

# Other Metabolic Functions of Water in Grapevines

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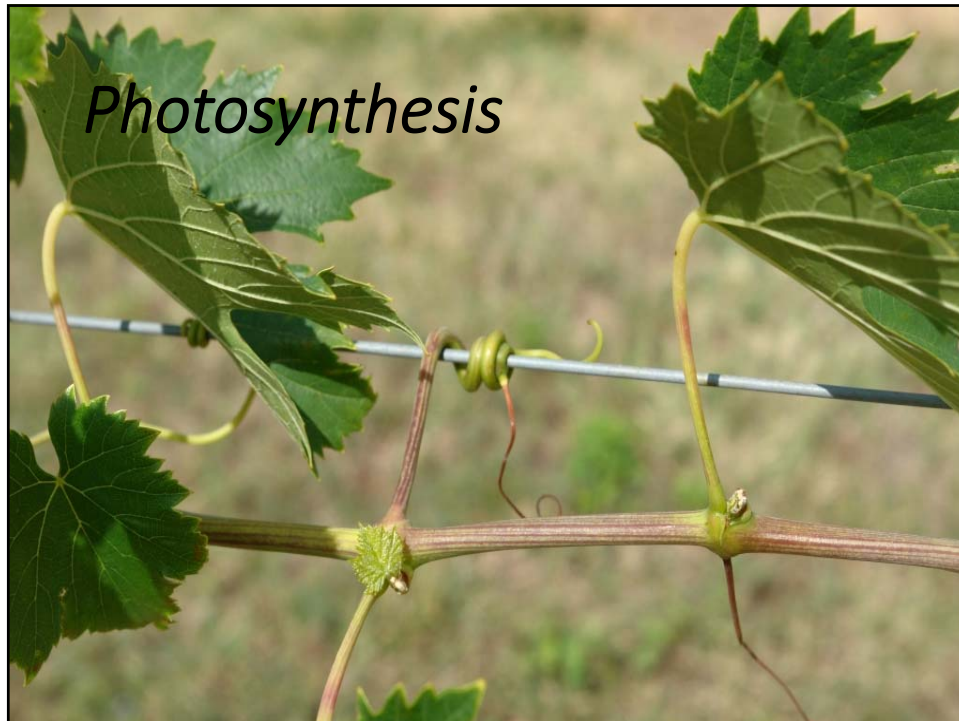
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## *Water is....*

- 80-90% of the fresh weight of living plant cells
- The Solvent by which gasses, salts and other solutes are moved in and out of plant cells and from organ to organ
- An Important reagent in numerous plant biochemical and biophysical processes
- The agent responsible for plant turgor and the proper functioning of stomata





## Photosynthesis

- Photosynthesis is the use of  $\text{CO}_2$  and Water ( $\text{H}_2\text{O}$ ) by Plants to Produce Glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and  $\text{O}_2$
- The energy source is Sunlight
- Photosynthesis is the Process by which Grapevines Produce Usable Energy for the Vine



*In Addition to Several Other Tangential Processes, Limiting Water Directly Limits Photosynthesis Depriving the Vine of Energy*





