



Culinary Institute
of America

Physiology of Taste

Day 1



Learning Objectives

- Define the physiology of taste.
- Describe the role papillae, taste buds, and saliva play in taste.
- Identify the five basic tastes and their culinary and physiological significance.
- Differentiate between true tastes and trigeminal sensations such as spiciness, astringency, and alkaloid bitterness.
- Explain what and how senses influence flavor.
- Define sensory fatigue and how it can be avoided.

Please Note:

- As part of this presentation, you will be asked to taste a series of unlabeled food products.
- All products used in this session are plant based.
- Please inform the instructor if you have any special concerns or allergies.



What is the Physiology of Taste?

Physiology

- the scientific study of the bodily functions of living organisms and their counterparts

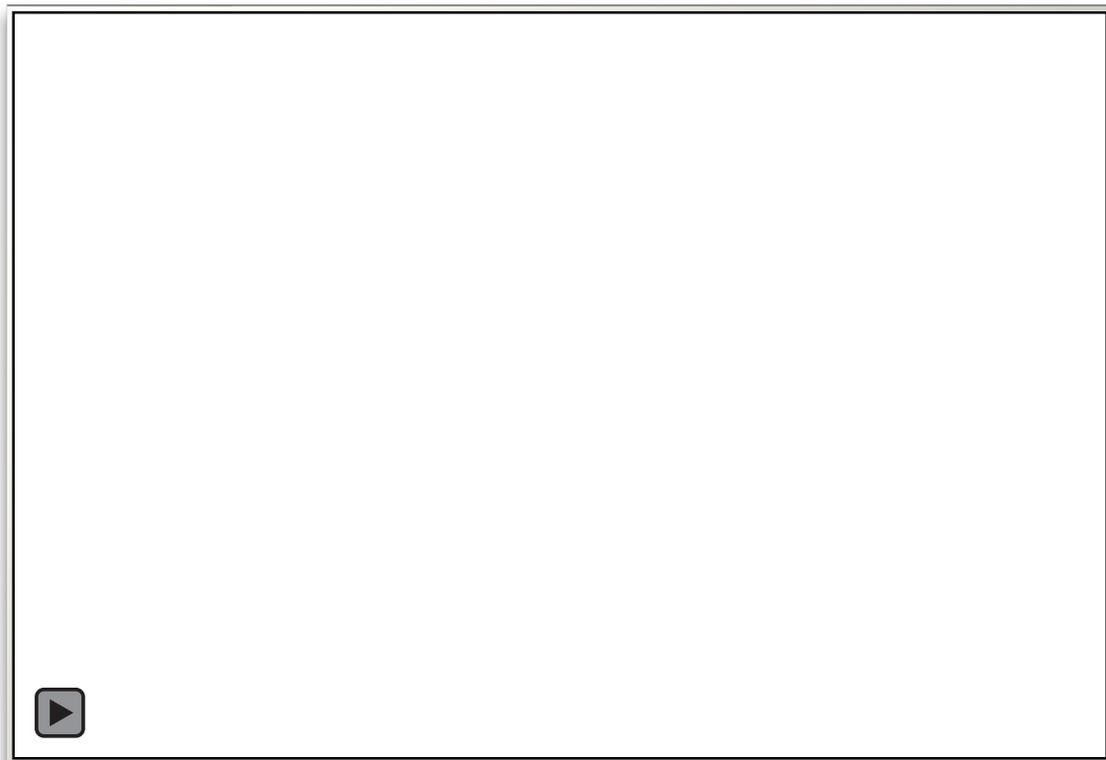
Taste

- One of the special senses which perceives and distinguishes the sweet, sour, bitter or salty quality of a dissolved substance
- Mediated by taste buds on the tongue

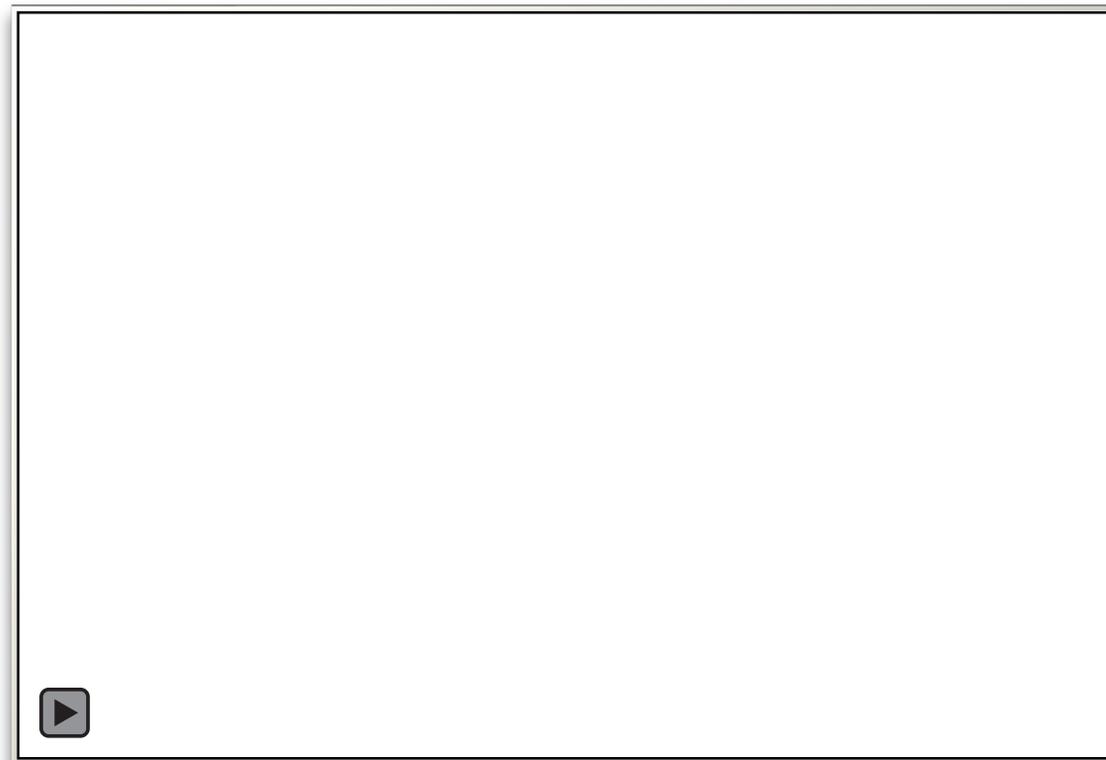


Taste...

