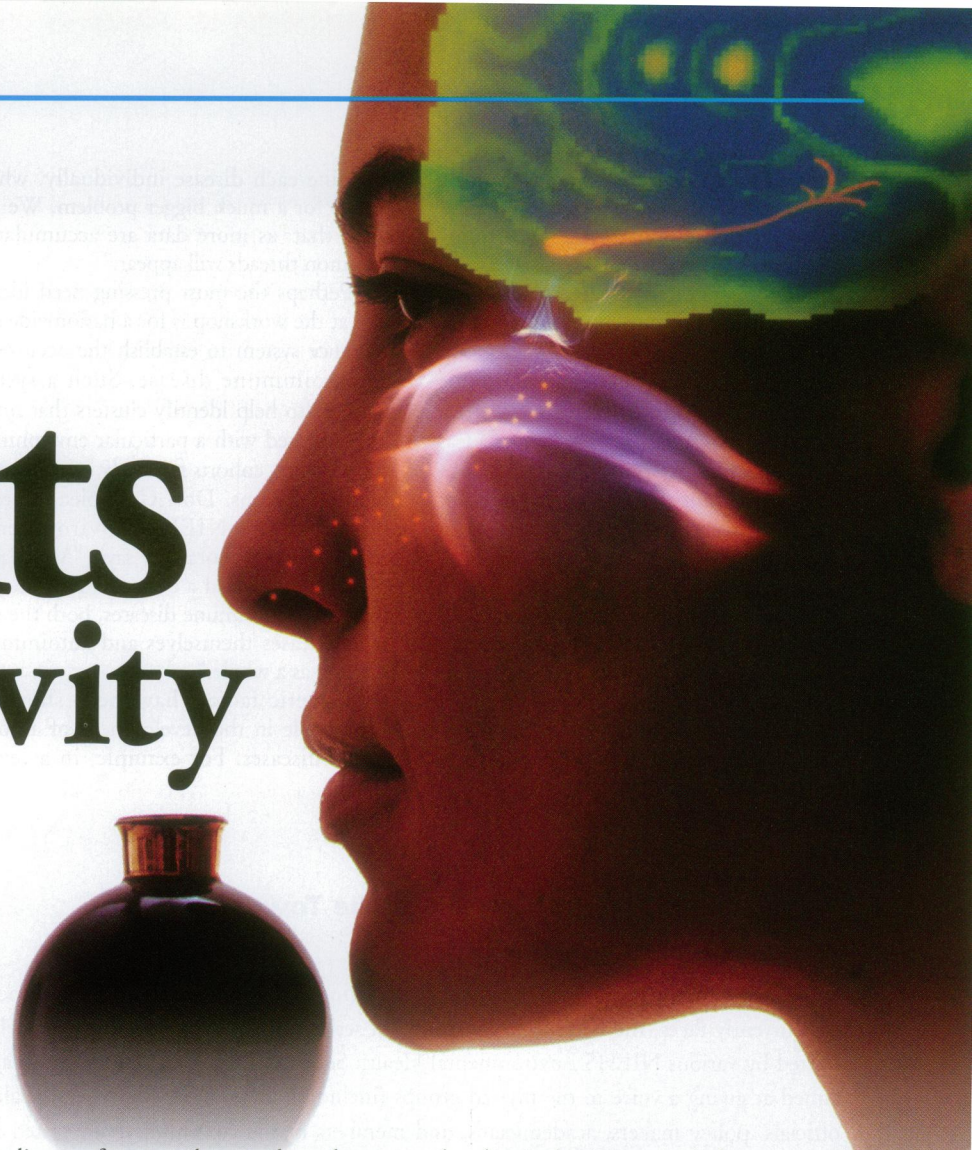
Scents & Sensitivity



Fragrance is ubiquitous in nature and plays a major role in both helping animals and humans locate food and enticing them to reproduce. Throughout history, humans have drawn fragrances from the natural environment for a variety of purposes, including use in religious and burial rituals, in aphrodisiacs, and to cover foul odors. In the late 1800s, the first fragrance containing synthesized ingredients was introduced. Since then, people have used chemicals extensively to mimic scents from nature.

