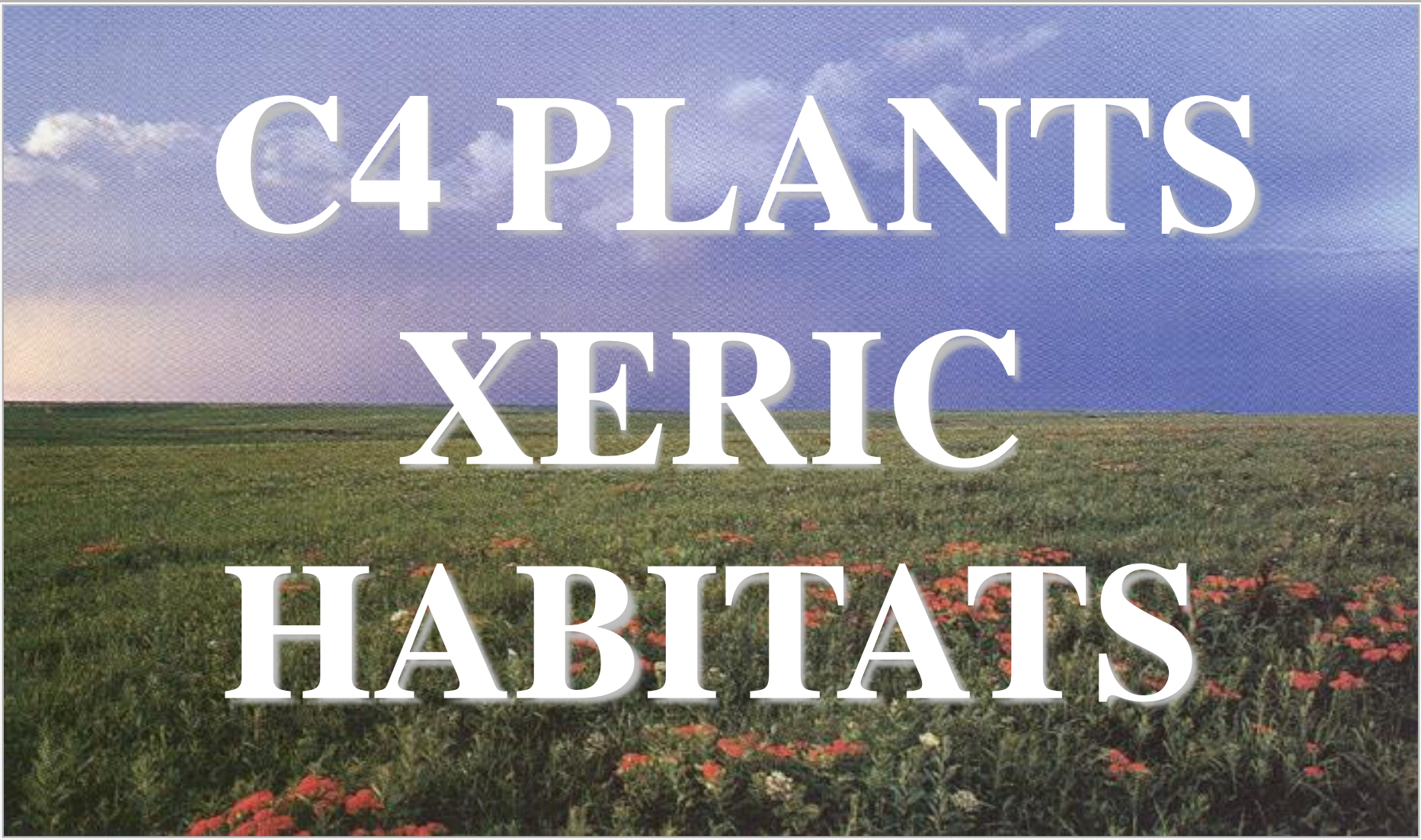


C4 ECOLOGY

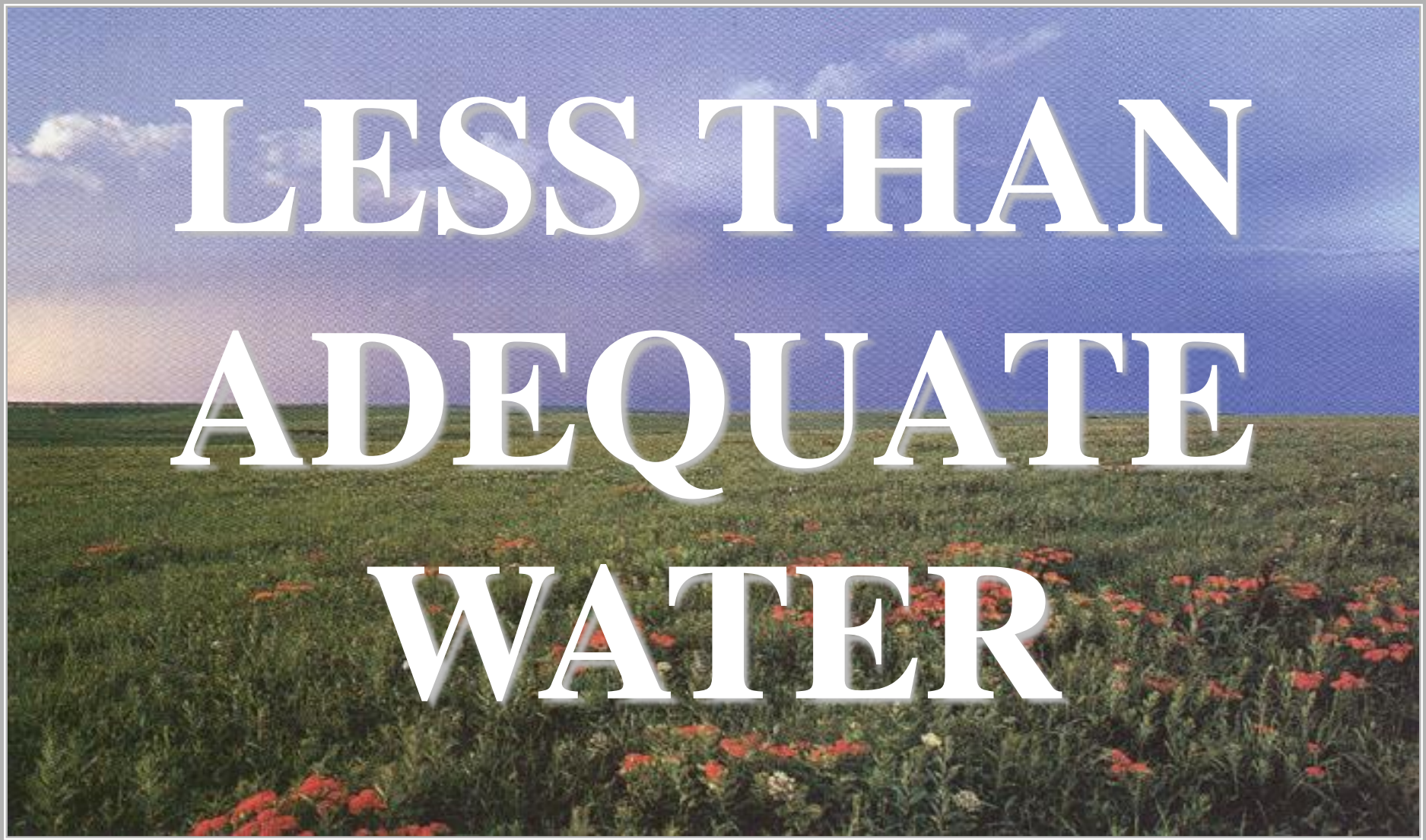


C4 PLANTS
XERIC
HABITATS

XERIC HABITATS

C4 ECOLOGY

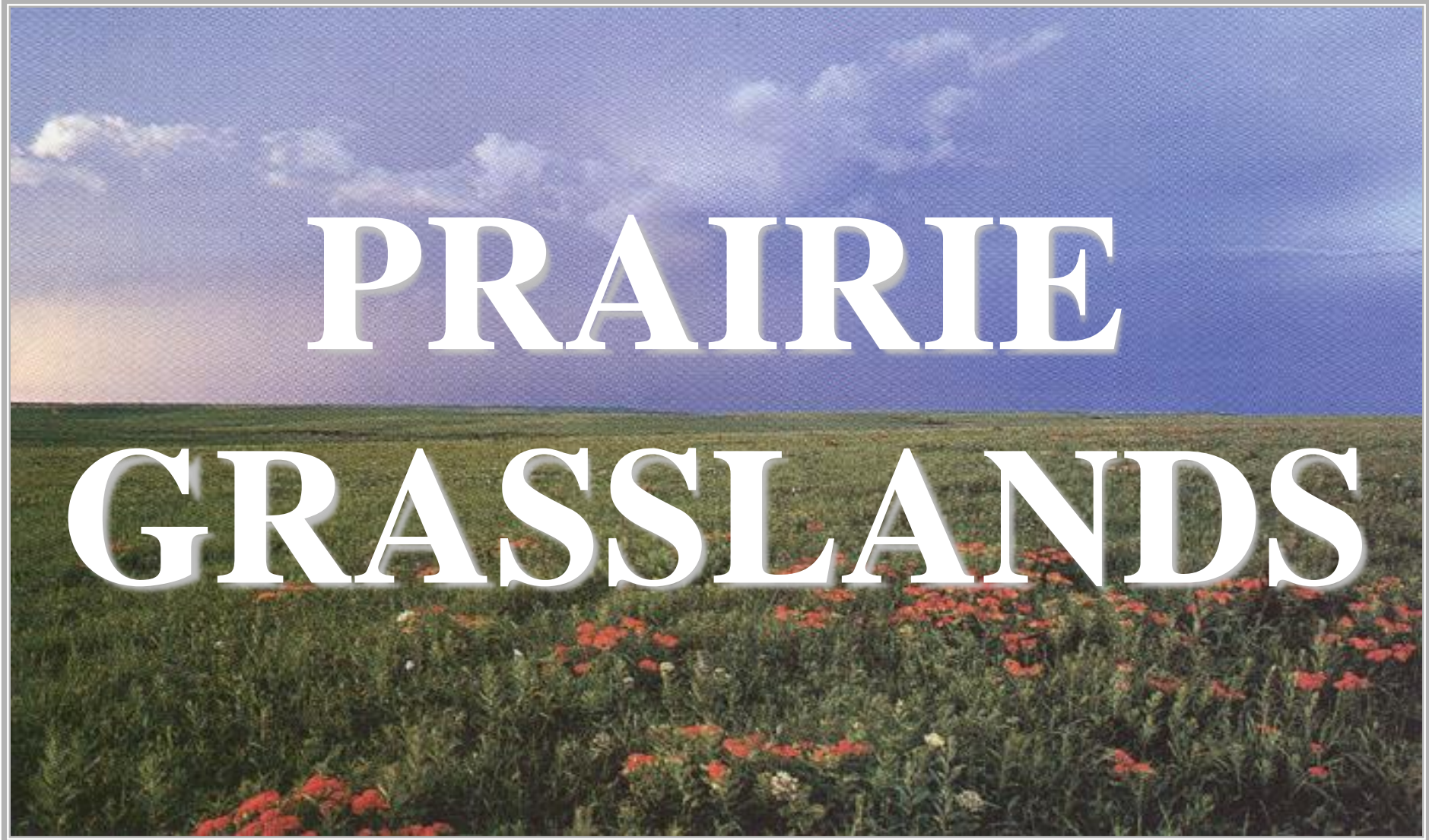
EG



LESS THAN
ADEQUATE
WATER

XERIC HABITATS

C4 ECOLOGY



XERIC HABITATS



DARK REACTION

CRASSULACEAN

ACID METABOLISM



**CRASSULACEAN
ACID MMETABOLISM**

SYNONYMOUS

CAM PATHWAY



**CRASSULACEAN
PLANT FAMILY**



V

CRASSULACEAN PLANT FAMILY

ELICITATED CAM PATHWAY

**CAM PLANT
VERY
EFFICIENT
CO₂
FIXATION**



**CAM PLANT
VERY LOW
TRANSPIRATION**



CAMPLANT DESERT PLANT



CAM PLANT CONDUCTS C3 AND C4



CAM PLANT MODIFIED C4 PLANT



CAM PLANT

KRANTZ LEAF

ANATOMY

ABSENT

MESOPHYLL

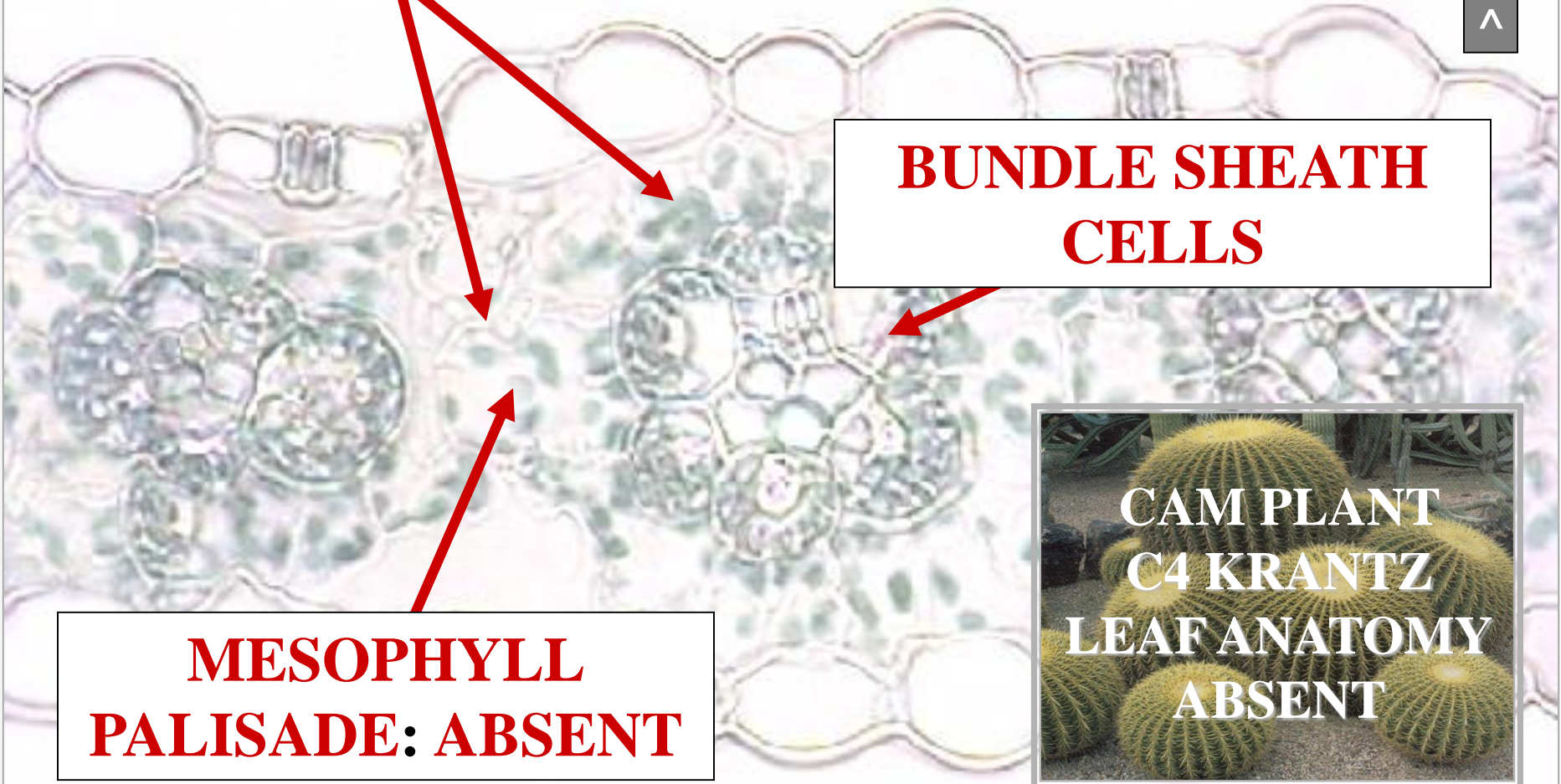
C4 LEAF

**BUNDLE SHEATH
CELLS**

**MESOPHYLL
PALISADE: ABSENT**

**CAM PLANT
C4 KRANTZ
LEAF ANATOMY
ABSENT**

KRANTZ C4 LEAF ANATOMY





CAM PATHWAY SPECIFICS

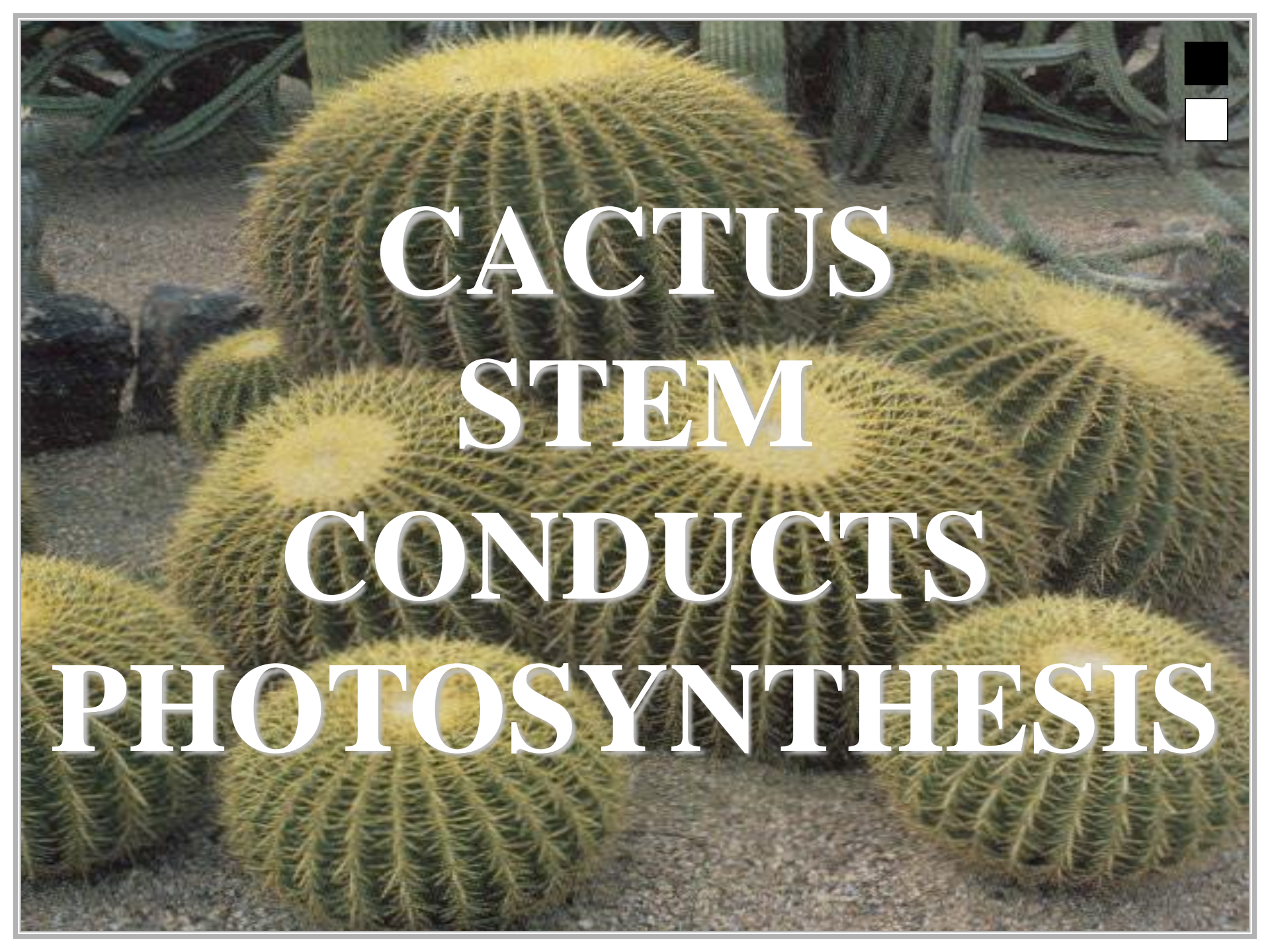


CAM PATHWAY CACTUS PLANT



ST

CACTUS DESERT CAM PLANT



**CACTUS
STEM
CONDUCTS
PHOTOSYNTHESIS**

CAM PATHWAY DARK HOURS



CAM PATHWAY LIGHT HOURS





CAM PATHWAY DARK HOURS

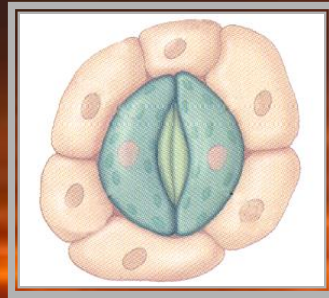
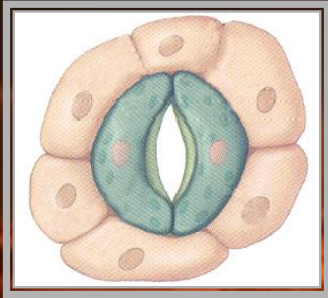
CAMPATHWAY DARK HOURS



