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: Humans are Omnivores!**

*Bizarre Foods with Andrew Zimmern*

**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

**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
**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)

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

**The anatomy of taste**

- papillae
- taste buds
- taste cells

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_QNh

The Neural “Code” for Taste

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

Two competing views:

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

“Cross-Fiber Theory”
aka Population Code for Taste

So, there is a preferred taste molecule
Others will cause attenuated responses (depending on how well they bind)

Brain mechanisms of taste

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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

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https://www.youtube.com/watch?v=W7Pzhvypg9A
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PTC: Tasters and Non-tasters

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

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

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)

Miracle fruit

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Taste: just one component of flavor

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

[Image of taste identification chart with and without smell]