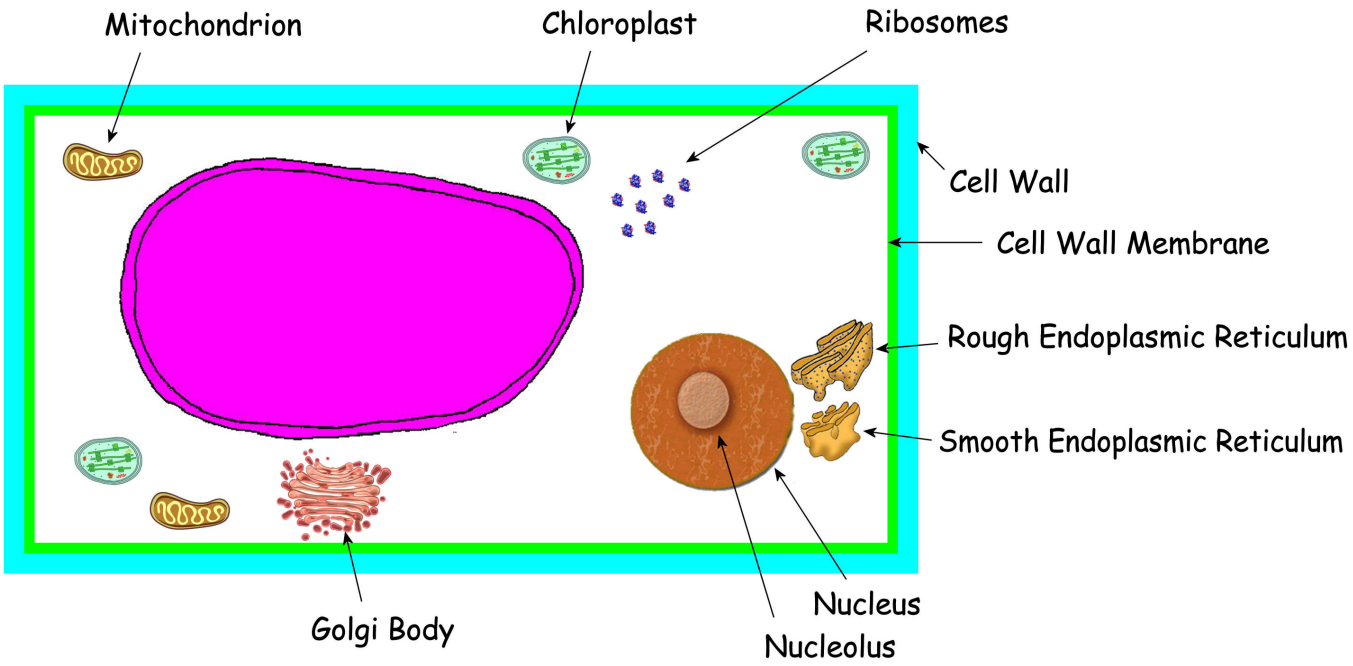
Plant Tissues and Cells – Looking to the Core of Plant Biology

Understanding basic plant biology can be the key to being able to understand many articles a grower may look into from the research they do to solve a plant health issue or achieve better yield from their crop. Readers here will come from all backgrounds and experience. Here I will attempt to touch on key and interesting issues, give enough background to facilitate understanding but keep the conversation clear enough to reach most every reader. The QR Code at the end of this article will go into definitions of some of the most pertinent plant biology terms.

Cells are the fundamental level to begin our exploration and the basic unit of life. Plant cells have their nucleus bound with a membrane (they are eukaryotic), and the DNA is enclosed within that nucleus. The most distinctive feature of a plant cell is the cell wall outside this membrane and that it contains Organelles. This wall is made of cellulose and its prime function is support and rigidity.



Sketch # 1

We want our crops to grow with vigor and health, to produce lots of large tasty fruit with the minimum of disease and stress. If we want to learn from the many informational articles available, and then to put the best practices into effect on our own crops, we need to have a strong background on what's happening inside the plant and how each of the various recommendations might affect other aspects of our crop.

Plants are made of organs which are made from tissues. Tissues are simply a group of cells that also work together to perform a specific job. Plant tissue, similar to human tissue in some ways is built from specialized cells which in turn contain specific "Organelles" or plant cell structures that exist inside the cell itself.

Sketch #1 shows a number of these organelles, the Vacuole is one of them, filled with fluid and helps the cell keep its shape. Another organelle; The Golgi Bodies are located near the

nucleus of the cell. These package proteins and carbohydrates into a membrane and export them from the cell. Two other very important organelles are: Chloroplasts and Mitochondrion. Chloroplasts contain chlorophyll and perform photosynthesis, while the Mitochondrion has the special function of performing respiration – converting sugars into energy. For a complete discussion of the many organelles, use the QR code at the end of article and explore the link for a glossary for cell terminology.

