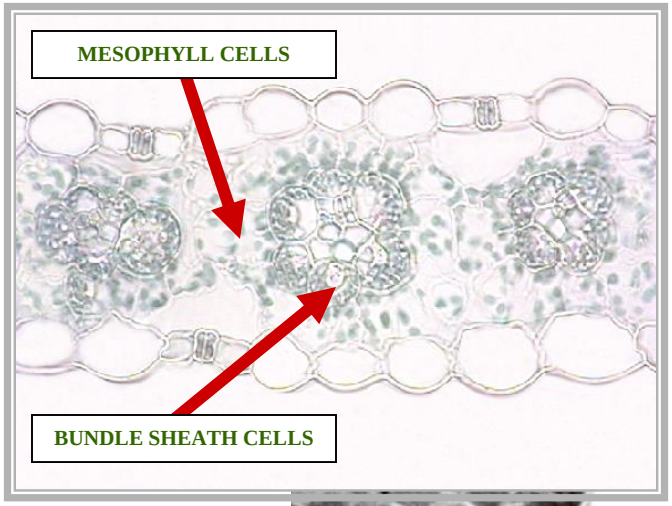
HATCH & SLACK CYCLE

CORN

ATMOSPHERE



C4 LEAF

= CHEMICAL ENERGY

ALL RXTS REQUIRE A SPECIFIC ENZYME

C4

¿

G

CO_2 + RIBULOSE BISPHOSPHATE / (RUBP)

FEEDSBACK

G

+

RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)

UNSTABLE 6C COMPOUND

PHOSPHOGLYCERATE / (PGA)

ATP

BISPHOSPHOGLYCERATE / (BIPGA)

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

COMPLEX SERIES CHEMICAL RXTS (CSCR)

GLUCOSE

PHOSPHOGLYCERATE / (PGA)

ATP

BISPHOSPHOGLYCERATE / (BIPGA)

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

COMPLEX SERIES CHEMICAL RXTS (CSCR)

ATP

RIBULOSE BISPHOSPHATE / (RUBP)

C3

C3 PATHWAY

CALVIN CYCLE

= CHEMICAL ENERGY

HATCH & SLACK CYCLE

CORN

PEP-ASE

PEP

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

ATMOSPHERE

C3

RUBP

PGA

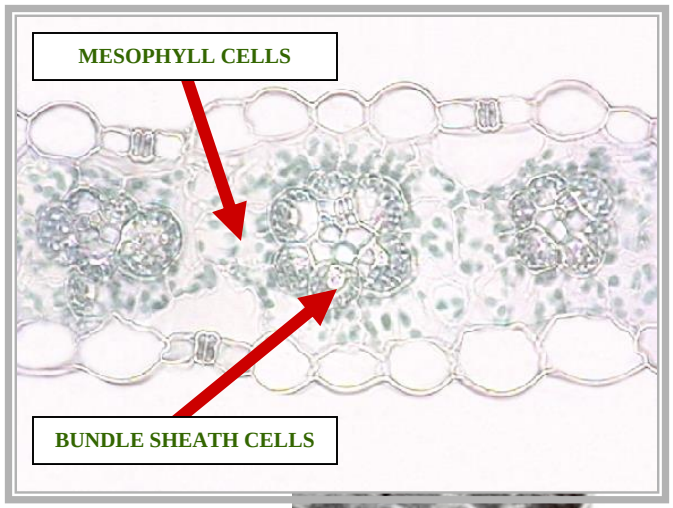
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

M

HATCH & SLACK CYCLE

CORN

PEP-ASE

PEP

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

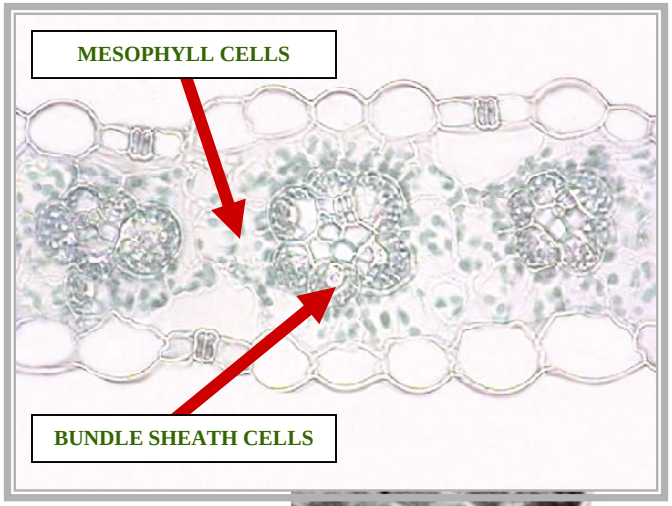
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

?

A

QUESTION

DOES A C4 PLANT ALSO CONDUCT C3?

QUESTION

C4

+

ANSWER

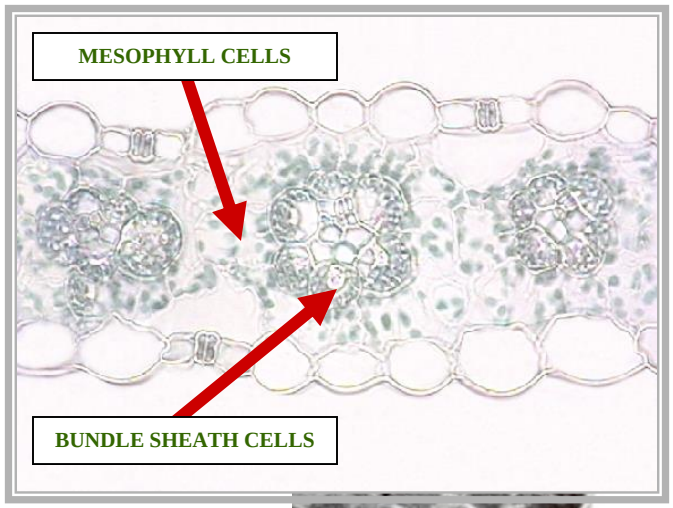
YES

ANSWER

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



C4 LEAF

PEP-ASE

PEP

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

BUNDLE-SHEATH CELL CHLOROPLAST

= CHEMICAL ENERGY

C4

?


?
C4 PLANTS

C4 PATHWAY
&
C3 PATHWAY
?

CATABOLIC METABOLISM & ANABOLIC METABOLISM ?

EXERGONIC REACTIONS & ENDERGONIC REACTIONS ?

REDUCTION REACTIONS & OXIDATION REACTIONS ?

LIGHT REACTION & DARK REACTION ?


C4 PLANTS

C4 PATHWAY
&
C3 PATHWAY
?
CP
>


C4 PLANTS

C4 PATHWAY
&
C3 PATHWAY
!!!COUPLED!!!

HATCH & SLACK CYCLE

CORN

PEP-ASE

PEP

OXALOACETATE

CO2

MALATE

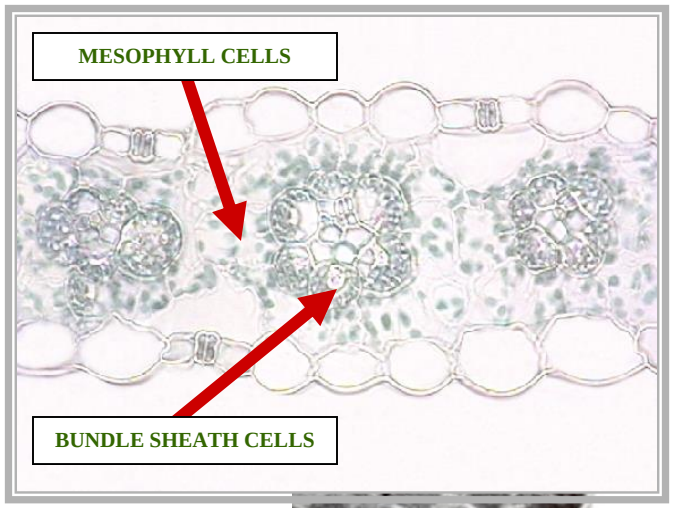
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

PYRUVATE

HATCH & SLACK CYCLE

CORN

PEP-ASE

PEP

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

ATMOSPHERE

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

C3

RUBP

PGA

RUBP-ASE

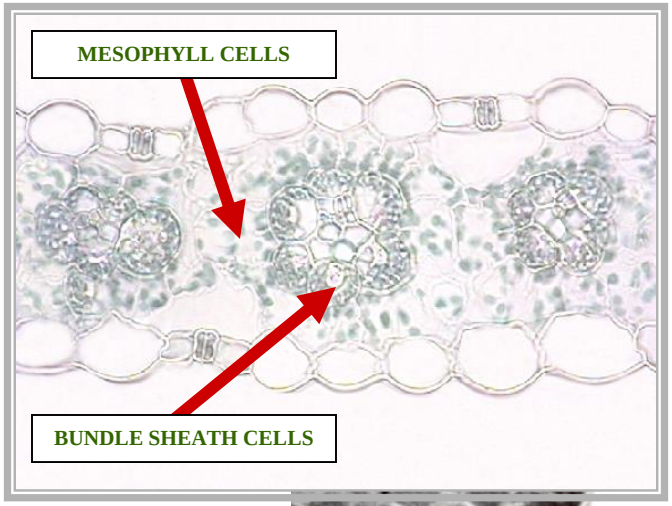
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

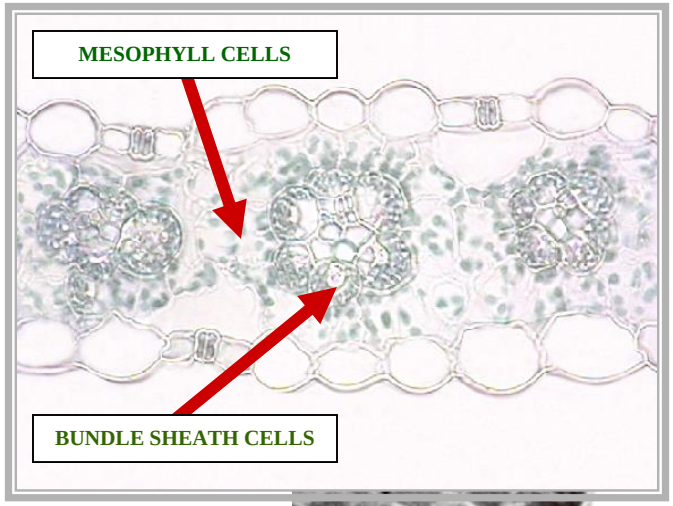
= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



C4 LEAF

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

ALL RXTS REQUIRE A SPECIFIC ENZYME

C4

MESOPHYLL CELL CYTOSOL

HATCH & SLACK CYCLE

CORN

PEP-ASE

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

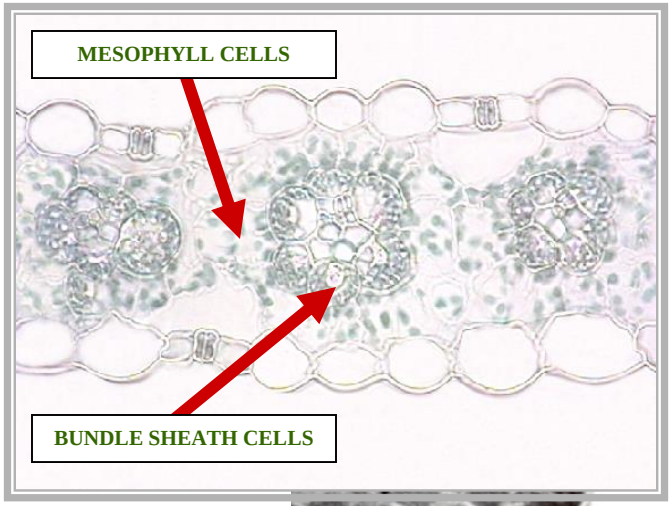
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

PEP

HATCH & SLACK CYCLE

CORN

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

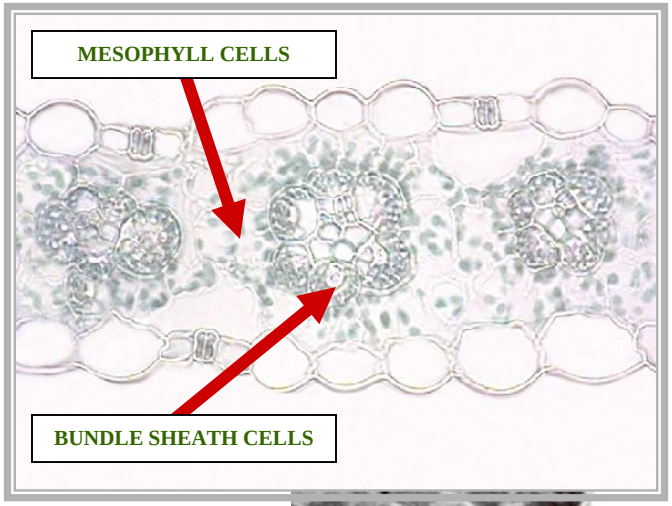
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

A

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

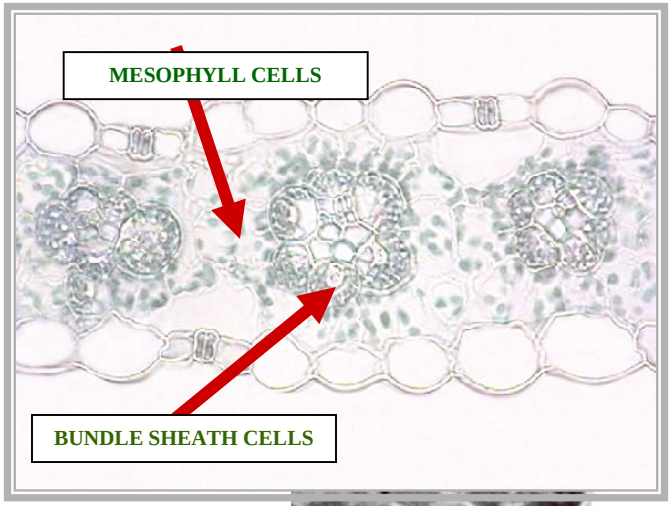
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

