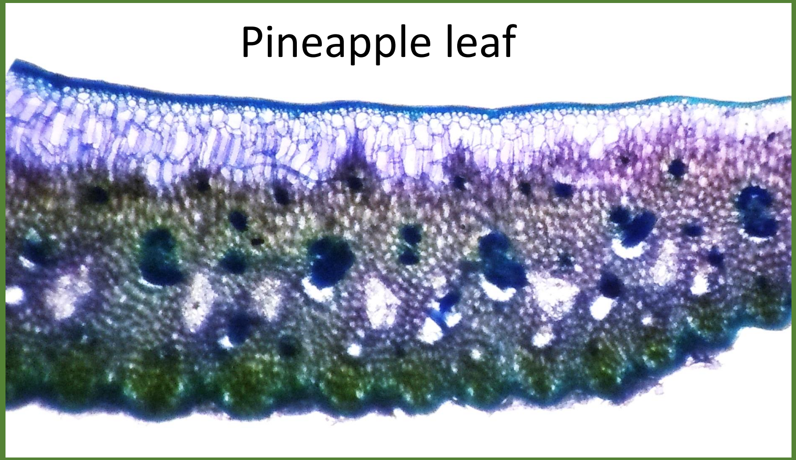
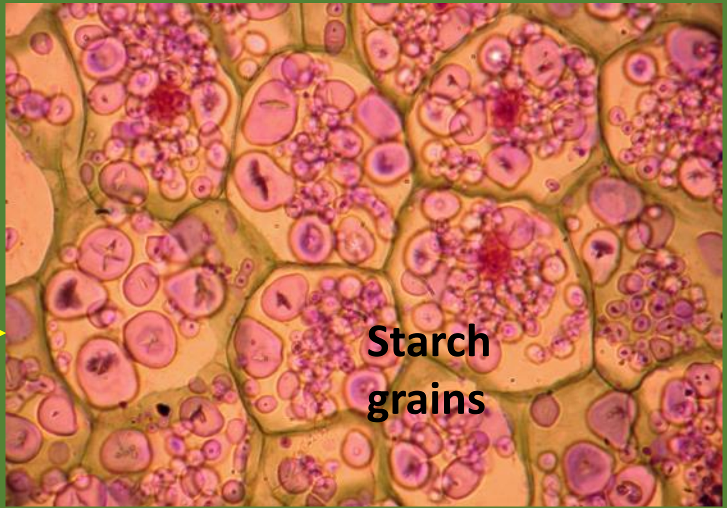
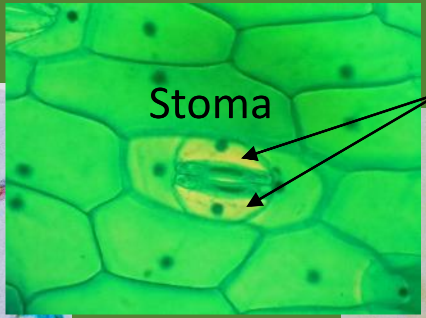


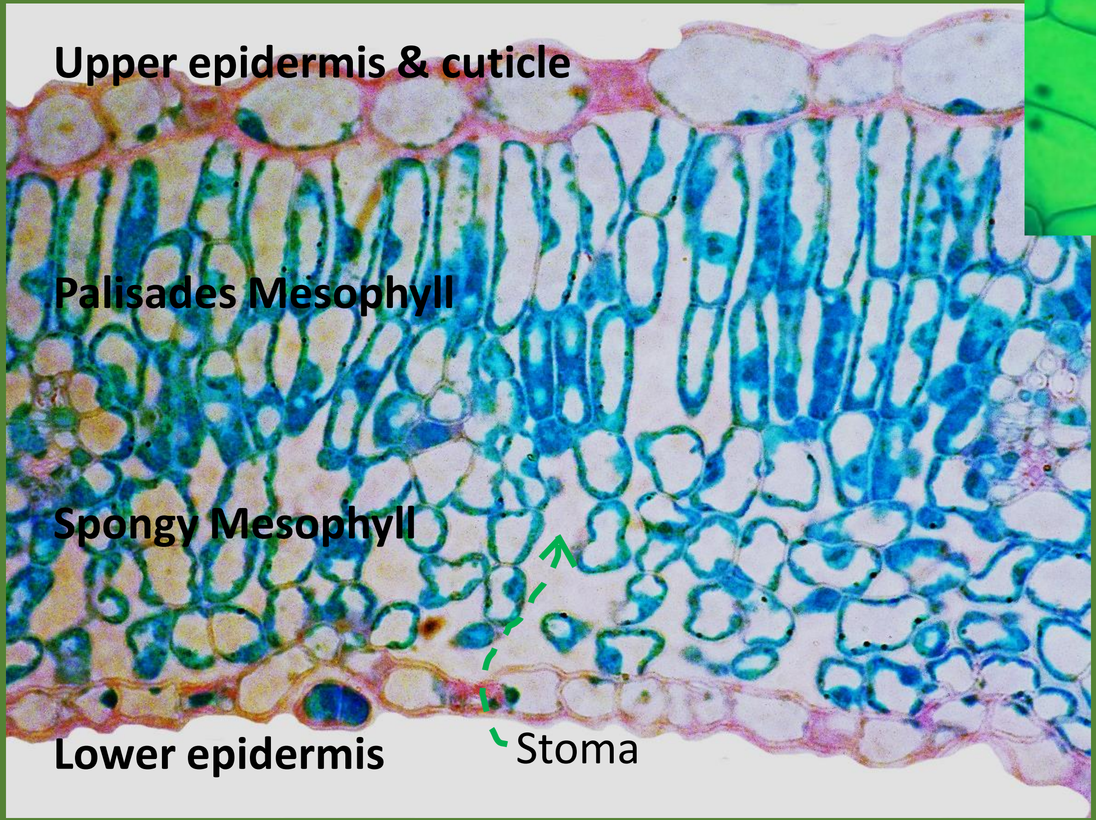
PHOTOSYNTHESIS:

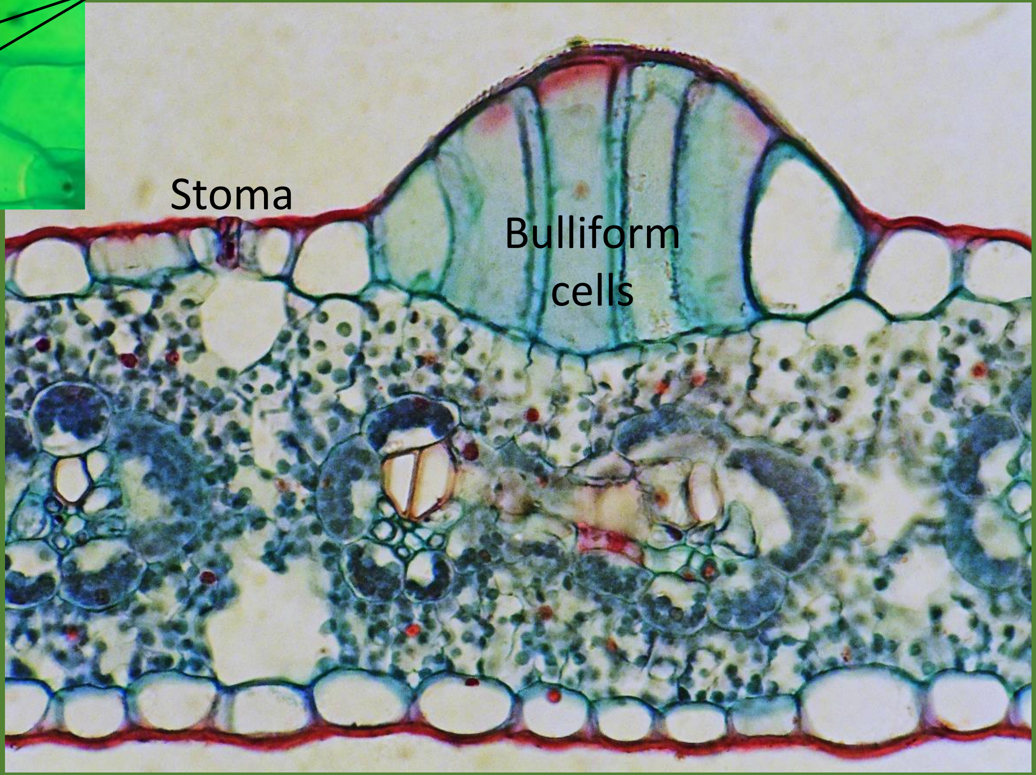
$$6\ CO_2 + 6\ H_2O \longrightarrow 6\ O_2 + C_6H_{12}O_6$$

