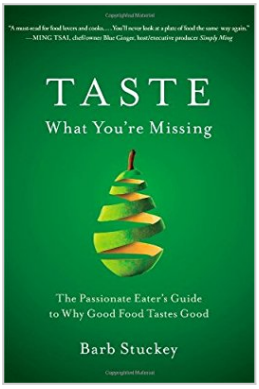

Taste What You're Missing: The Passionate Eater's Guide to Why Good Food Tastes Good

By Barb Stuckey

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Whether it's a grilled cheese sandwich with tomato soup, maple-cured bacon sizzling hot from the pan, or a salted caramel coated in dark chocolate, you know when food tastes good to you. But you may not know the amazing story behind *why* you love some foods and can't tolerate others.

Whether it's a grilled cheese sandwich with tomato soup, maple-cured bacon sizzling hot from the pan, or a salted caramel coated in dark chocolate, you know when food tastes good to you. But you may not know the amazing story behind *why* you love some foods and can't tolerate others. Now, in *Taste What You're Missing*, the first book that demystifies the science of taste, you'll learn how your individual biology, genetics, and brain create a personal experience of everything you taste—and how you can make the most of it.

A seasoned food developer to whom food companies turn for help in creating delicious new products, Barb Stuckey reveals that much of what we think we know about how taste works is wrong. And the truth is much more fascinating—for instance, your tongue is *not* divided into quadrants for sweet, sour, salt, and bitter and only a fraction of what you taste happens in your mouth. As Stuckey explains how our five senses work together to form "flavor perceptions," she tells intriguing stories about people who have lost the sense of smell or taste and the unexpected ways their experience of food changes as a result. You'll learn why kids (and some adults) turn up their noses at Brussels sprouts and broccoli, how salt makes grapefruit sweet, and why you drink your coffee black while your spouse loads it with cream and sugar.

Stuckey also provides eye-opening experiments in which you can discover your unique "taster type" and learn why you react instinctively to certain foods, in particular why your response to bitterness is unique. You'll find ways to improve your ability to discern flavors, detect ingredients, and devise taste combinations in your own kitchen for delectable results.

Taste What You're Missing gives curious eaters, Food Network watchers, kitchen

tinkerers, and armchair Top Chefs the understanding and language to impress friends and families with insider knowledge about everything edible. What Harold McGee did for the science of cooking Barb Stuckey does for the science of taste in *Taste What You're Missing*, a calorie-free way to get more pleasure from every bite.

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Editorial Review

Review
“Barb Stuckey’s book makes the complicated science of food and taste accessible to anyone. It is as enjoyable a read as it is a thorough summary of why ‘good’ tastes ‘good.’”
—David Chang, Chef/owner of Momofuku

“*Taste What You're Missing* would be useful to anyone who cooks- with or without a culinary degree.” (?Peter Rainsford, Ph.D., Vice President, Academic Affairs, The Culinary Institute of America)

“Understanding taste and flavor (and the difference between them) is one of the foundations of great cuisine. Barb Stuckey’s book is an excellent primer on the subject. Her enthusiasm for food and science is infectious, and she explains with clarity and humor (and some neat little experiments you can try out) exactly what happens as we eat. Great reading for cooks, foodies and indeed anyone interested in the sensory world that surrounds us.”

– Heston Blumenthal, chef and owner of the Fat Duck restaurant

"Simply Fascinating! Compelling! A page-turner. TASTE should be required reading for anyone who eats. In layman's terms, Barb Stuckey gives us the tools to analyze and diagnose our food neuroses, as well as get the most out of every plate of food we consume. I think if we were better tasters as a whole, we would seek out better, and yes, healthier foods for ourselves and our children. Barbara confirmed for me that there is truly no need for "kids' meals." She also convinced me to put a paper reinforcement label and blue dye on my tongue." --Carla Hall, Top Chef All-Star, Co-host on *The Chew*, and founder, Alchemy by Carla Hall

"A fascinating book that will change the way you think of everything you eat or drink forever."

--Kathleen Flinn, author of *The Sharper Your Knife, the Less You Cry* and *The Kitchen Counter Cooking School*

“This book brilliantly weaves the subjective experience of eating together with the objective science of taste perception. A must read for food lovers and cooks alike. You'll never look at a plate of food the same again.” --Ming Tsai, Chef/Owner Blue Ginger, Host/Executive Producer “Simply Ming”

A helpful, systematic approach to developing a discriminating palate." (--Kirkus)

About the Author
Barb Stuckey is a professional food developer who leads the marketing, food trend tracking, and consumer research functions at Mattson, North America’s largest independent developer of new foods and beverages. She and her HyperTaster fiancé divide their time between San Francisco and Healdsburg, in Northern California’s wine country.

Taste

1

Taste

I was in Philadelphia in a minivan heading to the restaurant Buddakan with five researchers from Monell, a nonprofit research institution focused on uncovering the scientific mysteries of taste and smell. Seated behind me was Marci Pelchat, whose expertise includes food cravings and food addiction. One of the chattier scientists from Monell, she pointed out landmarks during our quick ride. Reading Terminal Market, Pelchat told me, houses downtown Philly's version of a farmers' market, although it has become a tourist destination.

"But I think you can still get pickled tongue there," she said.

