
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

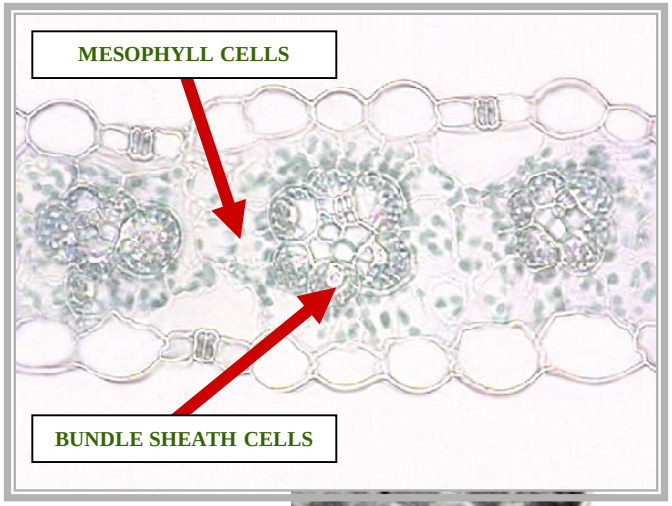
PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4



C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

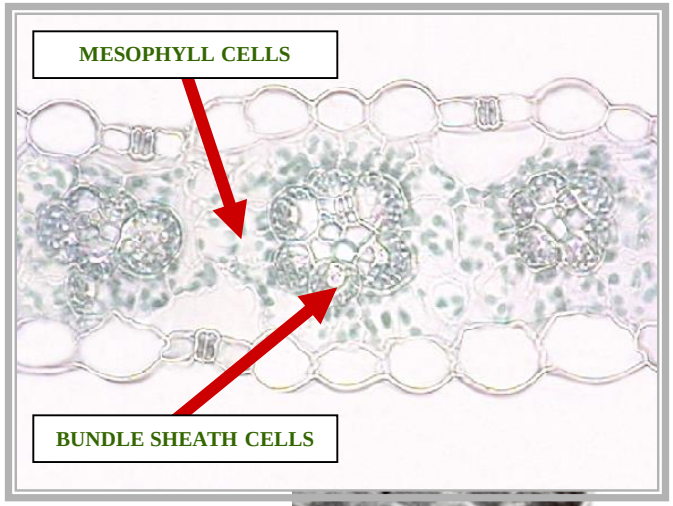
P

PYRUVATE

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



C4 LEAF

PEP-ASE

PEP

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CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

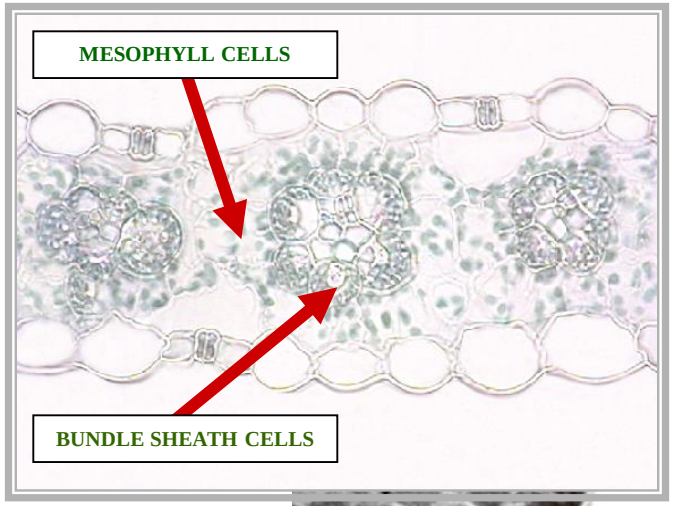
= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



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ALL RXTS REQUIRE A SPECIFIC ENZYME