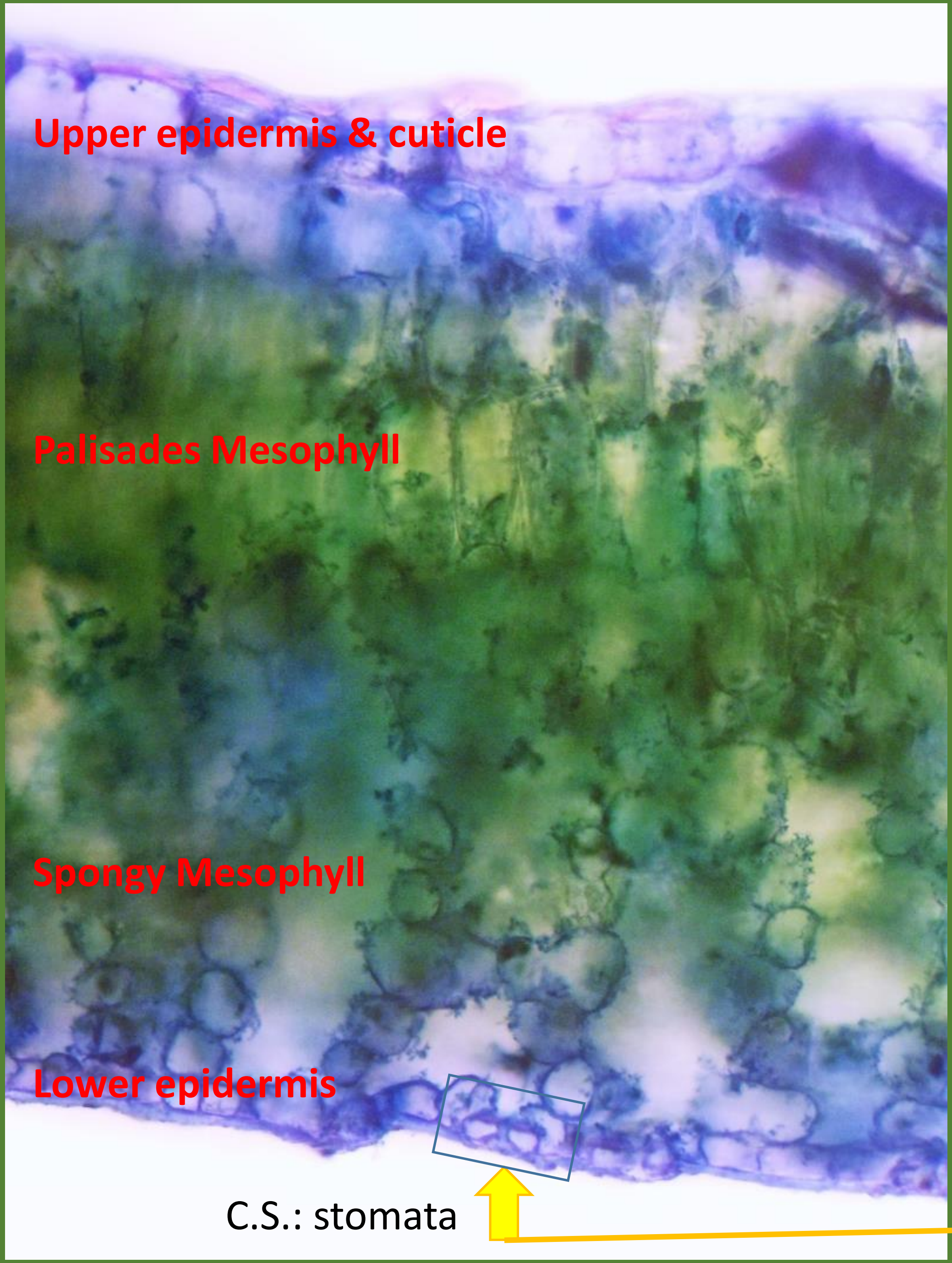
C3, C4 & CAM

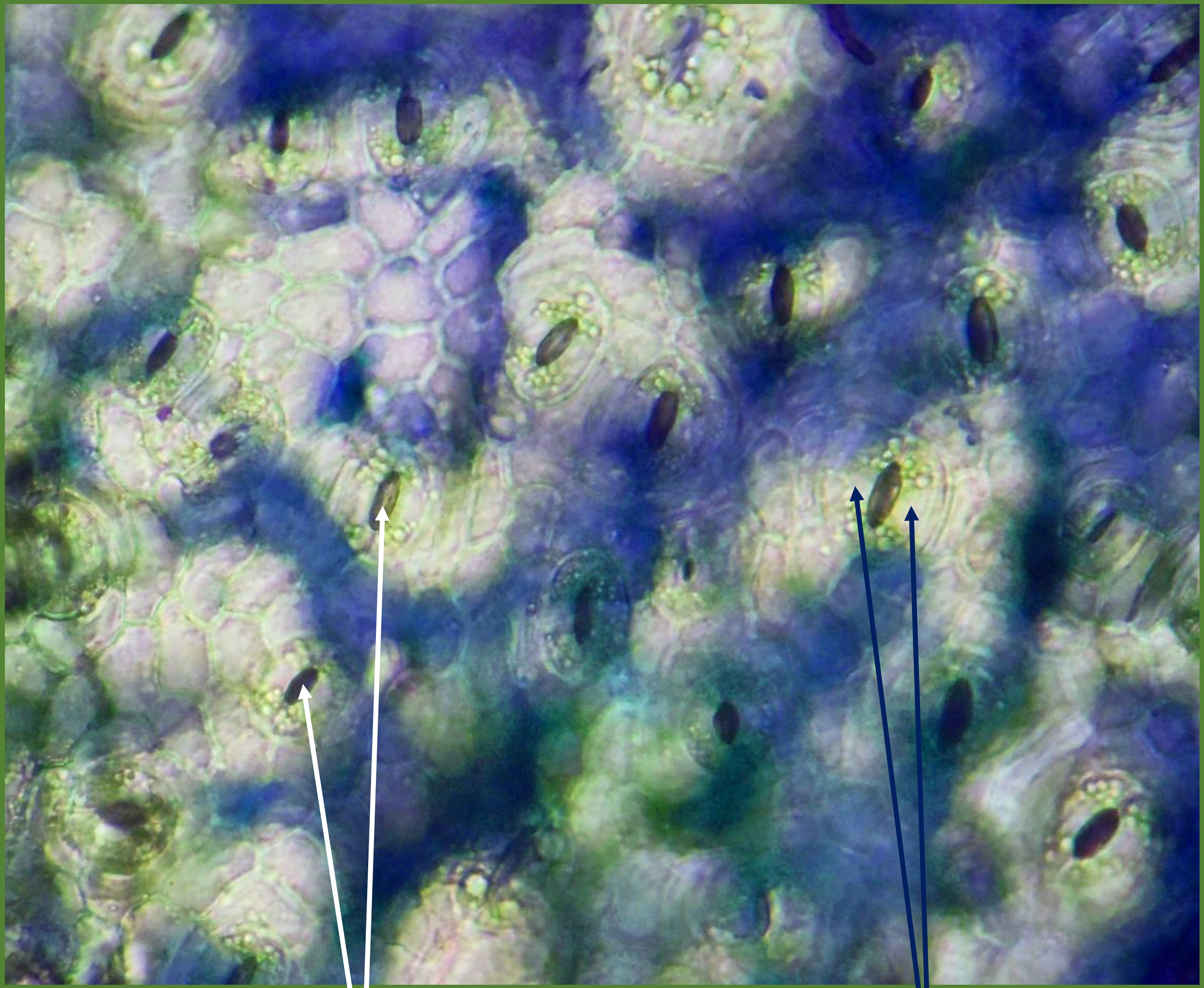






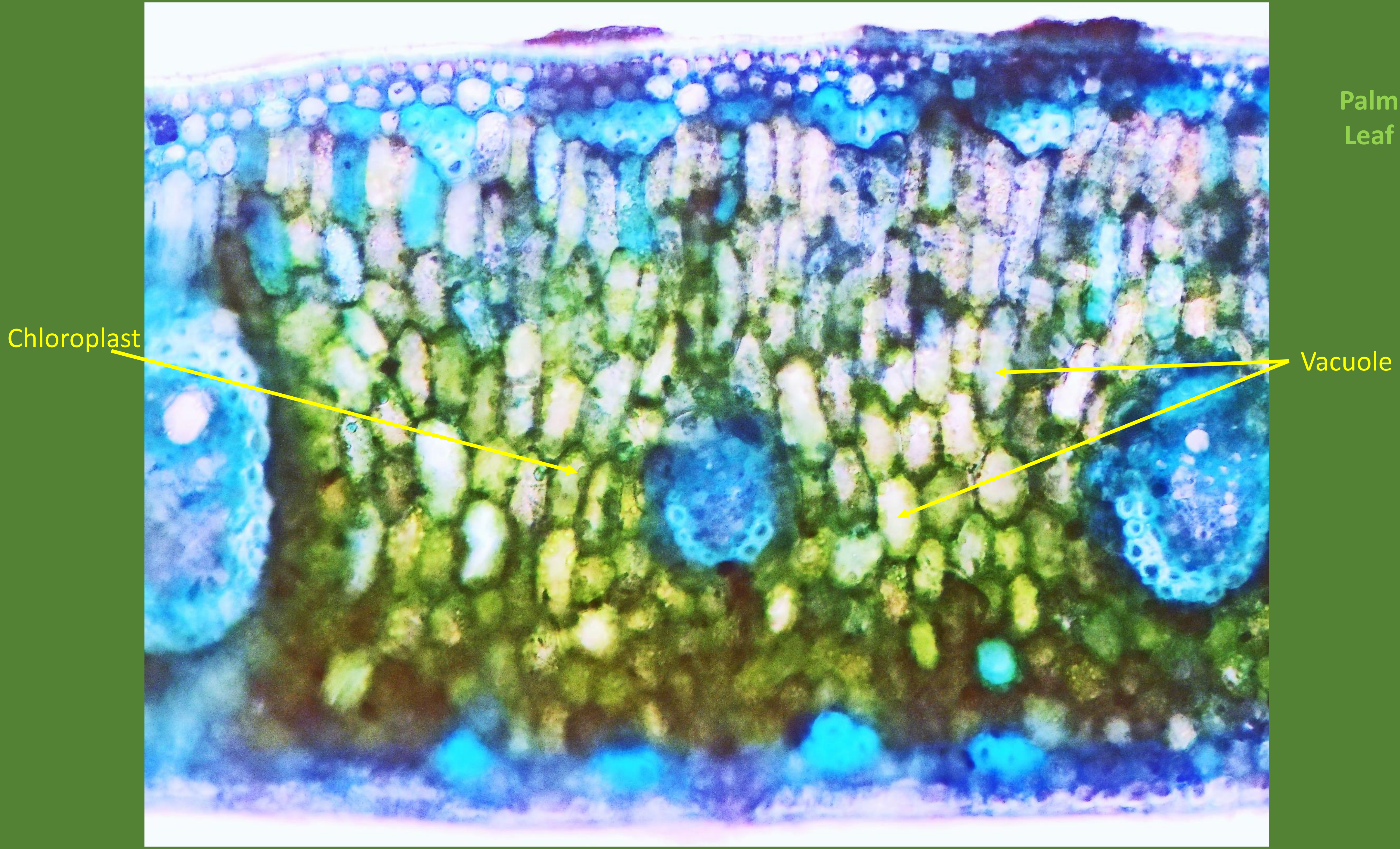




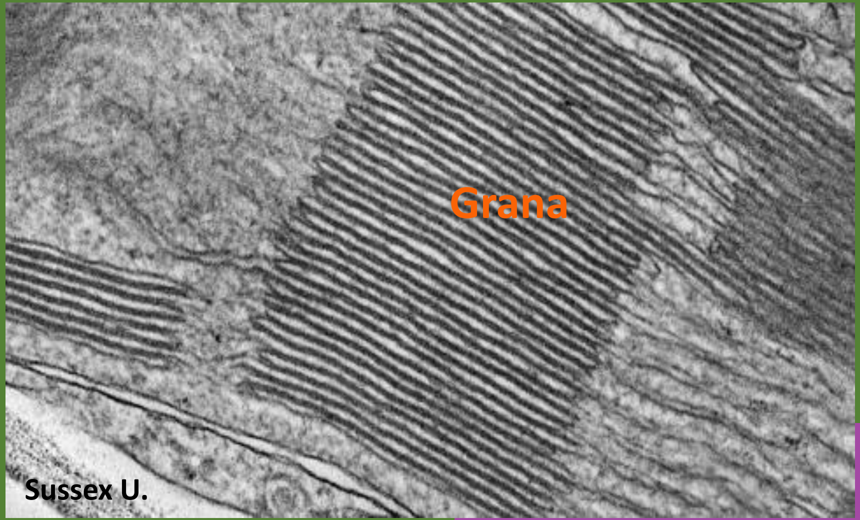


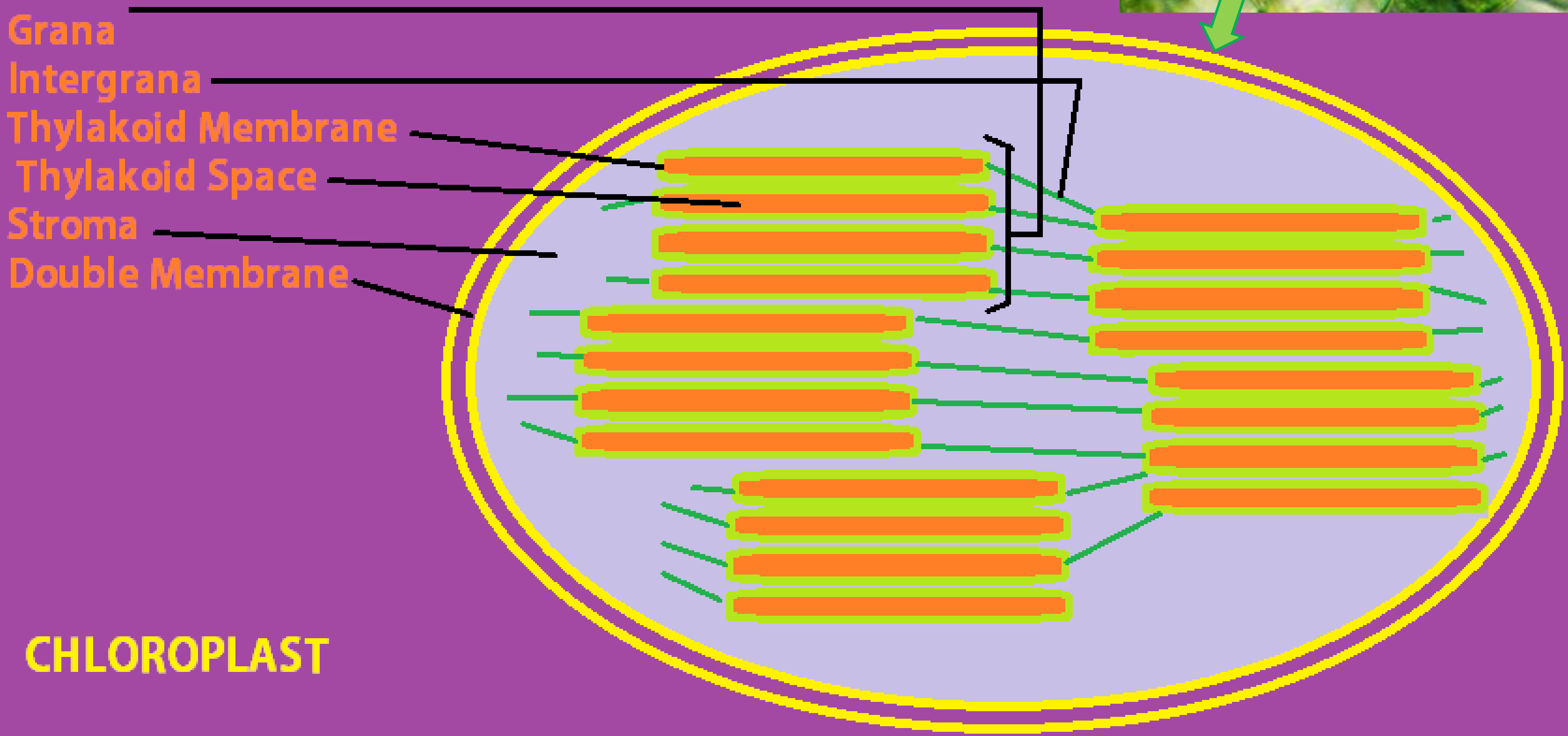
Lower leaf surface showing
STOMATA & Guard Cells

Palm Leaf



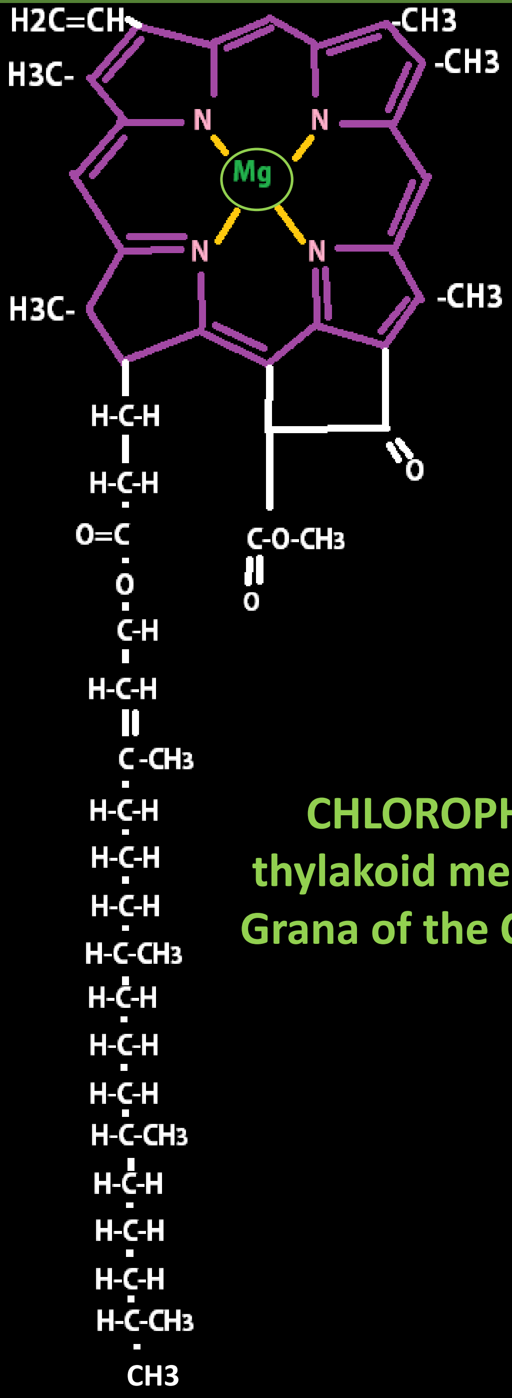
In photosynthesis , chlorophyll-a uses sunlight to oxidize water to Oxygen and releases Hydrogen & 2 electrons with high energy levels. These e- are passed down a cytochrome transport system to a hydrogen pump molecule in the thylakoid membrane which uses the e- energy to pump the hydrogens across the membrane giving a large positive charge to the thylakoid space. The H+ ions free fall (equilibrium) back through a machine-like molecule (ATP Synthase) which spins and the energy is used to turn ADP + P into ATP to be used in the Calvin Cycle to make sugars. This is called Photosystem II (P680). Photosystem I (P700), also on the Thylakoid Membrane of the Grana of the Chloroplast, simultaneously uses light to re-energize e- through a cytochrome system which powers NADP-synthase to turn NADP plus H+ into NADPH. ATP & NADPH are used as energy currency to link up Carbon atoms from CO_2 to make sugar molecules in the stroma of the chloroplast via the Calvin Cycle and an enzyme called RUBISCO.





CHLOROPLAST

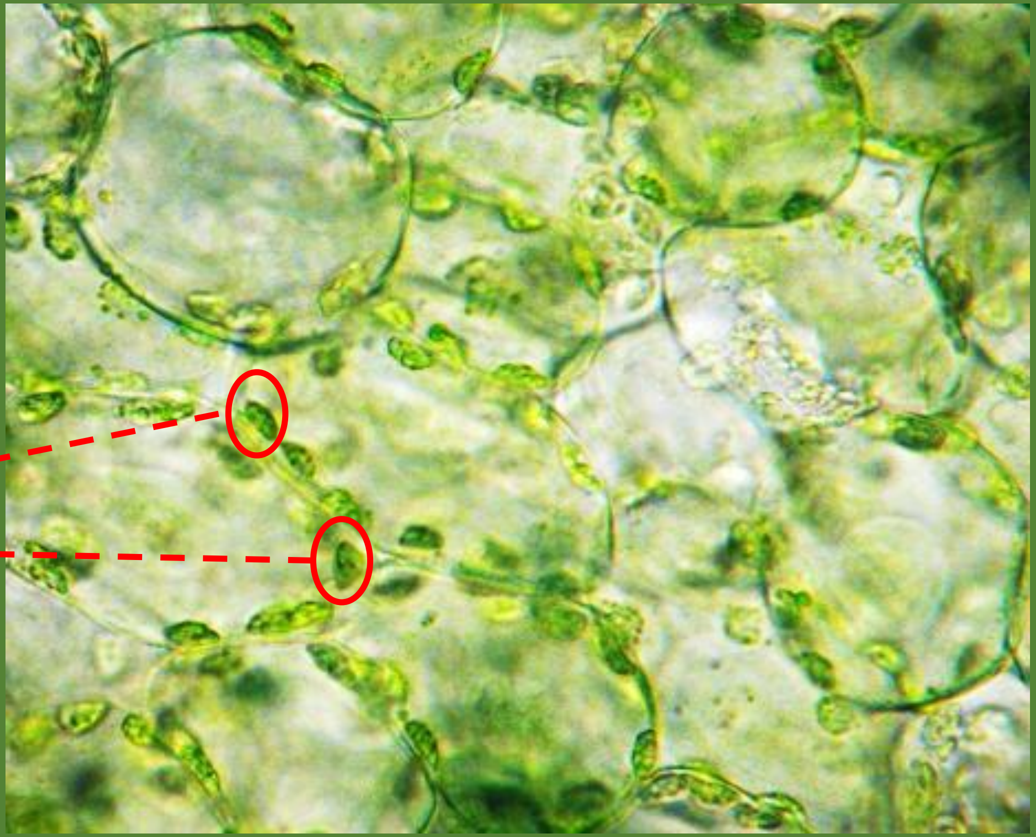
Magnesium 'porphyrin'