"Beef tongue?" I asked, remembering it from the Jewish delis of my youth, where the sight of a five-pound cow's tongue would make me squeal.

"Kosher tongue?" inquired Bob Margolskee, a Monellian who studies taste at the molecular level.

"Yes, you know, cow tongue that's been cured like corned beef. You slice it to make sandwiches," said Pelchat. "I bought a whole one there to use as a prop for a demonstration on taste that I was giving a while ago. It's an amazing way to point out the papillae on the tongue. Just like ours, only bigger."

"I'm in need of a tongue," chimed in Michael Tordoff, a researcher at Monell who studies, among other things, our taste for the mineral calcium.

"You mean a human tongue?" I asked. "For research?"

"Yes," he answered. Human tissue samples are apparently hard to obtain.

"I'm not just looking for any tongue," said Tordoff, "I'm looking for a fresh tongue."

"Some people at Monell just lop off their own tastebuds," Margolskee told me as we arrived at the restaurant. When you dine with sensory scientists, disturbing visual images about their work accompany the meal.

The first thing I learned when I got to Monell was how the improper use of the word taste sends sensory scientists into a bit of a tizzy. I was corrected no fewer than five times for using the word taste to mean the combination of taste, smell, and texture. Science demands proper terminology, but since I'm not a scientist, I don't use their jargon. I speak and write in plain English, as you do, and I say things such as I can't taste anything when I have a cold and my nose is stuffed up. Yet my taste system, as the scientists pointed out, is most likely perfectly functional. It's my sense of smell that is compromised when I have the flu. Taste is just the tip of the iceberg, since most of what we think of as taste is smell. Some of the food odors we smell come from sniffing the food when it's under our nose (outside the mouth). But most of the aromas we perceive

when we eat are released in the mouth and reach the nose through the mouth.

When you eat something new, you taste it for the first time, although you'll also smell, feel, and touch it. When someone asks you whether you like a food, he asks if you like the taste of it, but what he really wants to know is if you like its combination of smell, taste, texture, appearance, and sound. Yet taste has become the default word for the experience of eating food—in both noun and verb form—because we do (using correct scientific terminology) taste with our mouth.

You instinctively know that what you experience when you eat is just as dependent on your nose as on your tongue. In fact, research has proved that every other sense—sight, hearing, touch, and smell—can influence what you taste as well. But you don't eat with your nose. You don't put food into your ears or eyes. When the system is working the way it should, you put food into your mouth.

This causes us to connect flavor to the mouth because it's the place we taste, the place where taste sensations are initially sparked. But only a small portion of what you experience as flavor happens on the tongue. Linking the entire experience of food to the mouth, though understandable, is what causes the confusion.

There are only five tastes that humans can detect using their mouths, alone. Technically speaking, if it's not one of the five Basic Tastes, it's not a taste at all. Everything else we experience in the mouth is either an aroma or a texture. The combination of these three characteristics—tastes, aromas, and texture—is correctly called flavor. The tastes in a tomato include sweet, sour, and umami (the taste described as savory or brothy). The aromas in a tomato include grassy, green, fruity, musty, and earthy. The texture depends largely on how ripe the fruit is and how it has been prepared, from juicy, firm, raw tomatoes to tender, soft, simmered ones. And the overall flavor of a tomato is what you know of as a tomato, the whole gestalt.

To appreciate, firsthand, how profound the difference between taste and smell is, I suggest you try the exercise called Separating Taste from Smell, which is at the end of this chapter. Plug your nose, and while holding it shut, put a jelly bean in your mouth and start chewing. After a few chews, you'll easily detect the two Basic Tastes evident in it: sweet and sour. Once you release your nostrils, the aromas of it will spring forth: tropical, cherry, pear, melon, buttered popcorn. The flavor of the jelly bean you've chosen is the combination of the two Basic Tastes, the signature aromas of whatever flavor you've chosen, and the texture, chewy-tender.

Of course, you don't have to use a jelly bean to isolate the taste from the aroma of a food. Use a cherry tomato or fig or strawberry and you'll experience the same thing. With your nose pinched shut, you'll detect very little of the characteristic flavor of what's in your mouth. You'll get only sweet, sour, bitter, salt, or umami. Release your nostrils, breathe, and then you will get the aromas of tomato, fig, or strawberry.

In Taste What You're Missing, I'm going to use plain English and say, "when you taste a tomato" even though I may be talking about the total multisensorial experience of eating a tomato. But I will also use (and recommend the common usage of) the term savor as a verb when the word taste is scientifically incorrect. For example, "When you savor a tomato, you get the green aroma first, followed by the basic tastes sweet and sour." We usually think of savoring something as consuming it with delight. But Merriam-Webster defines the verb savor as "to have experience of," so savor really does work in sentences where the word taste is incorrect.

The linguistic tendency to use the word taste to mean flavor is not an idiosyncrasy of the English language. University of Pennsylvania professor Paul Rozin asked bilingual speakers of nine languages to provide synonyms for the words taste and flavor. They were given a dictionary to see if they could find better words.

And then they were educated on the difference between the Basic Tastes and aroma. In seven of the nine languages (Spanish, German, Czech, Hebrew, Hindi, Tamil, Mandarin Chinese), it appears that this same idiosyncrasy exists, so that if it goes in the mouth, it's tasted. Only Hungarian and French seemed to have words that hinted at a distinction between the concept of taste versus that of taste plus aroma: what you know now is flavor.