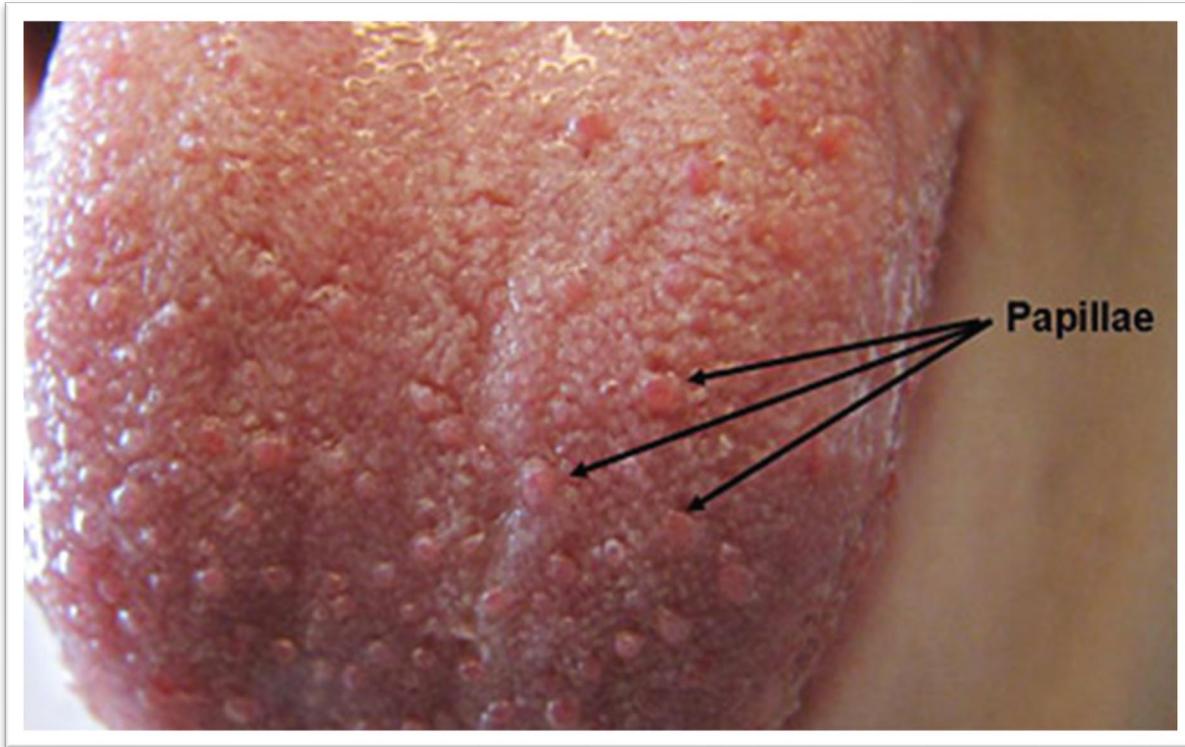
...is a big source of pleasure in most lives, a complex realm of satisfaction both physiological...



...and emotional, much of which involves memories of childhood.



The Human Tongue

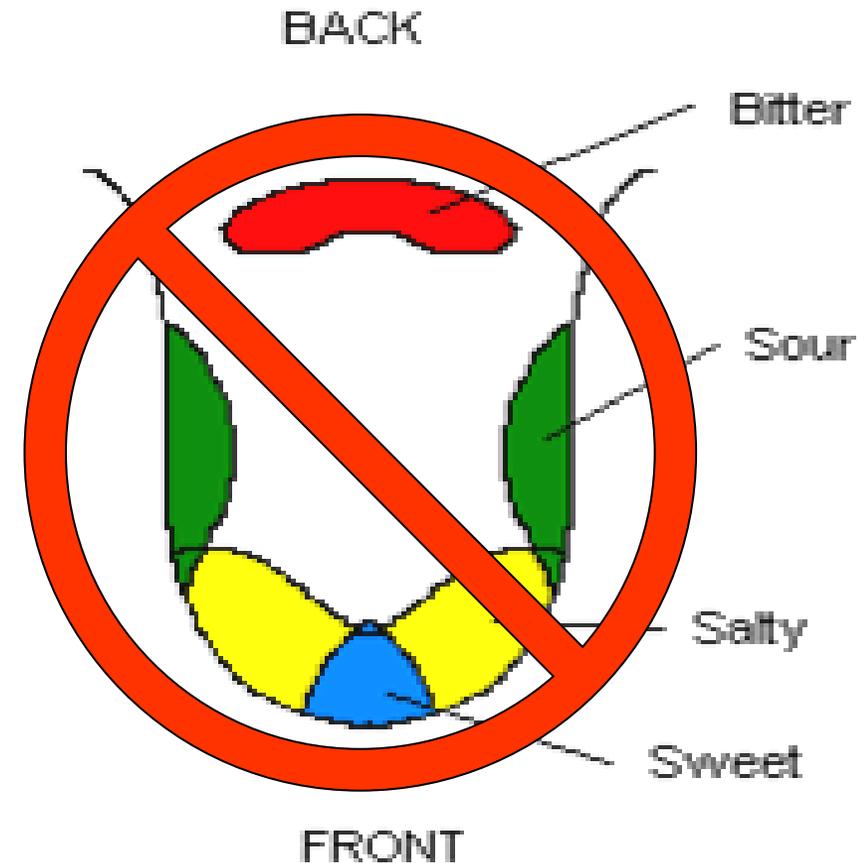


Papillae

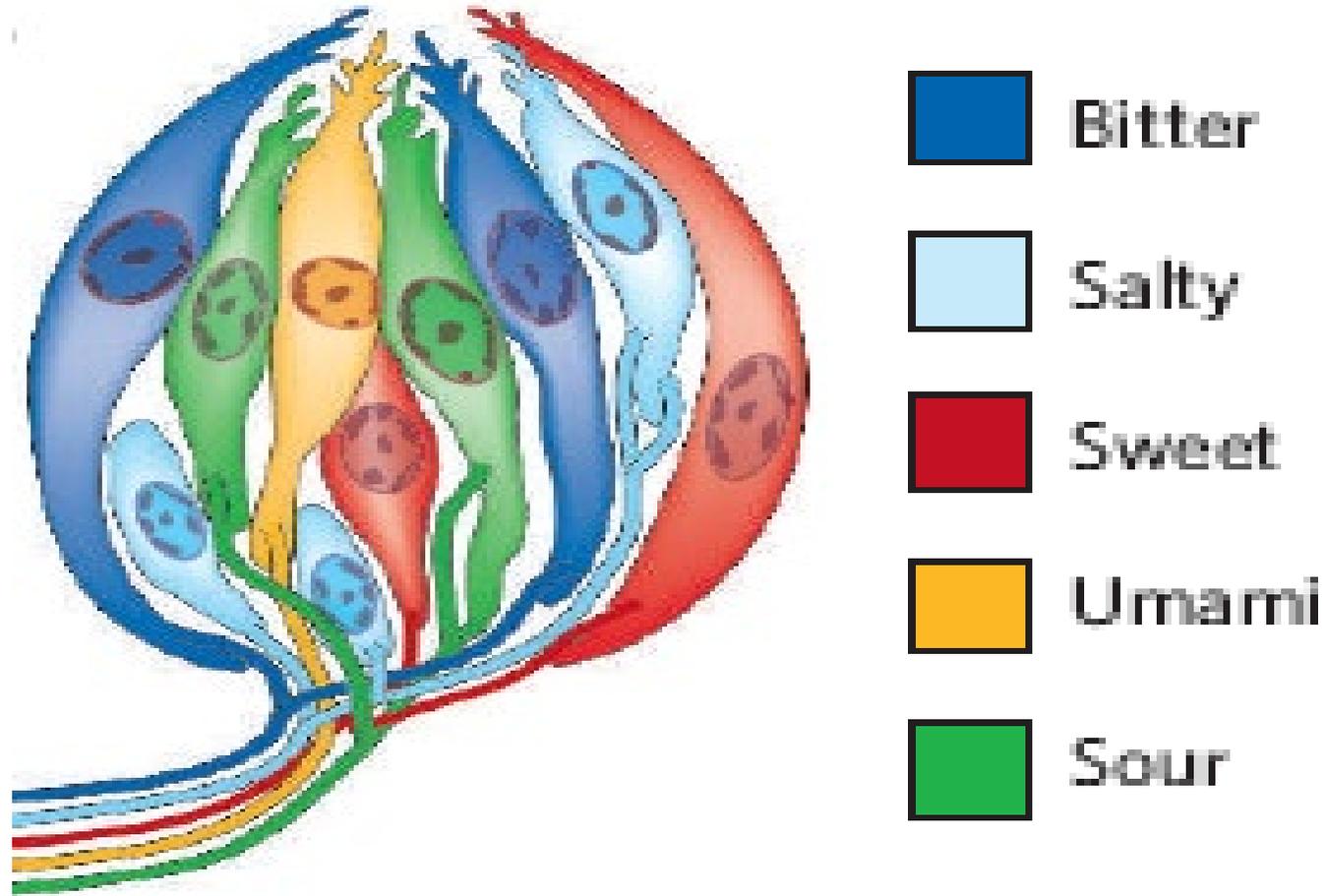
- Contain 1 to 300 taste buds
- About 6,000 per mouth
- Amount varies dramatically among individuals
- Amount varies with age
 - Few when born
 - Increase steadily
 - Declines around age 40
- Life expectancy of a taste bud is 10 days

The Truth about Tastes and the Tongue Map

- The classic "tongue map" is inaccurate and outdated
- The original map was based on a misinterpretation of early research
- **All** areas of the tongue can detect all five tastes: **sweet, sour, salty, bitter, umami**, due to the presence of taste buds
- However, these tastes may have greater sensitivity in the areas shown on the "map"
- We also can perceive alkaline and metallic tastes



A Taste Bud and Its Receptor Cells



What Type of Taster Are You?