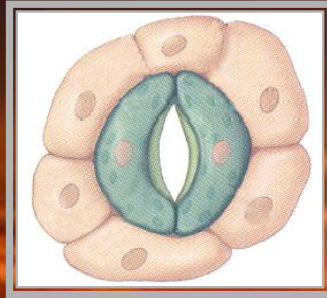


STEM STOMATE

CAM PATHWAY DARK HOURS

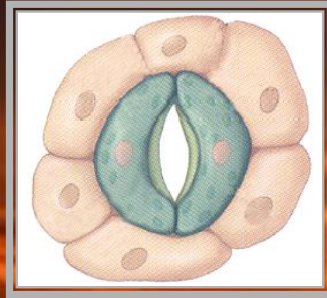


CAM PATHWAY DARK HOURS



**STOMATES
OPEN**

DARK HOURS
HIGH HUMIDITY



STOMATES
OPEN

PLANT

ATMOSPHERE

SH

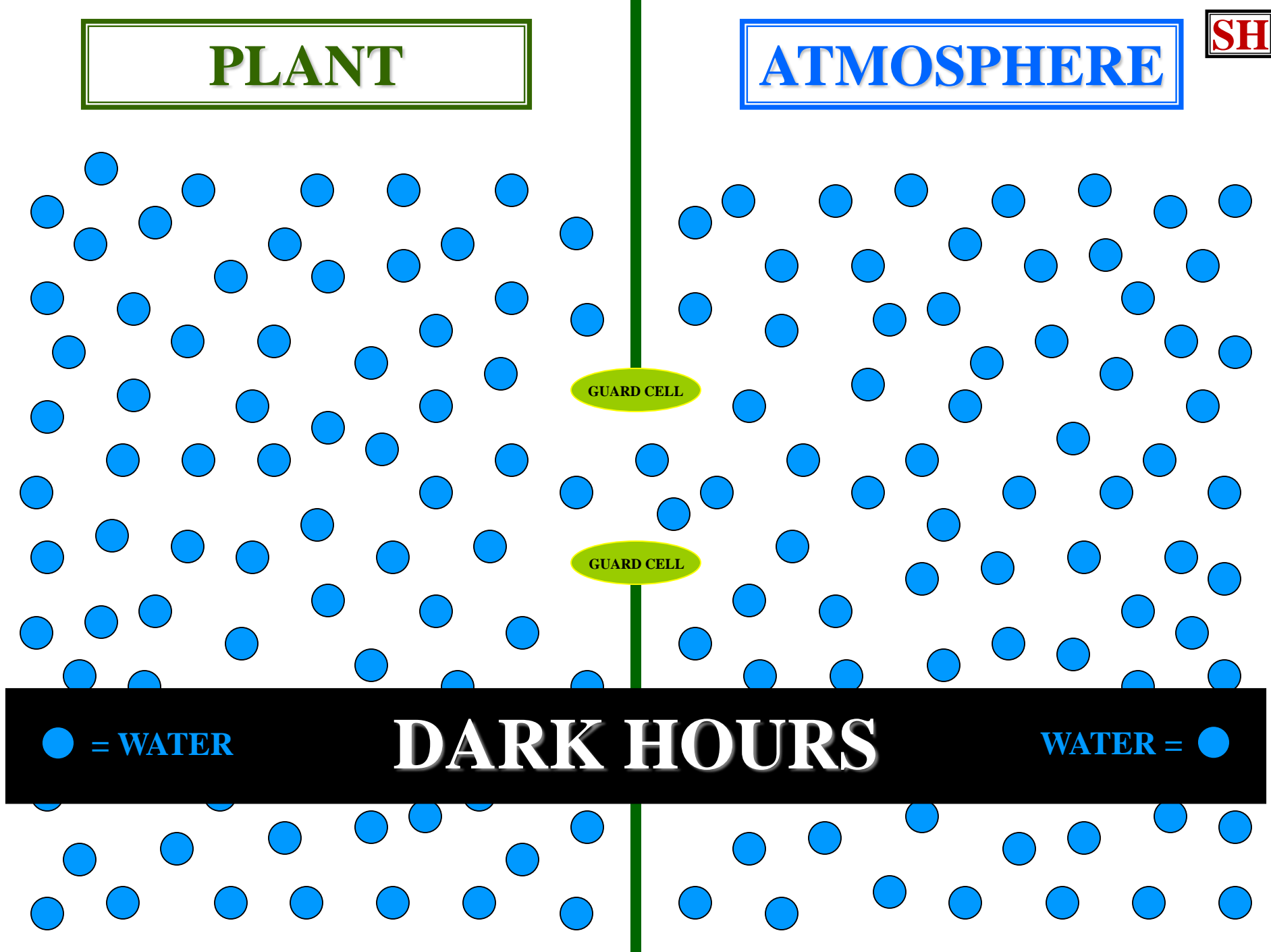
GUARD CELL

GUARD CELL

● = WATER

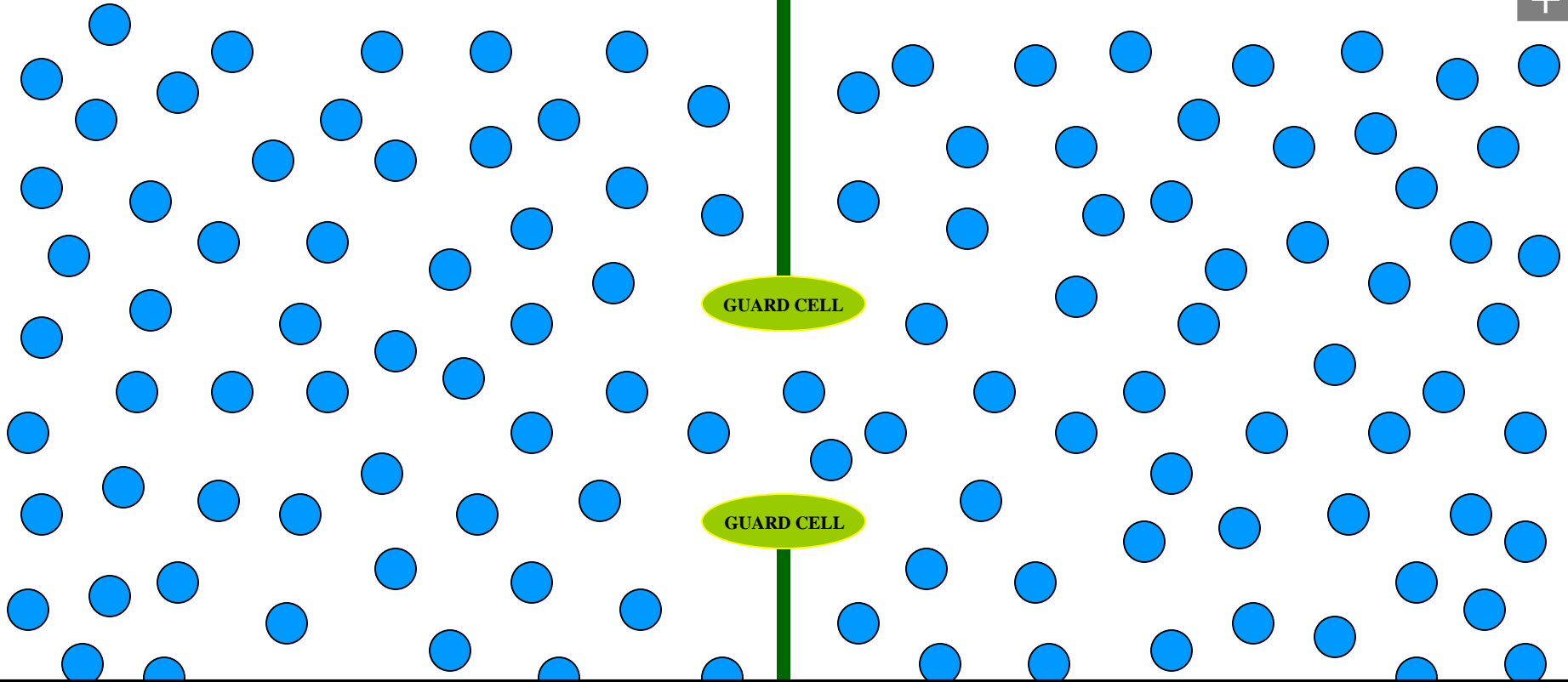
DARK HOURS

WATER = ●



PLANT

ATMOSPHERE



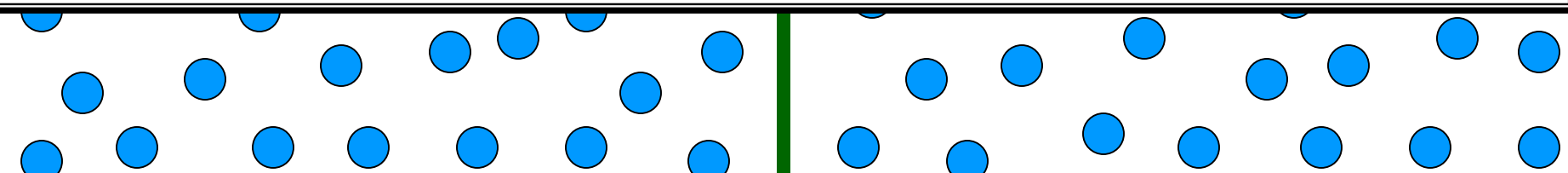
GUARD CELL

GUARD CELL

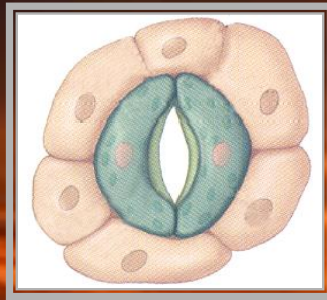
● = WATER

SHALLOW GRADIENT

WATER = ●



CAM PATHWAY DARK HOURS

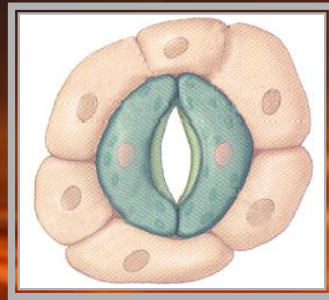


TRANSPIRATION
POTENTIAL

CAM PATHWAY DARK HOURS



0

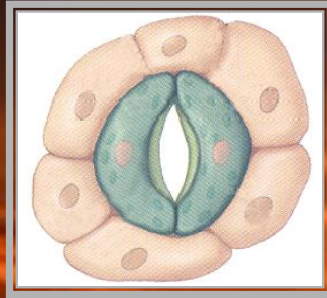


VERY LOW
TRANSPIRATION
POTENTIAL

CAM PATHWAY DARK HOURS



CO₂



STOMATES
OPEN

DARK HOURS

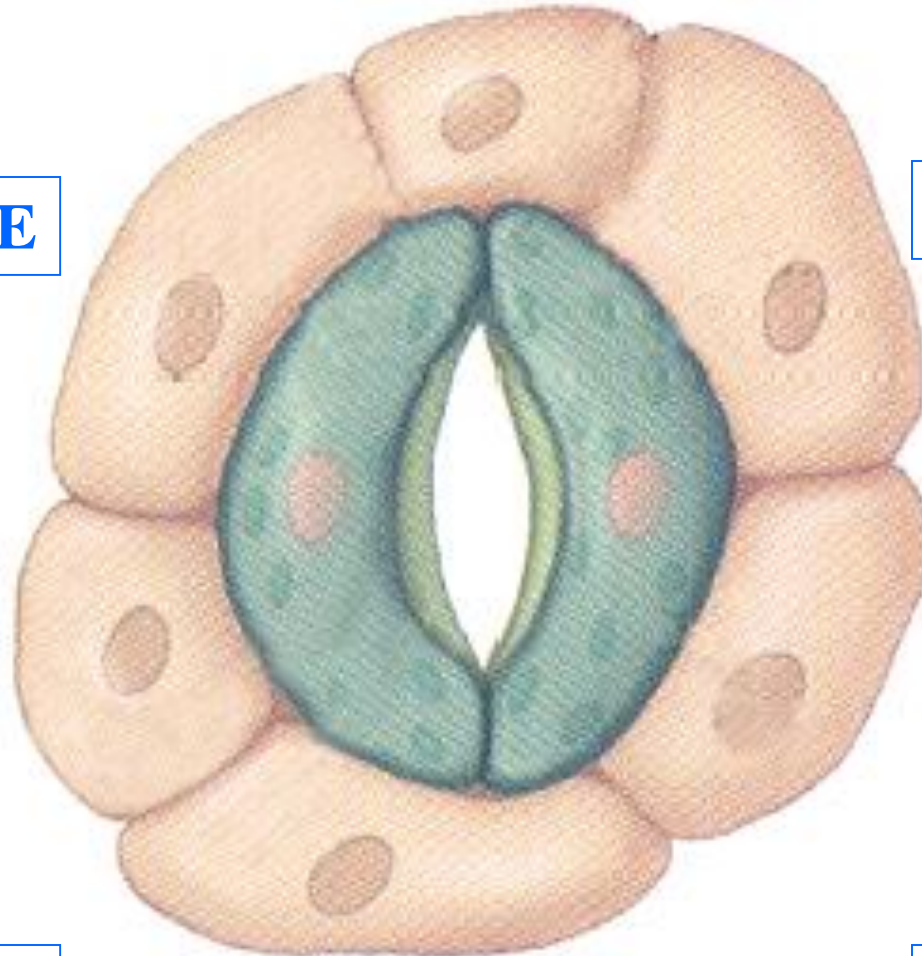
STEM STOMATE

DARK HOURS

D

CO₂

ATMOSPHERE



CO₂

ATMOSPHERE

CO₂

ATMOSPHERE

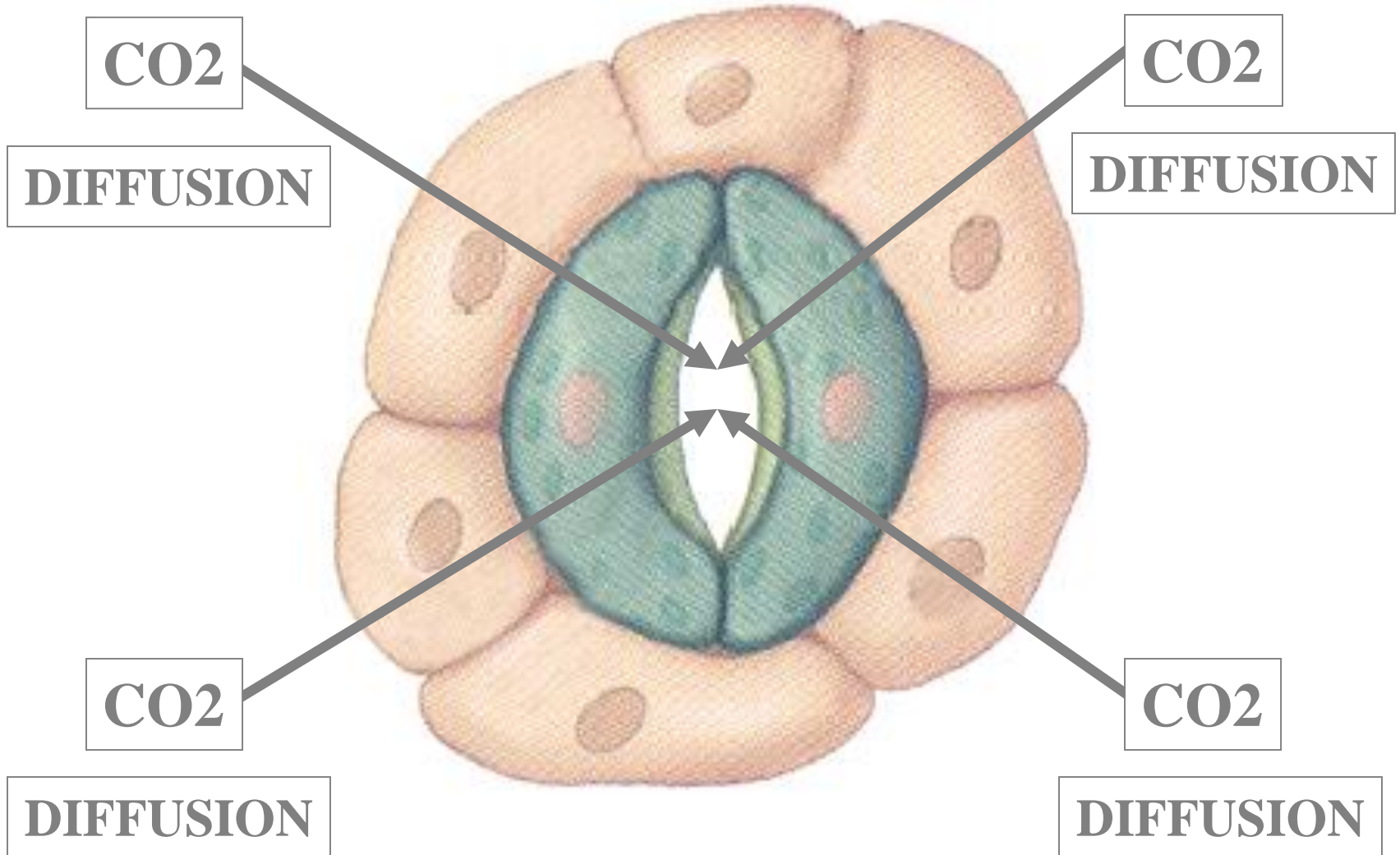
CO₂

ATMOSPHERE

DARK HOURS

STEM STOMATE

DARK HOURS





**STEM
MESOPHYLL
CELL
CYTOSOL**



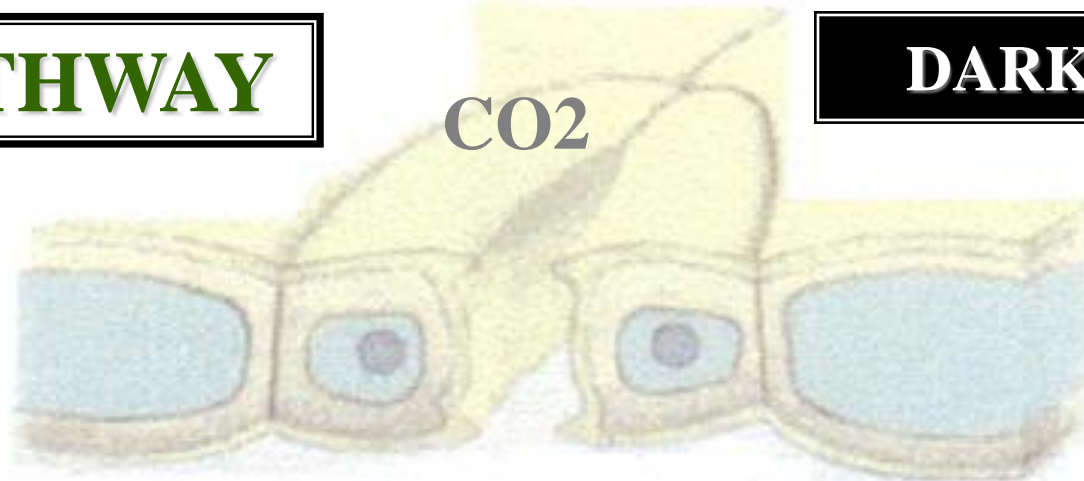
CAM PATHWAY CO₂ FIXATION

CAM PATHWAY

DARK HOURS

CO₂

ATMOSPHERE



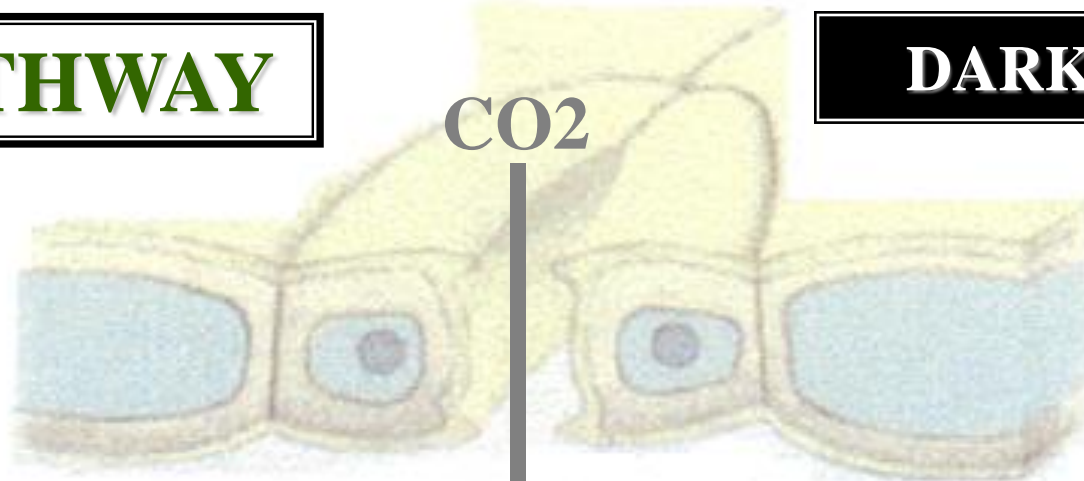
D

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



DIFFUSION



CO2

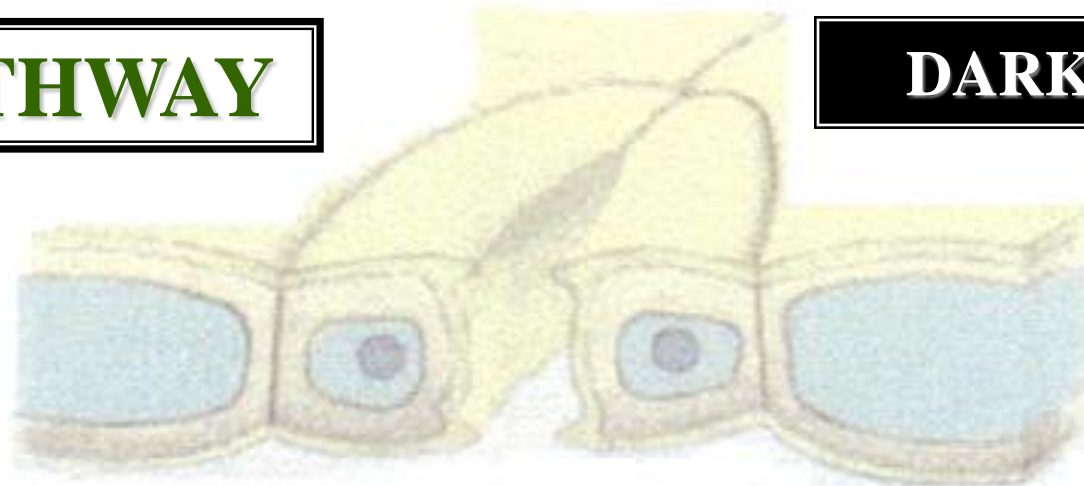
P

