

Taste & Smell

The “chemical” senses (*gustation* and *olfaction*)

Lesser senses?

- phylogenetically ancient sensory systems (even bacteria do it)
- produce pleasure, excitement
- promote attraction or repulsion
- crucial in regulating food intake
- capable of generating vivid emotional experiences
- bring back lost memories

Taste (literally, to “test” or “sample”)

Taste enables an organism to avoid toxins and consume nutrients - taste is ingestion's 'last' chance to detect poison

Eating plays a central role in many of the important ceremonial events in our lives

- weddings
- victory banquets
- funerals
- birthdays & holidays
- religious ceremonies



Venom pushes

Taste: Humans are “Omnivores”



Taste: outline

- Basics of taste
 - basic sensations
 - anatomy of taste
 - neural mechanisms of taste
- Taste variations
 - taste disorders
 - individual differences in taste sensitivity
 - changing your taste sensation
- Interactions with other senses
 - flavor
 - taste & smell

The violence of eating: **mastication**

Pulverize and macerate cellular material by repeated crushing and tearing actions executed at a rate of about 100 chews/min. Why?

- Aid in digestion
- Promote release of taste stimulants



What is tasted?

- To be tasted, at least some of the molecules in a substance must dissolve in saliva (i.e. be soluble)
- This is why you cannot taste the difference between a plastic spoon and a stainless-steel spoon
 - And why things DO taste different when you use spoons from “Connections” (their spoons are made out of corn products)

The chemistry of taste

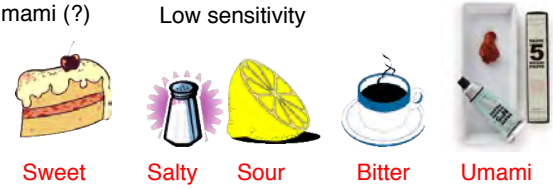
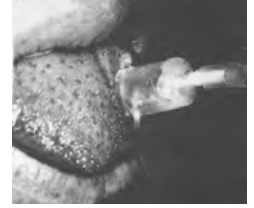
Five basic taste sensations:

- Sweet – sugars, some amino acids
- Salty – metal ions (inorganic salts)
- Sour – hydrogen ions (acids)
- Bitter – alkaloids such as quinine, caffeine, nicotine
- Umami** – amino acid glutamate (MSG)

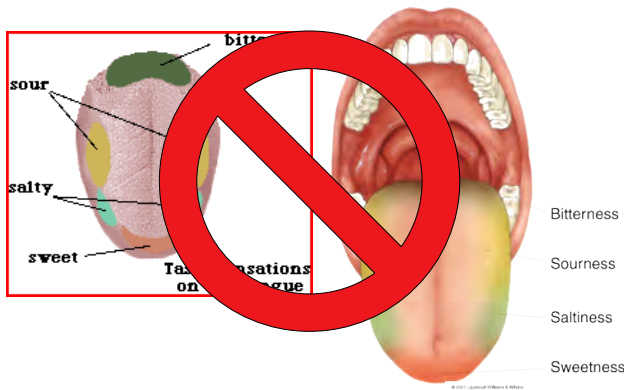


Taste sensitivity

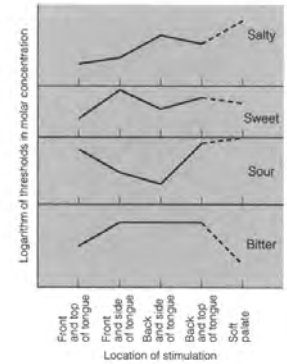
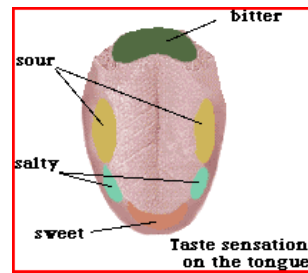
Taste quality	Threshold concentration
sweet	1:200
salty	1:400
sour	1:130,000
bitter	1:2,000,000
Umami (?)	Low sensitivity



The anatomy of taste

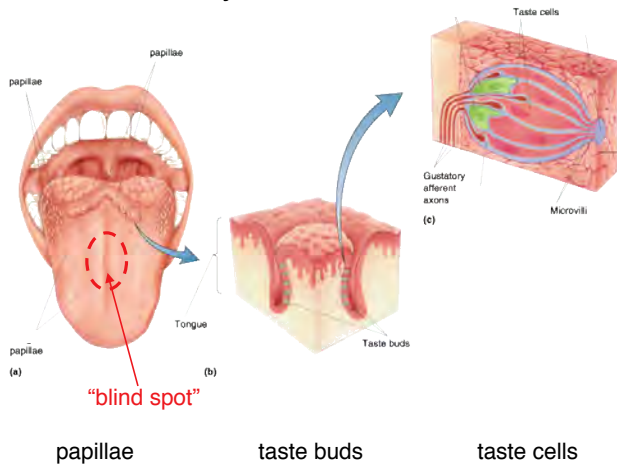


The anatomy of taste



indicated areas are MOST sensitive to a particular taste type

The anatomy of taste



Taste buds



Each taste bud (think "garlic") houses anywhere from 50 to 100 taste cells (and these are constantly dying and being replaced)