Non-tasters:

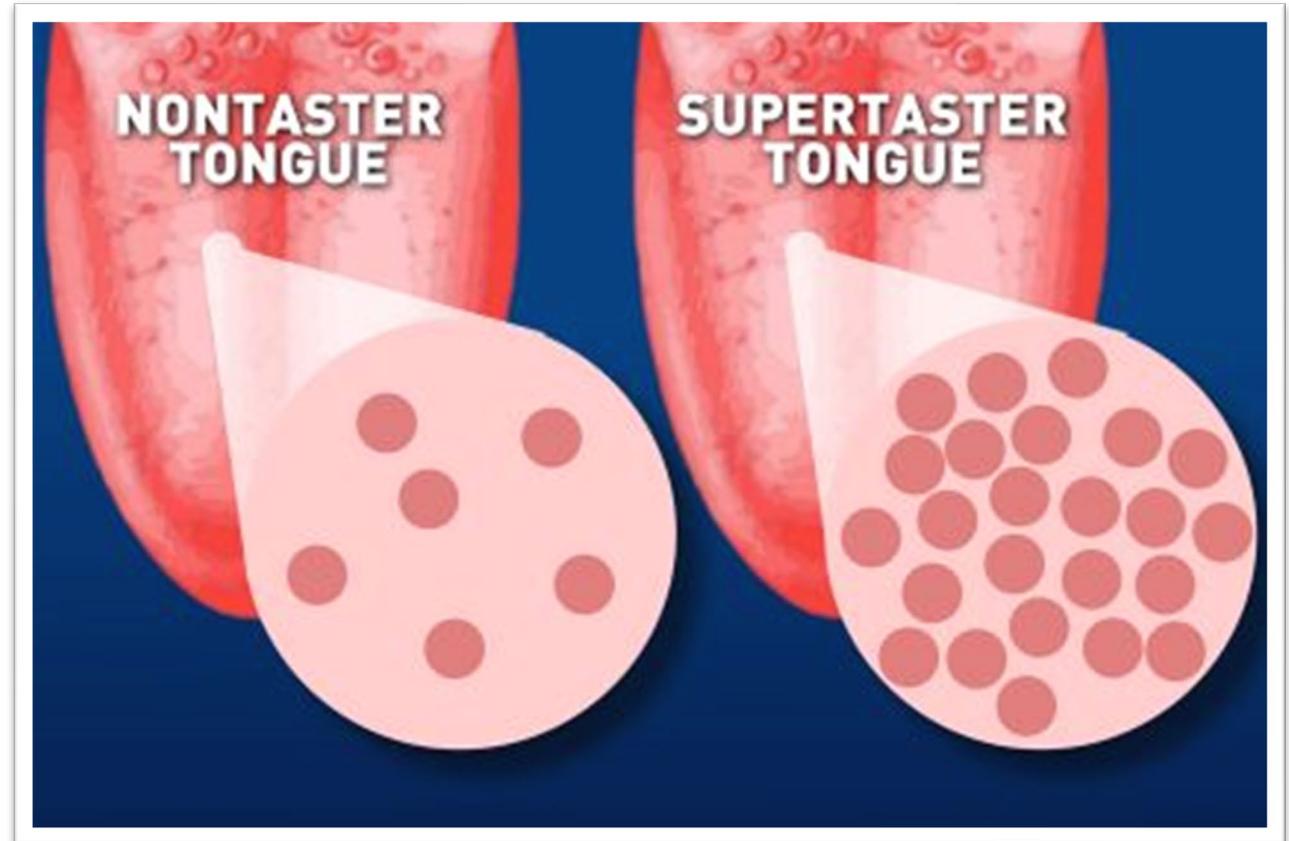
- 2000 taste buds
- 25% of the population

Taster:

- 5,000 taste buds
- 50% of the population

Super-taster:

- 8,000 taste buds
- 25% of the population
- $\frac{2}{3}$ are women



Saliva

- A clean, tasteless, odorless, slightly acidic, viscous fluid
- Produced by salivary and mucus glands
- Has anti-bacterial properties
- Lifetime output about 6,000 gallons

What does it do?

- Lubricates food for digestive passage
- Maintains pH balance
- Initiates digestion
- Helps us taste by dissolving salt, sugar, etc.



What Creates Flavor?

Taste

The detection of the five basic qualities from dissolved substances by receptors on the tongue

+

Aroma

The smell of food, sensed through receptors in the nose, which accounts for 80% of what we perceive as flavor

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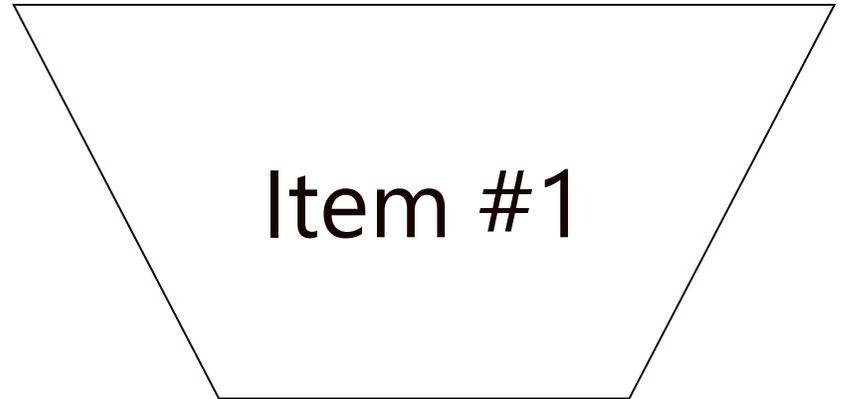
Flavor

The overall sensory perception of a food



Sensory Perception Analysis

- Hold your nose closed
 - “Chew” on jellybean slowly and thoroughly...
 - Analyze what you can taste...
 - What do you taste?
-
- On my mark, gently inhale through your mouth.
 - Release your nose and gently exhale through your nose.
 - What do you taste?



