**LESSON PLAN NAME: Jelly Bean Tasting**

**Topic:** Sensory system, Gustation, Olfaction, Cross-modal interactions

**Developed by:** Kelley Remole

**Grades:** All Ages

**Vocabulary words:** Olfaction, Gustation, Perception, Synesthesia

**Materials:** bag of jelly beans, hand sanitizer or neoprene gloves (for safe food handling), plate to fit a handful jelly beans

**Time needed: 5-10 min**

Introduction (3 min): How do we think about flavor? Do we think about how some senses can influence others?

Activity part 1 (1 min): Eat one of the jelly beans in the “taste only” condition

Activity part 2 (1 min): Eat another jelly bean in the “taste+smell” condition

Discussion (2 minutes): What does this teach us about our senses?

**Summary:** Use a fun and naturally engaging activity to demonstrate how there are cross-modality interactions in our sensations: how our experience of one sense can inform another.

**Prerequisites for Students:** None

**Learning Goals:**

* Think about how our senses work together, and how the lines between them can be blurred at the level of perception
* Convergence of input streams to the brain as you move away from the sensory periphery
* (Advanced) Receptor cells communicate with your brain to tell you about your environment.
* (Advanced) Receptors can be sensitive to different degrees (tasting sweet vs. tasting a flavor)
* (Advanced) Relation to development by pruning, “cross wiring” effects like synesthesia
* (Advanced) Think about how we can isolate sub-causes of function in a complex, interacting system: analogy to “Knock-Down” studies.

**Background for instructor:**

* Refresh basic knowledge what the brain does
* Refresh basic knowledge of neuroanatomy, where cross-modal interactions might happen (associative cortex? Thalamus?)
* Refresh ideas of neurodevelopment as pruninge
* Review examples of synesthesia type phenomena
* Review of basic philosophy behing genetic Knock Out/Knock Down studies

**Set-up:** Lay out different cups of jelly beans, along with hand sanitizer/neoprene gloves

**Lesson Outline:**

Any number of people can administer the task, scaled with the popularity of the station. Ask people “Have you ever been disappointed by how bland food tastes when you’ve got a cold?” Our sense of smell is actually responsible for a lot of what we call flavor. Let me show you how. You are going to plug your nose and choose a jelly bean to eat. Put the jelly bean in your mouth and start chewing—with your nose still plugged. Think about what you are sensing as you chew. When you are halfway done chewing, unplug your nose and exhale through your nose. What do you sense now? You’ll probably find that you could only discriminate taste in a very limited way when you nose was plugged- that it was just sweet. When you unplugged your nose all of us a sudden you could “taste” the flavor, and tell so much more than just “sweet”. This is because our sense of smell is responsible for most of what we “taste” with our tongue.

Alternatively: Introduce activity and then have people close their eyes, plug their nose, and hold out their hand. You place a jelly bean in their hand and they put it in their mouth without seeing the color. Once they start chewing they can open their eyes. Ask them to identify the flavor while their nose is plugged and then when they exhale.

**Explanation:**

What we normally identify as our sense of taste is not just what we can sense with the receptors on our tongue: it involves other senses too. Although all of our senses are taken in on different parts of the body, with different sensors, they all go to the same place: the brain. One of the benefits of this is that the brain can take into account different information from different sources: imagine how hard it would be to find your favorite jelly beans if you couldn’t link the color of the jelly bean (vision) to the flavor (taste): you would have to lick all of them! Sometimes, two senses are so closely related that we can even “confuse” one for the other, as is the case here. Neuroscientists are still trying to discover where in the brain these cross-modal sensory consolidation takes place; where we could first have a “perception” of an orange flavored jelly bean: one possibility is in the thalamus, long thought to be a kind of “sensory relay”, as well as association cortex, which takes in much of the input from across different sensory modes and so has the potential to work with very complex combinations of stimuli.

**Additional activities for classroom setting:**

(In depth discussion) Have people eat another jelly bean (not plugging their nose) and think about where they perceive the flavor. We perceive flavor as coming from our tongue even though flavor is an integration of smell and taste. (And even after learning that flavor comes from the nose, we still perceive it on the tongue – so you can’t always believe what your brain is telling you!)

(Other examples) Discuss other ways in which different senses can inform one another:

[**https://www.youtube.com/watch?v=G-lN8vWm3m0**](https://www.youtube.com/watch?v=G-lN8vWm3m0) **(McGurk Effect)**

[**https://www.youtube.com/watch?v=cyfJFE1\_Cpk**](https://www.youtube.com/watch?v=cyfJFE1_Cpk) **(Synesthetic Artist Wassily Kandinsky)**

[**https://www.youtube.com/watch?v=Yyah49\_Oz78**](https://www.youtube.com/watch?v=Yyah49_Oz78) **(Ratatouille: Gustation and Vision)**

(Vision and Audition) Try showing a video of the McGurk Effect (link above)

(Vision and Audition) Consider the case where you have more of an interaction than normal: the art of Wassily Kandinsky, a synesthetic

(Vision and Taste) See the Ratatouille video

**Wrap-up, final thoughts**: 1. Consider that there are people living without the sense of smell (anosmia); or with a greatly reduced sense of smell (hyposmia). Note that often, one of the major health risks posed to these people is that they will either overeat heavily salted/deep fried foods, or lose the will to eat.

2. Consider what makes this kind of cross sensory communication different from others: Could we imagine situations where our smell informs our vision, our touch informs our hearing, or our hearing informs our taste? What makes certain kinds of sensory interactions “normal”, and others not so? (Discuss synesthesia)

3. Note that the techniques used here are representative of the philosophy that biologists use to study complex systems, when we don’t know what individual parts of the system are doing. Imagine that our question was, how do gustation and olfaction contribute to the perception of flavor? This is the approach that we could take to isolate these effects independently, and to then think about how they might interact with one another. Discuss pros and cons of this approach.

**NOTES:**

* See this website for a nice review of olfaction. [http://www.sirc.org/publik/smell\_lhuman.html](http://www.sirc.org/publik/smell_human.html)
* See this website for a review of the actual condition: <http://www.anosmiafoundation.com/disability.shtml#Dangers>