Reading: How do we detect odors?

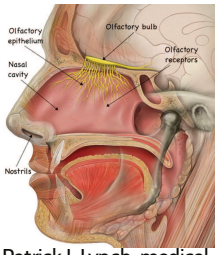
Imagine back to a time when you smelled something really pleasant, such as a type of flower, soap, or food. When you smelled these, how far away was the source from your nose? Was it right up against your nose? Or was it something you smelled from across the room or from something farther away?

Now imagine a time you smelled something that you did not like the odor of, such as burnt popcorn, hot asphalt, or a skunk. How close or far away were you from these things when you could smell them?

There are some odors that are very strong, such as lilacs, fresh baked cookies, burnt toast, or vinegar. Many times we can detect these smells even when we are not near the source they came from. How do you think we are able to smell something that is coming from something far away from our nose?

The way we smell something from far away is related to the movement of molecules from the source of the odor to our nose. This process is similar to what happens to water molecules when they evaporate. Have you ever left a glass of water out overnight? What have you noticed happening to the amount of water in the glass over time? Overtime you probably noticed that the amount of water in the glass has decreased due to the water evaporating and becoming water vapor. This means molecules of water have separated from other molecules of water and are now in the air. The same thing happens to other substances—over time molecules of the substance can evaporate and the molecules then go into the air and move around. Eventually these molecules can reach our nose. This is what happens when we detect an odor. Our nose is detecting a certain type of molecule reaching it.

When these molecules reach our nose and we breathe them in, they enter the nasal cavity where there is mucus that these molecules dissolve in. Under this mucus is what is called the olfactory epithelium, where there are special receptors that can detect odors, called olfactory receptors. These receptors can detect many different odors. "The receptors are like locks and the keys to open these locks are the odor molecules that float past," explains Leslie Vosshall, a scientist who studies olfaction at Rockefeller University.[1] "Each receptor can be activated by many different types of molecules, and each molecule of an odor can activate several different types of receptors. Think of a lock that can be opened by 10 different keys. Two of the keys are a perfect fit and open the door easily. The other eight don't fit as well, and it takes more jiggling to get the door open," explains Vosshall. The molecules are like the keys that open these locks.



Patrick J. Lynch, medical illustrator; C. Carl Jaffe, MD, cardiologist. CCBY 2.5 Generic.

Once the odors make contact with a receptor they stick to it and are "locked" into the receptors. When this happens these types of receptor neurons relay a signal to the brain through other nerve cells that are part of a structure called the olfactory bulb that is located at the back of the nose. These signals are processed by our brain. Memories of other experiences with similar signals help us categorize and recognize times when we detected the same or very similar odor.

Similar odors tend to be caused by similar shaped molecules that reach these nerve cells. Different molecules have different atoms that make them up. Each different substance, therefore, is made of different kinds of molecules. When these different molecules enter our nose and nasal cavity, they might connect to one of the many different receptors that are able to accept their shape of molecule. Some molecules aren't detected by our receptors, because their shape doesn't fit into any of them. This explains why some molecules of substances that reach our noses seem odorless to us.

Most scents we recognize are composed of more than one type of odor molecule reaching our noses; a whiff of lavender, for example, is made up of 7 different types molecules and 2 of the main ones are linalool and linalyl acetate. When all 7 of those molecule types are received by the different receptors at the same time a signal is sent to the brain that we are smelling lavender.

There are scientists who study the sense of smell. These scientists estimate there to be around 1 trillion different scents that a human can potentially detect.

Adapted from the following sources:

1. Marin, A. (2015, Jan.). *Making sense of scents: Smell and the brain.* Retrieved from: www.brainfacts.org/thinking-sensing-and-behaving/smell/2015/making-sense-of-scents-smell-and-the-brain.
2. Williams, S.C.P. (2014, Mar.). Human Nose Can Detect a Trillion Smells. *Science*. www.sciencemag.org/news/2014/03/human-nose-can-detect-trillion-smells.
3. Morrison, J. (2014, Mar.). Human Nose Can Detect 1 Trillion Odours. *Nature News*. Retrieved from: www.nature.com/news/human-nose-can-detect-1-trillion-odours-1.14904.
4. Klein, J. (2018, Jan.) They Hunt. They Gather. They're Very Good at Talking About Smells. *The New York Times.* Retrieved from: www.nytimes.com/2018/01/19/science/smells-descriptions-hunter-gatherers.html.
5. California Deaf and Blind Services (2004). The Sense of Smell: A Powerful Sense. Reprinted by: www.tsbvi.edu/seehear/summer05/smell.htm#:~:text=Vaporized%20odor%20molecules%20(chemicals)%20floating,receptor%20neurons%20detect%20the%20odor.