

Beer, Mead and the Human Sense of Taste

Ken Schramm

The Compleat Meadmaker

Who wants a Taste?

Ken Schramm

The Compleat Meadmaker

Friday 2:45 - 3:45

- Fermentation Management, Greg Doss, Wyeast, Grand Ballroom East
- Science behind the Art: Hops in Brewing, Wegner, Grand West
- Beer, Mead and Human Sense of taste, Plaza 5 & 6

Friday 2:45 - 3:45

- Measurement of the Flux and Zenith-Angle Distribution of Upward Throughgoing Muons in malt extraction, Hawking, Ambassador room
- $\nu_{\mu} \leftrightarrow \nu_{\tau}$ oscillation hypothesis $\sin^2 2\theta > 0.4$ μ
 $\pi 0 = 4 \cdot 10^{-7} \text{ (T}\cdot\text{m)} / A$ $1 \times 10^{-3} < \Delta m^2 < 1 \times 10^{-1} \text{ eV}^2$ for Hop Utilization, HAL 9000, by the Pod Bay doors

Friday 2:45 - 3:45

1992

- “Do I really have to Boil for an Hour?” Papazian, Grand teton ballroom
- “What’s the difference between Alpha Acid and the brown acid that is circulating around that isn’t too good?” Ray Daniels, waterfront room

Human Sensation

- Vision

- Hearing

- Taste

- Smell

- Touch

Human Sensation (Exteroceptive)

- Photo-sensation - Sight
- Mechano-sensation – Auditory ,
Touch
- Chemo-sensation - Taste and
Smell

Human Sensation

- Thermal Sensation - Receptors still unidentified
- Interoceptive:
- Proprioceptive Sense (where your limbs are) & Balance
- internal organ sensation - pain, breathing, heart beat

Taste and Smell: Chemo-sensation

- What is it?
- How Does it Work?

Toast:

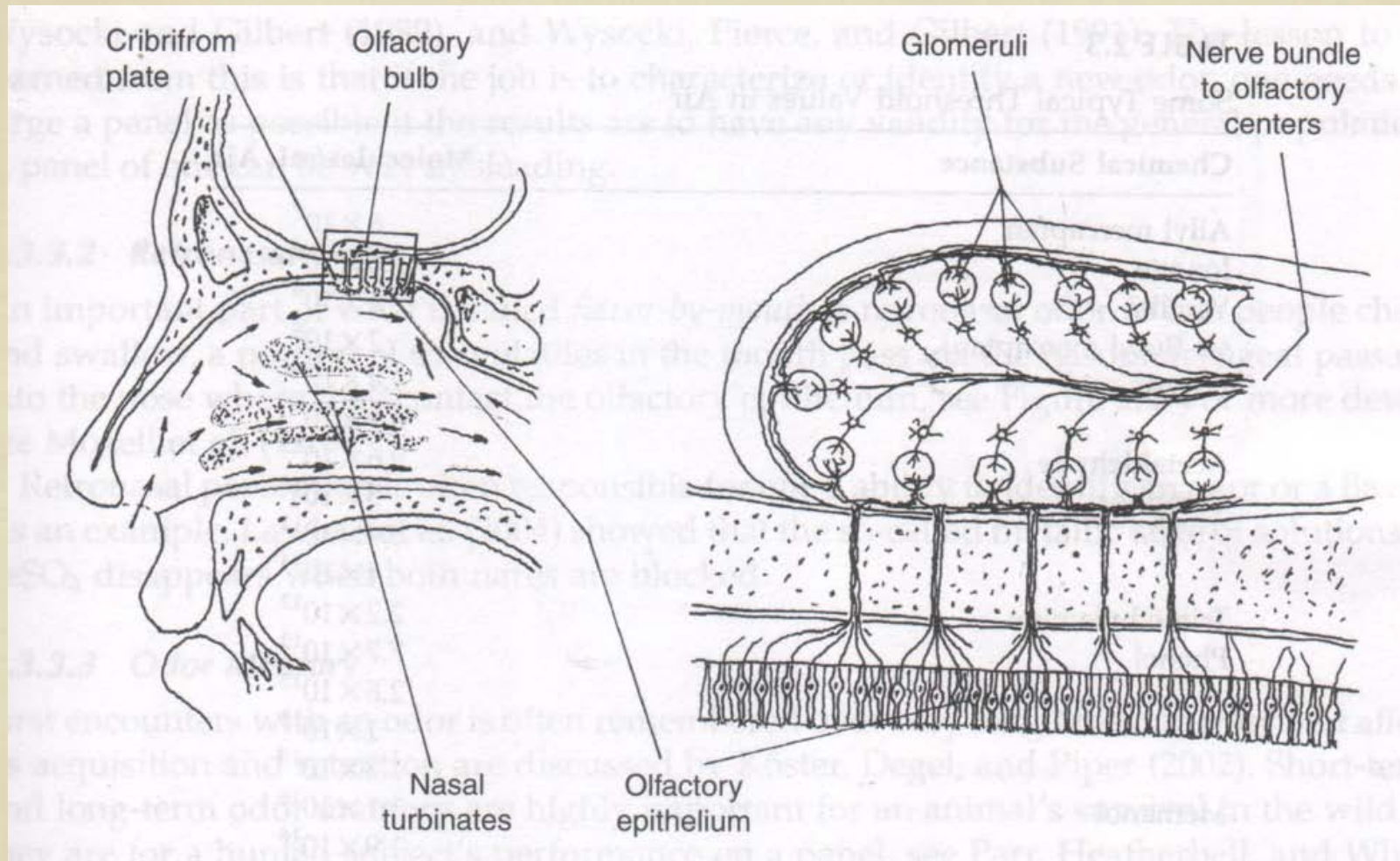
- Morten, Michael, Greg
Noonan, Bill
- “Man, I Love this Hobby”

