Purple (and Red, Orange, Yellow) Power

Your mom might tell you, the lunch ladies might tell you, your doctor might tell you ... eat those colorful fruits and vegetables! But why?

Most of the color in foods comes from a big family of chemicals called *flavonoids*. The name comes from the Latin word *flavus* which means yellow. If your diet is rich in fruits and vegetables, you consume a lot of flavonoids. That's a good thing, since scientists are learning more all the time about how *flavonoids* improve health and help reduce the risk of heart disease and certain cancers.

Scientists divide the flavonoid family into six smaller groups. You can see the names of these groups and some of the foods from each group on the "family tree" below. Take a look at the chemical structures for all six flavenoid groups. What do you notice that is similar about all of them? What variations do you see that are unique to each group?

The Power of Antioxidants

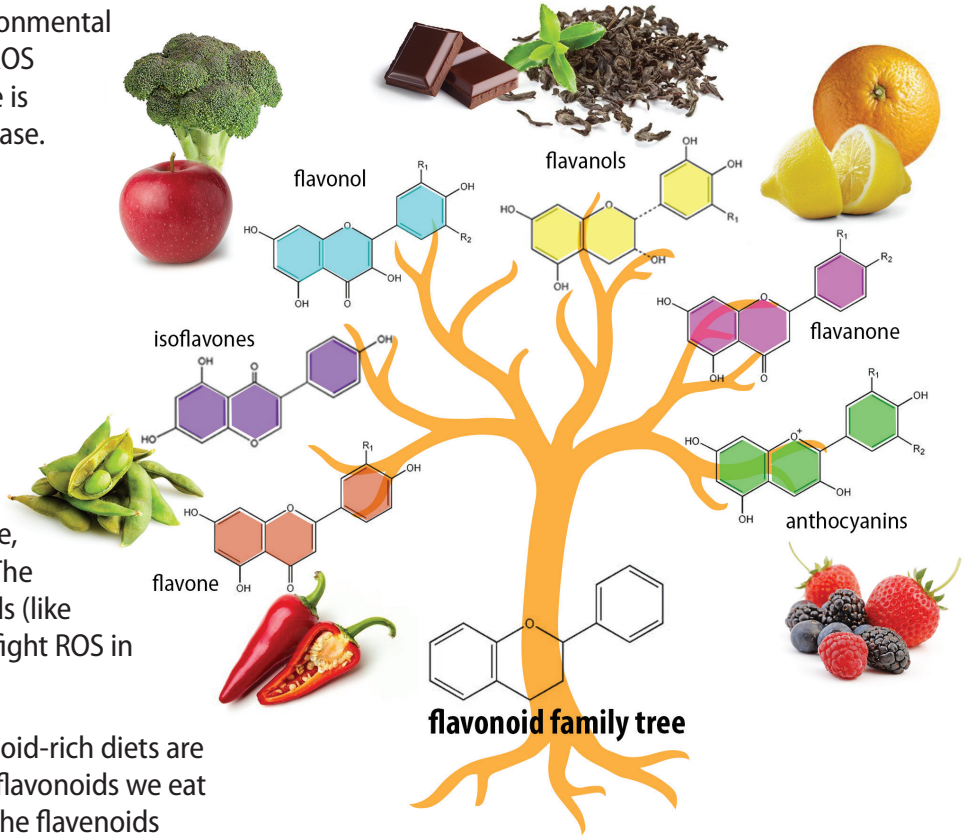
Your cells constantly obtain food and convert it to energy. This chemical process is called cell metabolism. Cell metabolism is essential to life, but cell metabolism also produces chemicals that can damage cells called *reactive oxygen species* (ROS). Your body creates a constant supply of another group of chemicals called *antioxidants* to react with the ROS before they can cause too much damage.

However, under stress or exposure to environmental toxicants, your body may make too many ROS or not enough antioxidants. This imbalance is called oxidative stress and may lead to disease.

ROS **ANTIOXIDANTS**

oxidative stress

Because our bodies need antioxidants, scientists are interested in how much antioxidant power foods have. In a test tube, flavonoids work as excellent antioxidants. The question is, does eating flavonoid-rich foods (like the ones shown on the "family tree") help fight ROS in cells and reduce oxidative stress ?



Scientists know that people who eat flavonoid-rich diets are healthier. But, it turns out that most of the flavonoids we eat get destroyed during digestion. If most of the flavenoids get destroyed, how does eating them help us? Current scientific research is looking at this exact question.

One flavonoid research story

Scientists like *Bernie Hennig* at the University of Kentucky are doing exciting new research on how flavenoids can help protect our cells. New research is showing that certain flavenoids (from the *flavonol* and *flavanol* groups) can protect cells from damage caused by environmental toxicants called PCBs.

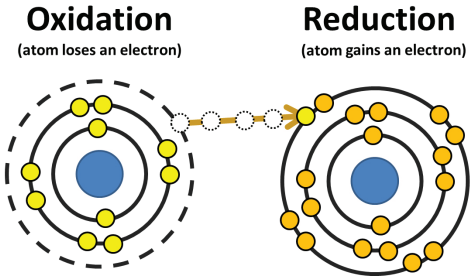
PCBs can turn on certain genes which then produce enzymes. These enzymes cause inflammation of the cells that line blood vessels, leading to a disease called arthereoschlorosis (a thickening and hardening of arteries). The *flavonols* and *flavanols* slow down production of the damaging enzymes and also reduce the harmful effects of any enzymes that are still produced.

Why do plants have flavonoids?

We might enjoy and benefit from eating flavonoid-rich foods, but plants don't make flavonoids in their cells for us! Plants are investing their energy and nutrients in making flavonoids, and the plants need to get a payback for that! This diverse group of chemicals benefits plants in lots of ways. The colors of flowers attract pollinators such as bees and butterflies; the colors of fruits attract animals who eat the fruit and disperse the seeds. Flavonoids help seeds germinate and help seedlings grow and develop. Flavonoids also protect plants from frost and drought and act as a UV-filter.

What are oxidation and reduction?

Cell metabolism produces ROS through a process called *oxidation.* Oxidation is the loss of electrons by a molecule, atom, or ion. Oxidation is always paired with reduction. Reduction is the gain of electrons by a molecule, atom, or ion.



Antioxidants are chemicals that react with ROS before they can react with other cell chemicals in a harmful manner. Plant and animal cells contain many types of antioxidants. For example, vitamins C, A, and E are antioxidants. Cells manufacture antioxidants and we also get antioxidants from food.

Anthocyanins—flavenoids with color tricks

The cups in the picture all contain juice from purple cabbage. The only difference between them is the pH of the liquid.

Anthocyanins are the type of flavenoids found in blue, purple, and red foods such as blueberries, cranberries, blackberries, cherries, grapes, purple cabbage, and eggplant.

Anthocyanins are especially interesting because they change color depending on acidity. You may remember that household items like lemon juice and vinegar are acids and baking soda and ammonia are bases. Scientists represent how acidic or basic something is using a scale called pH, where a pH of less than 7 is acidic, a pH of more than 7 is basic, and a pH of 7 is neutral.

Anthocyanins can be used as pH indicators because they are pink in acidic solutions, purple in neutral solutions, and greenish-yellow in basic solutions.

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