Flavor

Flavor is created through a multi-sensory interaction that includes:

Taste:

the five basic tastes detected by the tongue

Sound:

affects our sense of food's texture, freshness, and appeal

Touch:

the texture and physical feel of food in the mouth

Trigeminal sensations:

physical reactions to chemical irritants

Smell:

aromas that shape recognize as flavor

Sight:

visual cues that influence how we expect food to taste

Temperature:

affects how flavors are released and perceived

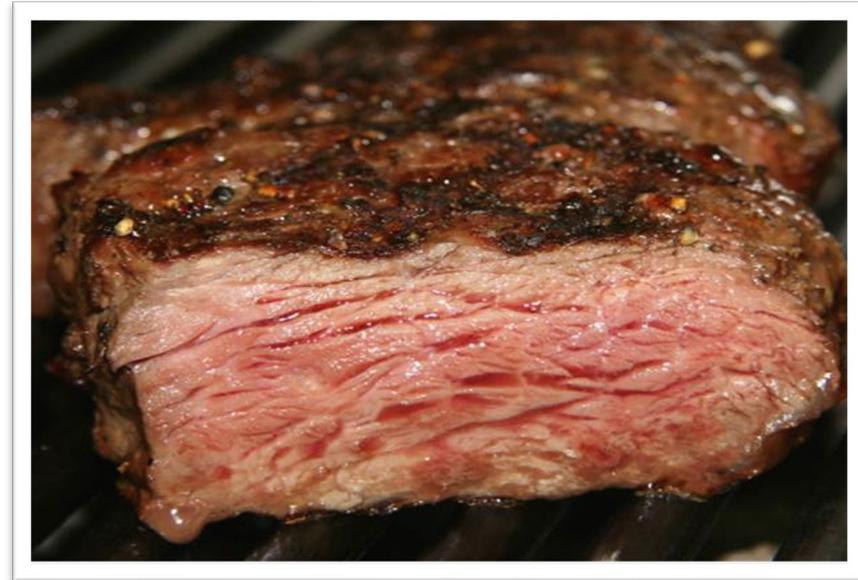
Seeing Flavor



Bright colors indicate
freshness/proper
doneness



Steaming foods
imply hot foods



Juicy looking foods
hint at succulence

Hearing Flavor

- The sounds a food makes influences the perception of its flavor
- **Think of:**
 - A sizzling platter of fajitas
 - The fizzle of champagne
 - Crunching potato chips
 - Biting a crisp apples



Smelling Flavor

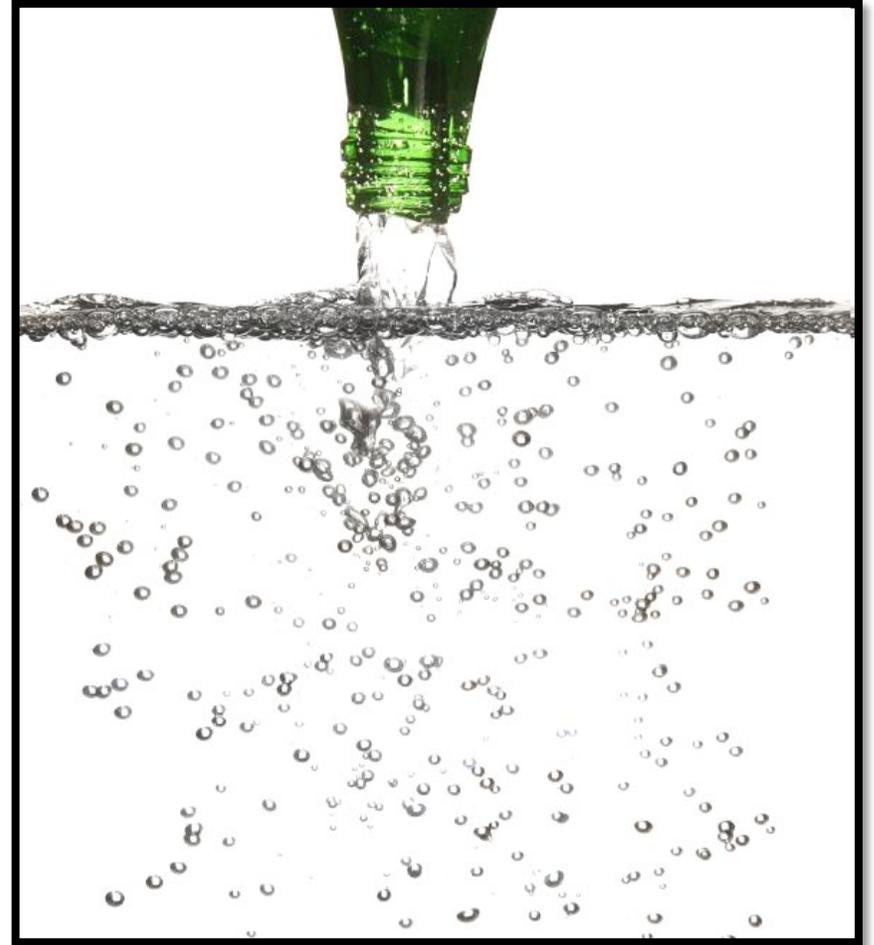
- **Very** important role in flavor
 - Accounts for 80% of what we perceive as flavor
- Often your first impression of food
- Hundreds of aromas recognized
- Often aromas stimulate memories
- Loss of sense of smell limits flavor depth



Feeling Flavor

Flavor can be felt in a variety of different ways:

- Fingers or utensils play first role: resistance, slipperiness, crunch
- Tongue and mouth: teeth, interior surface, lips
- “Spicy/hot” pain: from exposed nerve endings via Trigeminal nerve
- Other sensations: carbonation, “coolth”



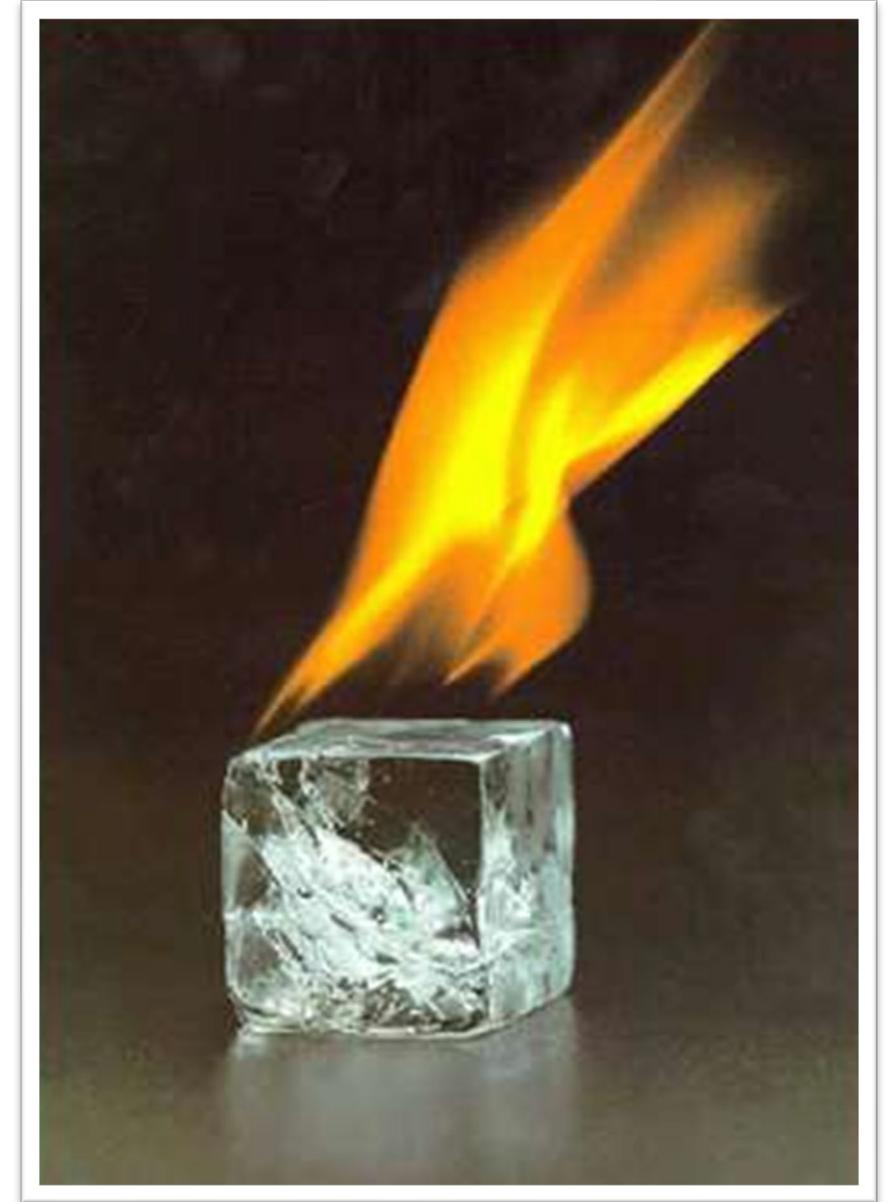
Texture: Crispy vs. Crunchy

- The softer the item, the more texture it deserves
 - Soft cheese/crispy crackers
 - Hard cheese/soft baguette
- **Crisp:** quick, light snap on first bite (potato chips)
- **Crunch:** firm texture that lasts through chewing (pita chips)
- Can something be crunchy but not crispy?



