Sour Sensory Science

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and Other Brewery Things


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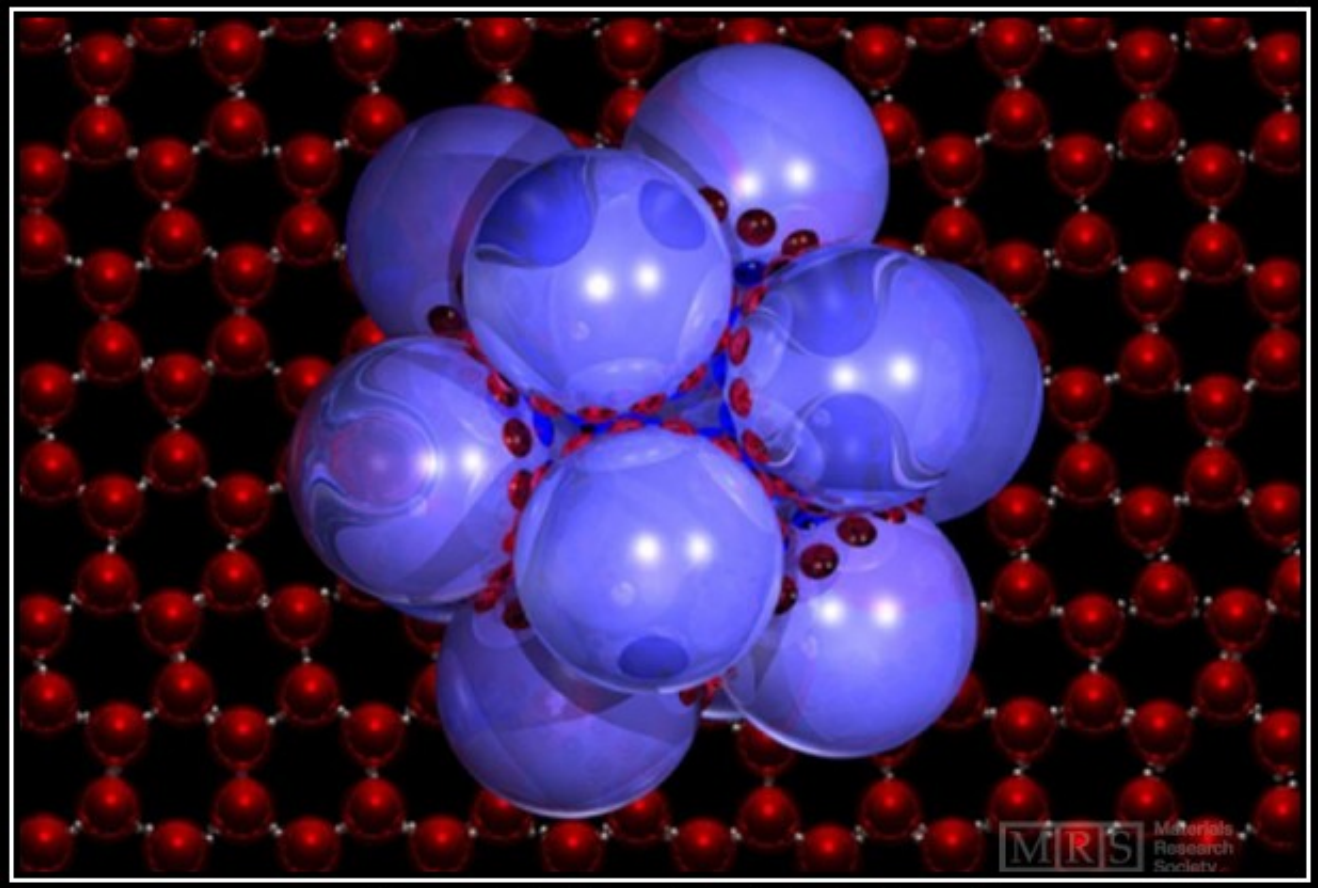


SCIENCE

If you don't make mistakes, you're doing it wrong.
If you don't correct those mistakes, you're doing it really wrong.
If you can't accept that you're mistaken, you're not doing it at all.

