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Delicious-ology: The Science of Delicious Food

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DELICIOUS-OLOGY

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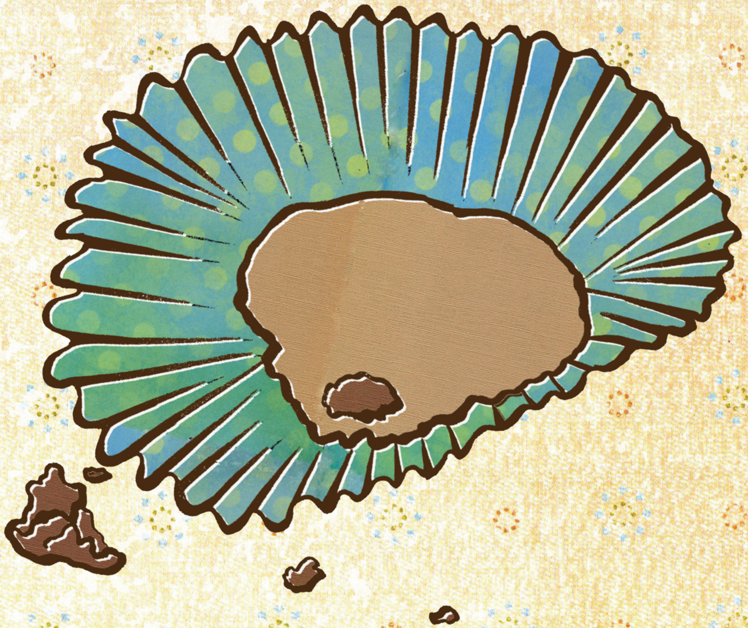

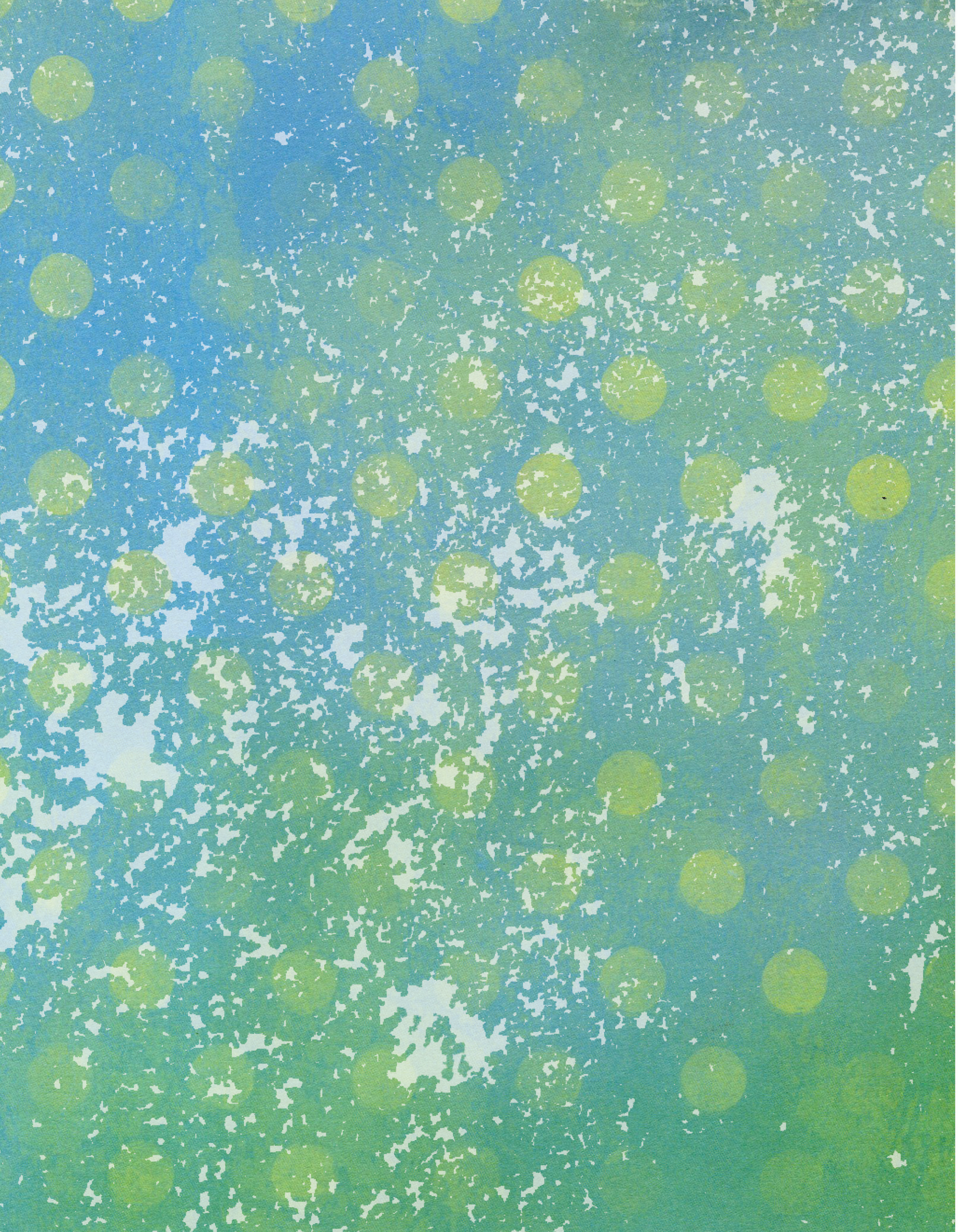

The Science of Delicious Food

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Introduction

This book is for you if you enjoy watching documentaries on the History or Discovery Channel, taking things apart just to put together again, experimenting, and most of all, creating and eating delicious food. For the purposes of this book, we'll call these inquisitive and hungry people geeks (you know it's true).

We're a creative lot– unafraid to try anything...maybe a bit too unafraid, but hasn't had that Darwin Award moment (yet). The type of geek who is either "all on or all off," who addresses every aspect of the perfect cup of coffee, down to measuring the pressure with which the grinds are tamped into the espresso machine's portailter. This kind of geek is always on the search for the next bit of knowledge. If you're this type, this book will inspire you and make your tummy happy.

And if you're not an über-geek, but a bit more mainstream, fear not! Maybe you're comfortable in the kitchen and would like new ideas, or perhaps you're not quite sure where to start but are ready to give it a go.

This book will show you easy ways to try new things. Regardless of which type of geek you are, as long as you have "the courage of your convictions" to pick up the spatula and try, you'll do fine. The goal of this book is to point out new ways of thinking about the tools in that drawer full of kitchen gear.

You can read this book two ways. If you want to "just cook," flip to the recipe index, pick a recipe, and skip straight to that page. The surrounding text will explain some aspects of the science behind the recipe. While the recipes in this book are chosen to complement and provide examples of the science, they're also recipes that are fantastic in and of themselves. This allows the various components of a meal to be covered in appropriate science sections, and also keeps each recipe short and easy. But if you're more interested in curling up on the couch with a cup of tea, pick a chapter based on your interests and tuck in.

The first portion of this book covers topics you should think about before turning on the oven: how to approach the kitchen and how to think about taste and smell. The middle portion covers key variables in cooking and baking, as well as some secondary variables. The last portion will help you make substitutions for you or your friends' food allergies.

Initializing the Kitchen

GETTING STARTED

I bet you're ready to break out the strip steaks, ice cream maker, fresh rosemary and throw it all onto the grill. But before we get cooking, let's take a look into the kitchen setup, tastes, and smells.

Figuring out which tools to have in the kitchen can be a daunting task, especially if you're just starting out. With so many products on the market, the number of decisions to be made can overwhelm anyone, especially overly analytical perfectionists (you know who you are). What type of knife should I buy? Which pan is right for me? Where should I store my cherry pitter?

Take a deep breath and relax. To a newbie, kitchen equipment probably seems like the key to success in the kitchen, but in all honesty, kitchen equipment isn't that important. Two sharp knives, two pots, two pans, a spoon to stir and a spatula to flip, and you're covered for 90% of the recipes out there and have a better kitchen setup than 90% of the world. Still, while having great kitchen equipment won't make or break you, having the right tool for the job, and one that you're comfortable with, does make the experience more enjoyable.

Back to the list of questions. The right answer to any question on which piece of kitchen equipment to use is: whatever works for you, is comfortable, and is safe. This chapter will cover the basic must-haves, but ultimately it is up to you to experiment and to adapt and modify these suggestions to it your needs and tastes. The one consistent piece of advice is to use common sense. In addition to the basic essentials, this chapter also provides some common sense tips on storage, kitchen organization, and other things to keep in mind if you're new to cooking, and maybe a few new ideas for the already initiated.

APPROACHING THE KITCHEN

So you've picked out a recipe to start with and you're raring to go. Now what? Beyond the grocery shopping list, there are a few things you can do before putting the knife to the cutting board to avoid mishaps while cooking.

Prepping Ingredients

When making a meal, start by prepping your ingredients before you begin the cooking process. Read through the entire recipe, and get out everything you need so you don't have to go hunting in the cupboards or the fridge halfway through.

Making stir-fry? Slice the vegetables into a bowl and set it aside before you start cooking. In some cases, you can do the prep work well in advance of when you start cooking the meal. Restaurants wash, cut, and store ingredients hours or even days ahead of when they're needed. The mise en place technique (French for "put in place") involves laying out all the ingredients and utensils needed to cook a dish before starting. If you are going to prepare the same dish multiple times (say, omelets for a large brunch), having a bunch of containers ready with the various fillings in them will allow you to work quickly. Mise en place isn't an absolute necessity, although it does generally make the cooking process smoother.

Measure out the ingredients at this stage whenever possible; this way you'll have a chance to discover if you're short of a critical ingredient (or if it's gone bad!) before committing to the cooking process. It also helps avoid those panicked moments of trying to locate a strainer that's wandered of while a sauce that needs immediate straining cools down. (Happens to me all the time...) Sure, a "just-in-time" approach is fine for simple meals. However, if you're cooking for a large number of people or attempting a particularly complicated menu, keep the mise en place approach in mind.

CALIBRATING YOUR INSTRUMENTS

A scientist can only run experiments and make observations up to the level of accuracy that his equipment allows. This isn't to say that you need to approach the kitchen with the same rigor that a scientist shows at the lab bench, but if you're trying to bake cookies or roast a chicken and your oven is off by 50°F, your results will be less than desirable. The largest variance in most kitchen equipment is usually the oven, and it can be hard to tell if your oven is running cold or hot just by feel. Check and calibrate your oven using an oven thermometer. See "The Two Things You Should Do to Your Oven" on the next page, for instructions on calibrating an oven using sugar.

THE TWO THINGS YOU SHOULD DO TO YOUR OVEN

One piece of equipment that you're probably stuck with is your oven. What makes an oven "good" is its ability to accurately measure and regulate heat. Since so many reactions in cooking are about controlling the rate of chemical reactions, an oven that keeps a steady temperature and isn't too cold or too hot can make a huge difference in your cooking and baking.

Improve your oven's recovery time and even out the heat: keep a pizza stone in the oven. Say you're baking cookies: oven set to 350°F, cookies on pan, ready to go. In an empty oven, the only thing hot is the air and the oven walls, and opening the door to pop the cookies in leaves you with just hot oven walls. You get much better results by keeping a pizza stone on the very bottom rack in the oven, with a rack directly above it.

The pizza stone does two things. First, it acts as a thermal mass, meaning faster recovery times for the hot air lost when you open the door to put your cookies in. Second, if you have an electric oven, the pizza stone serves as a diffuser between the heating element and the bottom of your baking tray. The heating element emits a hefty kick of thermal radiation, which normally hits the bottom side of whatever pan or bakeware you put in the oven. By interposing between the heating element and the tray, the pizza stone blocks the direct thermal radiation and evens out the temperature, leading to a more uniform heat. You can turn crappy ovens that burned everything into perfectly serviceable ones capable of turning out even "picky" dishes like souffles just by adding a pizza stone. Just remember that like any thermal mass, a pizza stone will add lag to heating up the oven, so make sure to allow extra time to preheat your oven.

Calibrate your oven using sugar. I know this sounds crazy, and yes, you should get an oven thermometer. But how do you know that the oven thermometer is right? Hmmm?

It's common practice to calibrate thermometers with ice water and boiling water because the temperatures are based on physical properties. Sugar has a similar property and can be used for checking the accuracy of your oven thermometer. Sucrose (table sugar) melts at 367°F. It turns from a powdered, granulated substance to something resembling glass.

Pour a spoonful of sugar into an oven-safe glass bowl or onto some foil on a cookie sheet and place in your oven, set to 350°F. Even after an hour, it should still be powdered. It might turn slightly brown due to decomposition, but it shouldn't melt. If it does, your oven is too hot. Next, turn your oven up to 375°F. The sugar should completely melt within 15 minutes or so. If it doesn't, your oven is calibrated too cold. Check to see if your oven has either an adjustment knob or a calibration off- set setting; otherwise, just keep in mind the offset when setting the temperature.

Kitchen Equipment

Regardless of your needs, a well-equipped home kitchen shouldn't cost much money. I once heard the products sold in consumer kitchen stores described as "kitchen jewelry." Stores like Williams-Sonoma offer beautiful products that make for beautiful gifts, but just because they call their products "professional-quality cookware" doesn't mean that professionals routinely use them. Sure, their kitchenware is beautiful and functional, but if you're willing to settle for just functionality and skip the bling factor, you can save a bundle.

If you live in a large city, look for a restaurant supply store. These stores stock aisle after aisle of every conceivable cooking, serving, and dining room product, down to the "Please wait to be seated" signs. If that fails, the Internet, as they say, "is your friend."If you do get stuck or want recommendations of which features to look for in a product, look at recent reviews from Adam Ried of *America's Test Kitchen* and *Cook's Illustrated* or Alton Brown of *Good Eats*. Products continually change as manufacturers revise, update, and improve their offerings, so don't be surprised if specific models you read about are no longer available. Common sense and thinking about your requirements are really all you need, though.

Bare Minimum Equipment

Here are the things you can't cook without. There are only so many things you can MacGyver.

KNIVES

Knife blades made of steel are manufactured in one of two ways: forging or stamping. Forged blades tend to be heavier and "drag" through cuts better due to the additional material present in the blade. Stamped blades are lighter and, because of the harder alloys used, hold an edge longer. Which type of knife is better is highly subjective and prone to starting flame wars (or is that flambé wars?), and with some specialty sashimi knives listing for upward of $1,000, there are plenty of options and rationales to go around. Some people simply like a lighter knife, while others prefer something with more heft. But what's not up for debate is each knife's purpose.

CHEF'S KNIFE

If you could take only one tool to a desert island, it should be your chef's knife. What size and style of chef's knife is best for you is a matter of preference. A typical chef's knife is around 8" to 9" long and has a slightly curved blade, which allows for rocking the blade for chopping and pulling the blade through foods. If you have a large work surface, try a 10" or larger knife.

BONING KNIFE

If you plan to cook fish and meat, consider acquiring a boning knife, which is designed to sweep around bones. A boning knife has a thinner, more flexible blade than a chef's knife, allowing you to avoid hitting bones, which would otherwise nick and damage the knife blade. Some chefs find them indispensable, while others rarely use them.

PARING KNIFE
A paring knife has a small blade and is probably the most versatile knife in the kitchen. Some chefs confess that their favorite knives are the scalloped paring knives, since they are useful for cutting so many different types of items. They're designed to be held up off the cutting board, knife in one hand, food item in the other, for tasks such as removing the core from an apple quarter or cutting out bad spots on a potato. The almost pencil-like grip design of some commercial paring knives allows you to twirl and spin the knife in your fingers, so you can cut around something by rotating the knife instead of rotating the food item. Scalloped blades—ones that are serrated—cut more easily.

BREAD KNIFE
Look for an offset bread knife, which has the handle raised up higher than the blade, avoiding the awkward moment of knuckles-touching- breadboard at the end of a slice. While not an everyday knife, in addition to cutting bread and slicing bagels, bread knives are also handy for cutting items like oranges, grapefruits, melons, and tomatoes because of the serrated blade.

KNIFE SKILLS 101
If you were going to develop PTKD (post-traumatic kitchen disorder) over something, it'd be from watching people use knives improperly.

Knives are the second most dangerous implements in the average kitchen. (Microplanes and mandolins hold the top spot.) When using a knife, always thinking about the "failure mode." If it slips, or something goes wrong, how is it going to go wrong? Where is the knife going to go if it does slip? How can you use the knife and position myself such that if an exception does occur, it isn't fatal? Of course, getting a good, clean cut and keeping the knife in good working order are also important. Here are some top tips for knife usage:

1. Don't use the edge of the blade to whack or crack hard objects, such as a walnut shell or a coconut; you'll nick it! Repeat after me: knives are not hammers (you know who you are). Unless, of course, you have a commercial knife that has a butt that actually is a hammer, in which case, go right ahead...

2. Feed the food into the cutting plane with your fingers positioned so that they can't get cut. Keep the fingers of the hand holding the item curled back, so that if you misjudge where the knife is, or it slips, your fingers are out of harm's way. You can also rub the upper side of the knife against your knuckles to get better control over the location of the knife. Use a smooth, long motion when cutting. Don't saw back and forth, and don't just press straight down (except for soft things like a block of cheese or a banana). Let the knife do the work!

3. When scraping food of a cutting board, flip the knife over and use the dull side of the blade. This will keep the sharpened side sharper.

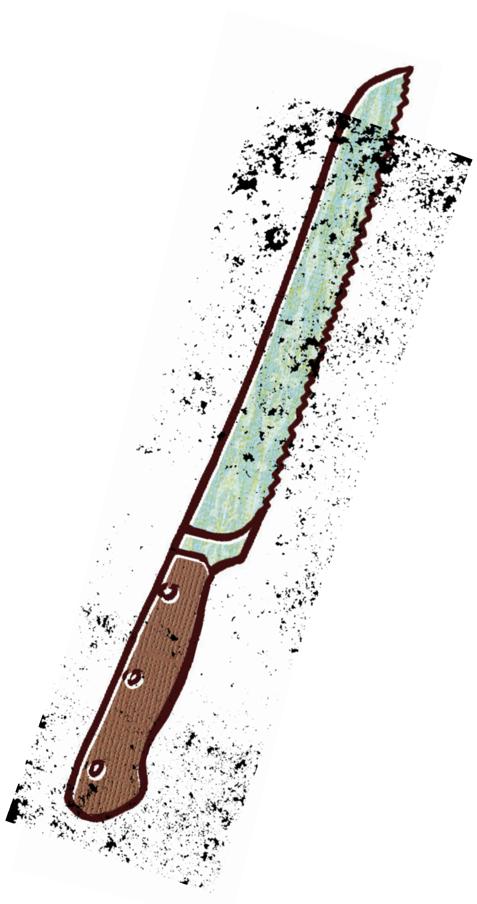
4. There's more than one way to hold a knife: try using a "pinch grip" instead of a "club grip." A pinch grip allows for more flexibility, as it gives you more dexterity in moving the knife.

5. You can, however, use the side of the blade as a quick way to crush garlic or pit cherries or olives. Place food on board, place side of blade on top of food, press down on blade with fist.

CUTTING BOARDS

Most cutting boards are made of either hardwoods, such as maple or walnut, or plastics like nylon or polyethylene. Regardless of which type you get, look for ones that are at least 12”× 18”. Bigger is better, as long as the board its in your sink or dishwasher. If you choose a plastic board, consider snagging both a rigid one, which can serve double duty as a serving board, and a thin, flexible one, which can be used as a makeshift funnel (e.g., chop veggies, pick up board, and curl it while sliding the food into your pan).

Always use two different cutting boards when working with meats: one for raw meats and a second for cooked items. Use a plastic cutting board for raw meats and a wooden one for after cooking because the difference in material to be an easy visual reminder. I toss the plastic cutting board into the dishwasher for cleanup. Since I have more than two boards, I use the plastic one exclusively for raw meats. Here are a few additional tips:



1. Place a bar towel or slip mat under your cutting board to prevent it from moving while you’re working.
2. Some cutting boards have a groove around the edge to prevent liquids from running over the edge. This is handy when you’re working with wet items, but it makes transferring dry items, such as diced potato, more difficult. Keep this in mind when choosing which board–or which side of a board–to use.
3. You can clean wooden cutting boards by wiping them down with white vinegar (the acidity kills most common bacteria). If your board smells (e.g., of garlic or fish), you can use lemon juice and salt to neutralize the odors.
4. Prep vegetables and fruits before starting to work on raw meats. This further reduces the chances of bacterial cross-contamination.
5. Plastic cutting boards have the advantage of being sterilized when washed in a dishwasher because the heated water kills common bacteria. (Don’t put your wooden cutting board in the dishwasher, though: the hot water will damage the board.) Note that washing a cutting board in the sink with hot water and soap is not sufficient to remove absolutely all traces of bacteria like E. coli.

POTS & PANS

When it comes to the metals used in making pans, there are two key variables: how quickly the metal dissipates heat and how much heat the metal can retain. For new cooks, the biggest issues are avoiding hot spots and being careful not to overheat the pan. Avoid hot spots by using pans with materials that conduct heat well (and avoid those really cheap thin pans). Also, don't just automatically crank the heat up to high. Hotter doesn't mean faster! All that being said, don't obsess over the "perfect" pan for a job.

Looking at cladded pans (two types of metals sandwiched together) and can't decide between copper and aluminum? If they're properly made (in terms of the thickness of the metal and the construction), there won't be a huge difference. Same thing when it comes to size and shape. Sure, to a professional it matters: cooking 10 pounds of onions in a narrower pot will yield more consistent results than cooking them in a wide, shallow pan (the narrower pot will retain water better, which assists in the cooking). But as a home chef, you'll typically achieve similar results in both cases, as long as you use common sense about the amount of heat you're using and keep a watchful eye on the pan.

As with knives, let your preferences and cooking style guide your selection of pots and pans, and be willing to experiment and replace items to suit your needs. Avoid purchasing a set of pots and pans, because sets often come with extra items that aren't quite ideal and end up wasting space and money. Instead, select each pot or pan individually and purchase only the ones that best suit your needs. Browse your local restaurant supply store or search for commercial products online. Commercial frying pans are cheap multi-taskers.

If you're going to splurge on a pot or pan, spring for an enameled cast iron pan (Le Creuset is the leading maker), a good skillet, or a sauté pan. When using pots and pans, follow these tips. Unless you're heating a pan to sauté something, don't absentmindedly leave it empty while it's heating on the burner. Overheating a pan, especially the nonstick type, will ruin the pan's finish and possibly warp it. Cast iron is the exception, but you still risk destroying the seasoned finish. Don't leave pots and pans soaking in water overnight. In some cases, the water can get "under" nonstick finishes and blister it. In the case of cast iron, the pans will rust.

FRYING PANS

A frying pan is a shallow, wide pan with slightly sloped edges. Look for frying pans that have a smooth cooking surface and are as large as your stovetop will comfortably accommodate. If you get one that's too large, the burners on your stove will heat the center but not the outer region, which will lead to uneven cooking.

Nonstick frying pans are useful for sautéing fish and for breakfast items such as eggs, pancakes, or crepes. Using a nonstick pan for eggs or fish also allows you to reduce the amount of butter or oil needed during cooking. Since nonstick coatings prevent the formation of fond (the bits of food that brown in the bottom of the pan and provide much of the flavor in sauces), you might also want to purchase a stainless steel frying or sauté pan.