Temperature and Flavor

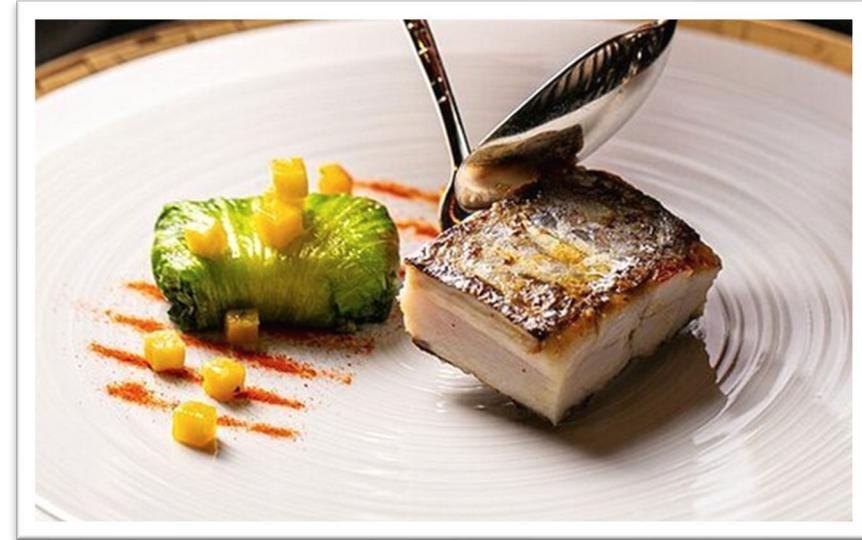
- Optimal tasting temperatures: between 72°F and 105°F
- We lose our ability to taste below 32°F and above 170°F
- Tastes such as sweetness, bitterness and umami are more intensely perceived at lukewarm temperatures
- Saltiness is more pronounced at colder temperatures



Perception and Presentation

Presentation shapes what we expect to eat:

- **Color & contrast:** bright sauces and vibrant garnishes suggest freshness and intensity
- **Plating style:** clean lines and balance signal care and quality
- **Texture cues:** glossy, crisp, or smooth elements hint at mouthfeel
- **Aromatics:** visual hints like herbs or flowers suggest complex flavors
- **Emotion:** presentation evokes season, culture, or luxury



Physiological Impacts on Flavor Perception

Medication:

some drugs can alter taste or reduce saliva, dulling flavor perception

Age:

taste and smell sensitivity often decline with age, reducing flavor intensity

Pregnancy:

hormonal changes can heighten or distort taste and smell

Injury:

damage to the mouth, nose, or nerves can interfere with flavor detection

Illness:

conditions like colds or infections can block smell and alter taste

Classification of Tastes

Sweet

Salty

Umami

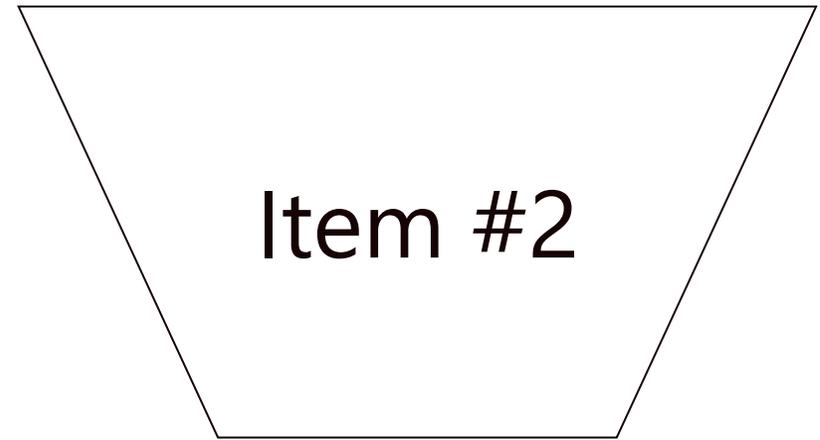
Bitter

Sour



Sensory Perception Analysis

- Take a sip of item #2 (*open nose*)
- “Chew” slowly and thoroughly...
- Analyze what you can taste...
- What do you taste?



Salt (Sodium Chloride)

- An essential nutrient
- Recognition threshold is 1 part per 400

Physiological tasks:

- Intercellular fluid balance
- Minimum intake varies per person

Culinary uses:

- Flavor and color enhancement
- Food preservation
- Sausage making
- Muting bitterness



Seasoning vs. Flavor Enhancing

Seasoning is like a volume switch:

- Acid
- Salt
- Spice

Flavor development and enhancement add:

- Balance
- Contrast
- Depth



Without seasoning



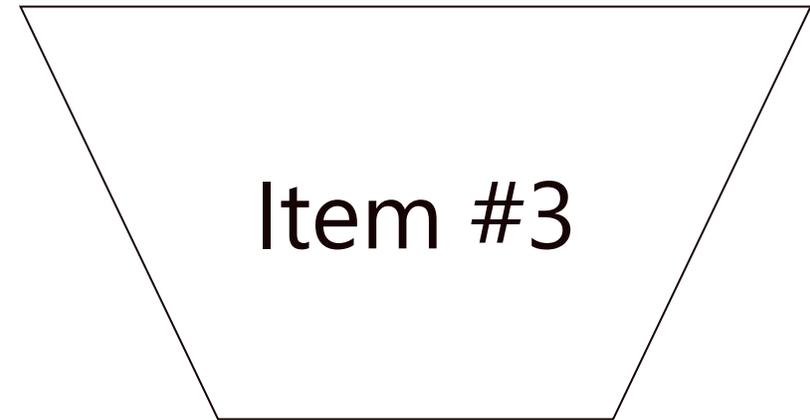
With seasoning



With flavor development and enhancement

Sensory Perception Analysis

- Take a sip of item #3 (*close nose*)
- “Chew” slowly and thoroughly...
- Analyze what you can taste...
- Now open your nose and taste...
- What do you taste?



