Taste

Objectives:

Concepts:

- Taste is a form of chemoreception, and is far more multidimensional than vision or audition
- Taste cells are found in taste buds, that
    - a) are distributed across the tongue
    - b) can sense more than just sour/sweet/salty/bitter
- Tastant molecules are detected based on solubility and concentration
    - Saliva is vital for taste perception
- Smell and taste are very intimately related
- Taste info is encoded by the tongue and delivered to the brain, where sensory processing allows us to perceive flavors

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Setup:

Materials:

- plastic spoons/toothpicks
- cups
- thermos
- blue food coloring
- transfer pipets/eye droppers
- sweet: ½ tsp table sugar dissolved in 2 T water, + other samples
- salty: ⅛ tsp table salt dissolved in 2 T water, + other samples
- sour: ½ tsp vinegar dissolved in 2 T water, + other samples
- bitter: tonic water/coffee, + other samples
- umami: MSG dissolved in water, + other samples
- hot sauce/peppermint extract

Teacher Preparation: What do mentors need to read/do/organize to be ready for the lesson? (e.g. print handouts, bring ice, watch demonstration dissection videos, etc.)

Classroom Preparation: What needs to be taken care of on-site? (e.g. arrange tables, assign students to groups, set up microscopes, etc.)

In the Classroom:

Warm-up Activity (5 minutes): While eating pizza, students at each table will write down as many words as they can to describe the experience of eating pizza - adjectives related to flavor, texture, mouthfeel, etc.

Lesson Introduction/Description (5 minutes):

Opening discussion about eating and tasting:

- "Why do we eat?"
- "What things can we taste?"
- "Why do we have the sense of taste?"

Activity (___ minutes): Details of the activity - group sizes, materials needed, procedure, etc.

Basic taste bud anatomy

Introductory questions:

1. "How do you think your sense of taste works?"
2. "What do taste buds do?"
3. "How is the brain involved in taste perception?"

Talk about the structure of a taste bud and how information is transmitted from the tongue to the brain (see diagrams).

Visualize taste buds by having each student:

- Place a drop of blue food coloring on the tip of his or her tongue. Do not let the tip of the food coloring tube touch the volunteer's tongue.
- Take a mouthful of water, swish it around in his or her mouth, and then spit it out.
- Ask the volunteer to make his or her tongue relatively dry by swallowing a couple of times. The remaining dye should stain all of the tongue blue except for the fungiform papillae, which will look like relatively large, lighter blue or pink bumps (in a sea of dark blue). These papillae are where the taste buds are.
- talk about

Probing the basic tastes

Note: There is no taste map (e.g., the tip of your tongue does not taste sweet better). This is, by and large, a myth. However, it's a myth that everyone believes, and this can be very instructive. Mentors should play this as if it were true for a bit, say that we are going to test to show it. After the students have tried it, reveal that there is no taste map. Students will often not believe you at first, because they will have experienced the map due to placebo effects. However, one thing you can do to convince them is to tell different groups that there are different maps, then have them discuss at the end. Alternatively, don't tell them what the specific sections of the (false) taste map are.

Label 5 cups of clear liquid (salt water, sugar water, vinegar, tonic water, MSG water) with numbers and record which cup contains which liquid. Students will map their tongues by dipping toothpicks into each solution and lightly touching different areas of their tongue.

Questions:

1. "Which liquid was salty/sweet/sour/bitter/umami?"
2. "Are parts of the tongue specific for certain tastes, or are they equally sensitive for all tastes?"
3. "What do you think is activating the taste buds for salty/sweet/sour/bitter?"
    - Salt = alkali metal ions, especially sodium and potassium (*"Why K+/Na+?"*)
    - Sweet = sugar molecules
    - Sour = hydrogen ions (pH)
    - Bitter = many possible molecules
    - Umami = glutamate

Probing further taste sensations

"Are there other taste sensations besides the standard 5 tastes?"

- Temperature - hot vs. cold food
- Texture - chocolate bar vs. cocoa powder, granulated vs powdered sugar
- Astringency - tea
- Spiciness/coolness - peppermint vs. capsaicin
- Fatty foods
- Carbonation

Spicy Solubility

"When you eat something super spicy, how can you make the burning sensation go away?"

Students will test which fluids are best for relieving the burning sensation due to capsaicin. After using an eye dropper to put spicy hot sauce on their tongue, students will try to reduce the burning sensation with the following liquids:

- Water
- Juice
- Coconut milk
- Milk

Explain to students that spiciness is sensed when capsaicin molecules bind to particular taste receptors on the tongue. Milk works well because it contains proteins that surround capsaicin so that it cannot bind to taste receptors (i.e. caseins in milk have higher binding affinities and act as detergents).

Extension: Scoville

Solubility

Influence of smell

- Eating while pinching your nose
- Jellybean test

Taste and Memory/Habituation

Anton Ego flashback scene from Ratatouille

aversive learning

Debrief (___ minutes): Whole-group discussion to ensure *all* students are at least at the expected level of understanding

Schedule (expected time):

x minutes **Warm-up Activity**

y minutes **Lesson Introduction**

z minutes **Activity**

a minutes **Debrief**

Notes/Concerns/Issues: Ideas about tricks that can aid understanding, issues students are likely to have, classroom management during the lesson, specific points to emphasize, etc.

http://neuroscience.uth.tmc.edu/s2/chapter09.html
https://faculty.washington.edu/chudler/taste.html

things we have
cups
peppermint extract
food coloring
citric acid
spoons

things heather is bringing
thermos
hot + cold tea
different sugars