SAUCEPANS

A saucepan, roughly as wide as it is tall and with straight sides, holds two to three quarts of liquid and is used in cooking liquid foods such as sauces, small batches of soups, and hot drinks like hot chocolate. Look for a pan that has a thick base, as this will help dissipate the heat and avoid hot spots that could burn your food. Keep in mind that many of the liquids cooked in a saucepan tend to be things that can burn, so it's worth spending a bit more to purchase a pan that conducts heat better. I picked up my favorite saucepan as an "odd lot" piece from a department store set. (Be sure to snag the lid as well!) You might prefer a saucier pan, one that has rounded corners that are easier to get into with a whisk or a spoon.

STOCKPOTS

A stockpot holds two or more gallons of liquid and is used in blanching vegetables, cooking pasta, and making soups. Since most applications for a stockpot involve a large amount of water, burning foods is not as much of a concern as it is with a saucepan– unless you can figure out how to burn water! The stockpot I use is one of the $20 cheap stainless steel commercial varieties. Make sure to pick up a lid as well, because commercial sellers tend to sell them separately.

CAST IRON PANS

You should have a good cast iron pan in your pot and pan collection. Cast iron pans are heavy, and their larger mass allows for better retention of heat. Cast iron pans can also be heated to higher temperatures than nonstick and stainless steel pans, making them ideal for searing foods such as meat. They're also handy for baking items such as corn bread or deep-dish pizza. Just remember to avoid cooking highly acidic items such as tomatoes in them, because the iron will react with acidic items.

As with frying pans, when washing cast iron, don't use soap. Instead, rinse the pan and wipe the inside to dislodge any stuck-on food, and then place the pan back on the stove. If the food is really stuck, throw in a few tablespoons of course salt and a spoonful or two of vinegar or lemon juice, and "sand" it of with a paper towel. Once your pan is clean, wipe it down with a little heat-stable oil such as canola or sunflower oil (but not extra virgin olive oil) and place on a burner set for low heat for a minute or so to thoroughly dry it out. And never let it sit in water for hours on end, because the water will ruin the finish. If you do end up with rust spots, don't fear. You can use a metal scrubbing brush to scrape away the rust, and then reseason the pan with a coating of oil.

MEASURING CUPS AND SCALES

In addition to the common items used for measuring (e.g., measuring cups and spoons), you should have a kitchen scale. You might not use it every day (or even every week), but there is no substitute for it when you need one.

You will obtain better accuracy when measuring by weight. Dry ingredients such as flour can become compressed, so the amount of flour in "1 cup" can vary quite a bit due to the amount of pressure present when it's packed. Also, it is easier to precisely measure weight than volume. Because much of cooking is about controlling chemical reactions based on the ratio of ingredients (say, flour and water), changes in the ratio will alter your results, especially in baking. Weighing ingredients also allows you to load ingredients serially: add 390 grams of flour, hit tare; 300 grams of water, hit tare; 7 grams of salt, hit tare; 2 grams of yeast, mix, let rest for 20 hours, and you've got no- knead bread. When choosing a scale, look for the following features:

A digital display, showing weights in grams and ounces, that has a tare function for zeroing out weight.

A flat surface on which you can place a bowl or dish (avoid scales that have built-in bowls)A scale that is capable of measuring up to at least 5 lbs in 0.05 oz or 1g increments. If you plan on following any "molecular gastronomy or modernist cuisine" recipes that use chemicals, you'll need to pick up a high-precision scale that measures in increments of 0.1 gram or finer.

THERMOMETERS AND TIMERS

Probe thermometers are awesome because they use a thermocouple attached to a long heat-safe lead, designed so that you can stick the probe into a piece of meat and set the controller to beep when it reaches the desired temperature. Timers are handy, and if you'll be doing much baking, one will be critical. But if you expect to be doing mostly cooking, a timer is just a proxy for checking when, say, an oven roast has reached temperature, in which case why not use something that actually checks that? And when it comes to food safety, it's not possible to "see" what a hamburger cooked to 160°F looks like, even when cut in half.

Infrared thermometers are great for taking dry temperatures, such as the surface temperature of a frying pan before you start making pancakes, or ice cream you've just made with liquid nitrogen. The other great thing about them is that they're instant: point, click, done. You can also use them to take the temperature of liquids in a pan without having to worry about handling a hot thermometer probe or washing it after. Keep in mind, though, that stainless steel is reflective in the IR range, just like a mirror reflects visible light– you'll end up taking the temperature of your ceiling, not the pan, if you try to meter an empty stainless steel pan. Also, IR thermometers only take surface temperature, so they shouldn't be used for checking internal temperatures for food safety.

Finally, we'd be remiss if we didn't mention the most overlooked but useful thermometer: your hands. Learn what various temperatures feel like: hold your hand above a hot pan, and notice how far away you can be and still "feel" the heat (thermal radiation). Stick your hand in an oven set to medium heat, remember that feeling, then compare it when you're working with a hot oven. For liquids, you can generally put your hand in water at around 130°F for a second or two, but at 140°F it'll pretty much be a reflexive "ouch!" Just remember to use a thermometer for foods that need to be cooked to a certain temperature for food safety reasons, which we will cover later.

SPOONS & CO

Few things symbolize cooking more than a spoon, and for good reason: stirring, tasting, adjusting the seasoning, stirring some more, and tasting again would be virtually impossible without a good spoon!

In an age of technology and modern plastics, there's just something comforting about a wooden spoon. Look for one that has a straight end, as opposed to a traditional spoon shape, because the straight edge is useful for scraping the inside corners and bottom of a pan to release frond.

SILICONE STIRRING SPATULAS

This type of spatula, in addition to making perfect scrambled eggs, is handy for folding egg whites into batters, scraping down the edges of bowls, and reaching into the corners of pots needing stirring. Silicone is also heat-stable up to 500°F.

WHISKS

If you're going to bake much, a whisk is essential. Go for a standard balloon whisk, not one of those funky attempts at wires with balls on the end or crazy little loopy things. Besides coming in handy when you want to whisk eggs and dressings, you should always whisk together the dry ingredients for baked goods to ensure that things like salt and baking powder are thoroughly blended with the flour.

KITCHEN SHEARS

Essentially heavy-duty scissors, kitchen shears are useful for cutting through bones and are a great alternative to a knife for cutting leafy greens, both small (chives) and large (Swiss chard). If you're serving soup into bowls and want to garnish with chives, instead of using a knife and cutting board, you can hold the chives directly above the bowl and use the shears to snip them directly into the bowl: faster, and fewer dishes, too!

TONGS

Think of tongs as heatproof extensions of your fingers. They're useful not just for lipping French toast in a frying pan or chicken on the grill, but also for picking up ramekins in the oven or grabbing a cookie tray when you're out of towels. Look for spring-loaded tongs that have silicone or heatproof tips, because these can be used with nonstick coated pans. Scalloped edges are also useful, because they tend to grip things better than their straight counterparts.

BAR TOWELS

In addition to wiping of counters with them, you can use bar towels (typically 12" × 18" terry towels with some thickness) as potholders, under a cutting board to prevent slippage, or as a liner in a bowl to help dry washed items such as blueberries or cherries. And you can never have enough of them.

MIXING BOWLS

While you can get away with using your dinner plates or soup bowls for holding some things, you'll invariably need mixing bowls for working with and storing your ingredients. You need two types: large metal bowls (12 to 16" diameter) and small glass bowls.

For metal bowls, poke around your nearest restaurant supply store for some cheap stainless steel ones, which should cost only a few dollars apiece. These bowls are large enough to hold cookie dough, cake batter, and soup, and they have enough room for chopped leafy greens that you plan to sauté. You can also toss them in the oven at low heat to keep cooked items warm.

Small glass bowls are also very useful, especially if you're using a mise en place setup. Measuring out chopped ingredients into small glass bowls ahead of time will allow you to toss the ingredients together much faster during the cooking process. If you have leftovers, just wrap the bowls with plastic wrap and store in the fridge. Look for glass bowls that are all the same size and that stack well. You'll often find these bowls available at your local hardware store.

Standard Kitchen Equipment

There is a balance between having the right tool for the right job and having too much stuff on hand. When looking at a potential kitchen tool, consider if you can do the task it's intended for with a tool you already have, and whether the new gizmo is a multi-tasker capable of solving more than one problem.

STRAINERS

Look for a strainer that has a metal mesh and a handle long enough to span your sink. Avoid strainers that have plastic parts; plastic isn't as strong or heat resistant and will eventually break. In addition to the normal application of straining cooked foods like pasta or washing berries, a metal strainer can double as a splatter guard when inverted above a frying pan. Depending on the types of food you are cooking, you might find a spider–a specialized spoon with a wide shallow mesh bowl and a long handle–helpful for scooping out items from pots of boiling water.

STORAGE CONTAINERS

While you can use consumer-grade plastic containers, the commercial-grade polycarbonate containers used in the restaurant industry are great: they're rugged enough to last a lifetime, can handle hot liquids, and are designed for holding the larger quantities you'll be handling for group cooking.

RICE COOKER WITH SLOW-COOK MODE

I'm in love with my rice cooker. Actually, that's not true; I'm in love with the slow-cook mode of my rice cooker, and you should be, too. As we'll discuss later, some chemical processes in cooking require a long period of time at a relatively specific temperatures. This is why you should make room for a rice cooker with a slow-cook mode: you can safely leave it on overnight, or even for a few days, without worrying about either the utility bill or the house burning down (something that you shouldn't do with almost any other source of heat in the kitchen). This handy appliance makes an entire class of dishes (braised short ribs, duck confit, beef stew) trivially easy. You could just get a slow cooker, but a rice cooker with slow-cook mode will also come in handy for those occasions when you actually want to make rice.

IMMERSION BLENDER

Skip the normal blender and go for an immersion blender. Sometimes called a stick blender, the blade part of the blender is mounted on a handle and immersed into a container that holds whatever it is you want to blend. When making soup, for example, instead of transferring the soup from pot to blender for puréeing, you take the immersion blender and run it directly in the pot. Quicker to use, easier to wash.

FOOD PROCESSOR

While not an essential, there are times when a food processor makes quick work of otherwise laborious tasks—for example, making pesto or slicing 10 pounds of onions or pulsing pie dough to incorporate flour and butter. They're expensive, though, and take up space. You might opt for a mandolin, instead, which can also be used to quickly make large piles of julienned (small matchstick-cut) veggies.

MIXERS & CO.

For baking, a handheld mixer or stand mixer is pretty much indispensable. Sure, you can use a whisk or a spoon, but when it comes to creaming together butter and sugar, you'll get better results with an electric mixer that can whip microscopic air bubbles into the mix. Besides a mixer, there are a few other electric devices that are worth their counter space.

Basic Food Storage

Should you wash your produce when you unpack your weekly groceries or at time of use? And how should you store various other foods? Here's how you should store them, from most to least perishable.

SEAFOOD
Seafood is the most perishable item you're likely to handle. Ideally, seafood should be used on the day of purchase. A day or two longer is okay, but past that point enzymes and spoilage bacteria begin to break down famine compounds, resulting in that undesirable fishy odor.

Fun science fact: Fish live in an environment that is roughly the same temperature as your fridge. The specific activity of some enzymes is much higher in fish than mammals at these temperatures. Putting seafood on ice buys a bit more time by increasing the activation energy needed for these reactions. Meat is already far enough away from the ideal reaction temperatures that the few extra degrees gained by storing it on ice don't change much.

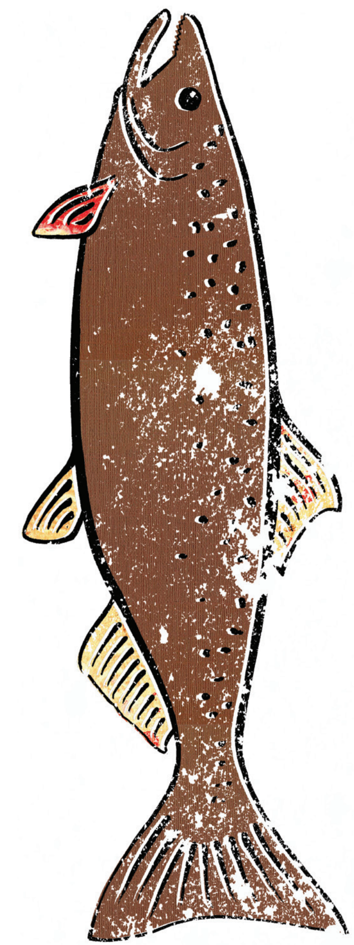
MEATS
Follow the sell-by or use-by date. The sell-by date is the point in time until which the store still considers the product safe for sale. (Not that you should push it, but it's not as if the meat will suddenly turn green and smelly at 12:01 a.m. the next day.)

The use-by date, as you'd imagine, is the recommended deadline to cook the food. If you have a package of chicken whose use-by date is today, cook it today, even if you're not ready to eat it. You can store the cooked product for a few more days. If you can't cook the fish or meat you've bought on or before its use-by date, toss it in the freezer. This will affect the texture, but at least the food won't go to waste.

Freezing meat does not kill bacteria. It takes being zapped with radiation AND over a month at 0°F to render nonviable the bacteria in salmonella- contaminated meats. Nice to know, but not very helpful unless you happen to have a radiation chamber lying around.

Store raw meats below fruits and vegetables in your refrigerator, because this reduces the likelihood of cross-contamination. Any liquid runoff from the meats won't be able to drip onto other foods that won't be effectively pasteurized by cooking. (Storing meats below other foods is required by health code in commercial establishments.)

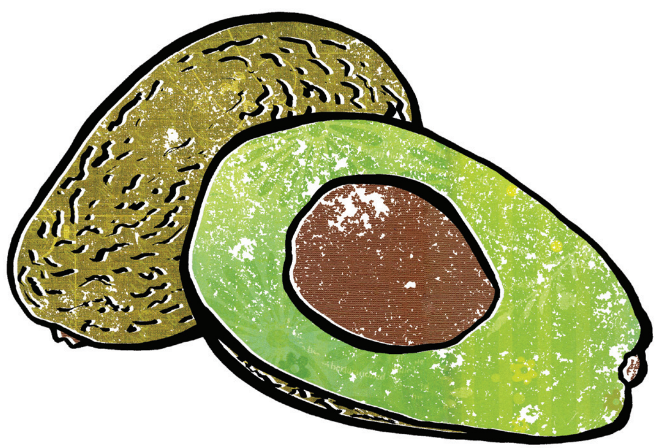
FRUITS AND VEGETABLES.
How you process and store fruits and vegetables impacts their ripeness and flavor, and can also delay the growth of mold. When it comes to ripening, there are two types of fruit: those that generate ethylene gas, which causes them to ripen, and those that don't generate it. For those that do ripen when exposed to ethylene, you can speed up ripening by storing them in a paper bag, which traps the gas.



Foods that Ripen in the Presence of Ethylene Gas

To speed up ripening, store these in a loosely folded paper bag out of direct sunlight, at room temperature.

APRICOTS, PEACHES, PLUMS
Ripe fruits will be aromatic and will yield slightly to a gentle squeeze, at which point you can store them in the fridge. Don't store unripe stone fruits in the refrigerator, in plastic bags, or in direct sunlight. If you're lucky enough to be gifted pounds and pounds of these fruits, either freeze them or make jam before they have a chance to go bad.



AVOCADOS
Ripe fruit will be slightly firm but will yield to gentle pressure. Color alone will not tell you if the avocado is ripe. Storing cut avocados with the pit doesn't prevent browning, which is due to both oxidation and an enzymatic reaction, but does stop browning where the pit prevents air from coming in contact with the flesh. Plastic wrap pressed down against the flesh works just as well, or if you have a vacuum sealer, go for overkill and seal them.

BANANAS
Leave at room temperature until ripe. To prevent further ripening, store in the refrigerator–the peel will turn brown, but the fruit will not change.

BLUEBERRIES
While blueberries do ripen in the presence of ethylene, their flavor is not improved from this. See advice for blackberries.

TOMATOES
Store at temperatures above 55°F. Storing in the fridge is okay for longer periods of time but will affect flavor and texture. If the ultimate destination for the tomatoes is a sauce, you can also cook them and then refrigerate or freeze the sauce.

POTATOES
Keep potatoes in a cool, dry place (but not the fridge). Sunlight can make the skin turn green. If this occurs, you must peel off the skin before eating. The green color is due to the presence of chlorophyll, which develops at the same time that the neurotoxins solanine and chaconine are produced. Since most of the nutrients in a potato are contained directly below the skin, avoid peeling them whenever possible.

Foods Unaffected or Negatively Impacted by Ethylene Gas

Store these separately from ethylene producing produce.

ASPARAGUS
Store stalks, with bottoms wrapped in a damp paper towel, in the crisper section or the coldest part of the fridge. You can also put them in a glass or mug, like cut lowers. Eat as soon as possible because the flavor diminishes with time.

BLACKBERRIES, RASPBERRIES, & STRAWBERRIES
Toss out any moldy or deformed berries. Immediately eat any overripe berries. Return the other berries to the original container, or arrange them (unwashed) in a shallow pan lined with paper towels and store in the fridge. To absorb additional moisture, place a paper towel on top of the berries. Wash them just prior to use; washing and storing them adds moisture that aids the growth of mold.

BROCCOLI, CABBAGE, COLLARD GREENS, KALE, LEEKS, SWISS CHARD
Store in the crisper drawer of the refrigerator or in a plastic bag poked with holes to allow for any excess moisture and ethylene.

CARROTS
Break off green tops. Rinse carrots, place in a plastic bag, and store in the crisper section of the fridge. Storing carrots in the fridge will preserve their flavor, texture, and beta-carotene content.

ONIONS
Keep in a cool, dry space away from bright light. Onions do best in an area that allows for air circulation. Do not place onions near potatoes, because potatoes give off both moisture and ethylene, causing onions to spoil more quickly.

LETTUCE & SALAD GREENS
Check greens bought in bunches for insects. Wash leaves, wrap in a towel or paper towel, and then store in the fridge in a plastic bag.

GARLIC
Store in a cool, dark place (but not the fridge). You can still use cloves that have sprouted, but they will not be as strong in flavor. The sprouts themselves can be cut up like scallions or chives and used in dishes.

Choosing Inputs

FLAVORS & INGREDIENTS

The secret to achieving that blissful sensation of yummy in your cooking is to pick good inputs: ingredients that carry good flavor, generate pleasure, and make your mouth water. The single most important variable in predicting the outcome of your culinary attempts is choosing the right ingredients. I'll say it again, because this is probably the second most important sentence in the book: picking the right ingredients for your dish is the biggest predictor of its success.

True, you need some skill to manipulate those inputs once they land in the frying pan– don't burn the dinner! But no amount of skill can correct for bad inputs. Cooking and engineering definitely share the maxim garbage in, garbage out (GIGO). This chapter covers what you need to know in order to avoid the "garbage in" condition while cooking.

The easiest way to turn a bunch of ingredients into something that tastes great is to buy good ingredients, pick a great recipe, and execute it faithfully. But as the type of geek who likes to be creative, I don't always want to follow a recipe slavishly. I want to understand how to improvise on one or create my own–how to write my own "code" in the kitchen to create something new.

Great chefs can imagine the taste of a combination of ingredients without picking up a spoon. Chef Grant Achatz, of Alinea fame, went through a bout with tongue cancer during which he wasn't able to taste anything, but he was still able to conceive flavor combinations, coming up with what some consider the best food in the nation. As you cook, take time to imagine how the dish you're working on will eventually taste, and check yourself by comparing that imagined taste against the real taste of the final product. Ultimately, knowing which inputs go together is based on having had a wide range of experience putting things together and having taken note of what works and what fails.

TASTE: GUSTATORY SENSE

Our tongues act as chemical detectors: receptor cells of the taste buds directly interact with chemicals and ions broken down by our saliva from food. Once triggered, the receptor cells send corresponding messages to our brains, which assemble the collective set of signals and compile the data into a taste and its relative strength.

The basic tastes in western cuisine that Leucippus (or more likely one of his grad students, Democritus) first described 2,400 years ago are salty, sweet, sour, and bitter. Taste researchers are beginning to discover that Leucippus and Democritus described only part of the picture, though. It turns out that our tongues are able to sense a few secondary tastes as well. About a hundred years ago, Dr. Kikunae Ikeda identified a fifth taste, which he named umami (sometimes called savory in English) and described as having a "meaty" flavor. Umami is triggered by receptors on the tongue sensing the amino acids glutamate and aspartate in foods such as broths, hard aged cheeses like Parmesan, mushrooms, meats, and MSG.

Our taste buds also detect and report oral irritation caused by chemicals such as ethyl alcohol and capsaicin, the compound that makes hot peppers hot. Try tasting a small pinch of cinnamon and then some cayenne pepper while keeping your nose plugged. Notice the sandy, flavorless sensation caused by the cinnamon as compared to the sandy, flavorless, burning sensation caused by the cayenne pepper. Capsaicin literally irritates the cells, which is why it's used in pepper sprays like Mace and in some antifouling paints used by the boating industry. Cellular irritation isn't limited to the "hot" reaction generated by compounds like capsaicin. Pungent reactions are triggered by other compounds, too. Szechuan peppers, used in Asian cooking, and Melegueta peppers, used in Africa, cause a mild pungent and numbing sensation. Another plant, Acmella oleracea, produces Szechuan buttons, edible lowers that are high in the compound spilanthol. Spilanthol causes a tingling reaction often compared to licking the terminals on a nine-volt battery.

Regardless of how many types of receptors there are on the tongue or the mechanisms by which taste sensations are triggered, the approach in cooking is the same: try to balance the various tastes (e.g., not too salty, not too sweet). Whether you find a set of flavors to be enjoyable or how you prefer tastes to be balanced depends in large part on how your brain is wired and trained to respond to basic tastes. If you're like many geeks I know, you might have an affinity for coffee with lots of sugar and milk or find a certain candy bar loaded with caramel and nuts and covered in chocolate irresistible. But why are these things delicious? Because our bodies find fats, sugars, and salts to be highly desirable, perhaps due to their scarcity in the wild and the relative ease with which we can process them for their nutrients.

Besides basic physiology, your cultural upbringing will affect where you find balance in tastes. That is, what one culture finds ideally balanced won't necessarily be the same for another culture. Americans generally prefer foods to taste sweeter than our European counterparts. Umami is a key taste in Japanese cuisine but has historically been given less formal consideration in the European tradition (although this is starting to change). Keep this in mind when you cook for others: what you find just right might be different than someone else's idea of perfection.

SMELL: OLFACTORY SENSE

While the sensation of taste is limited to a few basic (and important) sensations, smell is a cornucopia of data. We're wired to detect somewhere around 1,000 distinct compounds and are able to discern somewhere over 10,000 odors. Like taste, our sense of smell is based on sensory cells (chemoreceptors) being "turned on" by chemical compounds. In smell, these compounds are called odorants.

In the case of olfaction, the receptor cells are located in the olfactory epithelium in the nasal cavity and respond to volatile chemicals—that is, compounds that evaporate and can be suspended in air such that they pass through the nasal cavity where the chemoreceptors have a chance to detect them. Our sense of smell is much more acute than our sense of taste; for some compounds, our nose can detect odorants on the order of one part per trillion.