Sour

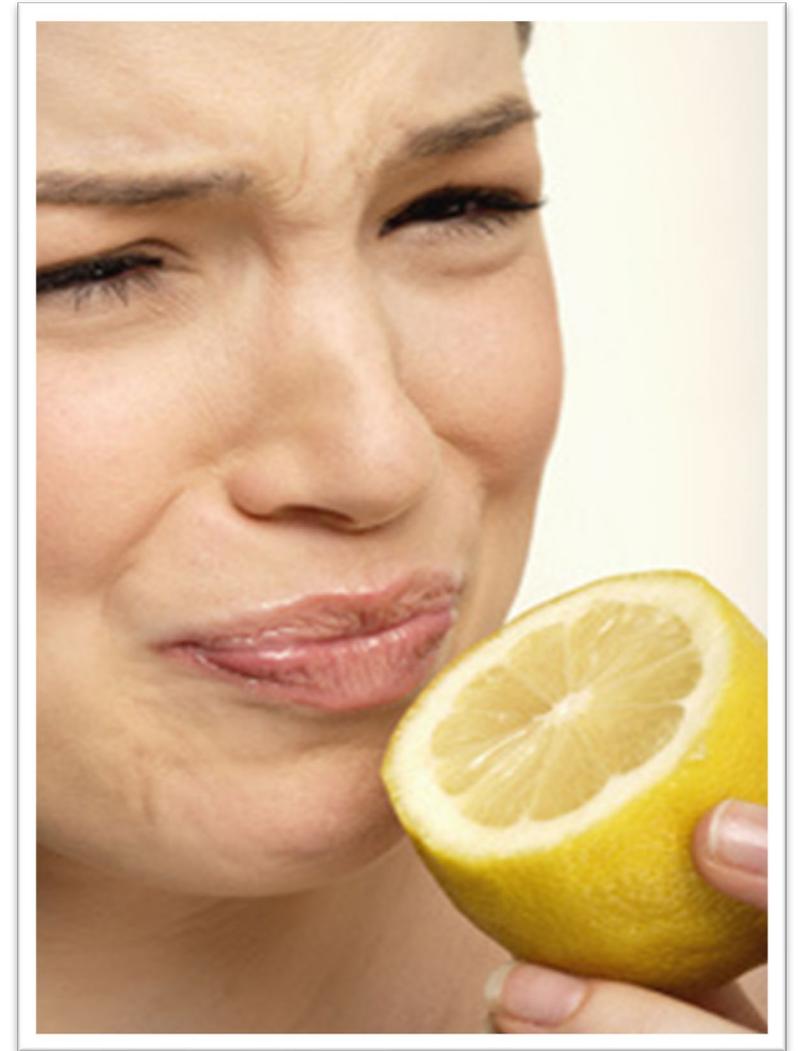
- Recognition threshold is 1 part per 130,000
- Causes enhanced saliva flow
- Potentially corrosive to tooth enamel

Indicates:

- Potential spoilage
- Fermentation
- Presence of vitamins
- Presence of acid (pH < 7)

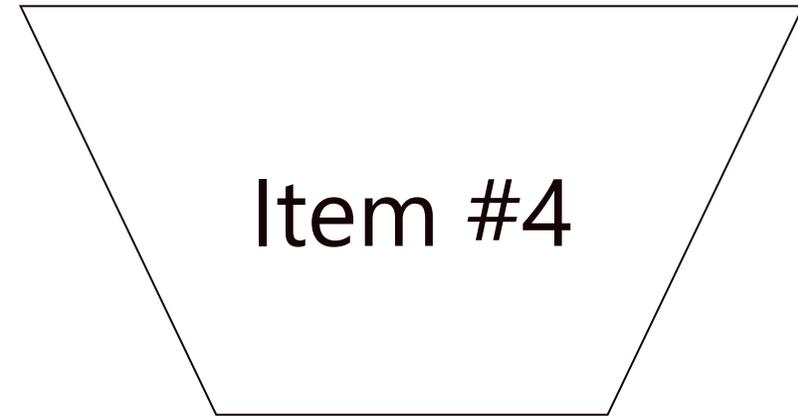
Culinary uses:

- Preservation
- Flavor enhancement
- Fresh appeal



Sensory Perception Analysis

- Take a bite of item #4 (*open nose*)
- Chew slowly and thoroughly...
- Analyze what you can taste...
- What do you taste?



Bitter

- Human have a very high sensitivity
- Recognition threshold is 1 part per 2,000,000

Indicates:

- Presence of toxins/ alkaloids
- Potentially harmful to health

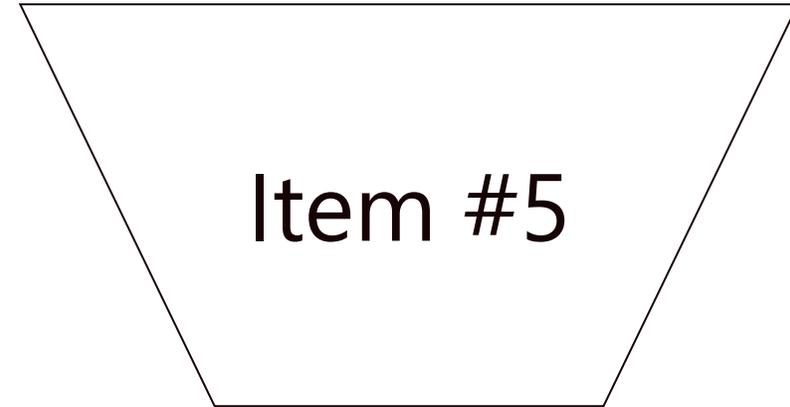
Most preferences for bitter are acquired tastes:

- Coffee
- Beer
- Bitter vegetables



Sensory Perception Analysis

- Take a sip of item #5 (*close nose*)
- “Chew” slowly and thoroughly...
- Analyze what you can taste...
- What do you taste?



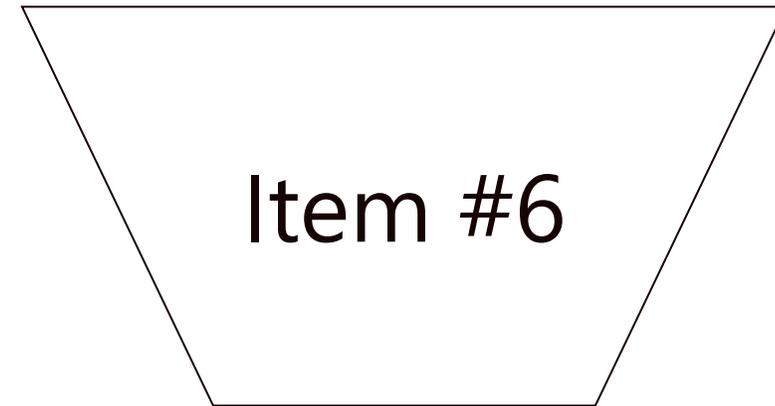
Sweet

- Humans have a high tolerance for sugar
- Recognition threshold is 1 part per 200
- Sugar and sweetness is usually perceived as pleasant
- Newborns naturally prefer sweetness, showing a biological tendency
- Sweetness signals simple carbohydrates; a quick energy source
- In excess, sugar contributes to obesity, diabetes, and heart disease



Sensory Perception Analysis

- Take a sip of item #6
(*close nose*)
- “Chew” slowly and thoroughly...
- Analyze what you can taste...
- What do you taste?



Umami

- *Umami* = *Umai* (delicious) + *Mi* (taste)
- Coined by Professor Kikunae Ikeda
- Recognized in 1985 as the fifth basic taste (not universally accepted)
- Caused by glutamic acid
- Glutamic acid is the base for MSG
- MSG is added to processed foods for flavor
- Umami being a taste is controversial due to MSG concerns



Umami Forms

Glutamates:

- Glutamic acid in vegetables
 - Kombu, tomatoes

Inosinates:

- Inosinic acid in animal proteins
 - Fish – bonito

Guanylate:

- Guanylic acid in fungi
 - Mushrooms, cheese

Synergistic flavor enhancement:

- When different forms are mixed, they amplify each other
- Example: Dashi = Bonito Flakes (Inosinates) + Kombu seaweed (Glutamates)