Bill Pfeiffer

Chemo-sensation: The Organs

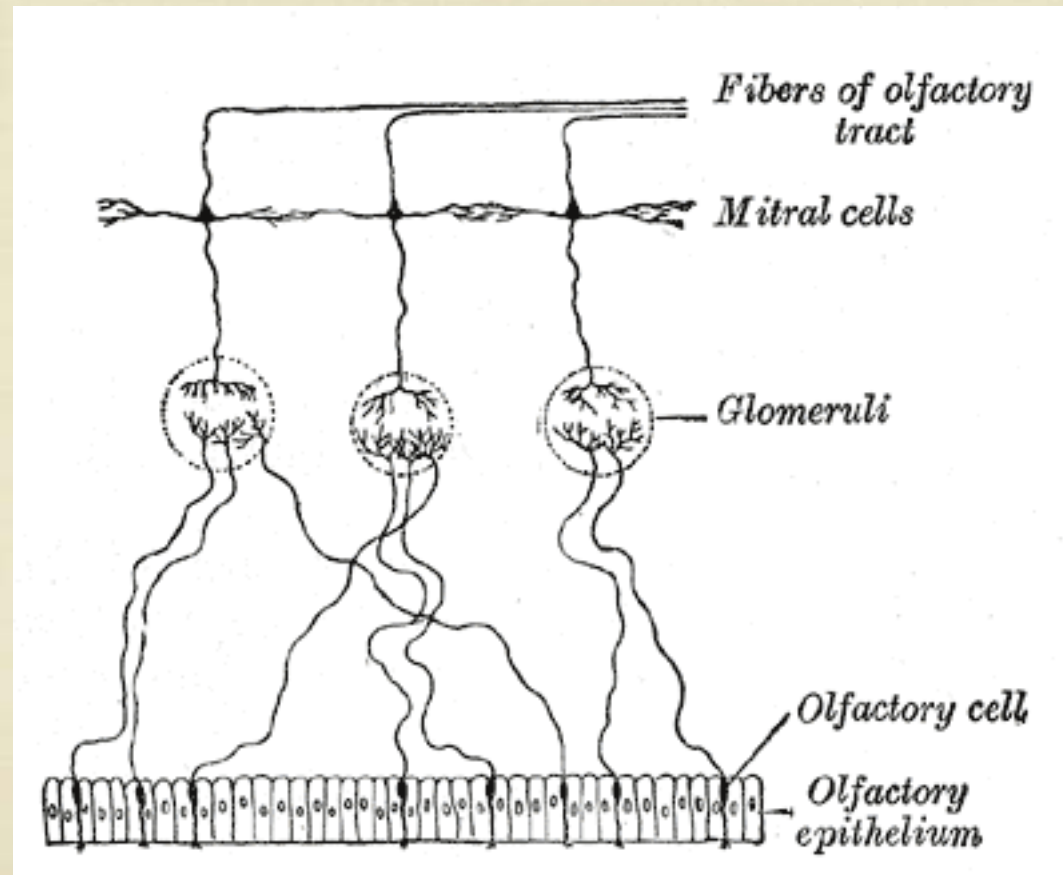
- The Olfactory Bulb
- Taste Buds

The Anatomy



- R. Axel, Scientific American, October, 1995

The Olfactory Bulb



■ Gray's Anatomy

The Olfactory Bulb

- Least well-known of the sensory organs
- Responds to odorants - thousands of them