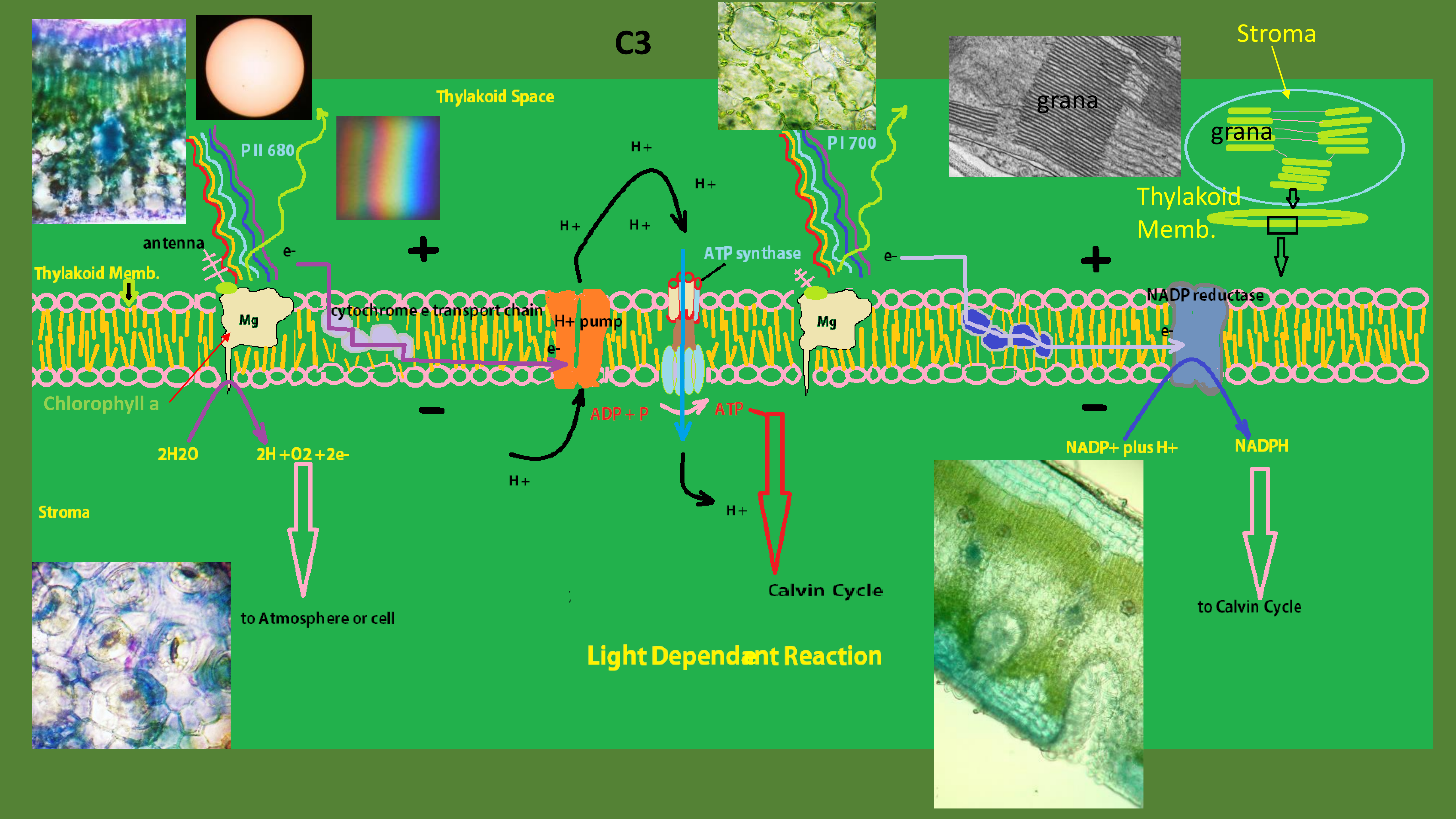


Hydrophobic tail

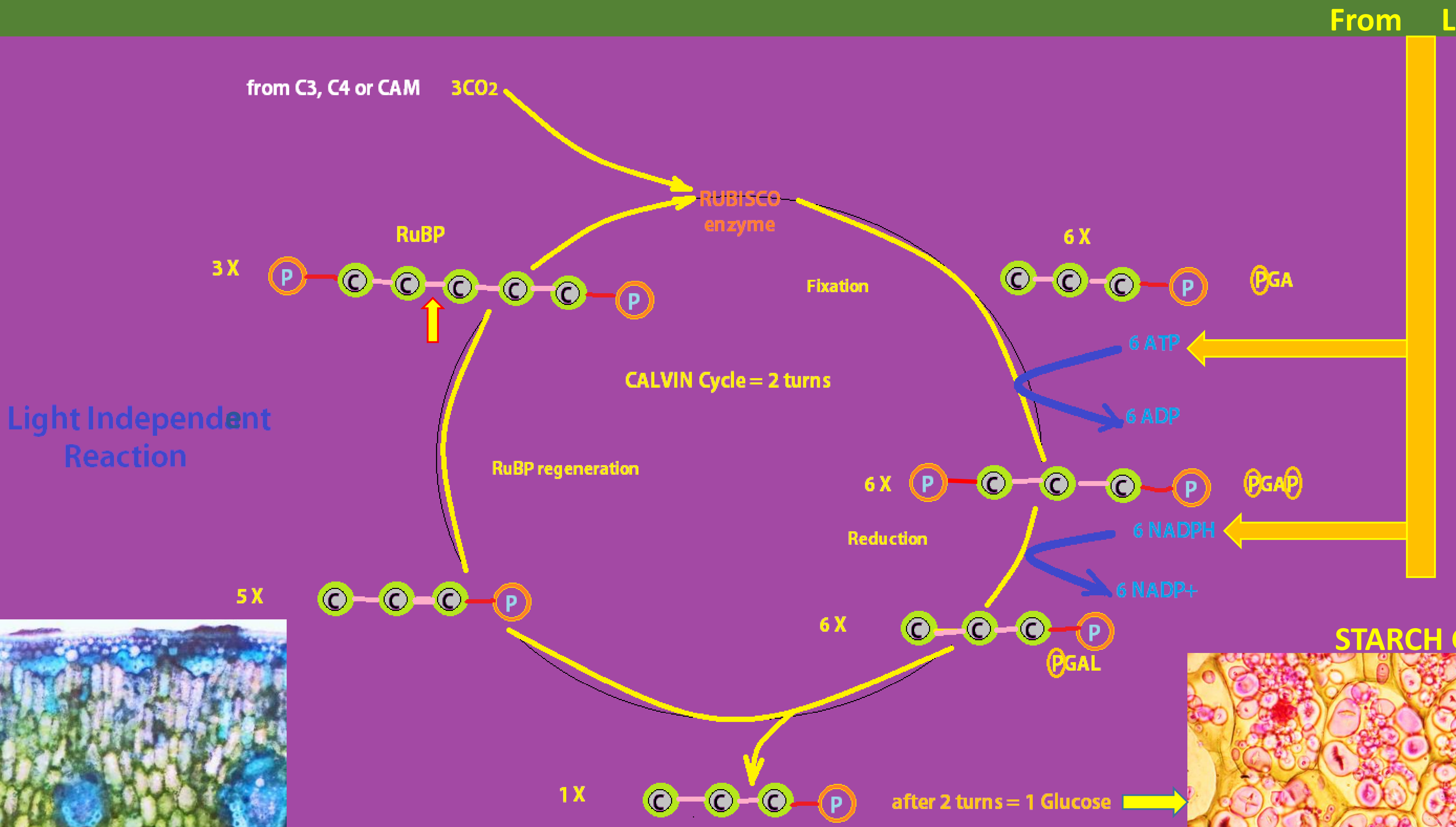
CHLOROPHYLL-a in thylakoid membranes of Grana of the Chloroplasts