The word for flavor in French is, not coincidentally, saveur.

Sensory Snack

Taste and smell are the only two senses we confuse. Imagine someone saying, "When I heard that Renoir, I was really moved." or "I like to watch the radio." It just doesn't happen.

The Five Basic Tastes

Once you learn the five building blocks of taste, you will see how they work in harmony with the other senses and start thinking more critically about what you're tasting. Four are familiar to most people: sweet, sour, salt, and bitter. The fifth, umami (pronounced ??a-mä'm?, which rhymes with "who MAH me") is a newer term, imported from Japan, which is loosely translated as savory, brothy, meaty, delicious, or round. Umami refers to the savory taste of certain proteins that make a good beef steak or soup stock taste so rich and full. If you were to take all the salt out of chicken or beef broth, you'd be left with umami. It isn't a taste we crave on its own. It really needs to be paired with salt. More about this complicated taste later in the book.

These five Basic Tastes are the only tastes that we can detect using our sense of taste without support from any other sense. For now, think about them as the five tips of a star. Throughout the book I'll be using the star as a tool to help you form a visual representation of how inextricably linked each taste is with the others, as well as how important all five senses are when you're experiencing food.

The Taste Star: The Five Basic Tastes

The Sensory Star: The Five Senses

I use the star shape because it's perfectly balanced, which is how I think about the five tastes: there isn't one taste that's more important than the others for making food taste good. Not every food should contain all five Basic Tastes. And not every food should contain all five in equal proportions. Take wine, for example. Most wines contain the sour and bitter tastes. Some wines are sweet. But almost no wines are salty. And this is a good thing: it doesn't belong.

Sensory Snack

Salted wines exist in the world of food manufacturing. For good reason.

Adding salt to wine makes it undrinkable, which is exactly what you want when you've got huge vats of it sitting around a food manufacturing plant; you want to make it as unattractive to your employees to imbibe as possible. The government classifies salted wine differently from unsalted wines so that companies such as sauce manufacturers can use salted wine in their formulas without a liquor license.

When you're cooking or seasoning a dish, it is important to make sure that one taste doesn't dominate the others, whether all five tastes are present or not. When one taste (or aroma) dominates, we say that the dish is out of balance; the way the star would be if one of the points were bigger than the others. A wine that tasted salty would definitely be out of balance.

When one taste is out of balance, it throws off the whole food, dish, or drink.

It's fairly easy to recognize a dish that's out of balance from too much salt or bitterness, because it will be unpleasant (as a salty wine would be). What's harder to identify is a dish with too much umami or savoriness. When you become more familiar with umami, you'll be able to tell when there's too much of it. Let's review the five Basic Tastes very broadly; then for each Basic Taste we will go into more depth in its own chapter.

Sweet

Sweet is the term we use for simple carbohydrate compounds such as sucrose, more commonly known as sugar. Almost universally, people describe sweet tastes as pleasant. While sugar is the purest form of this taste, lots of other things naturally taste sweet, such as fruit (which contains fructose) and dairy products (which contain lactose). Sugar is a quick source of calories, so we are genetically predisposed to seek out sweet things.

Sour

We use the term sour to describe the taste of acidity. Lemon juice and vinegar are two of the most prevalent sources of sourness in food; both liquids are high in acid (citric acid in the case of lemon juice, acetic acid in the case of vinegar). Acidity is usually pleasant but can quickly become unpleasant at high levels; a squeeze of lemon can brighten up the flavor of grilled fish or a glass of iced tea, but straight lemon juice is mouth-puckeringly unpleasant. Some people, however, love the extreme sourness of lemons so much that they suck on lemons repeatedly. This can cause the enamel on their teeth to erode if they do it often enough for a long enough period of time. In a pretty nifty design—compliments of Mother Nature—most people find that foods with tooth-rotting acid levels are too sour to eat.

Some acids make foods and beverages taste fresh and bright, whereas other acids indicate spoilage and can

trigger instant rejection of those foods. Acids also help preserve some foods, such as pickles.

Bitter

Individual tolerance varies more widely for bitter foods than for any of the other Basic Tastes. Bitter foods can be very unpleasant on their own if they are not balanced by other tastes and flavors. Coffee, tea, and red wine are common bitter beverages that can be delicious when carefully crafted. Most compounds with medicinal effects have a bitter taste—some at low levels, some at high levels. Our ability to taste bitterness has evolved to help us identify substances that can be toxic. Caffeine, for instance, is extremely bitter. It has a very real, well-recognized medicinal benefit—stimulation—but at high levels it can be toxic. Many poisons taste bitter and their medicinal effect—death—is one you probably want to avoid. That's why it makes sense that humans have a complicated, distrustful view of bitter tastes.

Salt

Salt is the term we use to describe the taste of sodium ions. The most common form of salt is sodium chloride, which we add to food while cooking or sprinkle on at the table. Many foods naturally contain sodium, such as seafood and celery. Salt is critical to life, but we cannot store excess sodium in our bodies, so we are programmed to seek it out in the form of food. In modern times, getting just enough sodium in our diets—without excess—has proved to be a bigger challenge than getting too little. Regardless of how much sodium we consume, our craving for salt is natural—and critical to survival.