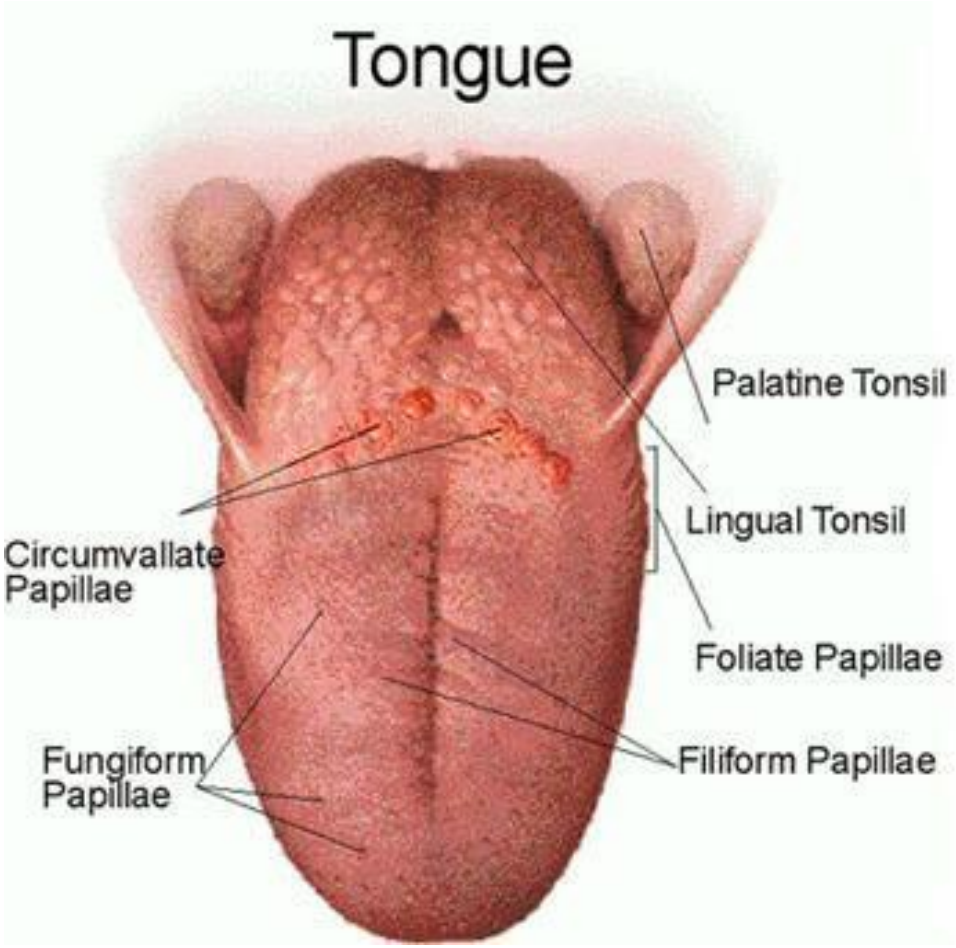
What is Sour?

- One of the basic tastes along with sweet, bitter, salty and umami.
- Sour taste characteristics are associated with acids (i.e. citric, lactic, malic, tartaric, fumaric, acetic, phosphoric) and free hydrogen ions
- Natures defense to signal rancidity, spoilage and to protect against acid/base unbalances (maintain acid-base homeostasis)
- Age Effects
  - No to Yes to No again