There are a few different theories as to how the chemoreceptors responsible for detecting smell work, from the appealingly simple to more complex chemical models. The more recent models suggest that an odorant can bind to a number of different types of chemoreceptors and a chemoreceptor can accept a number of different types of odorants. That is, any given odor triggers a number of different receptors, and your brain applies something akin to a fuzzy pattern-matching algorithm to recall the closest prior memory. Regardless of the details, the common theme of the various models suggests that we smell based on some set of attributes such as the shape, size, and configuration of the odor molecules.

This more complex model—in which a single odorant needs to be picked up by multiple receptors—also suggests an explanation for why some items smell odd when you receive only a weak, partial whiff. To use a music analogy, it's like not hearing the entire set of notes that make up a chord: our brains can't correctly match the sensation and might find a different prior memory closer to the partial "chord" and misidentify the smell.

While you might think of smell as being only what you sense when leaning forward and using your nose to take a whiff of a rose, that's only half the picture. Odors also travel from food in your mouth into the nasal cavity through the shared airway passage: you're smelling the food that you're "tasting."When cooking, keep in mind that you can smell only volatile compounds in a dish. You can make nonvolatile compounds volatile by adding alcohol (e.g., wine in sauces), which raises the vapor pressure and lowers the surface tension of the compounds, making it that much more likely that they will evaporate and pass by your chemoreceptors. Temperature also plays an important role in olfaction. We have a harder time smelling cold foods because temperature partially determines a substance's volatility. Your sense of taste is affected by temperature, too. Researchers have found that the intensity of primary tastes varies with the temperature both of the food itself and of the tongue. The ideal temperature is 95°F the approximate temperature of the top of the tongue. Colder foods result in tastes having lower perceived strength, especially for sugars.

It's been suggested that red wines are best served at room temperature to help convey their odors, while white wines are better served chilled to moderate the levels of volatile compounds and sweetness. This would make sense—by chilling white wine, it'll be less likely to overpower the milder meals that they customarily accompany, such as fish.

SMELL + TASTE = FLAVOR

Taste is the set of sensations picked up by taste buds on the tongue (gustatory sense), while smell is the set of sensations detected by the nose (olfactory sense). Even though much of what we commonly think of as taste is really smell, our perception of flavor is actually the result of the combination of these two senses.

When you take a sip of a chocolate milkshake, the flavor you experience is a combination of tastes picked up by your tongue (sweet, a tiny bit salty) combined with smells detected by your nose (chocolate, dairy, a little vanilla, and maybe a hint of egg). Our brains trick us into thinking that the sensation is a single input, located somewhere around the mouth, but in reality the "sense" of flavor is happening up in the grey matter. In addition to the taste and smell, our brains also factor in other data picked up by our mouths, such as chemical irritation (think hot peppers) and texture, but this data plays only a minor role in how we sense most flavors.

The most important variable for good flavor is the quality of the individual ingredients you use. If the strawberries smell so amazing that they make your mouth water, they're probably good. If the fish looks appealing, doesn't feel slimy, and smells "clean," you're good to go. But if an avocado has no real smell and feels like it would be better suited for a game of mini-football, there's little chance that guacamole made from it will be particularly appealing. And if the meat is a week past its use-by date and is home to bacteria that have evolved to be smart enough to say, "well, hello there" when you open the package? Definitely not good.

For a tomato-based dish to taste good, the tomatoes in it should taste and smell like tomatoes. Just because the grocery store has a sign that reads "tomato" next to a pile of red things that look like tomatoes but don't smell like much doesn't make them automatically worthy of a place on your dinner plate. Though they just might not be ripe yet, more likely than not they're a variety that will never be truly flavorful. While serviceable in a sandwich, many of the current mass-produced versions rarely bring the pow or bam that is the hallmark of great food.

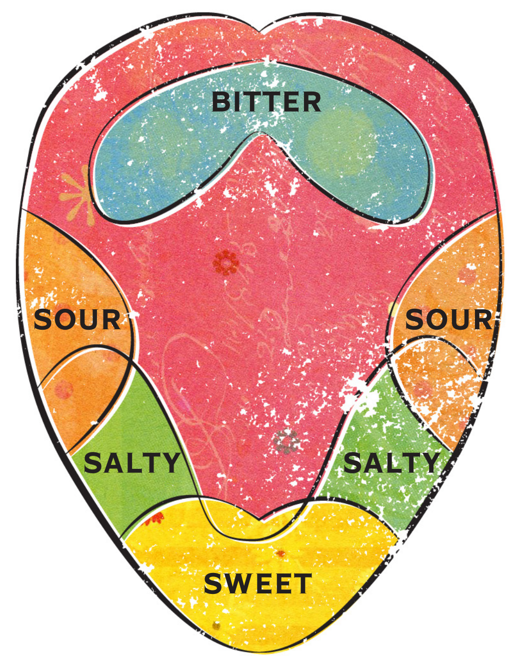
When it comes to detecting quality, your nose is a great tool. Fruits should smell fragrant, fish should have little or no smell, and meats should smell mild and perhaps a little gamey, but never bad. Smelling things isn't foolproof–some cheeses are supposed to smell like sweaty gym socks and there are some foodborne illness-causing bacteria that have no odor–so you should still use common sense. Still, your sense of smell remains the best way to find good flavor as well as root out whatever evil might be lurking inside.

TASTES:
BITTER, SALTY, SOUR, SWEET, UMAMI, OTHERS

You'll have an easier time seasoning dishes if you understand the five primary tastes the tongue can detect, as well as how it responds to "other" things (for example, the chemicals that give hot peppers their kick, carbonated drinks their effervescence, and peppermint candies their cooling sensation).

When cooking, regardless of the recipe and technique, you always want to adjust and correct the primary tastes in a dish. There is just too much variability in any given product for a recipe to accurately prescribe how much of a taste modifier is necessary to achieve a balanced taste for most dishes: one apple might be sweeter than another, in which case you'll need to adjust the amount of sugar in your applesauce, and today's batch of fish might be slightly fresher than last week's, changing the amount of lemon juice you'll want. Because taste preferences vary among individuals, you can sometimes solve the balance problems by letting the diners adjust the taste themselves. This is why fish is so often served with a slice of lemon, why we have salt on the table (don't take offense at someone "disagreeing" with your "perfectly seasoned" entrée), and why tea and coffee are served with sugar on the side. Still, you can't serve a dish with every possible taste modifier, and you should adjust the seasonings so that it's generally pleasing.

Tastes on the Tongue



Some parts of your tongue are more are more sensitive to certain tastes than others. Use your tongue wisely and maximize your food's flavor!

Bitter

Bitter is the only taste that takes some learning to like. Some primitive part of our brain seems to reject bitter tastes by default, probably because many toxic plants taste bitter. This same primitive mechanism is why bitter foods are unappealing to kids: they haven't learned to tolerate, let alone enjoy, the sensation of bitterness. Dandelion greens, rhubarb, and uncooked artichoke leaves all contain bitter oils that cause them to taste bitter; not surprisingly, I couldn't stand those things as a kid.

Adding salt can neutralize bitterness, which is why a pinch of salt in a salad that contains bitter items such as dandelion greens helps balance the flavor. Sugar can also be used to mask bitterness. Try grilling or broiling Belgian endive lightly sprinkled with sugar. Quarter the endive down the center to get four identical wedges and place them on a baking sheet or oven-safe pan. Sprinkle with a small amount of sugar. You can also drizzle a small amount of melted butter or olive oil on top. Transfer the tray to a grill or place it under a broiler for a minute or two, until the endive becomes slightly soft and the edges of the leaves begin to turn brown. Serve with blue cheese or use the endive as a vegetable accompaniment to stronger flavored fish. Bitterness seems to lend itself exceedingly well to drinks: unsweetened chocolate, raw coffee, tea, hops (used in making beer), and kola nuts (kola as in cola as in soft drinks) are all bitter.

And many before-meal aperitifs are bitter, from the classic Campari to the simple parsley-dipped-in-salt-water customary during Passover. Conventional wisdom states that bitter foods increase the body's production of bile and digestive enzymes, helping in digestion. The food science literature doesn't seem to support the conventional wisdom, though.

Salty

Salt (sodium chloride) makes foods taste better by selectively filtering out the taste of bitterness, resulting in the other primary tastes and flavors coming through more strongly. The addition of a small quantity of salt (not too much!) enhances other foods, bringing a "fullness" to foods that might otherwise have what is described as a "flat" flavor. This is why so many sweet dishes—cookies, chocolate cake, even hot chocolate—call for a pinch of salt. How much salt is in a pinch? Enough that it amps up the food's flavor, but not so much that the salt becomes a distinct flavor in itself. A "pinch" isn't an exact measurement—traditionally, it's literally the amount of salt you can pinch between your thumb and index finger—but if you need to start somewhere, try using ¼ teaspoon.

In larger quantities, salt acts as an ingredient as much as a flavor enhancer. Mussels liberally sprinkled with salt, bagels topped with coarse salt, salty lassi (an Indian yogurt drink), even chocolate ice cream or brownies with sea salt sprinkled on top all taste inherently different without the salt. When using salt as a topping, use a coarse, flaky variety, not rock or kosher salt or table salt. (I happen to use Maldon sea salt flakes.)In some recipes, salt is used for its chemical properties, such as the osmosis of cellular fluids for food preservation. Because salt masks bitterness, those of us who taste things like broccoli, Brussels sprouts, and kale as being bitter tend to add more salt to compensate.

Sour

Sour tastes are caused by acids in foods. The sensation of sourness is detected by part of the taste bud (ion channels) interacting with the hydrogen ions in the acids. Quite literally, your sour taste buds are a primitive chemical pH tester. In cooking, lemon juice and vinegar are commonly used to make dishes more sour, sometimes for effect but more often to bring balance. When cooking, taste the food and think about the balance of both saltiness and sourness, adding an ingredient such as vinegar to "brighten up" the flavors.

From an evolutionary perspective, we appear to have evolved to taste sourness as one method of determining spoilage, because a number of acids are produced by bacteria during the breakdown of food. This isn't to say that sourness in food is always due to bacterial breakdown or that the fermentation caused by bacterial breakdown necessarily results in bad food. Lemon juice is sour due to citric acid, and yogurt (pH of 3.8–4.2) acquires a sour taste because of the lactic acid created by the bacteria breaking down the lactose in the milk (pH of 6.0–6.8).

Sweet

We're hardwired to like sweet foods—no surprise here. 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.

Our desire for sweetness changes over our lifespan. Researchers have found that our preference for sweetness decreases 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!) And the infamous sweet tooth isn't unique to American kids either; this finding holds up in other cultures.

Sugar is good at simultaneously promoting other flavors while masking sour and bitter tastes. Take ginger, which has a strong, pungent, and slightly sour taste. With a bit of sugar, it becomes enjoyable on its own; sugared and dipped in chocolate, it becomes irresistible.

Taste Combinations

	BITTER SOUR	BITTER SWEET	BITTER SALTY
SINGLE INGREDIENT	Cranberries Grapefruit	Bitter parsley Granny Smith apples	N/A
COMBINATION EXAMPLE	Negroni (cocktail with gin, vermouth, Campari)	Bittersweet chocolate Coffee/tea with sugar/honey	Sautéed kale with salt Mustard greens with bacon

	SALTY SOUR	SALTY SWEET	SOUR SWEET
SINGLE INGREDIENT	Pickles Preserved lemon peel	Seaweed (slightly sweet via mannitol)	Oranges
COMBINATION EXAMPLE	Salad dressings	Watermelon & feta Banana & cheddar Cantaloupe & prosciutto Chocolate covered pretzels	Lemonade Grilled corn with lime juice

Umami (a.k.a. Savory)

Umami (a Japanese word that roughly translates to "savory") generates a meaty, broth-like, lip-smacking sensation typically triggered by some amino acids and nucleotides (glutamate is the poster child; inosinate, guanylate, and aspartate are also not uncommon). Glutamate is naturally present in a number of foods, especially mushrooms. To an average American palate, umami is more subtle than the four primary tastes. It tends to amplify our other senses of taste. For example, in dishes with salt, umami "brings out" the salty taste, meaning that you can cut the amount of salt in a dish by adding umami-tasting ingredients.

If you're unable to imagine the taste of umami, make a simple broth by rehydrating a tablespoon of dried shiitake mushrooms in 1 cup of boiling water. Let the mushrooms steep for at least 15 minutes, and then remove them and save them for something else (mmm, stir-fry). Taste the liquid; it will have a high glutamate content dissolved out from the mushrooms. (If this is too much work for you, I suppose you could just snag a container of MSG from your local Asian grocery store and dissolve a small amount in a glass of water.)Why we've evolved to have taste sensors for umami isn't fully clear. Sweetness and saltiness are both associated with positive attributes of food (quick energy in the case of sweets and an element essential for regulating blood pressure in the case of saltiness), while sourness and bitterness indicate potential danger.

Perhaps umami is a more subtle indicator of protein content, as a way of ensuring we ingest enough amino acids to maintain muscle function. Regardless, umami is worth understanding for the hedonistic value alone. MSG (mono- sodium glutamate) is to umami what sugar is to sweetness: as a chemical, it's relatively odorless (still full of taste!), but it triggers the umami receptors on the tongue. MSG has gotten a bit of a bad rap in the United States, but so have salt and sugar at various times.

There are plenty of natural sources of glutamate. Many traditional Japanese dishes call for dashi, a stock made from ingredients high in natural glutamate such as kombu seaweed (2.2% glutamate by weight). Making dashi is super easy: in a pot, place 3 cups (700g) cold water and a 6" / 15 cm strip of kombu (dried kelp), and let rest for 10 minutes. Bring to a boil slowly on low heat. Remove the kombu just before the water begins to boil and add 10g of bonito flakes (flakes of dried and smoked bonito fish). Bring to a boil, remove from heat, and strain out the bonito lakes. This liquid is dashi.

To make miso soup, add miso paste, diced tofu, and (optionally) sliced green onions, nori, or wakame (an edible seaweed).Glutamate occurs naturally in many other foods–for example, beef (0.1%) and cabbage (0.1%). And if you're like most geeks and pizza makes your mouth water, it might be because of the glutamate in the ingredients: Parmesan cheese (1.2%), tomatoes (0.14%), and mushrooms (0.07%).

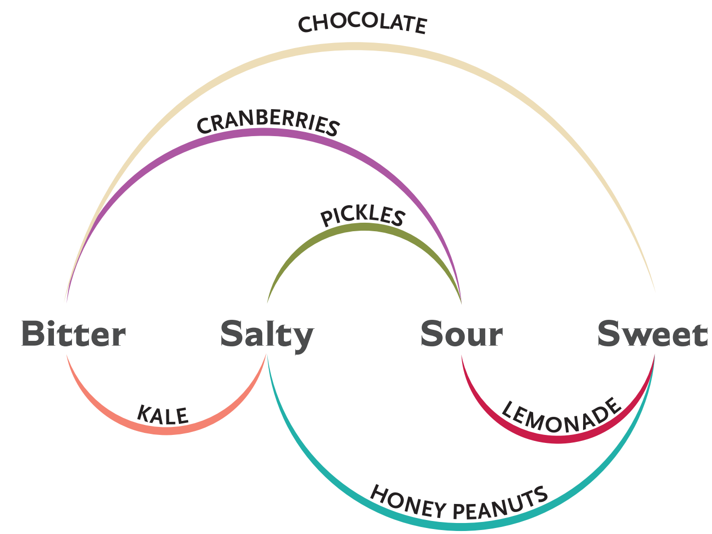
COMBINATIONS OF TASTES & SMELLS

Most dishes involve a combination of ingredients that contain at least two different primary tastes, because the combination brings balance and adds depth and complexity. Whether the dish is a French classic or a simple item of produce, the taste will be simple ("one note") unless it's paired with at least one other.

To alter the flavor of fresh fruit, you can sprinkle it with sugar (try this on strawberries) or salt (on grapefruit), wet it with lime juice (papaya, watermelon, peaches with honey), or combine it with an ingredient from another taste family (sweet watermelon and salty feta cheese). If you can find fresh papaya, try slicing it and sprinkling a bit of cayenne pepper and salt on top of the pieces for a salty/sweet/hot combination. Try replacing the papaya with other tropical fruits and the cayenne pepper with other hot items. Guava and chili pepper? Mango salad with jalapeños and cilantro? Strawberries and black pepper? For another twist, try mixing foods high in fats with hot ingredients. They should pair well with ingredients that contain capsaicin, because capsaicin is fat soluble. Experiment with avocado and sriracha sauce, commonly known as rooster sauce for the drawing on the bottle of a popular brand.

Many foods are combinations of three or more primary tastes. Ketchup, for example, is surprisingly complex, with tastes of umami (tomatoes), sourness (vinegar), sweetness (sugar), and saltiness (salt). Taste combinations are equally important in drinks. The hallmark of a well-mixed cocktail is the balance between bitter (bitters) and sweet (sugar). Likewise, unless you've learned to enjoy bitterness, coffee and tea (slightly bitter) are commonly combined with sweeteners (milk, sugar, honey) or acidifiers (lemon juice, orange juice) to balance out the tastes.

In some cases, the combination of different primary tastes is achieved by serving two separate components together, pairing one dish with a second on the basis that the two will complement each other. In Indian food, for example, the salty sweetness of a yogurt lassi balances out the spicy hotness of curries. Consider the following combinations of primary flavors. With the exception of bitter/salty, every pair of primary tastes is a common combination.



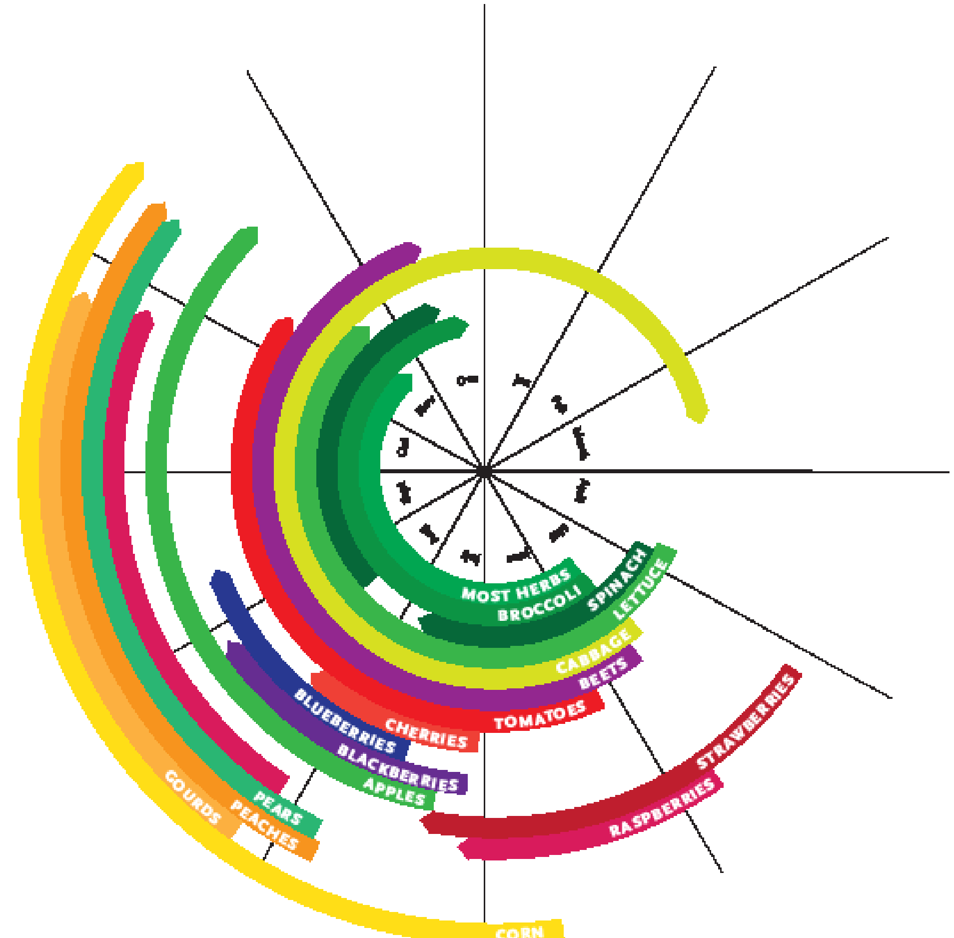
Cultural Tastes

	BITTER	SOUR	SALTY	SWEET	UMAMI	HOT
CHINESE	Chinese broccoli Bitter melon	Rice vinegar Plum sauce	Soy sauce Oyster sauce	Plum sauce Jujubes Hoisin sauce	Dried mushrooms Oyster sauce	Mustard Szechwan peppers Ginger root
FRENCH	Frisée Radish Endive Olives	Red wine vinegar Lemon juice	Olives Capers	Sugar	Tomato Mushroom	Dijion mustard Black, white & green peppercorns
SOUTHEAST ASIAN	Tangerine peel Pomelo	Tamarin Kaffir limes	Fish sauce Dried shrimp	Coconut milk	Fermented bean paste	Bird chili Thai chili
INDIAN	Asafetida Fenugreek Bitter melon	Lemon Lime Amchur (ground green mangos) Tamarind	Kala namak (black salt)	Sugar Jaggery	Tomato	Black pepper Chilies Cayenne pepper Black mustard seed Ginger Cloves
ITALIAN	Broccoli rabe Olives Artichoke Radicchio	Balsamic vinegar Lemon	Prosciutto Cheese Capers & anchovies	Sugar Carmelized veggies Raisins & dried fruits	Tomato Parmesan cheese	Garlic Black pepper Italian hot chilies Cherry peppers
JAPANESE	Tea	Rice vinegar	Soy sauce Miso Seaweed	Mirin	Shitake mushroom Miso Dashi	Wasabi Chilies
LATIN AMERICA	Chocolate Beer	Tamarind Lime	Cheese Olive	Sugarcane	Tomato	Jalepeño Other peppers

SEASONAL METHOD

Cooking "within season" means using only those ingredients that have good, fresh flavor and are ripe. Restricting yourself to ingredients that are in season in your region is a great way of creating constant challenges and exposing yourself to new ingredients. And because in-season ingredients tend to be of higher quality and pack more of a flavor punch, it's that much easier to make the resulting dishes taste good. Next time you're at the grocery store, take note of what new fruits and vegetables have arrived and what is in dwindling supply.

Of course, not every ingredient in a dish is a "seasonal" ingredient. Cellar onions, storage apples, and pantry goods such as rice, flour, and beans are year-round staples and fair game. What is off-limits with this approach are those foods that are outside their growing season for where you live. Put another way, don't try making grilled peaches in February. Even if you can get a peach in February, it won't have the same flavor as a mid-summer peach, so it will invariably taste lat. Even if those peaches shipped from Chile taste okay, they won't be as good as the local in-season peaches, because they have to be of a variety that favors shipping durability and disease resistance over taste and texture. (Unless you happen to live in Chile.) One of the perks of using in-season ingredients, besides the quality, is that the abundance of the in-season produce generally means lower prices, too, as the supply-and-demand curves change. Grocery stores have to figure out how to sell all those zucchinis when they come up for harvest, and running specials is one of the standard ways of moving product. The same challenge applies even more if you're growing your own fruits



FRUIT & VEGETABLE HARVEST CALENDAR

In-season, local foods have the advantage of typically being fresher than their conventional counterparts, which is especially important for flavor in highly perishable foods such as heirloom tomatoes and fresh seafood.