Each taste cell contains multiple taste receptors (site at which molecules bind to proteins, thereby triggering electrical signal)

The anatomy of taste



http://www.youtube.com/watch?v=2Fhc0t_QNh8

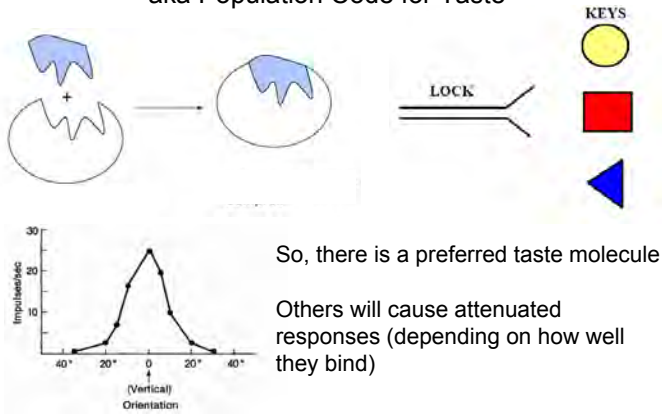
The Neural "Code" for Taste

How is taste information represented within array of taste cells? Do single taste cells respond broadly or selectively?

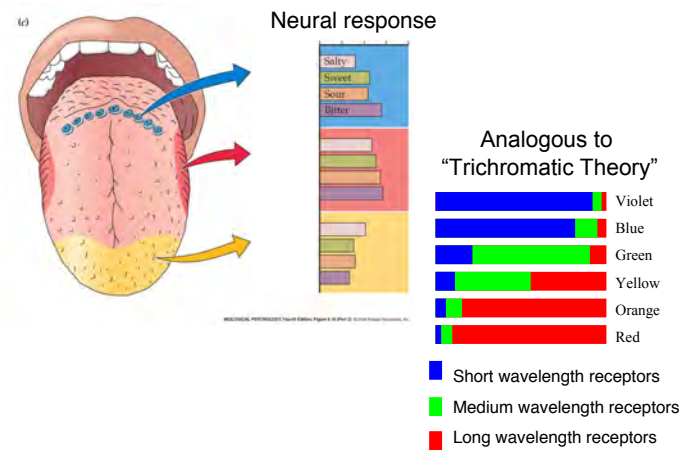
Two competing views:

- labeled-line hypothesis (specificity)
- cross-fiber hypothesis (broad tuning)

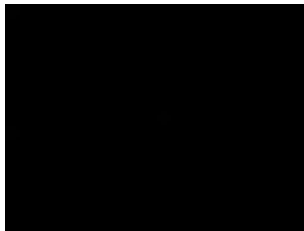
"Cross-Fiber Theory" aka Population Code for Taste



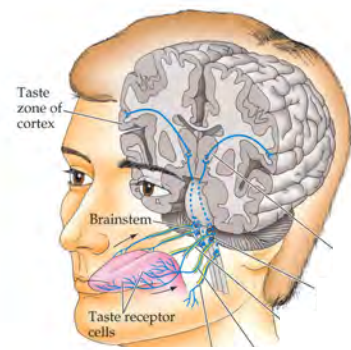
cross-fiber hypothesis (broad tuning)



[dramatically] Changing your taste sensations...



Brain mechanisms of taste



<http://www.cantudesigns.com/external/Sneak-Peak>

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Disorders of taste

Ageusia - complete loss of sense of taste

Selective ageusia - loss of specific taste sense

Hypogeusia - diminished taste sensitivity

Hypergeusia - enhanced taste sensitivity

Dysgeusia - distortion in taste perception

Individual differences in taste



http://www.youtube.com/watch?v=2Fhc0t_QNhs

Individual differences in taste

How many of you dislike:

Cabbage, Cauliflower, Brussels sprouts

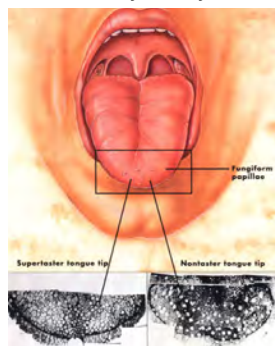
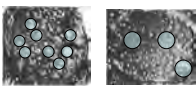
PTC: Tasters and Non-tasters