The Olfactory Bulb

- Appears to repopulate with new granular and periglomerular neurons
- Incredibly sensitive

Olfaction

- “...a trained perfumer can identify 150-200 different odor qualities (odor types)... the receptors’ sensitivity to different chemicals varies over a range of 10^{12} or more. typical thresholds vary from 1.3×10^{19} molecules/ml for ethane to 6×10^7 molecules for allyl mercaptan...”

Ethane Sensitivity:

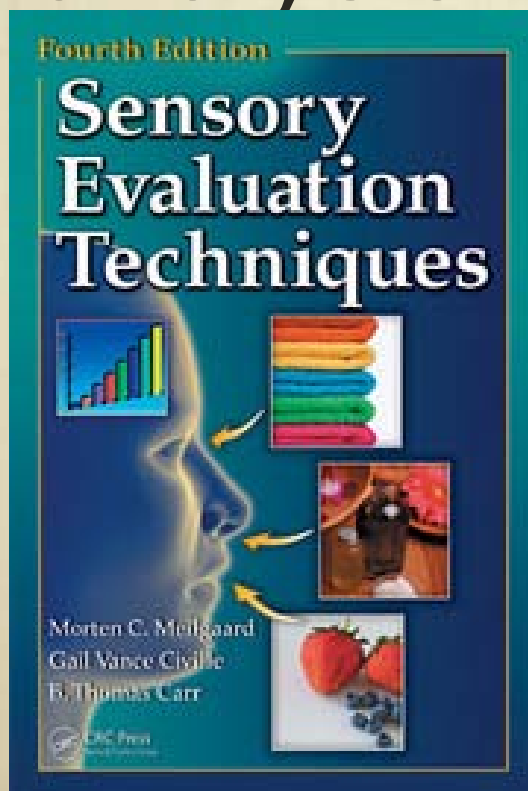
- 1.3 parts per
1,000,000,000,000,000,000

Olfaction

- “The most sensitive gas chromatographic method can detect 10^9 molecules/ml. This means that there are numerous odor substances, probably thousands occurring in nature, that the nose is 10- or 100-fold more sensitive to than the gas chromatograph...”

One sensitive schnozz

- “researchers are a long way away from being able to predict an odor from gas chromatographic analysis.”



- Meilgaard, Civille, Carr
Sensory Evaluation
Techniques, 2007

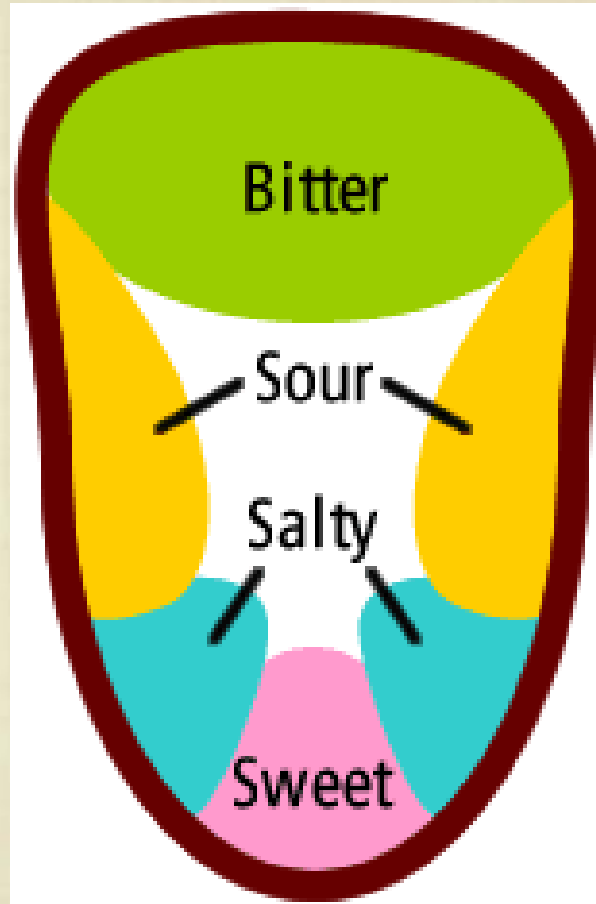
Olfaction

- ligands dissolve in mucus and bind to the Olfactory Receptor neurons (OR's)
- series of Domino reactions: G protein > Adenylate Cyclase > cyclic AMP > Na^+ and Ca^+ > K^- > action potential ("firing")