Local isn't always better, though. For example, if you live in a northern climate, you might find that produce such as radishes from traditional farms located where it gets hotter might taste better.

and vegetables, because a home garden can produce an abundance over a short period of time. If you figure out what to do with the 100 pounds of zucchini that all come ready in late summer, I know plenty of people who would like to hear it!

If it's the dead of winter and there's a foot of snow on the ground (incidentally, not the best time to eat out at restaurants specializing in local, organic fare), finding produce with "good flavor" can be a real challenge. You will have to work harder to produce flavors on par with those in summer meals. Working with the seasons means adapting the menu. There's a reason why classic French winter dishes like cassoulet (traditionally made with beans and slow cooked meats, but that description does not do this amazing dish justice–I make mine with duck confit, bacon, sausage, and beans, then slow roast it overnight) and coq au vin (stewed chicken in wine) use cellar vegetables such as onions, carrots, turnips, and potatoes and slow, long-cooking simmers to tenderize tougher cuts of meat. I can't imagine eating cassoulet mid-summer, let alone venting the heat generated from keeping the oven on for that long. Yet in the dead of winter, nothing's better.

Consider the following three soups: gazpacho, butternut squash, and white bean and garlic. The ingredients used in gazpacho and butternut squash soup are seasonal, so they tend to be made in the summer and autumn, respectively (of course, modern agricultural practices have greatly extended the availability of seasonal ingredients, and your climate might be more temperate than the sources of these traditions). White bean and garlic soup, on the other hand, uses pantry goods that can be had at any time of year. Thus, it is traditionally thought of as a winter soup, because it's one of the few dishes that can be made that time of year.

GAZPACHO (SUMMER)

Puree tomatoes using an immersion blender or food processor. Transfer the puréed tomato to a large bowl and add everything else. Stir to combine. Adjust salt to taste and add ground black pepper as desired.

2 large tomatoes, peeled and seeded
1 cucumber, peeled and seeded
1 cob corn, grilled or broiled and cut off the cob
1 sweet red bell pepper, grilled or broiled
½ small red onion, thinly sliced
2 tablespoons olive oil
2 cloves garlic, minced or pressed
1 teaspoon white wine vinegar or champagne vinegar
½ teaspoon salt

To peel tomatoes, drop them in boiling water for a few seconds and then pull them out with tongs or a mesh spider, and then just pull the skins off. You can cut an "x" shape into the skin before blanching, although I find the skin on some varieties of tomatoes will pull back regardless, as long as the water is at a full rolling boil. Experiment to see if it makes a difference!

"Cool and refreshing."



WHITE BEAN & GARLIC SOUP (WINTER)

In a bowl, soak the beans for several hours or overnight. After soaking overnight, drain the beans, place them in a pot, and fill it with water (try adding a few bay leaves or a sprig of rosemary). Bring to a boil and simmer for at least 15 minutes. Strain out the water and put the beans back in a pot (if using an immersion blender) or in the bowl of a food processor. Add to the pot or bowl with beans and then purée the rest of the ingredients until blended. Salt and pepper, to taste.

2 cups dry white beans, such as cannelloni beans
2 cups chicken or vegetable stock
1 medium yellow onion, diced and sautéed
3 slices French bread, coated in olive oil and toasted on both sides
½ head cooked garlic, peeled, crushed

Don't skip soaking and boiling the beans. Really. One type of protein present in beans–phytohaemagglutinin–causes extreme intestinal distress. The beans need to be boiled to denature this protein; cooking them in a slow cooker or sous vide setup will not denature the protein and actually makes things worse.

BUTTERNUT SQUASH SOUP (FALL)

This soup by itself is very basic. Garnish with whatever else you have on hand that you think might go well, such as garlic croutons and bacon. Or top with a small dab of cream, some toasted walnuts, and dried cranberries to give it a feeling of Thanksgiving. How about a teaspoon of maple syrup, a few thin slices of beef, and some fresh oregano? Chives, sour cream, and cheddar cheese? Why not! Instead of purchasing items to follow a recipe exactly, try using leftover ingredients from other meals to complement the squash soup. Purée all the ingredients in a food processor or with an immersion blender.

2 cups butternut squash, peeled, cubed, and roasted (about 1 medium squash)
2 cups chicken, turkey, or vegetable stock
1 small yellow onion, diced and sautéed
½ teaspoon salt (adjust to taste)

If you're in a rush, you can "jump-start" the squash by microwaving it first. Peel and quarter the squash, using a spoon to scoop out the seeds. Then, cube it into 1–2" pieces, drop it into a glass baking pan that's both oven and micro- wave safe, and nuke it for four to five minutes to partially heat the mass. Remove from microwave, coat the squash with olive oil and a light sprinkling of salt, and roast it in a preheated oven until done, about 20 to 30 minutes.

Time & Temperature

COOKING'S PRIMARY VARIABLE

Ever since cavemen first set up campfires and started roasting their kill, mankind has enjoyed a whole new set of flavors in food. Cooking is the application of heat to ingredients to transform them via chemical and physical reactions that improve flavor, reduce chances of foodborne illness, and increase nutritional value. From a culinary perspective, the more interesting and enjoyable changes are brought about when compounds in food undergo the following chemical reactions.

PROTEIN DENATURATION

The native form of a protein is the three-dimensional shape (conformation) assumed by the protein that is required for normal functioning. If this structure is disrupted (typically by heat or acid), the protein is said to be denatured. Changes in the shapes of proteins also alter their taste and texture.

Different proteins denature at different temperatures; most proteins in food denature in the range of 120–160°F. Egg whites, for example, begin to denature at 141°F and turn white because the shape of the denatured protein is no longer transparent to visible light. In meat, the protein myosin begins to denature around 122°F; another protein, actin, begins to denature around 150°F. Most people prefer meat cooked such that myosin is denatured while keeping the actin native.

MAILLARD REACTION

A Maillard reaction is a browning reaction that gives foods an aromatic and mouth-watering aroma. Usually triggered by heat, this occurs when an amino acid and certain types of sugars break down and then recombine into hundreds of different types of compounds. The exact by-products and resulting smells depend upon the amino acids present in the food being cooked, but as an example, imagine the rich smell of the crispy skin on a roasted chicken.

For culinary purposes, the reaction generally becomes noticeable around 310°F, although the reaction rate depends on pH, chemical reagents in the food, and amount of time at any given temperature. Many meats are roasted at or above 325°F – at temperatures lower than this, the Maillard reaction hardly occurs.

SIMPLE BEEF STEW

In a pan, sear the beef. After browning the outsides of the beef, transfer the meat to the bowl of the rice cooker. Using the same pan, sauté the onions. After the onions have started to caramelize, transfer them to the rice cooker. Toss in a can or two of diced tomatoes (enough to cover the beef). Add seasonings–such as oregano, thyme, or rosemary–and salt and pepper. You can start the cooking in the morning before work and arrive home to a quick and easy dinner of beef stew.

1-2 lbs cubed stewing beef
one or two diced onions (red, yellow, or white)
1-2 canned tomatoes
oregano, thyme, rosemary, salt, pepper to taste
diced potatoes (if desired)
canned beans (if desired)
1 tablespoon ketchup (if desired)
1 tablespoon port (if desired)

Choose a cheap cut for stewing; more expensive cuts won't have as much collagen, which will affect the texture, as we'll discuss.

You can add diced potatoes, canned beans, or other starches as well. Throw in a tablespoon of ketchup and port to add more flavors. Leave to slow cook for at least six hours.

CARAMELIZATION

Caramelization is the result of the breakdown of sugars, which, like the Maillard reaction, generates hundreds of compounds that smell delicious. Pure sucrose (the type of sugar in granulated sugar) caramelizes at between 320–400°F, with only the middle range of 356–370°F generating rich flavors. In baking, those goods that are baked at 375°F generally have a noticeably browned exterior, while those baked at or below 350°F remain lighter-colored.

"Great," you're probably thinking, "but how does knowing any of this actually help me cook?" You can tell when something is done cooking by understanding what reactions you want to trigger and then detecting when those reactions have occurred.

Cooking a steak? Check the internal temperature with a thermometer; once it's reached 140°F, the myosin proteins will have begun to denature. Baking crispy chocolate chip cookies at 375°F? Open your eyes and keep your nose online; the cookies will be just about done when they begin to turn brown and you're able to smell the caramelization occurring. Really, it's that simple. Foods are "done" when they achieve a certain state, once they have undergone the desired chemical reactions. As soon as the reactions have occurred, pop the food out; it's done cooking.

Smell, touch, sight, sound, taste: learn to use all of your senses in cooking. Meat that has been cooked until it is medium rare– a point at which myosin has denatured and actin has yet to denature– will feel firmer and also visibly shrink. The bubbling sound of a sauce that's being boiled and reduced will sound

"Perfect for those chilly winter nights."

different once the water is mostly evaporated, as bubbles pushing up through the thicker liquid will have a different sound. Bread crust that has reached the temperatures at which Maillard reactions and caramelization occur will smell wonderful, and you'll see the color shift toward golden brown. By extension, this also means that the crust of the bread must reach a temperature of 310°F before it begins to turn brown, which you can verify using an IR thermometer. (Bread flour has both proteins and sugars, so both caramelization and Maillard reactions occur during baking.) This chapter shows you when and how these changes occur so that you can become comfortable saying, "It's done!" We'll start by looking at the differences between the common sources of heat in cooking and how differences in the type of heat and temperatures impact cooking.

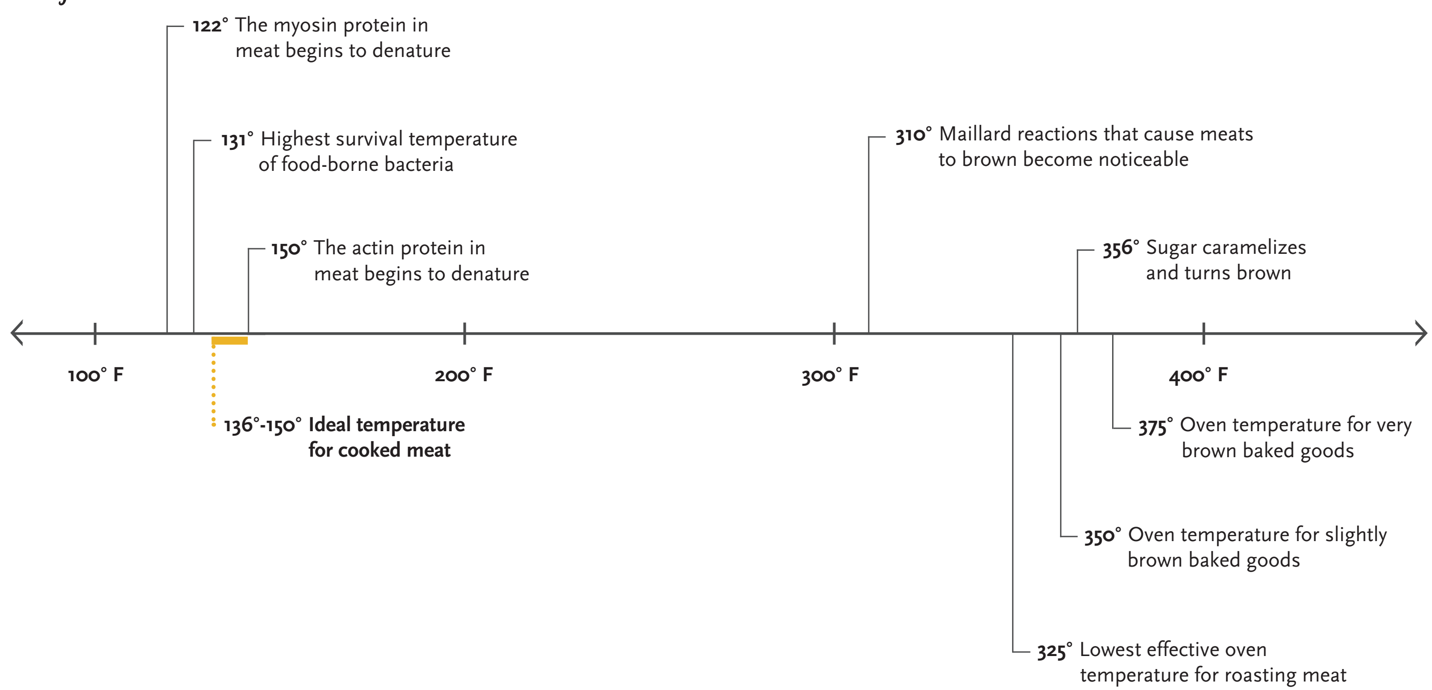
Since one of the main reasons for cooking is reducing the chances of foodborne illness, we'll also discuss the key issues in food safety, including a look at how to manage bacterial contamination and parasites, along with some example recipes to demonstrate the principles behind food safety. The remainder of the chapter will then examine a number of key temperature points, starting with the coldest and ending with the hottest, discussing the importance of each temperature point and giving example recipes to illustrate the reactions that occur at each of these temperatures.

There are a few "big picture" things to notice about these common temperatures in cooking. For one, notice that browning reactions (Maillard reactions and caramelization) occur well above the boiling point of water. If you're cooking something by boiling it in a pot of water or stewing it in liquid, it's impossible for high-heat reactions to occur, because the temperature can't go much above 216°F, the boiling point of moderately salted water. If you're cooking a stew, such as the simple beef stew recipe, sear the meats and caramelize the onions separately before adding them to the stew. This way, you'll get the rich, complex flavors generated by these browning reactions into the dish. If you were to stew just the uncooked items, you'd never get these high-heat reactions.

Another neat thing to notice in the temperature graph is the fact that proteins denature in relatively narrow temperature ranges. When we cook, we're adding heat to the food specifically to trigger these chemical and physical reactions. It's not so much about the temperature of the oven, grill, or whatever environment you're cooking in, but the temperature of the item of food itself.

Cooked = Time × Temperature

Since the primary chemical reactions in cooking are triggered by heat, let's take a look at a chart of the temperatures at which the reactions we've just described begin to occur, along with the temperatures that we commonly use for applying heat to food.



Cooked = Time × Temperature *

This has to be one of the hand-waviest formulas ever. Apologies. To make up for it, here's an actual mathematical model for temperature change as a function of heat being applied. Remember to cook until medium-rare!

*

$$\mathbf{t}_{i(J+1)} = \frac{(q_i \cdot \tau dh + 1_m \cdot d\tau \cdot (t_{i(j-1)} + t_{i(j+1)}) + m_c \cdot c_m \cdot h_{ij})}{2 \cdot 1_m \cdot Fd\tau + m_c \cdot c_M \cdot dh}$$

$$\mathbf{K}_{1i} = 0.00836 - 0.001402\ pH + 5.5 \cdot 10^{-7} \cdot t^2$$

$$\mathbf{K}_{2i} = -0.27\ 8 + 7\ .325 \cdot 10pH - 3.482 \cdot 10^{-5} \cdot t^2$$

$$\mathbf{K}_{3i} = 2.537 \cdot 10^{-3} - 1.493 \cdot 10^{-4} \cdot t_i + 2.198 \cdot 10^{-5} \cdot t^2$$

$$\mathbf{K}_{4i} = 2.537 \cdot 10^{-2} - 9.172 \cdot 10^{-3} pH + 3.157 \cdot 10^{-5} \cdot t_i^2$$

$$\mathbf{m}_{1t.i} = m_0^b - (m_0^b - m_t^b) \cdot e^{-K1i \cdot t}$$

$$\mathbf{m}_{2t.i} = m_0^b - (m_0^b - m_t^b) \cdot e^{-K2i \cdot t}$$

$$\mathbf{m}_{3t.i} = m_0^b - (m_0^b - m_t^b) \cdot e^{-K3i \cdot t}$$

$$\mathbf{m}_{4t.i} = m_0^b - (m_0^b - m_t^b) \cdot e^{-K4i \cdot t}$$

METHODS OF HEAT TRANSFER

There are three methods of transferring heat into foods: conduction, convection, and radiation. While the heating method doesn't change the temperature at which chemical reactions occur, the rate of heat transfer is different among them, meaning that the length of time needed to cook identical steaks via each method will be different. The table below shows the common cooking techniques broken out by their primary means of heat transfer.

Conduction

Conduction is the simplest type of heat transfer to understand because it's the most common: it's what you experience whenever you touch a cold countertop or grasp a warm cup of coffee. In cooking, those methods that transfer heat by direct contact between food and a hot material, such as the hot metal of a skillet, are conduction methods. Dropping a steak onto a hot cast iron pan, for example, causes thermal energy from the skillet to be transferred to the colder steak as the neighboring molecules distribute kinetic energy in an effort to equalize the difference in temperature.

Convection

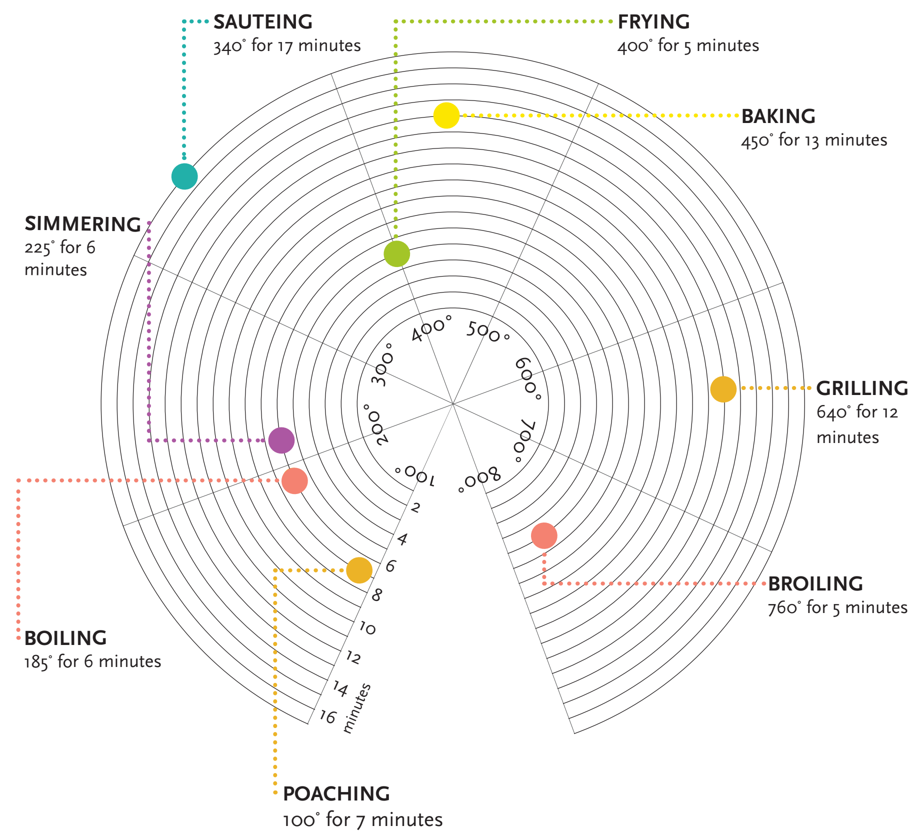
Convection methods of heat transfer–baking, roasting, boiling, steaming–all work by circulating a hot material against a cold one, causing the two materials to undergo conduction to transfer heat. In baking and roasting, the hot air of the oven imparts the heat; in boiling and steaming, it's the water that does this.

Those heat methods that involve water are called wet heat methods; all others fall into the dry heat category. One major difference between these two categories is that wet methods don't reach the temperatures necessary for Maillard reactions or caramelization (with the exception of pressure cooking, which does get up to temperature while remaining moist). The flavorful compounds produced by Maillard reactions in grilled or oven-roasted items won't be present in braised or stewed foods: steamed carrots, for example, won't undergo any caramelization, leaving the food with a subtler flavor. Brussels sprouts are commonly boiled and widely hated. Next time you cook them, quarter them, coat with olive oil and sprinkle with salt, and cook them under a broiler set to medium.

Another key difference between most of the dry versus wet methods is the higher speed of heat transfer typical in wet methods. Water conducts heat roughly 23 times faster than air (air's coefficient of thermal conductivity is 0.026, olive oil's is 0.17, and water's is 0.61), which is why hard-cooked eggs finish faster in a wet environment even at a lower temperature. One exception to this wet-is-faster-than-dry rule is deep-fat frying. Oil is technically dry (there's no moisture present), but for culinary purposes it acts a lot like water: it has a high rate of heat transfer with the added benefit of being hot enough to trigger a large number of caramelization and Maillard reactions. (Mmm, donuts!)

Wet methods have their drawbacks (including, depending on the desired result, the lack of the aforementioned chemical reactions). While the subtler flavors achieved without browning reactions can be desirable, as in a gently cooked piece of fish, it's also much easier to overcook foods with wet methods. When cooking meat, the hot liquid interacting with it can quickly raise its temperature above 160°F, the point at which a significant percentage of the actin proteins in meats are denatured, giving the meat a tough, dry texture. For pieces of meat with large amounts of fat and collagen (such as ribs, shanks, or poultry legs), this isn't as much of an issue, because the fats and collagen (which converts to gelatin) will mask the toughness brought about by the denatured actin. But for leaner cuts of meat, especially fish and poultry, take care that the meat doesn't get too hot! The trick for these low-collagen types of meats is to keep your liquids at a gentle simmer, around 160°F, and minimize the time that the meat spends in the liquid.

Temperature of Cooking Environment



Radiation

Radiant methods of heat transfer impart energy in the form of electromagnetic energy, typically microwaves or infrared radiation. The warmth you feel when sunlight hits your skin is radiant heat.

In cooking, radiant heat methods are the only ones in which the energy being applied to the food can be either reflected or absorbed by the food. You can use this reflective property to redirect energy away from parts of something you're cooking. One technique for baking pie shells, for example, includes putting foil around the edge, to prevent overcooking the outer ring of crust. Likewise, if you're broiling something, such as a chicken, and part of the meat is starting to burn, you can put a small piece of aluminum foil directly on top of that part of meat. It might be a hack, but in a pinch it's a decent way to avoid burning part of a dish, and nobody but you, me, and everyone else who reads this book will ever know.

Combinations of heat

The various techniques for applying heat to food differ in other ways than just the mechanisms of heat transfer. In roasting and baking we apply heat from all directions, while in searing and sautéing heat is applied from only one side. This is why we lip pancakes (stovetop, heat from below) but not cakes (oven, heat from all directions). The same food can turn out vastly different under different heat conditions. Batter for pancakes (conduction via stovetop) is similar to that for muffins (convection via baking) and waffles (conduction), but the end result differs widely.

To further complicate things, most cooking methods are actually combinations of different types of heat transfer. Broiling, for example, primarily heats the food via thermal radiation, but the surrounding air in the oven also heats up as it comes in contact with the oven walls, then comes in contact with the food and supplies additional heat via convection. Likewise, baking is primarily convection (via hot air) but also some amount of radiation (from the hot oven walls). "Convection ovens" are nothing more than normal ovens with a blower inside to help move the air around more quickly. All ovens are, by definition, convection ovens, in the sense that heat is transferred by the movement of hot air. Adding a fan just moves the air more quickly, leading to a higher temperature difference at the surface of the (cold) food you're cooking.