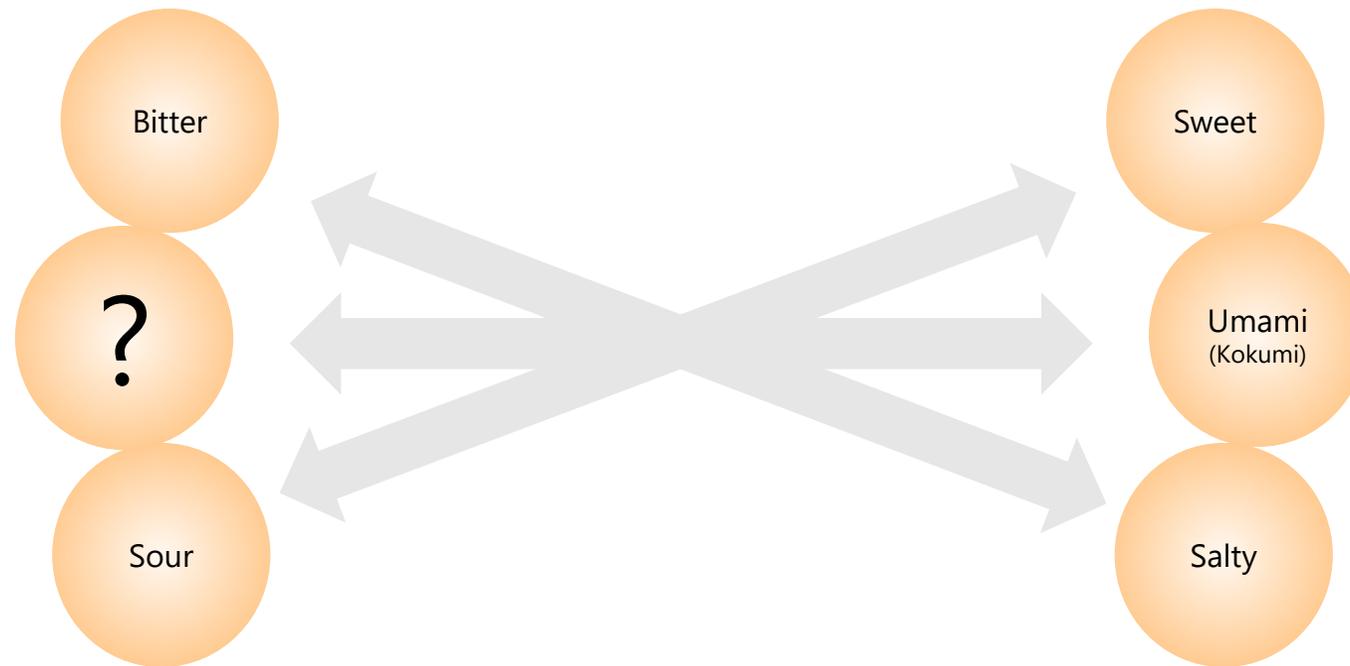


Umami-Rich Foods

- Aged cheese
- Seafood
- Fermented vegetables
- Aged, fermented, cured meats
- Green tea
- Mushrooms
- Tomatoes
- Grapefruit
- Soy products
- Seaweed



If Umami/Kokumi leverage decomposition for the purpose of enhancing flavor...



... is there a counterplay?

...Can (or do?) we counterbalance the flavor contributions of Umami/Kokumi?

- Fresh herbs
- Citrus
- Green olives
- Green chilis & tomatillos

Is the opposite true?

- Under-ripe fruit (papaya)
- Vegetables – as the star!



Let's call it Vigor!

Sensory Perception Analysis

- Take a bite of item #7 (*close nose*)
- Chew slowly and thoroughly...
- Analyze what you can taste...
- What do you taste?



Sensory Perception Analysis

- Taste the hot sauce
- Pain is often a desired "flavor"
- Sensations dull with frequency



Trigeminal Sensations Misidentified as Taste

Astringency:

- Dry, puckering, or chalky mouthfeel
- Caused by tannins (bind to salivary proteins)
- Found in unripe fruits, green tea, red wine

Spiciness (pungency):

- Burning or irritating sensation, reduces with exposure
- Caused by capsaicin or piperidine
- Activates pain receptors, not taste buds
- Found in peppers, chiles, peppercorns

Alkaloid sensations:

- Bitter, metallic, or scratchy mouthfeel
- Caused by plant alkaloids such as piperine
- Detected via trigeminal nerve
- Found in spices, herbs, nightshades

Sensory Fatigue

Too much information results in reduced sensitivity

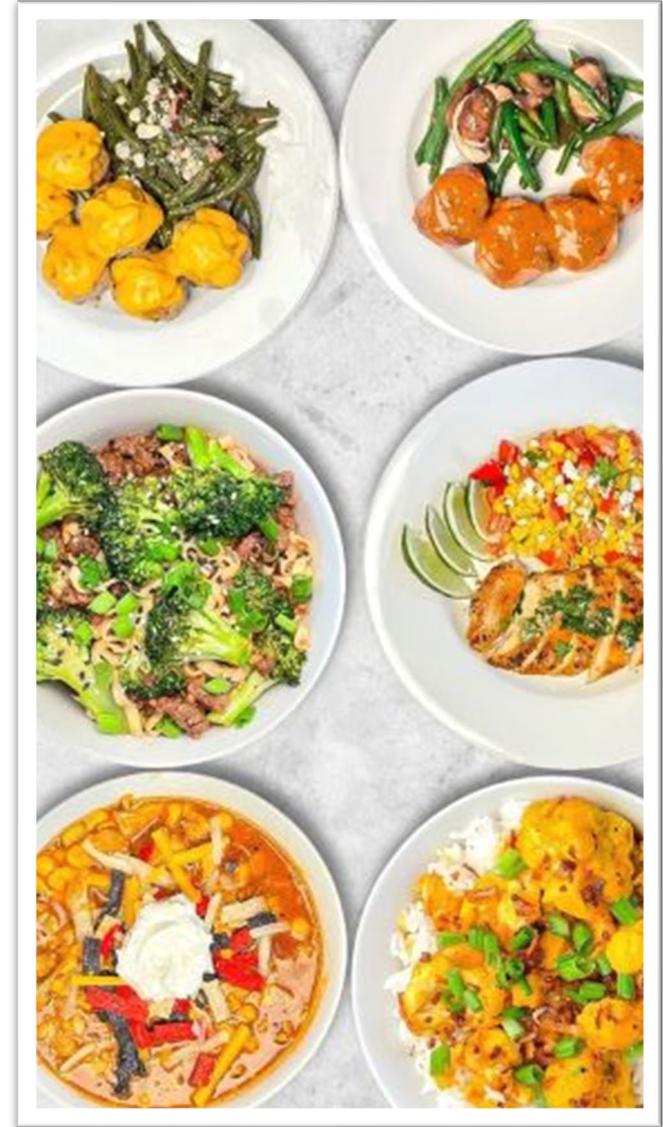
How can we avoid this?