## Respiration

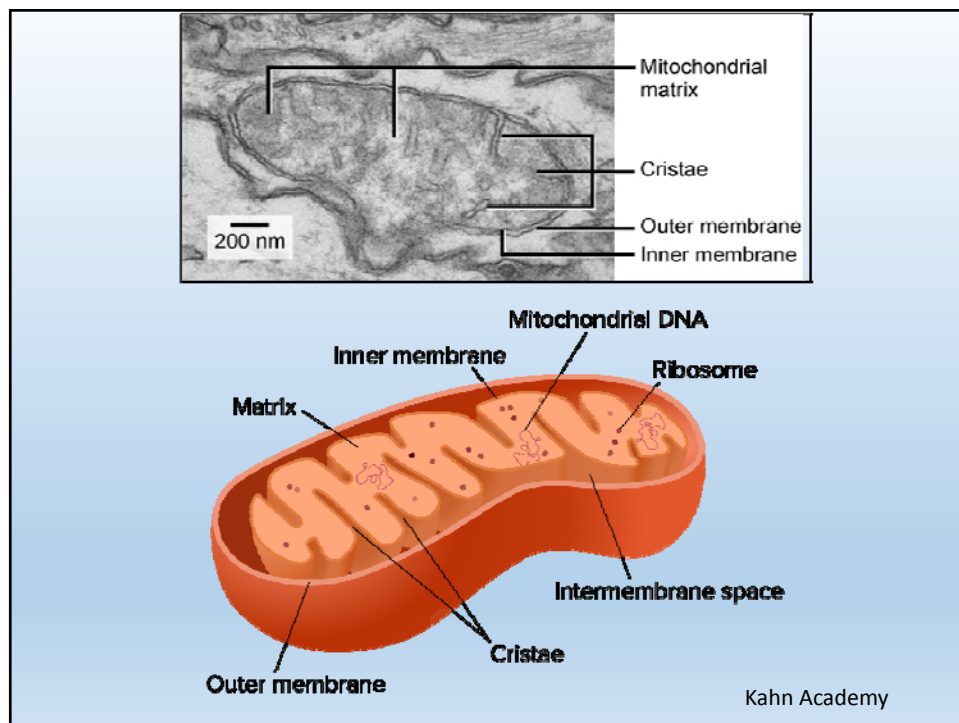
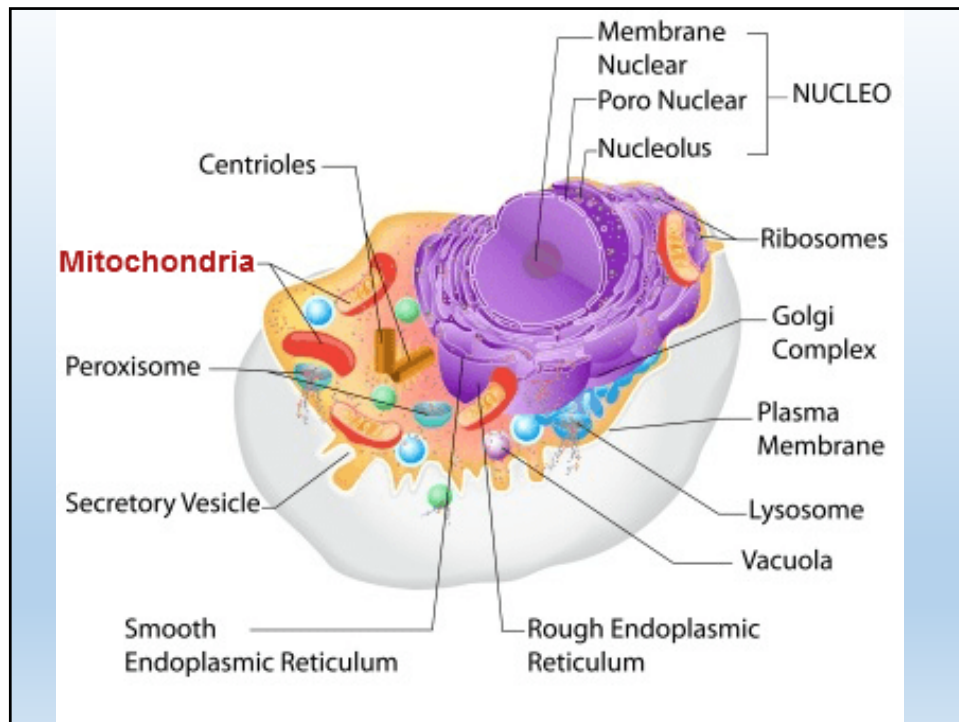
**Respiration**