To a kitchen newbie, working with combinations of heat might be frustrating, but as you get experience with different heat sources and come to understand how they differ, you'll be able to switch methods in the middle of cooking to adjust how a food item is heating up. For example, if you like your lasagna like I do–toasty warm in the middle and with a delicious browned top–the middle needs to get hot enough to melt the cheese and allow the flavors to meld, while the top needs to be hot enough to brown. Baking alone won't generate much of a toasted top, and broiling won't produce a warm center. However, baking until it's almost done and then switching to the broiler achieves both results.

KEY TEMPERATURES IN COOKING

Most discussions of cooking are structured around the different heat transfer methods listed at the beginning of this chapter. Instead of looking at sources of heat, the rest of this chapter is going to take a different approach and talk about what reactions happen when each of the critical temperatures in the following table is reached, briefly touching on cooking techniques that relate to each temperature as they come up.

104°F and 122°F: Proteins in Fish & Meat Denature

Chances are, you haven't given much thought to the chemical reactions that happen to a piece of meat when the animal supplying it is slaughtered. The primary change is, to put it bluntly, that the animal is dead, meaning the circulatory system is no longer supplying the muscle tissue with glycogen from the liver or oxygen-carrying blood. Without oxygen, the cells in the muscle die, and pre-existing glycogen in the muscle tissue dissipates, causing the thick and thin myoilaments in the muscle to ire of and bind together (resulting in the state called rigor mortis). Somewhere around 8 to 24 hours later, the glycogen supply is exhausted and enzymes naturally present in the meat begin to break down the bonds created during rigor mortis (post- mortem proteolysis). Butchering before this process has run its course will affect the texture of the meat.

Sensory panels have found that chicken breasts cut of the carcass before rigor mortis was over have a tougher texture than meat left on the bone longer. And since time is money, much mass-produced meat is slaughtered and then butchered straightaway. (Why roasted whole birds taste better!) Proteins in meat can be divided into three general categories: myoibrillar proteins (found in muscle tissue, these enable muscles to contract), stromal proteins (connective tissue, including tendons, that provide structure), and sarcoplasmic proteins (e.g., blood). We'll talk about myoibrillar proteins here and save the stromal proteins for the section on collagen later in the chapter.

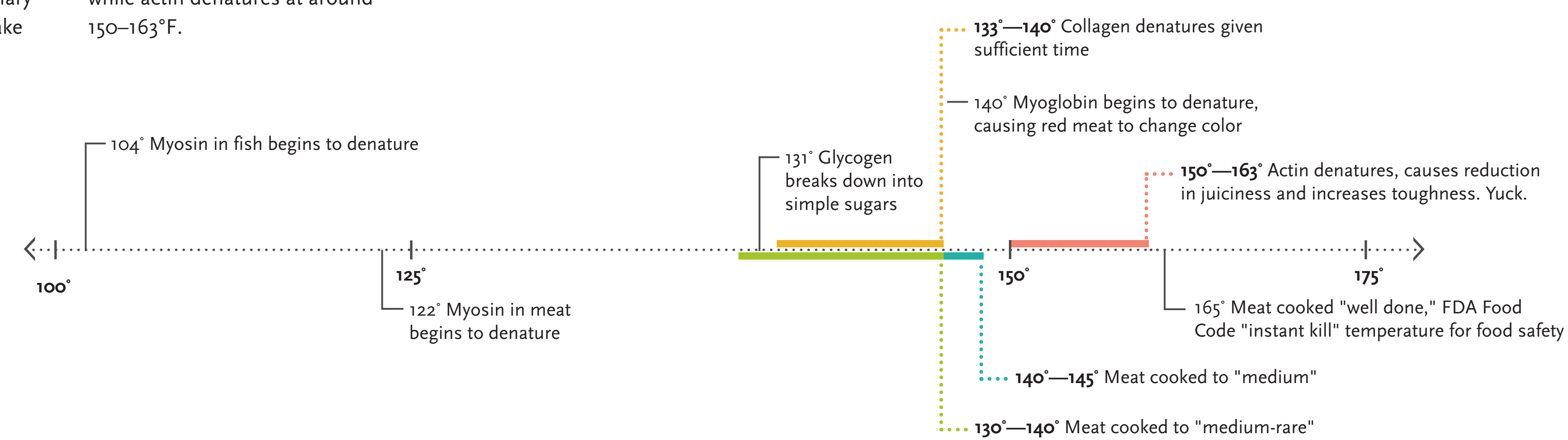
Muscle tissue is primarily composed of only a few types of proteins, with myosin and actin being the two most important types in cooking. About two-thirds of the proteins in mammals are myoibrillar proteins. The amount of actin and myosin differs by animal type and region. Fish, for example, are made up of roughly twice as much of these proteins as mammals.

Lean meat is mostly water (65–80%), protein (16–22%), and fat (1.5–13%), with sugars such as glycogen (0.5–1.3%) and minerals (1%) contributing only a minor amount of the mass. When it comes to cooking a piece of fish or meat, the key to success is to understand how to manipulate the proteins and fats. Although fats can be a significant portion of the mass, they are relatively easy to manage, because they don't provide toughness. This leaves proteins as the key variable in cooking meats.

Of the proteins present in meat, myosin and actin are the most important from a culinary texture perspective. If you take only one thing away from this section, let it be this: denatured myosin = yummy; denatured actin = yucky. Dry, overcooked meats aren't tough because of lack of water inside the meat; they're tough because on a microscopic level, the actin proteins have denatured and squeezed out liquid in the muscle fibers. Myosin in fish begins to noticeably denature at temperatures as low as 104°F; actin denatures at around 140°F. In land animals, which have to survive warmer environments and heat waves, myosin denatures in the range of 122–140°F(depending on exposure time, pH, etc.) while actin denatures at around 150–163°F.

The texture of some cuts of meat can be improved by tenderizing. Marinades and brines chemically tenderize the flesh, either enzymatically (examples include bromelain, an enzyme found in pineapple, and zingibain, found in fresh ginger) or as a solvent (some proteins are soluble in salt solutions).

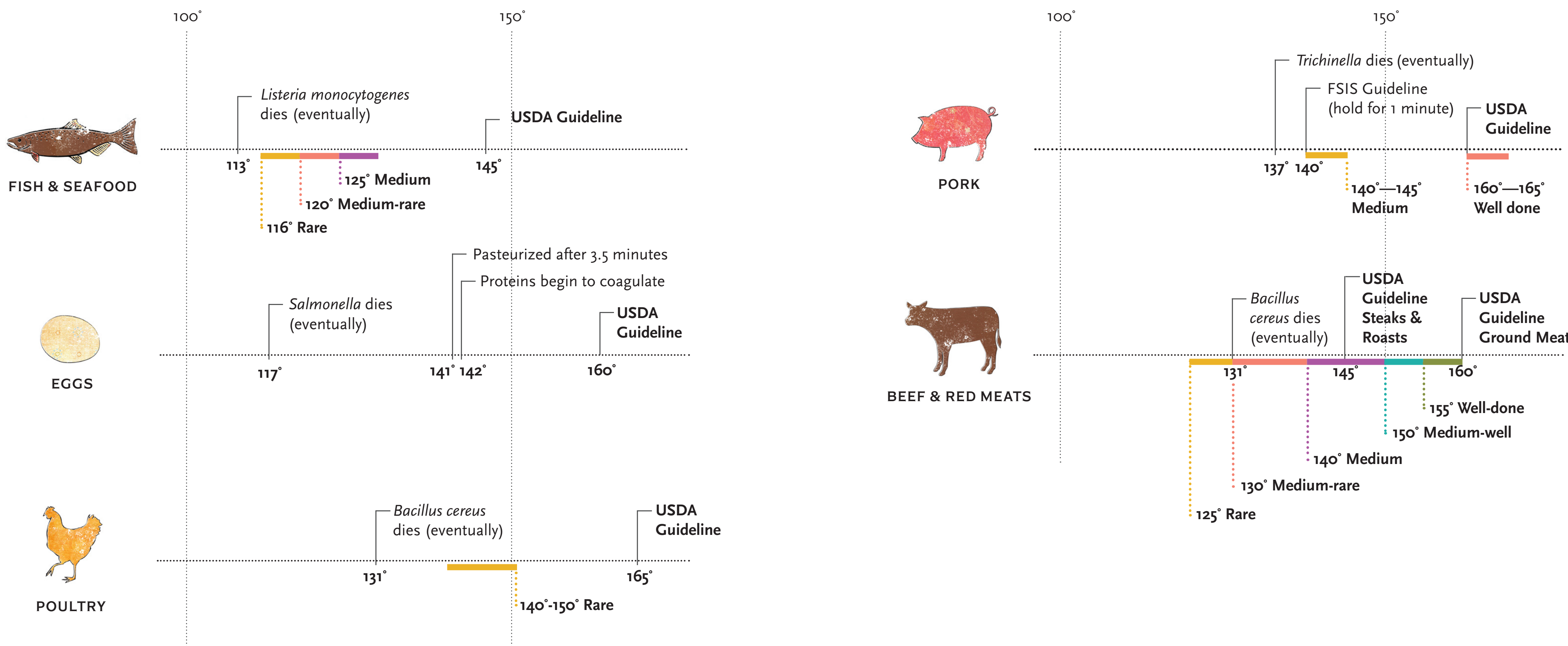
Dry aging steaks works by giving enzymes naturally present in the meat time to break down the structure of collagen and muscle fibers. Dry aging will affect texture for at least the first seven days. Dry aging also changes the flavor of the meat: less aged beef tastes more metallic, more aged tastes gamier. Which is "better" is a matter of personal taste preference. (Perhaps some of us are physiologically more sensitive to metallic tastes.) Retail cuts are typically 5 to 7 days old, but some restaurants use meat aged 14 to 21 days.



DENATURATION TEMPERATURE OF VARIOUS TYPE OF PROTEINS AND STANDARD DONENESS LEVELS

Cooking Temps for Various Proteins

Food cooked to the colored temperatures are considered raw or undercooked. Seafood and poultry cooked medium or rare must be held for a sufficient period of time at the stated temperature in order for it to be pasturized.



SOY GINGER MARINADE

The salt in the soy sauce and zingibain in the ginger give this marinade both chemical and enzymatic tenderizers. Mix this up, transfer it to a re-sealable bag, and toss in some meat, such as flank steaks. Allow to marinate for an hour or two in the fridge, and then pan sear the meat.

1 cup soy sauce
2 tablespoons grated fresh ginger or ginger paste
1 teaspoon ground black pepper

"Zingy, salty, and spicy!"

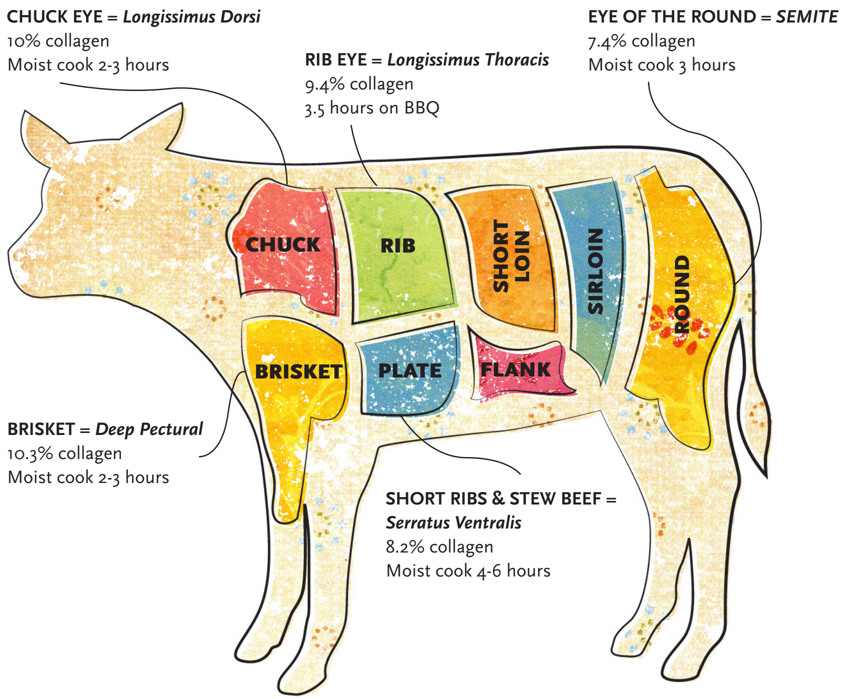
SEARED TUNA WITH CUMIN & SALT

Pan searing is one of those truly simple cooking methods that produces a fantastic flavor and also happens to take care of bacterial surface contamination in the process. The key to getting a rich brown crust is to use a cast iron pan, which has a higher thermal mass than almost any other kind of pan. When you drop the tuna onto the pan, the outside will sear and cook quickly while leaving as much of the center as possible in its raw state.

3–4 oz of raw tuna
1 tablespoon cumin seed
½ teaspoon sea salt

Slice the tuna into roughly equal-sized portions, since you'll be cooking them one or two at a time. On a flat plate, measure out the cumin seed and salt (preferably a flaky salt such as Malden sea salt) per piece of tuna. On a second plate, pour a few tablespoons of a high-heat-stable oil, such as refined canola, sunflower, or safflower oil.

Place a cast iron pan on a burner set as hot as possible. Wait for the pan to heat up thoroughly, until it just begins to smoke. For each serving of tuna, dredge all sides in the cumin & salt mix, and then briefly dip all sides in the oil to give the fish a thin coating. Sear all sides of the fish. Flip to a new side once the current facedown side's cumin seeds begin to brown and toast, about 30 to 45 seconds per side. Slice into ½ slices and serve as part of a salad (place fish on top of mixed greens) or main dish (try serving with rice, risotto, or Japanese udon noodles).



Older animals have higher levels of collagen. As animals age, the collagen structure has more time to form additional crosslinks between the strands in the collagen helix, resulting in increased toughness. This is why older chickens, for example, are traditionally cooked in long, slow roasts. (The French go so far as to use different words for old versus young chickens: poule instead of poulet.) Most commercial meat, however, is young at time of slaughter, so the age of the animal is no longer an important factor.

The other easy rule of thumb for collagen levels is to look at the relative price of the meat: because high-collagen cuts require more work to cook and come out with a generally drier texture, people tend to favor other cuts, so the high-collagen cuts are cheaper.

SLOW-COOKED SHORT RIBS

Short ribs and other high-collagen cuts of meat aren't difficult to work with, they just require time at temperature (collagen takes many hours to hydrolyze). The trick is to cook this type of meat "low and slow"—for a long time at low temperature. Too cold, and the collagen won't break down; too hot, and the water in the meat will evaporate, drying it out. Using a slow cooker cooks the meat in the ideal temperature range. After all, this is what they're designed for!

This is an intentionally easy recipe, but don't let this fool you: slow-cooked meats can be amazingly good, and if you're cooking for a dinner party, they make for easy work when you go to assemble the dinner. If you have a rice cooker, check to see if it has a "slow- cook" setting. In this mode, the rice cooker will heat foods to a temperature typically between 170–190°F, which is warm enough to be safe from bacterial contamination and cool enough to not steam-dry the meat.

Pour a bottle of barbeque sauce into the bowl of the rice cooker or slow cooker. Add the short ribs, arranging them in a layer so that the barbeque sauce covers the meat. Slow-cook for at least four hours (longer is fine). Try starting this in the morning before going to work—the slow cooker will keep the food safe, and the extra time will help ensure that the collagen is fully dissolved.

Ideally, you should pan sear the short ribs (in a cast iron pan) for a minute or two before cooking. As discussed at the beginning of this chapter, this will cause browning reactions, bringing a richness to the final end product.

Keep in mind the danger zone rule covered earlier. Don't load up a slow cooker with so much cold meat that the cooker will be unable to raise the temperature above 140°F within a two-hour period.

Try adding other ingredients to the sauce, or making your own sauce if you like. You can pour a tablespoon or so of wine or port into the empty BBQ sauce jar to "rinse out" the thick sauce, then pour the port-sauce slurry into the slow cooker.

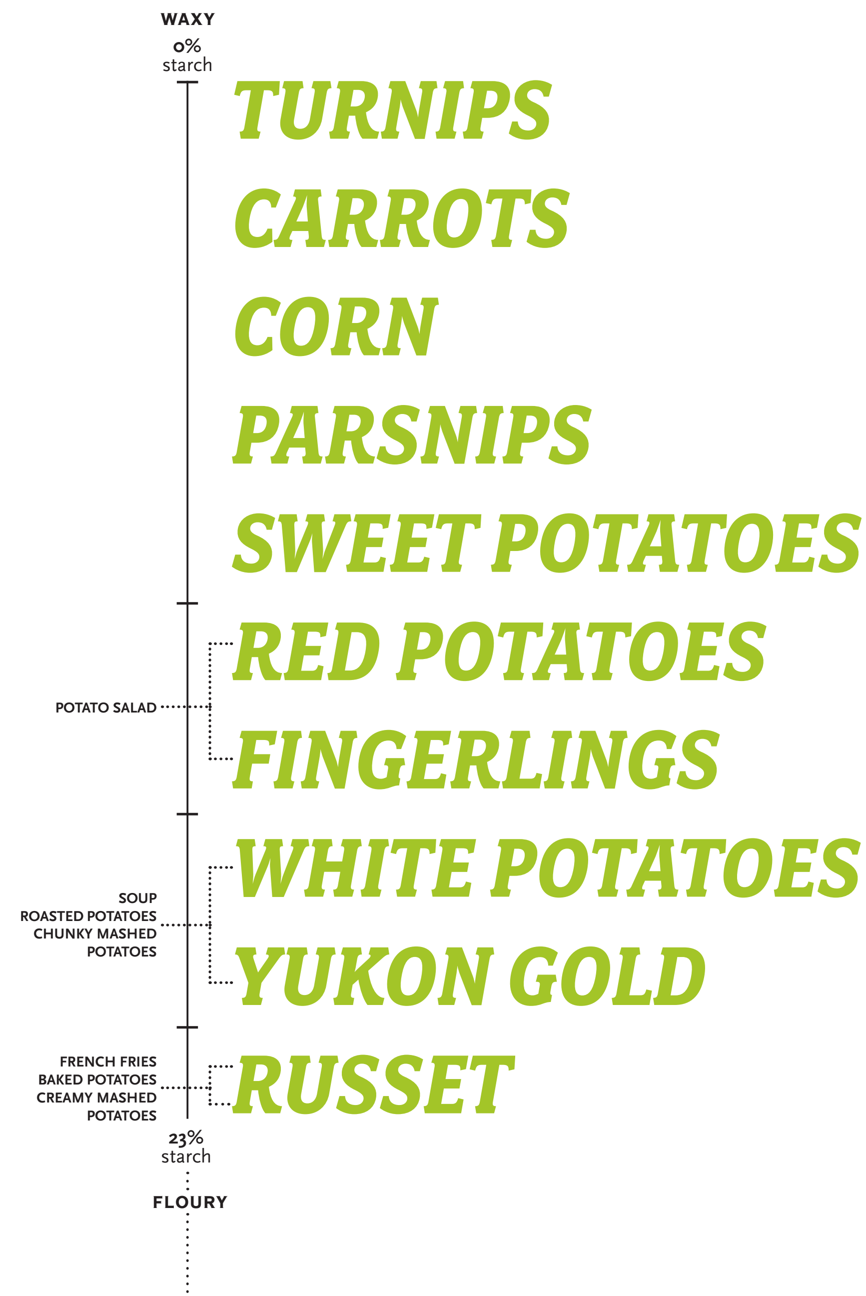
158°F:
Vegetable Starches Break Down

Whereas meat is predominately proteins and fats, plants are composed primarily of carbohydrates such as cellulose, starch, and pectin. Unlike proteins in meat, which are extremely sensitive to heat and can quickly turn into shoe leather if cooked too hot, carbohydrates in plants are generally more forgiving when exposed to higher temperatures. (This is probably why we have meat thermometers but not vegetable thermometers.)Cooking starchy vegetables such as potatoes causes the starches to gelatinize (i.e., swell up and become thicker). In their raw form, starches exist as semi-crystalline structures that your body can only partially digest. Cooking causes them to melt, absorb water, swell, and convert to a form that can be more easily broken down by your digestive system.

The point at which starch granules gelatinize depends on more than just the single variable of temperature. The type of starch, the length of time at temperature, the amount of moisture in the environment, and processing conditions all impact the point at which any particular starch granule swells up and gelatinizes. Leafy green vegetables also undergo changes when cooked. Most noticeably, they lose their green color as the membranes around the chloroplasts in the cells rupture. This same rupturing and damage to the cell structure is what improves the texture of tougher greens such as Swiss chard and kale.

For starchy plants (think potatoes), cook them so that they reach the temperature at which they gelatinize, typically in the range of 180–190°F.

STARCH LEVELS IN COMMON VEGGIES



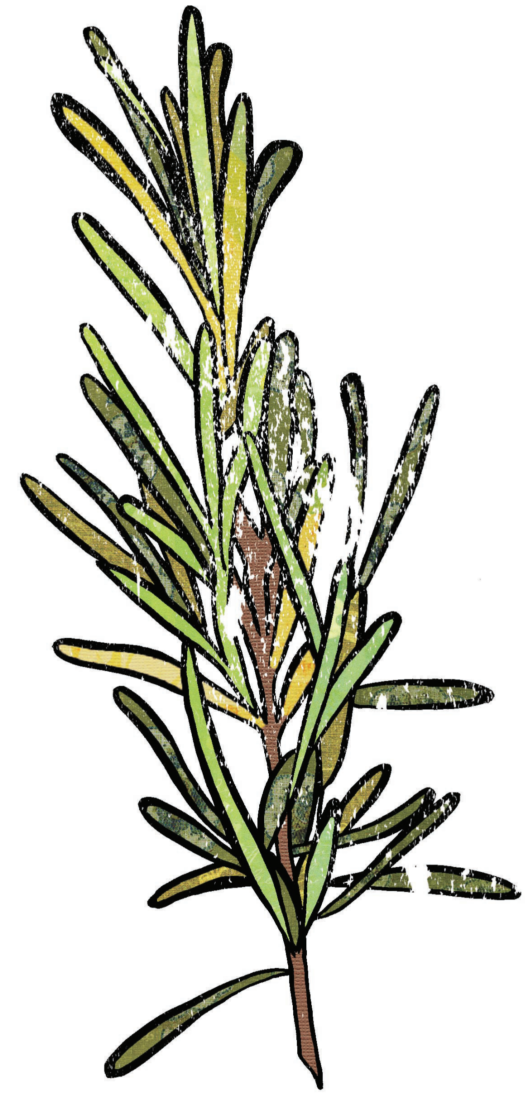
ROSEMARY MASHED POTATOES

3 to 4 medium red potatoes
½ cup sour cream
¼ cup milk
4 teaspoons butter,
2 teaspoons chopped rosemary
¼ teaspoon salt
¼ teaspoon ground pepper

This simple mashed potato recipe uses the microwave for cooking the potatoes. If you're in the anti-microwave category, consider this: cooking a potato– or any other starchy root vegetable– requires gelatinizing the starches. For this to occur, two things need to happen: the starch granules need to get hot enough to literally melt, and they need to be exposed to water so that the granules absorb and swell up, which causes the texture of the tissue to change. Luckily, the temperature at which most starches undergo the gelatinization process is below the boiling point of water, and there's enough water naturally present in potatoes for this to happen without any intervention needed. Try popping a sweet potato in your microwave for a few minutes– fast, easy, and healthy!

