

Botanist in the Kitchen

Aching for strawberries

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If you have ever doubted the practical side of plant anatomy, keep reading, as Katherine explains what you can learn about flowers by cutting up a strawberry. As it turns out, this enigmatic little gem is packed with coincidences and apocrypha along with its citric acid and anthocyanins. Could it turn out to be true that a strawberry is a berry after all?

Welcome to early June, when strawberry season is finally well underway across the US, as far north as the upper Midwest and New England. Here in the promised land where little green plastic baskets are never empty (coastal northern California), there is still a peak season for strawberries, since the popular varieties don't reach their full potential until mid-May.

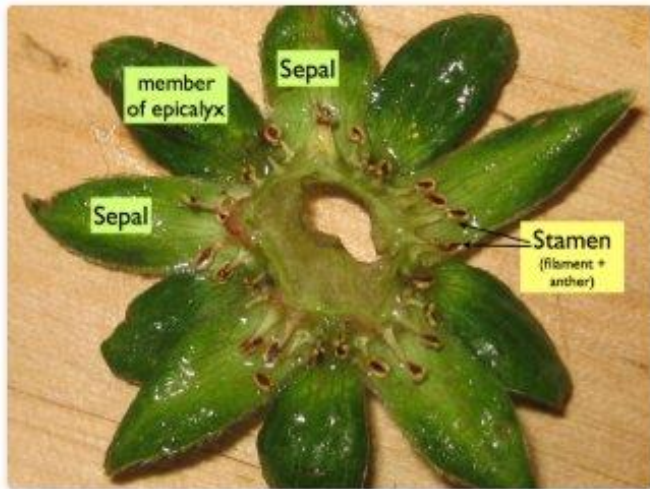
With so many strawberries in so many kitchens this month, now is the perfect time to merge botany lab and breakfast preparation by working through the many parts of a strawberry. Once you have mastered berry dissection, I promise you will find it a surprisingly versatile skill. Having the confidence to steer a conversation towards strawberry anatomy can help you recover from one of the more awkward inevitabilities of summer – biting gracefully through an enormous chocolate-covered strawberry just as you are introduced to the mother of the bride. After you have pointed out the veins and ovaries and have explained the developmental origin of the epicalyx, she won't remember the red juice and bits of chocolate shell you have just dribbled down your frontside. Or so has been my experience.

The botanists' way to cut up a strawberry (*Fragaria x ananassa*)

For this exercise, all you really need is a fresh strawberry (the fresher the better) and a small paring knife. Reading glasses or a hand lens might be helpful, too.

1. Examine the whole berry. The first thing to notice about a whole strawberry is its relationship to the flower it came from. The stem where it was attached to the plant was originally the stem holding up the flower; so if the stem is pointing up, you have to imagine a flower pointing downwards. Or you can turn the berry stem-side down.
2. Look at the green fringe of sepals. This was always known by my sister and me as the "Kermit collar." Sepals are the outermost ring of flower parts, and they often serve to protect the flower when it is still a bud. Together, the sepals are called a calyx.

Although it looks like there are ten sepals in two alternating rings of five, there are not. The outer ring is called an epicalyx and is actually composed of stipules, appendages of the sepals. Each sepal is flanked by two stipules, but the adjacent stipules from neighboring sepals fuse together, giving the impression that single stipules alternate with the sepals. (The whole rose family is characterized by stipules, which are easily seen as long flaps of tissue at the base of a rose leaf).



Calyx (ring of sepals) and epicalyx removed and oriented to show stamens

3. Lift the sepals (calyx) to reveal the stamens. The next whorl of appendages in from the sepals is normally composed of petals, but these are gone by the time strawberries have matured. Rarely, a small detached mildewed white petal is still stuck on the berry somewhere. What you will definitely be able to see under the sepals is a couple of rings of stamens, which remain attached the calyx. Strawberry stamens are paddle-shaped, the wide part being the anthers, where pollen is produced. By now, the anthers will have opened up to shed their pollen, and the slits should be visible.

4. Look very closely at the surface of the “berry” and question the way we normally talk about it. Here’s the “critical thinking” part of the exercise. Just inside the ring of stamens we expect to see one or more pistils, whose most important part is the ovary. Ovaries are the structures that contain the newly-fertilized eggs on their way to becoming seeds. The ovaries themselves are triggered by the seeds to mature into fruits.

If we follow the familiar botanical blueprint, we might start by guessing that the big red mound in the center of the strawberry flower has to be the mature ovary (the fruit.) But it is covered in tiny tan hard bits we usually call seeds. And we know perfectly well that seeds do not grow on the outside of a fruit. Making seeds on the outside of an ovary seems like a much bigger violation of expected developmental rules than producing an unexplained mound where we have gone looking for an ovary.

If you look very closely at one of those “seeds,” you will see that it is tipped with a tiny pin-headed thread. That thread is a style leading to an ovary. Any pollen grain landing on the stigma – the pin-head top – could germinate and develop a tube to digest its way through the style to deliver a sperm cell to the egg cell in the ovary.