$O_2$   
 $CO_2$   
 $H_2O$

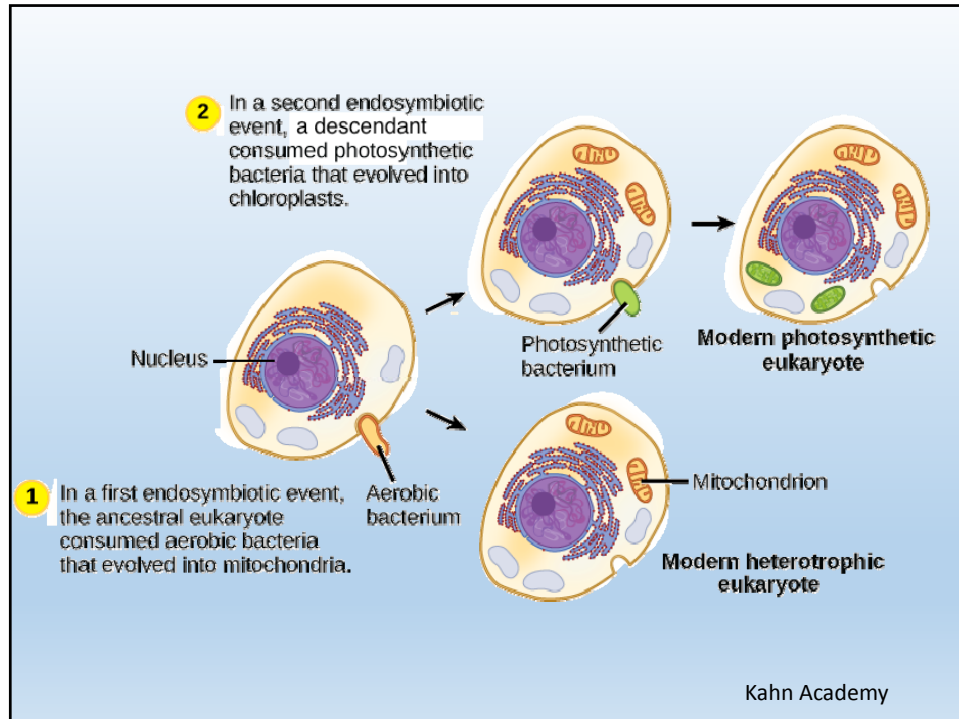
glucose is used up during cellular respiration to provide the plant with energy

<http://www.scienceunleashed.ie/GenImage.aspx?id=1022>

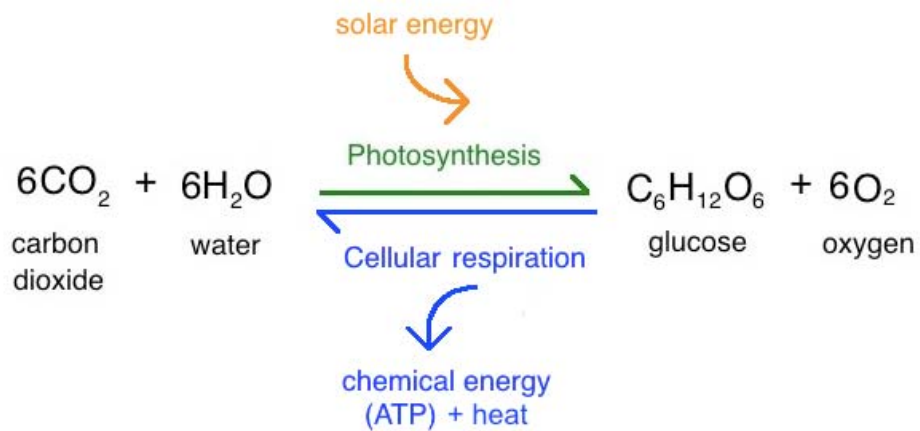
- Respiration involves a series of enzyme-driven reactions that allow plants to convert the stored energy of carbohydrates made from photosynthesis into a form of energy they can use to power growth and metabolic processes
- These reactions Break the molecular bonds of carbohydrates to create plant-usable energy in the form of adenosine triphosphate (ATP)
- Byproducts of these reactions are  $CO_2$ , Water and Heat







