FEATURE: If We Could Design a Nose

VOICE: If we wanted to design the ideal nose, how would we do it? What features would we build into it? And where would we install it on the body?

PROF.: As we think about those questions, we'll find some surprising answers. Let's talk.

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PROF.: If we wrote a job description for the nose, it would be a long and important list. It would include protecting us from infection and from poisons, diagnosing disease, detecting danger, identifying food and recognizing relatives.

VOICE: I think of the nose as primarily the organ of smell. You said another of its functions is protecting us from infection. How does that work?

PROF.: The nasal passages remove bacteria, dirt, smoke and other substances that would infect or irritate the lungs.

Hairs in the nostrils do the rough cleaning job. Then the mucus in the nose does the major cleaning. It acts like flypaper to trap bacteria and particles that get past the hairs.

VOICE: So mucus is ***adhesive***, to trap bacteria and other harmful substances.

PROF.: But to achieve that, the nose can't allow the mucus to stagnate. If it did, there would soon be a major buildup of pollution. So the nose produces a fresh supply of mucus many times per day. Small hair-like substances called Cilia [SIL-ee-uh] remove the old mucus, making continuous sweeping strokes.

Another protection against bacteria is a microbe-killer called lysozyme [LY-soh-zyme], the same substance that protects the eyes from infection.

VOICE: What else does the nose do, besides detecting odors and protecting the lungs from substances that would damage them?

PROF.: It conditions the air for the lungs. The lungs can't handle dry, freezing air, so the nasal passages warm and humidify it.

The turbinates or nasal conchae are long, narrow, curled bone shelves – shaped like a seashell and protruding from the side walls of each nostril. The late medical author J. D. Ratcliff called them "tiny radiators," with a blood supply that is enormous by comparison to its size, to provide heat to them.

VOICE: I read somewhere that our sense of taste depends more on the nose than on the tongue.

PROF.: That's true. Dr. Geoffrey Simmons writes, "To get an idea of how much your nose contributes to taste, pinch your nostrils together while eating. Food becomes dull and tasteless…" A person can still taste food with a damaged tongue, but a bad sinus infection will turn most food into tasting like soft cardboard.

VOICE: What did you mean when you said a few moments ago that our noses protect us from poison and from danger?

PROF.: Dr. Simmons answers that, without our sense of smell, "we would not be able to tell spoiled milk from fresh, perfumes from poisons, the fragrance of a flower from the stench of a dead animal." Police use the sense of smell to tell whether a gun has been fired or to estimate how long a body has been dead. Doctors can diagnose kidney failure by a patient's odor. Detecting the smell of a gas leak or smoke can save a person's life.

VOICE: I understand that we can smell substances because they eject "odor molecules" into the air. But I've read conflicting interpretations of how the nose determines what smell each molecule has.

One theory says that the molecule for each odor has a different shape and size. When a molecule fits into a particular odor receptor, it's like turning a key. It triggers a neuron to send a signal to the brain, and the brain interprets that signal as a certain odor.

PROF.: That seems to be at least partly true. But an article in *Science Daily* indicates that it's more complex than that. Some research seems to indicate that the receptors also respond to the fact that various molecules ***vibrate at different frequencies***.

VOICE: So a ***combination*** of molecule shape and vibration frequency determines what smell that molecule is dispatching to the brain?

PROF.: Some research seems to imply that. The brain deciphers the electrical signal and knows whether the substance is a delicious dessert or a deadly poison.

VOICE: We discovered on previous programs that the organs of seeing and hearing generate complex digital signals and send them to the brain. It sounds as if that's also true of the organs of smell.

PROF.: Definitely. Nobel laureate Dr. Richard Axel wrote an article for *Scientific American*, describing the anatomy of the nose and other organs that are involved in detecting odors. He called the article, "The Molecular Logic of Smell."

VOICE: "Logic" is a computer word, meaning coded information. One organ or person generates information in coded form, and another understands how to ***de-***code it and use it.

PROF.: Yes, and the portions of the brain and nervous system that process odors use several layers of computing to transmit and interpret that information. In mammals, the first detection of odors takes place at the back of the nose, in the small region known as the olfactory epithelium [ep-uh-THEE-lee-um]. Millions of neurons, the signaling cells of sensory systems, provide a direct physical connection between the external world and the brain. From one end of each neuron, hair-like sensors called cilia [SIL-ee-uh] extend outward and are in direct contact with the air. At the other end of the cell, a fiber known as an axon runs into the brain.

VOICE: How does that send digital signals to the brain?

PROF.: When an animal or human inhales odor-producing molecules, they attach to specialized receptor proteins. Odors bind to these receptors, generating an electrical signal that travels along the axons to the olfactory bulb, located in the front of the brain. This bulb serves as the first relay station for processing information in the brain. The bulb connects the nose with the olfactory cortex, which then projects to higher sensory centers in the cerebral cortex.

VOICE: So the nose and the nervous system recognize each smell by using several levels of computerized processing. The process of detecting odors involves parts of the body sending codes, and the brain and nervous system knowing how to ***de***-code those signals.

PROF.: That's right. Dr. Axel elaborates, "Somewhere in this arrangement lies an intricate logic that the brain uses to ***identify*** the odor detected in the nose, distinguish it from others, and trigger an emotional or behavioral response."

He and his researchers discovered that humans have 350 odor-receptors. Signals from them combine to inform the brain of 10,000 different smells.

VOICE: That sounds similar to the way our eyes can distinguish thousands of colors by various combinations of the three primary colors.

PROF.: That's a good comparison.

VOICE: Among the multitude of receptors, how does the brain identify which receptors have been turned on by a particular scent?

PROF.: Even Nobel laureates don't completely understand the process. Dr. Axel says several scenarios are possible, and he thinks one possible explanation makes more sense than the others.

He concludes, "But ***how*** does the olfactory cortex...decode the map provided by the olfactory bulb? This question is one of the central and most elusive problems in neurobiology." He spells out a fairly elaborate hypothesis of how he thinks it might occur. Then he concludes, "We have ***only begun*** to explore the logic of smell…"

VOICE: Why is the ***position*** of the nose important? Why is it between our eyes and above the mouth?

PROF.: If the nose were located somewhere else, it wouldn't be able to evaluate our food before we eat it. If it were located in the armpit, it would be overwhelmed by other smells. If the body grew it along the shins, it would be easily injured.

Dr. Simmons asks, "Where else could the nose best monitor incoming air and assess food, yet be connected to the lungs?" He answers, "Directly above the mouth is the ideal spot."

VOICE: Well, Professor, let's summarize the answers we discovered for the questions we asked at the beginning of the program. "If we wanted to design the ideal nose, how would we do it? What features would we build into it? And where would we install it on the body?"

PROF.: We couldn't improve on what the nose does, and we would not be able to improve on where it's located. It seems to be optimized for the several assignments in its job description.

VOICE: That's an interesting expression: "It seems to be optimized for the several assignments in its job description."

PROF.: Dr. Simmons asks, "…[C]ould the nose have come by chance to the proper location and have formed the complex neurological connections and the connections with mouth, throat, and windpipe by chance?"

He concludes the chapter on smell by asking, "Is it coincidence or an accident that the sense of smell monitors everything we eat and drink? Or inhale? Is it a mere chance mutation that the nose makes air going into the lungs safer, cleaner, and warmer?"

Or was God arranging things for our benefit when he made the nose so optimum?

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Sources:

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