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



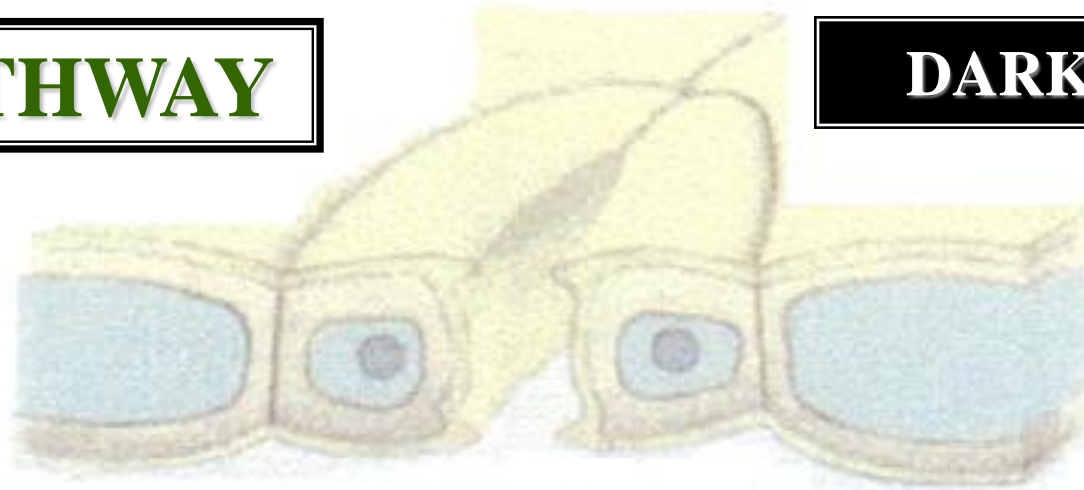
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MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



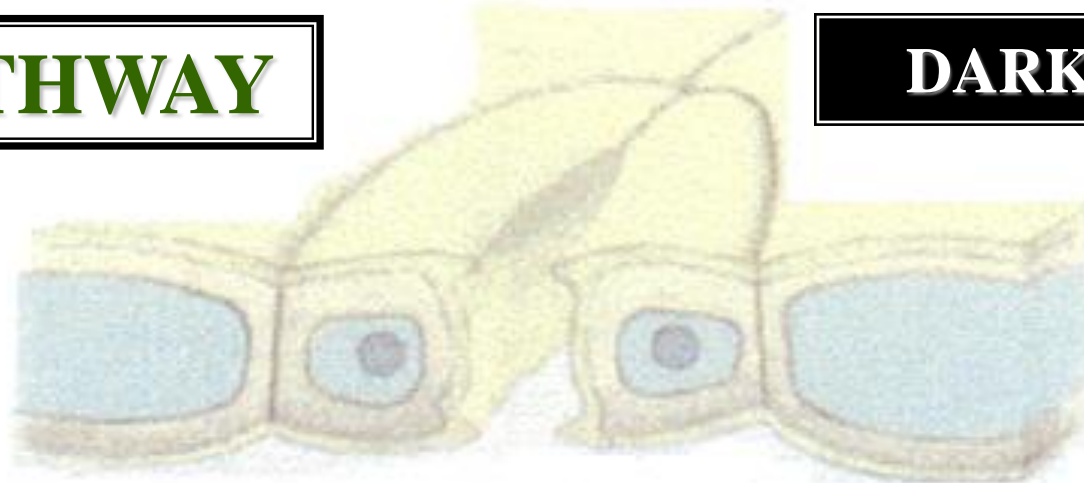
EZ

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



?

2

MESOPHYLL CELL / CYTOSOL

C3

CO₂
ENTERS
STROMA

C3

CO₂ + RIBULOSE BISPHOSEPHATE / (RUBP)

RIBULOSE BISPHOSEPHATE
CARBOXYLASE
(RUBP-CARBOXYLASE)

+

2 PHOSPHOGLYCERATE / (PGA)

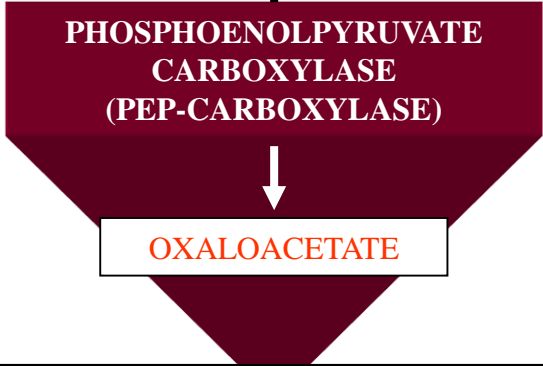
**INEFFICIENT
ENZYME**

C4

CO₂
ENTERS
MESOPHYLL CYTOSOL

C4

CO₂ + PHOSPHOENOLPYRUVATE / (PEP)



P

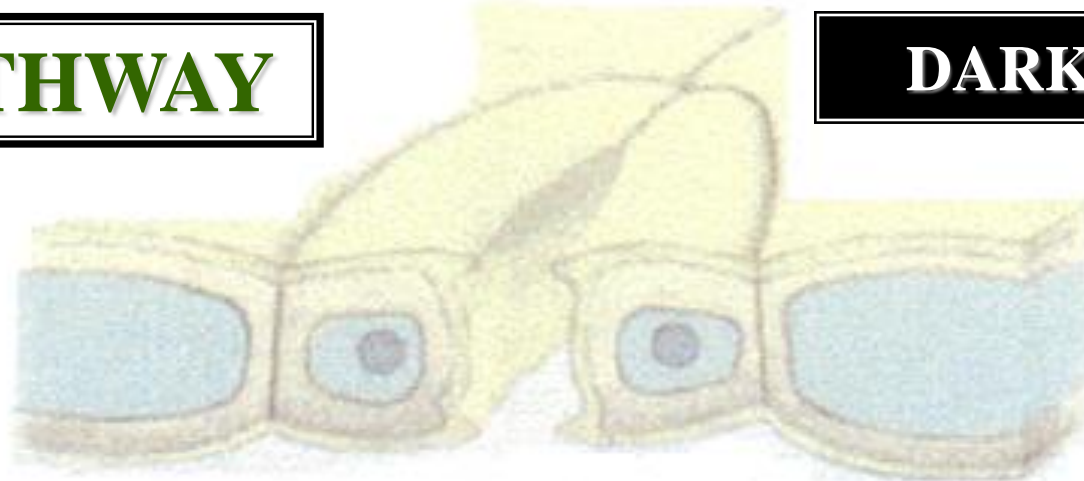
+

**EFFICIENT
ENZYME**

CAM PATHWAY

DARK HOURS

ATMOSPHERE



PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-ASE)

C4 CO2 FIXATION ENZYME

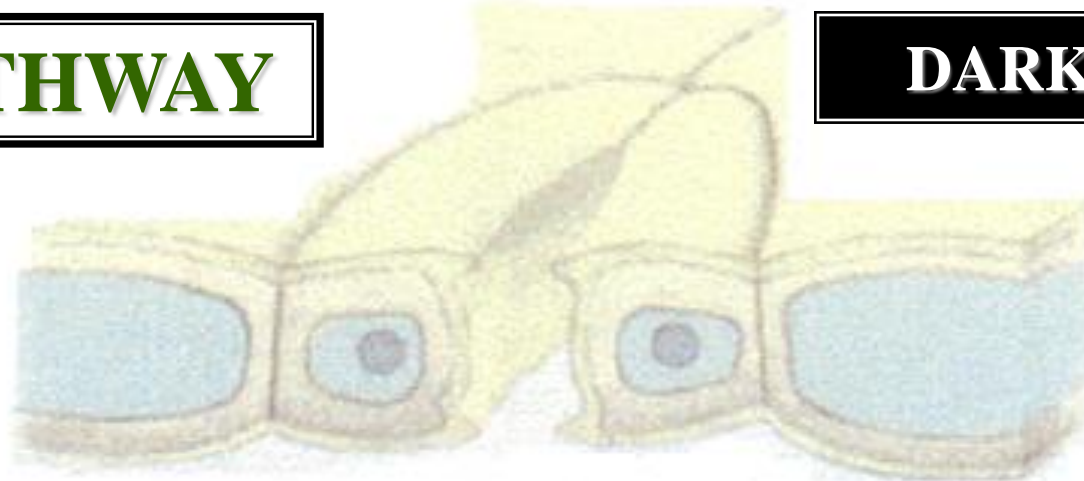
C4 R

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-ASE)

C4 CO2 FIXATION ENZYME

C4 CO2 FIXATION RXT

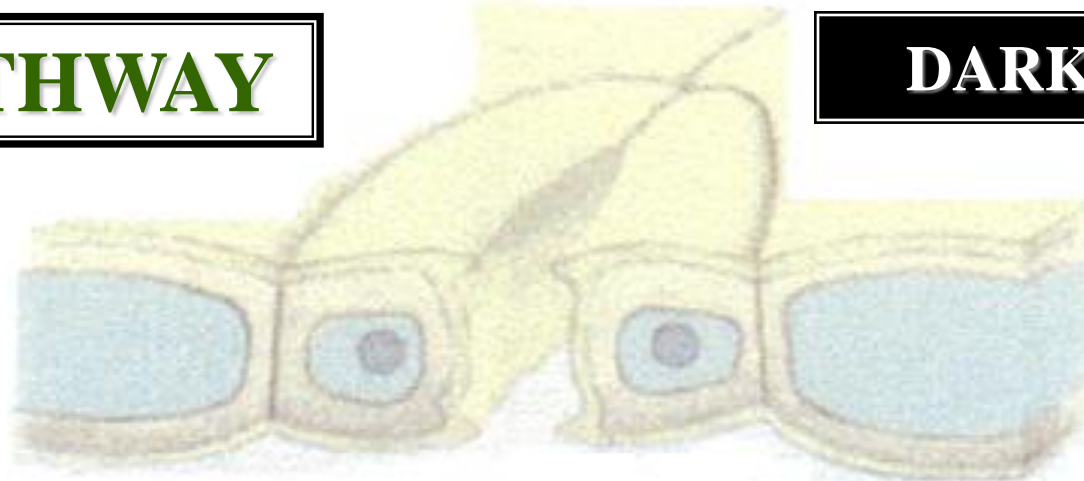
CAM

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-ASE)

CAM CO₂ FIXATION ENZYME

C₄ CO₂ FIXATION RXT

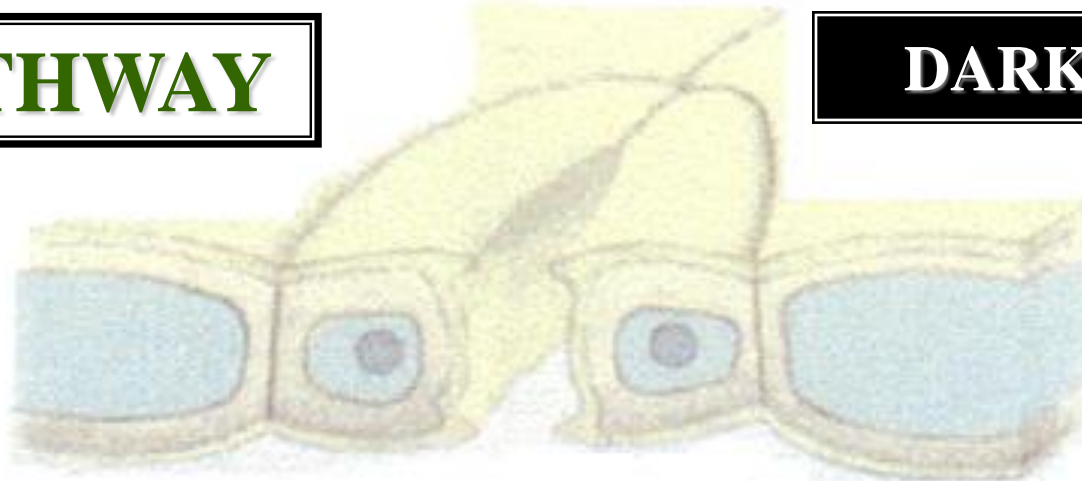
CAM

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-ASE)

CAM CO₂ FIXATION ENZYME

CAM CO₂ FIXATION RXT

M

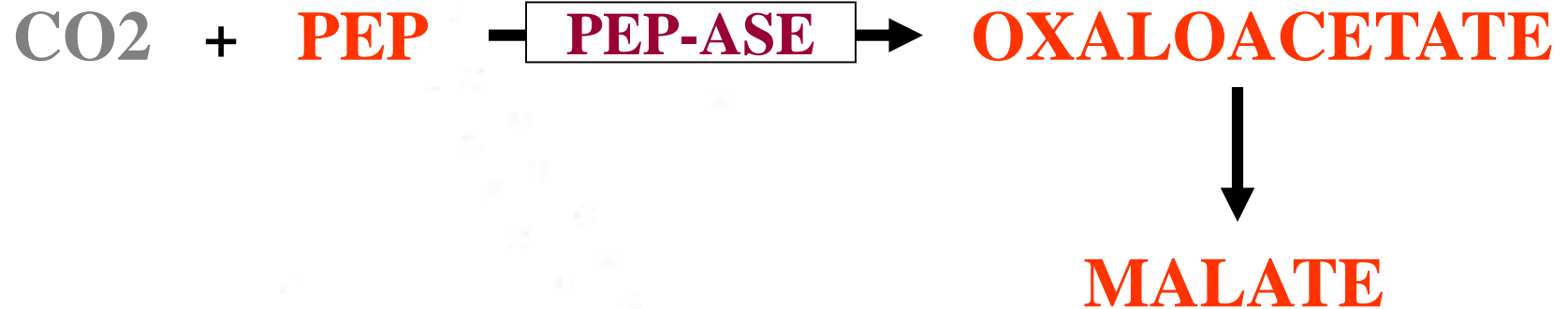
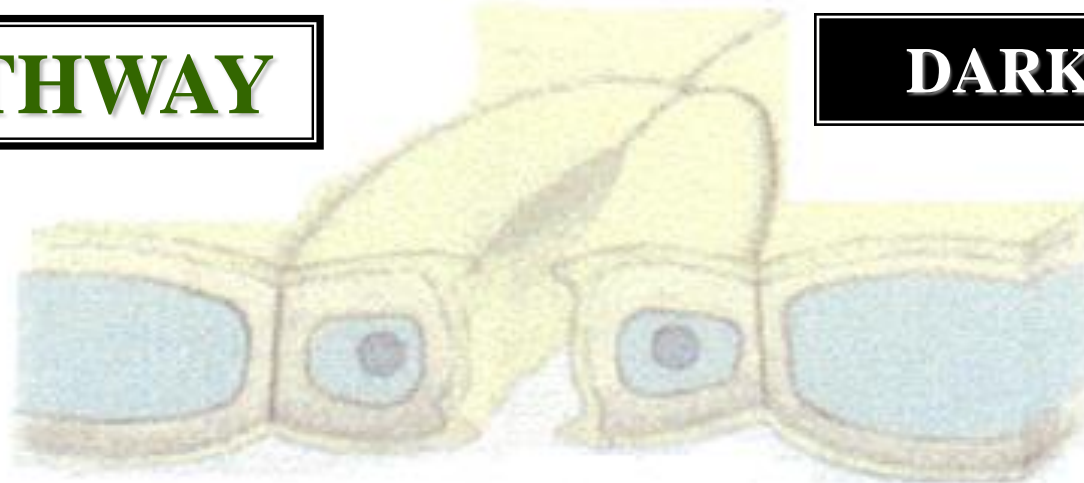


MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE

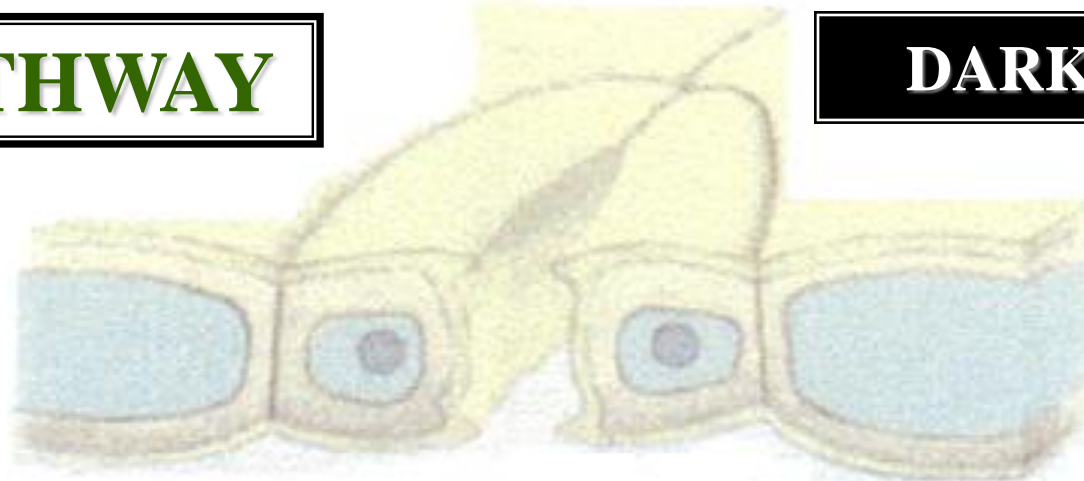


MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



VACUOLE

MESOPHYLL CELL / CYTOSOL

^

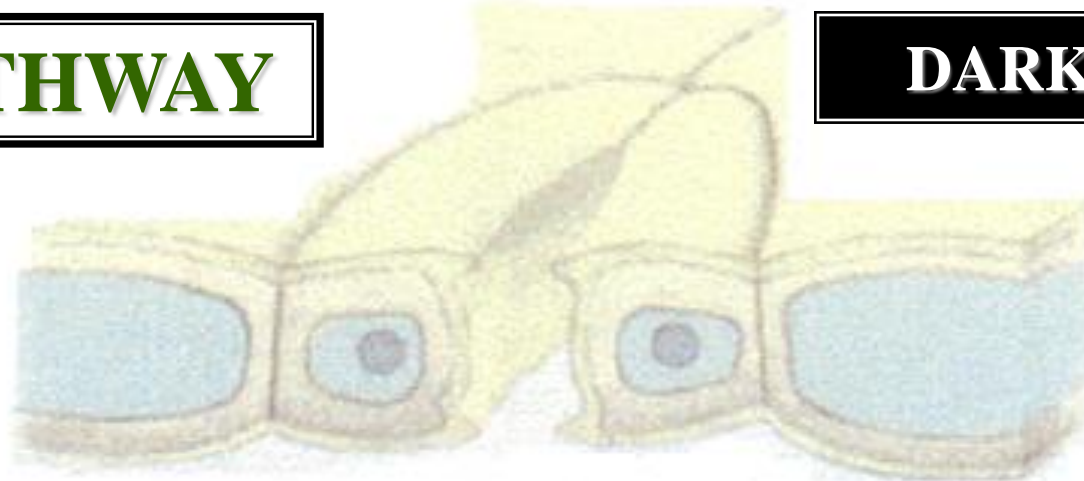


**STEM
MESOPHYLL
CELL
VACUOLE**

CAM PATHWAY

DARK HOURS

ATMOSPHERE



CO₂



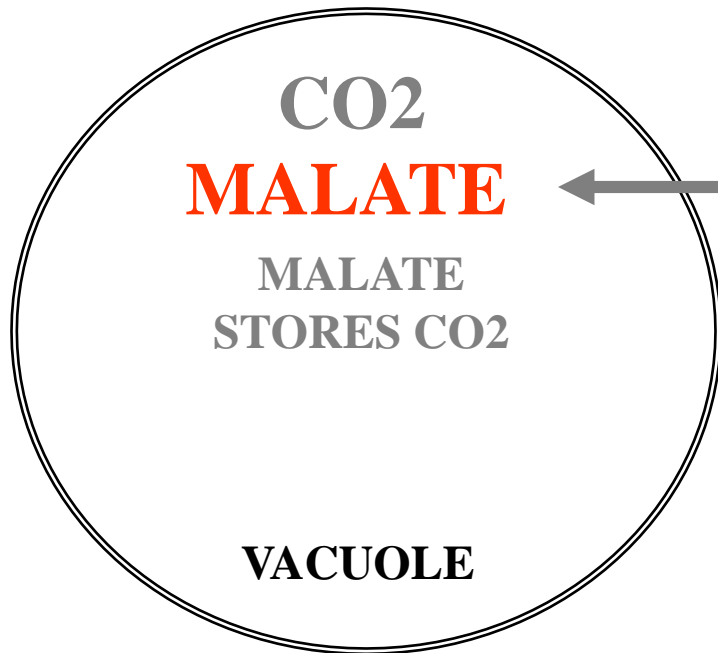
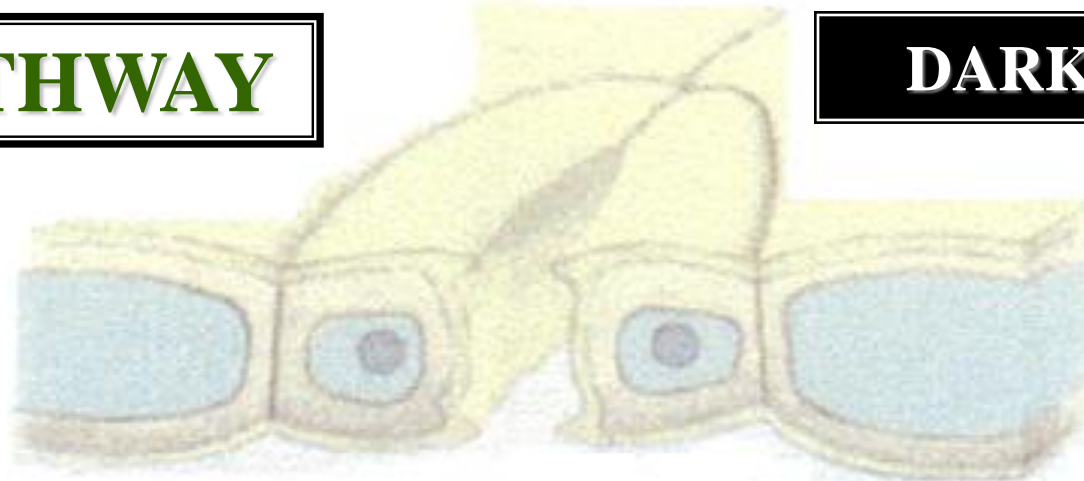
VACUOLE

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



SHUNTED

MALATE

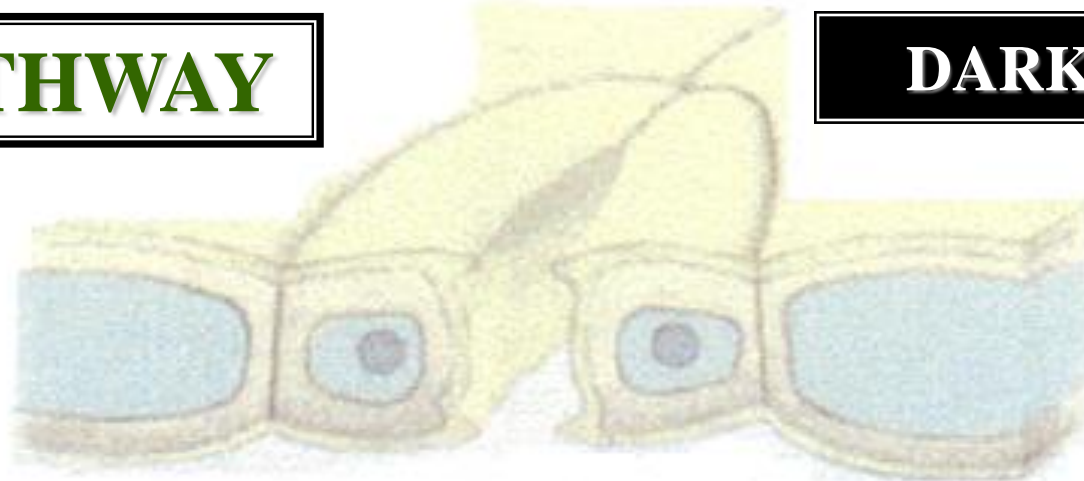
MESOPHYLL CELL / CYTOSOL

V

CAM PATHWAY

DARK HOURS

ATMOSPHERE



MALATE
STORES CO_2
VACUOLE
STORES MALATE

VACUOLE

MESOPHYLL CELL / CYTOSOL





**CAM PLANTS
FIXATE
CO₂
DURING
DARK HOURS**



**CAM PLANTS
STORE
CO₂ W/IN MALATE
DURING
DARK HOURS**



CAM PATHWAY LIGHT HOURS

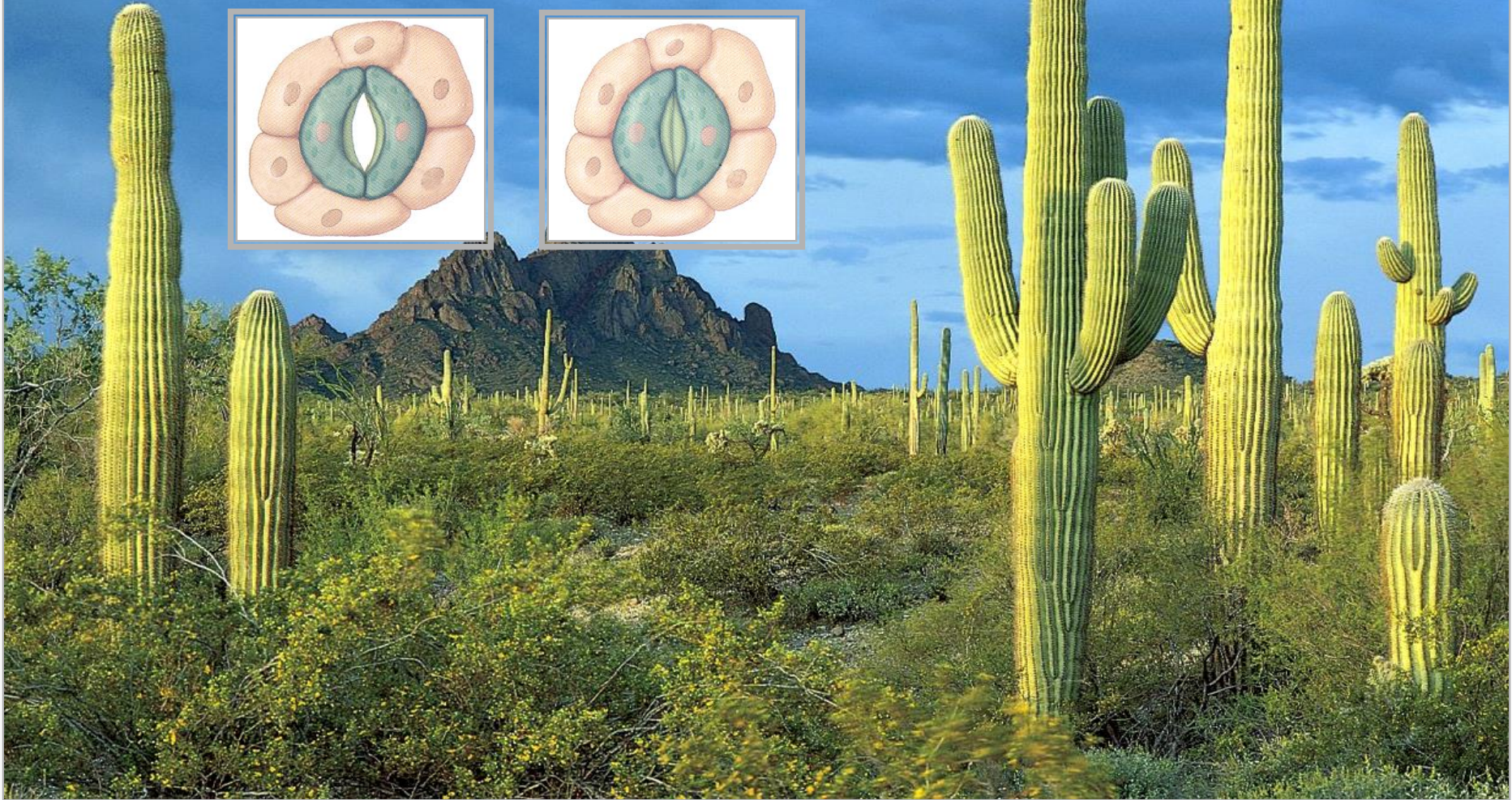
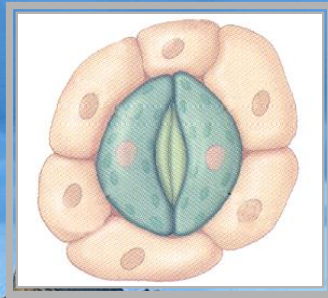
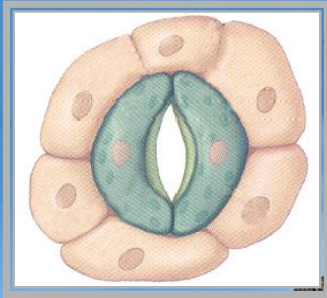
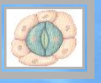
CAM PATHWAY LIGHT HOURS