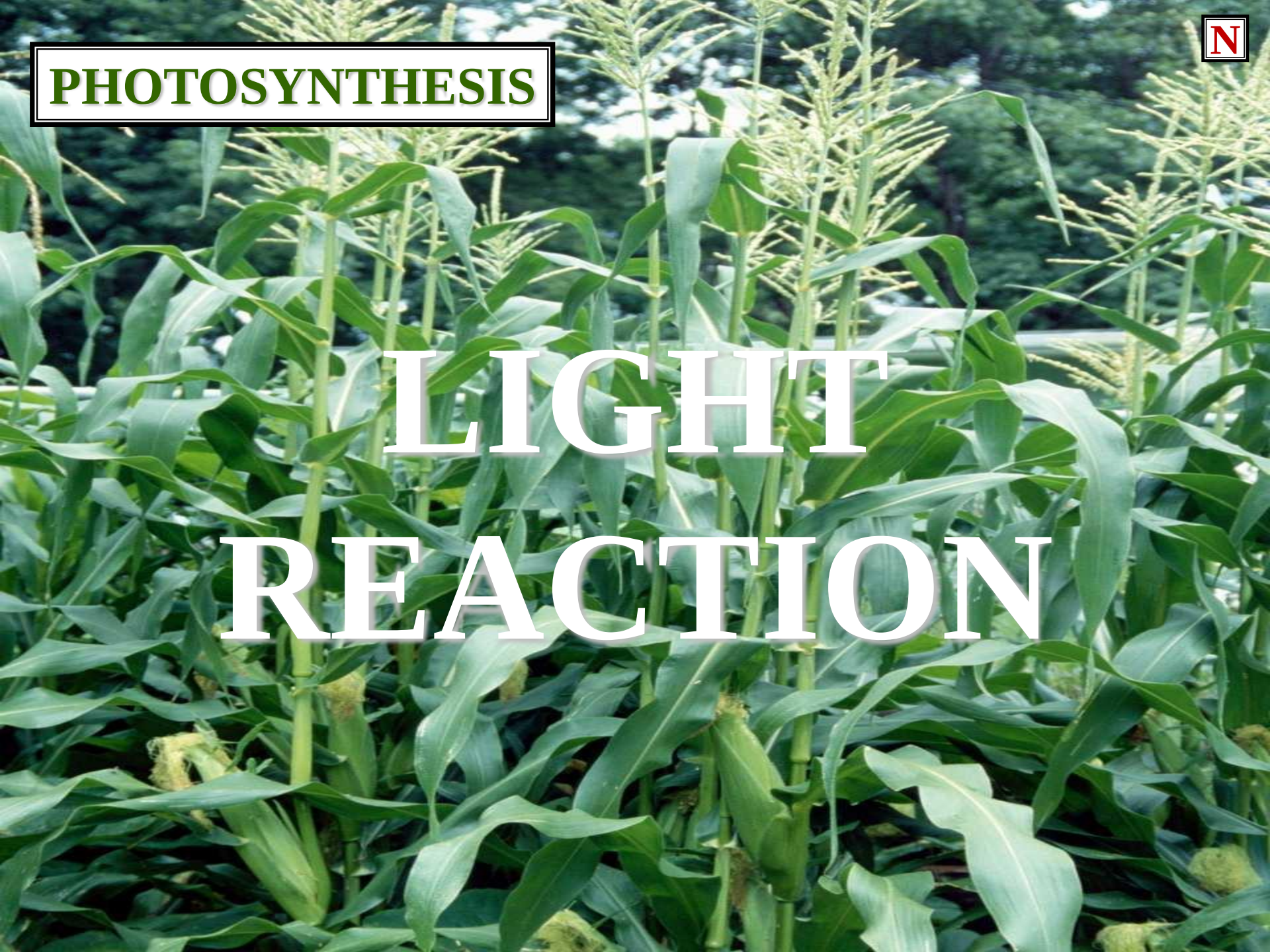
C4

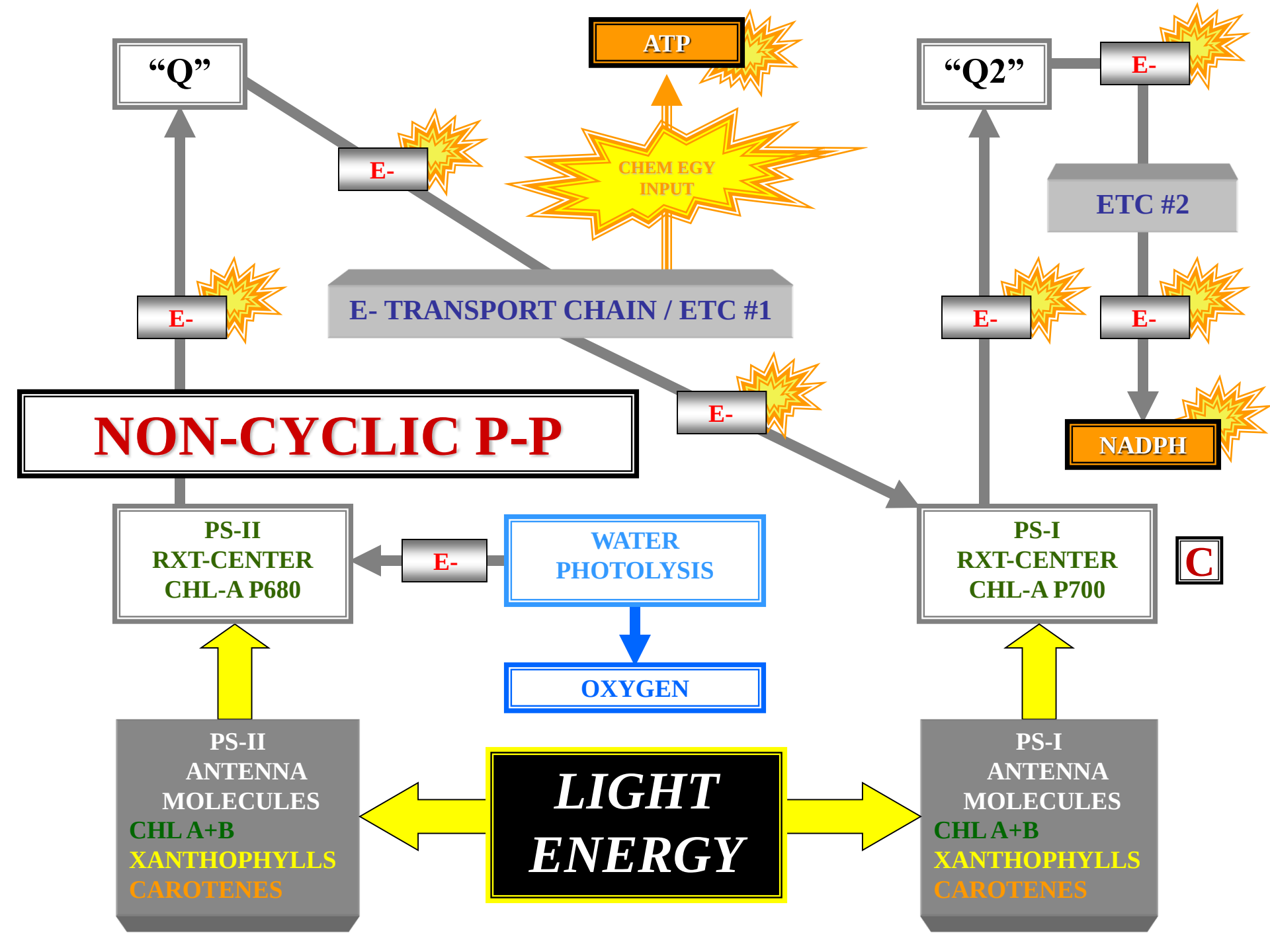
C4 LEAF

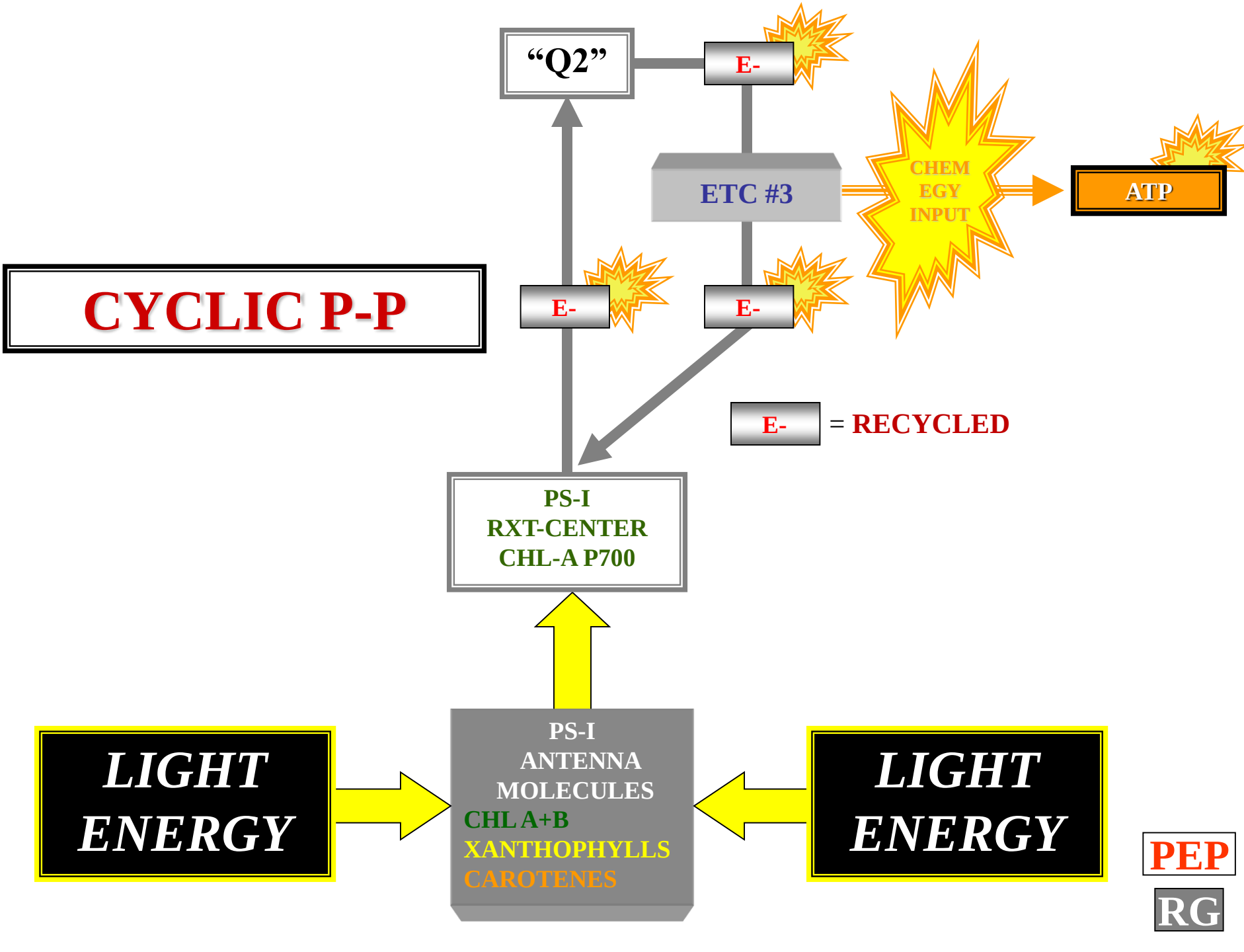
= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

LR


PHOTOSYNTHESIS
LIGHT
REACTION


"Q"
ATP
"Q2"
E-
CHEM EGY INPUT
ETC #2
E- TRANSPORT CHAIN / ETC #1
NON-CYCLIC P-P
NADPH
PS-II RXT-CENTER CHL-A P680
WATER PHOTOLYSIS
PS-I RXT-CENTER CHL-A P700
C
OXYGEN
PS-II ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT ENERGY
PS-I ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES


"Q2"
E-
ETC #3
CHEM EGY INPUT
ATP
CYCLIC P-P
E-
E-
E- = RECYCLED
PS-I
RXT-CENTER
CHL-A P700
PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT ENERGY
LIGHT ENERGY
PEP
RG

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

REGENERATED

PYRUVATE

OXALOACETATE

CO2

MALATE

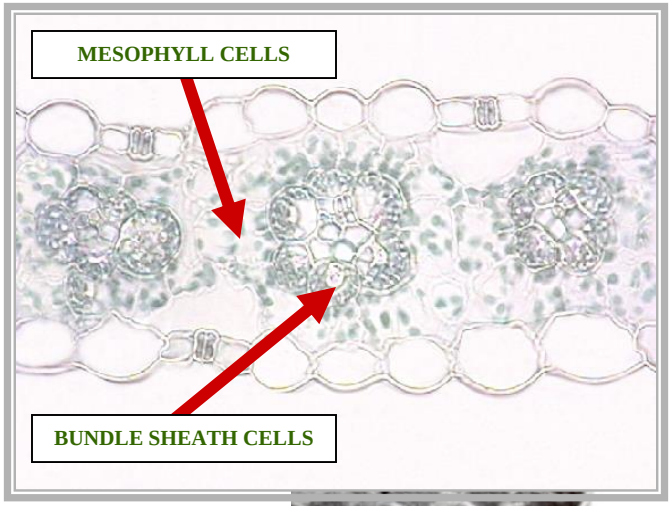
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

FB

HATCH & SLACK CYCLE

CORN

2 ATP

2 ADP

EGY

PEP-ASE

PEP

FEEDSBACK

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

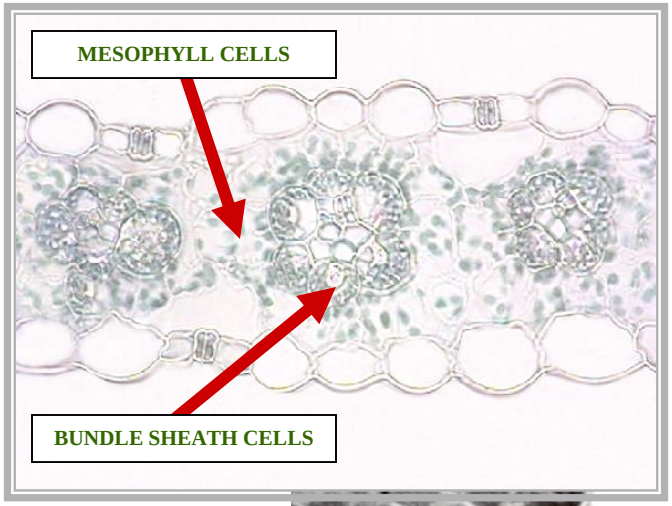
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



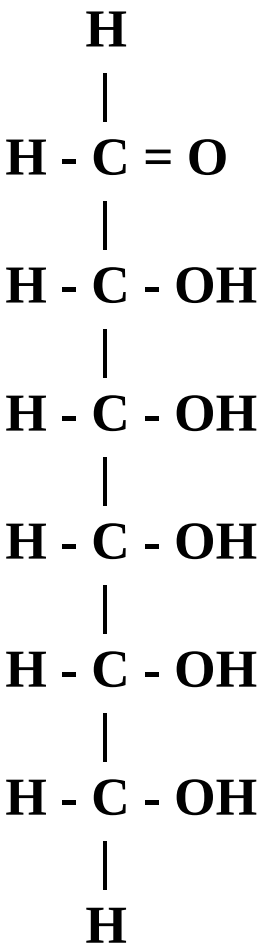
C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

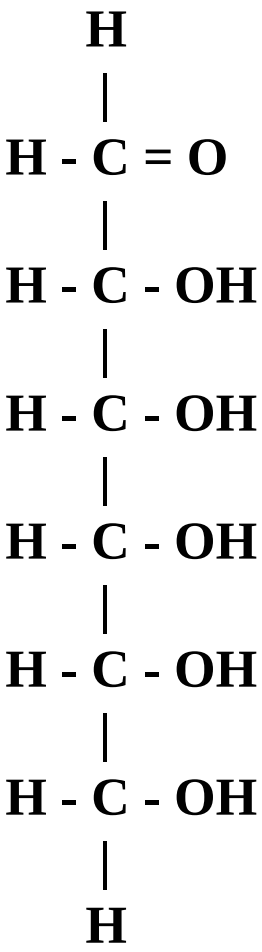
C4 PATHWAY ENERGY COST

GLUCOSE



C6H12O6

GLUCOSE



C6H12O6

GLUCOSE
6C
SUGAR

GLUCOSE
6C
SUGAR

QUESTION

WHAT COMPOUND CONTRIBUTES C ATOMS TO THE SYNTHESIS OF GLUCOSE?

QUESTION

HATCH & SLACK CYCLE

CORN

2 ATP

2 ADP

EGY

PEP-ASE

PEP

FEEDSBACK

PYRUVATE

OXALOACETATE

CO2

MALATE

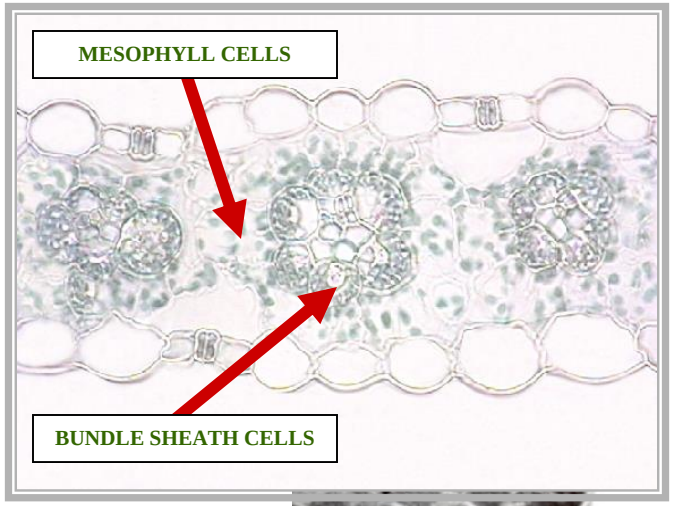
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

BUNDLE-SHEATH CELL CHLOROPLAST

C4

C4 LEAF

= CHEMICAL ENERGY

A

ANSWER

CO2

ANSWER

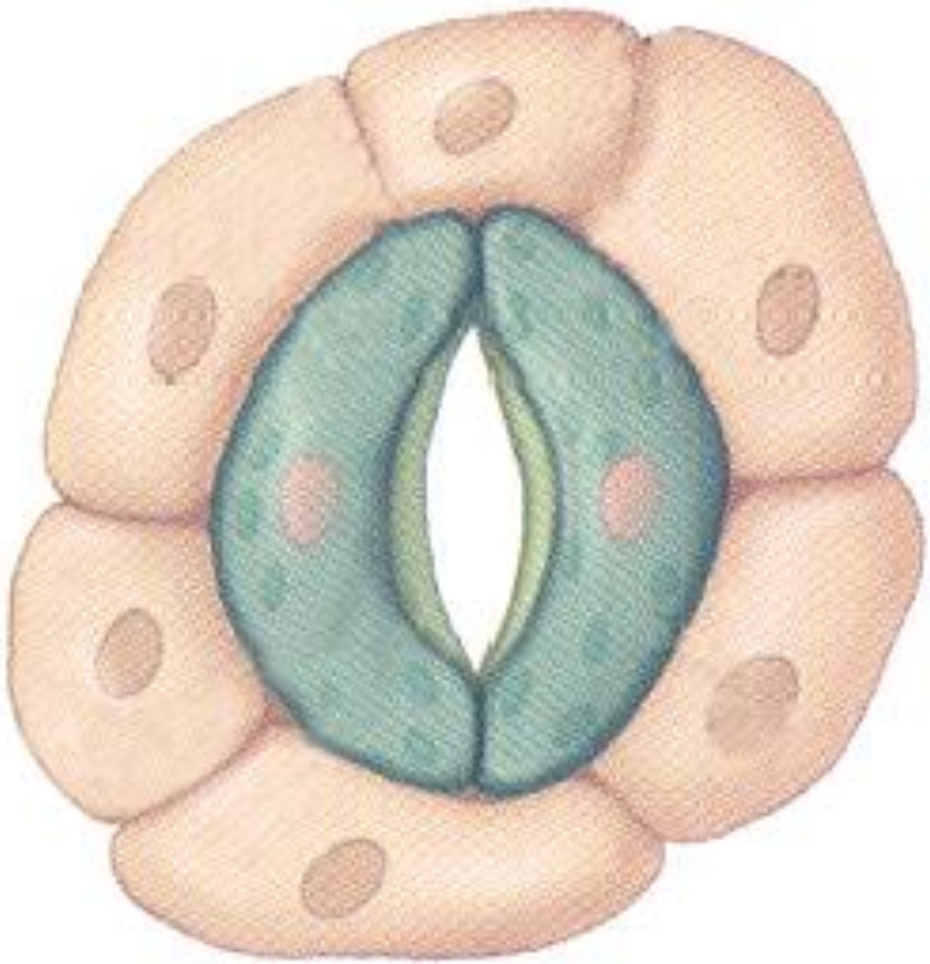
LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO2

