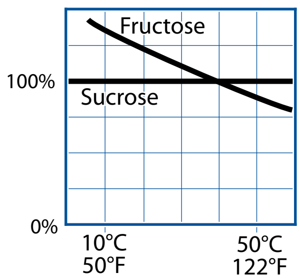
Sweet

As with salt, we're hardwired to like sweet foods. Sweet tastes signal quickly digestible calories and thus fast energy, which would have been more important in the days when picking up the groceries also involved picking up a spear. Just as the taste of saltiness tempts us to eat biologically necessary salt, the taste of sweetness entices us to eat life-sustaining, energy-rich foods. Our desire for sweetness changes over our lifespan, decreasing as we mature. A child's preference for sweet things is biologically related to the physical process of bone growth. (Quick, kids, run and tell your parents that your sweet tooth is because of *biology!*)

Cats can't taste sugar! Different animals have evolved to have different taste receptors based on their diets. Most pure carnivores—cats included—don't ingest carbs as part of their natural diets and appear to have no sweet detectors.

The taste cell receptors that trigger "sweet" messages are more complicated than their salty counterparts—not surprising given the difference in complexity between a single sodium ion and the compounds that our bodies can pull apart for energy. For a compound to register as sweet, it has to be able to latch onto two external points on the taste receptor cells that measure sweetness. To do this, the compound has to be shaped such that it can connect to both points *and* it has to have the right chemical structure to chemically bind at those two points. It's a remarkably specific "lock" that matches only a few dozen common natural "keys"—almost always various types of sugars.



Compared to sucrose, fructose becomes less sweet as it gets warmer—using it makes sense in cold beverages!

Subtle differences in how well compounds fit into the receptor cell's "lock" influence how sweet various compounds taste. Common table sugar (sucrose) fits relatively well, while the sugars in milk (lactose) aren't as adept and thus register as less sweet. The sugar fructose, common in fruits, tastes even sweeter than sucrose at room temperature, but as an excellent example of how complicated chemistry and biology can be, the sweetness of fructose decreases with temperature. The shape of a fructose molecule changes as it heats up, altering its ability to bind to sweet receptors. (For the chemistry geeks: fructose has a few heat-related *tautomers*—structural variations where a hydrogen atom moves over a spot, swapping the order of adjacent single and double bonds—and the tautomers that occur at warmer temperatures don't trigger the receptor cells in the same way.)

How we perceive sweetness also depends on how easily a compound binds to the taste receptors and how long it stays bound. Common table sugar, sucrose, makes only a weak connection to the receptor, which is why its onset is slow and it takes us a second or two to register "sweet!" when we taste it. Sucrose has a pleasant lingering taste, even at very high concentrations. On the other hand, fructose binds very quickly to our sweet taste receptors, but also washes away quickly. You'll find various forms of sweeteners have different taste sensations, ramping up and lingering for different lengths of time. With tasting, it's not just how strong a sensation is, but how we perceive it over time.

Compounds other than sugar can fit into the sweet receptor's detector. Lead, in the form of lead acetate, tastes sweet, as the ancient Romans unwittingly discovered. A few proteins, such as monellin, also taste sweet, and can act as sugar substitutes because of how easily they activate our sweet receptors. Sugar substitutes—both those that are synthetically created and those that are selectively extracted from plants—are selected to bind exceedingly well to taste receptors, analogous to examining the lock and designing as perfect a key for it as possible. Stevioside, the family of compounds in the stevia plant responsible for its sweetness, triggers sweetness perception at a dilution 300 to 600 times weaker than we need to detect sucrose; aspartame, a synthetic sweetener, is slightly less potent, noticeable at a concentration 150 to 200 times weaker than sucrose.

The efficacy of sugar substitutes as a weight-control mechanism isn't as clear-cut as you might think. Recent research is finding that diet sodas lead to *more* weight gain, although why this is the case is unknown. Possibly our bodies store fat based in part on the sensation of sweetness and not just calories in, or the specific artificial sweeteners may impact our gut bacteria and change how we handle food.

Sugar substitutes can also taste bitter at larger concentrations because of slight similarities between how bitter receptors and sweet receptors work. Some of the bitter receptors accept "twisted," nonplanar versions of the sugar substitute compounds—a key that fits one lock can potentially fit other locks! This fit issue is one reason why candies that rely on sugar (sucrose) for volume can't be made with sugar substitutes. Table sugar, as a cooking ingredient, is used for more than its sweet taste: it can bind water, cause and aid in browning reactions, ferment, and crystallize—it's remarkable how many different roles one simple molecule can fill, so it's no surprise that more complicated molecules have even more quirks!

The politics of sugar are complicated. Have you ever noticed that nutritional labels on foods in the US give a "percent daily value" for everything except sugar? The World Health Organization says to limit free sugars to 10% of your caloric intake and suggests 5% is ideal.

Tips

- In a recipe that calls for a specific type of sugar—say, corn syrup—it's often included for functional reasons, not taste. Corn syrup (100% glucose) inhibits crystal formation, which produces gritty textures, and this is why caramel candies and ice cream bases sometimes call for it.
- Modern brown sugar is made from white sugar with molasses added in, at about a 10:1 ratio. If you're cooking and are out of brown sugar, mix in about 2 tablespoons (30 mL) molasses per cup (200g) of sugar (more for darker brown sugar).
- When making sugar syrups for sweetening drinks like iced tea, be mindful of heat. Table sugar in water, when heated and simmered, will break down into fructose and glucose, which taste less sweet. A sugar syrup heated only briefly until the sugar is fully dissolved will taste sweeter than the same syrup heated and simmered.

To make something sweeter

- Add sugar, honey, or other sweeteners (see page 63); reduce sour or bitter ingredients.

If a dish is too sweet

- Increase sourness (e.g., add lemon juice or vinegar) or spiciness (e.g., add cayenne pepper).
- For culinary experimentalists, use a sweetness inhibitor (see page 393).