Consumers' fascination with scent has increased with the manufacture of a multitude of scented "personal" products including cosmetics, lotions, soaps, oils, and perfumes. There are more than 1,000 body fragrances (including colognes, perfumes, and toilet waters) on the market today, according to The Fragrance Foundation, a non-profit educational arm of the fragrance industry. Furthermore, scents are now added to a slew of commercial products ranging from cleaning products to tissues, from candles to diapers.

While many people enjoy wearing perfumes and using scented products, there is a growing outcry from some people who claim that exposure to certain fragrances, including perfumes and scented products, adversely impacts their health. They report symptoms such as headaches, dizziness, nausea, fatigue, shortness of breath, difficulty with concentration, and allergy-like symptoms. It has been shown that many asthmatic patients have adverse reactions to perfumes and other fragrances, and some researchers hypothesize that exposure to fragrance may actually cause asthma. People who suffer from multiple chemical sensitivity (MCS), a health condition in which exposure to one chemical is thought to lead to adverse reactions to other chemicals, claim that exposure to fragrance triggers various symptoms, often to the point that sufferers are incapacitated or must forgo many of their usual activities to avoid exposure.

As information continues to surface on the issue of indoor air pollution, it appears that fragrances may represent part of the problem. Some researchers believe that exposure to the types of chemicals found in many scented products may contribute to the development and exacerbation of sick building syndrome, a health condition allegedly caused by indoor air pollution. The chemicals in perfumes, colognes, and deodorants worn by employees add to the chemical mixtures in indoor air, as do fragrances in cleaning products. In addition, some building owners pump certain fragrances—believed to evoke an emotional response that results in increased work productivity—through office ventilation systems.

Claudia Miller, an associate professor of environmental and occupational medicine at the University of Texas Health Sciences Center in San Antonio, says that several studies indicate that 15–30% of the general population report some sensitivity to chemicals, including fragrances, and 4–6% report that chemical intolerance has a major impact on their quality of life. Of these people, more than 80% report that exposure to fragrances is bothersome. Miller, who has conducted extensive research on MCS and coauthored the book *Chemical Exposures: Low Levels and High Stakes*, adds that many Gulf War veterans report new chemical intolerances since the war, including sensitivity to fragrances.

Gerald McEwen, vice president of science at the Cosmetic, Toiletry, and Fragrance Association, a Washington, DC-based trade association for the personal care products industry, says that fragrance materials in most products are at very low

concentrations, and that people who claim to be adversely affected by scented products may actually be reacting to other chemicals in the products or in their environments. He says that affected people are more likely to identify fragrances as the offending agents because they are readily noticeable. McEwen further suggests that reactions to fragrance could be psychological. "This could be a conditioned response just as easily as an organic response," he says.

This theory has many proponents, including Sally Satel, a lecturer in psychiatry in Yale University School of Medicine's department of psychiatry. In her article, published in the May 1997 issue of *Psychiatric Times*, Satel refers to MCS, sick building syndrome, and other chemical sensitivity illnesses as having "elements of paranoia and hypervigilance (directed toward the physical environment), somatization (as well as stress-induced psychosomatic symptoms), hypochondriasis, hysteria, and suggestibility."

Components of Fragrances

The process of developing fragrances is a complex mixture of chemistry and art. Not only must the chemicals used be compatible, the combination must also be aesthetically pleasing to the nose. Synthetic ingredients are less expensive than natural ingredients, and can be created year-round, while the supply of natural ingredients depends on season and availability. Once synthetic ingredients were introduced to the marketplace, perfumes and fragrance materials became more widespread as the demand and supply increased. It is estimated that there are more than 3,000 chemicals used in the manufacture of fragrances. Synthetic organic chemicals constitute more than 80–90% (by weight and value) of the raw materials used in flavor and fragrance formulations. A single fragrance may contain as few as 10 chemicals or as many as several hundred. Like many other chemicals and chemical mixtures in widespread use today, little is known about the impact fragrances have on human health.

Because of the complex and competitive nature of fragrance development, manufacturers were given the right to protect their products through state trade secret laws, which allow them to not disclose the ingredients to anyone. Due to the secrecy surrounding fragrance ingredients, claims of adverse reactions to fragrances may be difficult or impossible to link to particular fragrance chemicals. Such secrecy also makes it difficult for researchers to study the health effects of fragrances. "Because of the number of chemicals and their different volatilities, polarities, and other properties, analysis is expensive and technically sophisticated," says Lance Wallace, an environmental scientist in the EPA's Office of Research and Development in Reston, Virginia.