Microwave potatoes until cooked, about six minutes. After cooking, cut the potatoes into small pieces that can be mashed with the back of a fork. Add and mash together the other ingredients.

For a tangy version, trying substituting plain yogurt for a portion of the sour cream. Different types of potatoes have different amounts of starch. Varieties with high starch content (e.g., russets, the brown ones with rough skin) turn out lighter and fluffier when baked and are generally better for baked or mashed potatoes. Lower-starch varieties (red or yellow potatoes, typically smaller and smooth-skinned) hold their shape better and are better suited for applications in which you want the potato to stay intact, such as potato salad. Of course, there's still a lot of room for personal preference.



"Drunken pears!"

POACHED PEARS IN RED WINE

2 medium pears
1 cup red wine
¼ teaspoon ground pepper

Poached pears are easy, tasty, and quick. And, at least compared to most desserts, they're relatively healthy, or at least until the vanilla ice cream and caramel sauce are added. Much of our enjoyment of fruit comes from not just their flavor but also their texture. Consider an apple that's lacking in crispiness or a banana that's been bruised and become mushy: without their customary texture, their appeal is lost. But this isn't always the case. Poaching fruits such as pears causes similar changes in the structure of the fruit's flesh, breaking down cell walls and affecting the bonds between neighboring cells to create a softer texture that's infused with the flavor of the poaching liquid.

In a shallow saucepan or frying pan, place the pears sliced lengthwise into eights or twelfths, and the wine and pepper.

Set the pan over medium to low heat, bringing the wine to a simmer and then poaching the pears for 5-10 minutes. Flip them halfway through, so that both sides spend some time facedown in the liquid. Remove the pears and discard the liquid. Or you can reduce the liquid down to a syrup.

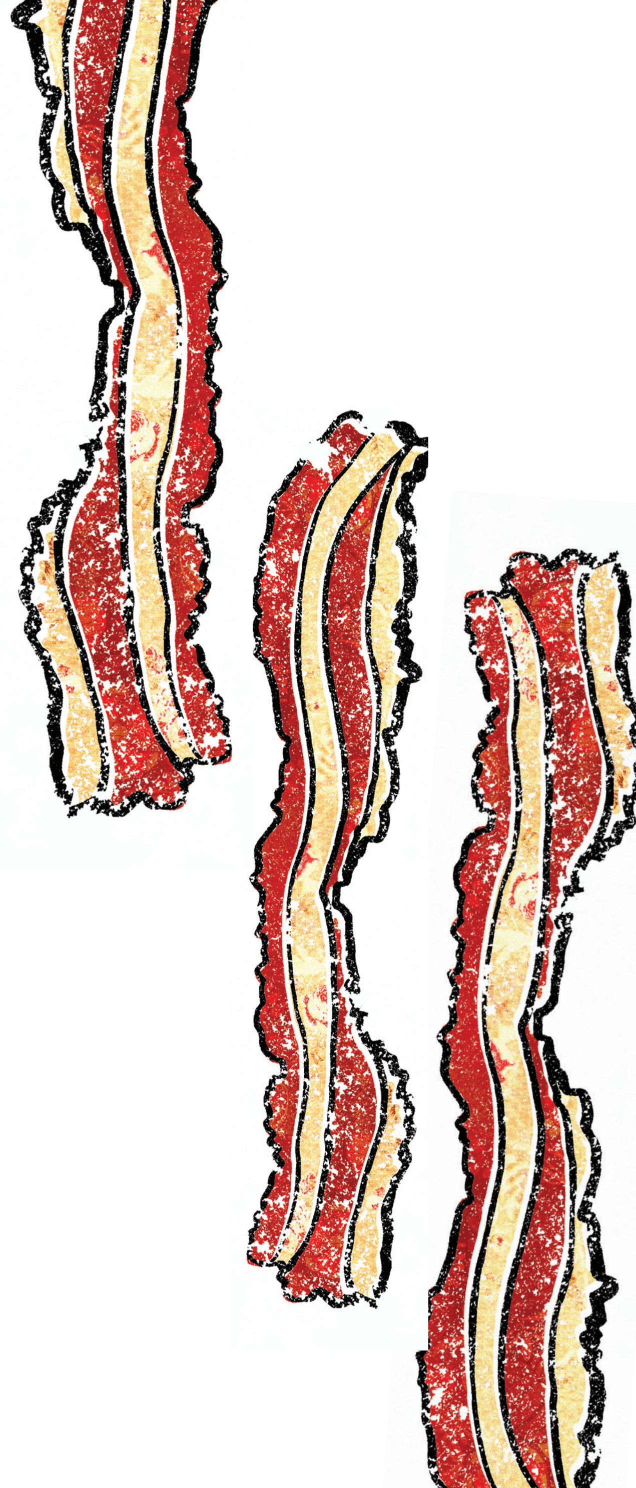
310°F: Maillard Reactions Become Noticeable

The Maillard reaction turns foods brown and generates mostly pleasant volatile aromatic compounds. You can thank Maillard reactions for the nice golden-brown color and rich aromas of a Thanksgiving turkey, Fourth of July hamburger, and Sunday brunch bacon. If you're still not able to conjure up the tastes brought about by Maillard reactions, take two slices of white bread and toast them– one until just before it begins to turn brown, the second until it has a golden-brown color– and taste the noticable difference.

The nutty, toasted, complex flavors generated by the Maillard reaction are created by the hundreds of compounds formed when amino acids and certain types of sugars combine and then break down. Named after the French chemist Louis Camille Maillard, who first described it in the 1910's, the Maillard reaction is specifically a reaction between amino acids (from proteins) and reducing sugars, which are sugars that form aldehydes or ketone- based organic compounds in an alkaline solution (which allows them to react with the amines). Glucose, the primary sugar in muscle tissue, is a reducing sugar; sucrose (common table sugar) is not.

Maillard reactions aren't solely dependent on temperature. Besides temperature, there are a number of other variables that affect the reaction rate. More alkaline foods undergo Maillard reactions more easily. Egg whites, for example, can undergo Maillard reactions at the lower temperatures and higher pressure found in a pressure cooker. The amount of water and the types and availability of reactants in the food also determine the rate at which Maillard reactions will occur. It's even possible for Maillard reactions to happen at room temperature, given sufficient time and reagents: self-tanning products work via the same chemical reaction!

All things considered, though, in culinary applications– cooking at moderately hot temperatures for short periods of time– the 310°F temperature given here serves as a good marker of when Maillard reactions begin to occur at a noticeable rate, whether you're looking through your oven door or sautéing on the stovetop.



SEARED SCALLOPS

Scallops are one of those surprisingly easy but often overlooked items. Sure, fresh scallops are expensive, but you only need a few for a quick appetizer or part of a meal.

Prepare the scallops for cooking by patting them dry with a paper towel and placing them on a plate or cutting board. If your scallops still have their bases attached, peel them off using your fingers and save them for some other purpose.

Place a frying pan over medium-high heat. Once the pan is hot, melt about 1 tablespoon of butter– enough to create a thick coating– in the pan. Using a pair of tongs, place the scallops, flat side down, into the butter. They should sizzle when they hit the pan; if they don't, turn the heat up.

Let them sear until the bottoms begin to turn golden brown, about two minutes. Don't poke or prod the scallops while they're cooking; otherwise, you'll interfere with the heat transfer between the butter and scallop flesh. Once the first side is done cooking (you can use the tongs to pick one up and inspect its cooked side), flip the scallops to cook on the second flat side, again waiting until golden brown, about two minutes. When you flip them, place the scallops on areas of the pan that didn't have scallops on them before. These areas will be hotter and have more butter; you can take advantage of this to cook the scallops more readily.

Try serving these scallops on top of a small simple salad– say, some arugula & rocket tossed with a light balsamic vinegar dressing and some diced shallots and radishes.

If you're not sure if the scallops are done, transfer one to a cutting board and cut it in half. You can hide the fact that you checked for doneness by slicing all of the pieces in half and serving them this way. This lets you check that they're all done as well.

You can dredge the uncooked scallops in bread-crumbs or another light, starchy coating. If you have wasabi peas, use either a mortar and pestle or blender to grind and transfer them to a plate for dredging the scallops.

356°F: Sugar Begins to Visibly Caramelize

Unlike the Maillard reaction, which requires the presence of both amino acids and sugars and has a number of interdependent variables influencing the particular temperature of reaction, caramelization (the decomposition via dehydration of sugar molecules such as sucrose) is relatively simple, at least by comparison. Pure sucrose melts at 367°F; decomposition begins at lower temperatures (somewhere in the range of 320–340°F and continues up until around 390°F.)

Melting is not the same thing as decomposition– sucrose has a distinct melting point, which can be used as a clever way of calibrating your oven. Like the Maillard reaction, caramelization results in hundreds of compounds being generated as a sugar decomposes, and these new compounds result in both browning and the generation of enjoyable aromas in foods such as baked goods, coffee, and roasted nuts.

For some foods, these aromas, as wonderful as they might be, can overpower or interfere with the flavors brought by the ingredients, such as in a light gingersnap cookie or a brownie. For this reason, some baked goods are cooked at 350°F or even 325°F so that they don't see much caramelization, while other foods are cooked at 375°F or higher to facilitate it.

When cooking, ask yourself if what you are cooking is something that you want to have caramelize, and if so, set your oven to at least 375°F. If you're finding that your food isn't coming out browned, it's possible that your oven is running too cold. If items that shouldn't be turning brown are coming out overdone, your oven is probably too hot.

Fructose, a simpler form of sugar found in fruit and honey, caramelizes at a lower temperature than sucrose, starting around 230°F. If you have other constraints on baking temperature (say, water content in the dough prevents it from reaching a higher temperature), you can add honey to the recipe. This will result in a browner product, because the largest chemical component in honey is fructose (~40% by weight; glucose comes in second at ~30%).

CARAMEL SAUCE

Caramel sauce is one of those components that seems complicated and mysterious until you make it, at which point you're left wondering, "Really, that's it?" Next time you're eating a bowl of ice cream, serving poached pears, or looking for a topping for brownies or cheesecake, try making your own.

Traditional methods for making caramel sauce involve starting with water, sugar, and sometimes corn syrup as a way of preventing sugar crystal formation. This method is necessary if you are making a sugar syrup below the melting point of pure sucrose, but if you are making a medium-brown caramel sauce– above the melting point of sucrose– you can entirely skip the candy thermometer, water, and corn syrup and take a shortcut by just melting the sugar by itself.

1 cup granulated sugar
1 cup heavy cream

In a skillet or large pan over medium-high heat the sugar.

Keep an eye on the sugar until it begins to melt, at which point turn your burner down to low heat. Once the outer portions have melted and begin to turn brown, use a wooden spoon to stir the unmelted and melted portions together to distribute the heat more evenly and to avoid burning the hotter portions.

Once all the sugar is melted, slowly add the cream while stirring or whisking to combine. This thing is a calorie bomb: 1,589 calories between the cup of heavy cream and cup of sugar. It's so good, though!

Some recipes call for adding corn syrup to the sugar as you heat it. This is because the sucrose molecules, which have a crystalline structure, can form large crystals and chunk up in the process of heating. The corn syrup inhibits this. If you heat the plain sugar with a watchful eye and don't stir it until it gets hot enough, the corn syrup isn't necessary. (It would be necessary, however, if you were only heating the sugar to lower temperatures– temperatures below the melting point– for other kinds of candy making.) Try adding a pinch of salt or a dash of vanilla extract or lemon juice to the resulting caramel.

Different temperature points in the decomposition range yield different flavor compounds. For a more complex flavor, try making two batches of caramel sauce, one in which the sugar has just barely melted and a second where the caramel sauce is allowed to brown a bit more. The two batches will have distinctly different flavors; mixing them together (once cooled) will result in a fuller, more complex flavor.

Sucrose has a high latent heat– that is, the sugar molecule is able to move and wiggle in many different directions. Because of this, sucrose gives off much more energy when going through the phase transition from liquid to a solid, so it will burn you much, much worse than many other things in the kitchen at the same temperature range. There's a reason pastry chefs call this stuff "liquid Napalm."

Air

BAKING'S KEY VARIABLE

If time and temperature are the key variables in cooking, air is the key variable in baking. While few of us would list air as an ingredient, it's critical to many foods. Most baked goods rely on air for their texture, flavor, and appearance. Baking powder and baking soda generate carbon dioxide, giving rise to cakes and quick breads. Air bubbles trapped in whisked egg whites lift soufflés, lighten meringues, and elevate angel food cakes. And yeast provides texture and adds complex flavors to bread and beer alike.

Unlike cooking, in which the chemical reactions are almost always in balance from the start–a chef rarely needs to tinker with ratios to get a protein to set–baking requires a well-balanced ratio of ingredients from the get-go to trigger the chemical reactions that create and trap air. Achieving this balance is often about precise measurements at the beginning, and unlike most meat and potato dishes, it's virtually impossible to adjust the composition of baked goods as they cook. And as a further challenge, the error tolerances involved in baking are generally much tighter than those in cooking.

If you're the meticulous type–methodical, enjoy precision, prefer a tidy environment–or the type of person who likes to express affection through giving food, you'll probably enjoy baking more than cooking. On the other hand, if you have a wing-it-as-you-go, adapting-on-the-fly style, cooking is more likely to be your thing. But even if baking isn't your thing, the engineering behind it can be fascinating, and plenty of applications in the "winging it" category can benefit from understanding the techniques discussed here.

GLUTEN

Light, fluffy foods need two things: air and something to trap that air. This might seem obvious, but without some way of holding on to air while cooking, baked goods would be flat. This is where gluten comes in.

Gluten is created when two proteins, glutenin and gliadin, come into contact and form what chemists call cross-links: bonds between two molecules that hold them together. In the kitchen, this cross-linking is done by kneading doughs, and instead of talking about cross- links, bakers speak of developing the gluten: the two proteins bind and then the resulting gluten molecules begin to stick together to form an elastic, stretchy membrane. The same stretchy, elastic property is also responsible for helping trap air bubbles in bread doughs: the gluten forms a 3-D mesh that traps air generated by organisms such as yeast and chemicals like baking powder.

Regardless of the rising mechanism, understanding how to control gluten formation will vastly improve your baked goods. Do you want air bubbles to be trapped in the food, or do you want them to escape as the food is cooked? Breads and cakes rely heavily on air for texture, while cookies need less.

The easiest way to control the amount of gluten developed is to use ingredients that have more (or less) of the glutenin and gliadin proteins. Wheat, of course, is the most common source of gluten; rye and barley also have these proteins in small quantities. For practical purposes, though, wheat flour is the primary source of gluten.

Here are three important things to keep in mind when working with gluten:

FATS INTERFERE WITH THE FORMATION OF GLUTEN.

This is why cookies, which have a lot of flour but also a lot of butter, still manage to crumble. And the opposite is true for water, which helps with gluten formation. The more water there is– up to a point, we're not talking soup here– the more likely it is that glutenin and gliadin will bind.

USE THE APPROPRIATE FLOUR.

Different types of wheat flours have different levels of gluten. Cake flour is low in gluten; bread flour is high in gluten. (All-purpose flour should really be called "general compromise" flour: it just takes the middle ground, which is fine when gluten levels aren't so important.) If you're baking something that would suffer from the elastic texture brought about by gluten– that should have a crumbly texture such as a chocolate cake– use cake or pastry flours, and definitely avoid bread flour. Fat inhibits gluten formation; water aids it.

MECHANICAL AGITATION & TIME DEVELOP GLUTEN.

Mechanical agitation (a.k.a. kneading)– physically ramming the glutenin and gliadin proteins together– increases the chances for those crosslinks to form and thus increases the amount of gluten in the food. Time, too, develops gluten, by giving the glutenin and gliadin the opportunity to eventually crosslink as the dough subtly moves.

When making breads, gluten impacts the texture not just with its stretchy, elastic quality, but also with its ability to trap and hold on to air. If you're making a loaf of bread using whole wheat flour or grains low in gluten, adding some bread flour (start with 50% by weight) will result in a lighter loaf. You can also add gluten flour, which is wheat flour that has had bran and starch removed (yielding a 70%+ gluten content). Try making a loaf of whole wheat bread with 10% of the flour (by weight) replaced with gluten flour (sometimes called vital gluten flour).

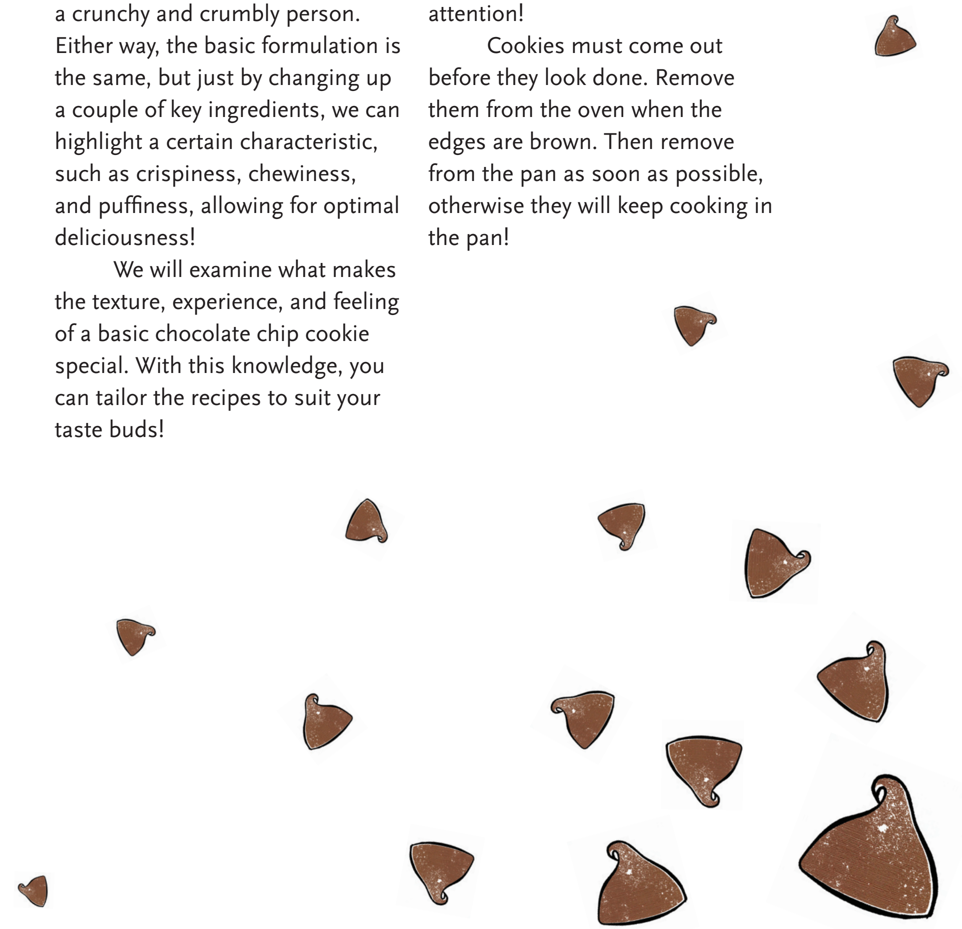
Three Types of Chocolate Chip Cookies

What kind of cookies do you like? Light and airy? Or dense and chewy? Maybe you're more of a crunchy and crumbly person. Either way, the basic formulation is the same, but just by changing up a couple of key ingredients, we can highlight a certain characteristic, such as crispiness, chewiness, and puffiness, allowing for optimal deliciousness!

We will examine what makes the texture, experience, and feeling of a basic chocolate chip cookie special. With this knowledge, you can tailor the recipes to suit your taste buds!

All three of these recipes call for a similar methodology but have some key differences. So pay close attention!

Cookies must come out before they look done. Remove them from the oven when the edges are brown. Then remove from the pan as soon as possible, otherwise they will keep cooking in the pan!



THE THIN

2 sticks unsalted butter
2 ¼ cups all-purpose flour
1 cup sugar
½ cup brown sugar
1 teaspoon kosher salt
1 teaspoon baking soda
1 egg
2 ounces milk
1 ½ teaspoons vanilla extract
2 cups semisweet chocolate chips

Heat oven to 375 degrees F. Sift together the flour, salt, and baking soda in a mixing bowl. Combine the egg, milk, and vanilla and bring to room temperature in another bowl.

Cream the butter in the mixer's work bowl, starting on low speed to soften the butter. Add the sugars. Increase the speed, and cream the mixture until light and fluffy. Reduce the speed and add the egg mixture slowly. Mix until well combined.

Slowly add the flour mixture, scraping the sides of the bowl until thoroughly combined. Stir in the chocolate chips. Scoop onto parchment-lined baking sheets, 6 cookies per sheet. Bake for 13 to 15 minutes, checking the cookies after 5 minutes.

THE PUFFY

1 cup butter-flavored shortening
2 ¼ cups cake flour
¾ cup sugar
1 cup brown sugar
1 teaspoon kosher salt
1 ½ teaspoons baking powder
2 eggs
1 ½ teaspoons vanilla extract
2 cups semisweet chocolate chips

Heat oven to 375 degrees F. Combine the shortening, sugar, and brown sugar in the mixer's work bowl, and cream until light and fluffy. In the meantime, sift together the cake flour, salt, and baking powder and set aside.

Add the eggs 1 at a time to the creamed mixture. Then add vanilla. Increase the speed until thoroughly incorporated.

With the mixer set to low, slowly add the dry ingredients to the shortening and combine well. Stir in the chocolate chips. Chill the dough. Scoop onto parchment-lined baking sheets, 6 per sheet. Bake for 13 minutes or until golden brown and puffy, checking the cookies after 5 minutes. Rotate the baking sheet for even browning.

THE CHEWY

2 sticks unsalted butter
2 ¼ bread flour
¼ cup granulated sugar
1 ¼ cup light brown sugar
1 teaspoon kosher salt
1 teaspoon baking soda
1 large egg
1 large egg yolk
2 tablespoons whole milk
1 ½ teaspoons vanilla extract
2 cups semisweet chocolate chips

Melt the butter in a 2-quart saucepan over low heat. Set aside to cool.

Sift together the flour, salt and baking soda onto a paper plate. Pour the butter into your stand mixer's work bowl. Add the sugar and brown sugar and beat with the paddle attachment on medium speed for 2 minutes.