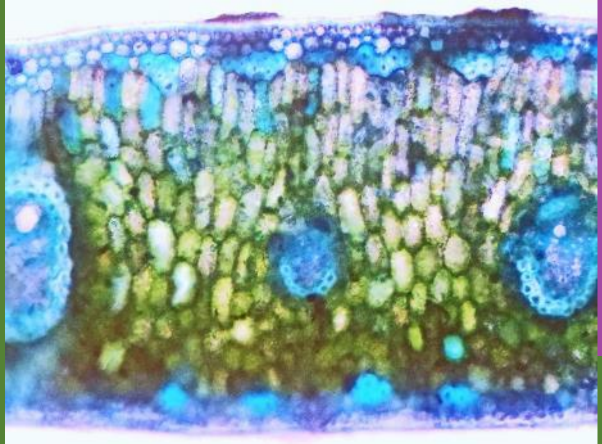
mesophyll



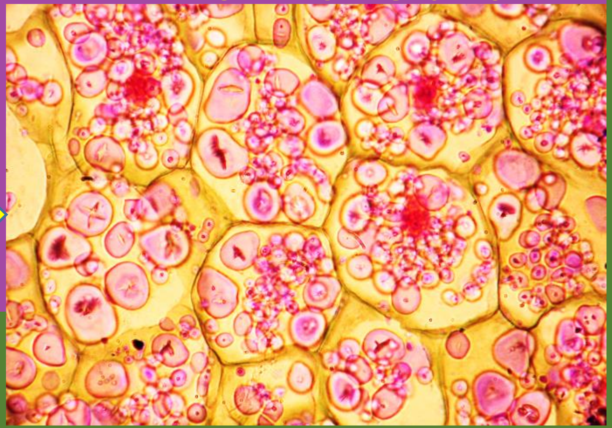


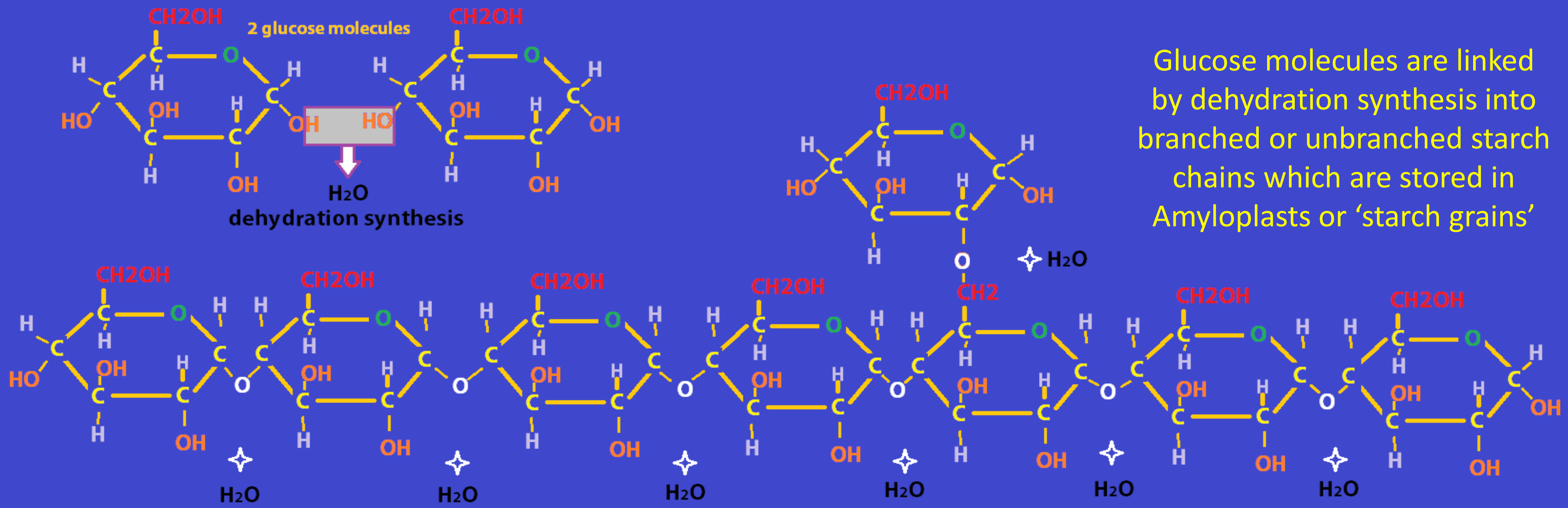
C3
Thylakoid Space
Stroma
grana
grana
Thylakoid
Memb.
P II 680
P I 700
H+
H+
H+
H+
antenna
e-
Thylakoid Memb.
Mg
cytochrome e transport chain
H+ pump
e-
ATP synthase
e-
Mg
NADP reductase
e-
Chlorophyll a
ADP + P
ATP
2H2O
2H +O2 +2e-
H+
H+
NADP+ plus H+
NADPH
Stroma
Calvin Cycle
to Atmosphere or cell
to Calvin Cycle
Light Dependant Reaction



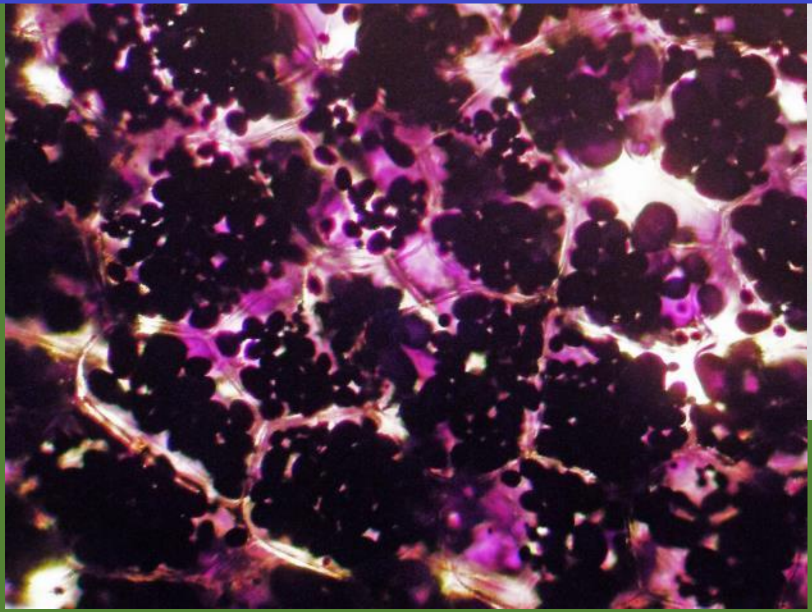


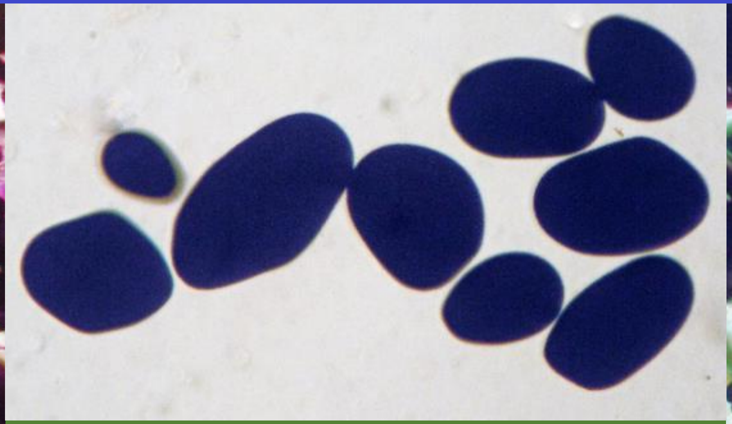
STARCH Grains

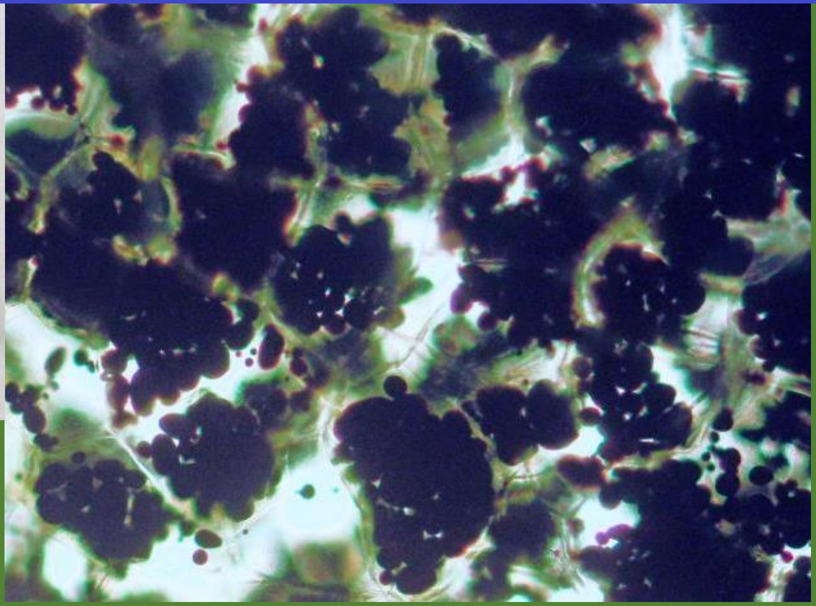




Glucose molecules are linked by dehydration synthesis into branched or unbranched starch chains which are stored in Amyloplasts or 'starch grains'