As part of efforts to identify substances that contribute to indoor air pollution, Wallace and colleagues conducted a study to identify volatile organic compounds emitted by fragranced products. These compounds can be both toxic and carcinogenic and have been associated with the symptoms of sick building syndrome.

The study, published in the proceedings of the Air & Waste Management Association's 84th Annual Meeting and Exhibition, held 16–21 June 1991, examined 31 selected scented products, including perfumes, soaps, and deodorants. The brand names were not revealed because only one semiquantitative analysis was made for each sample; therefore, the results could not be said to be indicative of that sample's typical composition. The researchers identified a total of 150 unique chemicals in the 31 products. Chemicals that appeared in more than half of the products included ethanol, limonene, linalool, β-phenethyl alcohol, and β-myrcene. The authors point out that few of these chemicals have been tested for carcinogenicity, but say that some, such as α-pinene, are known mutagens and others, such as camphor, have known toxic effects at high concentrations. Limonene has been tested for carcinogenicity and was observed to cause cancer in male rats, but not in mice or female rats. Wallace cautions that, while the chemicals have been identified as components of fragrances, health effects may occur at far higher doses than what may typically be found in fragrances.

Mary Lamielle, executive director of the National Center for Environmental Health Strategies, a national nonprofit organization dedicated to finding creative solutions for environmental health problems, points out that, even though the chemicals may be present at low levels in perfumes and products, people generally do not experience just a single exposure. "These same chemicals are cropping up in many different products," she says.

Self-regulated Industry

Currently, the fragrance industry is essentially self-regulated in the United States. The FDA's Office of Cosmetics and Colors has jurisdiction over perfumes and fragrances used in cosmetics, but does not require an approval process or premarket clearance for perfumes or cosmetics containing fragrance, says John Bailey, Jr., director of the office. Therefore, the FDA does not technically have jurisdiction over products until they are on the market. "It is up to the manufacturer to market a safe product," Bailey says. "If there's an identifiable public health risk, then certainly the agency can step in and take action." However, he says, "People claim to be sensitive to fragrances, but in spite of efforts to try to characterize the risk, the issue has defied a concise identification of a public health risk [and has] defied a good solid scientific definition. Therefore, the agency is not in a position to propose a change in regulation."

Due to the trade secret rules, the FDA does not require manufacturers to reveal fragrance ingredients to the agency, nor does it require them to list the fragrance ingredients on the products themselves. The manufacturer is simply required to list the collective term "fragrance" in the ingredients, a term that is often representative of a complex mixture of chemicals, Bailey says. But Bailey also says the industry does regulate itself through a safety review process, and that the FDA has periodically monitored this process.

Many manufacturers of fragrance chemicals conduct their own safety tests. In addition, the fragrance industry developed the Research Institute for Fragrance Materials (RIFM, pronounced "RIFF-um") in 1996 to conduct research on fragrance ingredients in order to ensure the

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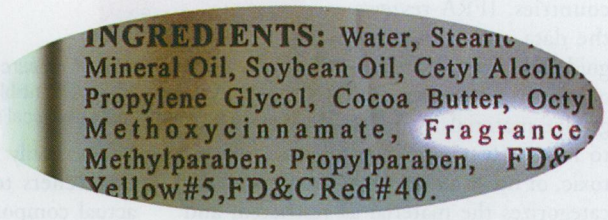