CO2



CO2

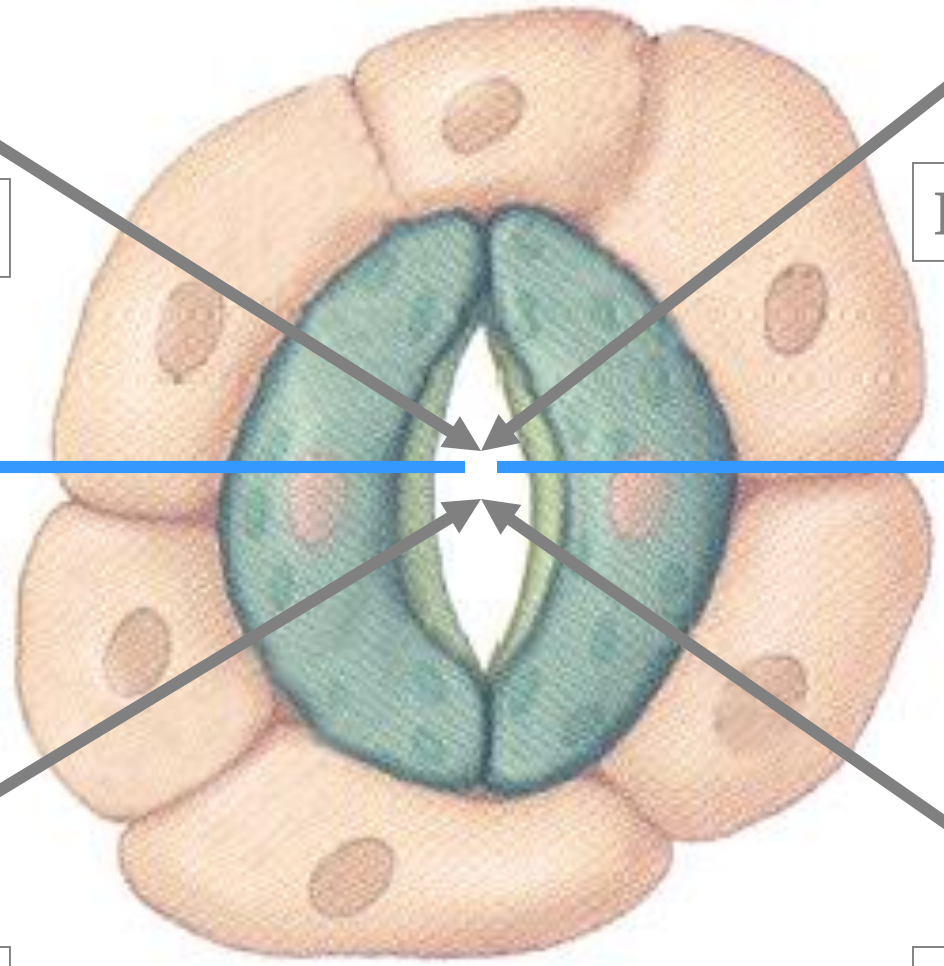
CO2

CO2

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

H2O

DIFFUSION

CO2

DIFFUSION

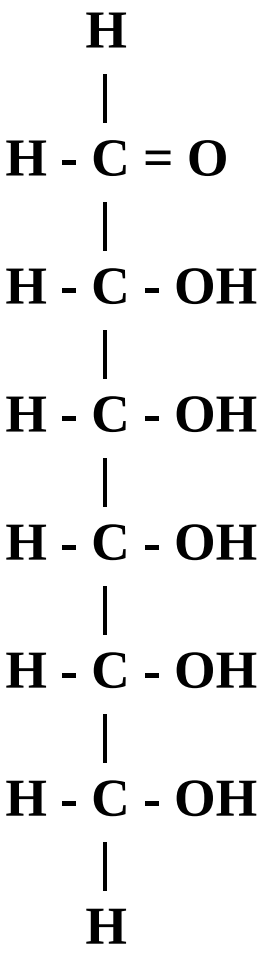
CO2

DIFFUSION

PHOTOSYNTHESIS

CO2
CO2
CO2
CO2
CO2
CO2

SYNTHESIZE



CARBON DIOXIDE

BUILDING BLOCK

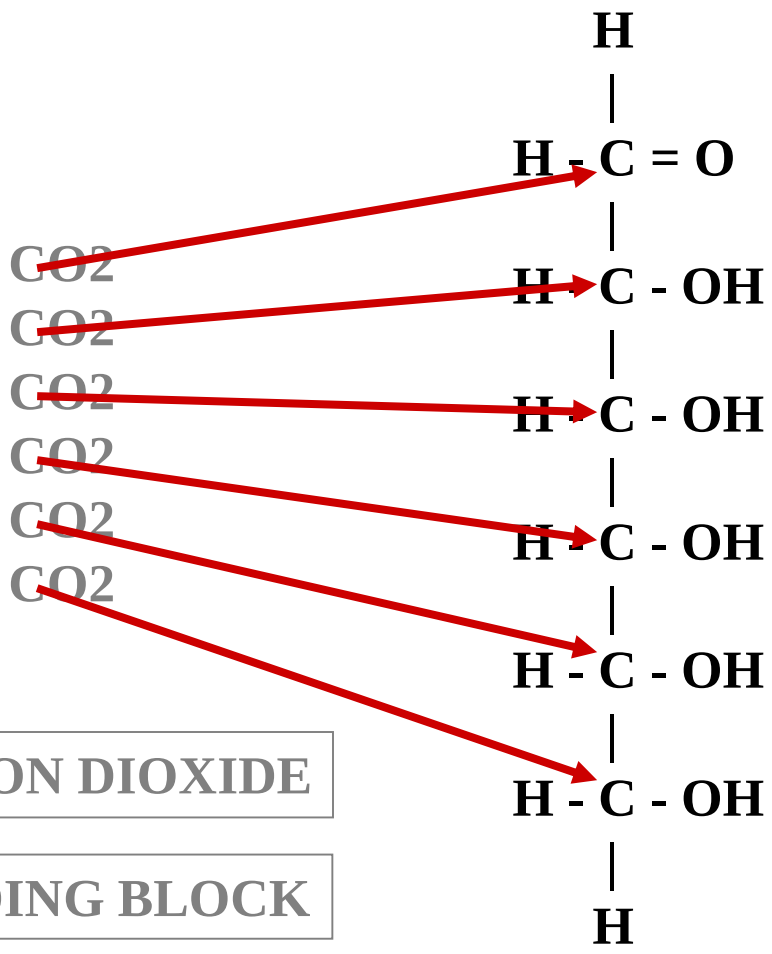
C6H12O6

GLUCOSE

PHOTOSYNTHESIS

CO2
1

¿



CARBON DIOXIDE

BUILDING BLOCK

C6H12O6

GLUCOSE

HATCH & SLACK CYCLE
C4 PATHWAY

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

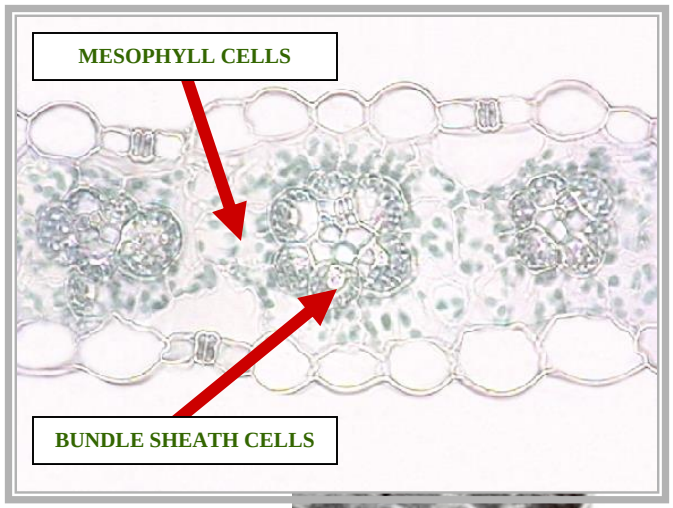
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

HATCH & SLACK CYCLE
C4 PATHWAY

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

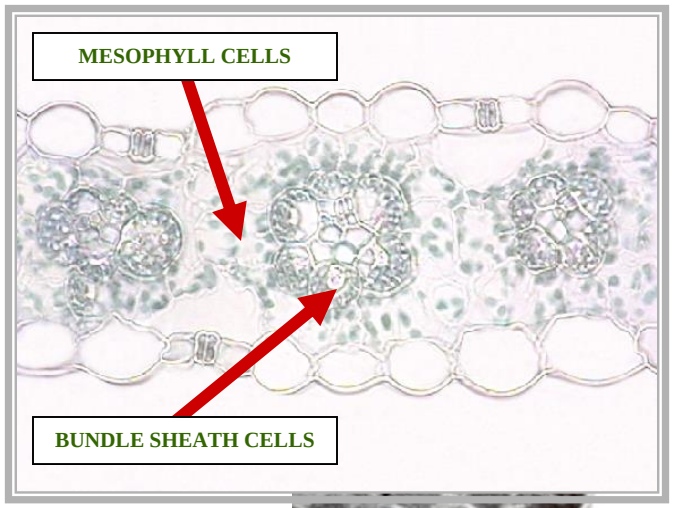
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

1 CO2 ADDED EACH C4 CYCLE

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

HATCH & SLACK CYCLE
C4 PATHWAY

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

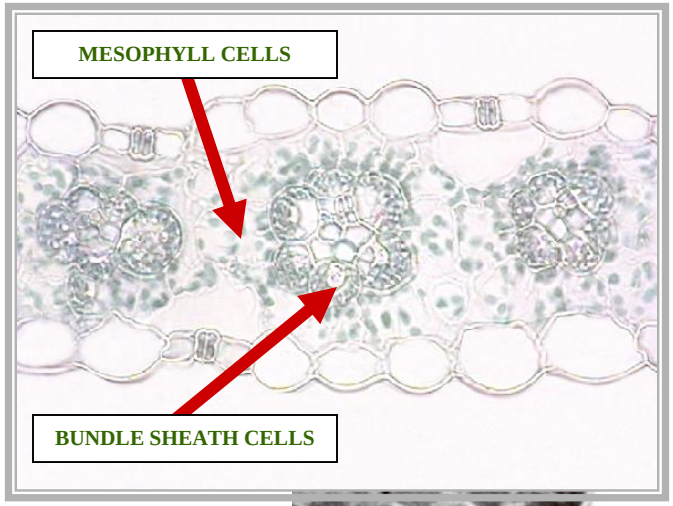
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

1 C ATOM ADDED EACH C4 CYCLE

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

6X

HATCH & SLACK CYCLE
C4 PATHWAY

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

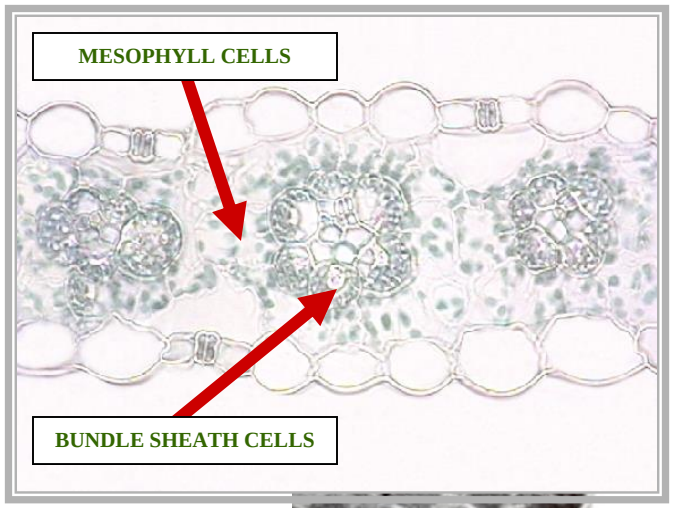
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C4 LEAF

C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

6X

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

?

A

QUESTION

DOES A C4 PLANT ALSO CONDUCT C3?

QUESTION

C4

+

ANSWER

YES

ANSWER

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

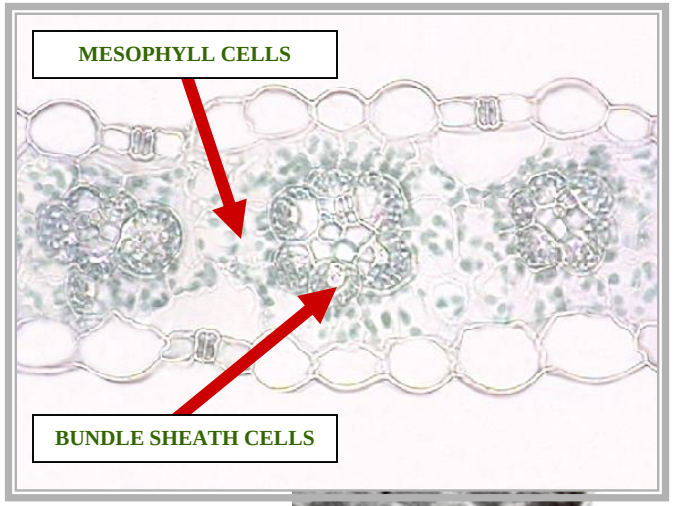
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

CP >


C4
C4 PLANTS

C4 PATHWAY
&
C3 PATHWAY
!!!COUPLED!!!

HATCH & SLACK CYCLE

CORN

12 ATP

12 ATP

EGY

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

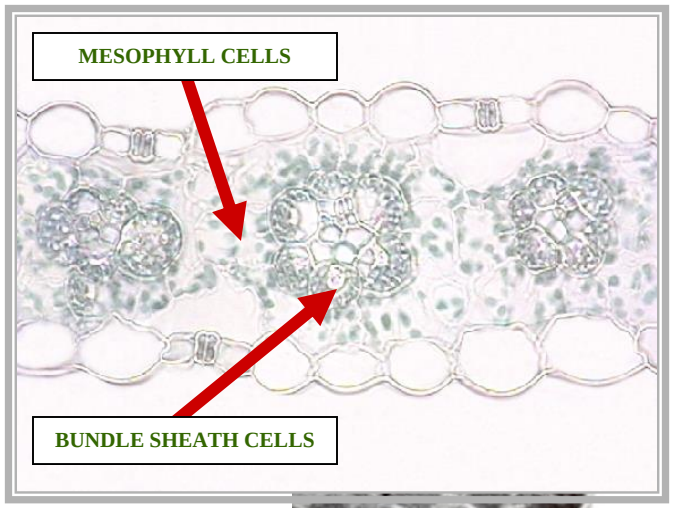
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

C3

CORN

CO2 + RIBULOSE BISPHOSPHATE / (RUBP)

FEEDSBACK

RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)

UNSTABLE 6C COMPOUND

PHOSPHOGLYCERATE / (PGA)

ATP

BISPHOSPHOGLYCERATE / (BIPGA)

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

COMPLEX SERIES CHEMICAL RXTS (CSCR)

GLUCOSE 6 CARBON SUGAR

PHOSPHOGLYCERATE / (PGA)

ATP

BISPHOSPHOGLYCERATE / (BIPGA)

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

COMPLEX SERIES CHEMICAL RXTS (CSCR)

ATP

RIBULOSE BISPHOSPHATE / (RUBP)

C3

C3 PATHWAY

CALVIN CYCLE

= CHEMICAL ENERGY

?

ENERGY EXPENSE

PHOTOSYNTHESIS

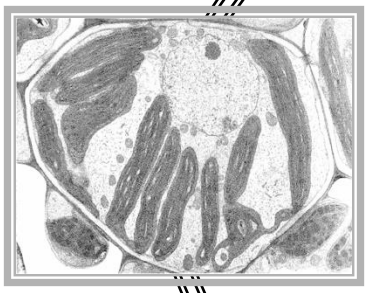
A

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID

?