Chemo-sensation: The Organs

- The Olfactory Bulb
- Taste Buds

The “Tongue Map”



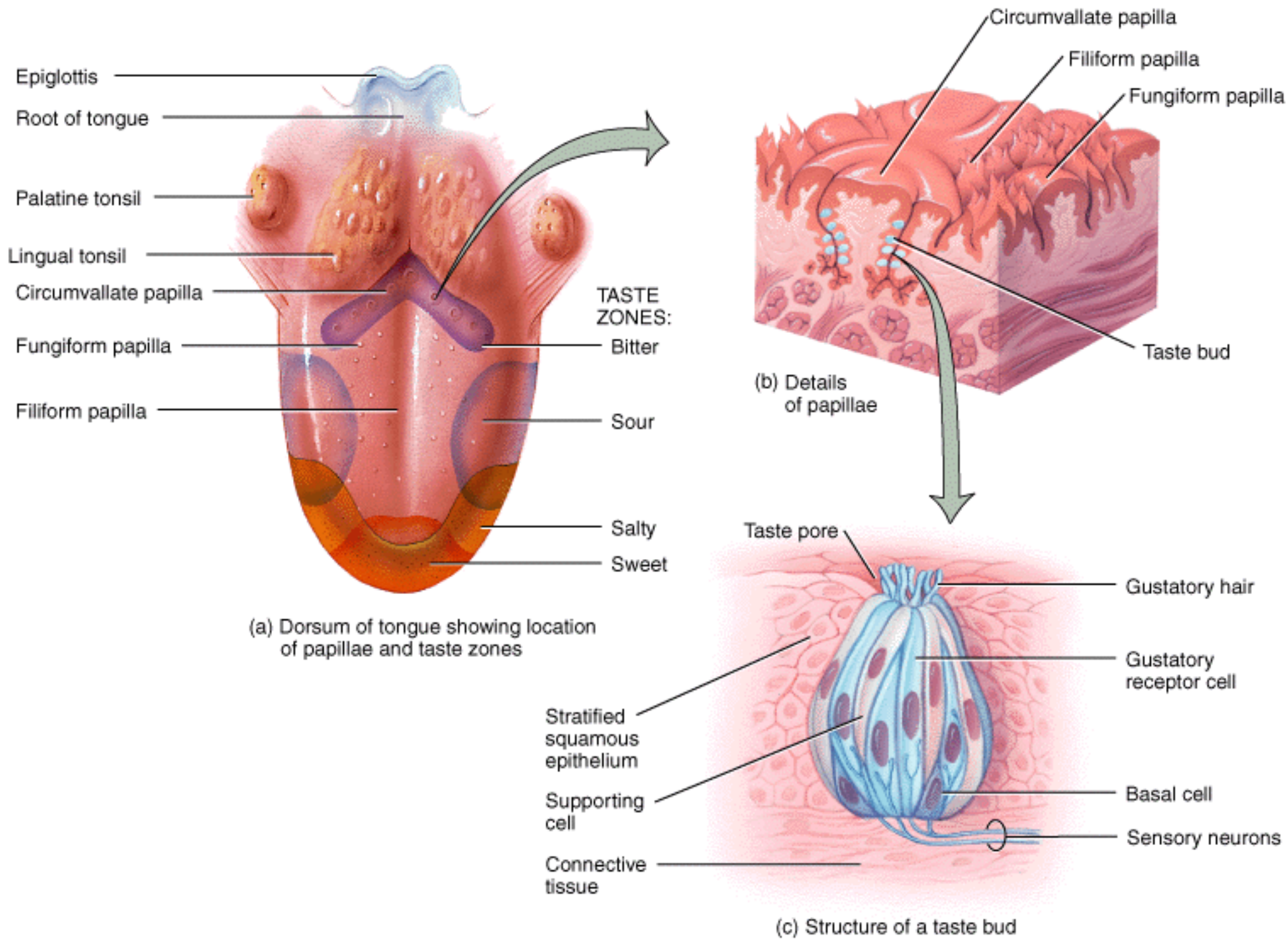
■ This is Bull^%&\$

The “Tongue Map”