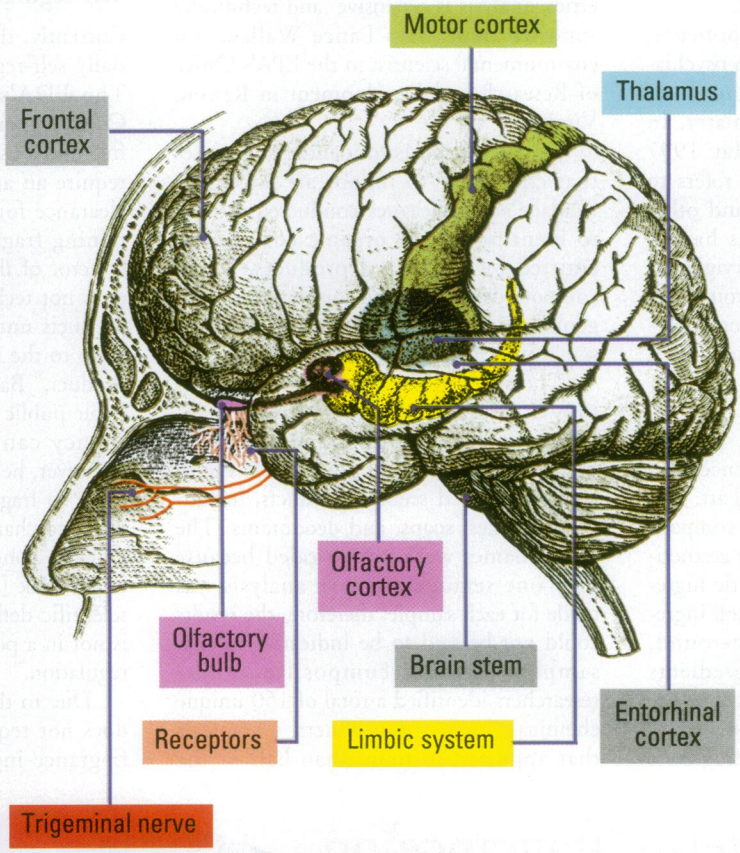
safety of perfumery materials. According to Glenn Roberts, a spokesperson for RIFM, fragrance ingredients undergo a multistep testing process. "We are committed to developing safe products," Roberts says.

RIFM tests raw perfumery materials that are selected by an independent expert panel made up largely of academics, Roberts says. The ingredients are most commonly tested for allergenicity, phototoxicity, and general toxicity by oral and dermal routes. Some of the tests are conducted on animals while others, such as skin patch tests, are conducted on humans. To date, RIFM has tested more than 1,300 fragrance materials, and publishes test results in scientific journals such as *Food and Chemical Toxicology*, says Roberts. The National Toxicology Program has also conducted tests on many of these chemicals.

The results of the fragrance screenings are then submitted by RIFM to the International Fragrance Association (IFRA), an international organization composed of more than 100 fragrance manufacturers from 15 countries. IFRA reviews the data and establishes guidelines for the safe use of the materials. If a fragrance material is found to have neurotoxic, carcinogenic, phototoxic, or other adverse health effects, IFRA categorizes the material as restricted, and recommends amounts of the material for use in fragrance formulas. While many companies voluntarily adhere to the IFRA safety guidelines, they are not required by law to follow any of the group's recommendations, or to limit the use of any fragrance materials. Roberts points out that, while RIFM tests only the raw materials, the manufacturers of the finished fragrance products also often conduct safety tests.

Research on Fragrances and the Sense of Smell

Extensive research has been conducted on the allergic effects of fragrances on skin, and many fragrance materials have been shown to cause dermal allergic reactions. RIFM conducts most of its research on the dermal effects of fragrances, rarely testing the effects of inhaling fragrance chemicals. Roberts says, "It has always been the scientific opinion of the industry that the skin is the primary route of exposure [for fragrances]." However, he says the industry "continues to think about and look at" the issue of respiratory testing.



Mind-body connection. Some researchers believe the proximity of the olfactory bulb to the limbic system in the brain is responsible for the strong link between emotion and the sense of smell, and may contribute to chemical sensitivity illnesses.

Not only is it difficult for nonindustry researchers to identify and quantify the actual components of fragrances, it is also challenging to study how inhaling these chemicals impacts human health because very little is known about the olfactory system, and very little research has been conducted on the passage of fragrance molecules into the body via this system. There is a strong link between the sense of smell and emotion; many researchers believe this is due to the proximity of the olfactory bulb to the limbic system, which popular media have dubbed "emotion central." The nasal passage offers a unique route of exposure for chemicals, which can proceed directly into the brain because of the proximity of these systems. "The olfactory/limbic tract is the most direct connection between our brains and the air we breathe," says Miller. "There is no blood–brain barrier." Studies have shown that in rodents, chemical molecules can move through the nose directly into the brain, passing through only one or two synapses. Miller says research indicates that molecules follow this same route in humans.