DK RXT

STROMA

CHLOROPLAST

ATMOSPHERE

OXYGEN

PHOTOSYNTHESIS

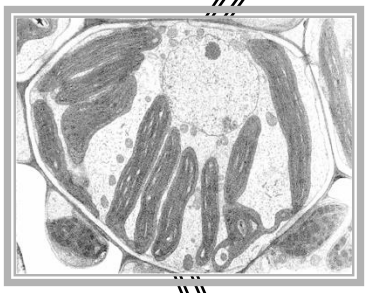
N

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID

ATP

DK RXT

STROMA

NON-CYCLIC P-P

CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN

PHOTOSYNTHESIS

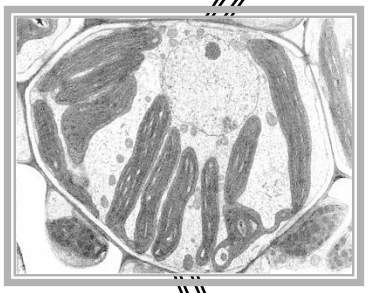
A

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID

NADPH

DK RXT

STROMA

NON-CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN


?
ATP
ENERGY EXPENSE
C4
CORN

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

? ATP/CO2

GLUCOSE

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

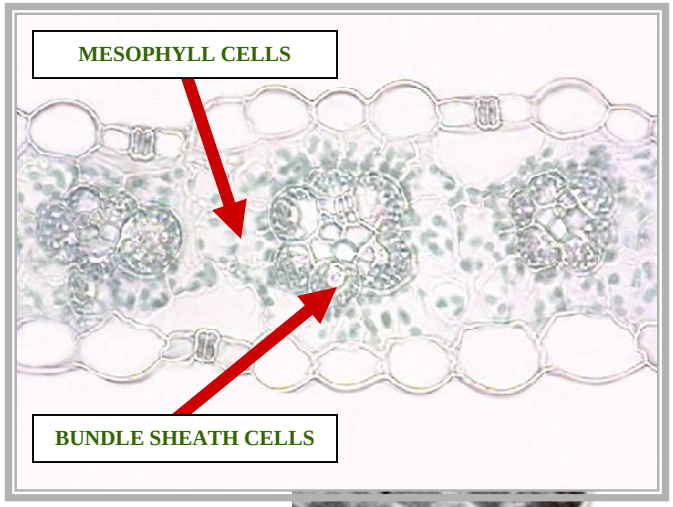
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

? C4

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

? ATP/CO2/C4

GLUCOSE

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

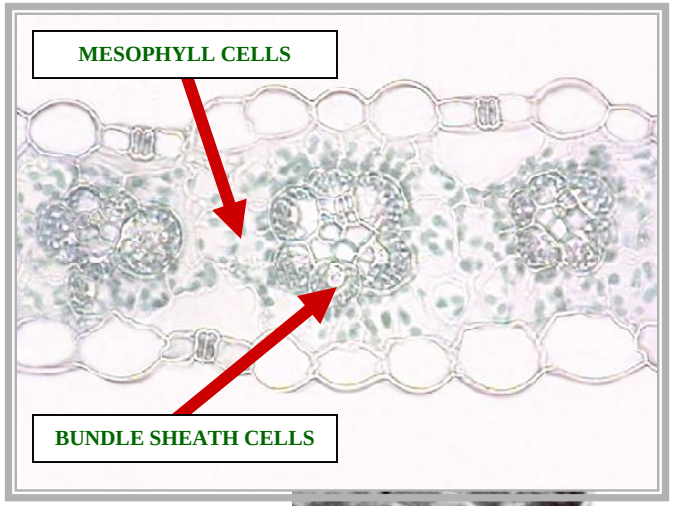
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

#

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

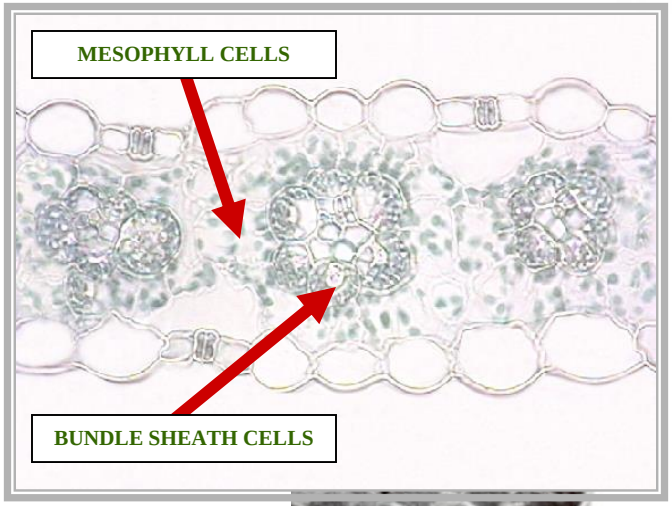
MESOPHYLL CELL CHLOROPLAST

2 ATP/CO2/C4

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

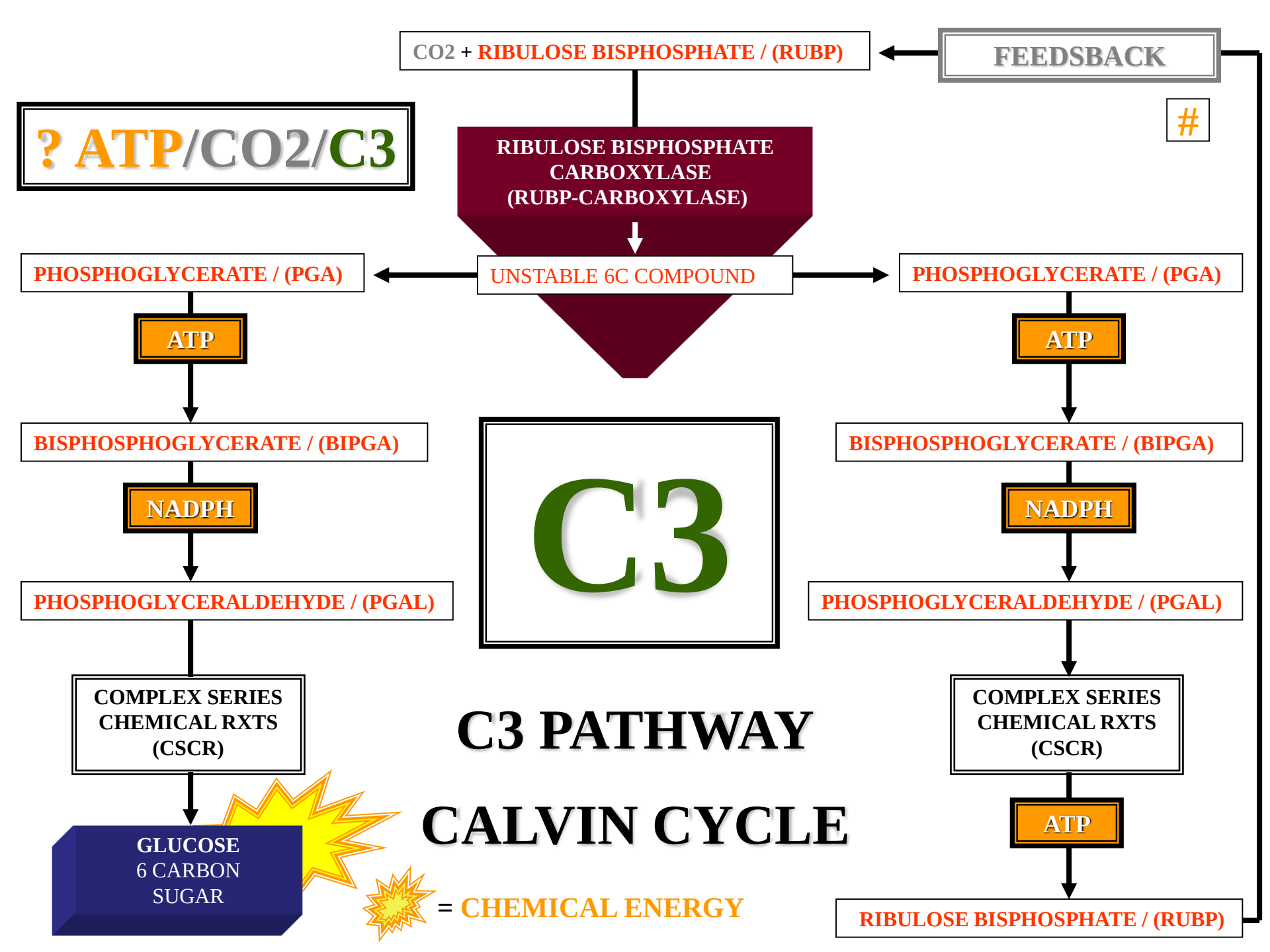
C4

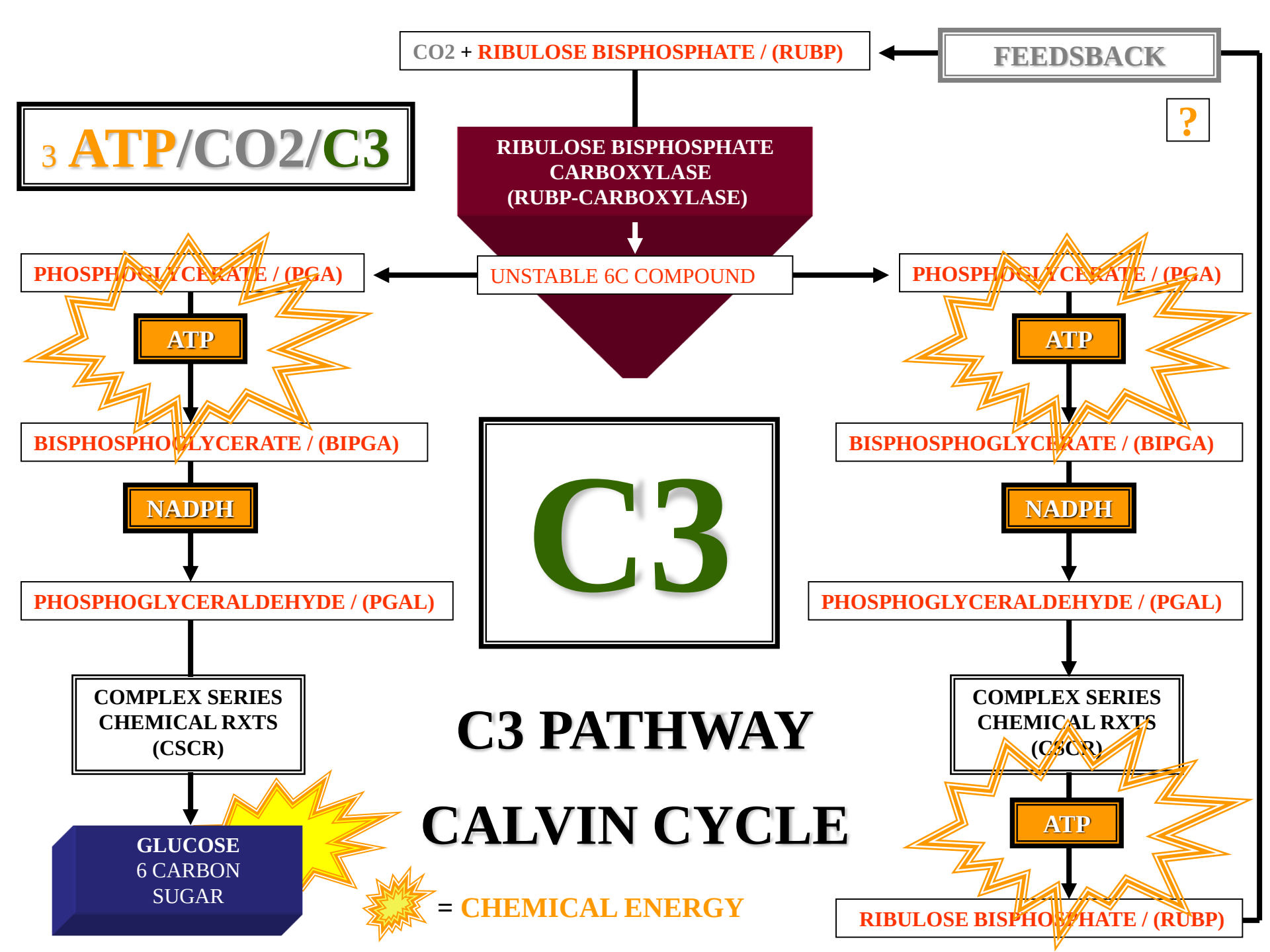
C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

? C3


CO2 + RIBULOSE BISPHOSPHATE / (RUBP)
FEEDSBACK
#
? ATP/CO2/C3
RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)
UNSTABLE 6C COMPOUND
PHOSPHOGLYCERATE / (PGA)
PHOSPHOGLYCERATE / (PGA)
ATP
ATP
BISPHOSPHOGLYCERATE / (BIPGA)
BISPHOSPHOGLYCERATE / (BIPGA)
NADPH
NADPH
C3
PHOSPHOGLYCERALDEHYDE / (PGAL)
PHOSPHOGLYCERALDEHYDE / (PGAL)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
C3 PATHWAY
CALVIN CYCLE
ATP
GLUCOSE 6 CARBON SUGAR
= CHEMICAL ENERGY
RIBULOSE BISPHOSPHATE / (RUBP)


CO2 + RIBULOSE BISPHOSPHATE / (RUBP)
FEEDSBACK
?
3 ATP/CO2/C3
RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)
UNSTABLE 6C COMPOUND
PHOSPHOGLYCERATE / (PGA)
PHOSPHOGLYCERATE / (PGA)
ATP
ATP
BISPHOSPHOGLYCERATE / (BIPGA)
BISPHOSPHOGLYCERATE / (BIPGA)
NADPH
NADPH
C3
PHOSPHOGLYCERALDEHYDE / (PGAL)
PHOSPHOGLYCERALDEHYDE / (PGAL)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
C3 PATHWAY
CALVIN CYCLE
ATP
GLUCOSE 6 CARBON SUGAR
= CHEMICAL ENERGY
RIBULOSE BISPHOSPHATE / (RUBP)

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

? ATP/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

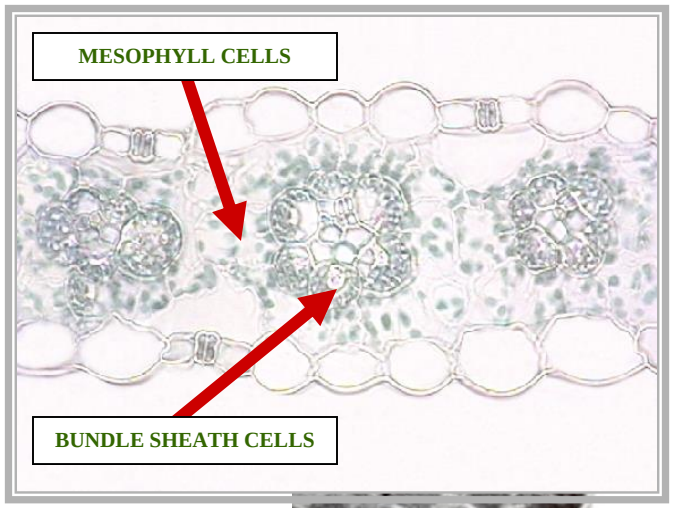
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

#

HATCH & SLACK CYCLE

5 ATP/CO2

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

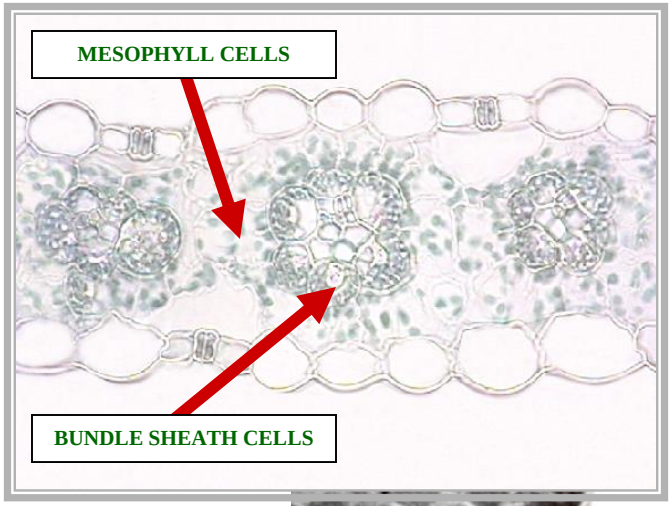
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