Tongue Mapping Debunked

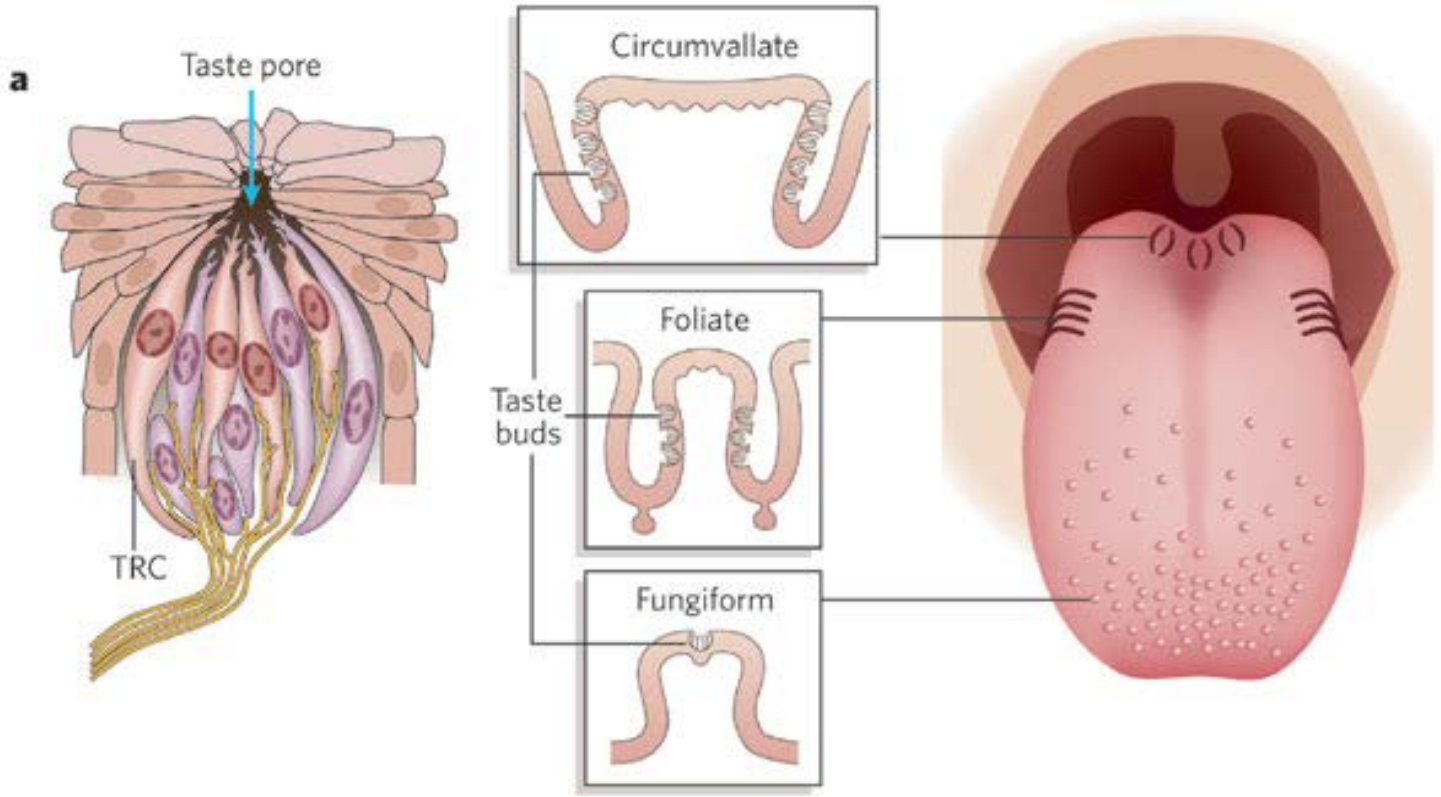
The Science of Beer

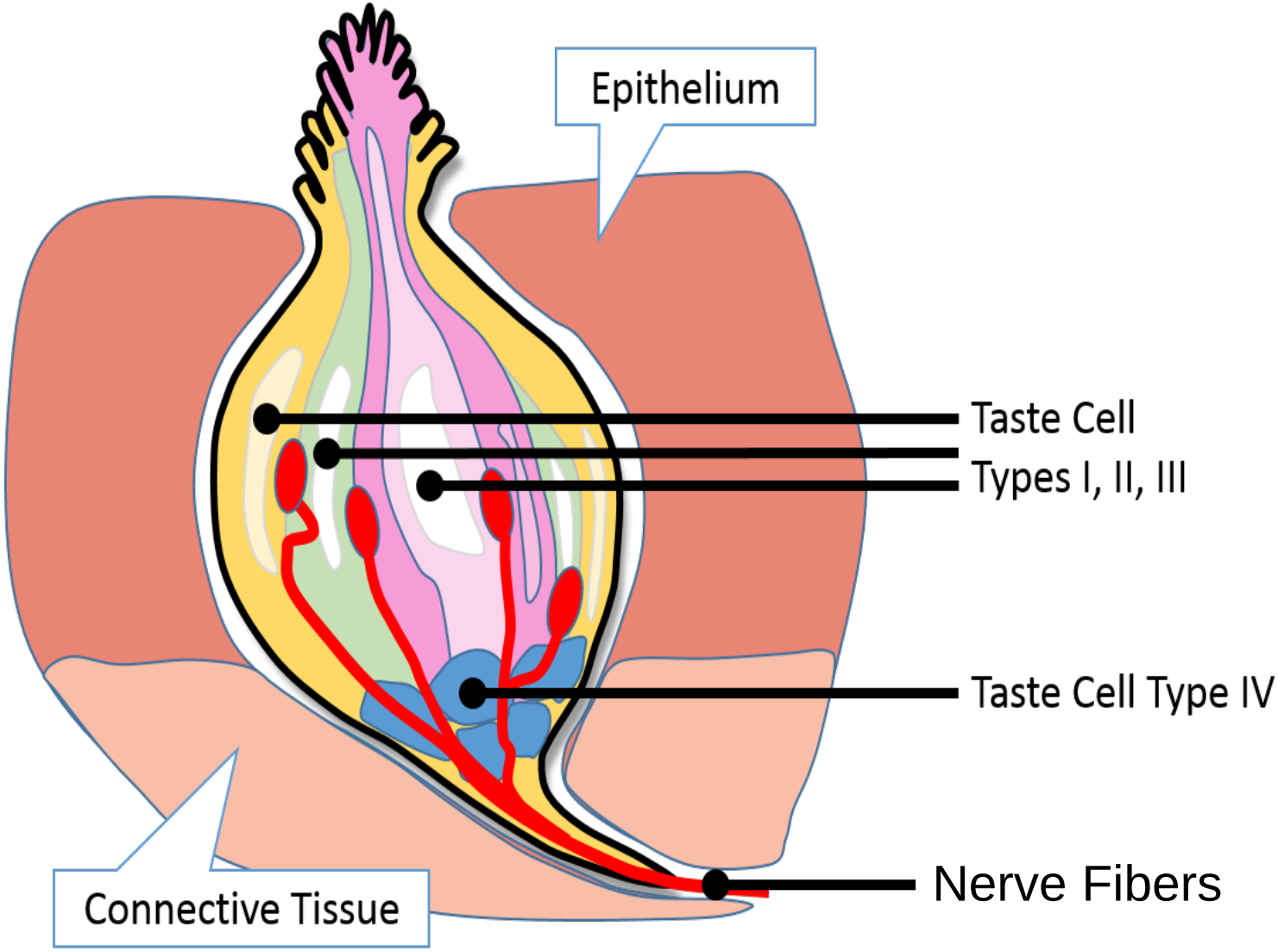
Taste Bud Papillae Locations

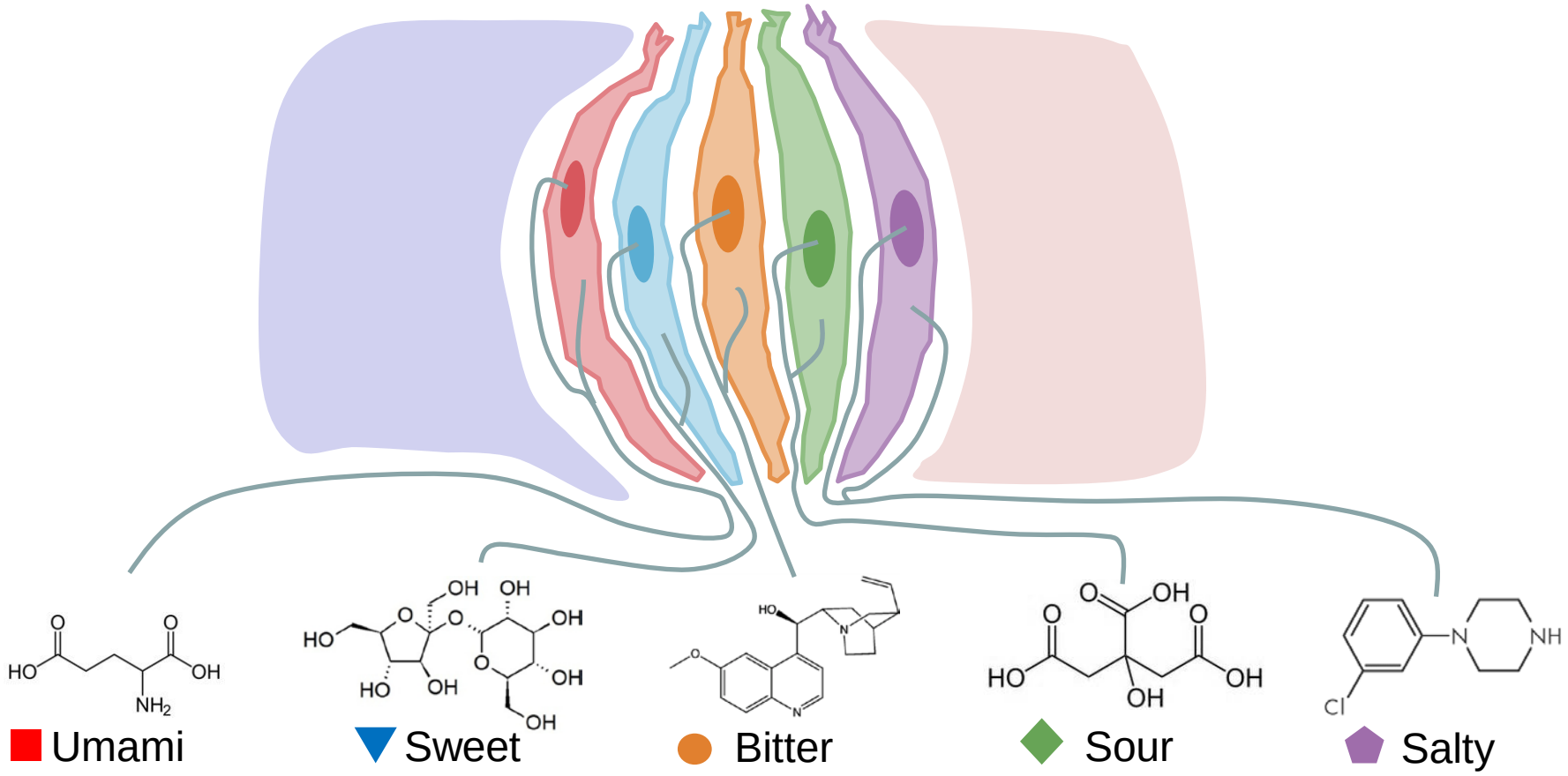


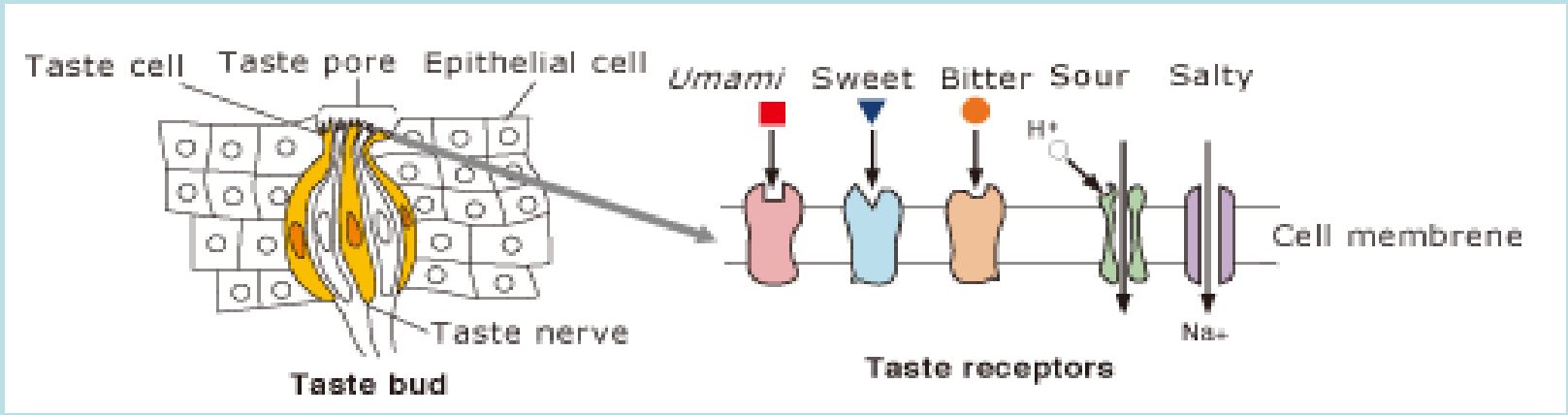
- Fungiform papillae
  - Visible mushroom shapes
  - Upper and scattered
- Filiform papillae
  - Front 2/3 of tongue
  - Do not contain taste buds
- Foliate papillae
  - Folds on sides of tongue
- Circumvallate papillae
  - Visible
  - Back of tongue

