this exhibition came to St. Louis from Madagascar, where cultivation is vital to the livelihood of farmers, including those around community-based conservation areas managed by the Missouri Botanical Garden. One such area, the Makirovana-Tsihomanaomby Massif, supports a small, degraded evergreen forest with rich biodiversity, including many threatened and locally endemic species. However, attracted by the cool, humid and shady conditions, hundreds of local farmers use this forest for cultivating valuable vanilla pods. Under an approach called dynamic agroforestry (DAF), which focuses on conserving biodiversity and protecting local livelihoods, the Garden supports a major initiative to promote successful vanilla production through settled cultivation on degraded land outside the forest.



Vanilla exhibit, sampling table
Lower level gallery
2025
Photo: Virginia Harold



Garden Scent Trapping at Ibity Massif, Madagascar

Since the 1970s, the Missouri Botanical Garden has been working in Madagascar to explore, conserve, and restore the region's unique flora in collaboration with local communities and the national government. One of these protected areas is Ibity Massif. Less than half the size of St. Louis City, this rocky area is home to at least 304 plant species, including 217 found only in Madagascar, and an astonishing 37 species known only locally. As part of the research into plant scents for this exhibition, a Garden team conducted a field trip within Ibity Massif to locate, describe, and scent trap a dozen of the most fragrant species—curated from the Garden's online database of past collections in the Herbarium, Tropicos—following a protocol set by Dr. Nisa Karimi. A few of these plants are on display in the exhibition as Herbarium specimens.

***V. planifolia* blossoms**
iStock: cholprapha

Dried vanilla bean pods
iStock: kaanates

The Invisible Language of Flowers

Floral perfume bouquets display an impressive diversity and complexity of chemical compounds. And it is not only the flowers—many of the other parts of plants also contain a fragrance. But why do plants smell in the first place?

Many plants use scents as their primary means of communication with other organisms. They produce volatile organic compounds (VOCs), a mixture of different chemicals that disperse through the air to attract pollinators and keep herbivores at bay. 90% of flowering plants need animal pollinators to sexually reproduce (as opposed to plants such as grasses and oaks whose pollen is often transferred by wind), and plants have a few smelly strategies to ensure the task gets done. Lots of plants give off sweet, floral aromas to entice birds, bees, and butterflies with the promise of sugary nectar. Not all flowers smell rosy, though. Countless flowers reek of sulphur, carrion, fish, or fungus. These plants want to entice lesser-known pollinators, such as fungus gnats, midges, bats, moth flies, small mammals, and others.

While for some insect species the females are the hard workers foraging for blossoms and pollen, it is the male orchid bees (euglossine bees) that work harder to get attention. Unlike most other insects, male orchid bees do not synthesize their own mating compounds, or pheromones. Instead, they collect them from the environment—from orchids, wood, fungus, and even feces. Males store and blend these chemicals in pouches on their hind legs, and in the presence of a female, release their perfume bouquet.

Two members of the Ramirez Lab at University of California, Davis have shared their research with the exhibition. Jasen Liu is investigating the influence of male euglossine bee pollination on evolutionary patterns of orchid floral scent and functional morphology. Marissa Sandoval is investigating the chemical ecology of an orchid bee mating system across different levels of biological organization. This research will address questions regarding mate choice and its implications for reproductive isolation among orchid bees.

Euglossa bee baiting
Metal mesh
Photo: Marissa Sandoval



Banho de Cheiro, the Brazilian Scent Bath

Banho de cheiro (Portuguese for “scented bath”) is a traditional Amazonian practice that uses aromatic herbs for physical and spiritual cleansing. This knowledge, rooted in Indigenous practices, has been passed down through generations and transformed by various communities and religions. In Brazil’s Amazon region, *banho de cheiro* is prepared by steeping leaves, roots, and aromatic plants in water, creating an infusion used for cleansing baths. *Banho de cheiro* is more than just herbs from Amazonia—it fuses Indigenous knowledge, African contributions, and Catholic traditions into a vibrant, collective ritual. The selection of plants varies according to the herbalist’s (*erveira/o*) knowledge, with dozens of species often used. The Brazilian Amazon, with its rich botanical diversity, underpins the practice’s cultural, spiritual, and medicinal dimensions.