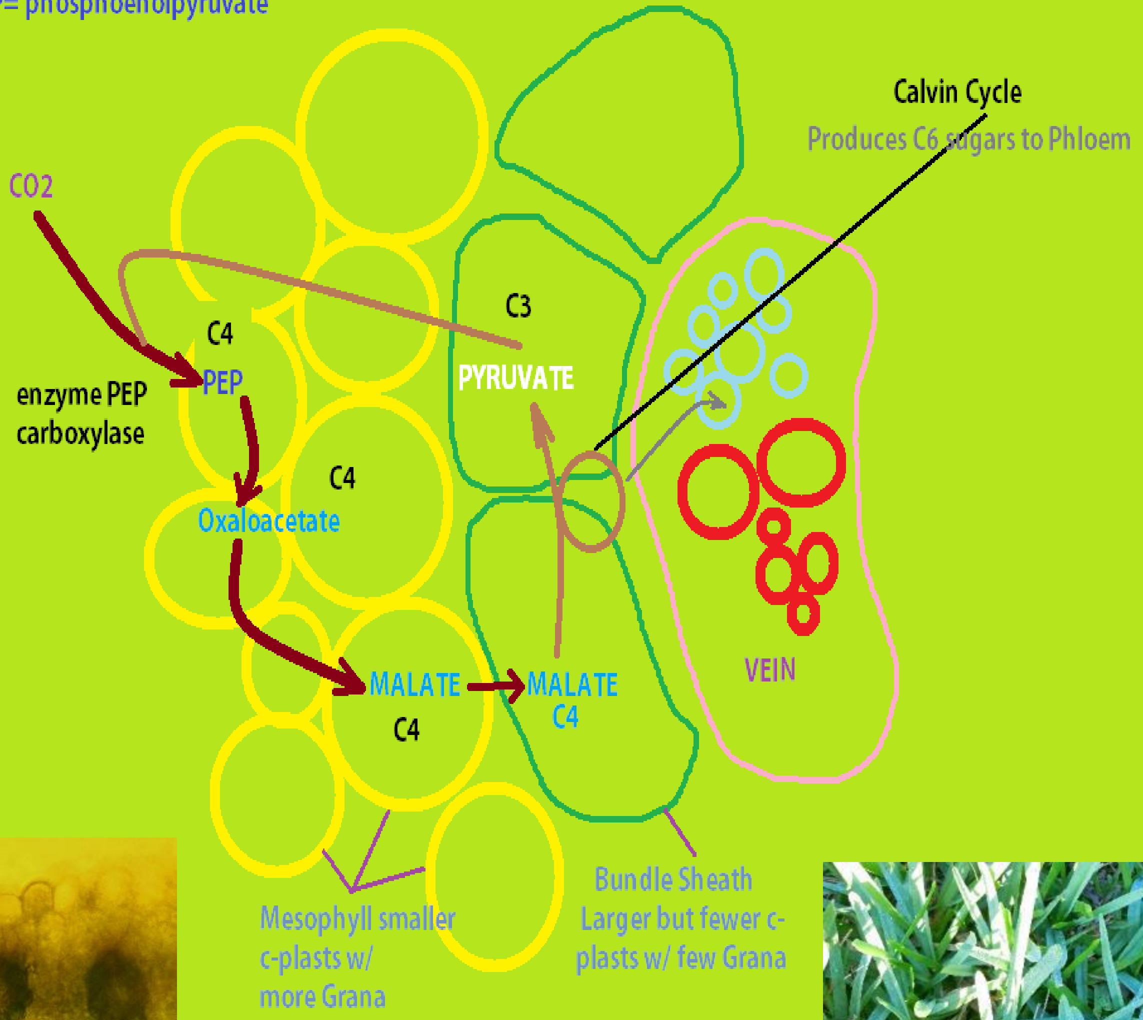


Potato Starch Grains stained purple-black by iodine

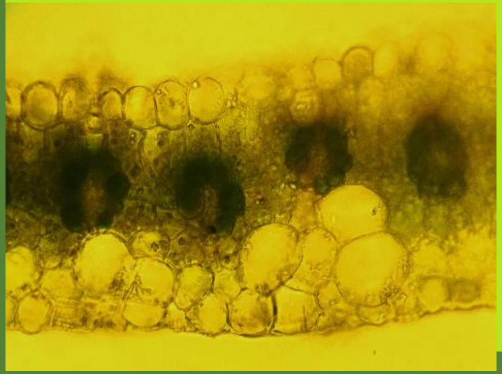
Grasses in hot/dry environments like wheat, corn & St.Augustine Grass