6X

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

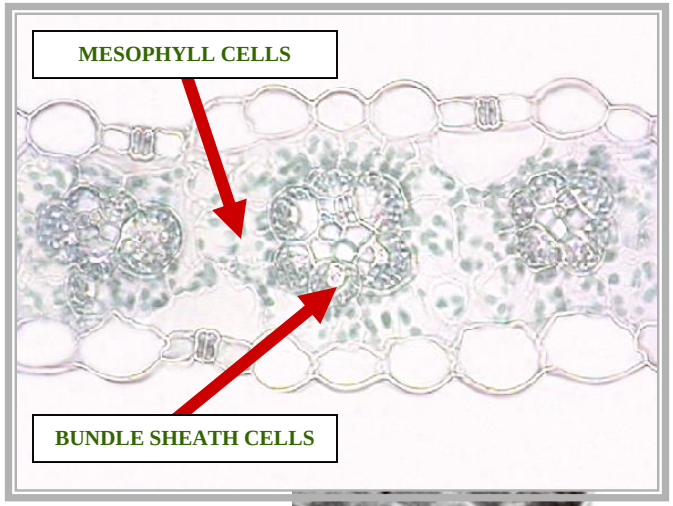
MESOPHYLL CELL CHLOROPLAST

5 ATP/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

6X

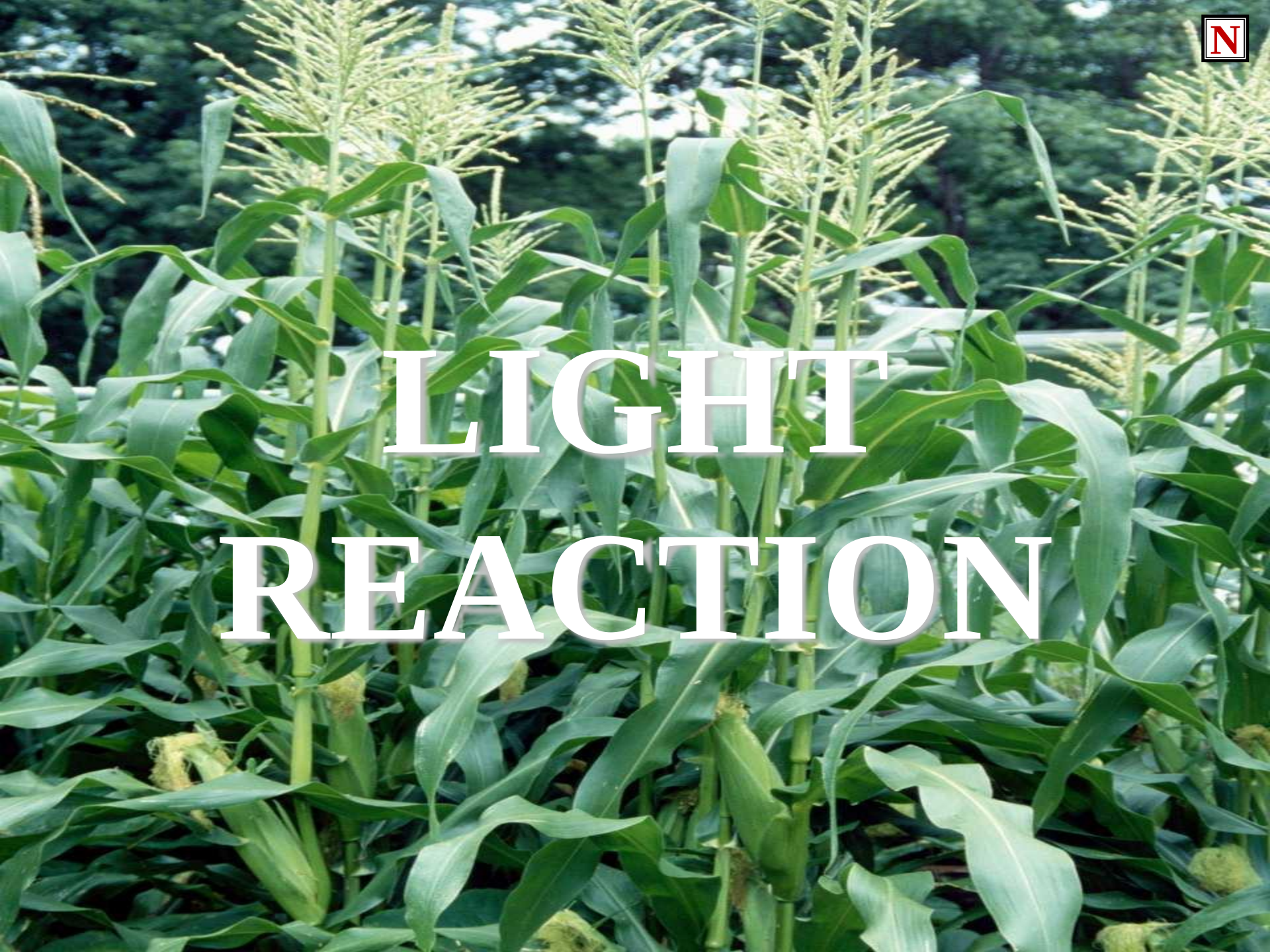
C4 LEAF

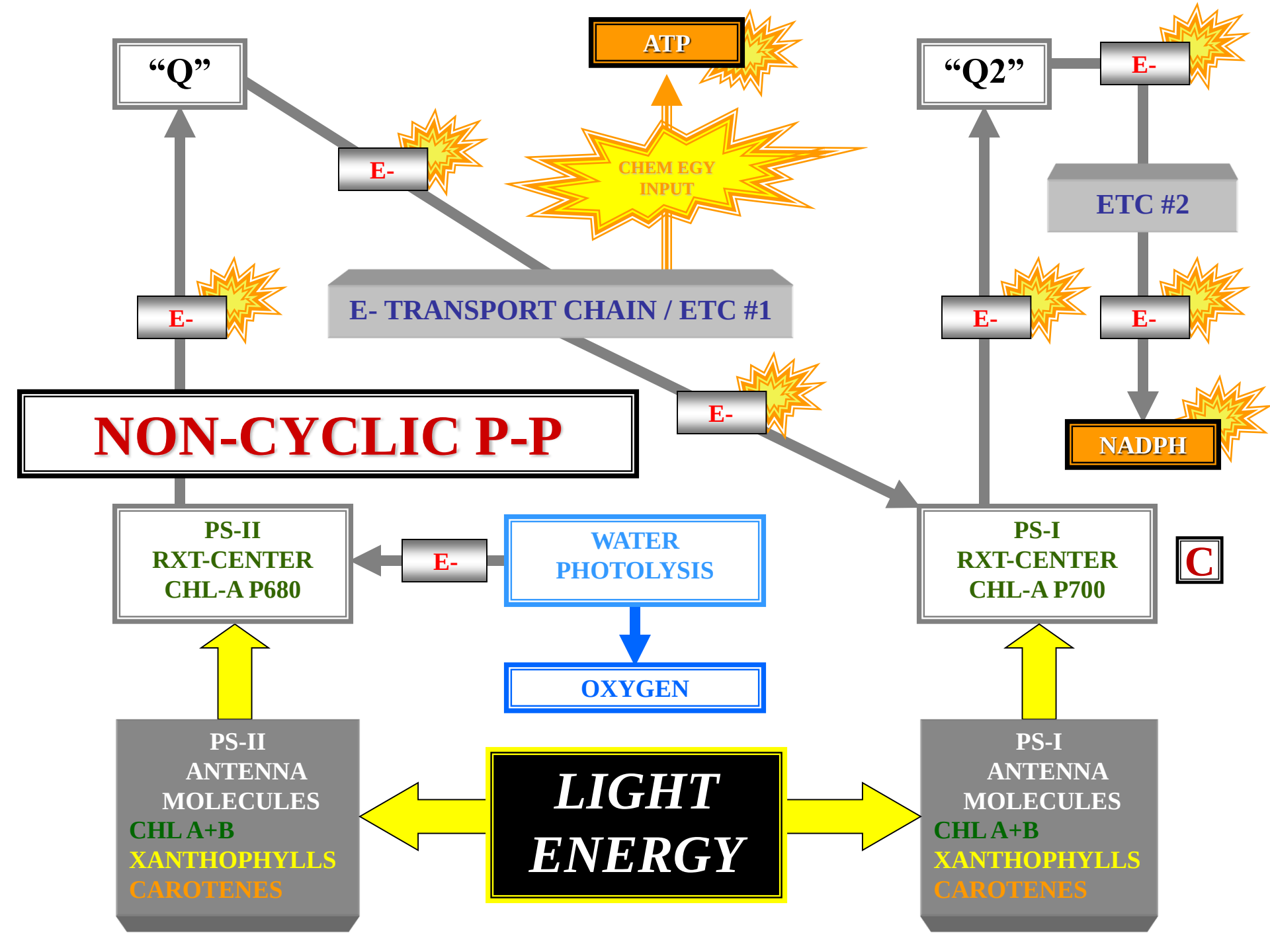
= CHEMICAL ENERGY

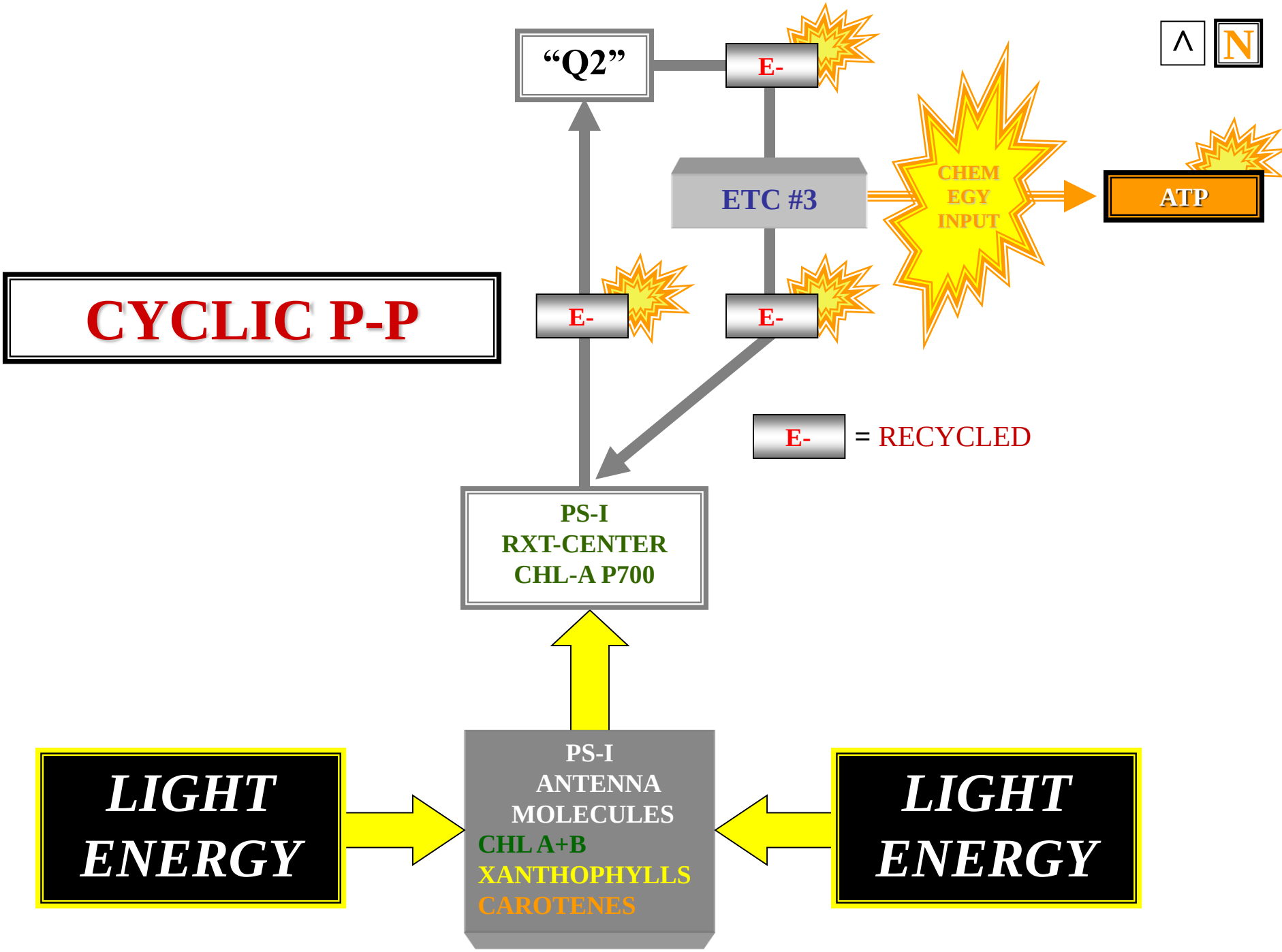
BUNDLE-SHEATH CELL CHLOROPLAST

#


PHOTOSYNTHESIS
LR
ATP
ENERGY EXPENSE
30 ATP
C4
CORN


LIGHT
REACTION


"Q"
ATP
"Q2"
E-
CHEM EGY INPUT
ETC #2
E- TRANSPORT CHAIN / ETC #1
NON-CYCLIC P-P
NADPH
PS-II RXT-CENTER CHL-A P680
WATER PHOTOLYSIS
PS-I RXT-CENTER CHL-A P700
C
OXYGEN
PS-II ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT ENERGY
PS-I ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES


"Q2"
E-
ETC #3
CHEM
EGY
INPUT
ATP
CYCLIC P-P
E-
E-
E- = RECYCLED
PS-I
RXT-CENTER
CHL-A P700
PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT
ENERGY
LIGHT
ENERGY


?
NADPH
ENERGY EXPENSE
C4
CORN

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

? NADPH/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

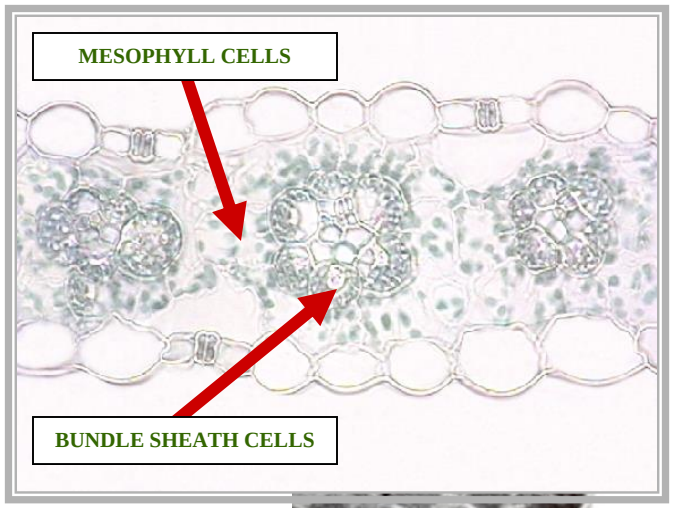
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

? C4

HATCH & SLACK CYCLE

CORN

? NADPH/CO2/C4

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

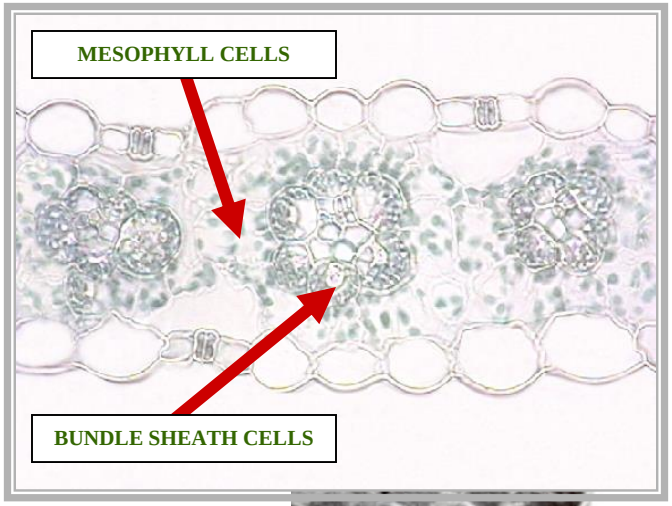
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

#

HATCH & SLACK CYCLE

CORN

0 NADPH/CO2/C4

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

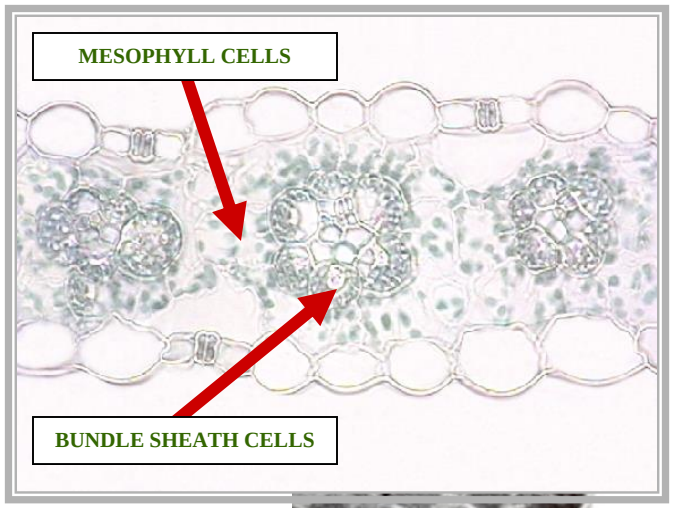
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