Umami

Umami is the most difficult taste to explain because the term is not commonly used outside the world of food or outside Japan, where the term originated. Umami is the taste of glutamates—amino acids that are present in some foods such as beef and mushrooms. The best-known umami-rich compound is glutamic acid—or glutamate—which occurs naturally in some foods such as mushrooms and seaweed. Monosodium glutamate (MSG) is the salt of glutamic acid and this form is often added to foods as a seasoning. We sometimes describe umami as tasting meaty, savory, satisfying, or full. Think of the difference between raw ground beef—which has little umami—and a well-cooked hamburger, which has lots. Other savory foods that are high in umami are cooked tomatoes and the king of umami: aged Parmesan cheese.

The Geography of the Tongue

How do we actually taste these five Basic Tastes? One possibility is that different regions of the tongue process different tastes—as on this map, some version of which you almost certainly saw in elementary school.

The taste map of the tongue. Be careful how you interpret this!

The map shows the geography of the tongue and which area corresponds to which taste. People love this anatomical map because it makes some sense of the multitude of things you taste simultaneously in your mouth when you eat. There's a major problem with it, though: it's completely misleading. It seems to say that you can taste only one of the five Basic Tastes on one area of your tongue. This is not true. You can taste all five of the Basic Tastes on all parts of your tongue. Certain tastes will be more intense in certain areas, but that doesn't mean you can't detect these tastes elsewhere. Sour is really intense on the side of the tongue

but you can taste sour everywhere. Prove it to yourself now by doing the Sour All Over Tasting exercise (at the end of the chapter): dip a cotton swab into distilled vinegar, a really tart liquid. Dab the swab around your mouth without swallowing. You should taste sour all over your mouth, not just on the sides of your tongue. That is, unless you have bald spots on your tongue or other damage to your taste nerves (as I do).

Breaking Down the Sense of Taste

Once you put food in your mouth, there are four dimensions of the sense of taste, according to Paul Breslin of Rutgers University and the Monell Chemical Senses Center. He calls the five Basic Tastes qualities. I like to think of the five Basic Tastes as the first question (Q) of taste, the What: What is it you're tasting? Sweet? Sour? Bitter? The taste qualities of a tomato are sweet and sour.

The second taste dimension is intensity, or the degree of magnitude of a taste. I think of this as the How: How intense is the taste? How strong? How weak? Examples of this would be an extremely sweet tomato and a mildly sour one.

The third dimension he calls oral location, or the Where: Where in the mouth or throat is the taste perceived? Again, the best example of oral location is that most people detect sourness most strongly on the sides of the tongue. As you just learned, you can taste each of the five Basic Tastes everywhere. Where you perceive them to be the strongest is relevant but probably won't affect your enjoyment of food.

The final dimension is the timing, or the When: When do you sense the taste? When does it start? When does it end? When is it the most intense? You may describe the timing of the tastes of homegrown cherry tomatoes as bitter and green at the beginning, as you bite through the outer skin. This would be called the initial or up-front taste. Then, as you keep chewing, you may experience sourness next. That would be the middle of the taste experience. And last, as you continue to chew and swallow, you may experience the sweetness. This would be the taste in the finish. The timing of taste is wonderfully illustrated by how differently we perceive the sweetness of sugar versus that of artificial sweeteners. Even though artificial sweeteners taste sweet, each one—sucralose, aspartame, saccharin, stevia, and so on—is detected in your mouth either faster or slower than sugar, and each lasts for a different length of time after the sweetness of sugar would have cleared from your mouth.

To really understand the way sweetness works for you, do the Sweetness Profile tasting exercise in the chapter on Sweet. I'll explore this in more detail there.

The Four Qs of Taste: What, How, Where, and When

What?

How?

Where?

When?

Type

Intensity

Location

Timing

Basic Tastes

Magnitude of the taste sensation

Perception of where in the mouth/throat the sensation occurs

When the taste is sensed

Examples:

Examples:

Example:

Example:

Sweet, sour, bitter, salt, umami

Mildy sweet or extremely sour

Sourness perceived more strongly on the side of the tongue

Sourness at the beginning, with a lingering bitter taste in the finish

Adapted from: Paul Breslin, Human Taste: Peripheral Anatomy, Taste Transduction, and Coding

Tasting food with your mouth is called gustation. This word comes from Latin and shares its origin with the word gusto. I love the simple redundancy of the term eating with gusto, which can also be translated as "gustation with gusto"—a good phrase to help you remember the scientific term for taste. Smelling aromas is referred to as olfaction.

Gustation + Olfaction + Texture = Flavor

We'll get into more later about each of these building-block tastes, as well as flavors, but for now, let's talk about how your mouth works.

Born-Again Buds

In 1999, when I was fairly new to my job at Mattson, I had a client in the vegetable business. The owners hired us to come up with exciting new vegetable appetizer ideas for their restaurant customers. After a few days of thinking about the assignment, I knew at least one of the ideas I wanted to create: cornmeal-crusted fried green tomatoes like the ones my father had cooked for us every summer weekend of my childhood. Typically, you make fried green tomatoes with unripe, green fruit that are harder and less juicy than ripe red ones. But because they're usually sliced before they're fried, the tomato slices are wet and flimsy and would be too difficult for our client to handle in the quantity needed for restaurants. As I worked through the idea in

my head, it morphed and emerged as cherry tomatoes—much easier to handle. When we couldn't find green cherry tomatoes, I decided to start experimenting with red, ripe ones just to see how they might work out. We call this the proof of concept phase.