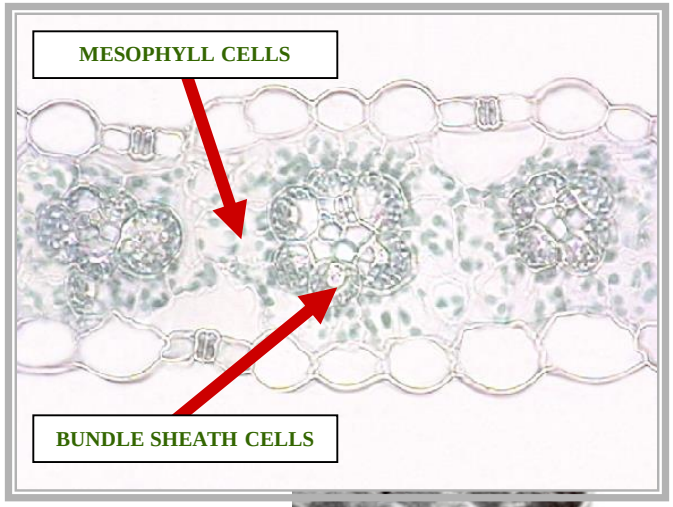
C4

MESOPHYLL CELL CYTOSOL

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



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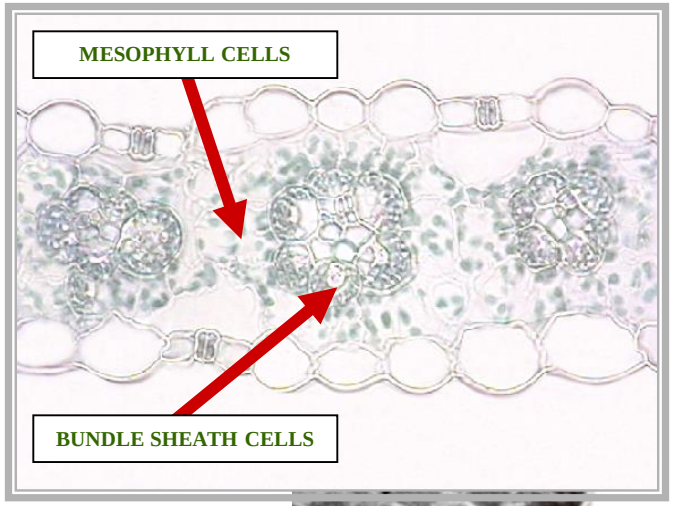
C4

PEP

HATCH & SLACK CYCLE

CORN

ATMOSPHERE



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MALATE

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BUNDLE-SHEATH CELL CHLOROPLAST

ALL RXTS REQUIRE A SPECIFIC ENZYME

C4

A

HATCH & SLACK CYCLE

CORN

2 ATP

2 ADP

EGY

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

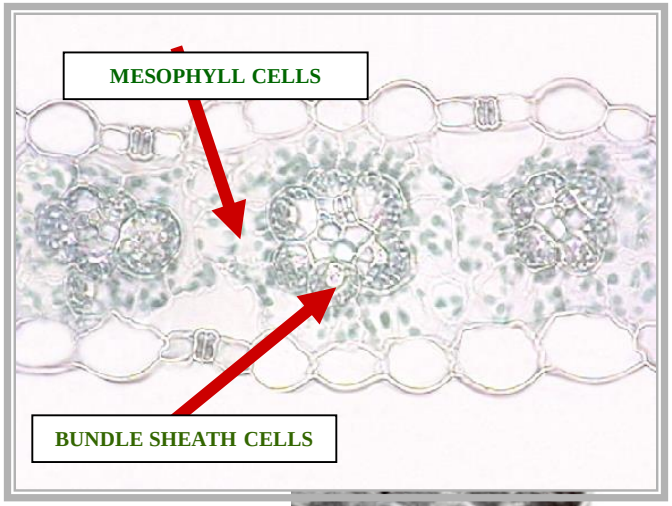
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

ALL RXTS REQUIRE A SPECIFIC ENZYME

ATMOSPHERE



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RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