Plant cell types are split into two groups Eukaryotic and Prokaryotic cells. Prokaryotic cells do not have a nucleus or organelles. Bacteria are an example of a Prokaryotic cell.

Eukaryotes

Fundamental cell types:

Parenchyma cells are the most common and bountiful cell type in a plant. It has a thin wall membrane as compared to others and makes up the soft or "herbal" part of the plant. These are found on the insides of leaves, flowers and fruits. They are not however, part of the epidermis (outside skin) or veins.

Collenchyma cells generally have thick primary walls composed of cellulose. These type cells are narrow elongated provide structure, especially for areas of new growth. These cells are "non-lignified" so they can stretch as the organ they comprise elongates. The Mesophyll cells belong to this type and have an abundance of Chloroplast for photosynthesis.

Sclerenchyma cells have thick lignified woody and stiff secondary walls and will quite often die when the plant is mature. They are mostly in the root system and remain after dying providing woody or sturdy parts for the plant.

Cells make up Tissues. There are three primary types of tissue in a plant. Dermal Tissue: This is like skin, in that among other things, it protects the other plant organs from attack. Vascular tissue: is responsible for transporting the nutrients from one part of the plant to another. These cells look very different from the other types. Ground Tissue: these cells perform photosynthesis, store energy (as a sugar), and some also provide structural support. Specialized tissues:

Meristem tissue may be at the tip, shoot or root of a plant. Meristematic cells, give rise to the three fundamental cell types and comprise that tissue in many plants where growth takes place. These cells have the ability to divide and multiply. They have the same function for plants as do stem cells have for animals. When cloning; it is vital to have Meristem tissue present in the specimen. Apical Meristem tissue will comprise the growing tip or "bud" on a branch.

Mesophyll tissue is comprised of Parenchyma cells. These type cells are mostly in the leaves and are loaded with chloroplasts. Within this group are Palisade, located near the surface of the leaf and Spongy, located under the Palisade group. Their primary role is photosynthesis.

Vascular or transporting tissue:

Xylem. Comprised of Xylem cells: Xylem tracheids, Xylem tracheae, Xylem fibers
Xylem cells are also known as water conducting cells. They are hard cells that bring water up to the leaves. They do not live past maturity but their cell wall remains to allow water to flow freely through the plant.

Phloem. Comprised of conducting or sieve cells, companion cells & Phloem Parenchyma cells. These make up a system of cells that organizes itself to transport sugars produced in the leaves throughout the plant as needed. The cells in these tissues live past maturity.

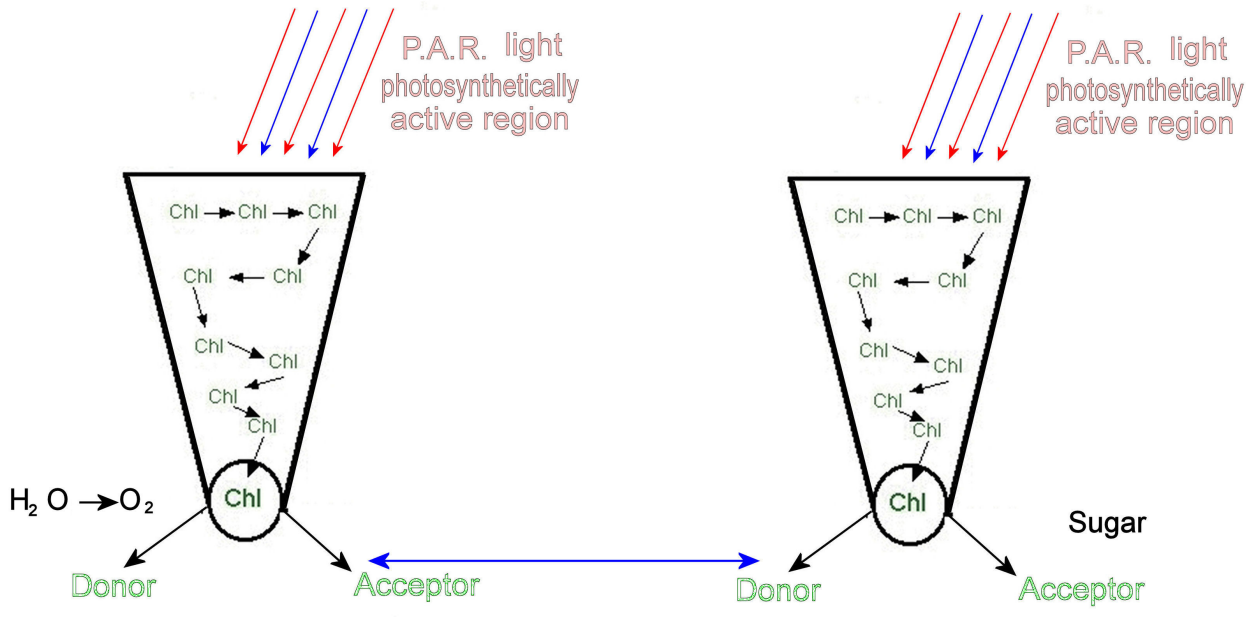
Cambium. Comprised of unspecialized Meristem cells; a type of Parenchyma cell. The Cambium is a secondary vascular tissue and is key to successful grafting.