Marianne Paloncy, one of our best chefs, called me into the food lab to show me samples of the inaugural batch of my creation. This is my favorite part of my job: seeing and tasting the physical manifestation of an idea. The little cherry tomatoes dipped in batter and lightly coated in cornmeal were adorably cute and promised crunch and flavor. They'd make a perfect restaurant appetizer.

Paloncy dropped a handful of them into the fryer basket and we waited two minutes for the cornmeal to crisp up on the outside, while the little spheres bobbed around in the bubbling oil. When she pulled them out of the fryer, they were glowingly golden brown. I couldn't resist. As I reached my hand into the fryer basket, Paloncy started to speak, but before I could register her warning, I'd already popped a tomato and was pressing it against the roof of my mouth with my tongue. The 375°F frying oil, which had heated the copious water inside the red (ripe and juicy!) tomato, exploded in my mouth with excruciating force and volume. I opened up instinctively and spit out the entire thing, along with a huge flap of skin that I'd burned off the roof of my mouth. I could barely talk. There goes my tasting career, I thought.

Luckily, my damaged palate healed and the thousands of cells I'd scorched off my tongue and the roof of my mouth were replaced within two weeks, the normal amount of time it takes taste cells to regenerate. In fact, cells are constantly turning over from normal wear and tear. This programmed cell death makes perfect sense, since our taste buds are built to be abused, says Breslin: "If you could make a car that could regenerate parts for you, the thing you'd want to regenerate would be the treads on your tires." You could say the lava-hot tomato burned the rubber off the roof of my mouth.

If I injured my mouth on a hot cherry tomato, I knew that beyond the liability concern, my client's customers would have trouble getting the appetizer to diners within the small window of time between when the food came out of the fryer as scorching lava and before it cooled to mealy limpness. So I scrapped the cornmeal-crusted cherry tomato. But my accident gave me an appreciation for the mouth's resilience and new insight into how important it is to have a mouth that functions properly. Much of the pleasure in eating comes from taste and texture, two things that were compromised (or painful) while I was healing. Still, I was shocked by how quickly my sense of taste came back. The mouth is one of the most important tools we have to ensure our survival as a species. At the most basic level, if we don't eat, we can't nourish ourselves. And if we eat dangerous things, we can poison ourselves. If our sense of taste were to fail, we'd be at great risk.

The Two Ways We Smell

When you put food in your mouth, your sharp Homo sapiens teeth come together to tear it into smaller pieces. Chewing, also called mastication, is what we do to prepare food for digestion. Chewing increases the surface area of the food, so that the enzymes in our body can start to release the nutrition from it. If you were to swallow food whole, you'd eventually digest it, but your digestive system would have to work much harder. One of the reasons we have such sharp teeth is to jump-start the process of getting energy from food. Another benefit of pulverizing the food into tiny bits is that we get to enjoy the flavor of it while we chew. The enjoyment of food reinforces our behavior and we eat again, which insures that we get proper nutrition.

Taste and the Two Ways We Smell

When you crush food between your teeth, tongue, cheeks, and the roof of your mouth (the soft palate), the aromas are released and get sucked up through your nose as you breathe. This flow of aromas from your mouth to your nose is called retronasal olfaction. This term is a mouthful (pun intended) so I'm going to refer to it as mouth-smelling. It's different from the type of smelling you do with your nose when you sniff something that's outside your body. Technically, smelling through your nose while the food is still outside your mouth is called orthonasal olfaction, but I'm going to refer to it as nose-smelling.

One important thing to remember about these terms is that in both cases, your nose is where the smell processing occurs. There are no olfactory receptors in your mouth. But in mouth-smelling (retronasal olfaction), your mouth is where the aroma molecules came from, on their way to being processed in your nose. In nose-smelling (orthonasal olfaction), the aroma molecules come in through your nose, and are processed in your nose. Please don't ever say, "I smell with my mouth." This statement is untrue. You smell with your nose from inside your mouth by means of retronasal olfaction.

Sensory Snack

The human jaw is the only joint in the body where the left side and the right side are unable to function independently.

When you see people slurping wine, they're doing it to increase retronasal olfaction, or mouth-smelling. Slurping in air while tasting increases the flow of aromas, allowing you to smell and taste more—more quickly. While chewing with the mouth open is a social taboo in the United States, doing so would actually help us savor better because it would increase mouth-smelling. I will beam like a proud teacher if this book results in an eating public that slurps more unabashedly when eating and drinking. The more slurping you do, the more flavor you get.

You start to taste your food when the compounds in it change form in your mouth. With a crunchy food like a potato chip, you don't start to taste until it mixes with your saliva and starts to break down. Saliva moistens dry food and helps release tastes and aromas. There are enzymes in saliva that break large molecules into smaller ones that have more flavor. The very makeup of saliva helps you taste.

The second way you taste is when a soft food like chocolate starts to dissolve from the heat of your mouth. One of the most seductive qualities of good chocolate is that it melts precisely at human body temperature, which provides a textural experience unlike any other food. This fact makes chocolate one of nature's most perfect foods.