The presence of a stigma and style tells us that each of those “seeds” is actually an individual matured ovary, and the strawberry mound is thus covered in several separate tiny hard fruits. We call those fruits achenes (ay-keens) so that we can make jokes about our achene hearts (and because they are a type of single-seeded indehiscent fruit derived from a superior ovary.)

5. Finally, put the knife into the “berry.” Now that we know that the red mound is not the fruit, and that the real fruits are called achenes and not berries, we know that we are definitely getting at least 5 fruits a day if we eat strawberries. What we get from the red mound, though, is the sweet, tart, juicy, vitamin-packed object of our spring dreams. Botanically, the red mound is a very thick flower axis called a receptacle, upon which the sepals, petals, stamens, and pistils develop.



Cut off the “top” (where the calyx and epicalyx are) to reveal the inside of the strawberry. Notice the white lines running out to the surface of the receptacle where they feed directly into the achenes. Those are veins, feeding the developing seeds inside the achenes. The hollow center results when the outer part of the receptacle grows faster than the inner part.

Strawberries vs. blackberries and raspberries

To summarize, then, a strawberry (not a berry) is a fleshy sweet floral axis (receptacle) covered in many separate dry fruits called achenes. It is conceptually helpful to contrast strawberries with the closely related cane berries (or brambles), which include blackberries and raspberries (*Rubus* species). Like strawberries, cane berries have an enlarged receptacle covered in individual fruits; however, unlike strawberries, cane berries have a dry, bland receptacle. In cane berries, it is the actual fruits that are fleshy and sweet. Although the fruits are not achenes, they are also not properly called berries. Cane berry fruits have a fleshy mesocarp (“middle fruit”) surrounding a pit (a stony endocarp), containing a single seed. They are essentially miniature plums. For more on this type of fruit – a drupe – see last year’s post on peaches. Raspberries seem hollow because their receptacles stay behind on the bush, and the drupes cohere in a beautiful jewel-tone dome. Blackberry receptacles are harvested and eaten with the rest of the Strawberries and cane berries use different strategies to the same end, but both are effective. Whether it is the receptacle of the strawberry or the drupelets of the cane berry, a sweet and fleshy structure attracts and rewards seed dispersers while a small hard covering – the achene wall or the drupe pit – protects the actual seeds against being digested.

Coincidences and confusions

Many people will have already heard that strawberries are not berries, but what is a berry? A berry-type fruit is fleshy throughout, without any hard or papery bits such as the pit of a drupe or the papery insides of an apple. Grapes are berries, as are

persimmons. Other familiar berries include eggplants, green peppers, and tomatoes. Avocados are debated but seem to me to fit the definition. Olives are not berries because their seed is inside a pit. They are drupes, like peaches, plums, and cherries.

But strawberry confusion, both botanical and historical, goes way beyond the falseness of the fruit. For example, the modern horticultural strawberry is called *Fragaria x ananassa*, the “pineapple strawberry.” The “x” in the name marks its hybrid origin. Early breeders were not trying to make a strawberry that went well with pineapple chunks on a fruit platter (although it would be fun to spread that rumor.) They apparently thought that the hybrid shared some flavors with pineapples. Undoubtedly, many interesting flavors have been lost in the subsequent 400 years of breeding for homogeneity.

Interestingly, pineapples – which are obviously neither pines nor apples – are true berries. The large spiny yellow-green structure is an aggregate of berries, buried down into a flowering axis.

Although both parent species of our current strawberry came from the Americas – the previously domesticated *F. chiloensis* from Chile and *F. virginiana* from the eastern U.S. – the first hybridization happened in France in the 17th century. This may be why we so often associate strawberries with France. The original French strawberry, the *fraise de bois*, was very popular until it was replaced first by *F. virginiana* and then by the hybrid pineapple strawberry.

Coincidences?

It was a French spy sent to Chile and Peru by King Louis XIV who was responsible for bringing the Chilean species to France where it could cross with the Virginia species. This spy’s name was Amédée Frézier. Frézier looks and sounds remarkably like “fraisier,” the French word for a strawberry plant (and a strawberry cake). Frézier is a variant of Fraser (Frasier, Frazier, Frizzelle, etc.), a Scottish clan with its roots in France, whose coat of arms features strawberry flowers. (I am also a Fraser of sorts; my mother’s mother was a Frizzelle.)

It is interesting enough that Captain Frézier was predestined by his family name to be the father of the modern strawberry, but it might be even more so. One story holds that in the early 10th century, a French nobleman hosted a feast for King Charles III of France and an Italian Cardinal, who were traveling together. The nobleman ended the meal with a simple plate of perfect strawberries, which so impressed the king that he gave the nobleman the name Frasier and a coat of arms bedecked with strawberry blossoms.

And what was the nobleman’s original name? **Julius de Berry.**