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[Olfaction is involved with obesity in that smell... in Encyclopedia of Obesity](#)

Summary Article: **Axel, Richard (1946-)**
from *The Hutchinson Dictionary of Scientific Biography*

Place: United States of America

Subject: biography, biology

US neurobiologist who discovered the molecular mechanisms by which we perceive odours. In 2004, he received the Nobel Prize for Physiology or Medicine.

Axel was born 2 July 1946 in New York City. He studied literature at Columbia and discovered his passion for biological research when he worked as a glass washer for Bernard Weinstein (1930-2008), a medical professor who investigated the genetic code. He obtained a medical doctorate from Johns Hopkins University, Baltimore, Maryland in 1970, even though he recalls being so incompetent at clinical work that his supervisors made him promise never to practice medicine on a live patient. Axel finally got his chance to perform research in molecular biology with molecular biologist Sol Spiegelman (1914-1983) at Columbia University, where he became an assistant professor in 1974 and a professor in 1978.

In the early days, his lab developed new ways of introducing foreign genes into mammalian cells in culture, which became an important tool of the nascent biotechnology industry. His group also identified the CD4 receptor which allows the AIDS virus, HIV, to attach itself to immune cells and infect them.

In 1982, Axel started to apply molecular biology to problems from neuroscience through a collaboration with his Columbia faculty colleague Eric Kandel, who investigated the molecular basis of memory in the sea snail *Aplysia*. Combining his new molecular biology techniques with Kandel's experience in neurobiology, Axel's group identified a family of genes linked to the innate behaviour patterns associated with egg-laying.

In 1988, Linda Buck came to his lab and set out to investigate odour reception in mammals, about which next to nothing was known at the time. While scientists assumed that there must be specific receptor molecules for odorants in the ends of the olfactory neurons, no such receptor had been found.

Buck and Axel embarked on the search for the receptors using three key criteria. First, since we can distinguish odorants with very different structures, there would be a family of varied, but related, odorant receptors, which would be encoded by a family of many genes. Second, if odour works the same way as other senses, odorant receptors would be at least distantly related to the relatively small group of sensory receptors whose sequences were known at that time. Typically, these receptors share the ability to interact with a group of proteins known as G proteins, which serve as a switchboard in signal transduction. And finally, odorant receptors would be found in the olfactory epithelium, where olfactory sensory neurons are located.

Using these search criteria, Axel and Buck discovered a family of around 1,000 odour receptor genes in the rat, which they described in a breakthrough publication in 1991. It showed that the three criteria were correct, and that the odour receptors are in fact members of the larger super family of G-protein coupled receptors, which also includes molecules involved in vision, taste, and pain.

In 2004, Axel shared the Nobel Prize for Physiology or Medicine with his former coworker, Linda Buck. He has continued to apply methods of molecular biology to neurobiological problems, including the in-depth investigation of odour perception. In particular, his laboratory addresses the questions of how the sense of smell is established during embryonal development, how it changes over time, and how certain odours can elicit specific associations in the mind.

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