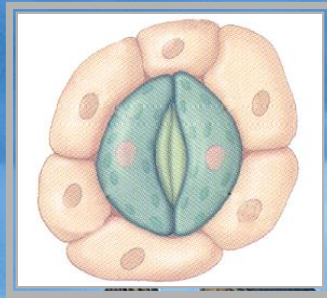


STEM STOMATE

CAM PATHWAY LIGHT HOURS

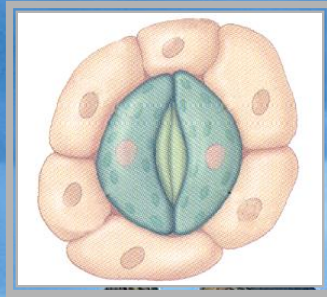


CAM PATHWAY LIGHT HOURS



STOMATES
CLOSE

LIGHT HOURS
LOW HUMIDITY

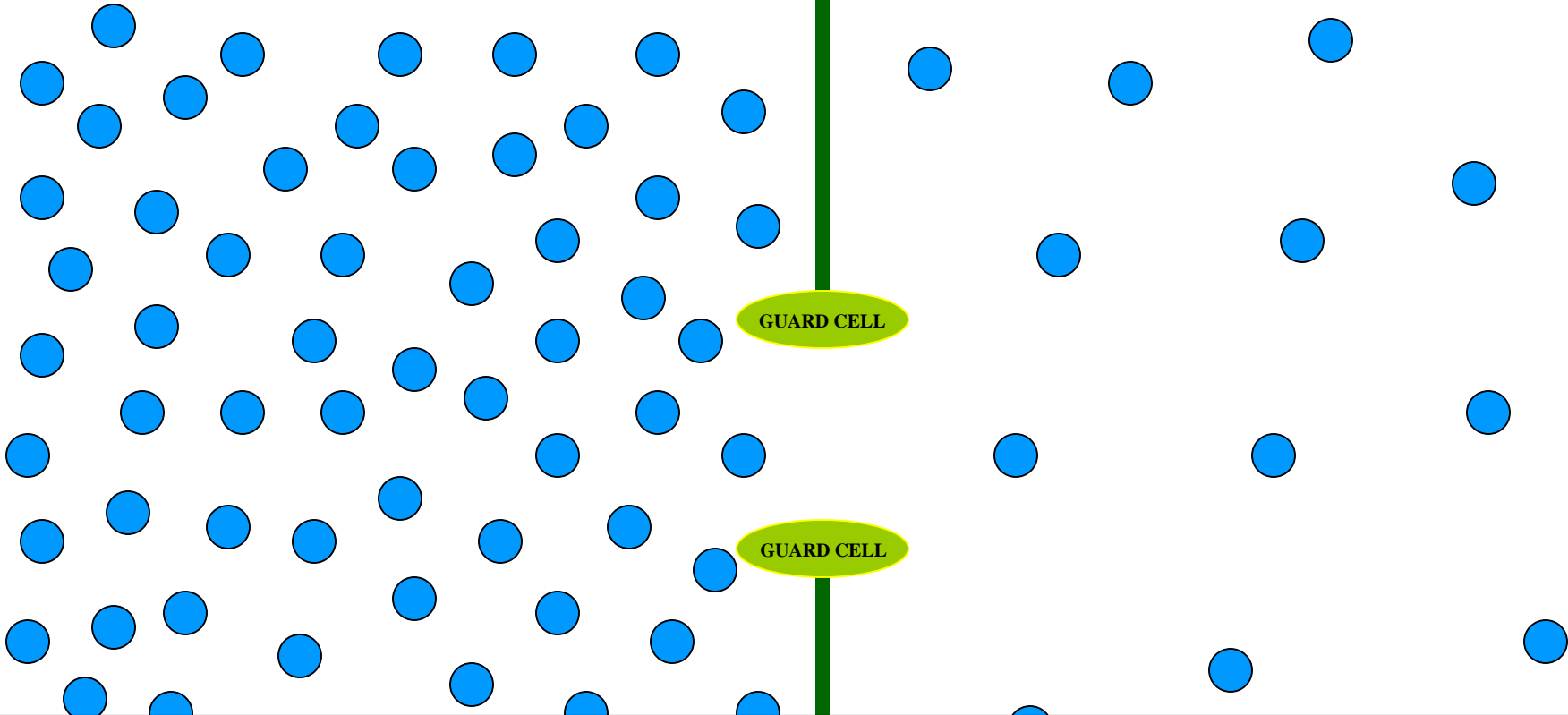


STOMATES
CLOSE

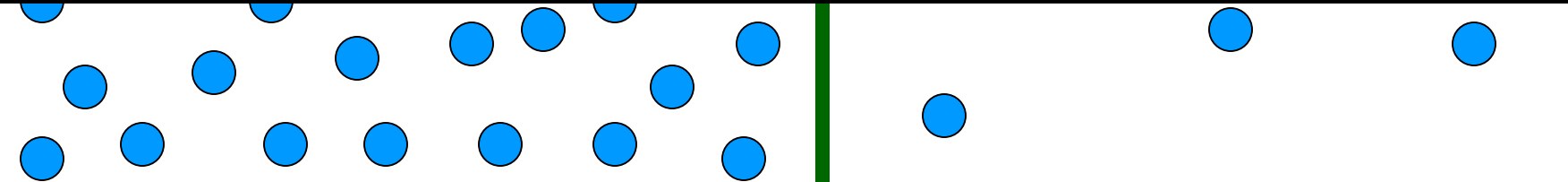


PLANT

ATMOSPHERE



LOW HUMIDITY LIGHT HOURS



PLANT

ATMOSPHERE

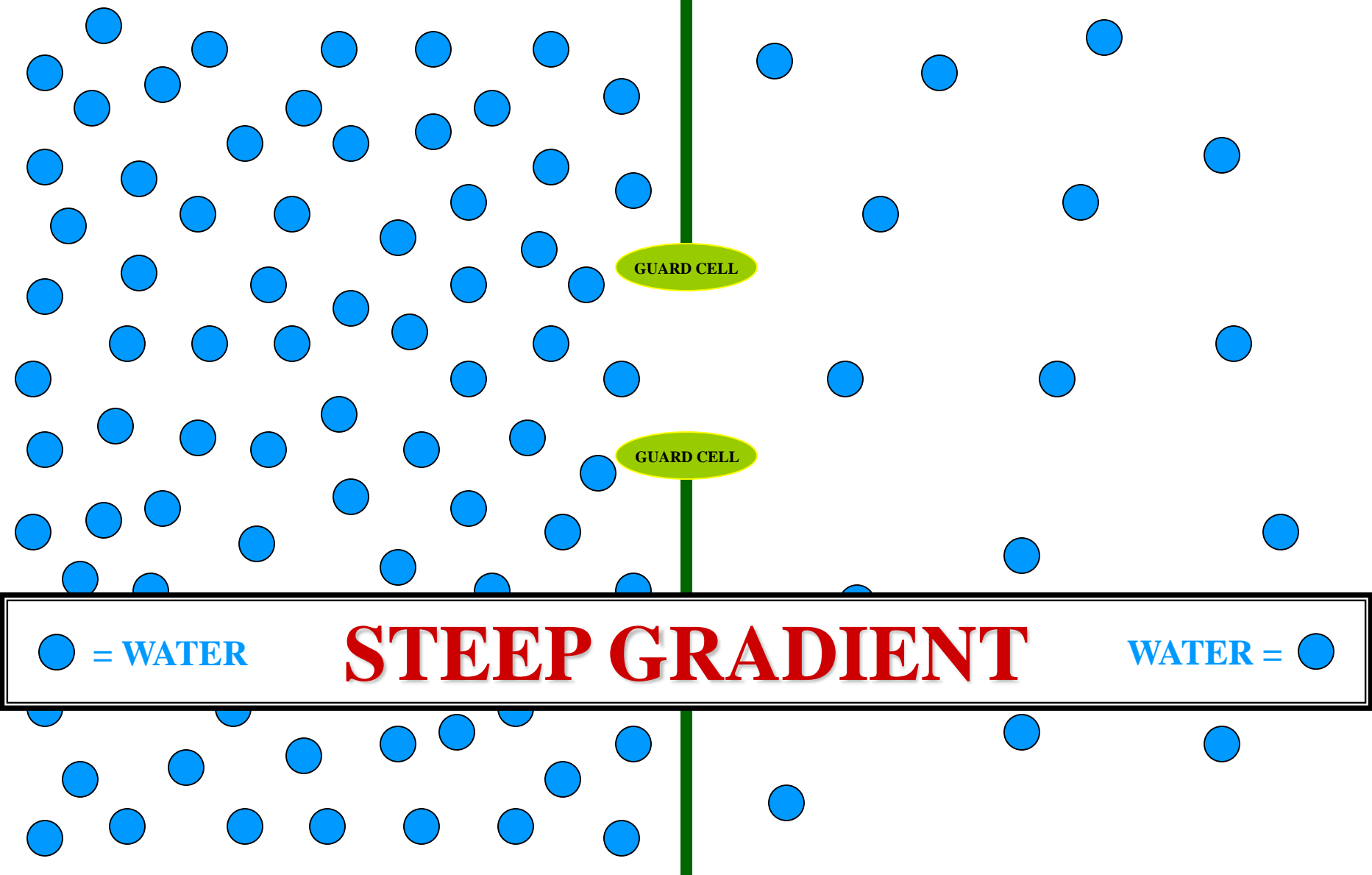
GUARD CELL

GUARD CELL

● = WATER

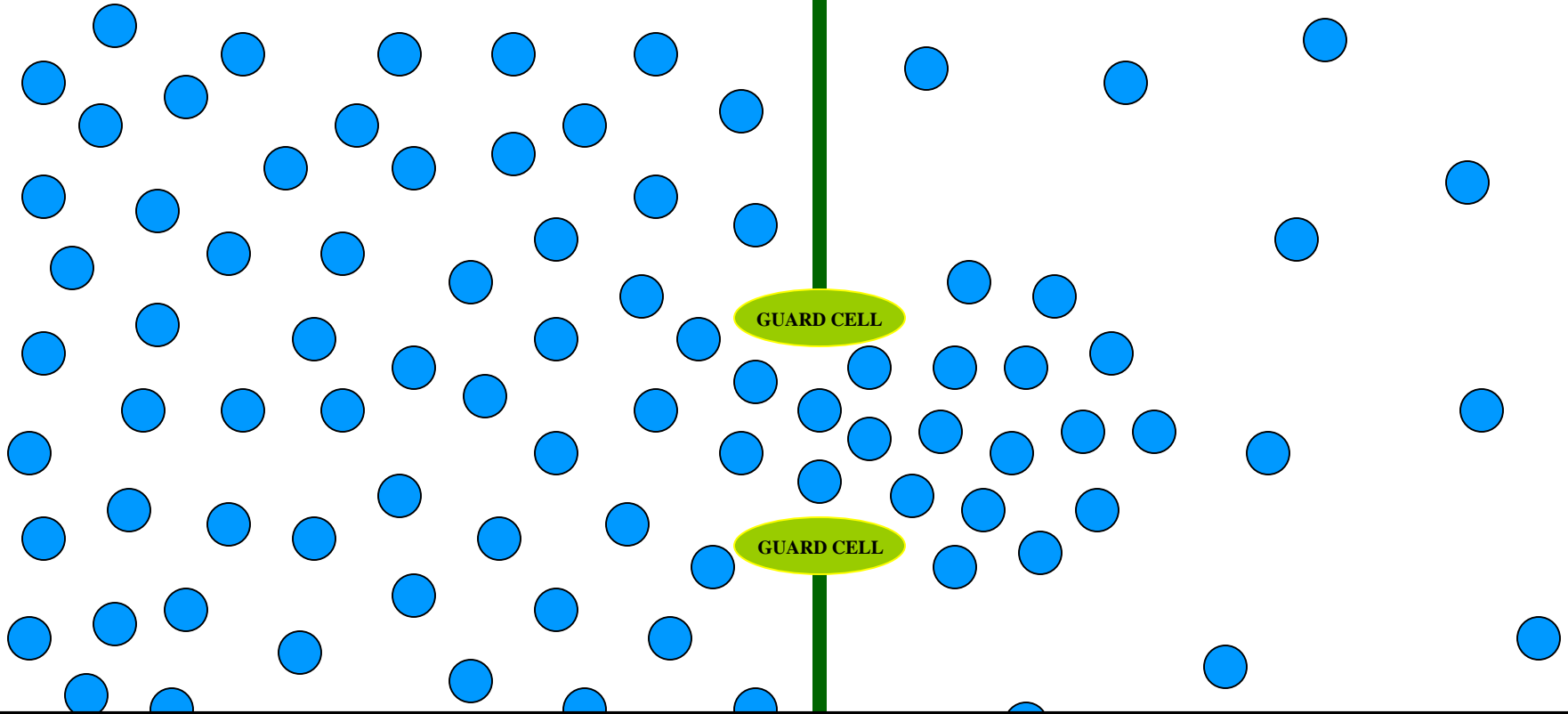
STEEP GRADIENT

WATER = ●



PLANT

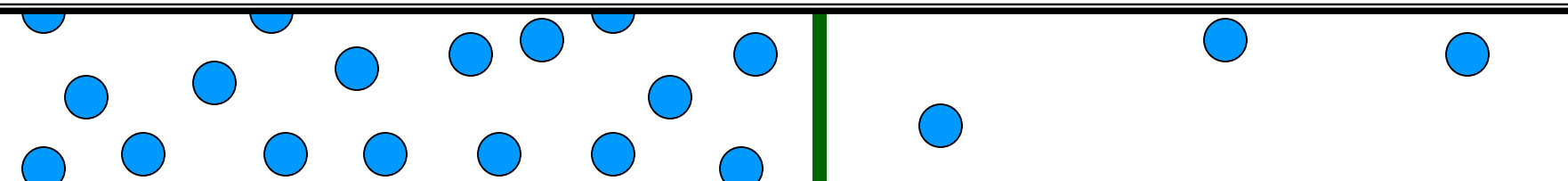
ATMOSPHERE



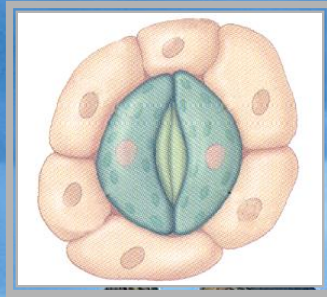
● = WATER

STEEP GRADIENT

WATER = ●



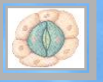
LIGHT HOURS
LOW HUMIDITY



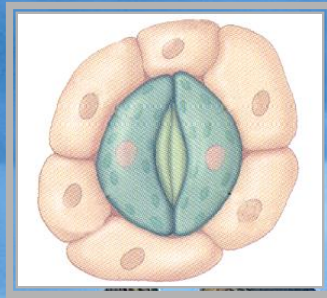
TRANSPIRATION
POTENTIAL



LIGHT HOURS
LOW HUMIDITY



C

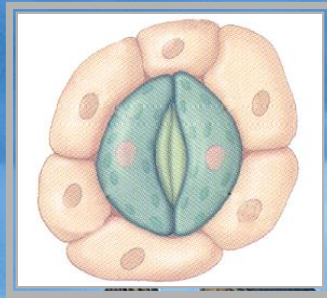


VERY HIGH
TRANSPIRATION
POTENTIAL



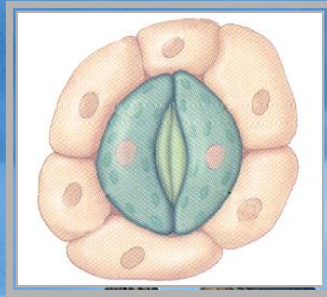
LIGHT HOURS
LOW HUMIDITY

?
T



STOMATES
CLOSE

LIGHT HOURS
LOW HUMIDITY

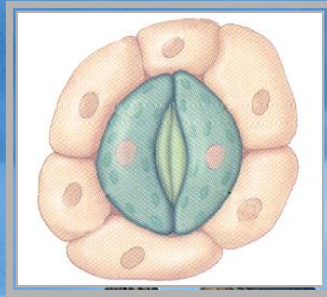


?

TRANSPIRATION

LIGHT HOURS
LOW HUMIDITY

?
C

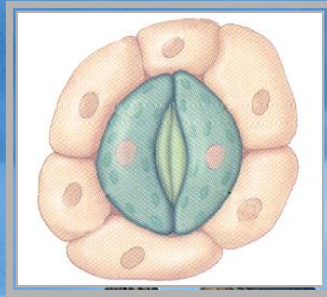


NO
TRANSPIRATION



LIGHT HOURS
LOW HUMIDITY

N

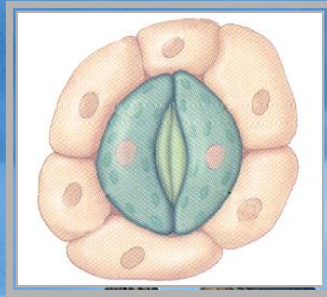


?

CO₂ FIXATION

LIGHT HOURS
LOW HUMIDITY

?



NO
CO₂ FIXATION

QUESTION

DOES THE CAM PLANT
NEED TO FIXATE CO₂
DURING THE
LIGHT HOURS?

QUESTION

ANSWER



NO

LIGHT HOURS CO₂

FIXATION NOT

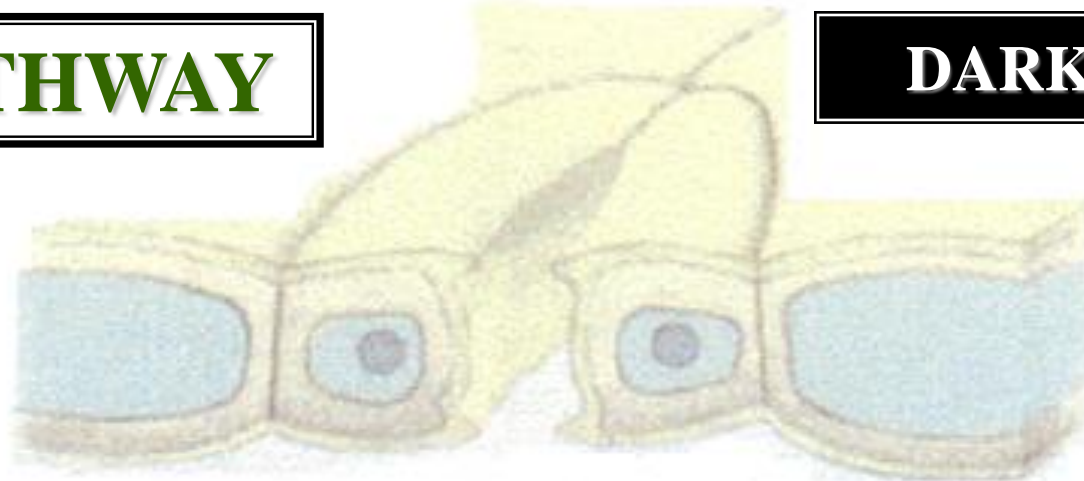
REQUIRED

ANSWER

CAM PATHWAY

DARK HOURS

ATMOSPHERE



CO₂



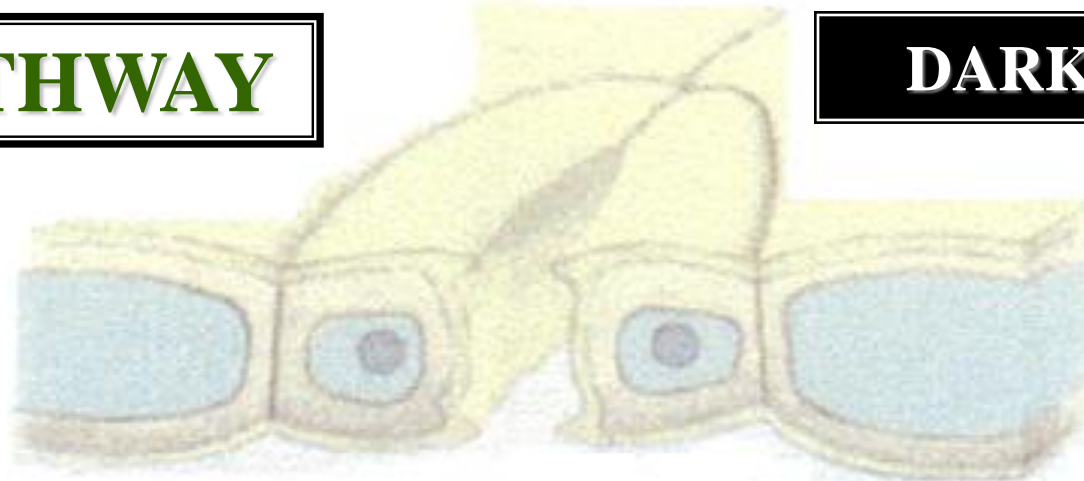
VACUOLE

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

DARK HOURS

ATMOSPHERE



MALATE STORES CO₂

VACUOLE

MESOPHYLL CELL / CYTOSOL

^



STEM
MESOPHYLL
CELL
CHLOROPLAST
THYLAKOID

CAM PATHWAY LIGHT HOURS



LR



CAM PATHWAY LIGHT HOURS



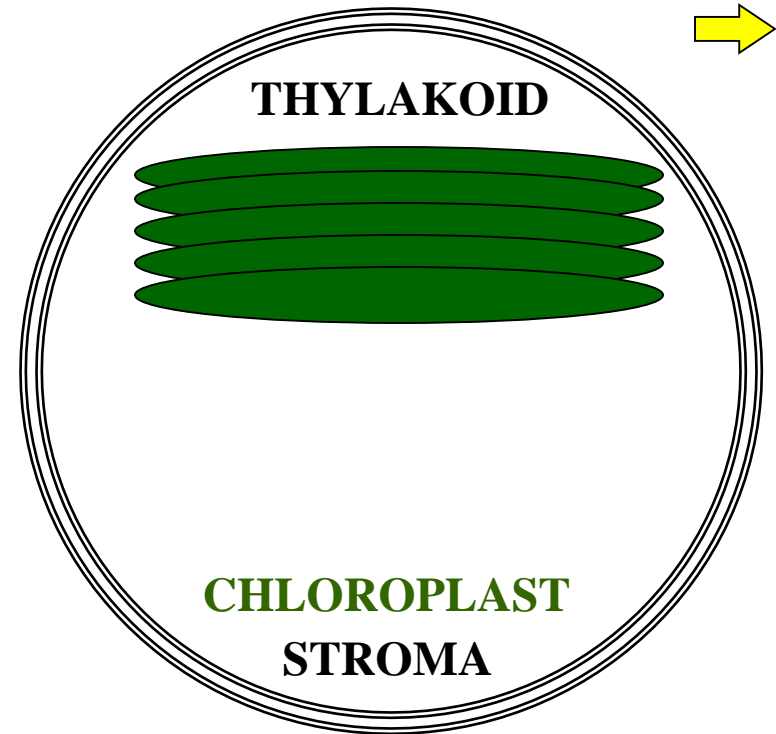
LIGHT REACTION
OCCURS



CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



MESOPHYLL CELL / CYTOSOL

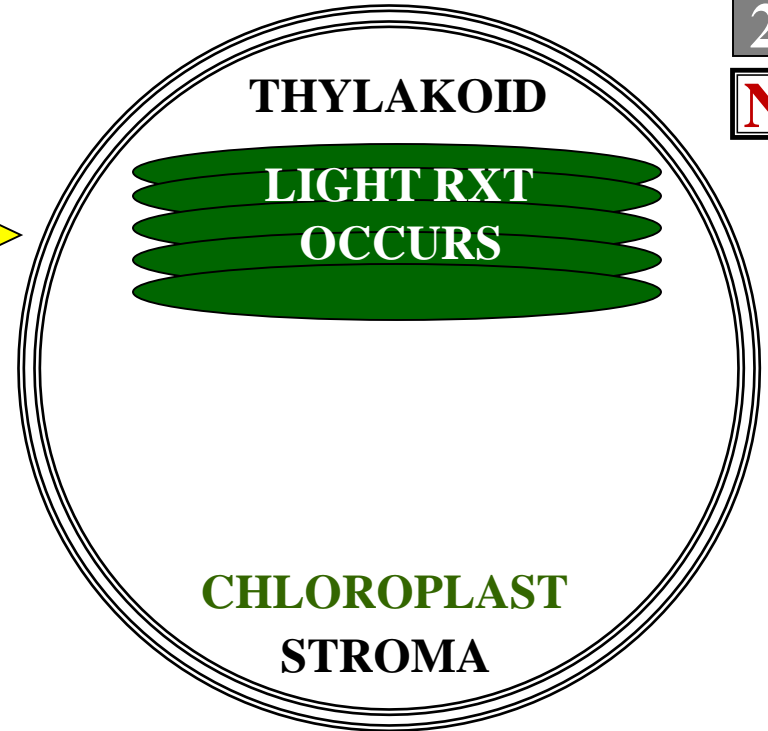
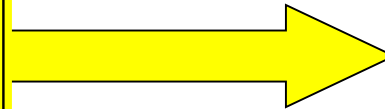
CAM PATHWAY

LIGHT HOURS

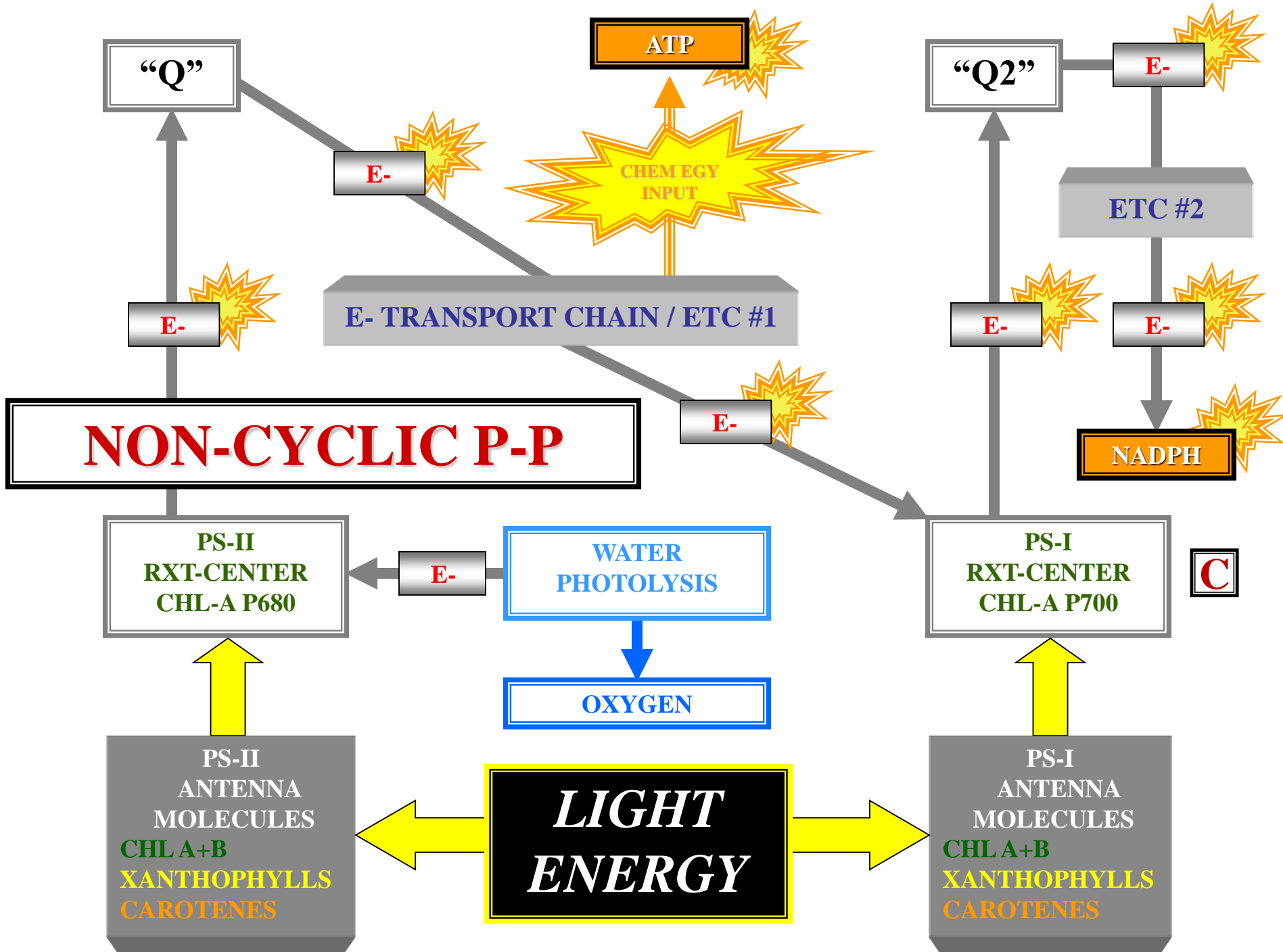
ATMOSPHERE



LIGHT



MESOPHYLL CELL / CYTOSOL



CYCLIC P-P

“Q2”

E-

ETC #3

CHEM
EGY
INPUT

ATP

E-

E-

E- = RECYCLED

PS-I
RXT-CENTER
CHL-A P700

LIGHT
ENERGY

PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

LIGHT
ENERGY

?