Adding moisture or heat—or both—to any food helps liberate volatile aromas from the food so you can experience mouth-smelling, which is where you experience most of the aromas from food. For instance, neither the potato chip nor the chocolate bar has much aroma on its own in its room-temperature state outside your mouth, even if you get really close and inhale deeply. It's not until you put the food in your mouth that the moisture and heat make it become the crave-able food you know it to be.

The quantity and quality of saliva that you produce enhance your sense of taste. The autoimmune disease Sjögren's syndrome causes the moisture-producing glands to shut down and patients often report that they

experience a loss of taste. This is because they have a dry mouth, trouble chewing, and difficulty swallowing, all of which interfere with important contributors to the flavor of food.

How does the information from the aromas and tastes that are released from food make it to your brain? Not surprisingly, the process begins on your tongue, the upper surface of which is covered with taste buds. How many buds you have determines your taster type (HyperTaster, Taster, or Tolerant Taster). Each taste bud contains millions of cells, most of whose surfaces are covered with taste receptors—proteins that recognize molecules in food and communicate that information to the cell itself, which in turn sends signals through nerves to the brain. While most receptor-bearing cells are in the taste buds, they are also present on the roof of your mouth, on the sides of your mouth, and in your throat.

There are horrific accounts of people who have had their tongues cut out who sometimes report still being able to taste, although swallowing is a problem. Swallowing is critically important to tasting because it triggers mouth-smelling. I'm skeptical of people who say they can savor a food or wine fully by swishing it around in their mouth and then spitting it out. In my professional opinion, you miss nuances of flavor when you don't swallow. Mouth-smelling continues as you swallow food, so spitting it out cuts off the flavor process perception from its natural progression.

For example, we experience the bitter Basic Taste most strongly at the back of the tongue. If swish-and-spit tasters doesn't allow the food to fully saturate those bitter-sensitive buds, their perception will be misinformed. Nonswallowers might argue that in certain circumstances, it may not be possible to swallow everything you taste. In some wine competitions, judges have to taste 100 or more wines in a single day, and one can only imagine the state they would be in if they'd swallowed even 100 small sips of each wine. My counterargument—independent of concerns about alcohol consumption—would be that these competitions make their judges taste too many wines in a single day. No one, no matter how good a taster she is, can discriminate between that many wines. A phenomenon called taste adaptation sets in after your tongue has been exposed to too many tastes in a short interval.

With each additional sample of a taste, you become more and more adapted to that taste: this means that you require more and more of it to get a similar level of intensity. Michael O'Mahony of the food science department at the University of California Davis writes,

A constant odor or taste stimulus will be perceived as decreasing in intensity while sensitivity to that stimulus is also decreased. For sensory evaluation, this poses problems. It means that a taste or odor has a tendency to vanish while it is being observed and that sensitivity to subsequent stimuli will be altered. Such sensitivity drift in the human instrument must be anticipated in the design of measurement procedures for the sensory evaluation of food.

And wine, I argue. The phenomenon of taste and smell adaptation gives overly intense wines an advantage if they are tasted late in the day, but puts them at a disadvantage if they are tasted early. Vice versa for subtle wines. If only the "human instrument"—our mouth, tongue, nose, eyes, ears, and brain—were less prone to the failures and foibles of the human condition.

Adaptation is also the reason you can't taste your own saliva. Your saliva contains sodium and potassium chloride, which make it slightly salty. Yet I'm sure you don't think of your mouth as having a salty taste. That's because you're adapted to it. Your taste cells are in constant contact with it twenty-four hours a day. In fact, the makeup of your saliva is changing all the time, but in such small increments that you don't notice

it. It takes a rapid increase in the concentration of salt in your mouth to wake up your adapted taste buds so that you recognize it as salty. This happens when you eat.

Your own saliva is possibly the only thing in the world that you will perceive as having zero flavor. Even water differs in composition from your saliva, so you experience water as having some sort of taste. You've probably even said something along the lines of "It tastes like water."

Chef Grant Achatz, of Alinea restaurant in Chicago, serves a twenty-three-course menu of small bites. This addresses the impact of adaptation, which he refers to as the law of diminishing returns. He understands that people don't need twenty-four ounces of steak to satisfy their craving. When talking about his tasting menu he says,

That's why the steak is only two ounces. By your fifth bite, you're really done with that steak. You know what it's going to taste like. The actual flavor starts to deaden on the palate. If we were to make you take ten more bites, by the time you got to bite fifteen, the steak's just not that compelling anymore. So if we have a series of twenty-three small courses, where it's a burst of flavor on the palate, then you move on to something completely different . . . and then completely different. That helps us set up a more exciting meal.

Sensory Snack

Some tastes can potentiate others, or mask others. For example, the sodium laurel sulphate in toothpaste makes orange juice taste very bitter. The sodium laurel sulphate masks the sweetness, which then potentiates the sourness and bitterness in the juice.

Conscious, Unconscious, and Conscientious Tasting

When something tastes wrong, your body usually won't let you swallow. That's a good thing: it means your taste system is effectively serving its role as gatekeeper of the body. When and if you swallow, your sinuses get a burst of flavorful vapors from the wad of food your tongue forces to the back of your throat. Technically the wad is called a bolus, although that term somehow manages to be even more unappetizing than wad. Again, this will happen only if you're breathing, something that I recommend you do constantly while you chew, and carefully when you swallow. You will continue to taste the food as long as the volatile aromas are being drawn back up into your nose through the normal course of chewing, breathing, and swallowing.