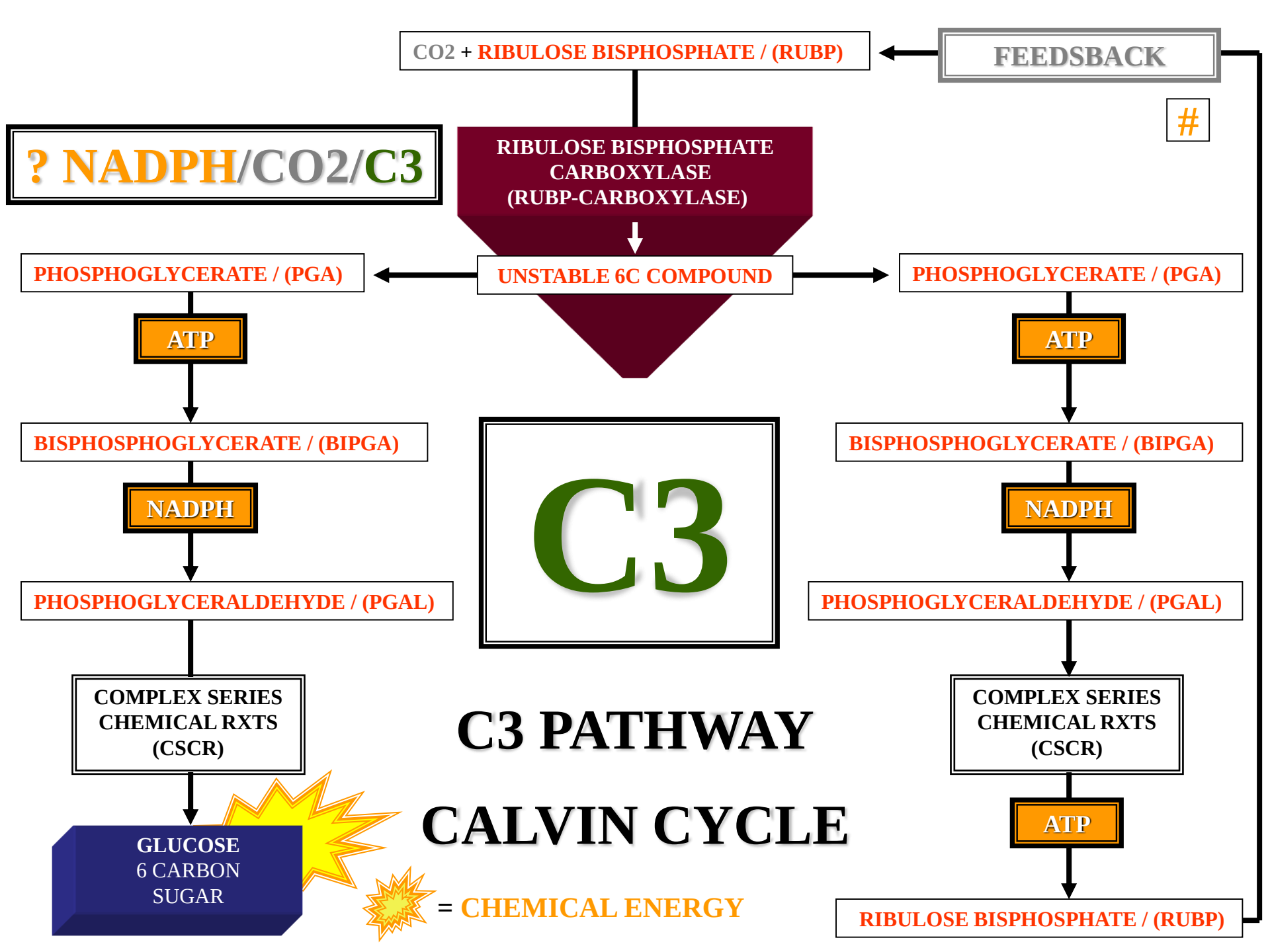
C4

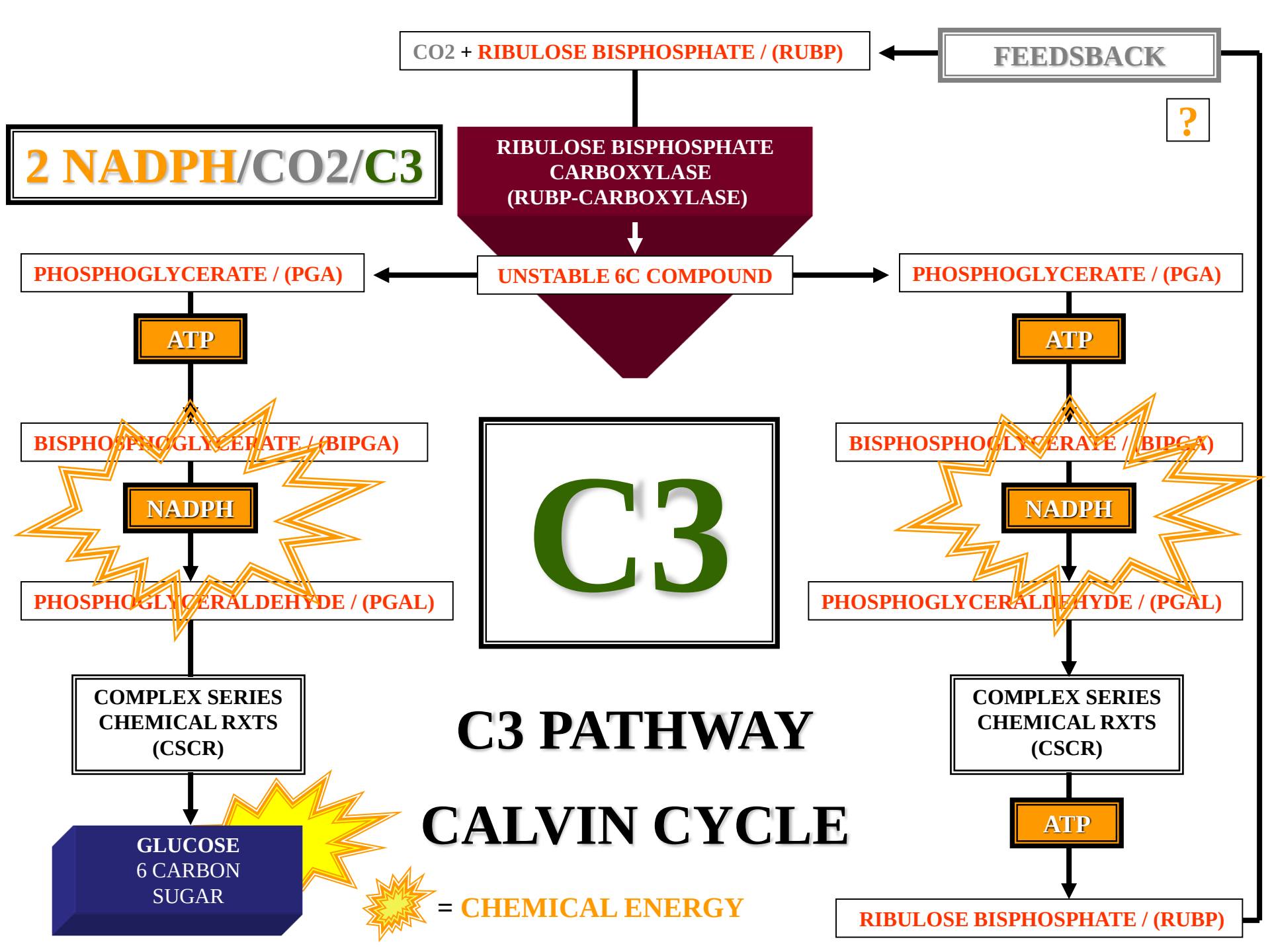
C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

? C3


CO2 + RIBULOSE BISPHOSPHATE / (RUBP)
FEEDSBACK
#
? NADPH/CO2/C3
RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)
UNSTABLE 6C COMPOUND
PHOSPHOGLYCERATE / (PGA)
PHOSPHOGLYCERATE / (PGA)
ATP
ATP
BISPHOSPHOGLYCERATE / (BIPGA)
BISPHOSPHOGLYCERATE / (BIPGA)
NADPH
NADPH
C3
PHOSPHOGLYCERALDEHYDE / (PGAL)
PHOSPHOGLYCERALDEHYDE / (PGAL)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
C3 PATHWAY
CALVIN CYCLE
ATP
GLUCOSE
6 CARBON
SUGAR
= CHEMICAL ENERGY
RIBULOSE BISPHOSPHATE / (RUBP)


CO2 + RIBULOSE BISPHOSPHATE / (RUBP)
FEEDSBACK
?
2 NADPH/CO2/C3
RIBULOSE BISPHOSPHATE CARBOXYLASE (RUBP-CARBOXYLASE)
UNSTABLE 6C COMPOUND
PHOSPHOGLYCERATE / (PGA)
PHOSPHOGLYCERATE / (PGA)
ATP
ATP
BISPHOSPHOGLYCERATE / (BIPGA)
BISPHOSPHOGLYCERATE / (BIPGA)
NADPH
NADPH
C3
PHOSPHOGLYCERALDEHYDE / (PGAL)
PHOSPHOGLYCERALDEHYDE / (PGAL)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
COMPLEX SERIES CHEMICAL RXTS (CSCR)
C3 PATHWAY
CALVIN CYCLE
ATP
GLUCOSE
6 CARBON
SUGAR
= CHEMICAL ENERGY
RIBULOSE BISPHOSPHATE / (RUBP)