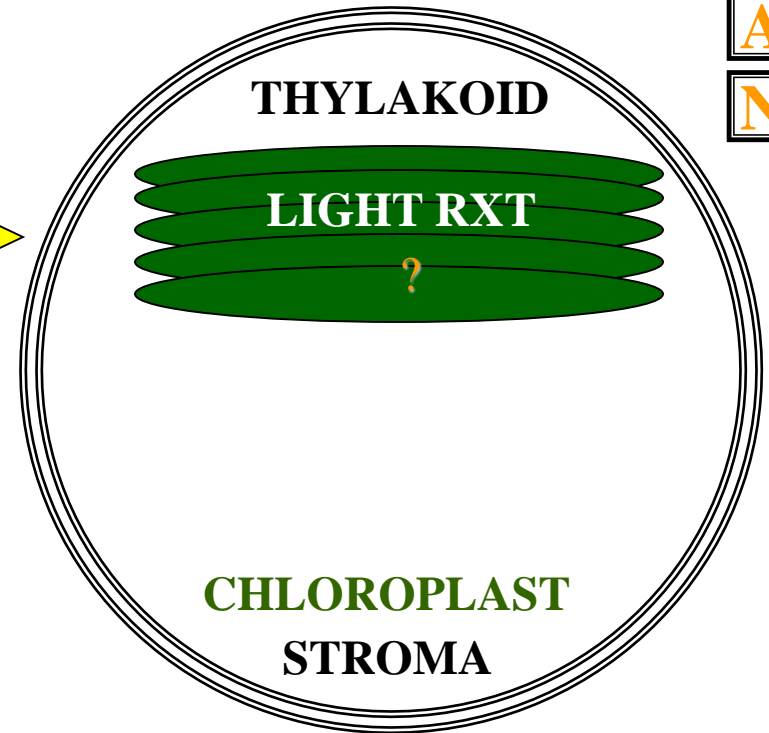
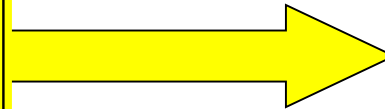
CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



LIGHT

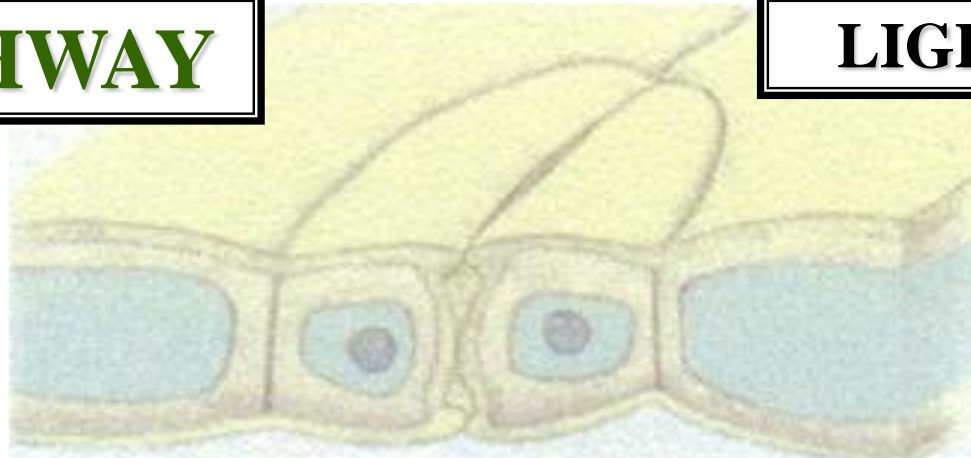


MESOPHYLL CELL / CYTOSOL

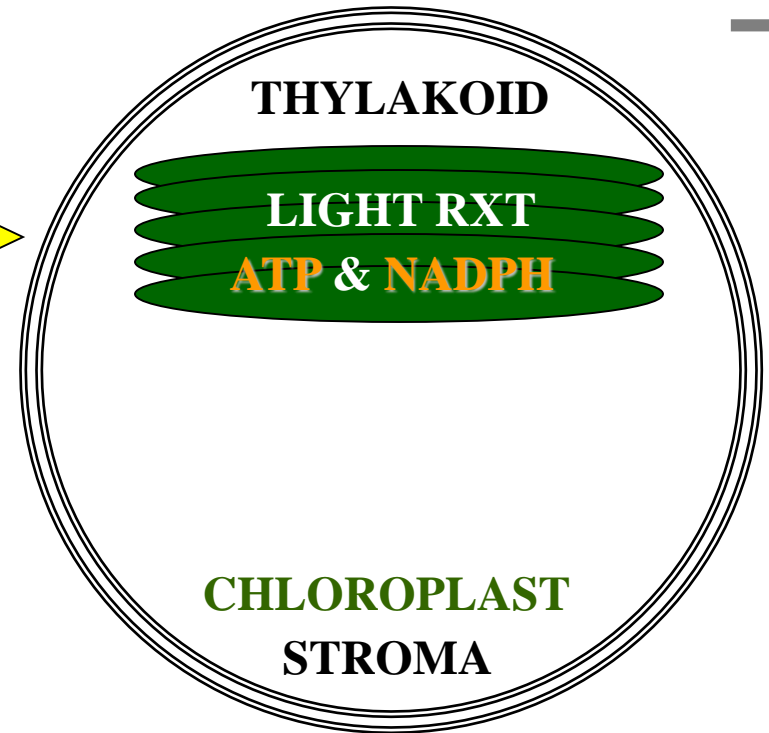
CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



LIGHT →

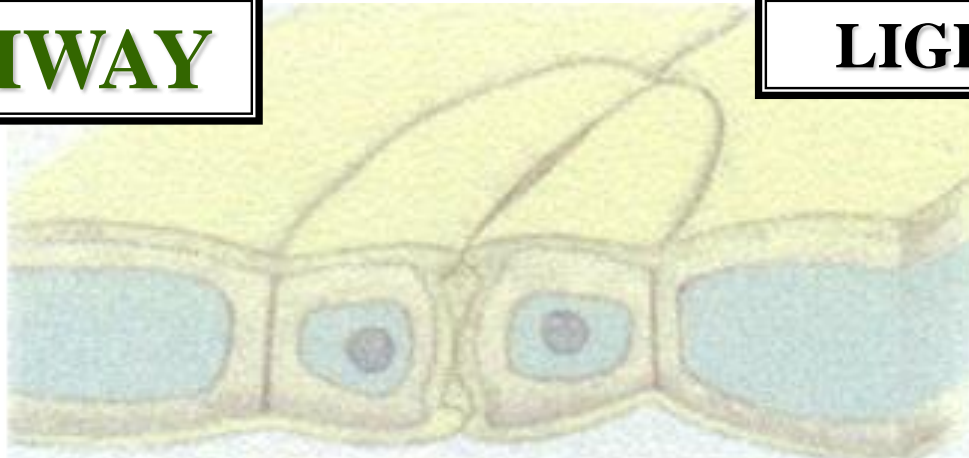


MESOPHYLL CELL / CYTOSOL

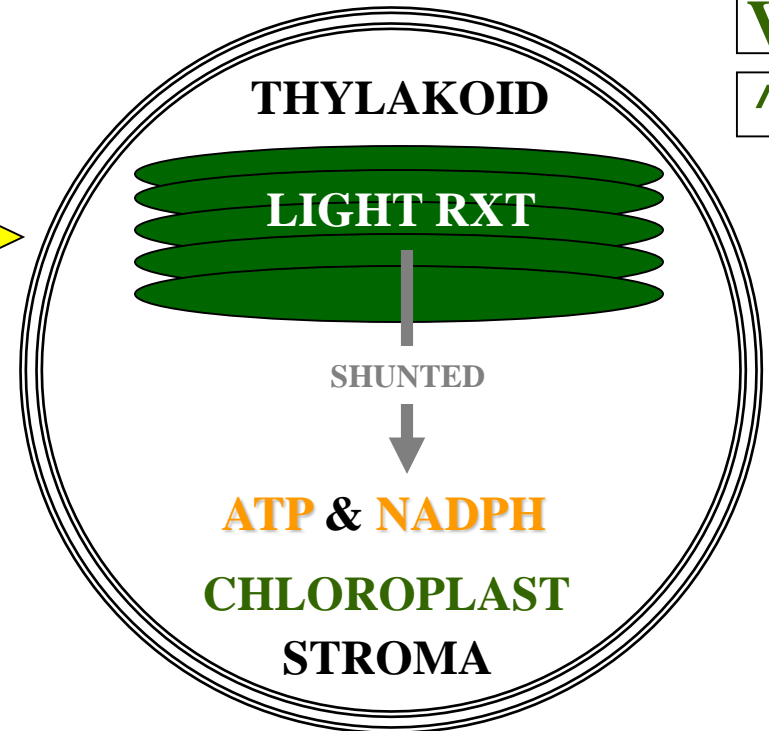
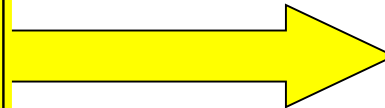
CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



LIGHT



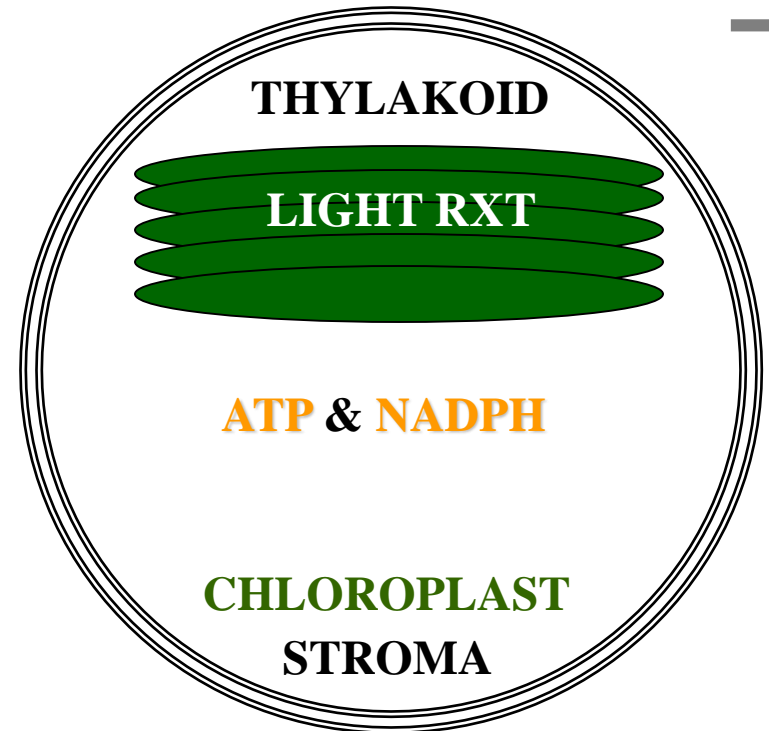
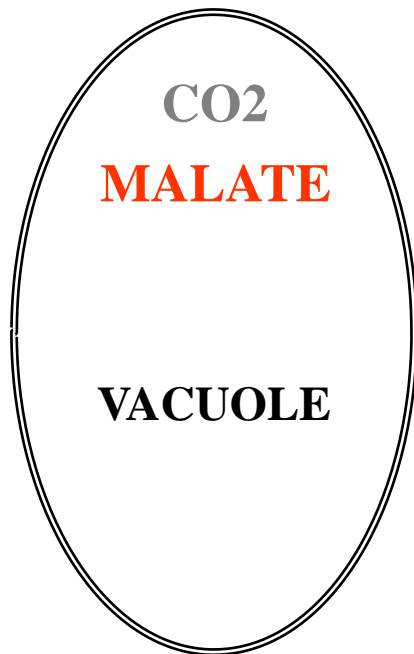
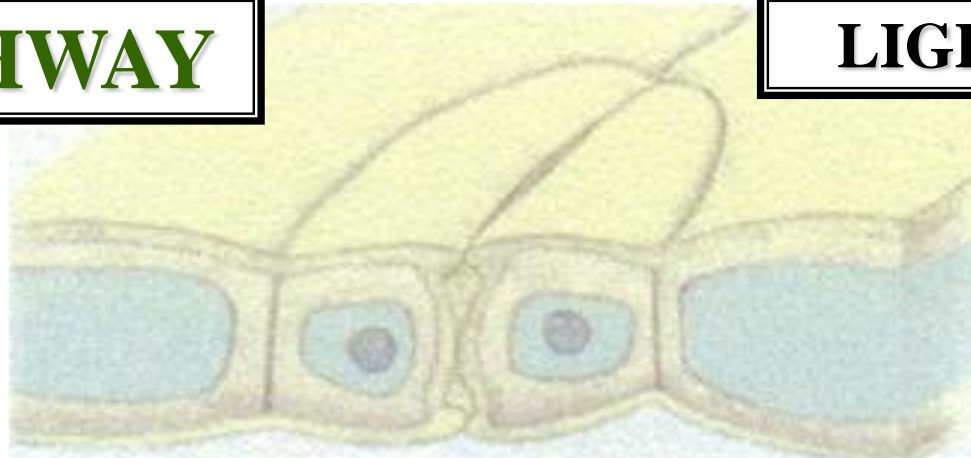
MESOPHYLL CELL / CYTOSOL

**STEM
MESOPHYLL
CELL
VACUOLE**

CAM PATHWAY

LIGHT HOURS

ATMOSPHERE

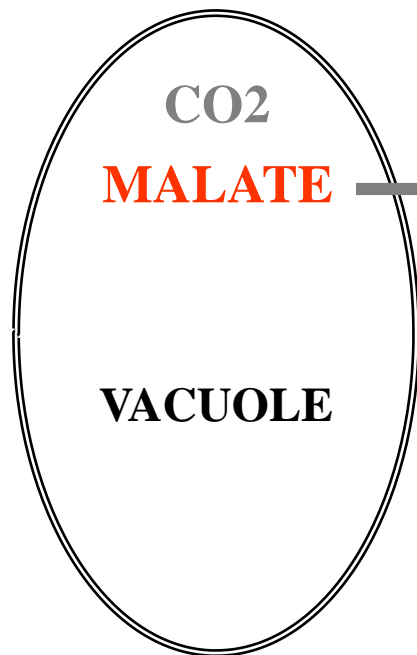


MESOPHYLL CELL / CYTOSOL

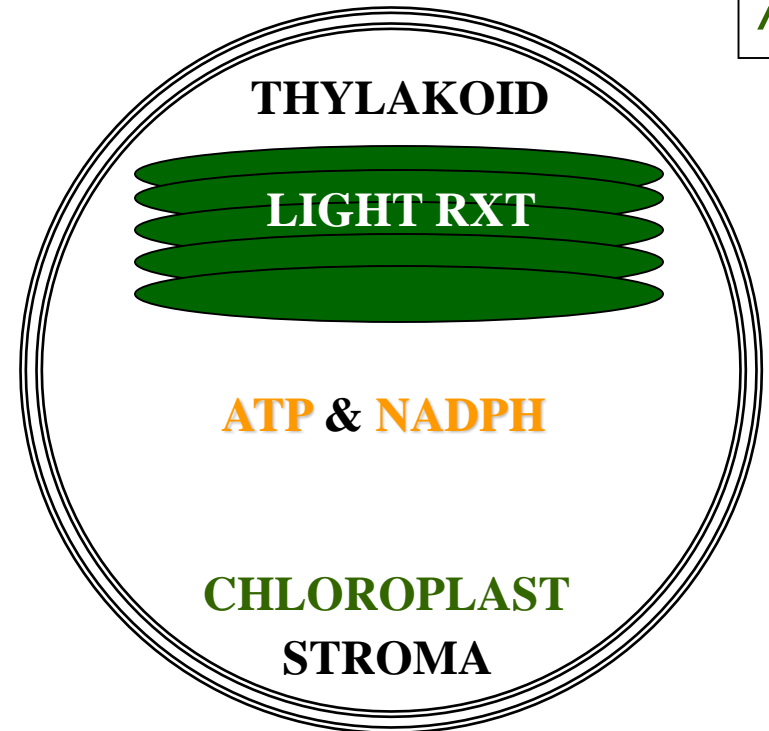
CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



SHUNTED



MESOPHYLL CELL / CYTOSOL



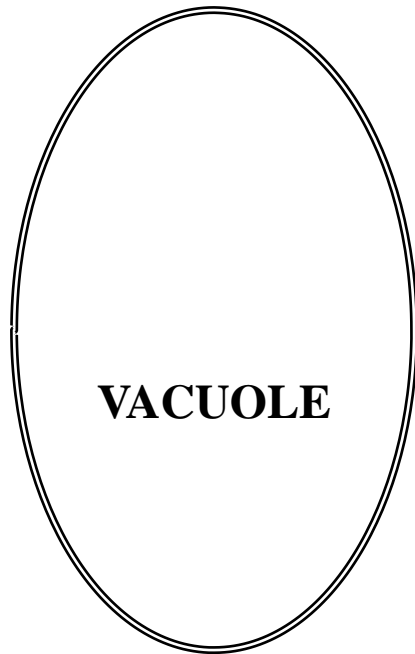
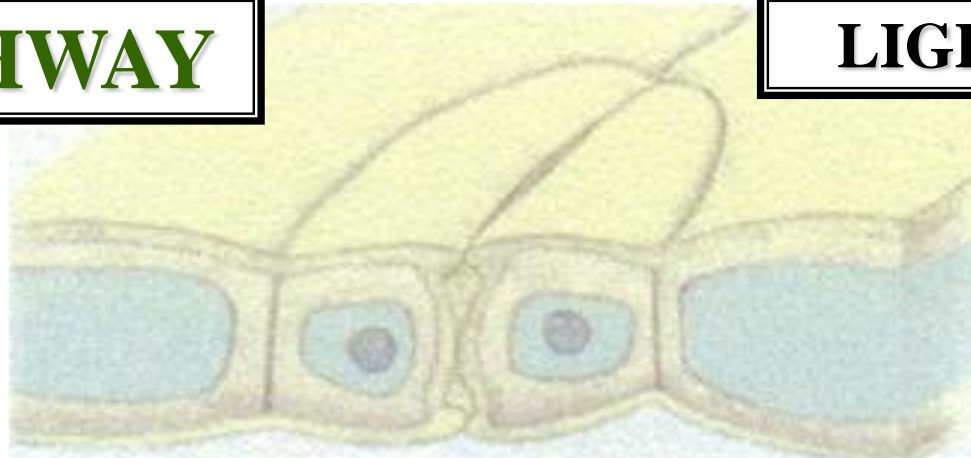