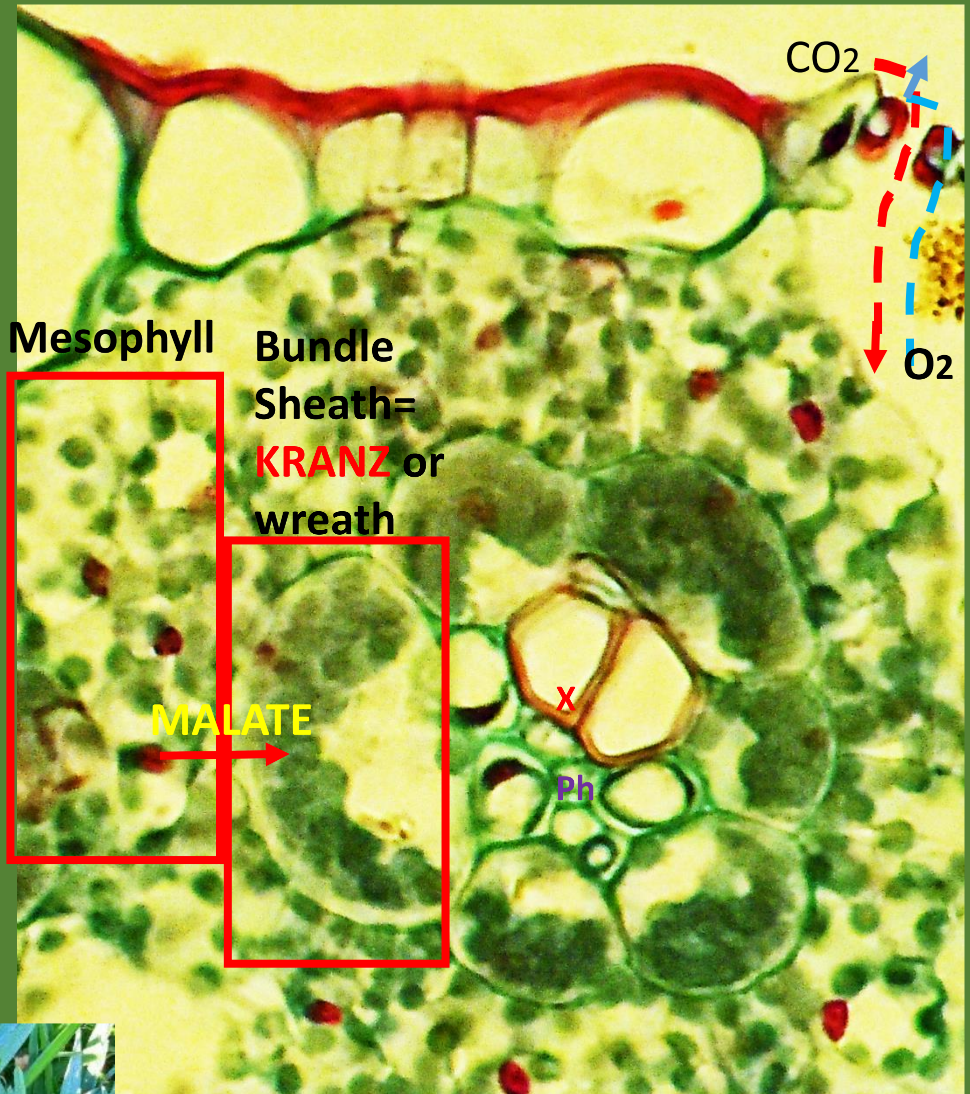
C4 Photosynthesis

PEP= phosphoenolpyruvate

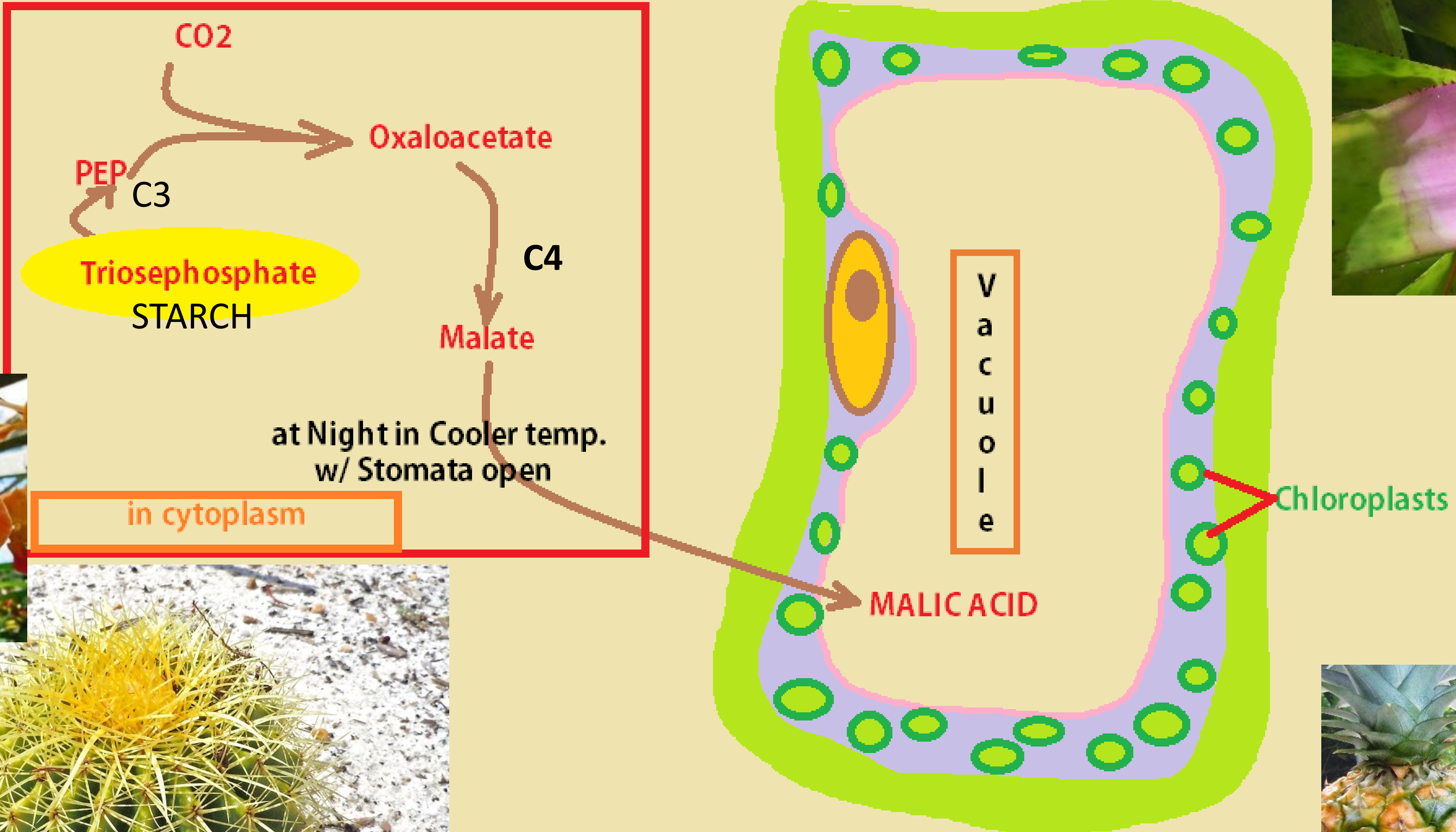


Malate is a C4 molecule that carries CO2 to Calvin Cycle



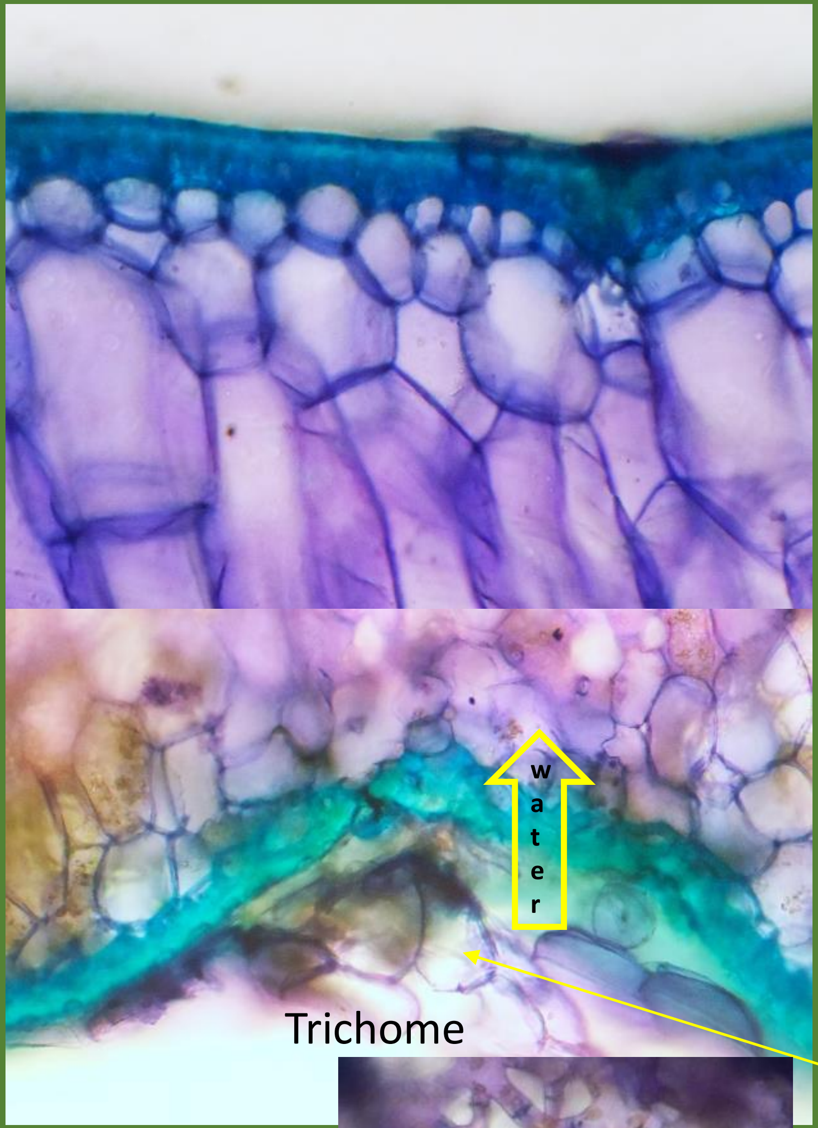


CAM: where water conservation is important

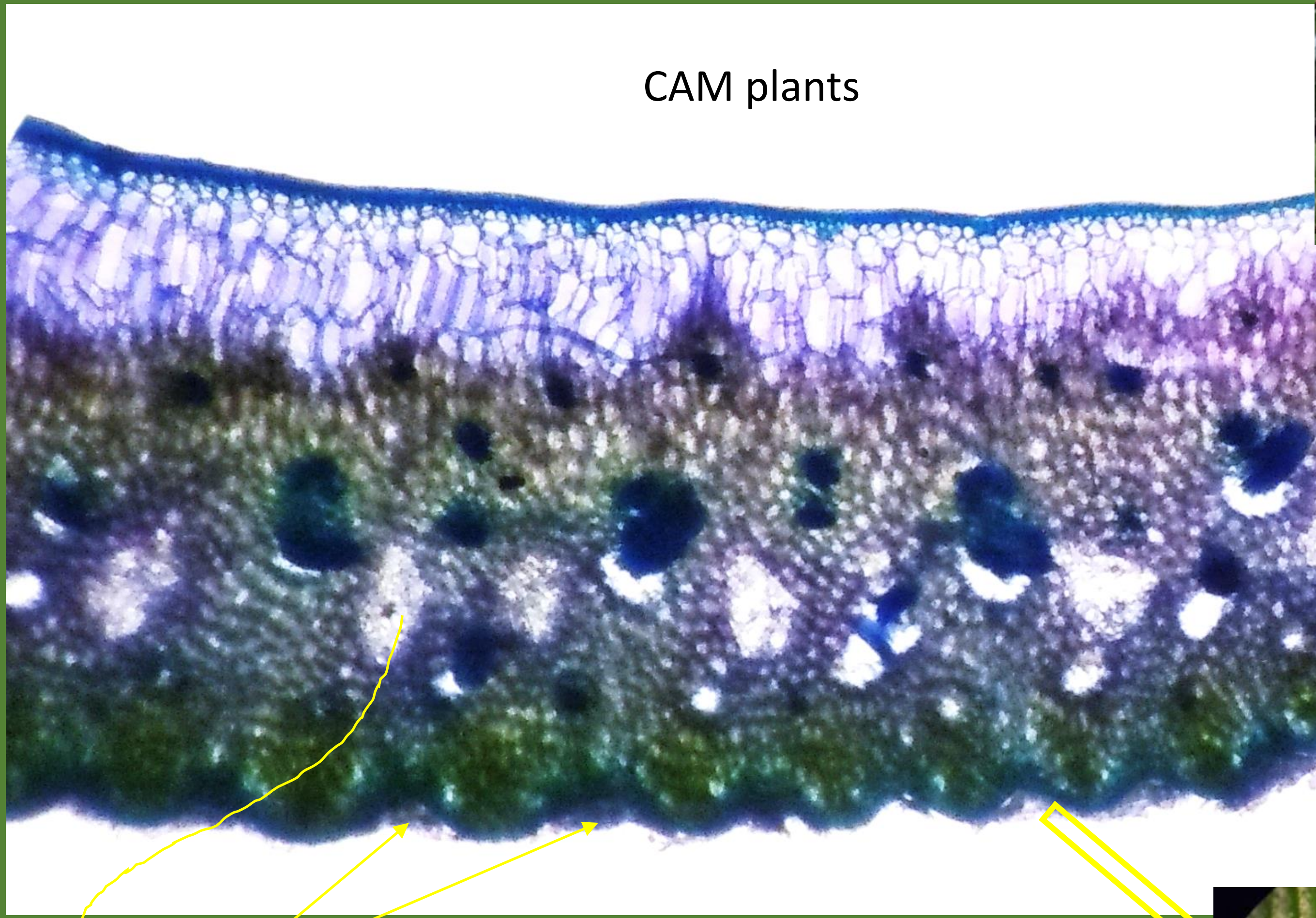


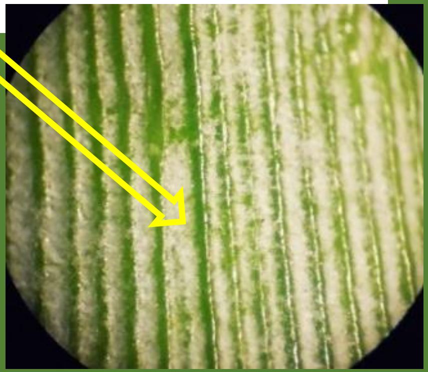
In Hot Day Stomata close & Malic Acid becomes Malate (C4) which gives up CO2 to Calvin Cycle & Pyruvate (C3)

Crassulacean Acid Metabolism (CAM)

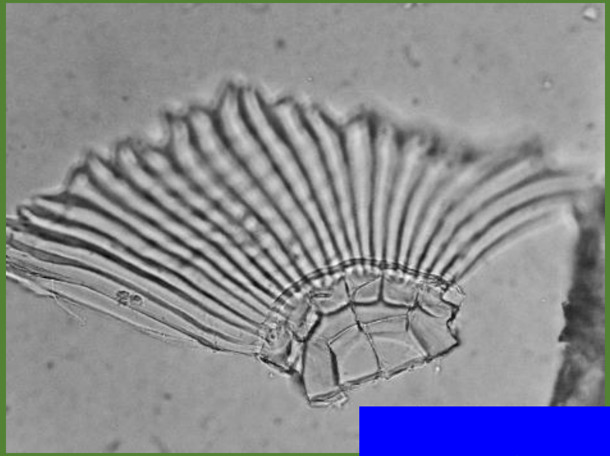


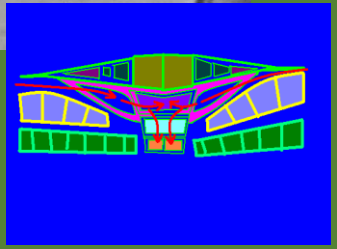
aerenchyma





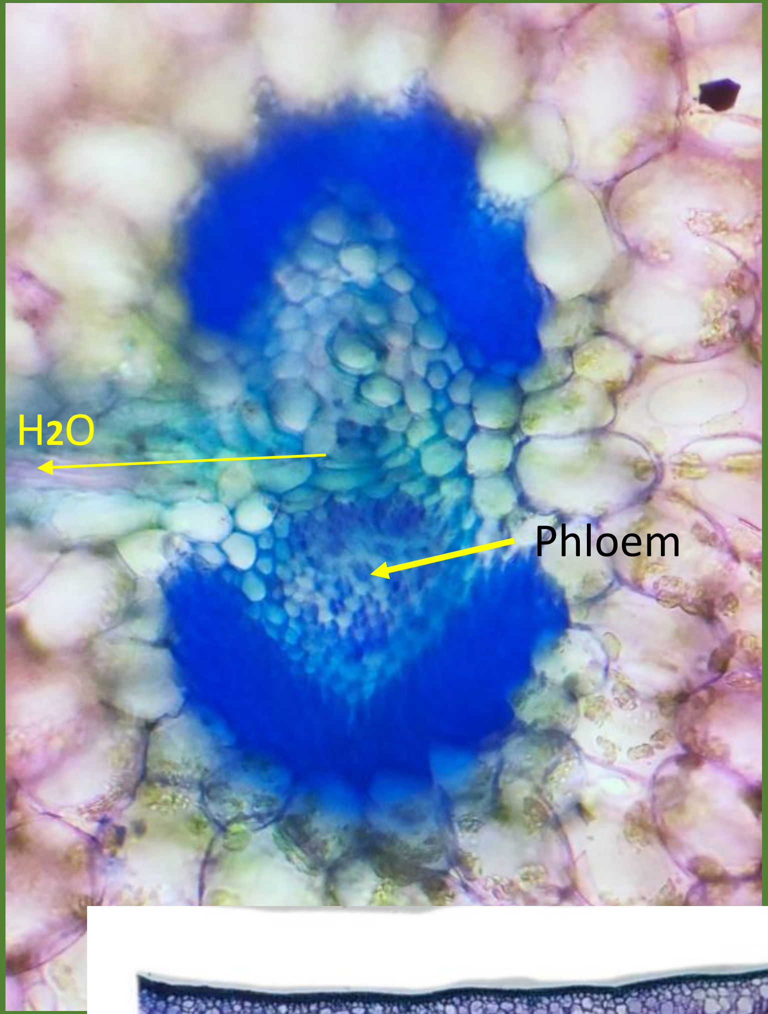
Trichomes collect water vapor in air and dew and funnel it to hidden stomata under the trichomes in dry environments: Pineapple, Tillandsia, Cacti