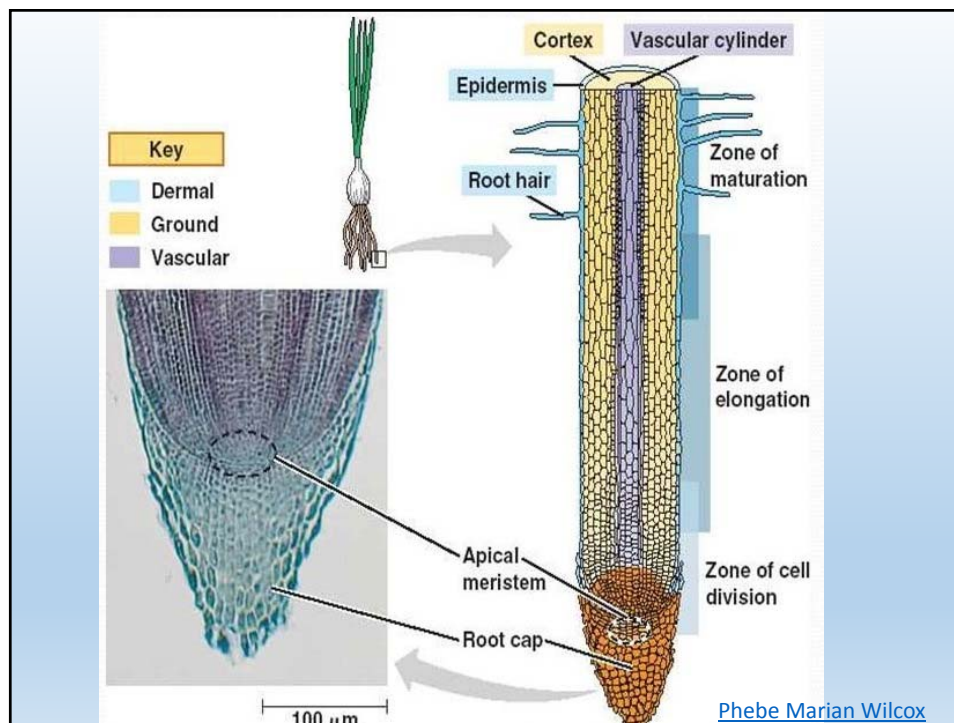
## Reactions Compared



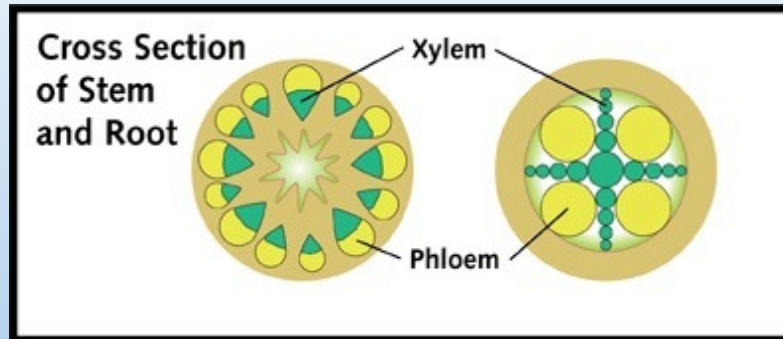
Kahn Academy

## *How Water Is Moved In Grapevines*

- Water & Nutrients Are Primarily Absorbed By New Root Tips
- Vines Go Through Numerous Cycles of Root Growth During the Annual Growth Cycle
- Dormancy is a Key Period of Root Growth In Our Climate
- Water Absorption Continues Through Dormancy Although Vine Direct Needs Are Small



