THE FRONT ROW at Scripps Research

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How do you feel? Molecules that sense touch and other pressures

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ABOUT THE LECTURE

It's difficult to research how we experience pain, touch, sound vibrations and blood flow. But now, scientists can more easily study such sensations thanks to Scripps Research professor Ardem Patapoutian, PhD, who helped identify PIEZO proteins—molecular sensors that convert physical stimuli into cellular signals, alerting the body of environmental changes. In his Front Row lecture, Patapoutian discussed these discoveries in sensory neuroscience, for which he and David Julius, PhD, were awarded the 2021 Nobel Prize in Physiology or Medicine.

TOP TAKEAWAY POINTS

- We can perceive two types of touch: The first, discriminative touch, is the ability to feel and recognize tactile details, such as shape, texture and object size, as well as pressure and vibrations. It's so sensitive that you can detect indentations that are 1/500 the diameter of a human hair. The second is affective touch, which includes emotional and comforting sensations that are experienced when touched gently. Related to touch is the underappreciated sense of proprioception—the ability to sense the location and movement of our body parts.

- Patapoutian co-discovered the PIEZO ion channels—named after the Greek word "píesi," which means "to press." When a cell is physically pressed or stretched, these channels open for tiny, charged particles called ions to flow into the cell, which generates a signal to the brain that helps us feel sensations. These channels are composed of two protein types—PIEZO1 and PIEZO2—and each is involved in different sensory processes. PIEZOs are not only found in animals but also in unicellular organisms and plants, with the latter being able to detect sensations like soil thickness.

- PIEZO1 senses pressure changes and tendon stretch. It also plays a role in various biological processes, such as wound healing, blood vessel formation and bone density regulation. Conversely, PIEZO2 senses fine tactile details, light touch and body position. This protein allows us to feel shapes and textures—and it's important for sensing where our limbs are in space.

- PIEZOs help regulate a range of vital functions, including respiration, urination, blood pressure and gut motility. For example, PIEZO2 detects how much our lungs expand and contract. The body uses this information to regulate breathing, ensuring that the lungs function efficiently and adjust to changes during exercise or rest. And PIEZO2 detects stretching in the gut, which is needed to coordinate the contractions required for proper digestion.

- Scientists at Scripps Research, including Patapoutian, are now harnessing their knowledge of PIEZOs to develop neuropathic pain medication. For instance, PIEZO2 is essential for tactile allodynia: an oversensitivity to touch where even mild sensations feel painful—like touching your shoulder if it has a sunburn. Therefore, blocking PIEZO2 may be a clinically relevant way to treat people who experience chronic pain.

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