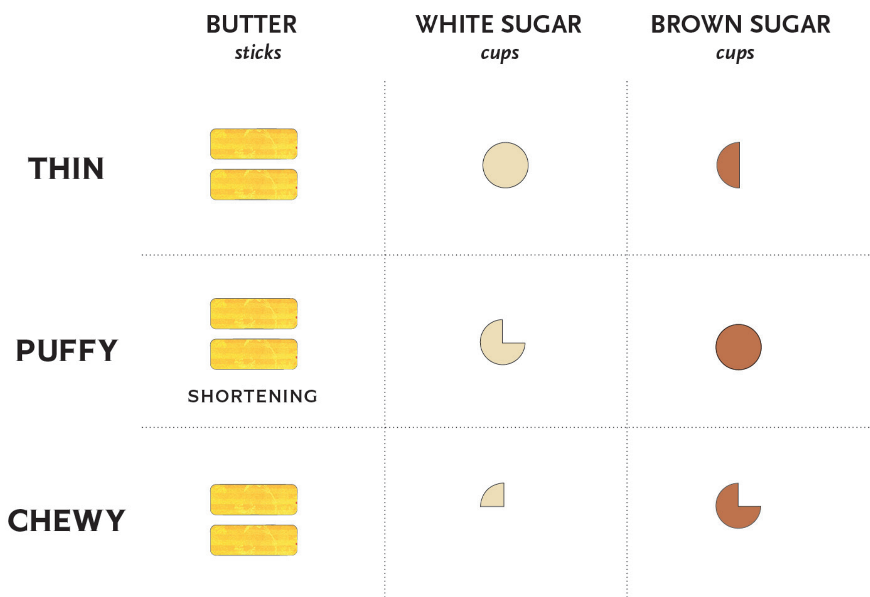
Meanwhile, whisk together the whole egg, the egg yolk, milk and vanilla extract in a measuring cup. Reduce the mixer speed and slowly add the egg mixture.
Mix until thoroughly combined, for 30 seconds.

Using the paper plate as a slide, gradually integrate the dry ingredients, stopping a couple of times to scrape down the sides of the bowl. Once the flour is worked in, drop the speed to "stir" and add the chocolate chips. Chill the dough for 1 hour.

Preheat the oven to 375°F and place racks in the top third and bottom third of the oven.

Scoop the dough into 2 tablespoon portions onto parchment-lined half sheet pans, 6 cookies per sheet. Bake 2 sheets at a time for 15 minutes, rotating the pans halfway through.

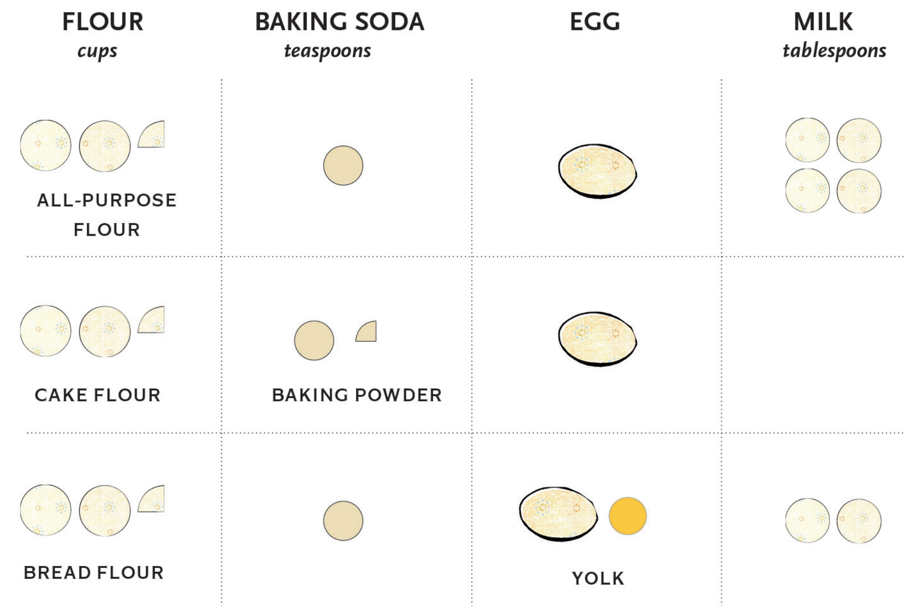
Cookie Chemistry



Shortening melts at a higher temperature than butter, so it remain solid longer. This gives the batter time to rise and set before it spreads.

The higher white to brown sugar ratio also adds crispiness.

The darker the sugar you use, the chewier they will be, due to the molasses. Molasses loves moisture and will attract moisture from the air, keeping them moist and chewy!



The lower protein cake flour will soak up less moisture making it available for steam production. The steam will lift the batter in the oven, making a puffier, cake like batter.

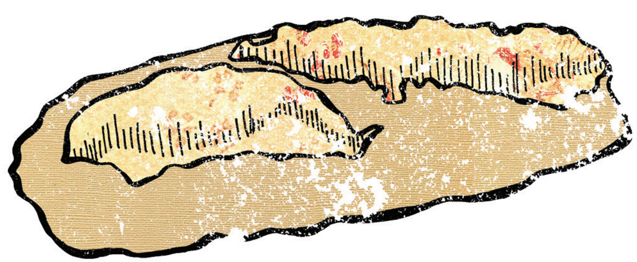
Bread flour absorbs more moisture than AP and has more gluten, so the cookie will stay moist and chewy!

Baking soda reduces the acidity of the batter, which then raising the temperature at which the batter sets. So increasing the baking soda by half will result in a thinner, crispier cookie.

Egg whites dry out baked goods, so adding yolks and taking out the whites will add to it's moistness.

BIOLOGICAL LEAVENERS

Biologically based leaveners—primarily yeast, but also bacteria for salt-rising breads—are surely the oldest method for generating air in foods. Presumably, a prehistoric baker first discovered that a bowl of flour and water left out will begin to ferment as yeast from the surrounding environment settles in it.



Yeast

Yeast is a single-celled fungus that enzymatically breaks down sugar and other sources of carbon to release carbon dioxide, ethanol, and other compounds, giving drinks their carbonation, spirits their alcohol, and beer and bread their distinctive flavors. Even making chocolate involves yeast—the cocoa beans are fermented, which generates the precursors to the chocolate flavor.

Different strains of yeast create different flavors. Over the years we've "domesticated" certain strains by selective breeding—from common baker's yeast for bread and wine (Saccharomyces cerevisiae) to those for beer (usually S. carlsbergensis, a.k.a. S. pastorianus).

Since there's plenty of yeast literally floating around, you don't have to directly spike your brew or seed your bread with yeast. New strains of yeast usually start out as wild hitchhikers, and sometimes they taste great. Traditionally winemakers relied on ambient yeasts present in their cellars or even on the grapes themselves.

However, the "Russian roulette yeast method" might not end so well when you're working in your kitchen: there's a decent chance you'll end up with a nasty and foul strain of yeast that'll generate unpleasant-tasting sulfur and phenol compounds. This is why you should add a "starter" strain: providing a large quantity of a particular strain ensures that it will outrace any other yeasts that might be present in the environment.

Like any living critter, yeast prefers to live in a particular temperature zone, with different strains preferring different temperatures. The yeast commonly used in baking breads—aptly named baker's yeast— does best at room temperature (55–75°F). In brewing beer, ales and stouts are made with a yeast that is similar to baker's yeast; it also thrives at room temperature. Lagers and steam beer use a bottom-fermenting yeast that prefers a cooler environment around 32–55° F. Keep in mind the temperature range that the yeast you're using likes, and remember: too hot, and it'll die.

YEAST IN BREADS

Baker's yeast comes in three varieties: instant, active dry, and fresh. All three types are the same strain: Saccharomyces cerevisiae. The instant and active dry versions have been dried so as to form a protective shell of dead yeast cells surrounding some still-living cells. Fresh yeast—also called cake yeast because it is sold in a compressed cake form—is essentially a block of the yeast without any protective shell, giving it a much shorter shelf life (well, fridge life): cake yeast is good for about two weeks in the fridge, whereas instant yeast is good for about a year and active dry yeast is good for about two years in the cupboard.

Instant and active dry yeast are essentially identical, with two differences. First, active dry yeast has a thicker protective shell around it. This gives it a longer shelf life, but it also means it must be soaked in water before use to soften up the protective shell. The second difference is that the quantity of active yeast cells in active dry yeast is lower than in instant yeast, because the thicker protective shell takes up more space: when a recipe calls for 1 teaspoon of active dry yeast, you can substitute in ¾ teaspoon of instant yeast.

Instant yeast is the easiest to work with: add it directly into the dry ingredients and mix. Unless you have reason to work with active dry or cake yeast, use instant yeast. Remember to store it in the fridge!

YEAST IN BEVERAGES

Wine, beer, and traditional sodas all depend on yeast to ferment sugar into alcohol and generate carbonation.

Selecting the appropriate strain of yeast and controlling the breeding environment—providing food, storing at proper temperatures— allows for the creation of our everyday drinks.

Some of these are easier processes to control than others. Wine, for example, is relatively straightforward, with few variables: vary the sugar level to control the amount of yeast activity and choose the grapes and strain of yeast per your desired type of wine (trace elements in the grapes themselves are usually responsible for the flavor and aromas in wine). Beer has more variables to play with: in addition to sugar levels, proteins and saccharides have to be controlled to correctly balance viscosity and head, and the bitterness of the hops has to be managed.

CHEMICAL LEAVENERS

While yeast allows for the creation of many delicious foods, it has two potential drawbacks: time and flavor. Commercial bakers with high volumes and those of us with limited time to play in the kitchen can't always afford to wait for yeast to do its thing.

Common Leaveners

Then there are the flavors and aromas generated by yeast, which would clash with the flavors in something like a chocolate cake. Chemical leaveners have neither of these problems and are divided into two categories.

BAKING SODA

A bicarbonate (HCO) that's bound with another molecule– typically sodium, but sometimes potassium and ammonium. When added to water, the bicarbonate dissolves and is able to react with acids to generate CO_2.

BAKING POWDER

A self-contained leavening system that generates carbon dioxide in the presence of water. Baking powders by definition contain a baking soda and acids for that baking soda to react with. The idea that these are categories, not single ingredients, is probably foreign to most home cooks, but the chemicals that make up a baking powder or baking soda can vary. Industrial food manufacturers use different compositions and particulate sizes depending upon the food being produced.

QUICK & EASY PIZZA

If there's one stereotypical geek food, it would have to be pizza: ubiquitous, cheap, and cheesy. But the stuff sold in your local strip mall is far inferior to what you can make at home. It's like the difference between canned fruit and the fresh thing: both can be good, but the fresh version is distinctly more nuanced.

Start by making pizza dough. You can also buy pizza dough at your grocery store or make it yourself! Set out a large cutting board and sprinkle a handful of flour in the center area. Preheat your oven to at least 450°F. Take about 1 lb of the dough and form it into a ball between your hands, kneading and folding it over. The dough should be just slightly sticky, but not so much that it actually remains stuck to your hand. If it's too sticky, add more flour by dredging it in the lour on the cutting board. Continue to work the dough until it reaches a firm consistency and has good elasticity when stretched. Begin to work the dough into a flat, round disc, and then roll it into a round pizza shape.

Par-bake the pizza dough by baking it on a pizza stone in a hot oven. You can transfer the pizza dough by carefully picking it up and laying it onto the stone; don't burn yourself! If you don't have a pizza stone, you can use a cast iron pan, upside down, to similar effect. Let the pizza bake for three to five minutes, until the dough has set. If the dough puffs up in one place, use a chef's knife to poke a small hole in the bubble and then use the flat side of the knife blade to push the puffed portion back down. Par-baking the dough isn't traditional, but it'll help avoid soggy, undercooked dough and also makes transferring the topped pizza into the oven a heck of a lot easier. It simplifies the cooking of the pizza, too: cook the dough until it's effectively ready, and then cook the toppings until they melt and fuse, as opposed to trying to get both to occur at the same time.

Once the pizza dough has been par-baked, remove it from the oven and place it on your cutting board. Add sauce and toppings. The sauce can be anything from a thin coating of olive oil to traditional tomato sauce. For toppings such as onions and sausage, sauté them before placing them on the pizza. Cooking the dough and toppings separately removes all the constraints associated with the various ingredients needing varying cooking times, leaving just three goals: melting the cheese to fuse the ingredients together, browning the edge of the crust, and browning the top surface of the toppings. Finish cooking by transferring the dressed pizza into the oven (using a pizza peel or, in a pinch, a piece of cardboard) and baking it until any cheese is melted and the pizza has begun to turn golden brown, about 8 to 12 minutes.

"Cheesy, bubbly, doughy, crispy, delicious & versatile!"

YEAST WAFFLES

Baker's yeast contains a number of enzymes, one of which, zymase, converts simple sugars (dextrose and fructose) into carbon dioxide and alcohol. It's this enzyme that gives yeast its rising capabilities. Zymase doesn't break down lactose sugars, though, so doughs and batters made with milk will end up tasting sweeter. This is why some bread recipes call for milk and why foods like yeast waffles come out with a rich, sweet flavor. At least two hours in advance, but preferably the night before, measure out and whisk together:

1 ¾ cups milk (whole, preferably)
½ cup melted butter
2 teaspoons sugar or honey
1 teaspoon salt (table salt)
2 ½ cups flour (all-purpose)
1 tablespoon instant yeast (not active dry)
2 large eggs

Cover and store at room temperature. Make sure to use a large bowl or container with enough headspace to allow the batter to rise. Briefly stir the batter and then bake in your waffle iron per instructions of your waffle iron manufacturer.

In baking, use table salt, not kosher or flake salt, because the salt will mix more uniformly into the batter. Try using honey, maple syrup, or agave nectar instead of sugar, and try substituting whole wheat flour or oat flour for half of the all-purpose flour.

If your waffles come out not as crispy as you like, toss them in an oven preheated to 250°F– hot enough to quickly evaporate out water, cold enough to avoid caramelization and Maillard reactions.

"Waffles are better than pancakes because you can fill all the squares with syrup!"

Baking Soda

Anyone who's done the third-grade science fair project using vinegar and baking soda to make a volcano can tell you that baking soda can generate a whole lot of gas really quickly. But in the kitchen, baking soda remains one of the bigger mysteries. How is it different from baking powder? And how do you know which one to use?

The quick answer would go something like: "Baking soda reacts with acid, so only use it when your ingredients are acidic." And as simple explanations go, this covers you 99% of the time when cooking. But baking soda is a little more complicated and interesting in a geeky way, so it's worth a brief digression into the chemistry. I promise this'll be short.

The baking soda you buy in the store is a specific chemical: sodium bicarbonate, $NaHCO_3$. Unlike baking powder, which is a blend of chemicals that are self-contained ("just add water and heat!"), when added to a dish, sodium bicarbonate needs something to react with in order to generate gas. Without something for sodium bicarbonate to dissolve into, it's an inert white powder. Upon getting wet– any moisture in any food will do– the sodium bicarbonate dissolves, meaning that the sodium ions are free to run around separately from the bicarbonate ions.

Most of us are familiar with the pH scale (the H stands for hydrogen; it's unclear what the p stands for, "power" and "potential" are the best guesses). The pH scale is a measure of the amount of available hydrogen ions in a solution. Chemicals that affect the number of hydrogen ions can be classified in one of two ways:

Acids (pH below 7): Proton donors; i.e., chemicals that increase the number of hydronium ions (H_3O+; the hydrogen binds with a water molecule) in the solution.

Bases (pH above 7): Proton receivers; i.e., chemicals that bind with hydronium ions, reducing their available concentration in a solution.

When it comes to pH, a bicarbonate ion has an interesting property that chemists call amphotericity: it can react with either an acid or a base. In the kitchen, so few things are actually basic– egg whites, baking soda, maybe the stuff in your ire extinguisher, and that's pretty much it– that you can safely ignore baking soda's ability to react with bases and just think of it as something that reacts with acids. Still, to understand baking soda, it's important to understand that bicarbonates react with other compounds and either raise the pH by reducing the amount of available acids or lower the pH by reducing the amount of available bases.

This phenomenon is called buffering: a buffer is something that stabilizes the pH level of a solution. Buffers hang out in the solution and, when an acid or base is added, glom on to it and prevent it from affecting the count of available hydronium ions. In a glass of pure water, there's not much for the bicarbonate ions from baking soda to interact with, so they just float around and taste generally nasty. But if you were to add a spoonful of vinegar– which is acetic acid– to that glass, the bicarbonate ions would react with the acetic acid and generate carbon dioxide.

Depending upon the amount of bicarbonate you started with, after you add the spoonful of vinegar the glass will be in one of three states (none of which involve being half-full or half-empty): bicarbonate ions still available but no acetic acid ions available, no bicarbonate ions available but acetic acid ions still available, or neither bicarbonate nor acetic acid ions freely available. In baking, it's this last state– a neutral balance– that we want to reach. Too much baking soda, and it won't all react with the acids in the food and will leave the food with a soapy, yucky taste. Not enough baking soda, and the food will remain slightly acidic (which is okay) and not have as much lift as possible (which is probably not okay– your food will be flat). To repeat one of my favorite quotes: "Dosage matters!"The reaction between baking soda and an acid is the key to understanding when you should use baking soda versus baking powder. This balancing act between acids and baking soda isn't a problem with baking powder, of course. This is because the baking powder is already balanced for you– the ratio of acids to bicarbonate is preset by the manufacturer.

If your ingredients aren't very acidic, baking soda won't have much to react with, so use baking powder. On the other hand, if your ingredients are extremely acidic, using baking soda will work, since there will be enough hydronium ions to react with. How much baking soda to use depends on the pH of the ingredients in your dish. Short of testing or calculating the pH, experimentation is the easiest way: take a guess and keep notes. Keep adding baking soda until the additional baking soda no longer helps with lift (or can be tasted). If you're still not getting enough lift at this point, switch to adding baking powder.

Baking Powder

Baking powder solves the "balancing act" problem encountered when using baking soda by including acids alongside the bicarbonates. And since the acids are specifically mixed into baking powder, they can be optimized for baking; you don't have to rely on whatever acids happen to be present in the food being made.

Baking powder, at its simplest, can be made with just one type of bicarbonate and one type of acid. This is why, in a pinch, you can make your own baking powder: 2 parts cream of tartar to 1 part baking soda. Cream of tartar–potassium hydrogen tartrate–will dissolve in water, freeing tartaric acid ($C_4H_6O_6$) to react with the sodium bicarbonate.

Commercial baking powders are a bit fancier than this, though. Different acids have different rates of reaction and reaction temperatures, so using multiple types of acid allows for the creation of a baking powder that's essentially time-released. This isn't just clever marketing: in baked goods, if the CO_2-generating reaction occurs too slowly, you'll end up with a dense, fallen product. And if those reactions happen too quickly, the food won't have time to properly set so as to be able to hold on to the gas, resulting in things like collapsed cakes with giant holes.

Double-acting baking powder– this is the stuff you'll find at the grocery store– uses both slow- and fast-acting acids to help prevent these types of problems. Fast-acting acids, such as tartaric acid (in cream of tartar) and monocalcium phosphate monohydrate, can work at room temperature low-acting acids, such as sodium aluminum sulfate, need heat and time to release CO_2. As long as the ratio of ingredients in your baked products is roughly correct and you're baking within an acceptable temperature range, baking powder is unlikely to be the culprit in failed baking experiments.

Still, if you're getting unexpected results with a commercial baking powder, check whether your ingredients are highly acidic. Acidity impacts baking powder; more acidic ingredients in a recipe will require less baking power. Even though commercial baking powders contain cornstarch, which absorbs moisture to extend the shelf life, the chemicals in baking powder will eventually react with each other. Standard shelf life is about six months after being opened.

MECHANICAL LEAVENERS

Mechanical leaveners work by trapping air within a liquid –usually by whipping egg whites, egg yolks, or cream–or by generating steam from water present in the food.

Unlike biological or chemical leavening methods, which rely on the chemical makeup of the food to generate air, mechanical rising techniques rely on the physical properties of the food to hold air. Because of this, mechanical leaveners can't just be added to a dish without considering the impact of the moisture or fat that they also add, which can throw of the ratios between ingredients such as lour and water or sugar and fats.

Egg Whites

Whisked egg whites are the Styrofoam of the culinary world: besides acting as space fillers in cakes, wales, and soufflés and as "insulators" in desserts like lemon meringue pie, when overcooked, they taste about the same as Styrofoam, too. All metaphors aside though, egg whites are much more forgiving than many cooks realize. With a little attention spent on understanding the chemistry and a bit of experimentation, egg-white foams are easy to master.

The key to understanding egg whites is to understand how foams themselves work. Whisking egg whites turns them into a light, airy foam by trapping air bubbles in a mesh of denatured proteins. Since regions of the proteins that make up egg whites are hydrophobic– literally, water-fearing– they normally curl up and form tight little balls to avoid interacting with the water. But when whisked, those regions of the proteins are slammed against air bubbles and unfold, and as more and more proteins are knocked against an air bubble, they form a layer around the bubble and essentially trap it in the liquid, creating a foam that's stable.

Oils– especially from egg yolks or any trace oils present in the whisking bowl– prevent egg whites from being whisked into a foam because they're also able to interact with the hydro- phobic sections of the proteins. Water and sugar don't interfere with the formation of protein-based foams for the same reason.

Once the air bubbles are encapsulated by the proteins in the egg white, it takes quite a bit of effort to get them to break. Exposing the whites to any oil before whisking is a problem; even a trace amount of fat from a small amount of stray egg yolk will interfere with the creation of the foam. But once the eggs are whisked, they're much more resilient. Try this experiment: whisk an egg white to soft peaks, then add ½ teaspoon olive oil and continue to whisk. It might surprise you how long it takes before the oil starts to noticeably interact with the foam, and even then, that the foam remains mostly stable.

MERINGUES

Egg whites, when whisked and combined with sugar, turn into a sweet, airy mixture suitable for folding into heavier bases, bringing a lightness and sweetness. Of course, sugar and egg whites are pretty good on their own– meringue cookies are nothing more than egg whites and sugar that have spent a little time in the oven. The sugar isn't just for taste, though; it helps stabilize the egg-white foam by increasing the viscosity of the water present in the foam, meaning that the cell walls in the foam remain thicker and are thus less likely to collapse. Net result? The meringue is better able to support the weight of anything you add into the foam.

FRENCH & ITALIAN MERINGUES

There are two general forms of meringues: those in which the sugar is directly added as the egg whites are whisked (French Meringue), and those in which the sugar is dissolved before the egg whites are whisked (Swiss and Italian Meringue– we'll cover Italian here, but they're similar). The French version tends to be drier (sugar is hydroscopic, sucking the moisture out of the whites– this is why it increases viscosity) and also grittier; the Italian version has a smoother, almost creamy texture.

FRENCH MERINGUE

3 egg whites
¾ cup of sugar

In a clean bowl, whisk egg whites to soft peak stage. Add the sugar– preferably super-fine sugar– one tablespoon at a time, while continuously whisking. If using regular sugar, you'll need to whisk longer to make sure the sugar is entirely dissolved. To check, roll a little bit of the meringue between two fingers (it shouldn't feel gritty).

ITALIAN MERINGUE

½ cup sugar
¼ cup water
3 egg whites

Create a simple syrup by heating in a saucepan sugar and water to 240°F. Set aside. In a clean bowl, whisk egg whites to soft peak stage. Slowly pour in sugar syrup while whisking continuously.

CHOCOLATE PORT CAKE

½ cup port (either tawny or ruby)
½ cup butter
3 oz bittersweet chocolate
4 large eggs
1 cup granulated sugar
¾ cup all-purpose flour
powdered sugar for decoration

One of the great things about this chocolate port cake– besides the chocolate and the port– is the recipe's wide error tolerances. Most foam cakes are very light (think angel food cake). The reason this recipe is so forgiving is that it uses a foam without trying to achieve the same lightness. You'll need a round baking pan or springform pan, 6–8." In a saucepan (over a burner set to low heat), melt and mix together.

Once butter is melted, turn off heat, remove pan from burner, and add chocolate, chopped into small pieces to facilitate melting.