PTC (*phenylthiocarbamide*) - bitter substance

non-tasters (approximately 1 out of 3 cannot taste PTC) are also less sensitive to bitter taste of cabbage, cauliflower and Brussels sprouts

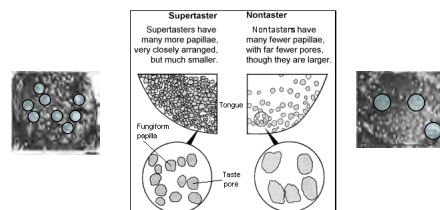
PTC: Tasters and Non-tasters

PTC tasters have more taste buds than non-tasters, and 'supertasters' have many, many more



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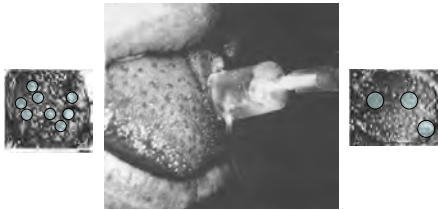


The average number of taste buds per square centimeter is 96, 184 and 425 for nontasters, tasters and supertasters, respectively.

(supertasters have more free nerve endings, which makes them more sensitive to **hot spices**.)

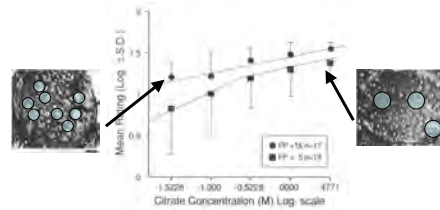
Magnitude of Taste Experience

The more taste cells you have, the stronger your taste sensations



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Modifying Taste

Try some of the demonstrations:

- plain water (ideally, distilled) tastes sweet after:
 - rinsing your mouth with diluted vinegar
 - drinking strong coffee
 - eating artichokes
- plain water tastes sour/bitter after:
 - washing with salty water
 - washing with very sweet water
- cold temperature alone can trigger taste sensations (try it using a paperclip placed in the freezer for an hour or so)

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Taste: just one component of flavor



"Oh, hey! I just love these things! ... Crunchy on the outside and a chewy center!"

Taste: just one component of flavor

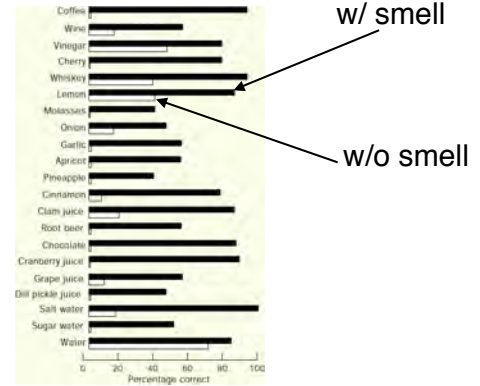
Taste
+
Touch
+
Temperature
+
Sound
+
Smell

FLAVOR

Taste identification with and without smell

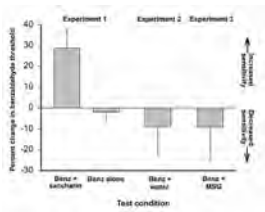


Taste identification with and without smell

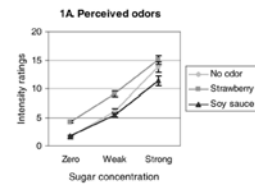


Smell and Taste interactions

Undetectable odor and undetectable taste



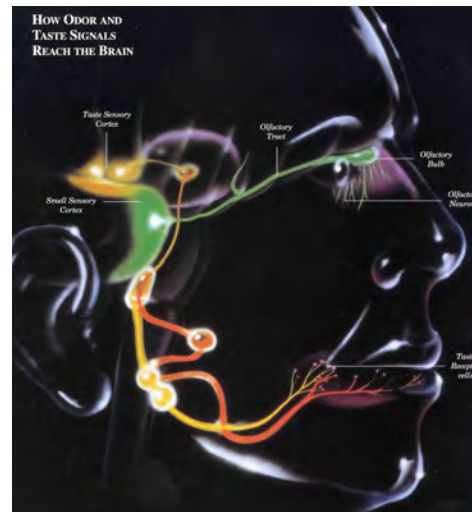
Odor influences perceived taste intensity



The merging of the senses: integration of subthreshold taste and smell
 P. Dalton, N. Doolittle, H. Nagata & P.A.S. Breslin
 Nature Neuroscience 3, 431 - 432 (2000)

Odor-induced changes in taste perception
 J. Djordjevic^{1,2}, R. J. Zatorre¹ and M. Jeon-Gottlieb²
 (1) Montreal Neurological Institute, McGill University, Montreal, Quebec, Canada
 (2) Montreal Neurological Institute, 2801 University Street, Montreal, Quebec, H3A 2B4, Canada

benzaldehyde -- cherry/almond smell



5 point curved was added to your exam grade