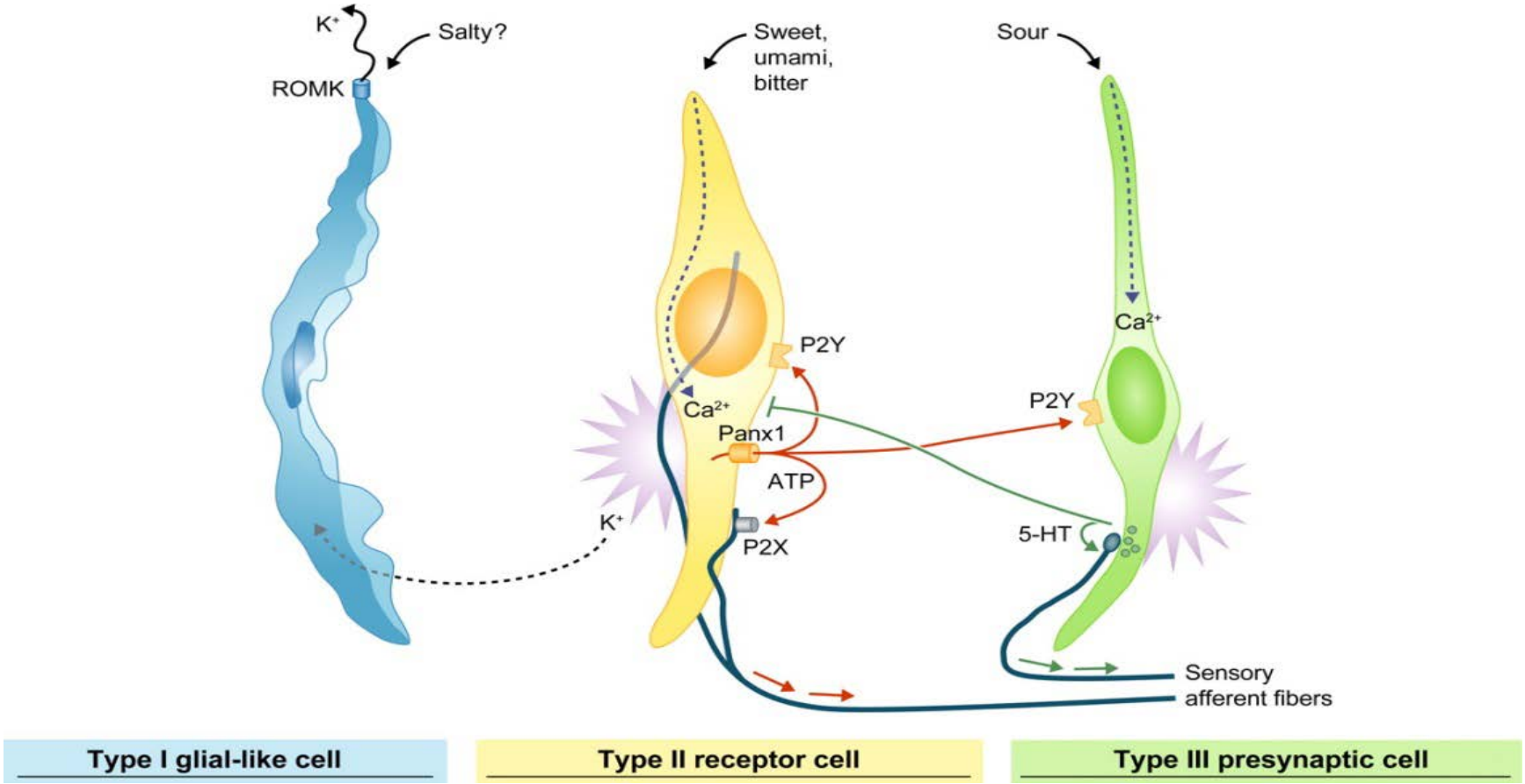
Taste buds locations are throughout the oral cavity, the pharynx, laryngeal epiglottis and the entrance of the esophagus




Epithelium
Taste Cell
Types I, II, III
Taste Cell Type IV
Nerve Fibers
Connective Tissue


Umami
Sweet
Bitter
Sour
Salty


Taste cell
Taste pore
Epithelial cell
Taste nerve
Taste bud
Umami
Sweet
Bitter
Sour
Salty
H+
Cell membrene
Na+
Taste receptors