## How Water Is Moved In Grapevines



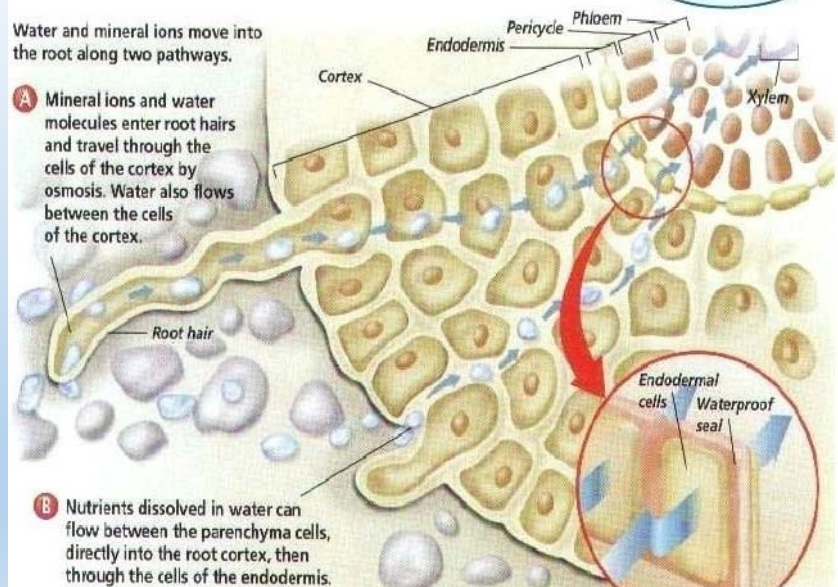
<http://science.jrank.org/>

## Water uptake in ROOT

Water and mineral ions move into the root along two pathways.

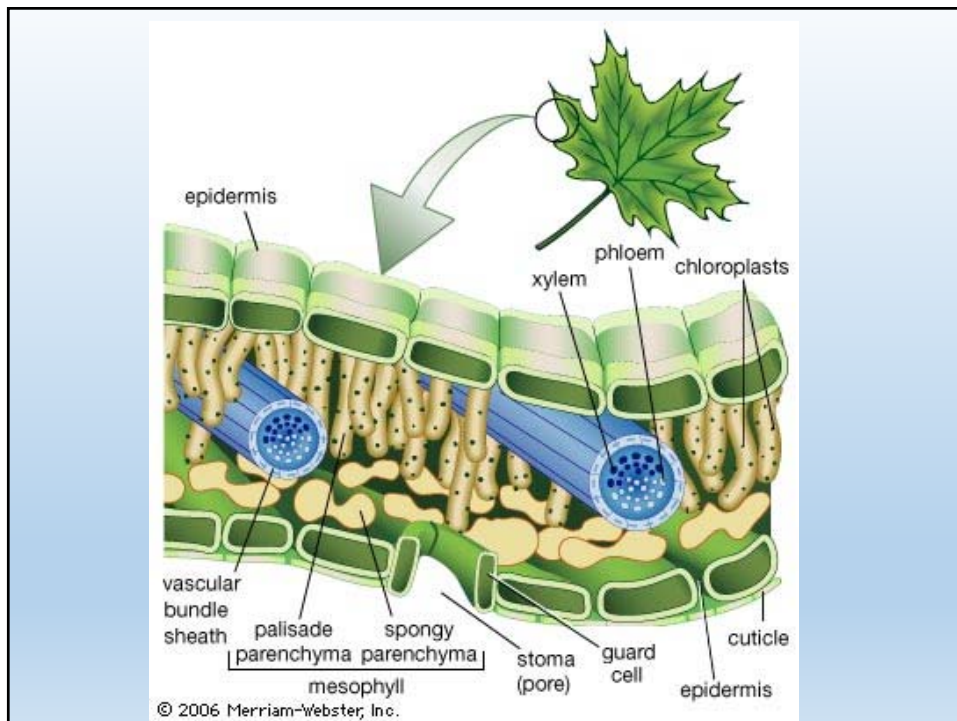
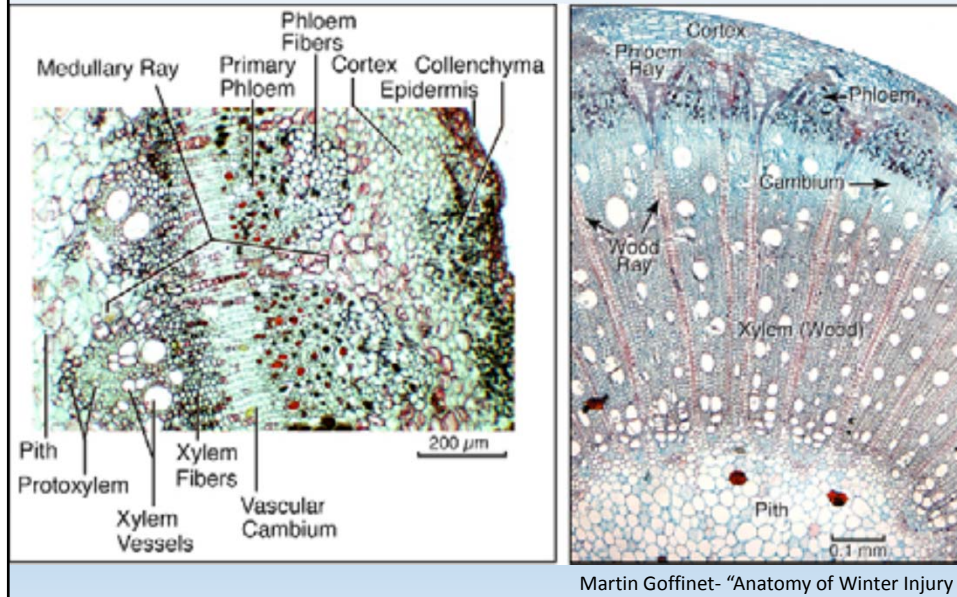
**A** Mineral ions and water molecules enter root hairs and travel through the cells of the cortex by osmosis. Water also flows between the cells of the cortex.