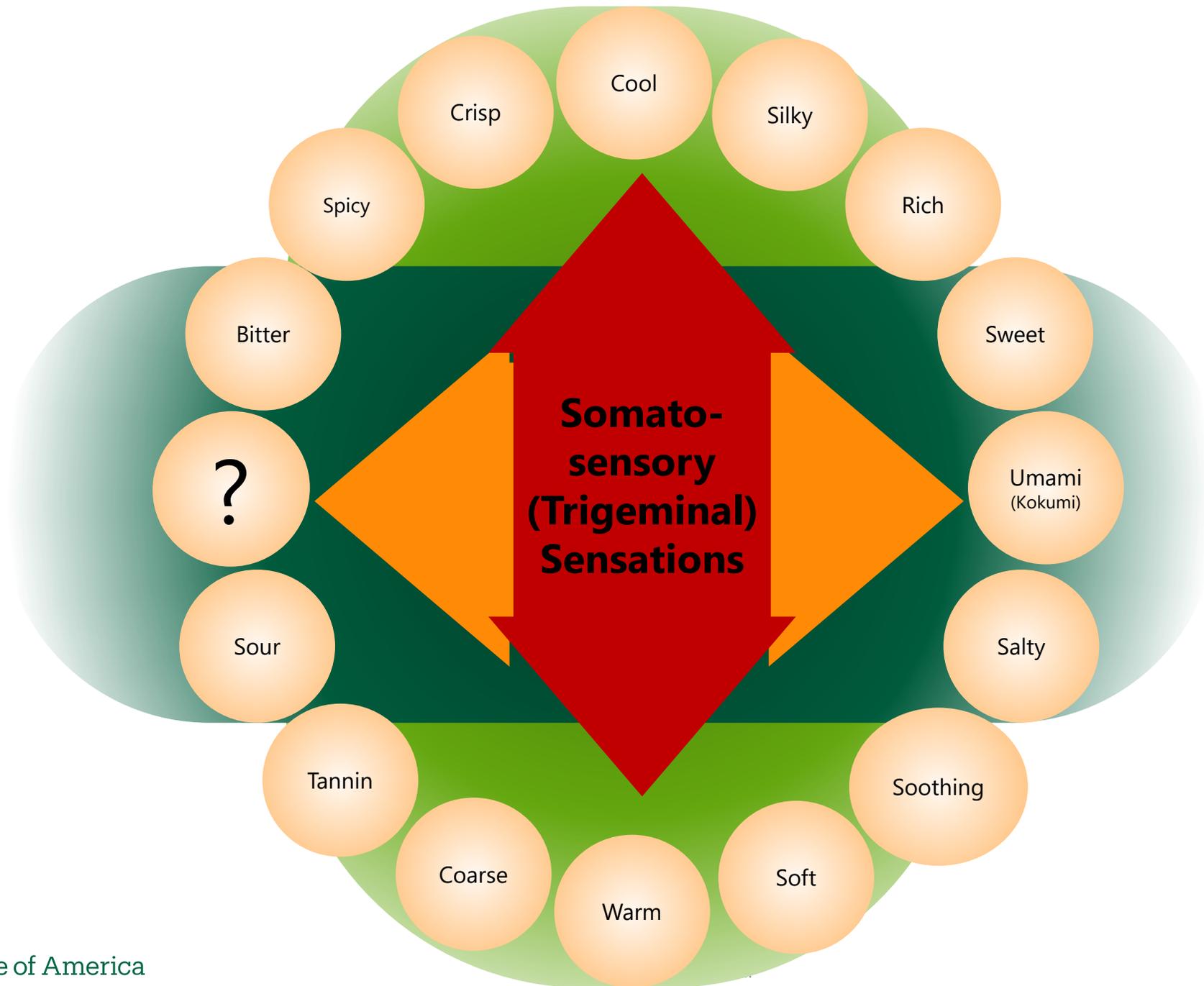
Contrasts and balances!

- Keep your food varied
- Keep it interesting

“The sensory system reacts to ever-present stimulus by reacting less to it.”

--Harold McGee, On Food and Cooking

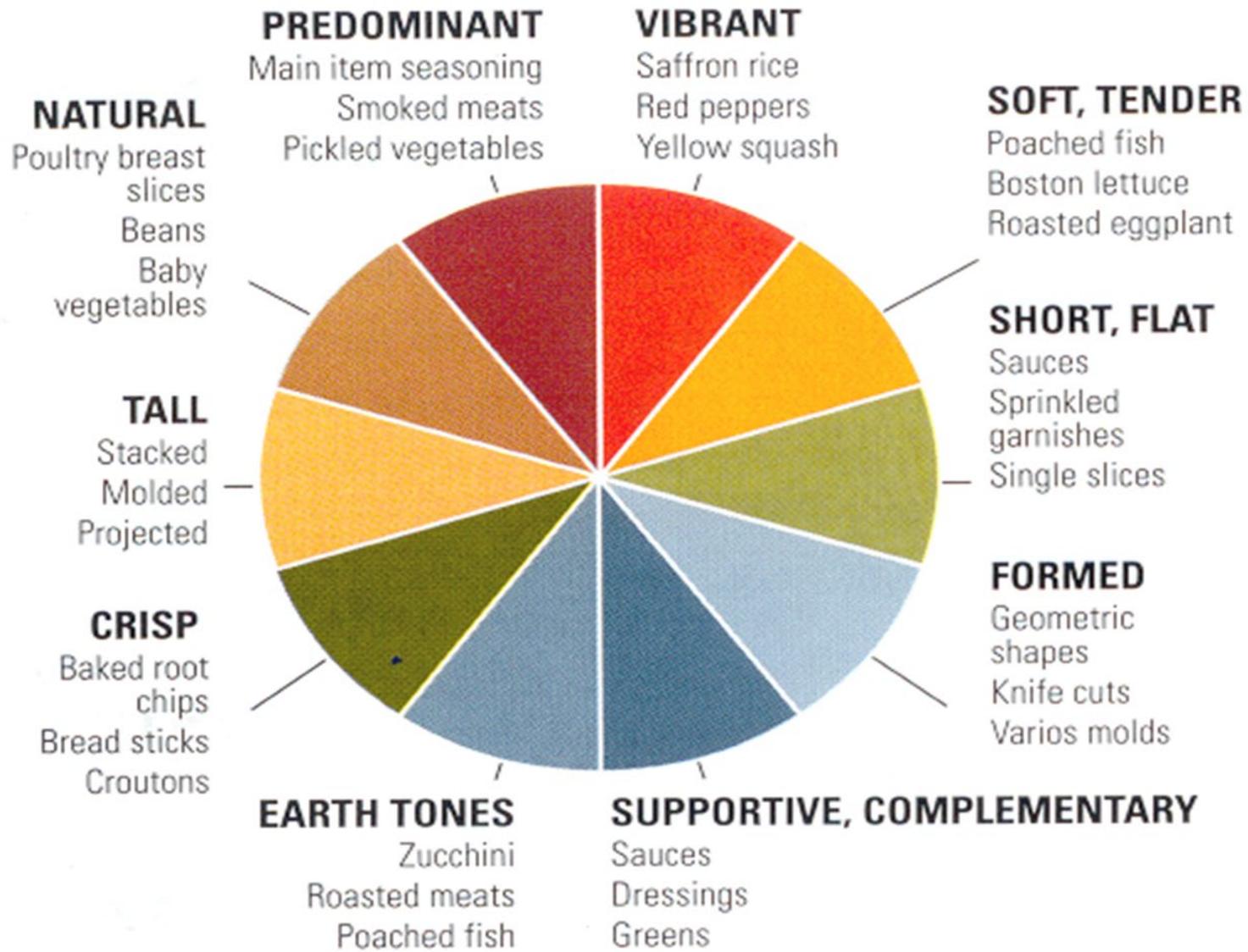




Yin?



Yang?



Food for Thought

When the meal you have ordered (or the dish you have made) misses the mark, is it a case of...

- Good concept, deficient cooking?
- Good concept, good cooking technique, but bad ingredients?
- Good concept, good cooking technique, good ingredients, but the seasonings miss the mark?
- Fabulous ingredients, great cooking, but bad concept?



Cooking is Eating with the Senses

Remember to consider all five senses when you cook...

- **Hearing:** listen for sizzling, boiling, or crunching
- **Seeing:** notice color, shape, and presentation
- **Touching:** feel texture, doneness, or temperature
- **Smelling:** detect aroma and freshness
- **Tasting:** balance flavors and seasoning



Looking Ahead: Day 5 LTO Assignment

Objective: Create a Limited Time Offer menu item for **Ono Market Café** that fits brand and operational guidelines.

LTO item requirements:

- **Form:** Sandwich, flatbread, or snack
- **Flavor:** Southeast Asian-inspired
- **Ingredients:** Include seafood, grilled meats, or grilled vegetables
- **Operations:** Use mostly existing inventory; add only up to 9 new SKUs from preferred suppliers

Goal: Bold, authentic flavor that is portable, quick to prepare, and appealing to millennials



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Any Questions?