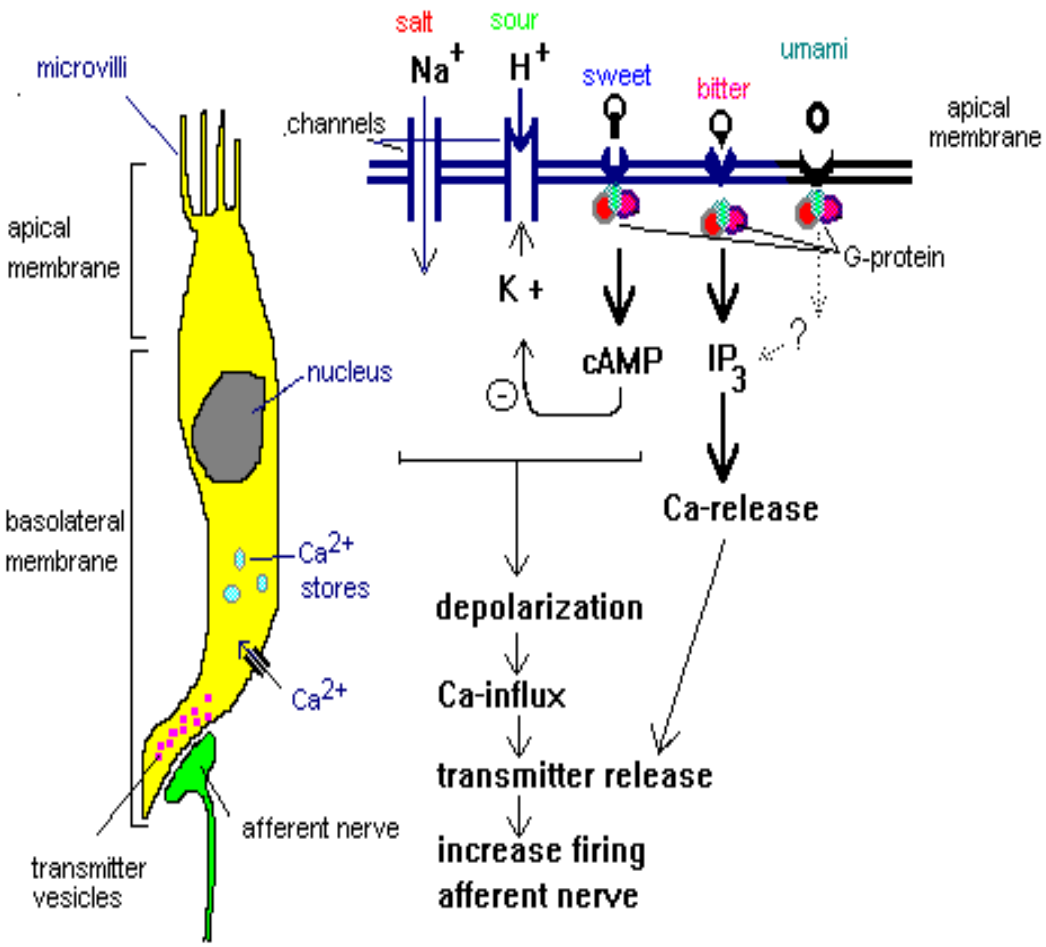
- Type I receptor cells are supporting cells that are stimulated by sodium ions
- Type II receptor cells coupled with G proteins, are stimulated by sweet, bitter, and umami tastants. In response to taste stimulation, receptor cells secrete ATP, a taste neurotransmitter.
- Type III cells are termed presynaptic cells and when stimulated by H^+ protons release the neurotransmitter serotonin (5-HT). This is a calcium dependent reaction also linked with potassium channels

Saliva

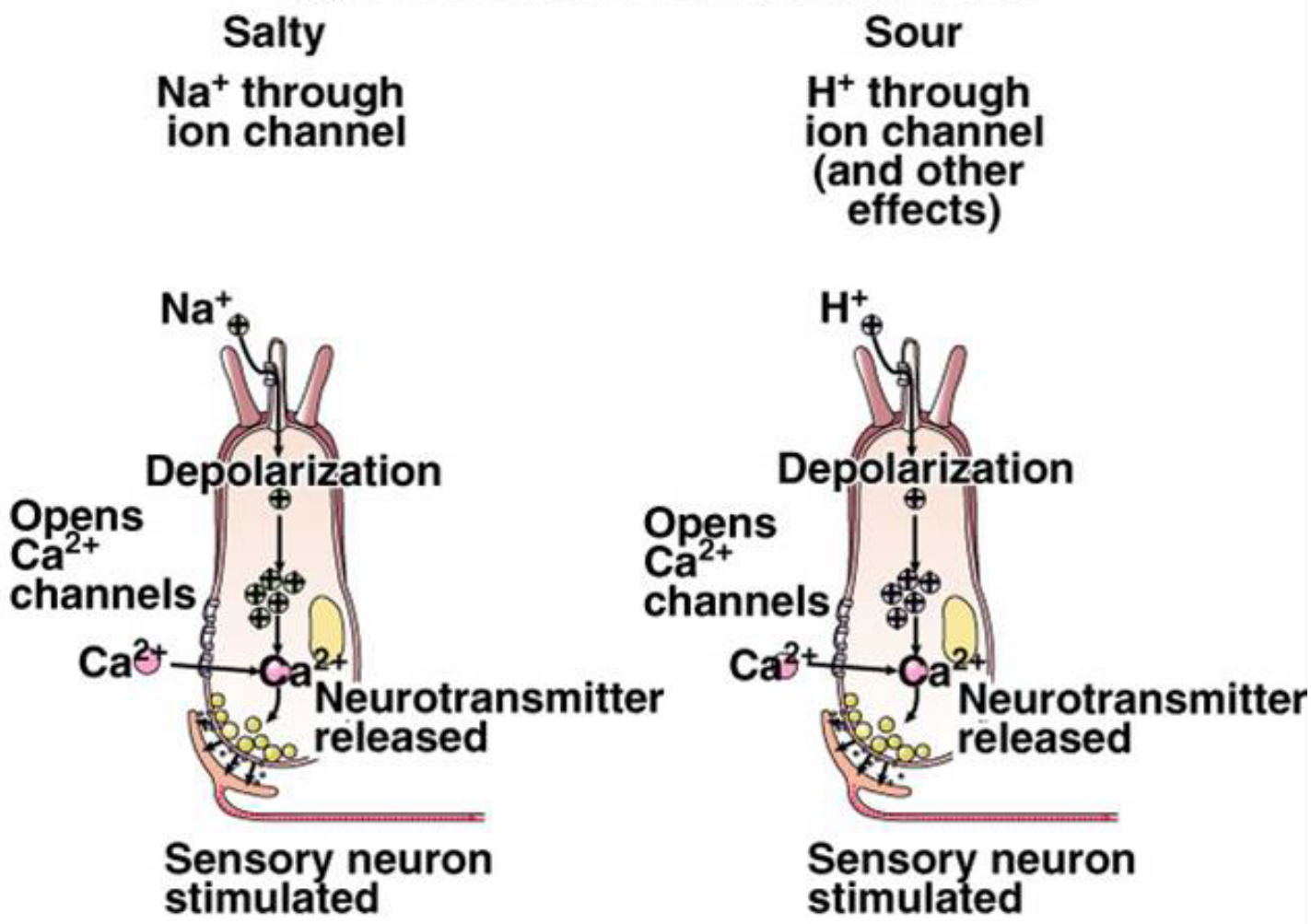
- Sense of Taste = Liquid Transportation
- Taste sensitivity alteration (i.e. NaCl)
- Sour tastes, acids, induce highest salivation flow and increases Na^+ concentration
- Buffer of bicarbonate ions
  - Decreases free H^+ ions