And that's it. The conscious tasting part of eating is over. To summarize, you derive the initial pleasure of tasting food only while it's in your mouth and throat. This is pretty obvious when you stop to think about it. But that's the problem: we don't often stop to think about savoring food. We're too busy reaching for the next mouthful. If you really want to taste something, it's a good idea to keep it in your mouth as long as possible. Put your fork down. Take a few breaths. Chew some more. Swish it around. Then swallow. From

that point forward, your food follows a very well-documented, studied path through your digestive tract.

I called the previous process the conscious part of tasting because scientists have recently discovered that we have taste cells much farther along in the digestive tract. There are cells in your stomach, small intestine, and pancreas that look and act exactly like those in your mouth. This was a surprise at first, says Monell scientist Bob Margolskee, but it makes sense: the gut needs to be able to identify food in order to know what to do with it.

“Our stomach and our intestines want to know what we’ve consumed. Then they can respond in the appropriate way by turning up the digestive juices,” he says. This phenomenon is known as gastrointestinal chemosensation. Even though we are not really conscious of tasting food much farther than our throat, our gut “tastes” nutrients and responds accordingly.

All of the sensory processes I’ve described thus far have one thing in common: their connection to the brain. When it comes to taste, this connection is an everyday matter of life or death. Making the wrong everyday choices with other senses, such as what music to listen to or what image to look at, may harm you, but probably won’t kill you. But making the wrong choice about what to eat can be lethal. Your taste system is set up to give important information to the brain instantaneously so that the body can react accordingly. To quote Monell scientist Danielle Reed, “Tasting is deciding.”

Of course, the system has its flaws. Many poisonous mushrooms are reported to be delicious, although the person who reported this probably ended up experiencing liver or kidney failure, a common side effect of the toxins that can be fatal. Or a rogue mushroom eater might develop a conditioned aversion to them in the future (if he survived). With a conditioned aversion, an eater associates a particular food with a bad outcome, and then avoids the food consciously or unconsciously. A not-so-careful wild mushroom forager might love the taste of those death cap mushrooms as they’re going down the first time, but he may develop an aversion to—a dislike of—all mushrooms in general as a result of vomiting or otherwise getting sick from them. He’ll probably be most averse to the straw mushroom, which looks like the death cap’s identical twin. It’s amazing what puking—or liver or kidney failure—will do to your food preferences. An old adage captures this survival mechanism: there are old mushroom foragers, and bold mushroom foragers, but there are no old, bold mushroom foragers.

I call conditioned aversions the Tequila Effect. Anyone who has drunk too much tequila and subsequently prayed to the porcelain god knows of what I write. For a period of time after you get sick from a certain food, you will recoil at the mere smell of it. In fact, it often takes disguising the offensive food to get you to ingest it again, such as by adding lime juice and triple sec, and salting the rim of the glass.

Another way Mother Nature can fool us is with dangerous compounds like botulinum toxin, which are flavorless. While lower doses administered topically under the brand name Botox can give you an unnaturally smooth forehead, higher doses ingested orally can result in muscle weakness, paralysis, and even death. These exceptions to the rules of taste are rare, however. Most wholesome, safe food tastes good. Most spoiled or poisonous food tastes bad. Your sense of taste gives you information as it gives you pleasure.

The Taste Committee

I have seen lots of depictions of the taste system, technical illustrations of the tongue and taste buds that are tough to decipher. But you probably don’t care about discerning the difference between the fungiform papillae (the taste buds at the front of your tongue) and the vallate papillae (those at the back). To describe the physiology of taste without getting too bogged down in the science, Monell’s Danielle Reed gave me one

of the best analogies for how taste works: it's like a committee meeting in your mouth.

Imagine your mouth as a meeting room full of business colleagues who serve on the taste committee. Each has been elected to represent others like themselves in the organization: a true democracy. These colleagues work together to tackle projects (food). The committee members get together frequently to discuss new projects (incoming food) and report to the boss (your brain). The five people on the committee represent each group of the taste team: Sweet, Sour, Bitter, Salt, and Umami. One or two of the members usually dominate the meetings. Sometimes they all get a word in. It depends on the project (the food). The hard work of the committee doesn't really come together until a member of the Retronasal Olfaction Team sweeps through the meeting room, like the flow of aromas from your mouth to your olfactory receptors. This is when the work gels.

Unless we pay really close attention to what we're eating, or unless one of the tastes or flavors is out of balance, we usually don't think about each taste and each aroma separately. We react to them all as if we've been sent a summary report from our taste and smell systems. Pepperoni pizza is our first conscious reaction to taking a bite of a favorite food, not sweet, salt, sour, umami tastes combined with tomato, Parmesan, cured meat, and green herbaceous aromas . . . ah, pepperoni pizza. We gloss over the details, but our brain fuses the information into one coherent packet of information.