**B** Nutrients dissolved in water can flow between the parenchyma cells, directly into the root cortex, then through the cells of the endodermis.



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## Grapevine Vascular System





## *Leaf Cuticle Differences Between Varieties Can Influence Water Loss*



## *How Does an Overabundance of Water Affect Vine Growth?*



- All living parts of Grapevines Respire
- Flooded Fields Deprive Roots of Oxygen Needed for Root Respiration  
Limiting uptake of Nutrients
- Flooding Often Decreases Stomatal Turgor Leading to a Reduction of Photosynthesis and Respiration

## *Water & Nutrient Uptake*

- Water & Nutrient Uptake are Closely Associated Because Available Nutrient Ions Are Dissolved in Soil Solution
- Nutrient Uptake By Grapevines Follows a Soil to Root to Shoot Pathway
- Leaf Transpiration Generates the Water Tension Needed for the Uptake of Nutrient Solutions



Adapted From 'Deficit Irrigation and Vine Mineral Nutrition'- Markus Keller

## *Water & Nutrient Uptake*



- In a Drying Soil, Uptake of Water & Nutrients Becomes Increasingly More Difficult
- Application of Nitrogen Can Render Vines More Susceptible to Drought Because N Favors Shoot Growth Over Root Growth
- Shoot Growth is the "Pacemaker" For Nutrient Uptake in Grapevines

Adapted From 'Deficit Irrigation and Vine Mineral Nutrition'- Markus Keller

## How Does Water Status Affect Grapevine Winter Hardiness

- In Preparation for Dormancy, Grapevines Begin Moving Water From Within Cells to Intercellular Spaces
- Cells Begin to Accumulate Proteins and Carbohydrates Which Act As Antifreeze Mechanism Within Plants
- K<sup>+</sup> ions, Activate Antioxidant System Within Plants Helping Them Survive Cold Events
- Water Deficit During Winter Inhibit All of These Functions