Sour Receptors

- Sour TRC triggered by the tastant protons H^+
- Cation channel is activated by pH (the H^+ ion concentration) and opens the channel. This causes a depolarizing receptor potential (shift from negative to positive) and activates Ca^{2+} channels, which increasing intercellular Ca^{2+}. {Huang et al., (2006) Nature 442, 934-8}
- The influx of Ca^{2+} causes neurotransmitters to be released – message sent!
- In 2006, discovery of the TRP (transient receptor potential) PKD2L1 ion channel responsible for our ability to detect sour



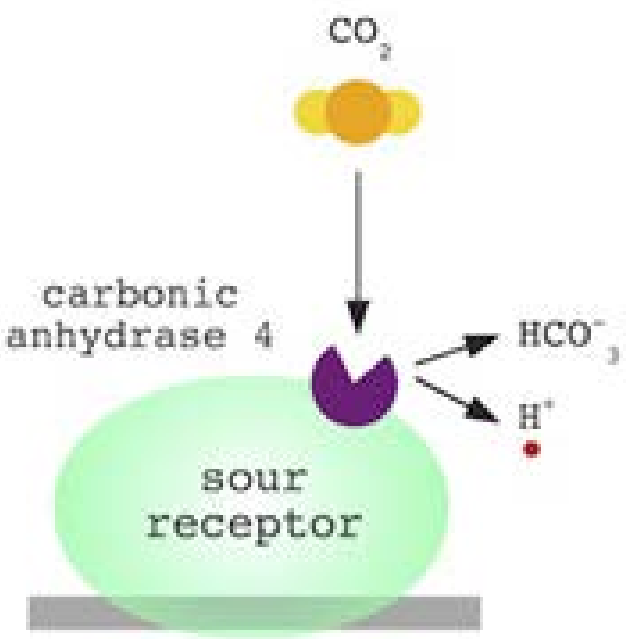
Sour and Salt Channels

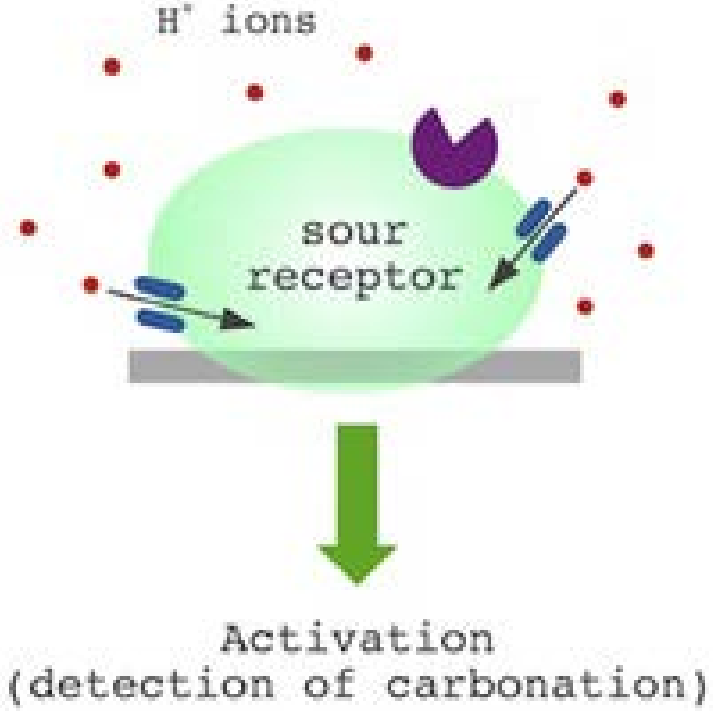


Sour and Sweet

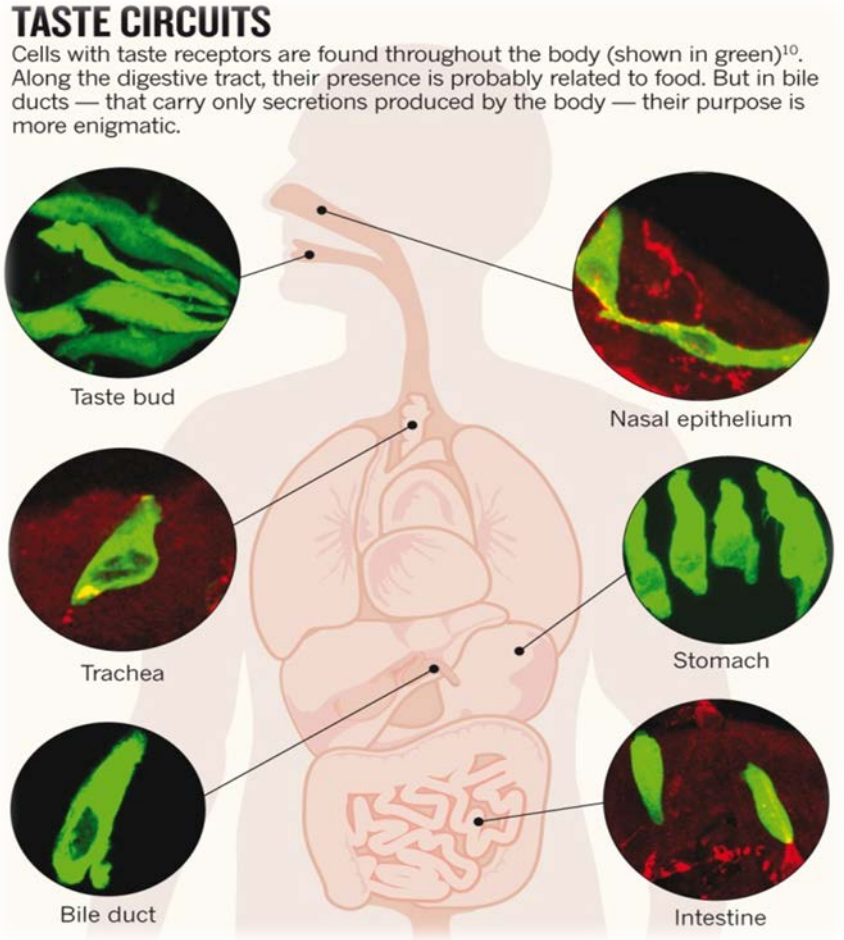
- Masking and Taste Inhibition
  - Perception Interference
  - Enhancement or Suppression
- Lemonade or Margaritas
  - Sugar vs Artificial Sweeteners
  - Concentration Taste Thresholds
  - Splenda is 600X sweeter than sucrose

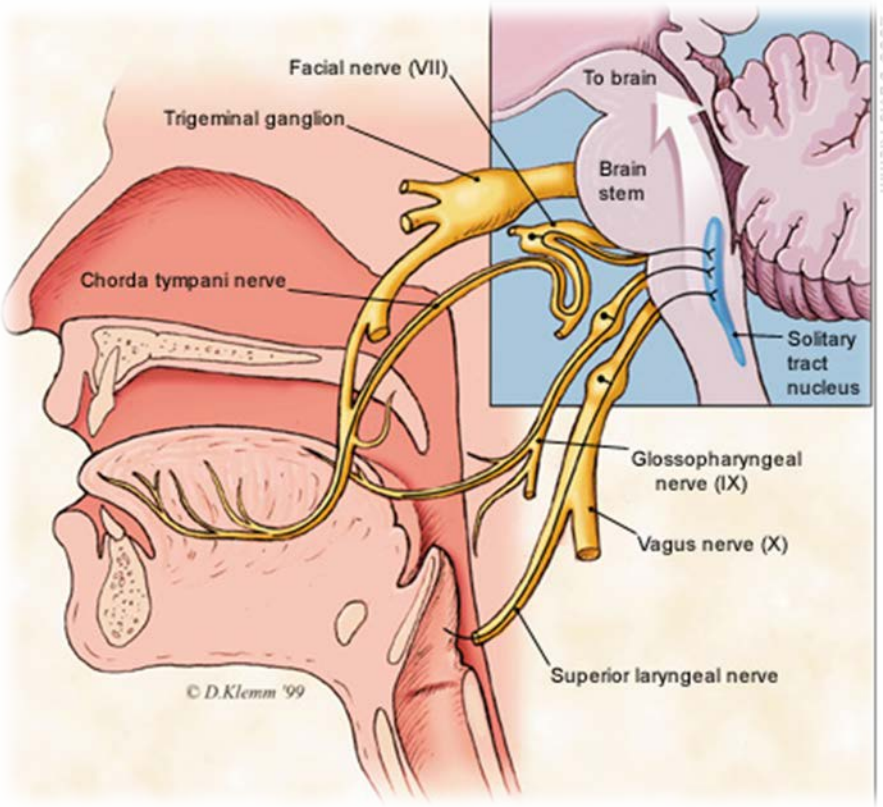
Sour and Carbonation





Beyond the Tongue





SOUR

Interact with	Associated Element	Interactions	Additional Comments
Sweet	Sugar	Complement or Contrast	Intensity Dependent
Sour	Acid	Complements / Cut	Like Cuts Like; increase salivation
Salt	Mineral	Contrast / Cut	
Bitter	Roast	Contrast / Cut	
Umami	Savory	Contrast / Emphasize	
Chemosensory Irritants	Capsaicin; ginger; mustard; peppermint; menthol	Complement or Contrast; Cut or Emphasize	Intensity Dependent
Tannins	Astringency	Complement	Intensity Dependent
Fat	Oil	Contrast / Cuts	
Alcohol	Warming	Complement or Contrast; Cut or Emphasize	Intensity Dependent

Sour Centric Beer Examples

American Sour Ales, American Brett beers (sometimes are acidic centric-see beer styles section), Belgian-Style Flanders, Belgian-Style Lambic, Gueze and Fruit Lambic, Belgian-Style Saison (some are acidic centric-see beer styles section), Belgian-Style Wit and Barrel-Aged Beer.

Barrels are like snowflakes – No two are the same

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