Leave the chocolate to melt in the port/butter mixture. In two bowls, separate the eggs. Make sure to use a clean glass or metal bowl for the egg whites, and be careful not to get any egg yolk into the whites. Whisk the egg whites to stiff peaks. In the bowl with the egg yolks, add the sugar.

Whisk the egg yolks and sugar together until thoroughly combined. The yolks and sugar should become a slightly lighter yellow after whisking for a minute or so. Pour the chocolate mixture into the egg yolk & sugar mixture and whisk to thoroughly combine.

Using a flat wooden spoon or flat spatula, add to the chocolate mixture and fold in (but do not overstir!) the flour. Then fold in the egg whites in thirds. That is, transfer about a third of the whisked egg whites into the chocolate mixture, mix together, and then repeat twice more. Don't worry about getting the whites perfectly incorporated, although the batter should be relatively well mixed together.

Grease your cake pan with butter and line the bottom with parchment paper, so as to make removing the cake from the pan easier. Transfer the mix to the cake pan and bake in an oven preheated to 350°F until a toothpick or knife, when poked into the center, comes out clean, around 30 minutes.

Let cool for at least 10 to 15 minutes, until the edges have pulled away from the sides. Dust with powdered sugar with a strainer above the cake.

MERINGUE COOKIES

3 egg whites
¾ cup of sugar
additional treats: ground almonds, chocolate chips, dried fruit, or cocoa powder

To make meringue cookies, start with either egg-white meringue recipe. Optionally fold into the meringue whatever ingredients you'd like– ground almonds, chocolate chips, dried fruit, cocoa powder. Using a spoon or piping bag, portion the meringue onto a cookie sheet lined with parchment paper. Bake in an oven preheated to 200°F for a few hours, until they freely come off the parchment paper.

Egg Yolks

If Eskimos have N words for describing snow, the French and Italians have N+1 words for describing dishes involving egg yolks. A number of these dishes use egg yolks to create light, airy foams by trapping air bubbles.

Egg yolks are much more complex than egg whites: ~51% water, ~16% protein, ~32% fat, and ~1% carbohydrates, while egg whites are only protein (~11%) and water. In their natural state, egg yolks are an emulsion.

An emulsion is a mixture of two liquids that are immiscible–that is, unable to mix (think oil and water). Mayonnaise is the classical culinary example. Egg yolks are an emulsion, too: the fats and water are held in suspension by some of the proteins, which act as emulsifiers– compounds that can hold immiscible liquids in suspension.

Like egg-white foams, egg-yolk foams trap air with denatured proteins that form a mesh around air bubbles. Unlike whites, though, the only way to denature the proteins in the yolk is with heat; the optimal temperature for egg-yolk foam creation is 162°F. Too hot, though, and the proteins coagulate, leading to a loss of air and affecting the texture.

SIMPLE WHITE WINE CHEESE SAUCE

3 eggs
¼ cup white wine
Parmesan cheese

This sauce needs very few ingredients and not much in the way of equipment–a whisk, a bowl, and a stovetop–making it an easy impromptu dish even in an unfamiliar kitchen. The only tricky part is preventing the eggs in this sauce from getting too hot and scrambling. If you have a gas burner, this can be done by moving the saucepan on and off a lame set to very low heat. Position yourself so that you can hold the pan with one hand while whisking with the other; you'll need to move the pan to regulate the temperature. If you have an electric burner, use a double-boiler instead: fill a large saucepan with water and place the saucepan with the mixture inside it.

In a saucepan, separate the yolks, saving the egg whites for some other dish. Add ¼ cup white wine and whisk to combine.

Once you're ready to start cooking, place the pan over the lame or in the water bowl bath and whisk continuously until the egg yolks have set and you have a frothy foam, about two to three times the volume of the original. This can take 5 to 10 minutes; have patience, it's better to go too slow than too quick. Add 2 to 3 tablespoons freshly grated Parmesan cheese and whisk until thoroughly combined. Add salt and pepper to taste, and serve on top of an entrée such as fish with asparagus.

BUTTER 20% fat

CLOTTED CREAM

DOUBLE CREAM

HEAVY CREAM

WHIPPING CREAM

LIGHT CREAM

HALF & HALF

WHOLE MILK

Percentage of Fat by Volume

When whipping cream, you need at least a 30% fat content. If the cream doesn't have enough fat globules to create a stable foam. Whipping high-quality cream increases its volume by 80% , but egg white can expand by over 600%! And remember, "fat is flavor," so don't skimp on the lipids in mashed potatoes, baked goods, or sweets!

Whipped Cream

Unlike eggs, in which proteins provide the structure for foam, cream relies on fats to provide the structure for a foam when whipped. During whisking, fat globules in the cream lose their outer membranes, exposing hydrophobic portions of the molecules. These exposed parts of the fat globules either bind with other fat globules or align themselves to orient the stripped region with an air bubble, forming a stable foam once enough of them have been aggregated together.

When working with whipped cream, keep in mind that the fats provide the structure. If the cream gets too warm, the fats will melt. This is why whipped cream can't be used to provide lift in most baked goods: the cream will melt before the starches and gluten in the flour can trap the air. Be sure to chill your bowl and the cream before whisking.

CHOCOLATE MOUSSE (WHIPPED CREAM VERSION)

4 oz of bittersweet chocolate
2 tablespoons of butter
2 tablespoons of cream
1 cup of whipping or heavy cream
4 tablespoons of sugar

Melt the chocolate in a microwave-safe bowl. Add the butter and cream and whisk to combine. Place in fridge to cool. In a chilled bowl, whisk the whipping or heavy cream with some sugar to soft peaks.

Make sure the chocolate mixture has cooled down to at least room temperature. Fold the whipped cream into the chocolate mix. Transfer mousse to individual serving glasses and refrigerate for several hours; overnight, preferably. Try replacing the 2 tablespoons of cream with 2 espresso, Grand Marnier, cognac, or another flavoring liquid.

CHOCOLATE MOUSSE (WHIPPED EGG WHITE VERSION)

½ cup of whipping or heavy cream
4 oz of bittersweet chocolate
4 eggs
4 tablespoons of sugar

In a saucepan, heat the cream to just below a boil and turn off heat. Add the chocolate that's been chopped into small chunks. Separate the eggs, putting 2 of the yolks into the saucepan and all the whites into a clean bowl for whisking. Save the other 2 yolks for a different recipe. Whisk the egg whites with the sugar to soft peaks.

Whisk the cream, chocolate, and yolks together to combine. Fold the whites into the sauce. Transfer mousse to individual serving glasses and refrigerate for several hours—overnight, preferably. The egg whites in this are uncooked, so there is a chance of salmonella. While it's rare in chicken eggs in the United States, if you are concerned, use pasteurized egg whites.

Cooking Around Allergies

SUBSTITUTIONS FOR COMMON ALLERGIES

So, you've just found out that someone you're cooking for is allergic to an ingredient in your favorite family dish. What to do?

This section includes a number of suggestions for ingredient substitutions for the eight most common allergies. This list contains many of the common ingredients and foods to avoid, but you should still check any questionable ingredients with your guests.

Food allergies are caused by an immune system response to certain types of proteins. In some individuals, the immune system misidentifies certain proteins as harmful and generates a histamine reaction in response to them. Immune reactions can occur within a few minutes to several hours of ingesting the offending food item. Minor reactions include a tingling sensation on the tongue or lips, itchy eyes, runny nose, or skin rashes lasting from a few hours to a day. More extreme reactions include throat constriction, nausea, vomiting, diarrhea, or coughing. Oh, and death.

If you ever encounter a reaction that involves tongue swelling, throat constriction, or restricted breathing– hallmarks of an anaphylactic reaction– call 911 and get to a hospital immediately, because the swelling can increase to the point where it cuts of the airway. Those who know that they have particularly strong allergies will often carry an Epipen, a small pen-sized medical device that auto-injects epinephrine to control the allergic reaction. Since an allergy is a response to a particular protein in food, not the food itself, and because some types of proteins denature below the temperature at which the foods containing them are cooked, certain allergies apply only to uncooked foods. Your guests will be able to tell you their particular constraints.

When shopping for a meal to cook for someone with an allergy, be sure to read the labels on any packaged goods you consider. Also, be careful if you are reusing components or sauces from previous meals, because things like soy and nuts can show up in unexpected places.

Dairy Allergies

INGREDIENTS TO AVOID
Casein, whey, whey solids, buttermilk solids, curds, milk solids, lactalbumin, caseinate, sodium caseinate.

FOODS COMMONLY CONTAINING DAIRY
Milk, buttermilk, chocolate, hot chocolate, "nondairy" creamers, baked goods, spreads including butter and many margarines, cheeses, yogurts, frozen yogurts, frozen desserts such as ice cream, sherbets, some sorbets, & whipped toppings.

FOR YOGURT
If you're a yogurt fan, check out soy yogurt or coconut milk yogurt. Try using it as a dip for fruit, or buy plain and use it to make a creamy salad dressing.

FOR MILK
Soy, rice, potato, almond, oat, hemp, and coconut milk are all possible substitutes for cow's milk. If you aren't dealing with a soy allergy as well, soy milk is a good option; it tastes pretty good and, when fortified, contains roughly the same amount of calcium and vitamin D (two important nutrients, especially for children). Rice milk is also often fortified and, like soy milk, can usually be found at the regular grocery store. Potato milk is available in specialty food stores in powder form.

FOR MARGARINE
When searching for a dairy-free margarine, be sure to examine the product labels carefully and make sure the ingredient list does not contain "milk derivatives." Also bear in mind that most "light" margarines are not suitable for baking. Look for Earth Balance Light and Fleischmann's Unsalted Margarine brands.

Egg Allergies

INGREDIENTS TO AVOID
Albumin, globulin, lysozyme, livetin, silici albuminate, Simplesse, vitellin, meringue, ingredients containing the word "egg" such as egg white, ingredients that begin with "ovo" (Latin for "egg").

FOODS COMMONLY CONTAINING EGGS
Baked goods (cookies, cakes, muffins, breads, crackers), desserts (custards, puddings, ice creams), battered foods (fish and chicken nuggets), meatballs, meatloaf, pastas, sauces, dressings, soups. While dishes like omelets and egg salads are out, you can still achieve reasonable results in baked goods. Eggs provide air and leavening in cakes, add structure to breads and cakes, and supply liquid in cookie doughs, cakes, and muffin batters. Determine which functions the egg provides in the baked item and experiment with using one of the following alternatives.

TO REPLACE ONE EGG IN BAKING
Baking powder, water, and oil. Whisk together until foamy: 1 ½ tablespoons oil, 1 ½ tablespoons warm water, and 1 teaspoon baking powder.

ENERG FOODS EGG REPLACER
Whisk with water until fluffy; then add to your mixture. This is a great all-purpose egg substitute.

FRUIT PUREE
In some cases, you can use a quarter cup of puréed banana or apple. Experiment!

FLAXSEED MEAL
Mix 1 tablespoon flaxseed meal with 3 tablespoons warm water; let sit for 10 minutes. It does have a strong flavor, so does not work as an all-purpose egg replacement, but can be useful in cakes, pumpkin bars, oatmeal applesauce cookies, and muffins.

UNFLAVORED GELATIN
Mix 1 teaspoon unflavored gelatin with 1 tablespoon warm water. You should be able to ind unflavored gelatins in your grocery store near the flavored gelatin (like Jell-O).

Peanut Allergies

INGREDIENTS TO AVOID
Peanuts, peanut butter, peanut starch, peanut lour, pea- nut oil, mixed nuts, crushed nuts, hydrolyzed plant protein, hydrolyzed vegetable protein, vegetable oil (if the source isn't specified), and depending upon the severity of the allergy, anything that states "may contain trace amounts of peanuts."

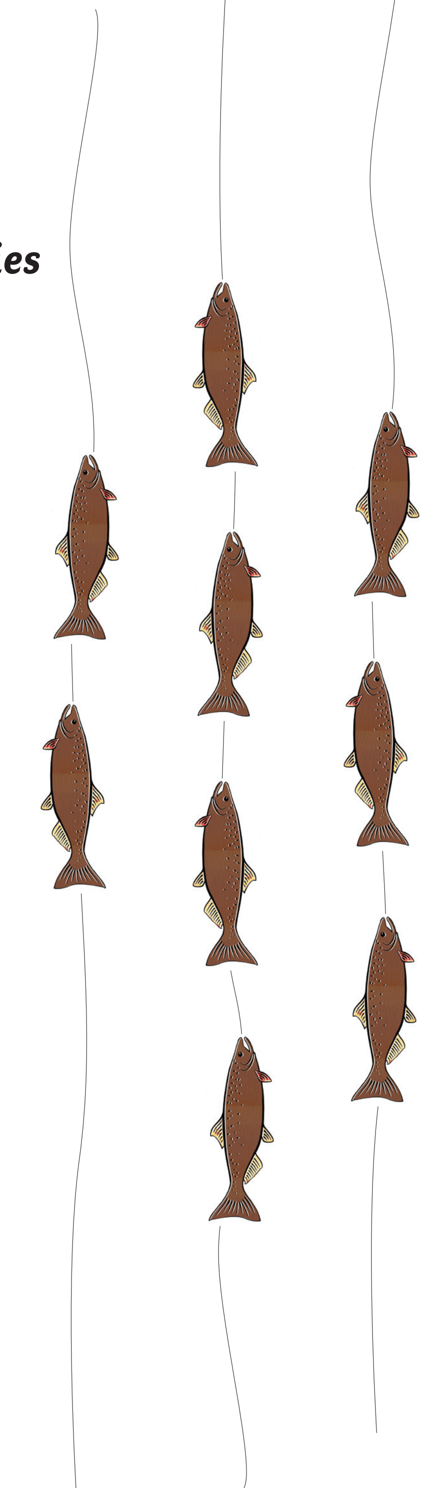
FOODS COMMONLY CONTAINING PEANUTS
Baked goods, baking mixes, chocolate and chocolate chips (many contain trace amounts of peanuts), candy, snacks, nut butters, cereals, sauces (peanuts are some- times used as a thickener), Asian food (stir fry, sauces, egg rolls), veggie burgers, marzipan (almond paste).

SUBSTITUTIONS
If you have a dish that calls for peanuts directly, you might be able to substitute something else, such as cashews or sunflower seeds. For peanut butter, you can use soy nut butter, almond butter, cashew butter, or sunflower butter, if your guest is not allergic to them (true seeds and soy beans differ from peanuts).

Fish & Shellfish Allergies

An allergy to fish does not necessarily mean an allergy to shellfish, and vice versa. However, if you are cooking for someone who has an allergy in either category, the safest approach is to entirely avoid fish and seafood, unless your guest has specifically advised you of allowable food items.

FOODS COMMONLY CONTAINING FISH OR SHELLFISH
Anything with fish or seafood, including imitation crab meat, Caesar salad, Caesar dressing, Worcestershire sauce, some pizzas, gelatin (sometimes derived from fish or shellfish bones), some marshmallows, some sauces, antipasto dishes.



Soy Allergies

FOODS COMMONLY CONTAINING SOY
Baby foods, baked goods (cakes, cookies, muffins, breads), baking mixes, breakfast cereals, packaged dinners like spaghetti or macaroni and cheese, canned tuna packed in oil, margarine, shortening, vegetable oil and anything with vegetable oil in it, snack foods (including crackers, chips, pretzels), nondairy creamers, vitamin supplements.

INGREDIENTS TO AVOID
Hydrolyzed soy protein, miso, shoyu sauce, soy-anything, soy protein concentrate, soy protein isolate, soy sauce, soybean, soybean granules, soybean curd, tempeh, textured vegetable protein ("TVP"), tofu.

SUBSTITUTIONS
There are no good substitutes for items like tofu and soy sauce, so choose recipes that don't directly rely on soy-based products. Note that soy is used in an amazing number of commercial products– often in places that you wouldn't suspect, such as pasta sauce– so read labels carefully!

Tree Nut Allergies

INGREDIENTS TO AVOID
Almond (butter, pastes such as marzipan, flavoring, extract), brazil nut, cashews (butter, flavoring, extract), chestnuts (water chestnuts are okay as they're not actually nuts), hazelnuts (filberts), hickory nuts, macadamia nuts (Queensland nut, bush nut, maroochi nut, queen of nuts, bauple nut), pecans, pine nuts, pinon (pignoli), pistachios, walnuts, nut meal, nougat, nut paste, Nutella.

SUBSTITUTIONS
Working around nut allergies can be tricky. As with peanut allergies, your best bet is to select recipes that don't rely on nuts. In salads and snacks, you can use seeds, such as sunflower, pumpkin, or seasame seeds. Sunflower butter can replace nut butters.

FOODS COMMONLY CONTAINING NUTS
Baked goods, snack foods, Asian foods, pesto, salads, candy. Cross-contamination is a major concern, so inspect packages for statements such as "may contain trace amounts of..."

Wheat Allergies

Note that a wheat allergy is not the same as a gluten intolerance. Wheat allergy is often confused with celiac disease (gluten intolerance), which is an autoimmune dis- order in which the small intestine reacts to the ingestion of gluten. Still, celiac disease is often easier to explain as a severe allergy so that people unfamiliar with the details of it understand the importance of handling food for those with it.

Wheat allergies are triggered by proteins present in wheat specifically, not the gluten. Unlike those who have wheat allergies, individuals with celiac disease must avoid all gluten, regardless of source. Be careful to avoid cross-contamination: even a knife used to butter toast might contain sufficient trace amounts of gluten to cause problems, so make sure to carefully wash and rinse utensils, dishes, and hands when cooking for someone with gluten intolerance.

INGREDIENTS TO AVOID:
Wheat (bran, germ, starch), bulgur, flour (graham, durham, enriched), gluten, modified food starch, malt, spelt, vegetable gums, semolina, hydrolyzed vegetable protein, starch, natural flavoring.

FOODS COMMONLY CONTAINING WHEAT:
Breads (bagels, muffins, rolls, donuts, pancakes), desserts (cakes, cookies, baking mixes, pies), snacks (crackers, chips, cereals), most commercial soups including broths, pastas (noodles, packaged dinners containing pasta), condiments (soy sauce, Worcestershire sauce, salad dressings, barbeque sauces, marinades, glazes, some vinegars), beverages (beer, nonalcoholic beer, ale, root beer, instant chocolate drink mixes), meats (frozen meats that are packaged with broth, lunch meats, hot dogs), gravies and sauces (most likely thickened with wheat flour), flour tortillas, tabbouleh (salad dish), pilafs.

SUBSTITUTIONS

FLOUR
Replacing wheat flour is tricky, because it contains gluten, which creates bread's characteristic elastic structure and texture. It is difficult to duplicate wheat baked goods (especially bread) without wheat flour. Some non-wheat flours, such as barley and rye flour, do contain the proteins necessary to form gluten.

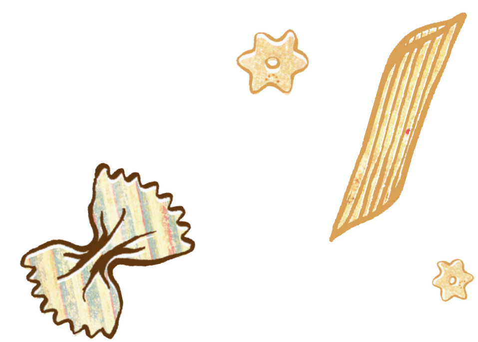
People with a wheat allergy can usually tolerate those flours while people with celiac disease cannot.

Rice flour and rye flour are easy to find. Check your regular grocery store. You can use either in place of wheat flour in some recipes (substituting at a 1:1 ratio). Tapioca starch, potato starch (use $^5/_8$ cups per 1 cup of wheat flour, a 0.625:1 ratio), potato flour, and sorghum flour can also be used.

You can achieve better results by blending several flours together. For an all-purpose flour mix, combine ¾ cups white rice flour, ¼ cup potato starch (not potato flour!), 2 tablespoons tapioca starch (also called tapioca flour), and, optionally, ¼ teaspoon xanthan gum.

PASTA
Luckily, there are great alternatives to wheat pasta! Pasta also comes in rice, corn, and quinoa varieties. Take care to not overcook these types of pasta, because they can get mushy and fall apart easily, and remember to make sure the colander is really clean if you've previously used it for wheat pasta.

SNACKS
If your guest is more sensitive or has celiac disease, be sure to double-check with the manufacturer about shared manufacturing lines and cross-contamination. Rice cakes, rice crackers, popcorn, and corn and potato chips make for excellent wheat-free snacks (but are not necessarily gluten-free).



Short & Sweet

Hopefully, this book has satisfied your inner geek and fat kid. I've had a wonderful time compiling, editing, and illustrating this little compendium. But between you and me, I just loved watching Good Eats, experimenting with new recipes, and having an excuse to make doodles of my favorite foods! Keep on eating!

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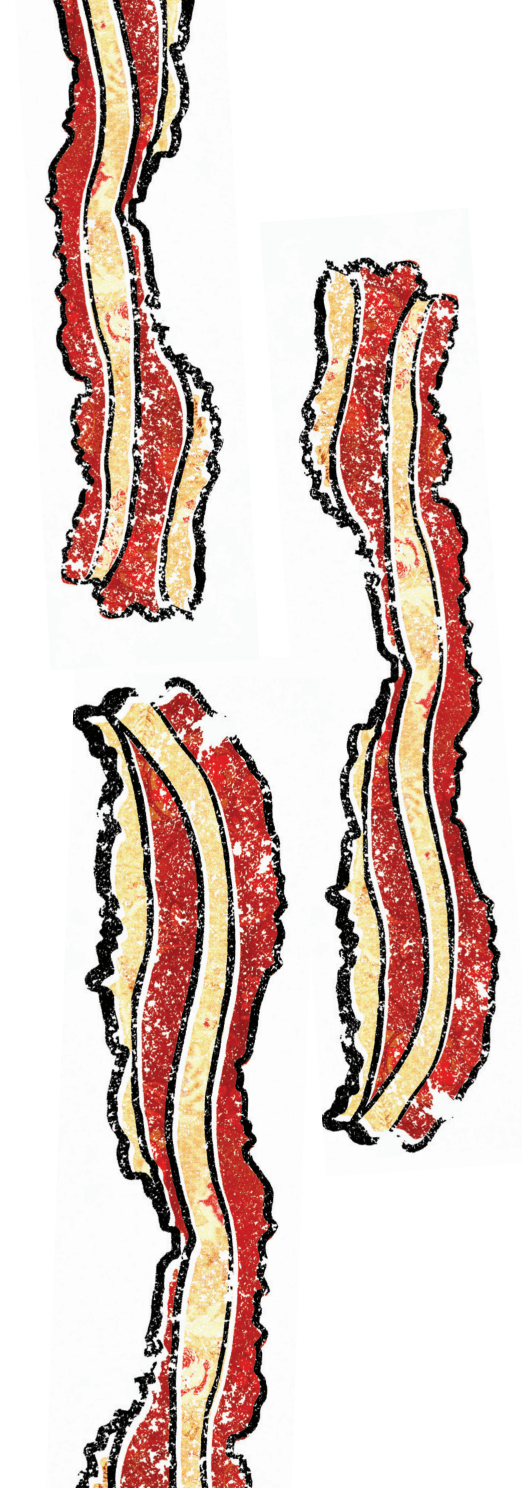

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