Name _____ **Instructor** _____ **Lab Section**_____

Objectives: To gain an understanding of:

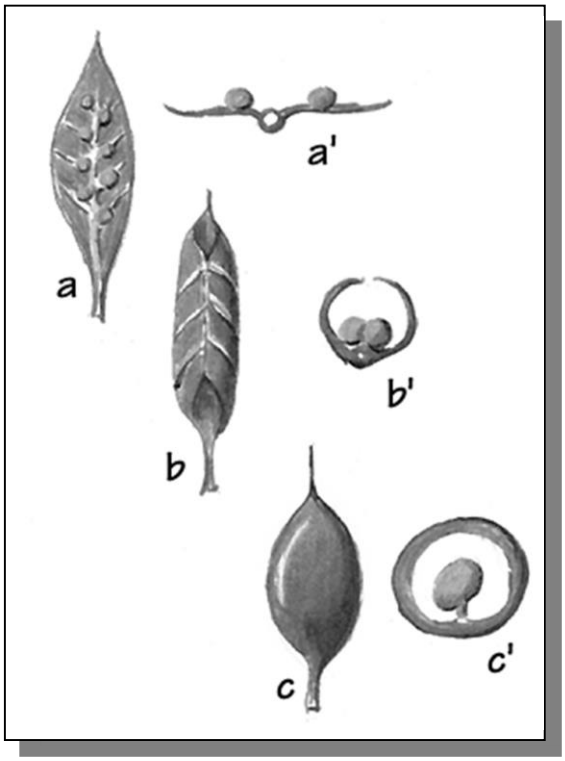
- The "biological perspective"
- The steps involved in hypothesis-based science
- Skills of observation using your senses to gather scientific information

Background material may be found in

- Chapter 1.7-1.8
- Chapter 17.10

Biology: Concepts & Connections, 8th ed.

Often, common things that you encounter every day may go unnoticed or unappreciated. During this lab we will explore the Santa Barbara City College campus and, in the laboratory, we will investigate common edible fruits with an emphasis on the Sweet Orange (*Citrus aurantium* var. *dulcis).* Santa Barbara City College is fortunate to have a wide variety of native, introduced and horticultural varieties of plants on campus. Currently, a major grant is allowing the restoration of some of the natural areas of our campus to return them to native vegetation. Consequently, there is much "biology" to be seen.



SEEDS, FRUITS AND VEGETABLES

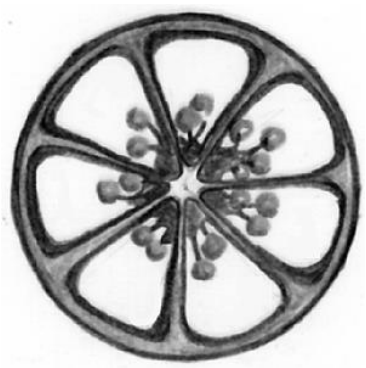
Fruits are the reproductive organs of plants. Seeds are the next generation (embryos) encapsulated by tissues of the parent plant. Vegetables are the vegetative or growth parts of the plant (roots, leaves and stems). Commonly, people refer to peas, beans, corn and tomatoes as vegetables; however, the first two are seeds and the second two are fruits.

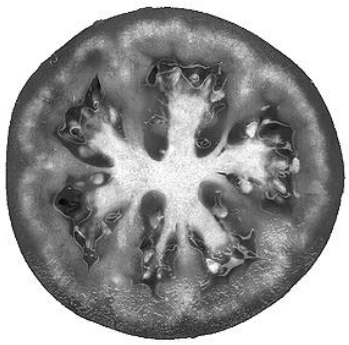
THE SWEET ORANGE

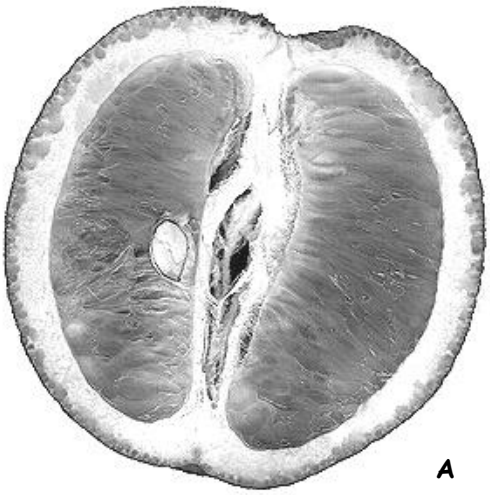
Citrus fruits, such as the Sweet Orange, belong to Rutaceae or the rue family which includes oranges, grapefruit, tangerines, limes, lemons and citrons. The Sweet Orange was brought from the Far East by Romans during their conquests of oriental territories around the first century. During expansion of Arab dominion, the orange became widely distributed throughout the Mediterranean and from there distributed worldwide to areas with mild climates such as Spain, Greece, Brazil, southern California and Florida.

The fruit of the genus *Citrus* is a type of berry called a hesperidium — a term derived from Greek mythology, referring to the golden apples that grew in the garden of the Hesperides. The name "orange", oddly, does not refer to its color but comes to us from the Sanskrit *nagarunga*, meaning "fruit favored by elephants". The Spanish word for orange is *naranja*.