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

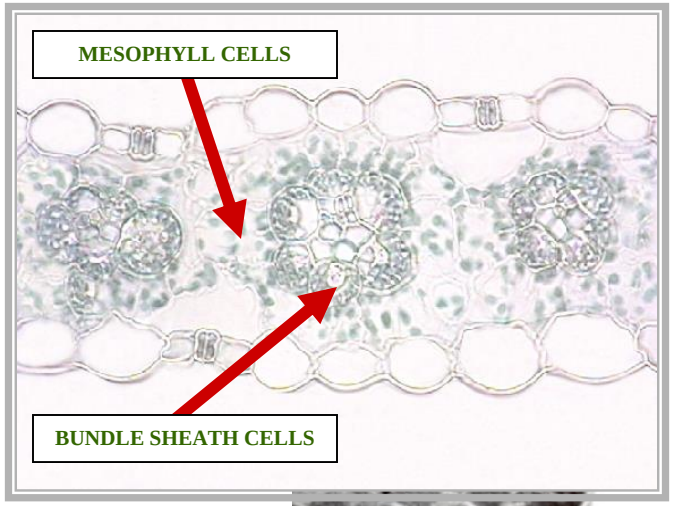
MESOPHYLL CELL CHLOROPLAST

? NADPH/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

#

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

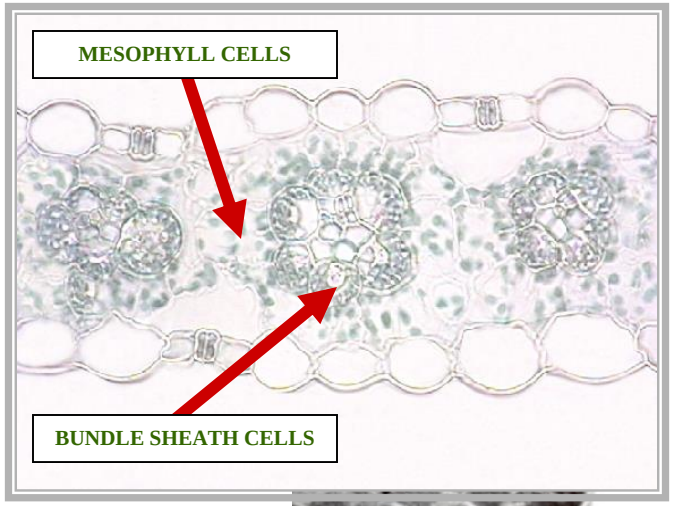
MESOPHYLL CELL CHLOROPLAST

2 NADPH/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

6X

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

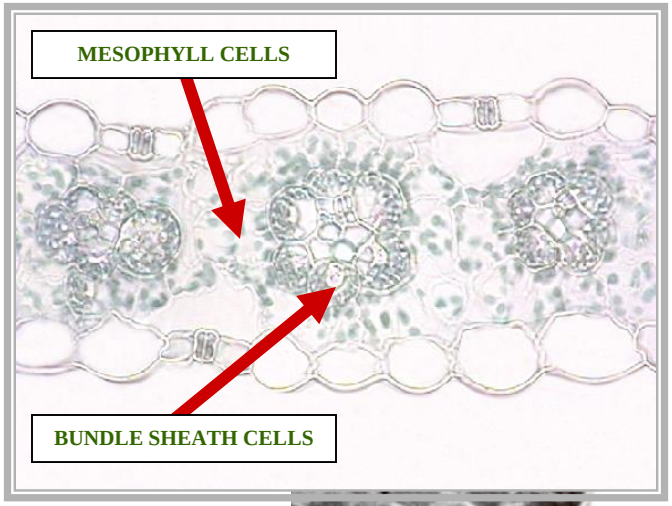
MESOPHYLL CELL CHLOROPLAST

2 NADPH/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

6X

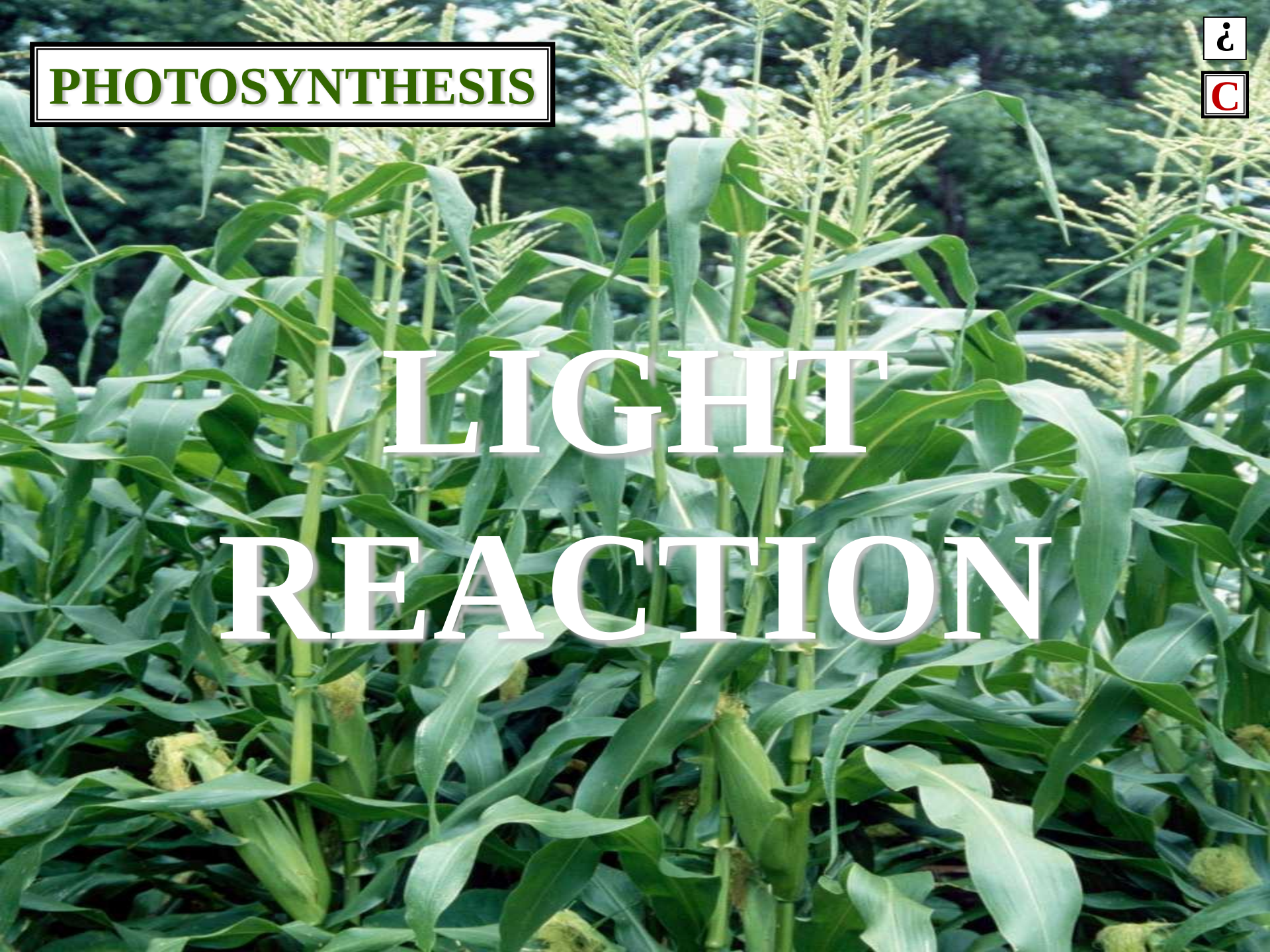
C4 LEAF

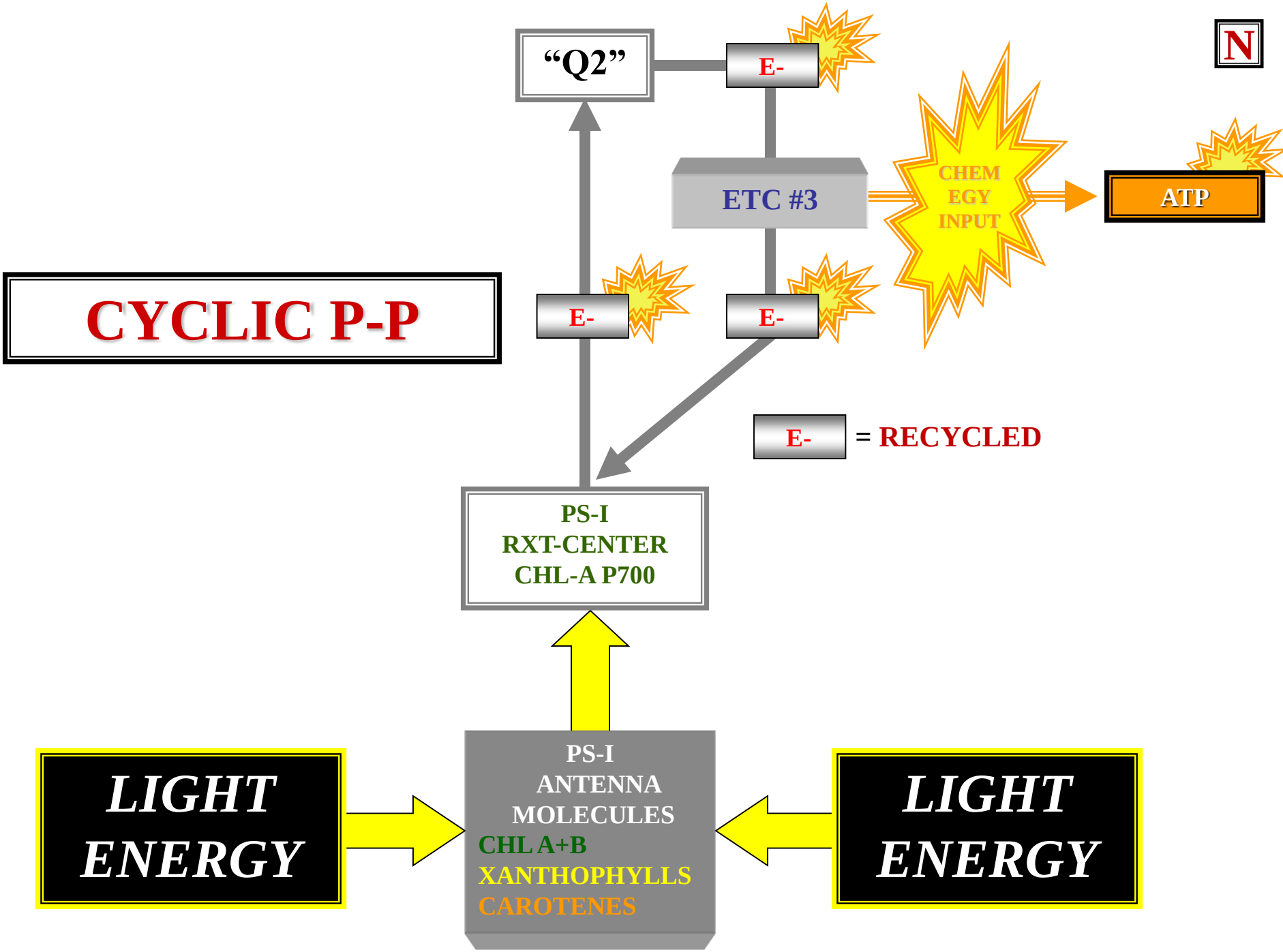
= CHEMICAL ENERGY

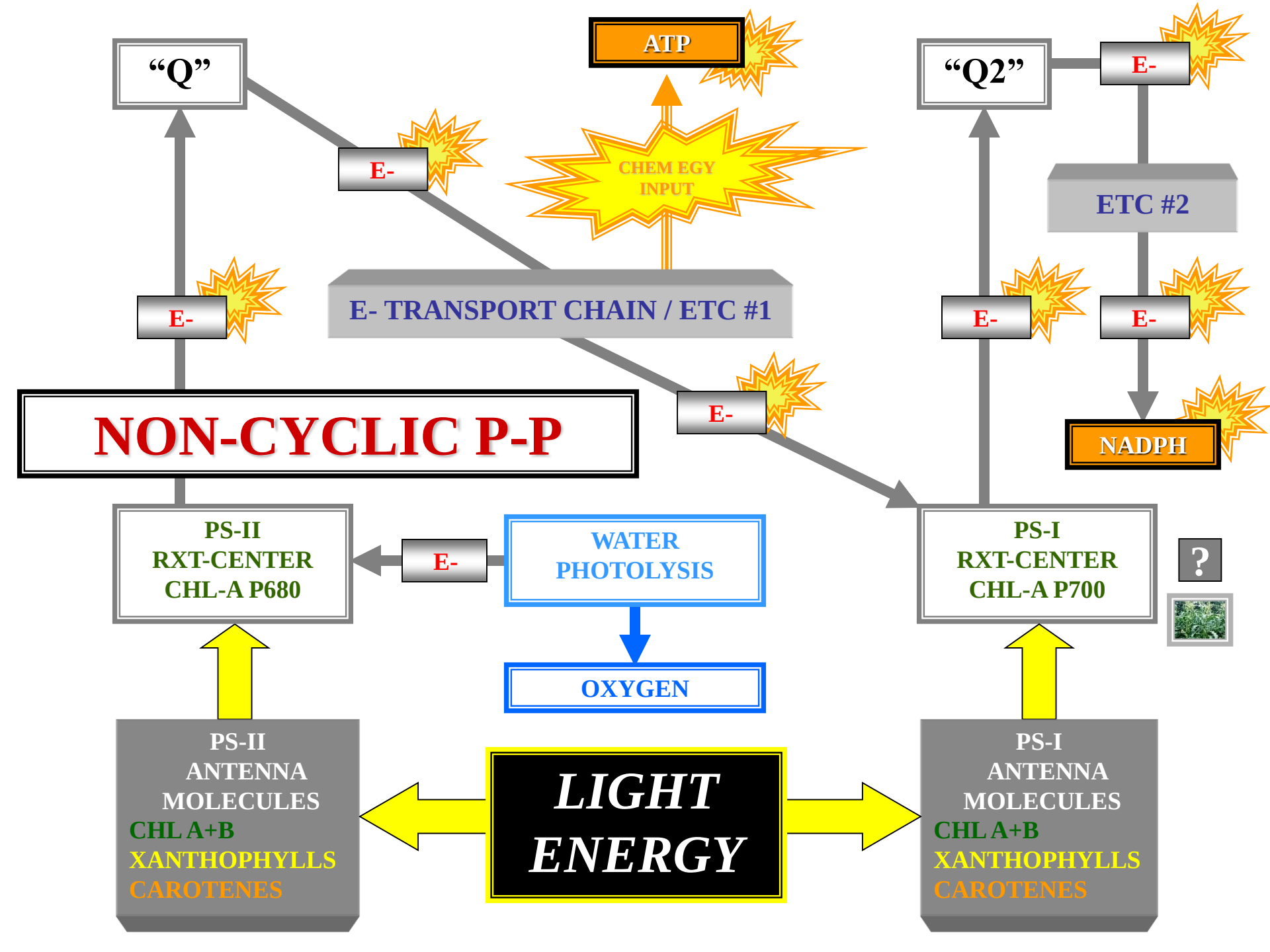
BUNDLE-SHEATH CELL CHLOROPLAST

#


LR
NADPH
ENERGY EXPENSE
12 NADPH
C4
CORN


PHOTOSYNTHESIS
¿
C
LIGHT
REACTION


N
"Q2"
E-
ETC #3
CHEM
EGY
INPUT
ATP
CYCLIC P-P
E-
E-
E- = RECYCLED
PS-I
RXT-CENTER
CHL-A P700
PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT
ENERGY
LIGHT
ENERGY


"Q"
ATP
"Q2"
E-
CHEM EGY INPUT
ETC #2
E- TRANSPORT CHAIN / ETC #1
NON-CYCLIC P-P
NADPH
PS-II RXT-CENTER CHL-A P680
WATER PHOTOLYSIS
PS-I RXT-CENTER CHL-A P700
?
OXYGEN
PS-II ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT ENERGY
PS-I ANTENNA MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES


C4 PLANTS
REQUIRE
MORE OR LESS
ATP
THAN C3 PLANTS?


?
C3
+
C4 PLANTS
REQUIRE
MORE
ATP
THAN C3 PLANTS

18

ATP

ENERGY EXPENSE

?

C3

MAPLE

30

ATP

ENERGY EXPENSE

18 ATP

C3

MAPLE

ATP

ENERGY EXPENSE

30 ATP

C4

CORN


!
12
C4 PLANTS
REQUIRE
12 ATP
MORE
THAN C3 PLANTS

HATCH & SLACK CYCLE

CORN

12 ATP

12 ADP

EGY

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

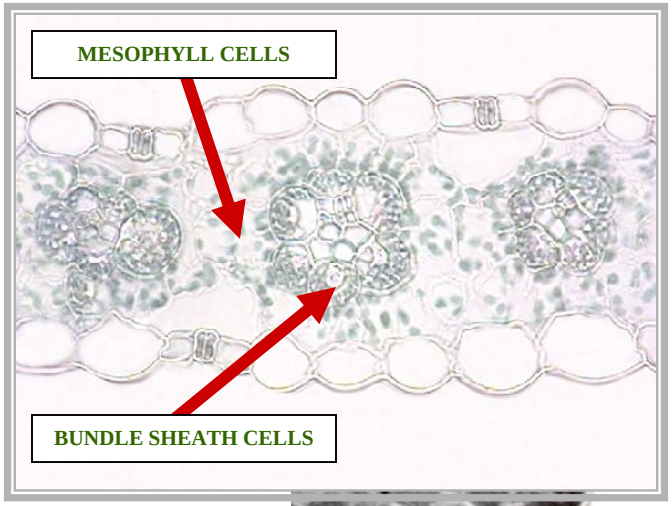
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

?

QUESTION

WHAT WOULD THE PLANT PREFER C3 OR C4?

QUESTION

E

ANSWER

PLANT WOULD PREFER C3

ANSWER


ENERGY

C4 PATHWAY ADVANTAGE

ENZYME

?

PHOSPHOENOLPYRUVATE CARBOXYLASE (PEP-ASE)

ENZYME

C4

CO2
ENTERS
MESOPHYLL CYTOSOL

↓

CO2 + PHOSPHOENOLPYRUVATE / (PEP)

PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-CARBOXYLASE)

↓

OXALOACETATE

E

?

ENZYME

C4 CO2 FIXATION ENZYME

C4

CO2
ENTERS
MESOPHYLL CYTOSOL

↓

CO2 + PHOSPHOENOLPYRUVATE / (PEP)

PHOSPHOENOLPYRUVATE
CARBOXYLASE
(PEP-CARBOXYLASE)

↓

OXALOACETATE

EFFICIENT ENZYME

C4 CO2 FIXATION ENZYME

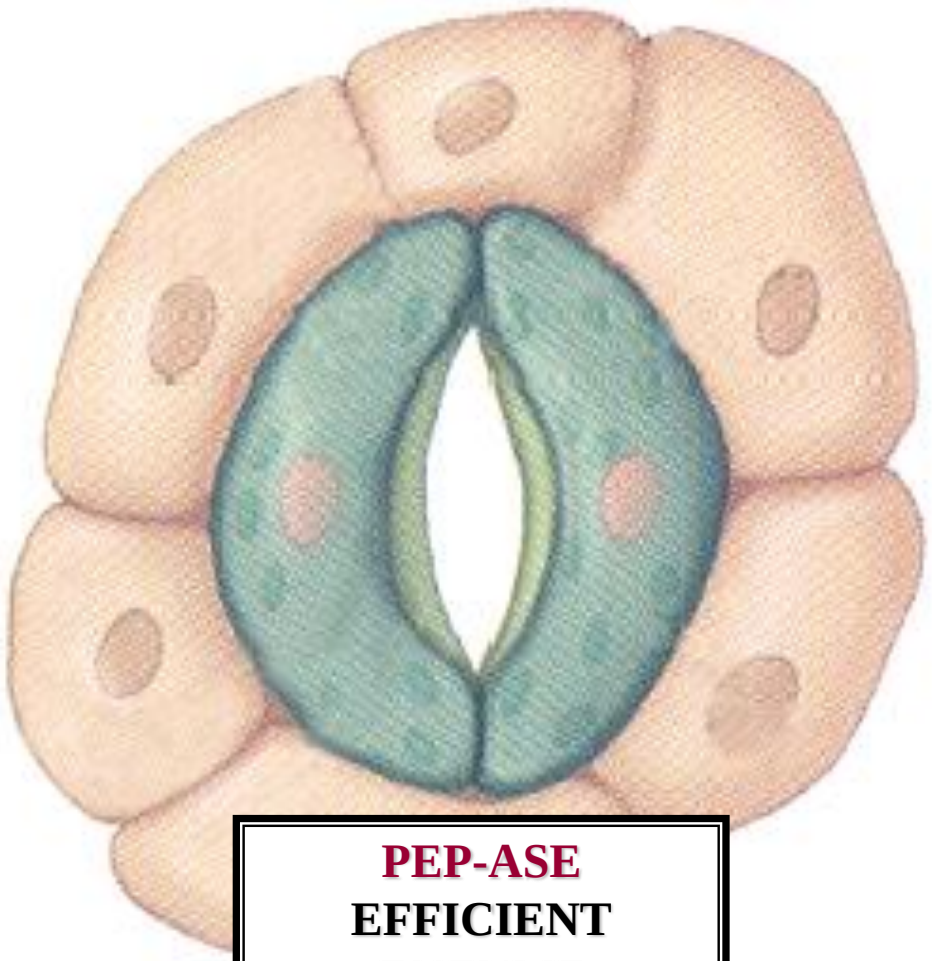
LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO2