Another problem in studying fragrances, according to Dennis Shusterman, an associate clinical professor in the division of occupational and environmental medicine and director of the Upper Airway Biology Lab at the University of California at San Francisco, is the assumption that the only property of a fragrance chemical is its ability to stimulate the olfactory nerve and produce the sensation of smell. "In fact, [such chemicals] can stimulate both the olfactory and the trigeminal nerve, which mediates irritation," Shusterman says. Stimulation of receptors in the trigeminal nerve results in the perception of irritancy or pungency, causing sensations such as stinging, burning, piquancy, prickling, freshness, and tingling. This process is referred to as sensory irritation and can result in a localized neurogenic inflammation.

Many researchers believe that exposure to fragrance and other chemicals can indeed cause irritation, which can mimic the symptoms of allergies. James Wells, a professor of medicine at the University of Oklahoma Health Sciences Center in Oklahoma City, recounts that in his private practice as an allergist, he has encountered many patients who complain of reactions to specific perfumes or fragrances. He has observed that in a vast majority of the cases, the reaction to the fragrances is one of irritation, not allergy. Wells says the reactions to irritants are less responsive to treatment than allergies, and that avoiding the offending chemicals appears to be the only effective solution. Wells stresses that he has not conducted research, but that in his clinical experience, he has found that these patients also react to other irritants, such as detergents, cleansers, and deodorizers that emit volatile chemicals into the air.

Common Chemicals Found in Fragrance Products

Chemical	Odor description	Possible health effects*
acetone	n/a	skin, eye, and mucosa irritation; headache; nausea; drowsiness
benzaldehyde	strong, sharp, sweet, bitter, almond, cherry	respiratory irritation; CNS depression; liver damage; dermatitis
benzyl acetate	sweet, floral, fruity, fresh	skin, eye, and respiratory tract irritation; decrease in blood pressure and depth of respiration; increase in cardiac rate
benzyl alcohol	light, floral, rose	skin, eye, mucosa, and respiratory tract irritation; delayed lung injury; GI disturbances; nausea; headache; dizziness
camphor	camphor, minty, phenolic, woody	burning sensation; coughing; wheezing; laryngitis; shortness of breath; headache; severe irritation of the mucosa, upper respiratory tract, eyes, and skin; flickering, darkening, or veiling of vision; noises in the ears; weakness; feeling of warmth; CNS depression; difficulty breathing
1,8-cineole	eucalyptus, mint, herbal, rosemary	epigastric burning; nausea; vomiting; vertigo; ataxia; muscle weakness; stupor; pallor
ethanol	n/a	skin and eye irritation; headache; nausea
ethyl acetate	dry, fruity, musty, pineapple	headache; nausea; vomiting; narcosis
limonene	lemon	skin irritation and sensitization; eye irritation and damage; dizziness; rapid and shallow breathing; tachycardia; bronchial irritation; unconsciousness; convulsions
methylene chloride	n/a	eye and respiratory tract irritation; headache; dizziness; stupor; nausea; vomiting; parasthesias of extremities; skin inflammation; skin burns; unconsciousness
α-pinene	fresh, sweet, pine, earthy, woody	palpitations; dizziness; nervous disturbances; chest pain; bronchitis; benign skin tumors

From: Wallace LA, Nelson WC, Pellizzari E, Raymer JH, Thomas KW. Identification of polar volatile organic compounds in consumer products and common microenvironments. Proceedings of Air & Waste Management Association 84th Annual Meeting & Exhibition, 16–21 June 1991, Vancouver, British Columbia.

*Some health effects may occur as result of chronic or high-level exposures to the chemical

Abbreviations: CNS, central nervous system; GI, gastrointestinal.

Sources: Material Safety Data Sheets. Cornell University, http://MSDS.PDC.CORNELL.EDU/issearch/msdssrch.htm

Chemical Health and Safety Information. National Toxicology Program, http://ntp-server.niehs.nih.gov/

The Good Scents Company, http://www.execpc.com/~goodscnt//index.html

Despite the similarity of the symptoms, though, Shusterman says existing studies indicate that the process behind chemical-induced irritation is a different phenomenon from allergies altogether. Shusterman adds that many studies have indicated that people who have preexisting nasal allergies such as hay fever either perceive or react more strongly to irritant chemicals.