A berry is a composite fruit evolutionarily derived from the fusion of individual fruits into a single structure. Thus both oranges and tomatoes are technically berries. Each section of an orange or tomato is called a carpel (individual fruit) which is a leaf folded to form a cavity (locule) containing the seeds. In the orange, the locule houses the juice-filled cells.







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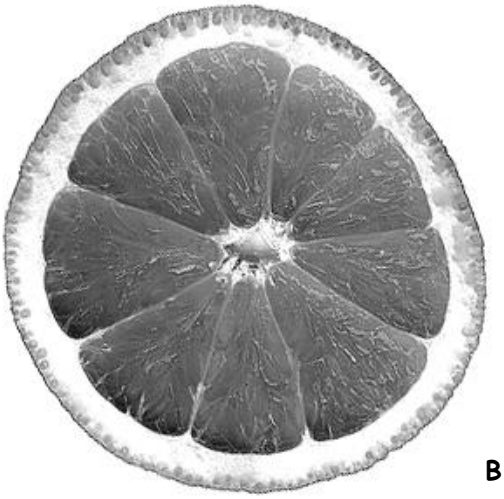

B

DISSECTION OF THE SWEET ORANGE

1. Working in pairs, select two oranges. Cut one orange in longitudinal section (parallel to the central axis, *top (a) diagram*). Cut the other orange in cross-section (perpendicular to the central axis, *bottom (b) diagram*).

2. Carefully examine the peel, segments and central axis of the oranges using all five of your unaided senses (touch, taste, smell, vision, and hearing). Be inventive and take time making notes and illustrations of your observations on the following *Notes and Drawings* sheets. Try to understand the structure and function of each individual part as well as how all parts are interrelated.

3. Continue your examination of the orange, repeating earlier visual observations with the aid of a hand lens and then a dissecting microscope.

As you complete the lab, you will be asked to provide ***hypotheses*** (trial ideas or explanations about how something works) about the various distinguishable parts of an orange. As you view the various parts of the orange, what do you think are the various functions of the parts of an orange? How do the parts of an orange allow the individual structure as well as the entire plant to survive and propagate (produce more plants)?

AN ICON USED IN THIS MANUAL

This icon indicates a question for which a written answer is required for credit in the completed lab assignment as per the direction of your specific lab instructor.

Notes and Drawings of your orange dissection

Notes and Drawings of your orange dissection

Hypothesize in the space below. Describe your hypotheses and ideas about the various functions of the parts of an orange. Make predictions based on your hypotheses. Can you think of any simple experiments that might support your hypotheses? Describe at least one of your experimental ideas.

Composition of Valencia Orange

Constituent	Peel	Whole Sections	Juice
Percent (grams per 100 grams of orange)			
Protein	1.53	1.13	1.00
Fat	0.23	0.30	0.29
Sugars:	7.55	9.10	9.72
Fructose (monosaccharide) Glucose (monosaccharide) Sucrose (disaccharide)			
Ash (Minerals)	0.78	0.48	0.34
(milligrams per 100 grams of orange)			
Calcium	161.0	36.7	9.5
Magnesium	22.2	11.5	11.3
Iron	0.8	0.77	0.33
Potassium	212.0	173.0	163.0
Sodium	3.0	1.3	0.7
Niacin	0.888	0.491	0.376
Carotenoids	9.9	3.4	2.8
β-Carotene (Vitamin A)	0.25	0.15	0.17
Thiamine (Vitamin B_1)	0.12	0.13	0.10
Riboflavin (Vitamin B_2)	0.091	0.033	0.027
Ascorbic Acid (Vitamin C)	43.5	39.5	

QUESTIONS

1. What is the function of the orange as a whole with regard to the long term survival and/or reproduction of orange trees? That is, why do orange trees produce oranges?

2. Look at the table to the left. What pigment, listed as constituent of oranges, is responsible for the orange color of the skin?

3. Some oranges may have green pigment in the outer skin. What plant pigment do you think that might be? Hint: *This pigment is not listed on the table, but those who have had some biology before may remember this pigment, which makes plants appear green*.

Note: Citrus fruits contain little starch and therefore do not sweeten much after picking. For this reason, a crop must reach the desired sugar-acid balance before they can be harvested. Color change is triggered by the arrival of colder temperatures while the fruit is still on the tree. In the tropics, oranges grown at low elevations are green at maturity.

Fruits purchased in stores are sometimes treated with ethylene to improve their color and are coated with an edible wax to retard moisture loss. Ethylene is a naturally occurring hydrocarbon in plants that regulates and promotes the ripening of fruit. California oranges can be distinguished from Florida's by their relatively thicker skins, which protect them from the west's dry climate.

4. What gives oranges their sweet taste? Please be as specific as you can.

5. What gives oranges their tart taste? Please be as specific as you can.

Clean-up:

_____ Wash and dry cutting boards and knives and return to side counter.

_____ Return all supplies to correct trays on the side counter.

_____ Unplug scope lights and wrap and secure cords. Illustrations, scopes and lights remain on tables.

LABORATORY NOTES

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