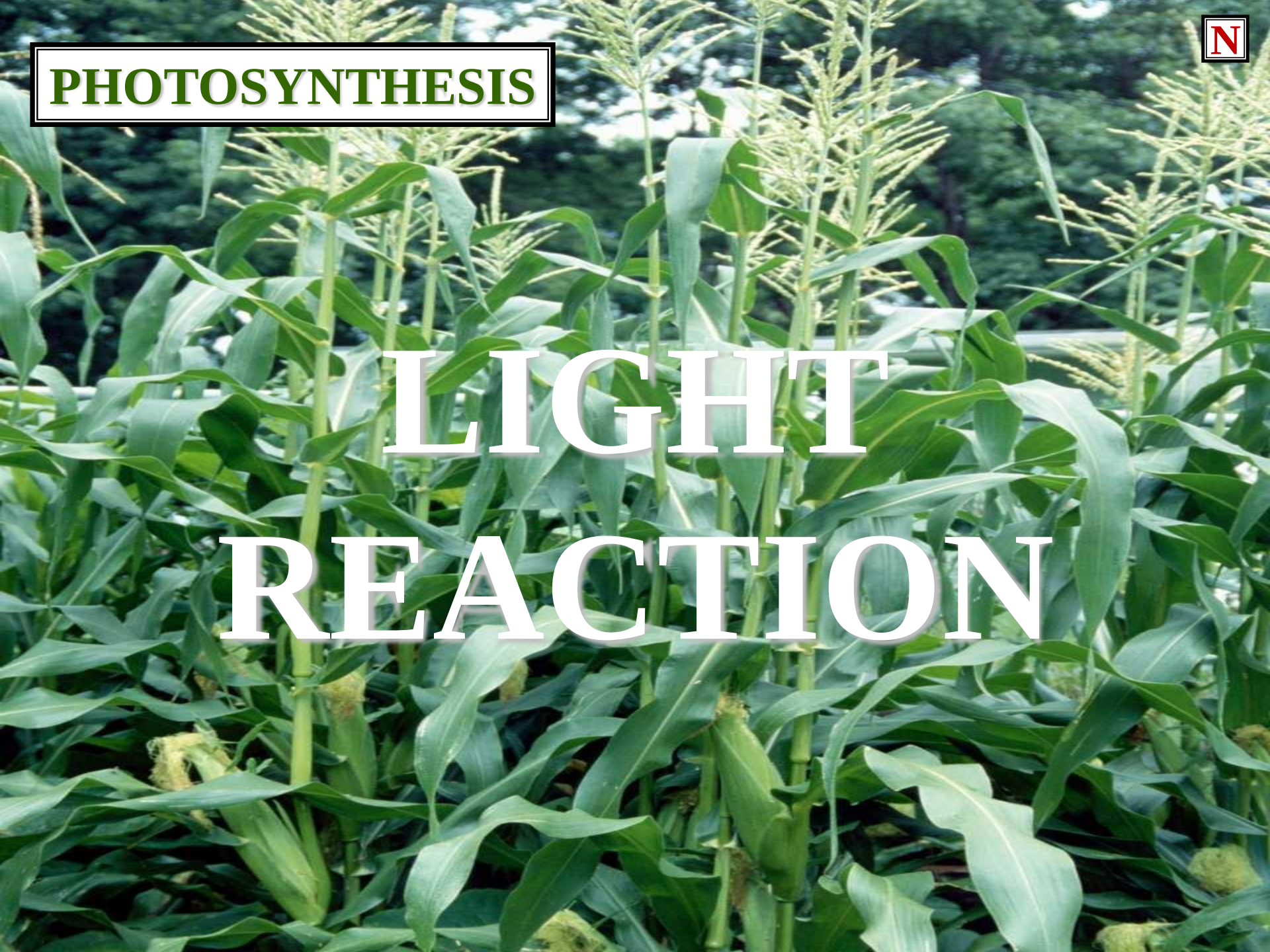
C4