Interview with **Maria Luciene Gama Santos**, *erveira* from northern Brazil. By Tombô Productions.



The three plants highlighted here are among those frequently used in *banho de cheiro*, representing both native and introduced species in Amazonia.

Patchouli
Pogostemon cablin
Luzon, Philippines
Lamiaceae; M. Ramos;
February 1, 1911
Courtesy of Missouri Botanical Garden Herbarium; 776232

Goat Weed (far left)
Ageratum conyzoides
Vicosa, Minas Gerais, Brazil
Asteraceae; Y. Mexia;
May 19, 1930
Courtesy of Missouri Botanical Garden Herbarium; 1022908

Pripricoa (left)
Cyperus articulatus
Maranhão, Brazil
Cyperaceae; N.A. Rosa;
June 30, 1978
Courtesy of Missouri Botanical Garden Herbarium; 5868933



Glossary of Perfumery Techniques

EXPRESSION

Product: Expressed Oil

Expression is a cold technique for extracting essential oils from the peel or zest of citrus fruits, which would degrade under the heat of steam distillation. Volatile compounds concentrated in glands within the fruit peel can be extracted using mechanical pressure, capturing all of the fruit's aromatic facets.

SOLVENT EXTRACTION

Product: Concrete / Absolute

Volatile solvent extraction is a method of isolating a plant's fragrant organic compounds by means of a solvent. It is one of the most widespread techniques in perfumery. Plant material is steeped in a solvent—such as purified

hexane—yielding a waxy, semi-solid, aromatic substance known as a concrete. This undergoes a secondary process called ethanol extraction to yield an absolute—a refined, highly fragrant liquid favored by perfumers.

ENFLEURAGE

Product: Pomade

Enfleurage is a method of extracting fragrant oils from fresh blossoms through absorption by a secondary animal or vegetable fat. While formalized in 18th-century France, the ancient Egyptians practiced a simplified version. Enfleurage makes it possible to draw out the volatile oils from aromatic flowers which are too delicate to for traditional distillation or extraction processes.

COLD ENFLEURAGE

Product: Pomade
(Secondary: Absolute)

Cold enfleurage is reserved

for flowers with delicate volatile oil compositions that can't tolerate heat, like tuberose, jasmine, hyacinth, and daffodil. Fresh petals are macerated in purified fat spread onto a glass pane until the pomade reaches the desired fragrance intensity. Another method uses oil-soaked cloth, and yet another variation involves packing fresh blossoms into an enclosed vat with oil-rich seeds like sesame (India) or almond (Italy).

HOT ENFLEURAGE

Product: Pomade
(Secondary: Absolute)

Hot enfleurage extracts fragrant oils from heat-tolerant blooms such as rose, orange blossom, and mimosa. Freshly gathered petals are combined with deodorized olive oil, lard, or beef tallow, then gently heated to release volatile compounds without damaging

the delicate petals. After days or weeks of maceration, the aromatic pomade is clarified with solvent to yield a crude absolute, then washed with ethyl alcohol to obtain a pure absolute.

STEAM DISTILLATION

Product: Essential Oil + Hydrosol

In steam distillation, hot vapors pass through plant material, volatilizing the fragrant oils. These vapors combine with steam and are condensed in a water-cooled chamber. The resulting mixture is separated in an essencier, yielding two products of different densities: an essential oil and a hydrosol (also called flower water or herbal distillate).