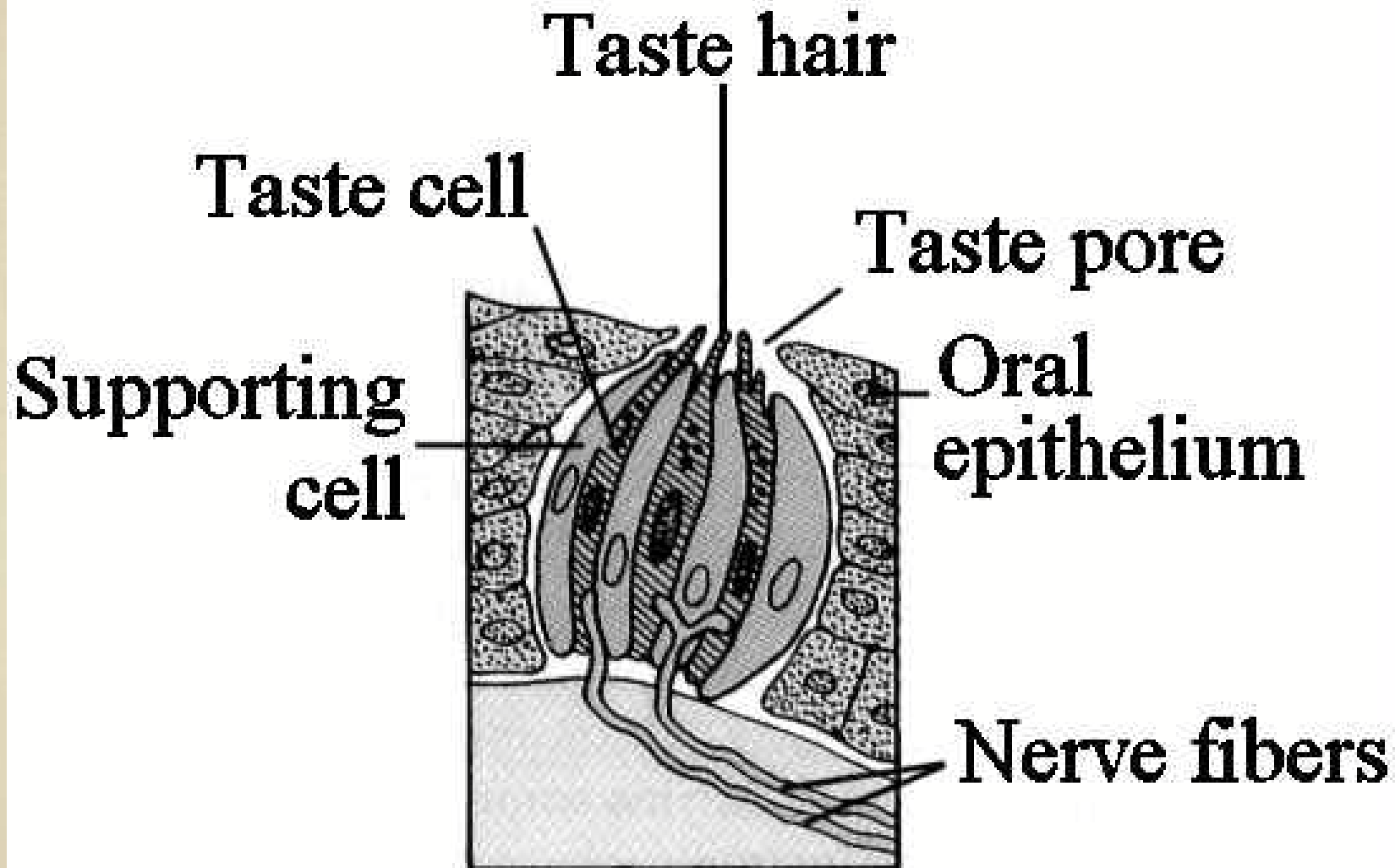
- Taste buds spread across the tongue
- The Test: Salt...
- Don't repeat it, please

How do we Taste?

- Taste receptors' "Taste Buds"
- Tastants: Chemicals that can be perceived by our taste buds



The Bud, Bud



Seeley, Rod R.; T.D. Stephens, and P. Tate. (1996).
Essentials of Anatomy & Physiology, 2nd ed. Mosby, NY. pg.240.

How do we Taste?