CO2



CO2

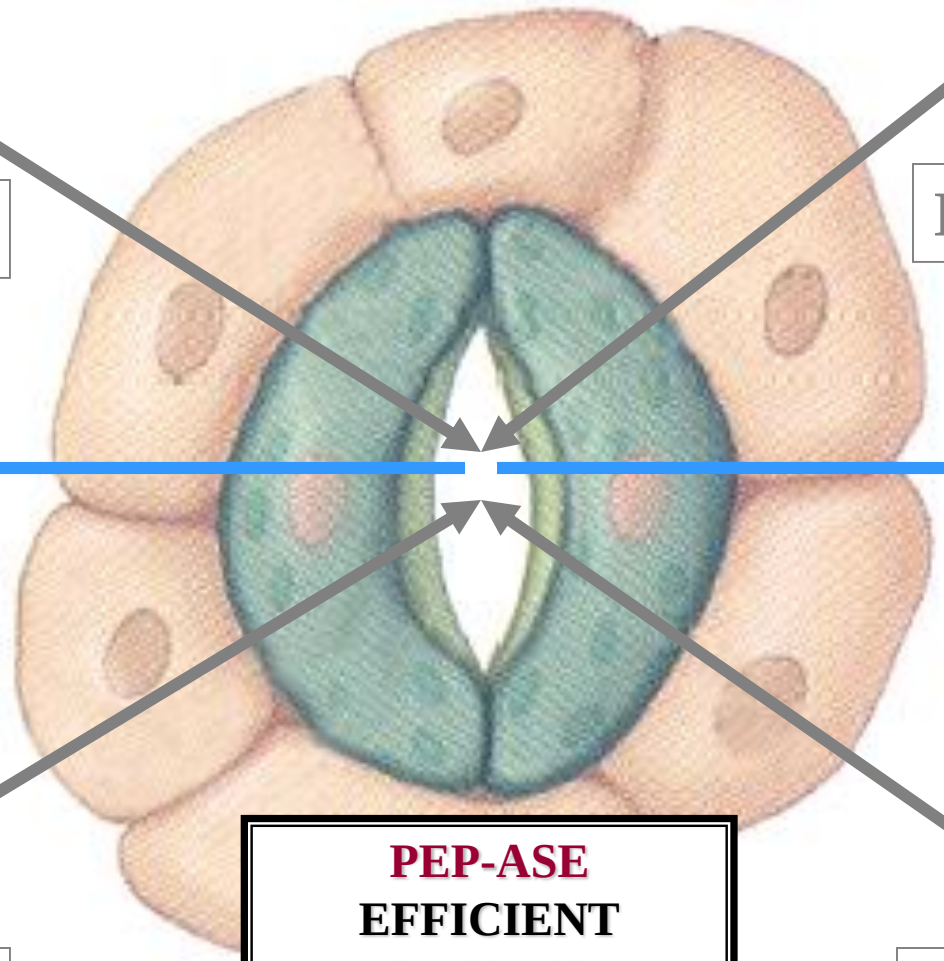
CO2

PEP-ASE
EFFICIENT
ENZYME

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

H2O

DIFFUSION

CO2

DIFFUSION

CO2

DIFFUSION

PEP-ASE
EFFICIENT
ENZYME

LEAF STOMATE

ATMOSPHERE

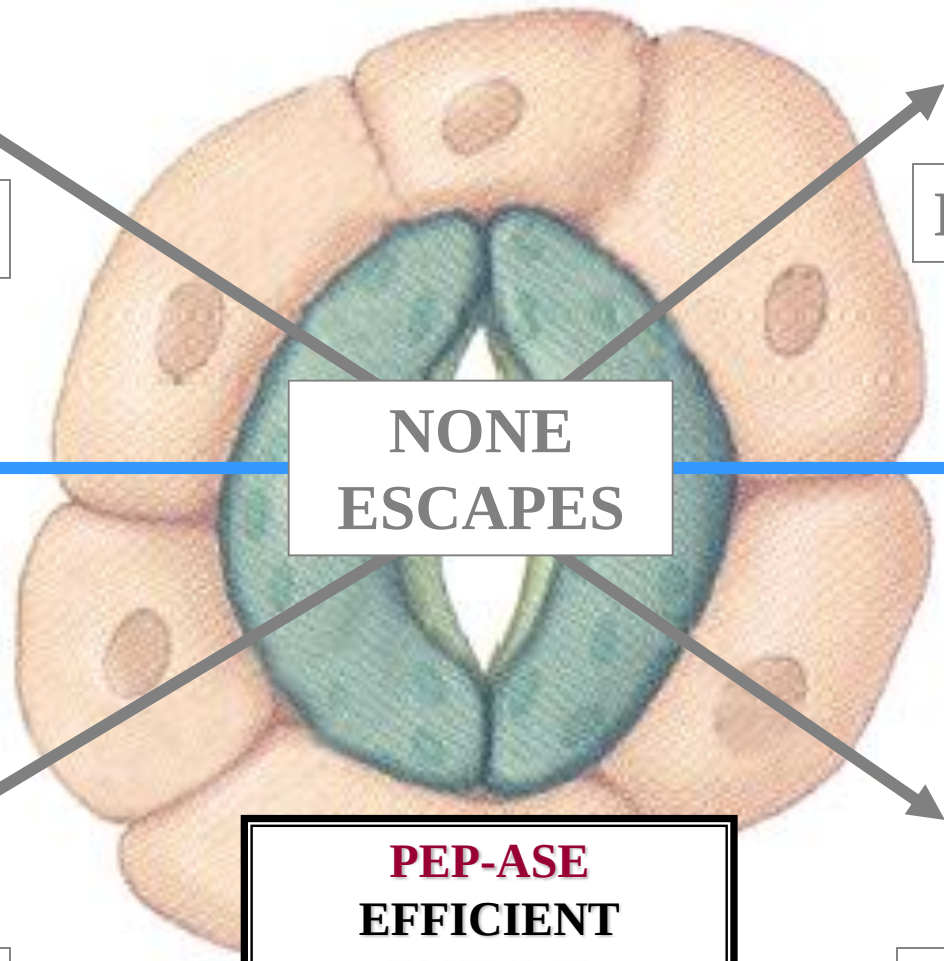
ATMOSPHERE

CO2

DIFFUSION

CO2

DIFFUSION



H2O

DIFFUSION

NONE ESCAPES

H2O

DIFFUSION

CO2

DIFFUSION

PEP-ASE
EFFICIENT
ENZYME

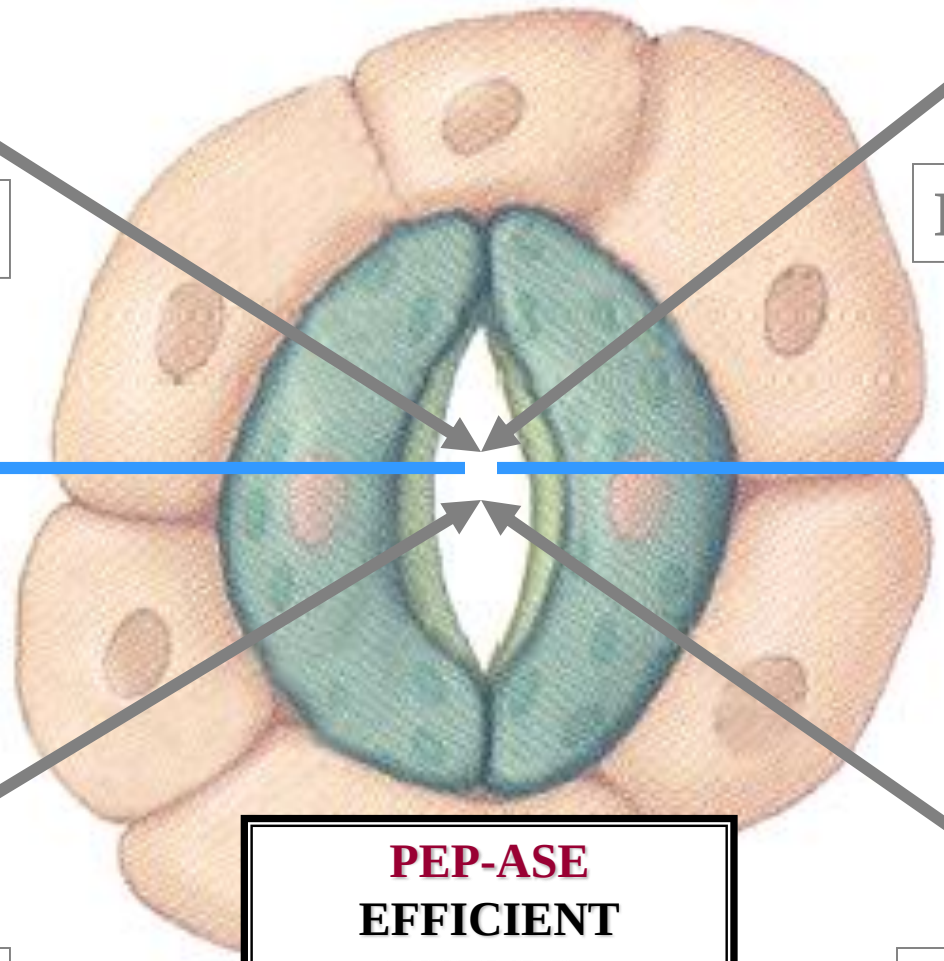
CO2

DIFFUSION

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

H2O

DIFFUSION

CO2

DIFFUSION

CO2

DIFFUSION

PEP-ASE
EFFICIENT
ENZYME

ATMOSPHERE

LEAF STOMATE

ATMOSPHERE

CO2

CO2

OPEN SHORT PERIODS

C4

C4

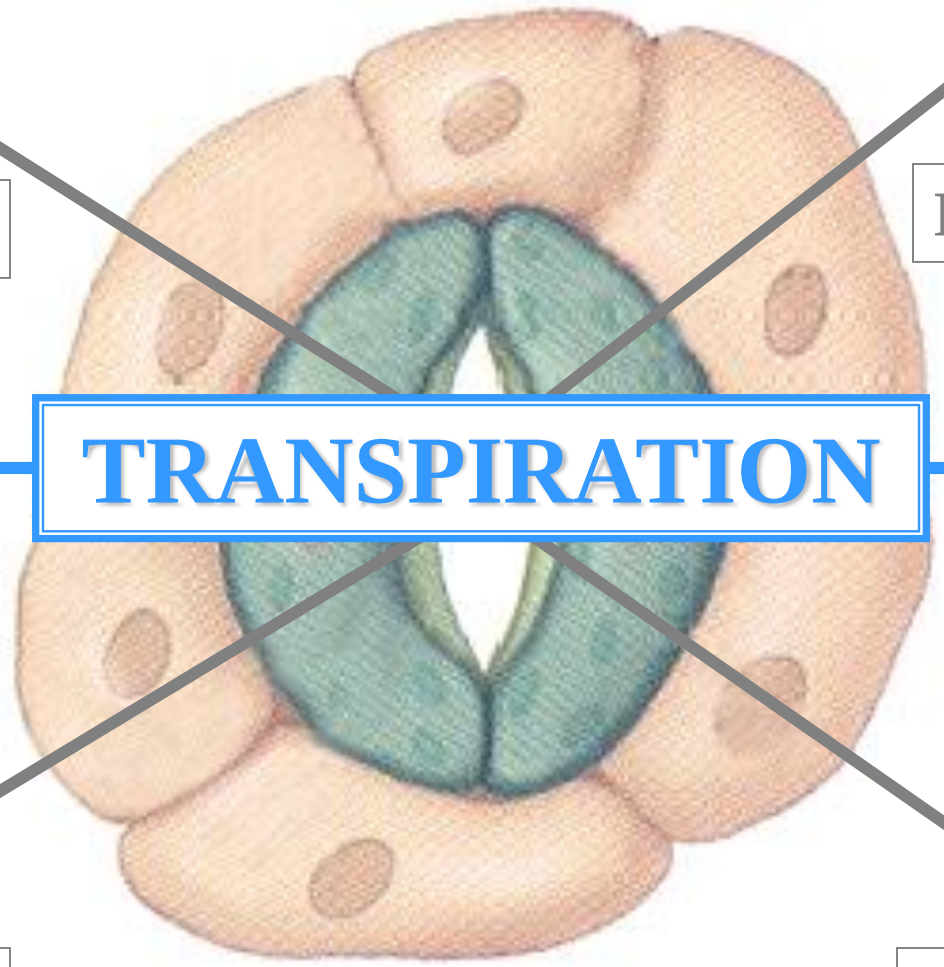
CO2

CO2

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

TRANSPIRATION

H2O

DIFFUSION

DIFFUSION

CO2

DIFFUSION

CO2

DIFFUSION

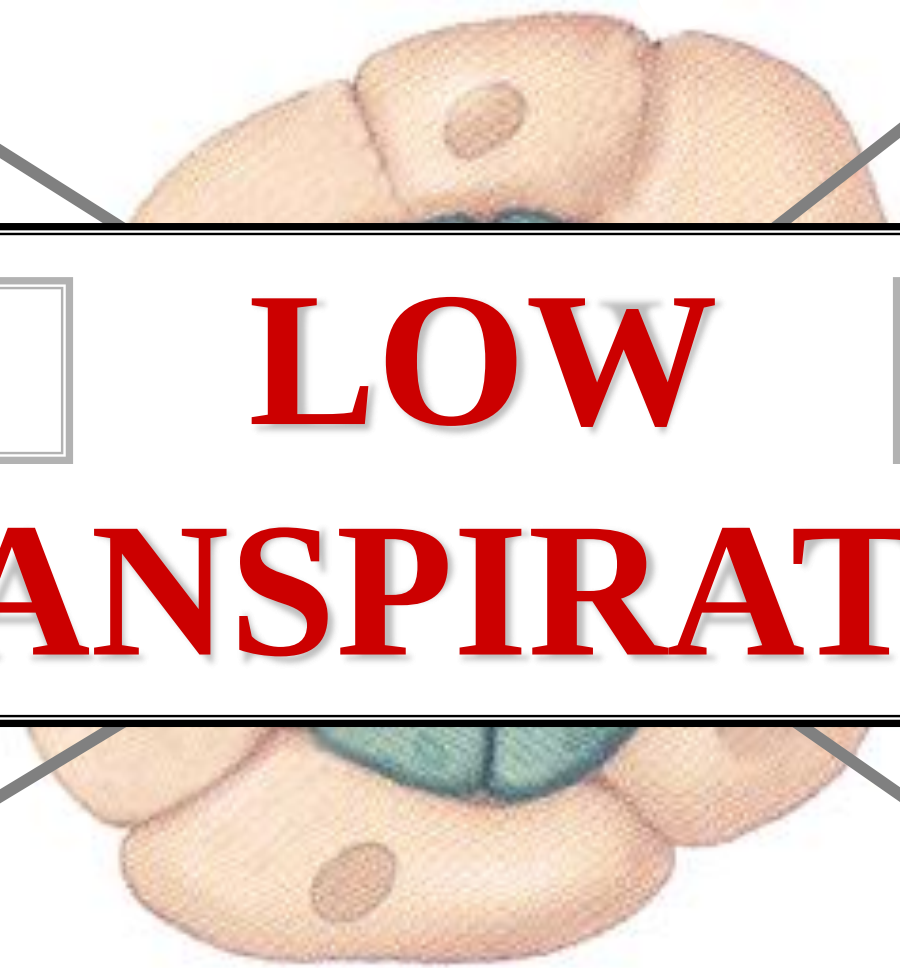
ATMOSPHERE

LEAF STOMATE

ATMOSPHERE

CO2

CO2



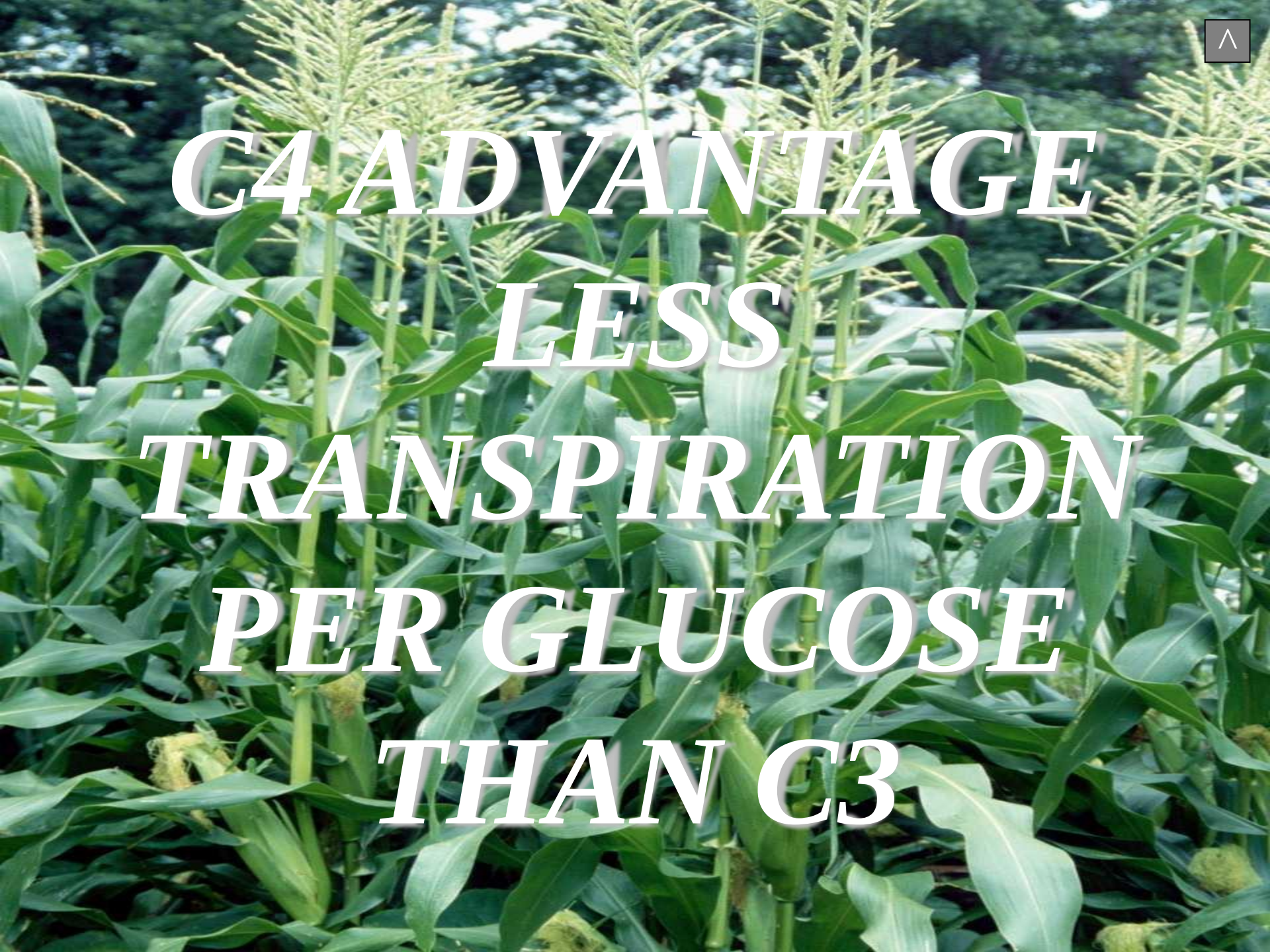
C4

LOW TRANSPIRATION

C4

CO2

CO2


C4 ADVANTAGE
LESS
TRANSPIRATION
PER GLUCOSE
THAN C3

C4 PATHWAY ECOLOGY