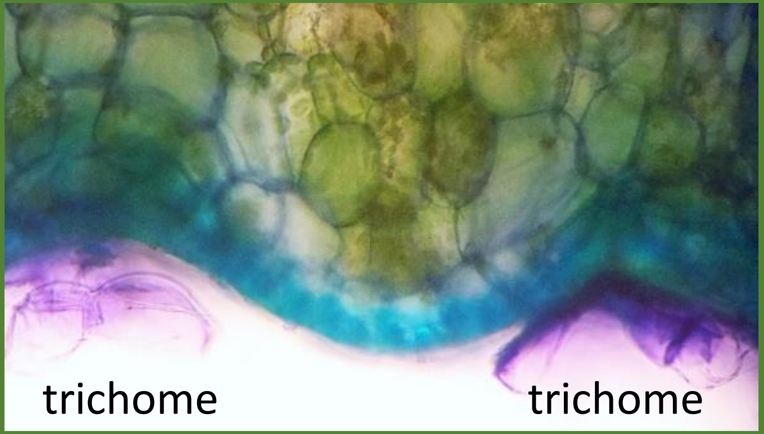


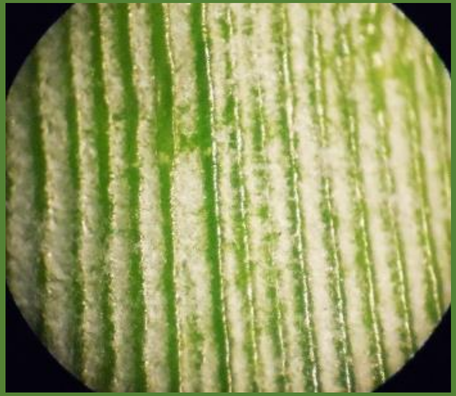


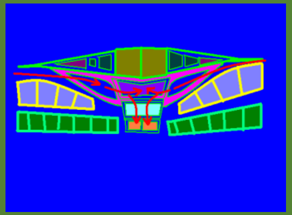
CAM photosynthesis- malic acid holds CO_2 in vacuole: releasd to Calvin cycle when stomata closed in day

Orchids, Bromylliads (*eg* Pineapple), the aerophytes & epiphytes & Cacti: stoma closed all day!

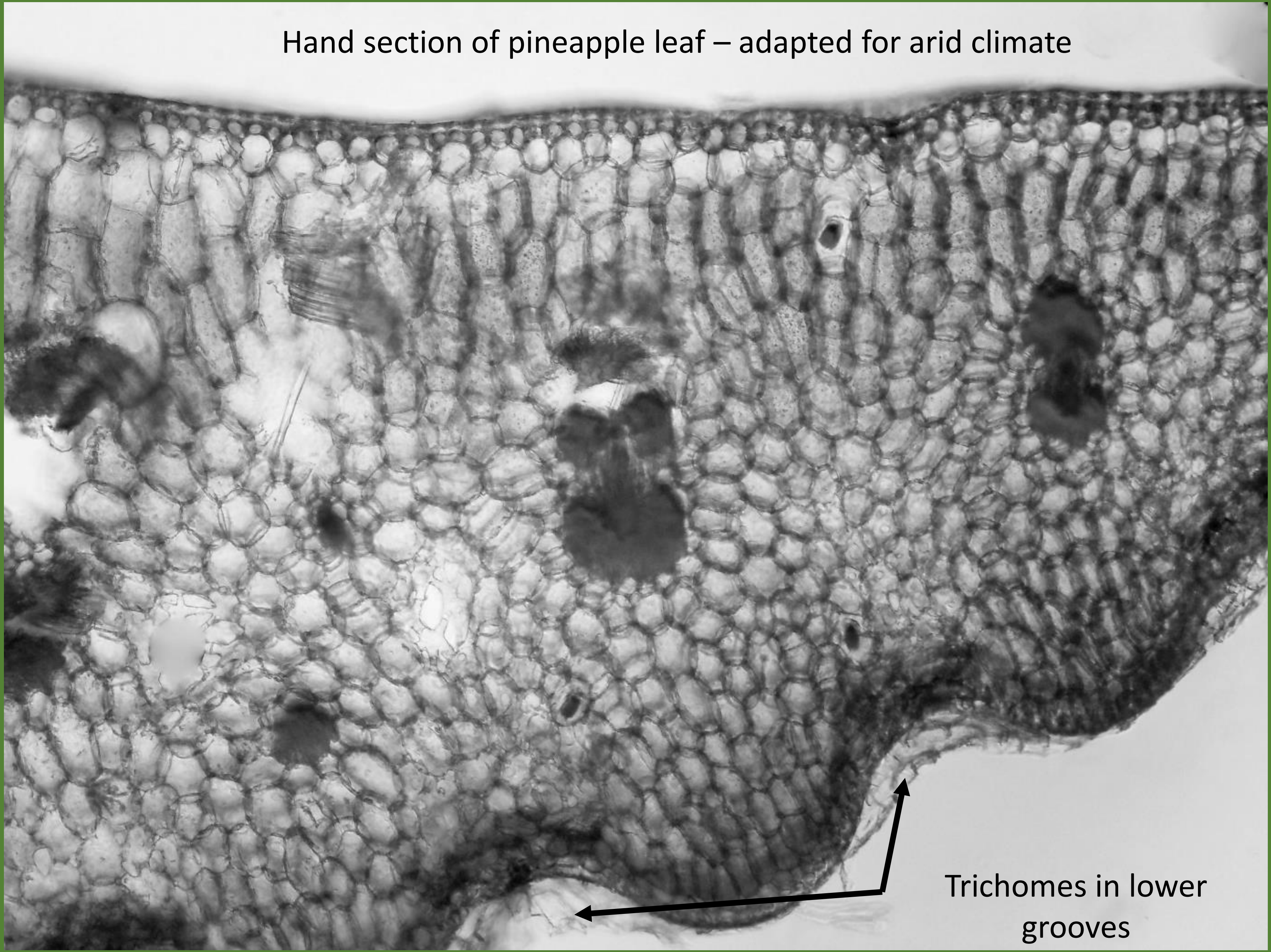


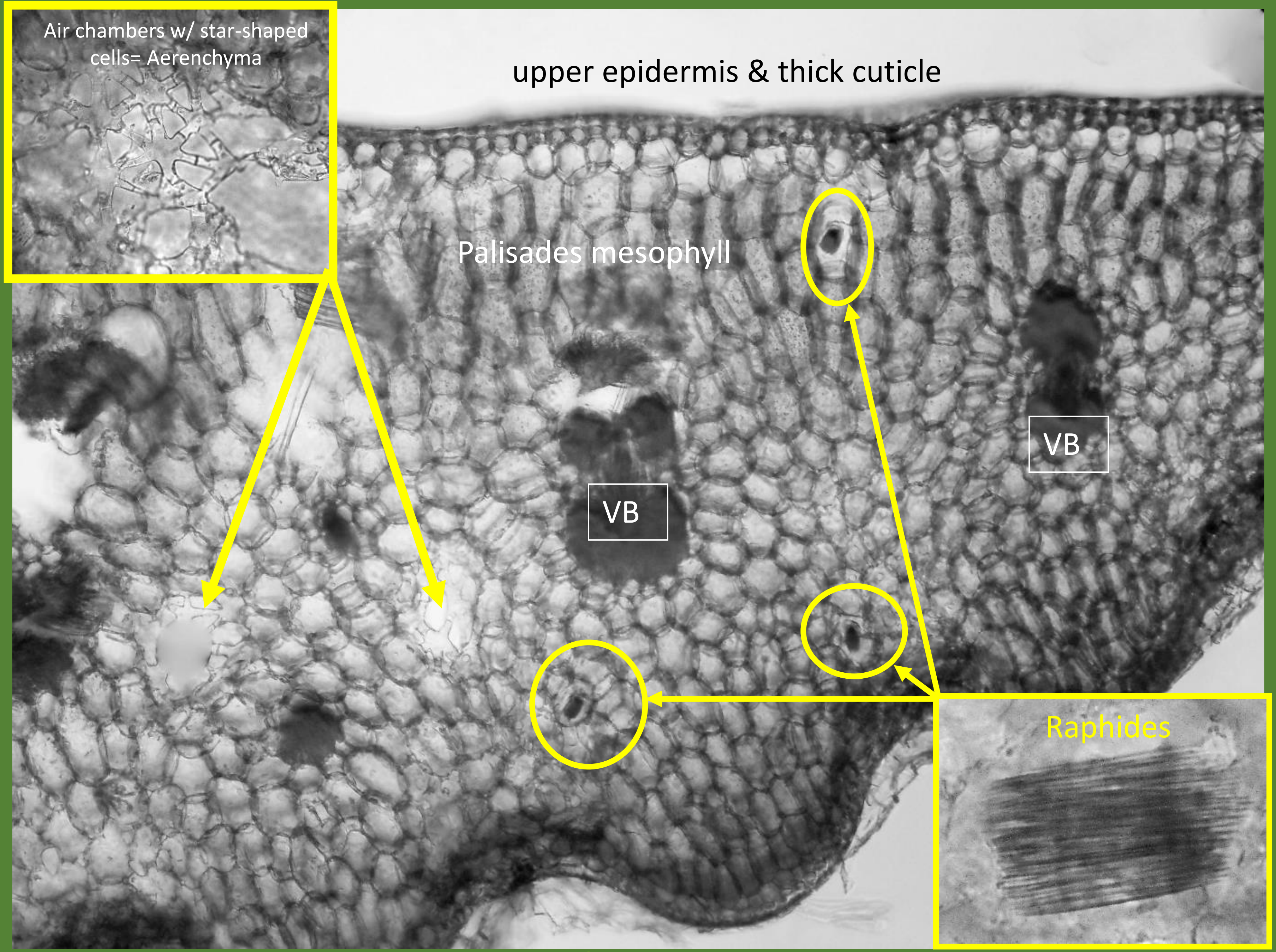






Abaxial leaf surface is grooved with scaly trichomes


Hand section of pineapple leaf – adapted for arid climate
Trichomes in lower grooves


Air chambers w/ star-shaped cells= Aerenchyma
upper epidermis & thick cuticle
Palisades mesophyll
VB
VB
Raphides
CAM plants