Sensory transduction

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*besides vision!
Olfaction

- In late 80's odorant receptors were cloned from cilia
- These were 7TM helix G-protein receptors (OR) stimulating a unique G\textsubscript{olf} protein, G\textsubscript{olf}
- Human OR genes number 500 but only about 30 are not pseudogenes!

Olfaction

- Each neuron expresses only 1 OR
- G\textsubscript{olf} stimulates Ad. Cyclase
- cAMP opens cation channels: depolarization occurs; action potential propagates

Olfaction

Decoding of olfactory stimuli - in mouse suggests a combinatorial mechanism
Olfaction

- All neurons expressing a given OR converge on a discrete area in the olfactory bulb
- The spatial pattern of OR stimulation is somehow transformed to a unique scent.

Taste

- More limited scope of possible tastes
- Olfaction contributes to complex tastes

- Gustation receptors are located in different areas
- In taste buds (~150 cells w/ sensory neurons) in papillae (big knobs)
Taste-Bitter
- So far only bitter receptors (G-protein Receptors) with Gα, gustducin have been found
- There are 50-100 genes (for bitter?) in the genome but they are mixed on taste buds

Taste
- Bitter receptors ? Stimulation by specific bitter substance of mT2R
- But different ones get mixed up in brain

Taste-Salty
- Salt receptors ? Direct sensation by Na+ ion channels blocked by Amiloride
- Analogous to the 4 subunit type channels (like K+)
Taste-Sweet
- Not isolated in humans but likely G-protein since gustducin knock-out mice can’t taste sweet substances
- Tre 1, a sugar responsive GPR has been found in flies

Taste-Umami
- Japanese-Deliciousness
- Lots in protein rich foods like soy sauce, roasted meat and and vegemite!
- Na+ Glutamate is the key (1903-Kikunae Ikeda)
- A GPR sensitive to glutamate in the brain is clipped by 399 amino acids in the buds to give low affinity umami receptor.

Hearing
- Mechanical stimulation of hair cells in cochlea is the key
- Hair cells are specialized neurons
Hearing
- Displacement of bundle by 3 Å results in a measurable membrane potential change (like 1 inch movement at the top of the Empire State building)

Tip link seems to pull open an ion "hatch": a mechanosensory channel
Back and forth flow induces an oscillating ion current

Touch
- Hot, Cold
- Pressure
- Capsaicin/hot receptor
- Cold/menthol receptor
Capsaicin and friends
Capsicum (chili pepper)

- Example: Capsaicin
- Capsaicin/hot receptor
- Reacts to noxious stimuli (heat, acid)
- Also involved in taste

Touch

- The receptor, VR1, is involved in nociception (pain sensation) as well.
- Used medicinally to alleviate pain by the principle of counterirritation
- How does this work?
UCSF Study Suggests Capsaicin Significantly Reduces Debilitating Nerve Pain. Mice without it don’t experience pain from heat.