Why does lettuce sometimes turn brown?

The chemistry that takes place when lettuce leaves become brown is the same chemistry we see when an apple is cut and turns brown, when green guacamole turns brown or when a green olive ripens and turns black. All these reactions occur when chemicals in the fruit or vegetable called polyphenols react with enzymes known as polyphenoloxidases. Enzymes are specialized protein molecules made within cells that serve as catalysts. In other words they speed up chemical reactions.

Normally within a cell the enzymes and the polyphenols are separated, but when cells are damaged, as in cutting an apple or tearing lettuce, their contents leak out and the polyphenols and the enzymes mix. The result is a reaction that oxidizes the polyphenols and allows them to link up with each other to produce a brown pigment. When lettuce leaves are torn, some cells are damaged and the browning reaction begins. But even if there is no tearing, even if we have a whole head of lettuce, there will eventually be browning. That's because aging of the cells also leads to damage and mixing of the polyphenols with the enzyme.

The age old question about lettuce is what causes more damage, tearing or cutting? Actually it seems not to make much difference. Some cooks argue that cutting is more destructive and leads to quicker browning but experiments do not bear this out. They even say that they can taste metal in a salad if a knife has been used. This is probably culinary snobbery. In any case, if the lettuce is eaten soon after it is prepared, as far as potential browning goes, it doesn't matter if it was cut or ripped. One more item about preparing lettuce: the dressing should always go on at the last moment because oil soaks into the leaves readily and makes them soggy. And noting that lettuce is soggy is not culinary snobbery.

So that's the how. What about the why? Actually we don't know. The main theory that crops up is that the brown pigment has anti-fungal and insecticidal properties. In other words, the damaged fruit or vegetable is trying to protect itself. The argument is that historically damage was caused by insects and fungi and that at the first sign of such damage the enzymes would swing into action to ward off further destruction. The problem is that nobody has clearly demonstrated that the brown pigments really do have antifungal or insecticidal properties. But there certainly is some interesting chemistry there.