It's really easy to give someone a piece of pepperoni pizza and ask him what he thinks about it because we know a lot about reactions to things like pizza and other compound foods. We don't know a lot about what happens at the level of the taste bud. Each taste bud contains many taste receptor cells, and some of these receptors detect bitter, some detect sweet, and some detect umami. Taste cells are specialized to detect only that one taste. Sweet, bitter, and umami tastes are detected when they latch onto a taste receptor in a hand-in-glove fashion. Scientists have yet to identify the ones that detect salt. Sour and salt have to pass through ion channels to be detected. It's a harder system to study, which is why we have yet to identify the salt receptor. The fact that both are detected similarly is one of the reasons people confuse salt and sour, as they do with Keane's risotto.

The taste cells in the mouth and throat are connected to three main nerves in the head called cranial nerves, which carry taste messages to the brain. Taste cells on the front of the tongue connect to a cranial nerve called the chorda tympani. There's a similar body part in the ear, the tympanum, both of which share a Latin root with the tympani drum. The chorda tympani, carrying taste information to the brain, passes right through the middle ear. The glossopharyngeal nerve connects the back of the tongue.

The taste receptor cells that function as the "rubber tires" of your mouth relay information to nerves that tell the brain about what you are tasting. Even though they're around for less than two weeks due to programmed cell death "tread replacement," the new taste cells that replace them reestablish a connection to the brain. The fact that this connection is cut and reconnected—continually—over a course of ten days proves just how important the taste system is.

There are other sensations that we perceive as tastes that aren't really tastes; nor are they smells. In fact they are related to the sense of touch—the same sense that detects pain. These sensations connect to the trigeminal nerve, which also transmits touch, pain, and the indication of temperature (what you feel when you drink something hot). Other examples of trigeminal sensations in the mouth are the cooling of mint and the spicy-hot of chile peppers. When you eat a salsa that's spicy-hot, you might say it tastes hot, but that would be incorrect (now I'm thinking like a scientist). You actually feel spicy-hot chiles. The trigeminal nerve is also the main facial nerve involved in classic migraine headaches. Not surprisingly, due to their shared relay to the brain, spicy foods are a common trigger of migraines.

We don’t know where the signals go once they move along the relay system from the taste receptor cell to the nerve to the brain. Perhaps one day we’ll have a cool map of the brain that marks sweet with a star, the way a map of the United States marks Washington, D.C., as the capital. But for now, we don’t know a lot about how taste works in the brain. The boss keeps his secrets well hidden.

Taste What You’re Missing: Separating Taste from Smell

I’m asking you to do this experiment with your eyes closed. Read it thoroughly up to the spoiler alert before attempting to do it. That way, you’ll know what to expect.

YOU WILL NEED

A bowl of jelly beans of various flavors (I am partial to Jelly Belly brand because they have very complex, realistic flavors)

If you are opposed to eating candy, I suggest you use a basket of mixed bite-size fruit such as grapes, strawberries, raspberries, and blueberries.

DIRECTIONS

1. Close your eyes and pinch your nose shut with one hand, so that you cannot breathe through your nose.

2. Without releasing your nose, put your other hand in the bowl, mix up the contents, pick one piece, and put it in your mouth without looking at it. (The idea is to remain unaware of what you are putting in your mouth.)

3. Begin to chew, slowly, without releasing your nose. Keep chewing.

4. Keep chewing, and without releasing your nose, think about what you taste. Sweet? Sour? Can you tell what flavor it is?

5. Release your nose.

SPOILER ALERT!!!

OBSERVE

1. When your nose is pinched, it’s likely you’ll taste only sweet and sour. That’s because those are the only two Basic Tastes that exist in most jelly beans and fruit. With your nose shut, your tongue—or gustatory system—is doing the best it can by identifying which Basic Tastes are present.

2. What happens when you release your nose is that the volatile aromas from the jelly bean escape back up through your nasal passages, into your olfactory system, where you experience smell. This system has a lot more than just five smells to work with. There are reportedly thousands of aromas that humans can detect.

Taste What You're Missing: Sour All Over

YOU WILL NEED

1 cup distilled white vinegar (any kind of vinegar will do, but distilled has the cleanest one-dimensional sour taste)

Shallow bowl or ramekin

1 cotton swab for each person who will taste

Saltine crackers and water for each taster

A handheld mirror for everyone who will be tasting

DIRECTIONS

1. Pour the vinegar into a shallow bowl or ramekin.

2. Dip the cotton swab into the vinegar.

3. Swab your tongue/mouth in distinct places, in order, being careful not to swallow or close your mouth until you've swabbed and tasted the spot you're exploring. You may want to break this up into four exercises.

a. Cleanse your palate with a saltine and water. Swab the middle of your tongue.

b. Cleanse your palate with a saltine and water. Swab the sides of your tongue.

c. Cleanse your palate with a saltine and water. Swab the back of your tongue.

d. Cleanse your palate with a saltine and water. Swab the insides of your cheeks.

OBSERVE

1. As you touch the swab around your mouth, notice what you experience.

2. What you are experiencing is the sour taste. Most people experience the sour taste on all tissues in the mouth.

3. You've just disproved the taste map diagram!

It's easy to prove that you can detect all tastes on all parts of the tongue. What's harder to prove is that this theory is completely wrong, which it is not. There are slight differences in the intensity at which we taste things in each area of the tongue. This truth is where the taste map originated.

Users Review

From reader reviews:

Suzanne Macdougall:

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