William Cain, a professor of surgery, Enrique Cometto-Muniz, an associate research scientist, and colleagues at the Chemosensory Perception Laboratory at the University of California at San Diego are conducting extensive research on the sense of smell and sensory irritation from chemicals in the indoor environment. Cometto-Muniz says the goal of the research is to provide further insight into the sense of smell so that it can be as well understood as the visual and aural senses. "We know very well the electromagnetic spectrum to which the eye responds and the vibrational spectrum to which the ear responds, but we don't know the chemical spectrum to which the nose responds," he says.

Cain says an important issue to consider in investigating the effects of fragrance on the body is differentiating between psychological irritation from unpleasant chemical odors and actual sensory irritation from chemicals. Because of the strong tie between the sense of smell and emotion, researchers say foul odors emitted by certain chemicals can provoke people to believe their health is being impacted when, in fact, the offending substance may be benign.

Cain and Cometto-Muniz are working to establish the odor and irritant thresholds of chemicals—at what level a chemical first is an odorant and then becomes an irritant. Identifying such thresholds will aid in distinguishing the psychological response to odor from measurable nasal and eye irritation. The involvement of anosmics, or people who have no sense of smell, in the studies allows for the "perfect opportunity to differentiate what is a trigeminal response from an olfactory response," says Cometto-Muniz.

So far, the group has successfully established the threshold levels of physiological irritation for several chemical mixtures. Their research has indicated that the higher the number of chemicals being combined, the lower their individual levels need to be to cause sensory reactions. Areas they plan to further investigate include chemical mixtures, as well as the role of time in sensory irritation and sense of smell. Cometto-Muniz says that when a person is exposed to an odor, the sensation appears to diminish over time as the person seemingly adapts to the odor, while sensory irritation occurs in an opposite manner—as time passes, irritation increases. While there are still many questions about how long-term sensory irritation may affect health, Cometto-Muniz points out that "sensory irritation is there to warn us that continued exposure could potentially be dangerous."

One of the few studies that has looked at the effects of inhalation of specific fragrance chemicals and perfumes was conducted at the private Anderson Laboratory in West Hartford, Vermont, by Rosalind Anderson, founder and owner of the laboratory, and Julius Anderson, vice president. The goal of the study was to determine whether fragrance products can produce acute toxic effects in mammals. The

Andersons exposed laboratory mice to five fragrance products—four colognes and one toilet water. The mice breathed the emissions of the products for 1 hour and then were tested using the ASTM-E-981 method to evaluate sensory irritation and pulmonary irritation, as well as a functional observational battery to look for changes in the nervous system function.

The study, published in the March–April 1998 issue of *Archives of Environmental Health*, showed that the emissions of the fragrances produced various combinations of sensory irritation, pulmonary irritation, decreases in expiratory airflow velocity, and alterations of the functional observational battery indicative of neurotoxicity. Neurotoxicity was more severe after mice were repeatedly exposed to the products.

The Andersons say the findings indicate that some fragrance products produce toxic effects in at least one mammalian species. In the study's conclusions, they wrote, "Collectively, the experimental data and chemistry predict that some humans exposed to these fragrance products might experience some combination of eye, nose, and/or throat irritation; respiratory difficulty; possibly bronchoconstriction or asthma-like reaction; and central nervous system reactions (e.g., dizziness, incoordination, confusion, fatigue). The results of our study might help explain why some individuals report an intolerance to [fragrance products] and why some [fragrance products] can exacerbate airflow limitation in some asthmatics."

Miller says it's important to recognize that many people who report sensitivities to fragrances also report sensitivities to other chemicals. Because fragrances are noticeable, they may be more commonly reported as causing symptoms than other chemicals. Miller conducted a study, published in the March–April 1995 issue of *Archives of Environmental Health*, that surveyed 112 people who reported onset of MCS following a well-documented exposure to either a pesticide exposure or remodeling of a building. Miller and colleagues hypothesize that MCS may be explained by what they call toxicant-induced loss of tolerance, a two-part process involving a single high-level chemical exposure followed by subsequent triggering of symptoms by everyday exposure to chemicals.

Scents-ing overload? Many manufacturers now offer fragrance-free versions of their products for consumers who prefer that not all personal products be scented.

Respondents were asked to identify possible trigger exposures via inhalation and ingestion and report symptoms. About 90% of respondents reported that perfumes triggered their symptoms, but Miller stresses that many other exposures triggered symptoms as well, including insecticides, traffic exhaust, new carpet, paint, and various foods. The most frequently reported symptoms included lethargy, memory difficulties, feelings of depression, dizziness, "spaciness," and shortness of breath.