No matter what the cell or tissue type they need food and oxygen to survive and grow. Some break down food molecules to release the stored energy inside. This process is called cellular respiration. Oxygen is also used to process food through oxidation. Plants primarily oxidize sugar for food.

How do plant cells and tissues get oxygen?

For the green tissues above ground, oxygen is a byproduct of the photosynthesis process. For root tissues which are in the dark and have no photosynthesis, this option is not possible. Root tissues must therefore take up oxygen from the soil in which they grow. The "hair roots" of the plant have a large surface to volume ratio and are semi-permeable. They can absorb oxygen from the pores in the soil.

Chloroplasts are key organelles within many plant cells for performing the function of photosynthesis. This function captures the energy from light provided. It is the chlorophyll within these chloroplasts that actually gives the ability to harvest energy. Light energy is absorbed by the chlorophyll within a limited frequency range. The molecules within the chlorophyll will become excited thus producing energy that is passed from one molecule to another. In the end the electron in a molecule must be ejected from the chlorophyll in order for energy to be captured and used. The process of electron ejection takes place only within chlorophyll molecules which are held in a protein complex known as a reaction center.



Above are two different reaction centers. The chlorophyll molecules (CHL) pass the excited electron along until it reaches the donor-acceptor region where it is passed to the second reaction center. In the end the water used by the first center is converted and available for fixation to sugars. These sugars will later be converted to energy through the process of respiration.

Understanding cellular versus root respiration

Mitochondria are the organelles within many plant cells that carry out the function of cellular respiration. Here the cell converts the sugars or photosynthates back into energy for various life processes, including growth. This process is quite similar to oxidation that occurs when wood is burned. So, the parallel image for these functions could be that photosynthesis creates, through cellular processes the glucose (or wood to burn), and then cellular respiration burns that wood to produce energy.

Because plant roots must "breathe in oxygen" in order to respire, the soil or other media they live in must provide this oxygen. In deep water culture oxygen must be infused into the water for this purpose. In many other grow media care must be taken not to over-water. Soggy soil prevents oxygen from being present for the plant root system. In this case the plant roots soon will no longer produce energy and fail. Water and nutrient will no longer be transported to the canopy above. The plant wilts and eventually dies if not corrected. When soil no longer contains oxygen it is called anaerobic and will eventually present a foul odor.

Often through this type of weakening a plant becomes prey to disease and insects. This is why when a gardener only treats the disease or controls insects it often is not long until that same plant once again is in stress and infested; this due to over-watering and soggy soil.

Function	Photosynthesis	Cellular Respiration
Stores energy as glucose	X	
Releases energy from glucose		x
Occurs in living plant cells	X	x
Releases or provides oxygen	X	
Releases Carbon Dioxide		x

We know that we need to provide good radiant sunshine or synthetic lighting for our crop in order to obtain the amount of cellular photosynthesis our crops demand, but to ignore another part of this formula, thorough root respiration only invites disappointment as regards the end goal; Maximum Yield!

Our soil or grow media will affect plant root respiration positively when it is adequately filled with oxygen. Soil that is too moist (wet beyond field capacity) and lacks sufficient oxygen will have plants where the root systems do not perform properly. In soil (or other non-fluid grow medias) the goal is to fully saturate the media during a watering cycle and then allow it to drain, evaporate and transpire (through the plant) long enough for healthy respiration to have occurred. You will note when reading up about various plant species that some do much better in wet and soggy soil than others. These are better capable of transporting oxygen produced by cellular respiration down to their roots. Where a plant can do this well, it can tolerate the lack of root respiration far better. Know this aspect of your crop, and do not keep the soil wet longer than that specie can handle.

Digging a little deeper into the science behind agriculture and horticulture will improve your understanding of various recommendations you might receive. When a recommendation does not seem to match this science you will be "tipped off" to question it, and look deeper into the issue. Using a better understanding of Plant Biology to improve the vigor of your crops is a very satisfying experience. Learn, take notes on each crop and be the best gardener you can be.

	Use your QR Reader app to visit the reference webpage for this article. You will be able to read the added information on how to make your understanding of advanced plant biology terminology better, and do additional research for your self on several articles that have been referenced in this piece.

Enjoy!

Frank Rauscher