



MONELL CHEMICAL SENSES CENTER

Advancing Discovery in Taste and Smell

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SCIENCE AT MONELL

Basic research at Monell increases fundamental knowledge about the mechanisms and functions of the senses of taste, smell, and chemesthesis – the chemically-stimulated skin sense (examples include the “bite” of hot peppers, the “tingle” of carbonation, or the “cool” of mint). Monell’s scientists choose research projects based on their own curiosity and interests, without regard to immediate practical applications. Findings are published in a wide variety of peer-reviewed scientific journals.

SCIENTIFIC RESEARCH PROGRAMS

Since Monell’s inception, its research has been highly interdisciplinary; sensory psychologists work with biophysicists, biochemists with behavioral neuroscientists, environmental scientists with geneticists. Clinical studies are conducted at the Monell-Jefferson Chemosensory Clinical Research Center, located at Thomas Jefferson University in Center City, Philadelphia. Although Monell has no formal departments or divisions, most of the Center’s science falls into one of seven major programmatic areas:

- **Sensation and Perception** reveals how humans recognize, perceive and respond to tastes, odors and chemical irritants. Many studies focus on individual differences, examining how genetics, age, gender, experience, and the environment influence sensory capabilities. Scientists also explore how interactions within and among the senses influence perception of chemosensory stimuli.
- **Neuroscience and Molecular Biology**
The Center’s neuroscientists address questions of how receptor cells recognize and respond to chemical stimuli, and how this information is transmitted to and processed in the brain. Studies use living human taste and olfactory receptor cells obtained from healthy and clinical populations, helping to characterize how chemosensory function changes with aging and disease states. Scientists are identifying the genes that encode proteins essential to taste and olfaction, along with genes responsible for individual differences in taste and odor sensitivity. Other studies explore how genetic differences in taste and smell relate to nutritional status, alcoholism and obesity.

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- **Environmental and Occupational Health** focuses on both positive and negative health effects of exposure to airborne chemicals in home, work, and outdoor environments. Studies examine the impact of volatile chemicals on chemosensory function and bodily processes, and address the role of cognitive expectations in the response to airborne chemicals. Experimental, epidemiological, and modeling approaches enhance understanding of the chemical senses in occupational and environmental settings.

- **Appetite and Nutrition** studies determinants of food and flavor preferences across the human lifespan, from infancy to old age. Researchers also explore basic biochemical, neural and physiological mechanisms controlling appetite and food intake to determine their role in overeating and the development of obesity. Other studies probe food cravings and appetites for salt and calcium.

- **Health and Well-Being** targets chemosensory dysfunction and its impact on our lives. Monell's research scientists interact with clinicians to understand and eventually alleviate chemosensory dysfunction, which can reduce quality of life, induce nutritional imbalance, and render us more vulnerable to food poisoning, environmental toxins, and fire hazards. The production and functions of human body and mouth odors are another focus of investigation.

- **Chemical Ecology and Communication** investigates the roles of chemical signals, including pheromones and individual 'odortypes', in human reproductive behavior and social communication. In conjunction with the U.S. Department of Agriculture, Monell scientists also study the mechanisms that underlie chemosensory-mediated attraction or repellency in birds, reptiles, and fish. This knowledge is helping to identify ways to protect threatened species, minimize crop damage, control non-indigenous species, and reduce conflicts between humans and wildlife.

- **Development, Aging and Regeneration**
 Studies in this program explore how the senses of taste and smell change across the lifespan, and how in turn these changes influence human nutrition and health. Because both taste and smell receptor cells continually turn over, these cells can provide important insights about cellular differentiation, growth, and regeneration; Monell scientists utilize olfactory receptor cells, which also are nerve cells, to model changes in the central nervous system associated with aging and neurodegenerative disease.

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BENEFITS OF MONELL'S RESEARCH

Basic research at Monell opens doors to discovery and progress in many areas related to health and quality of life, including: obesity; anorexia; diabetes; hypertension; psychiatric and neurodegenerative disease; multiple chemical sensitivity; excessive or unpleasant body odor production; smell loss; alcoholism; post-traumatic stress syndrome; fertility; pediatric nutrition; lactational performance; pharmacological compliance; aging; homeland security; occupational health; and environmental pollution.

A major focus involves the extensive collaboration between researchers in the fields of molecular biology and human sensory perception. Results increase understanding of the influential role of genetics in determining the wide range of human sensitivity to taste and odors, ultimately influencing food choice and nutrition across the lifespan.

Monell's science also provides insight into many of life's pleasures, such as the evocative scent of a sensual perfume, the complex and lingering flavor of a fine chocolate, or the indescribable emotional connection to the smell of a baby's head.

SELECTED ACCOMPLISHMENTS

- Defined the locus and sequencing of a gene coding for the primary human sweet taste receptor.
- Evaluating the impact of exposure to toxic mists and vapors on nasal inflammation and chemosensory loss among rescue and demolition workers at the World Trade Center site.
- Pioneered the study of 'odortypes', genetically-determined olfactory markers of individual identity.
- Provided understanding of bitter taste necessary for development of inhibitors against the bitter taste of several medications, helping to improve pharmaceutical compliance in pediatric and adult populations.
- Mapped genes for obesity in mice and humans, providing the groundwork needed to identify variation in the human genome that contributes to obesity.
- Used sensory properties to identify a novel anti-inflammatory pharmacological agent in olive oil.

- Demonstrated the important role of flavor experience during gestation and very early life on food and flavor choice and liking of children.
- Revolutionized the understanding of chemical communication through pheromones – compounds signaling reproductive, social, and individual information – in human and animals.
- Established the use of living human olfactory cells in research, aiding the study of neuropsychiatric disease such as bipolar disorder, neurodegenerative diseases including Alzheimer's and Parkinson's, and aging.
- Designed and analyzed the largest smell survey in history, over 1.6 million responses, in collaboration with *The National Geographic Magazine*.

SCIENCE EDUCATION

Advancing scientific education is an integral part of Monell's mission. The Center has provided training for hundreds of scientists from high school interns to post-doctoral fellows to senior investigators. Over 300 Ph.D.-level scientists have received training at Monell. An annual summer internship program introduces high school and college students to hands-on science research.

LOCATION

Monell's specialized laboratories and state-of-the-art facilities are located in University City, Philadelphia adjacent to the campus of the University of Pennsylvania. Due to Monell's success and sustained growth, the Center recently raised \$11.2 million to build state-of-the-art laboratories for current and new faculty in its integrated molecular biology and human sensory research programs. Monell is an important community asset, with its ongoing expansion playing a key role in the growing vitality and development of the University City neighborhood. The Center also is a vital resource that strengthens Philadelphia's reputation as an innovative science and technology hub.

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