**STEM
MESOPHYLL
CELL
CYTOSOL**

CAM PATHWAY

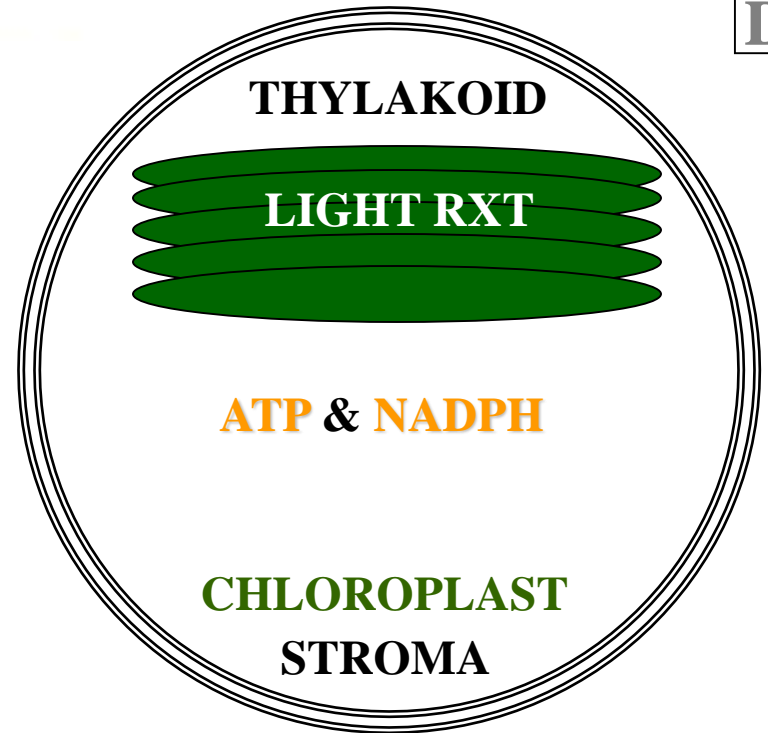
LIGHT HOURS

ATMOSPHERE



VACUOLE

CO₂
MALATE



D

THYLAKOID

LIGHT RXT

ATP & NADPH

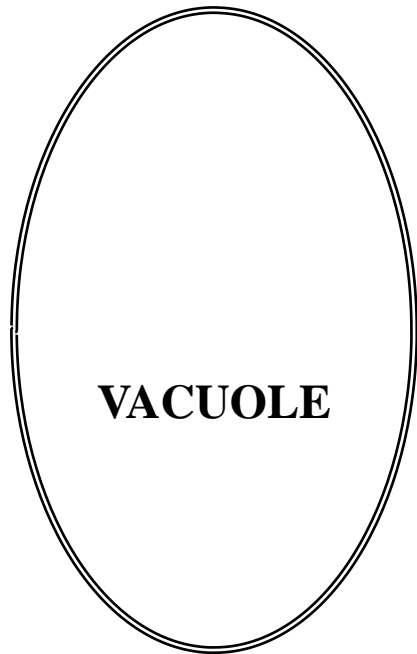
CHLOROPLAST
STROMA

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

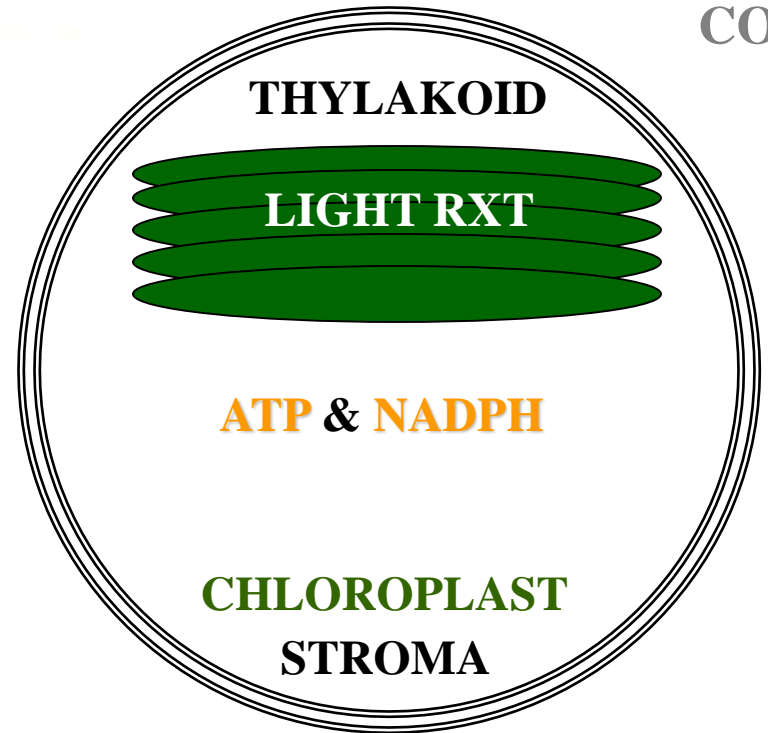
LIGHT HOURS

ATMOSPHERE



VACUOLE

CO₂
MALATE
|
DECARBOXYLATED



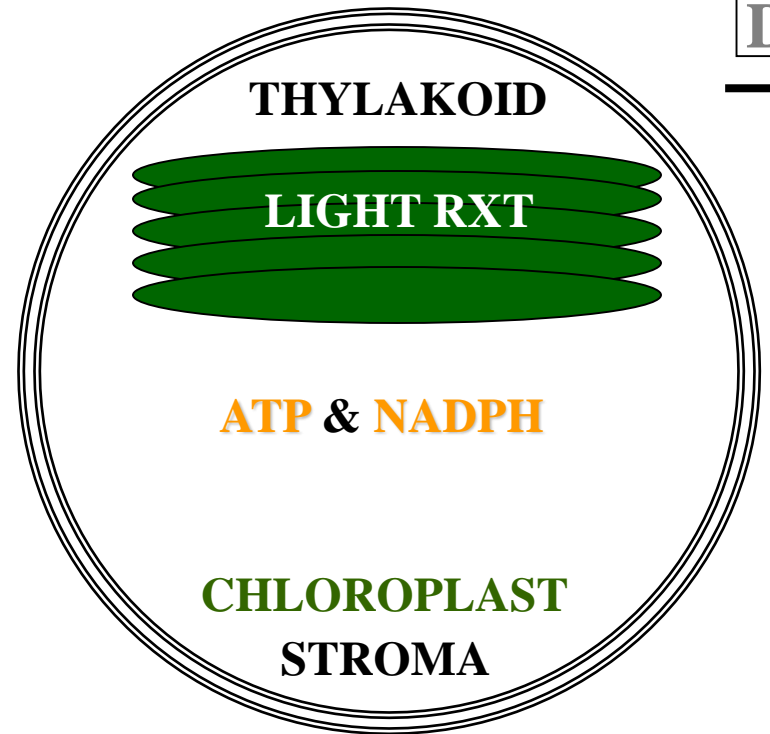
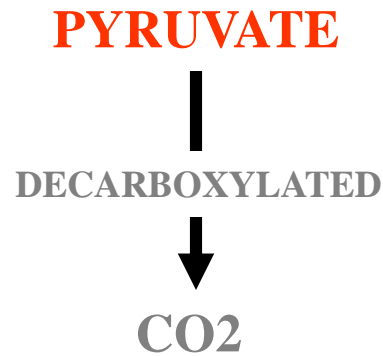
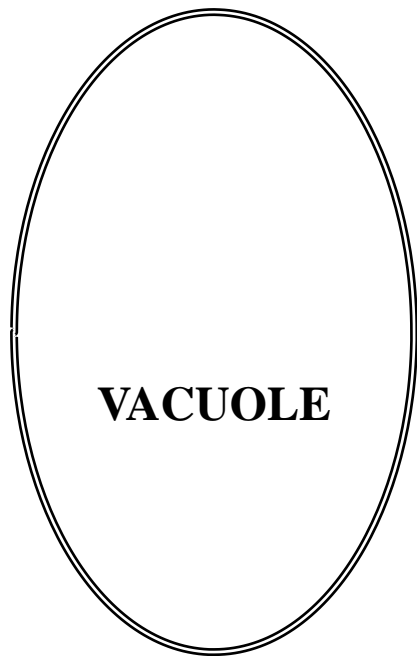
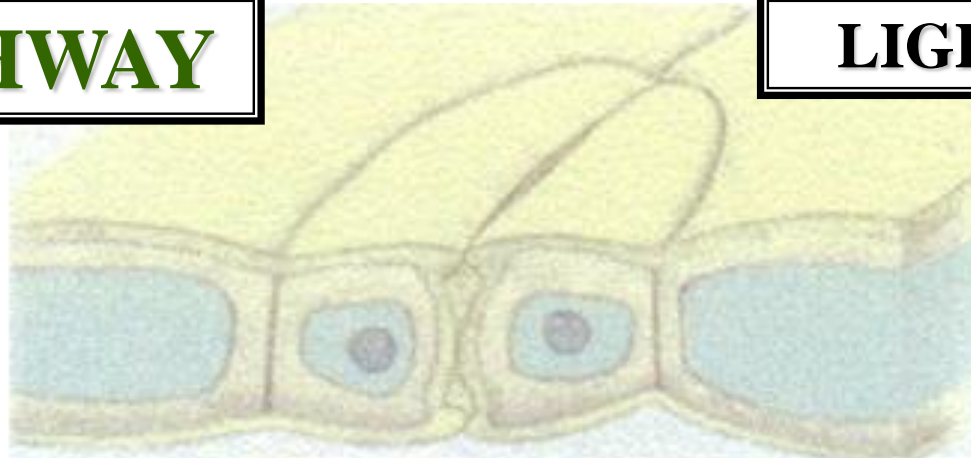
CO₂

MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

LIGHT HOURS

ATMOSPHERE

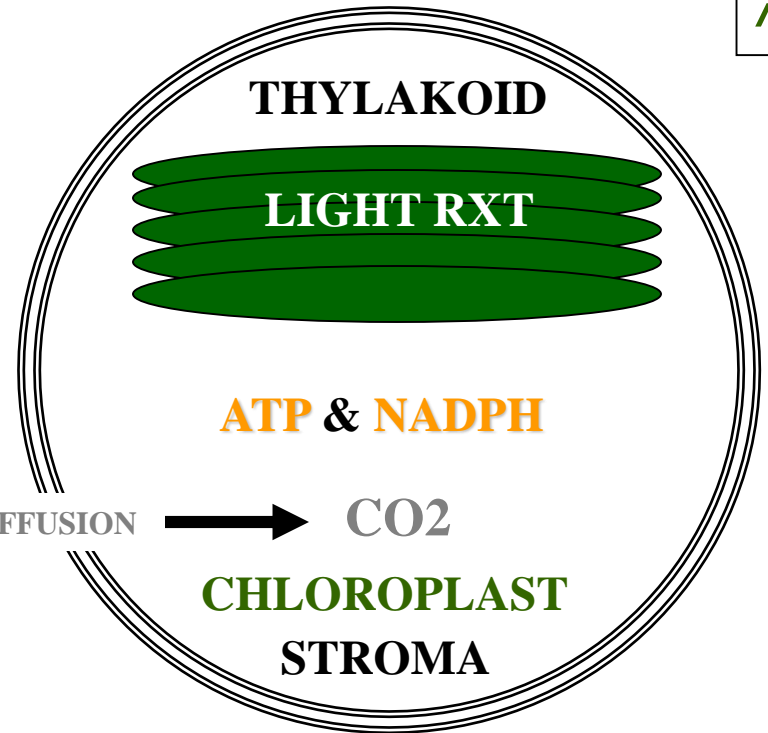
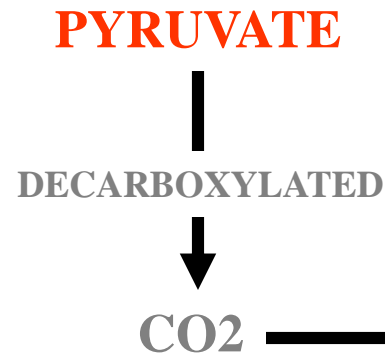
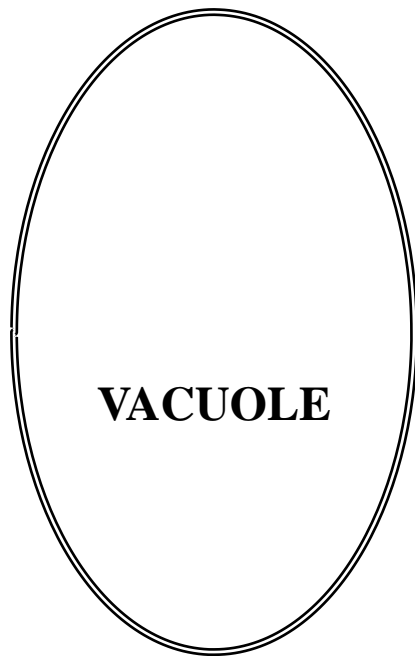
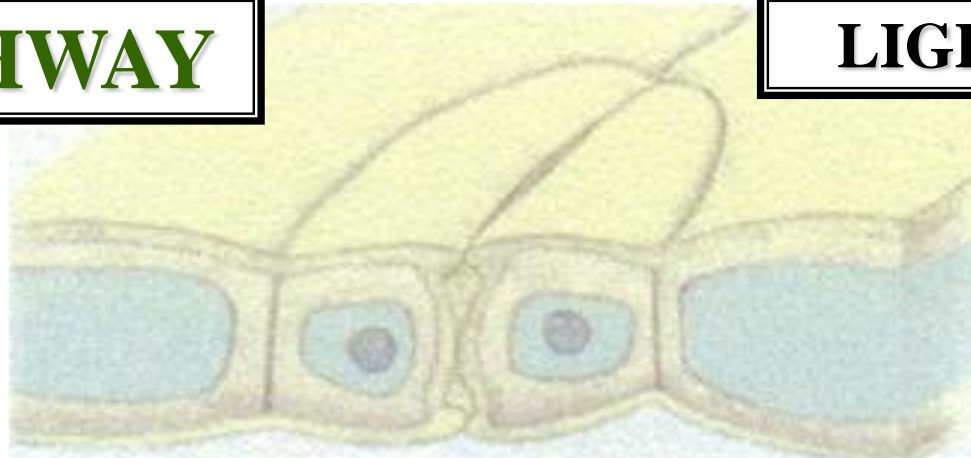


MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

LIGHT HOURS

ATMOSPHERE



MESOPHYLL CELL / CYTOSOL





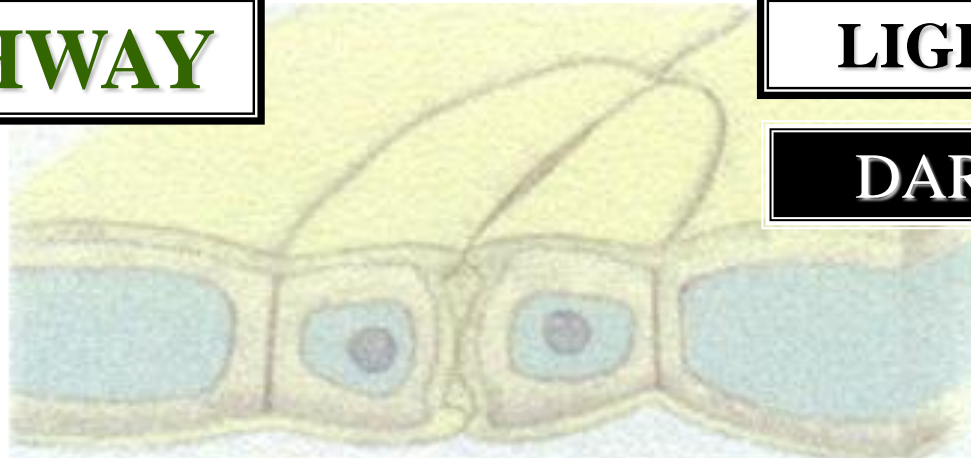
**STEM
MESOPHYLL
CELL
CHLOROPLAST
STROMA**

CAM PATHWAY

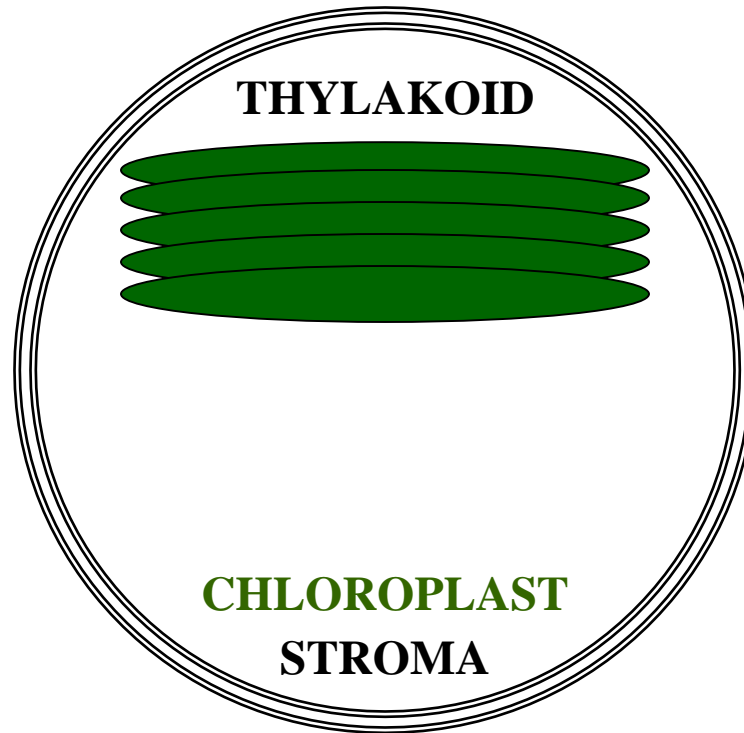
LIGHT HOURS

DARK HOURS

ATMOSPHERE



CO₂



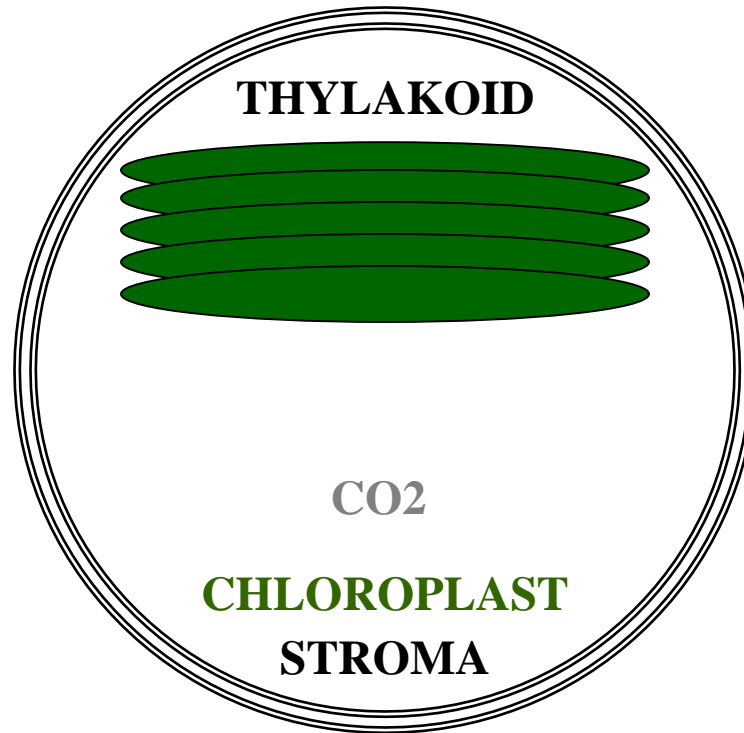
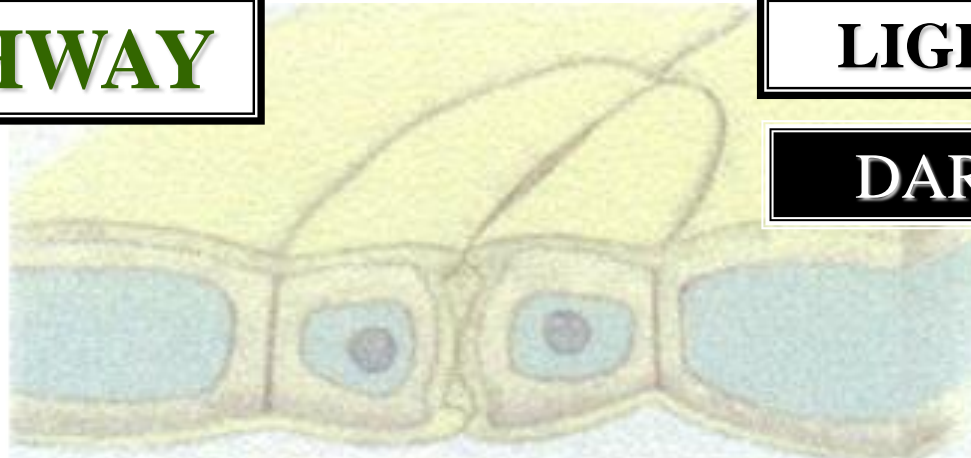
MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