- Tastants, AKA: Ligands, react with the Apical surface of the Receptor cells
- Collections of 100-200 taste receptor cells
- Create a chemical signal that is sent to the brain

The Elements of Taste:

What We Know

- Sweet: Sugars*
- Tart: Acids
- Bitter: Polyphenols
- Salty: Sodium and other salts
- Umami: Savory/Monosodium Glutamate*

* = Attractive taste

How do we Taste?

- Receptor cells: Two types...
 - Ion Channels
 - Salt (ENaC - Epithelial Sodium Channel)
 - Sour (Acid Sensing Ion Channels - ASICs, specifically PCKDs)

How do we Taste?

- Receptor cells
 - G Protein Coupled Receptors (GPCRs): Bind the tastant
 - T1R1+3 (umami)
 - T1R2+3, T1R3 (Sweet - also found in intestines)
 - T2R (Bitter)

Taste Receptors



Damn, Girl



How do we Taste?

- Chemical/Trigeminal Sense:
Irritants
- Ammonia, Onions, Ginger,
Capsaicin, menthol, CO₂ Burn
- Eyes, Nose & Mouth
- Transmitted via Trigeminal Nerve

Chemo-sensation: All in the Genes

- Ability to sense classes of smells and tastes
- Sensitivity levels
- Cannot be learned

Need some Volunteers

- Sodium Benzoate
- Can be sweet, salty, bitter or sour

Need some Volunteers

- PTC: phenylthiocarbamide
- Dominant Allele
- hTAS2R38: five different haplotypes
- Also subject to conditional variability

Chemo-sensation: All in the Genes

- Bitter receptor Proteins coded on Chromosomes 5, 7 & 12
- Estimated 50 - 100 taste receptor genes
- Odor: 1000 + receptors

Chemo-sensation: All in the Genes

- How do they do it?
- Gene knock out
- Mice

Genetics of sensation -

Key researchers:

- Linda Buck,
Harvard Med School
- Charles Zuker, UCSD

Chemo-sensation: All in the Genes

- Duo - trio testing
- Threshold testing: Paired Comparison tests
- What can be learned is Identification

The Elements of Taste: What We Know

- Sweet: Sugars
- low fidelity/low sensitivity receptors, to maximize preference for high calorie foods
- Flavor threshold for Sucrose: 2,600 ppm

The Elements of Taste: What We Know

- Tart: Acids
- Acetic Acid Threshold: 175-200 ppm
- Valeric Acid (Sweat/BO): 8 ppm
- Butyric (Butter/Cheesy): 2 ppm

The Elements of Taste: What We Know

- Tart: Acids
- can readily differentiate between acids
- Miracle fruit: Tricks sweet receptors and **NOT** Ion Channel

The Elements of Taste: What We Know

- Bitter: Polyphenols
- Threshold for Quercitrin:
250 ppm

The Elements of Taste: What I don't Know

- Salty: Sodium and other salts
- Umami: Savory/Monosodium Glutamate

Taste:

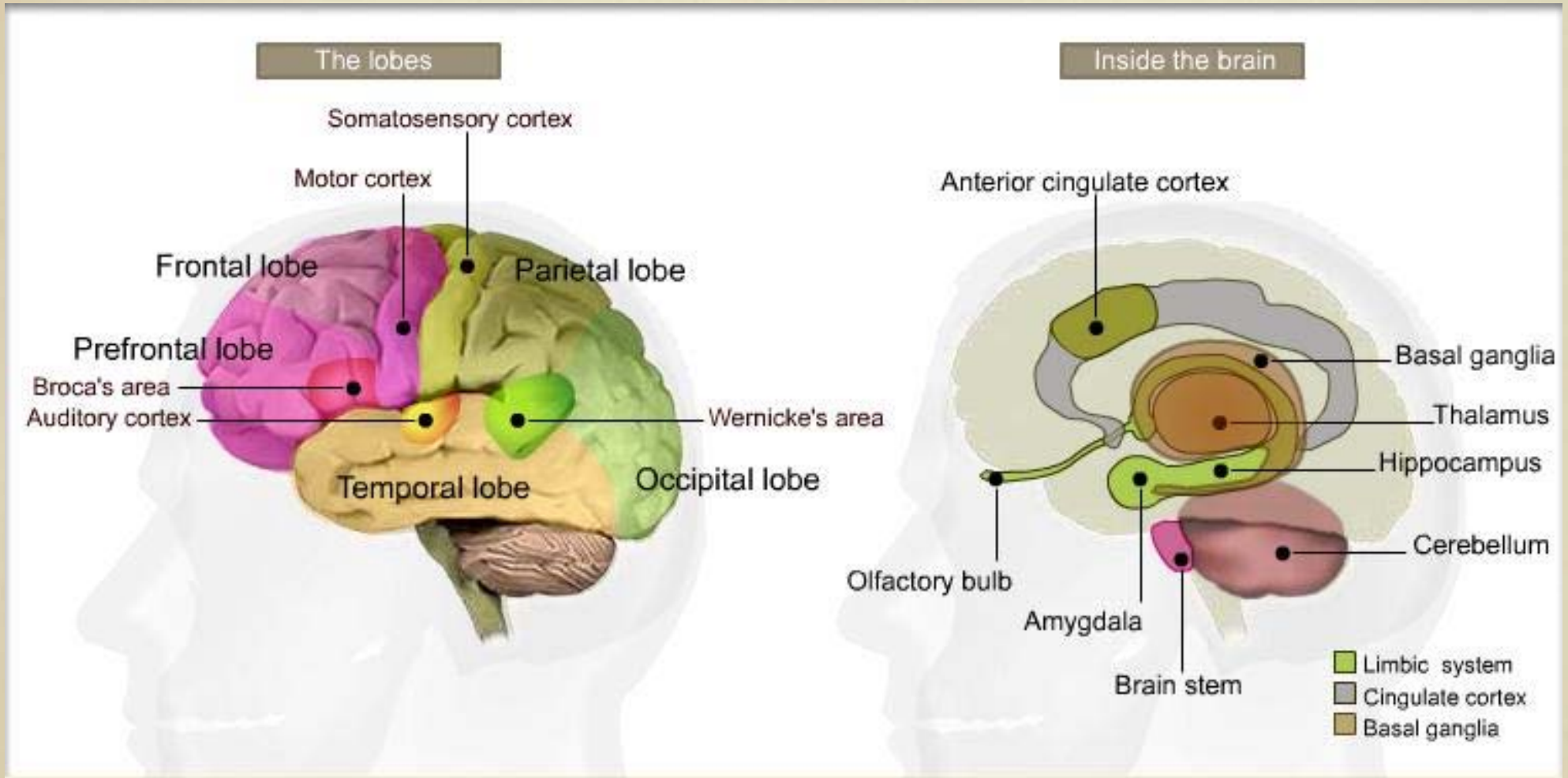
What We Don't Know

- The Complete relationship between Smell and Taste
- Are We Done Yet? -or- We don't know what we don't know

Tasting

- Gustatorial -vs-
- Analytical

Brain Anatomy



Taste & the Brain

- regions:

- amygdala

- frontal opercular/insular (primary)
taste cortex

- orbitofrontal cortex

- http://cal.vet.upenn.edu/projects/neurology/lab13/lab13_taste.htm

Taste & the Brain

- Neural Pathway
 - Receptor Cells (Taste Buds)>
 - Nucleus of Solitary Tract >
 - Thalamus (VPMpc Ventral posteromedial nucleus of the thalamus)>
 - Frontal Operculum (Primary Taste Cortex) Bifurcation>
 - Amygdala & Orbitofrontal Cortex

Smell & the Brain

- Neural Pathway:

- http://cal.vet.upenn.edu/projects/neurology/lab13/lab13_olfactory.htm

Smell & the Brain

- path of sensory tract
 - Receptor Cells (Olfactory Bulb)>
 - Glomeruli >
 - Olfactory tract>
 - Olfactory (Pyriform) Cortex
Bifurcation>
 - Amygdala & Orbitofrontal Cortex

Tasting Decorum

- Unscented Deodorant
- No Perfumes
- Brush and Floss
- Nasal Washes
- Table Talk

