



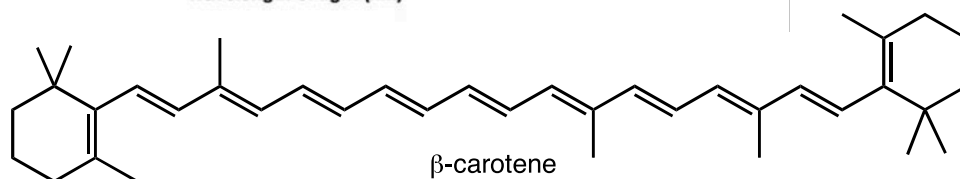
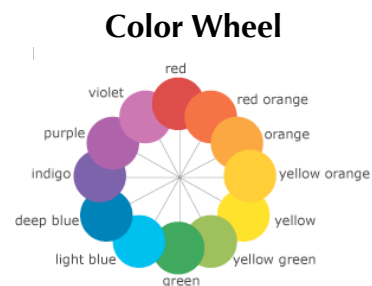
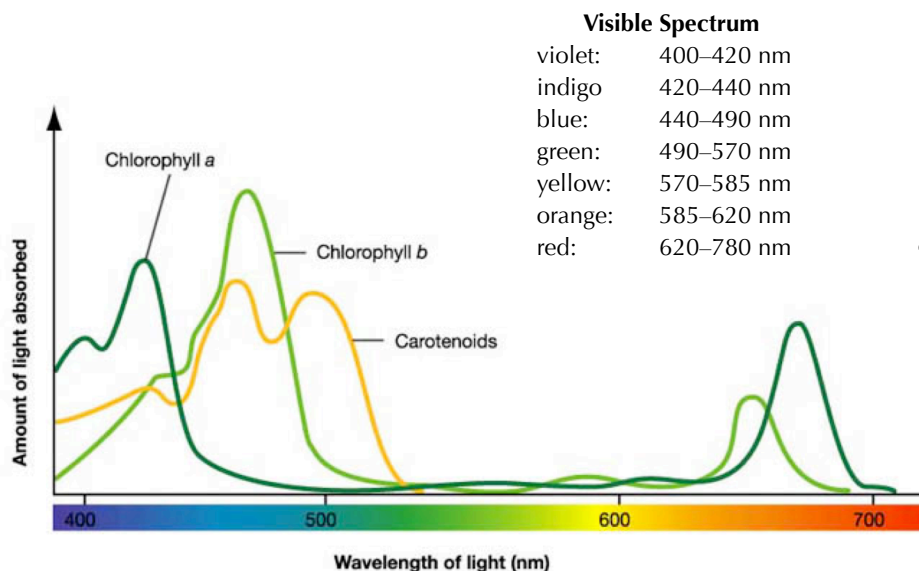
Experiment 4

Analysis of Red Cabbage Pigment

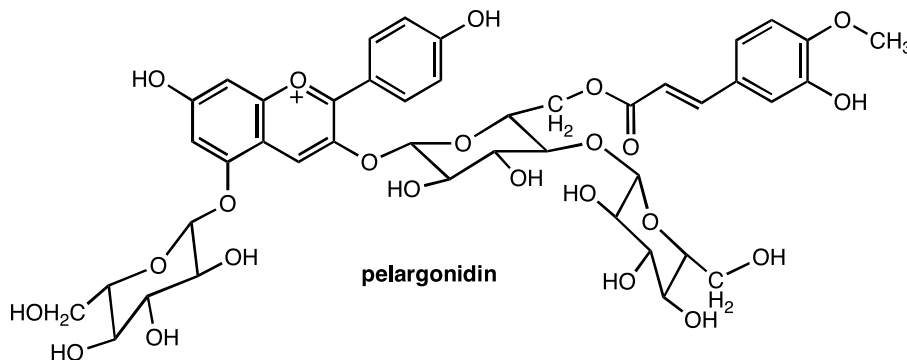
Chemistry 251
Fall 2012

Analysis of Red Cabbage Pigment

The absorption of UV-visible light by organic pigments causes excitation of their electrons, a transition that is accessible in the absorbing pigments because they have an extensive system of conjugated π -electrons. Pigments in plants absorb the energy required for photosynthesis, protect plants by absorbing UV-vis radiation that can cause DNA damage, or attract insects and other animals to aid in the plant's reproduction. Pigments selectively absorb specific wavelengths, whose photon energy matches the "HOMO-LUMO gap" of a particular pigment. The color that is observed is complementary to the color of radiation that is absorbed. For example, β -carotene, the pigment that gives carrots their orange color, absorbs light in the blue region at 483 nm. The appearance of the carrot is determined by the complement of blue, which is orange. The spectra of some photopigments are shown below.



The pigments in red cabbage belong to a group of compounds called anthocyanins, which are valued by nutritionists for the antioxidant behavior of their **phenolic** functional groups. Anthocyanins are part of a larger group of structures called flavonoids, many of which are important antioxidants. Anthocyanins are also responsible for the beautiful colors of leaves in the fall. The structure of pelargonidin, the major anthocyanin you are observing, is shown below. It is the same pigment found in the red geraniums that Professor Kuhlman and his students study. The color of water-soluble pelargonidin is sensitive to pH. The same cabbage is known by different names around the world as its color changes in response to soil pH. As an introduction to UV-visible absorbance spectroscopy, you will extract the pigment from red cabbage and observe its color changes due to pH. The general principles of UV-vis spectroscopy are described in Bruice, 6th ed. (Sections 13.17–13.21).



Warning: This dye will stain. Wear gloves at all times.

Procedure

A. Extract Pigment from Red Cabbage

Rip 5 red cabbage leaves into small pieces and place them in a 500 mL beaker. Add 50–100 mL of water and bring the mixture to a slow boil, stirring occasionally. Boil for 10 minutes or until the color of the solution turns purple. Remove the mixture from the hot plate and let it cool before filtering the mixture by gravity to obtain the liquid extract.

B. Observe Effects of Adding Acidic or Basic Solution

In clean test-tubes, add several drops of pigment extract to 3 mL each of vinegar, distilled water, and baking soda dissolved in water. Observe the color of the resulting solutions and test the pH of each solution using pH paper.

C. Absorbance Spectra

Obtain an absorbance spectrum from 400–800 nm of each of the three solutions from Part B. You may need to dilute the solutions with water or add a few more drops of pigment extract in order to assure that the absorbance of the largest peak is between 0.5 and 1.5 absorbance units (AU). Record the λ_{max} and absorbance of the major peaks in each spectrum. Print out at least one representative spectrum.