HYRDODISTILLATION

Product: Essential Oil + Hydrosol

Hydrodistillation, a technique related to steam distillation, is primarily used to extract rose

essential oil. In this method, the plant material is directly submerged in water and gently heated, causing the fragrant oils to volatilize. The resulting aromatic gases are then condensed, separated, and, in some cases, redistilled.

DRY DISTILLATION

Product: Essential Oil

Dry, or destructive, distillation extracts essential oils from gum resins and resinous woods—such as cade juniper and birch—that resist other methods. The raw material is heated directly in a copper still without water or steam, vaporizing fragrant compounds. The vapors are condensed and decanted, yielding aromatic oils. High heat may pyrolyze the plant matter, imparting a charred, toasted facet, while also potentially forming toxic molecules, which are removed through rectification.

FRACTIONAL DISTILLATION

Product: Essential Oil

Fractional distillation is a method of separating scent compounds from essential oils through selective isolation. Like steam distillation, it begins by heating plant material with steam. The distinction lies in the cooling, condensation, and vaporization stages, where time and temperature are carefully controlled to release specific aromatic compounds at their boiling points, producing a purified essential oil. This method also enables the removal of unwanted elements, such as color or allergens, and expands the perfumer's olfactory palette.

SUPERCRITICAL FLUID (CO₂) EXTRACTION

Product: CO₂ Extract

Supercritical fluid extraction is a modern technique for selectively isolating aromatic

compounds from flowers, leaves, and resins. Pressurized, temperature-controlled carbon dioxide (CO₂) in its supercritical state—neither liquid nor gas—acts as a solvent to isolate specific fragrance molecules. While it sounds (and is) highly scientific, the method is completely safe—CO₂ is harmless, non-flammable, and recyclable. Some of the more common CO₂ extracts include jasmine, rose, frankincense, and vanilla.

HEADSPACE

Product: Chemical Signature

Headspace is an innovative method of capturing odor molecules from plants—or any aromatic material that releases volatile organic compounds—for laboratory analysis. Developed in the early 1970s, it isolates the “headspace” of plants whose scents were previously unreproducible or inaccessible through traditional extraction.

This includes complex aromas, like the full olfactory profile of a flower—petals, stems, and leaves; flowers with strong aromas but minimal essential oil yield; and other aromas not typically part of the perfumery lexicon.

Aromatic material is enclosed in an airtight chamber, and a gas is passed through capturing its volatile scent compounds in an absorbent filter. These are analyzed by Gas Chromatography–Mass Spectrometry (GC-MS) to separate and identify each component. Once the scent's chemical composition is recorded, it can be precisely recreated, forming the basis for new perfumes.

BERGAMOT
CAMPANITA
WITCH HAZEL
BITTER ORANGE
IXORA
OAK MOSS
TUBEROSE
GARDENIA
VANILLA
JASMINE
WATER LILY
BAOBAB
LAVENDER
ROSE
IRIS
CARRION FLOWER
PERU BALSAM
ROCK ROSE

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—Nezka Pfeifer
Museum Curator,
Stephen and Peter Sachs Museum

Saving Plants through Scent

Founded in 2018, a community of scientists, artists, and beauty industry experts launched The Red List Project (TRLP) which focuses on conservation of the most critically endangered plants, as designated by the International Union for Conservation of Nature (IUCN)

Red List Unit. Direct in-country conservation action is supported by profits generated from the sale of fragranced products based upon the scent of threatened species.

Two featured room scents—by renowned perfumer Spyros Drosopoulos of Baruti Perfumes—were created by using headspace scent trapping technology as well as the perfumer's interpretation of the fragrance of the threatened plants and their surroundings: *Viola ucraina* and *Portlandia platantha*.



B A R U T I
barutiperfumes.com

the red list  project
theredlistproject.org

Back cover:

Bergamot

Citrus × bergamia Risso & Poit.

Riverside, California;

Andrew C. Sanders & T.B. Salvato;

December 20, 2006;

Courtesy of Missouri Botanical Garden

Herbarium; 6035002





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