LIGHT HOURS

DARK HOURS

ATMOSPHERE



MESOPHYLL CELL / CYTOSOL

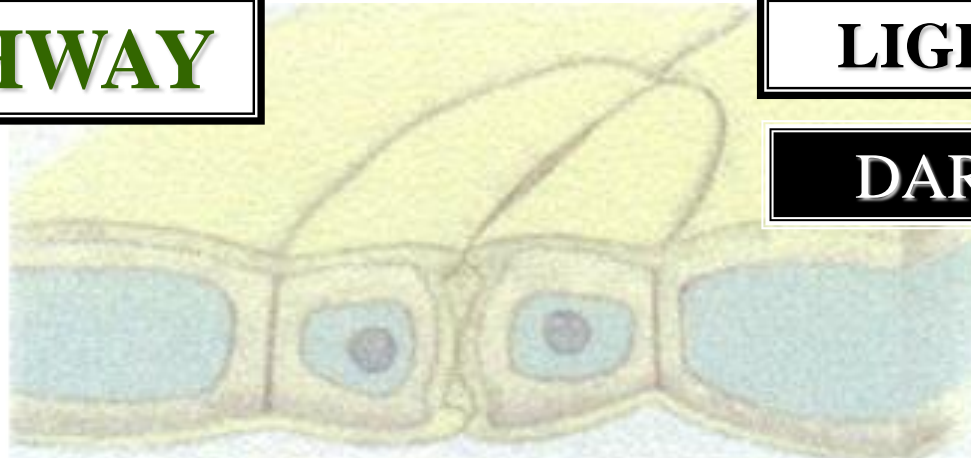


CAM PATHWAY

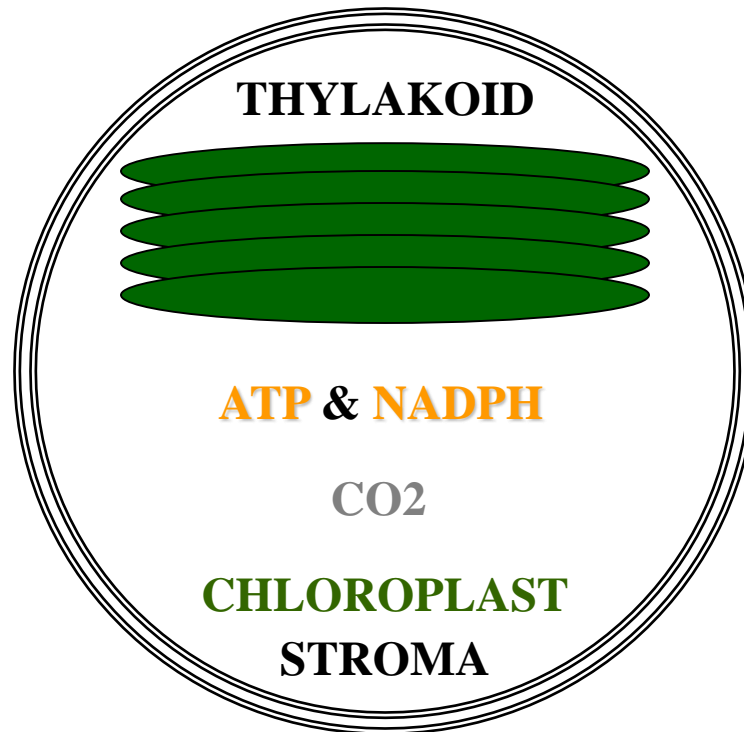
LIGHT HOURS

DARK HOURS

ATMOSPHERE



DK



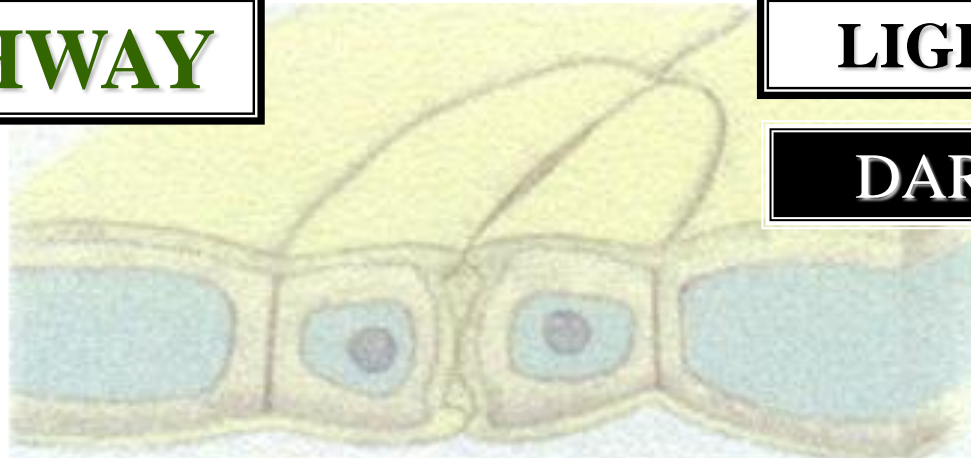
MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

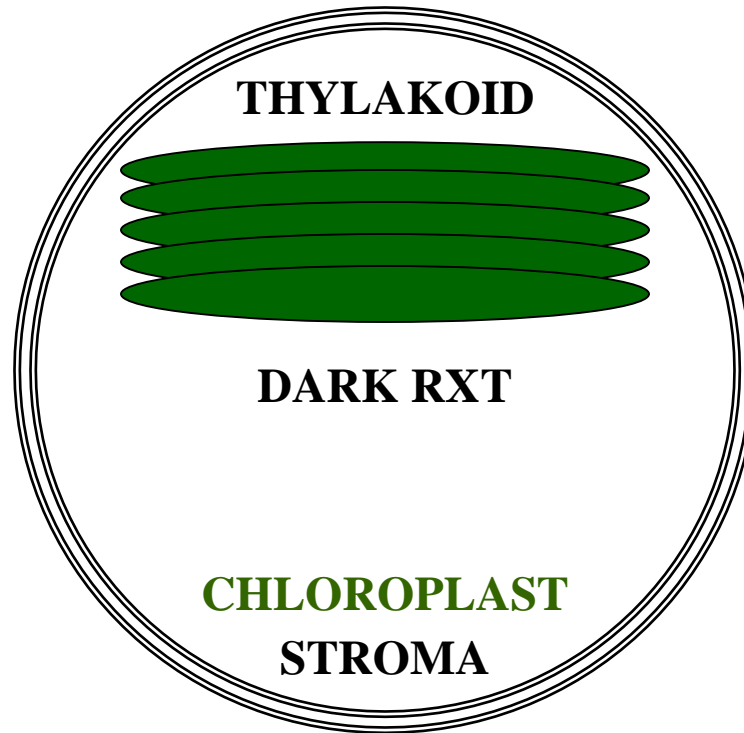
LIGHT HOURS

ATMOSPHERE

DARK HOURS



C3



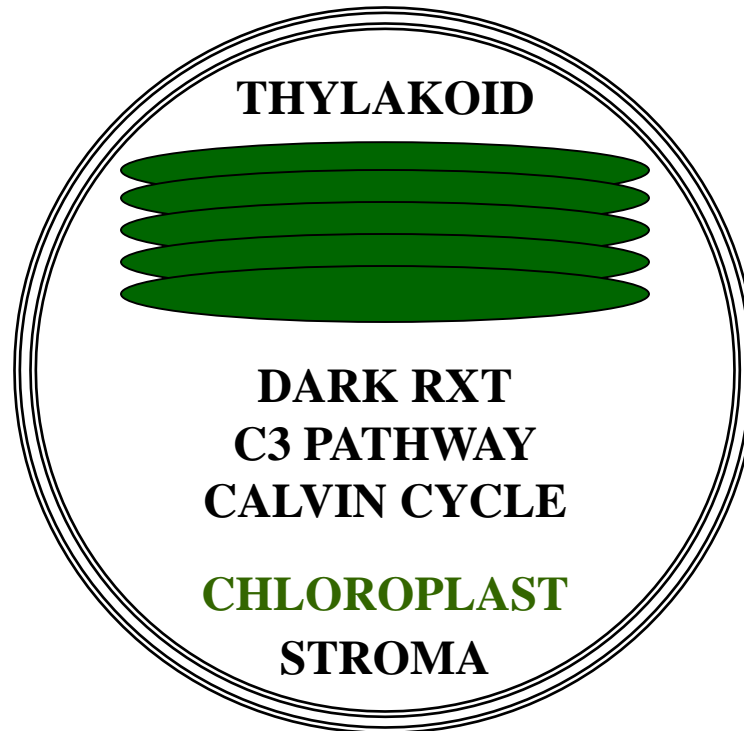
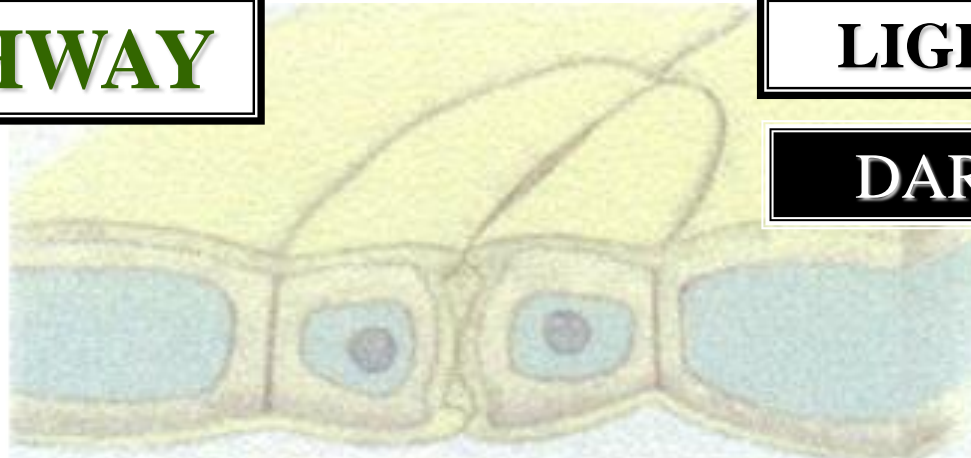
MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

LIGHT HOURS

DARK HOURS

ATMOSPHERE



MESOPHYLL CELL / CYTOSOL

G



+



CO₂ + **RIBULOSE BISPHOSEPHATE / (RUBP)**

FEEDBACK

**RIBULOSE BISPHOSEPHATE
CARBOXYLASE
(RUBP-CARBOXYLASE)**

+

G

PHOSPHOGLYCERATE / (PGA)

UNSTABLE 6C COMPOUND

PHOSPHOGLYCERATE / (PGA)

ATP

ATP

BISPHOSEPHOGLYCERATE / (BIPGA)

BISPHOSEPHOGLYCERATE / (BIPGA)

NADPH

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

PHOSPHOGLYCERALDEHYDE / (PGAL)

C₃

**COMPLEX SERIES
CHEMICAL RXTS
(CSCR)**

**COMPLEX SERIES
CHEMICAL RXTS
(CSCR)**

GLUCOSE

**C₃ PATHWAY
CALVIN CYCLE**

ATP

RIBULOSE BISPHOSEPHATE / (RUBP)

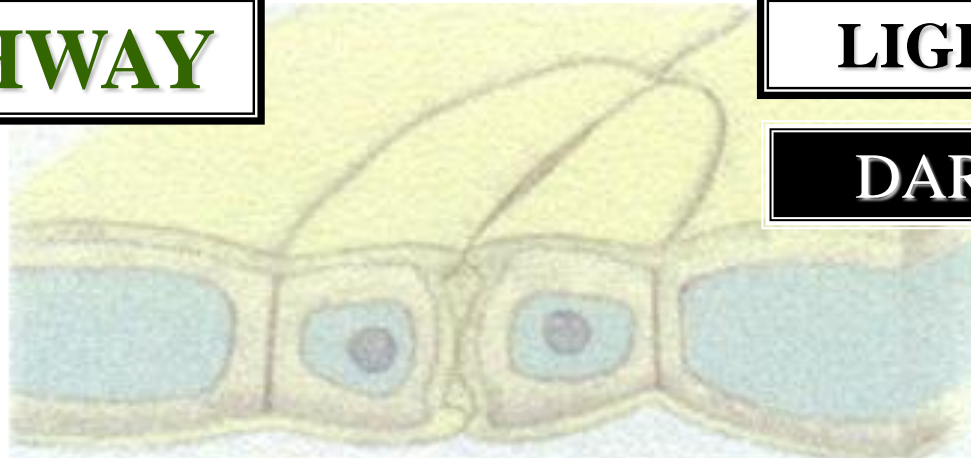
= CHEMICAL ENERGY

CAM PATHWAY

LIGHT HOURS

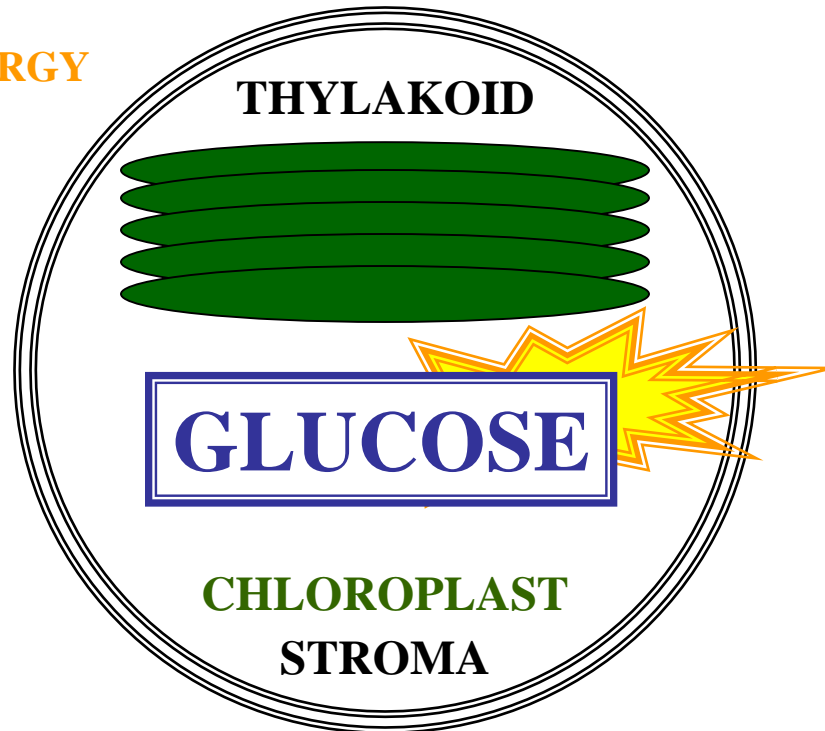
DARK HOURS

ATMOSPHERE



= CHEMICAL ENERGY

M



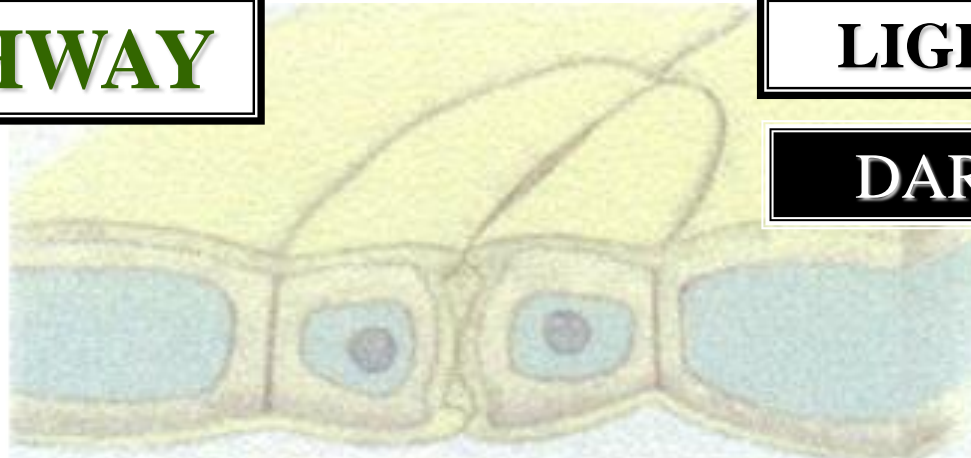
MESOPHYLL CELL / CYTOSOL

CAM PATHWAY

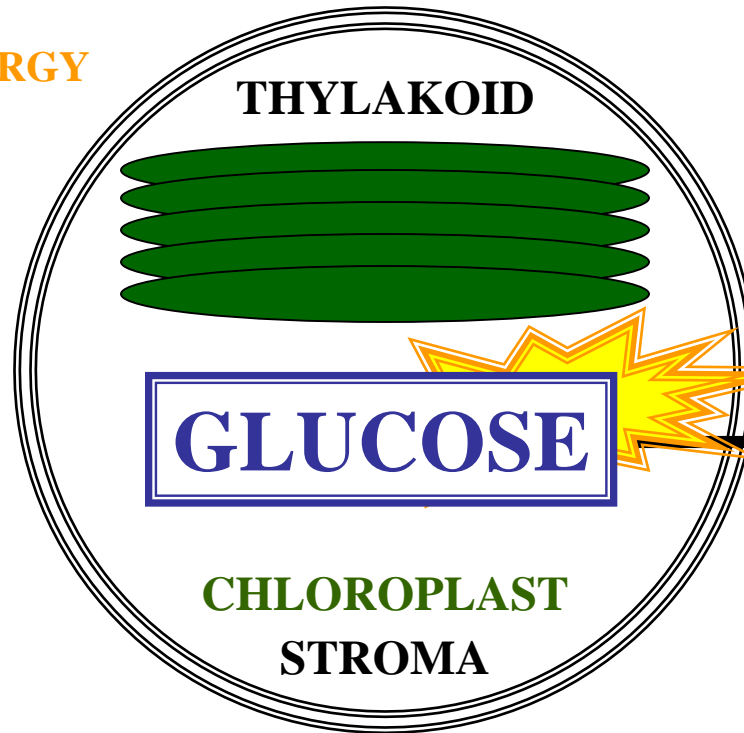
LIGHT HOURS

DARK HOURS

ATMOSPHERE



= CHEMICAL ENERGY



GLUCOSE

CHLOROPLAST
STROMA

MESOPHYLL CELL / CYTOSOL

METABOLISM