One other issue to consider is that of the effect of fragrance exposure on children's health. Today, many children's products are scented, and there are many fragrances marketed specifically toward children. Betty Bridges, a registered nurse and founder of the Fragranced Products Information Network, a Web site containing information about chemicals used in scented products and their health effects, says that children may be more susceptible to the effects of such products because of their smaller size, their higher respiratory rate, and their thinner skin. However, little research has been done on this issue.

A Fragrance-free Future?

Some patient groups claim that in the next decade, the issue of fragrance will be as controversial as today's tobacco smoke issue. They say the debate over people's right to smoke versus others' right to breathe clean air could also be applied to fragrance. McEwen calls the comparison between tobacco smoke and fragrances "absurd," saying, "Fragrances are scents that are basically taken from nature. They have been around forever. There is no process of combustion involved and they are not addictive."

However, many organizations are taking the fragrance sensitivity issue seriously. At an American Chemical Society meeting held in August 1998 in Boston, Massachusetts, attendees were asked not to wear fragrances due to the number of chemically sensitive people attending the meeting. Miller says that requests for people to refrain from wearing scented products are appearing with more frequency on social invitations, as well as in public meeting notices. At the University of Minnesota School of Social Work in Minneapolis, signs are posted at entrances to the department, stating, "Some persons employed or studying in the School of Social Work report sensitivities to various chemical-based or scented products. We ask for everyone's cooperation in our efforts to accommodate their health concerns."

In recent years, perhaps in response to the abundance of fragrance encountered by people on a daily basis, the trend of scenting products has been somewhat reversed. Many manufacturers are now removing fragrance from products and touting "fragrance-free" and "unscented" versions of products such as laundry detergent and fabric softeners.

However, chemically sensitive patients warn that, even though a product is labeled unscented or fragrance-free, it doesn't necessarily mean that it contains no fragrance chemicals. As studies have documented, manufacturers will often add masking chemicals to cover the scent of other chemicals in the product, resulting

in a product that does not produce a detectable scent.

As for manufacturers that label their products as fragrance-free or unscented, Bailey says the FDA requires them to list the term "fragrance" in the ingredients when any fragrance materials are used—even masking ingredients. If the manufacturer fails to list fragrance ingredients, the FDA has the power to take regulatory action.

Whether the fragrance issue can and will be regulated remains to be seen. The U.S. Postal Service passed a regulation in April 1990 stating that "a fragrance advertising sample is nonmailable unless the sample meets the following requirement: It must be sealed, wrapped, treated, or otherwise prepared in a manner reasonably designed to prevent individuals from being unknowingly or involuntarily exposed to the sample." The California state government expanded the concept of that rule in 1992 by passing a regulation stating that "Any fragrance advertising insert contained in a newspaper, magazine, mailing, or other periodically printed material shall contain only microencapsulated oils. Glue tabs or binders shall be used to prevent premature activation of the fragrance advertising insert." In addition, several magazines now offer a "scent-free" version at the subscriber's request.

Lamielle and others are working to raise awareness of the issue of fragrance sensitivity. "Unfortunately, a lot of people don't realize that this is a serious issue, because it sounds so trivial," she says. "There's a huge population who do get sick from these products." In order to help solve the problem, Lamielle says that people should use less-toxic, unscented products and be considerate of those who are affected by fragrance sensitivity.

The issue of the environmental health effects of fragrances is complex, controversial, and slowly garnering more public attention. While Lamielle and Bridges say the number of people claiming to be affected by fragrances seems to be growing, Roberts says the fragrance industry has not seen an increase in complaints from consumers. "Fragrance helps many people enjoy their lives, but if there is a problem, we hope that [consumers] will call the manufacturers and we'll work to resolve it. We are always open to new ideas," says Roberts.

McEwen says it is important not to forget the many benefits of fragrances. They are used in the identification of different products, for instance by distinguishing a cough syrup from an emetic. They can also mask objectionable odors in certain products. "Fragrance really is like beautiful colors, beautiful music—a sensory phenomenon. It makes life better," McEwen says.

In the end, however, the only indisputable fact is that there is a lack of research on the issue. Says Miller, "It's worrisome, and should be explored with good, careful scientific studies."

Brandy E. Fisher

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