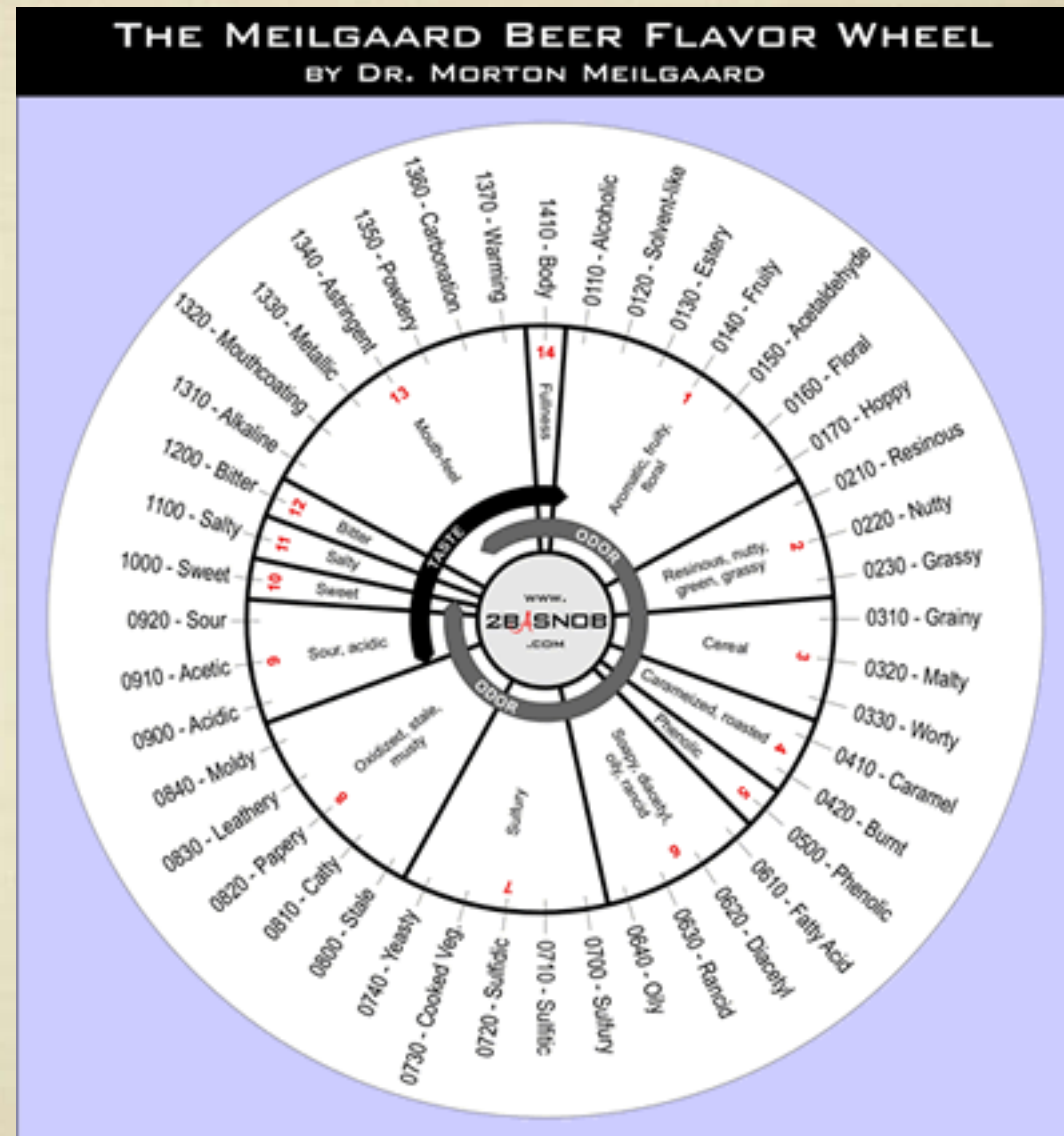
Tasting

- Verbal Overshadowing - verbalization can induce a processing shift that interferes with the application of non-verbal operations
- Jonathon W. Schooler, UCSB
- 1996 - documented VO in intermediate wine drinkers

Taste and Aroma

Analysis

- Dr. Morton Meilgaard
- Beer Flavor Wheel
- Flavor thresholds
- Principal peak



Central Location Testing

- The Pepsi Challenge
- Sip Testing
- Out of context

Central Location Testing

- “New Coke”
- Altered the recipe even further away from what differentiated them from Pepsi
- Beat Pepsi at the “Pepsi Challenge”

Tasting...

- The professional level
- will adoption improve our practice?
- What and How?

Now What?

- Achievable, incremental steps
- Maximize objectivity
- increase Credibility

Now What?

- Threshold testing
- “Gifted Taster” Status
 - Known Tastants
 - Comprehensive List
 - True Calibration
- Re-evaluation of our forms, methodologies and terminology

Now What?

- Threshold testing
- language Capacity development
- Re-evaluation of our forms, methodologies and terminology

Connecting the Dots

- Tastes

- Smells

- Words

The Words

**“LIFE IS SHORT.
DON'T LEAVE ANY
PLEASURE ON THE TABLE.”**