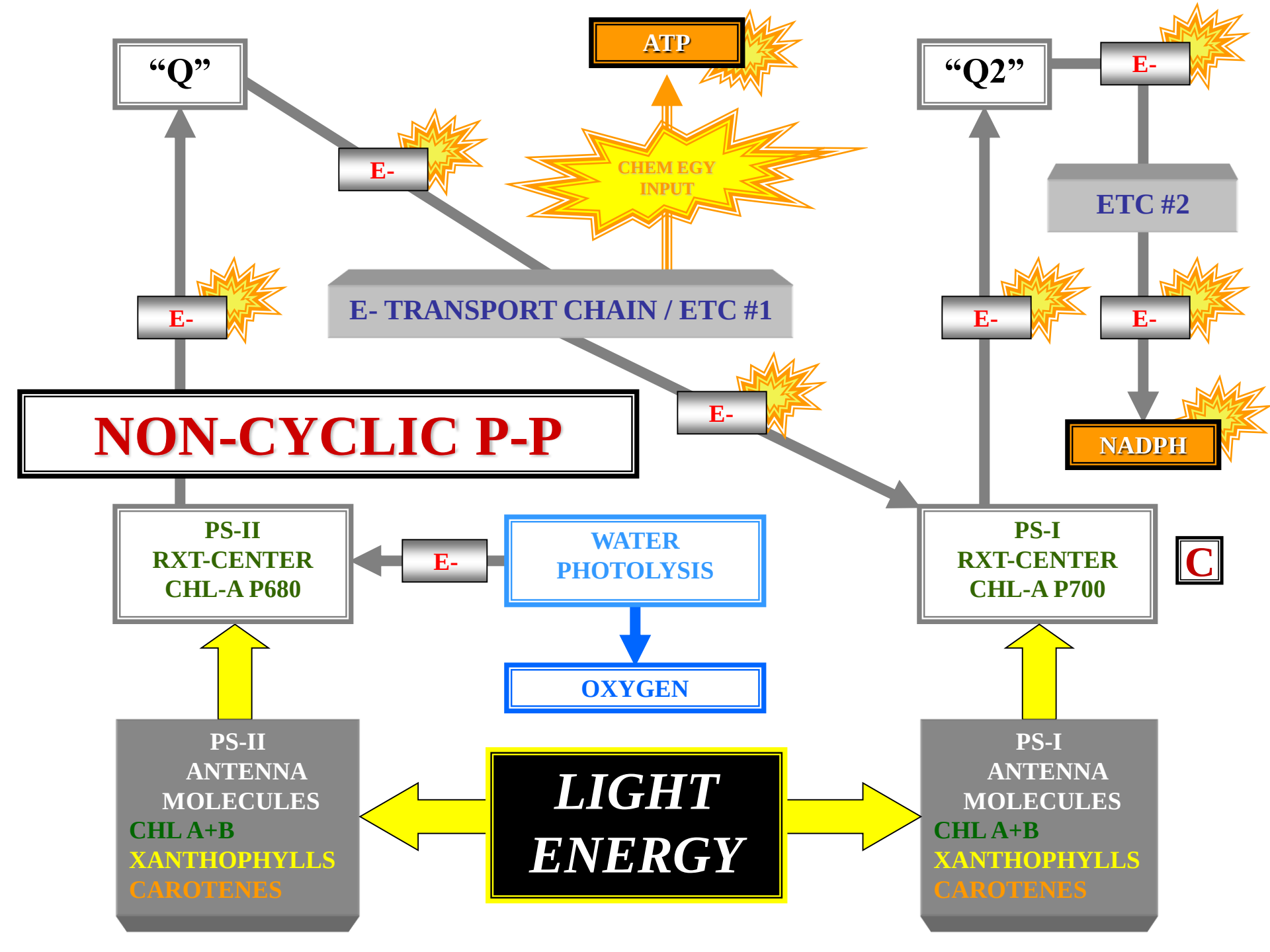
C4 LEAF

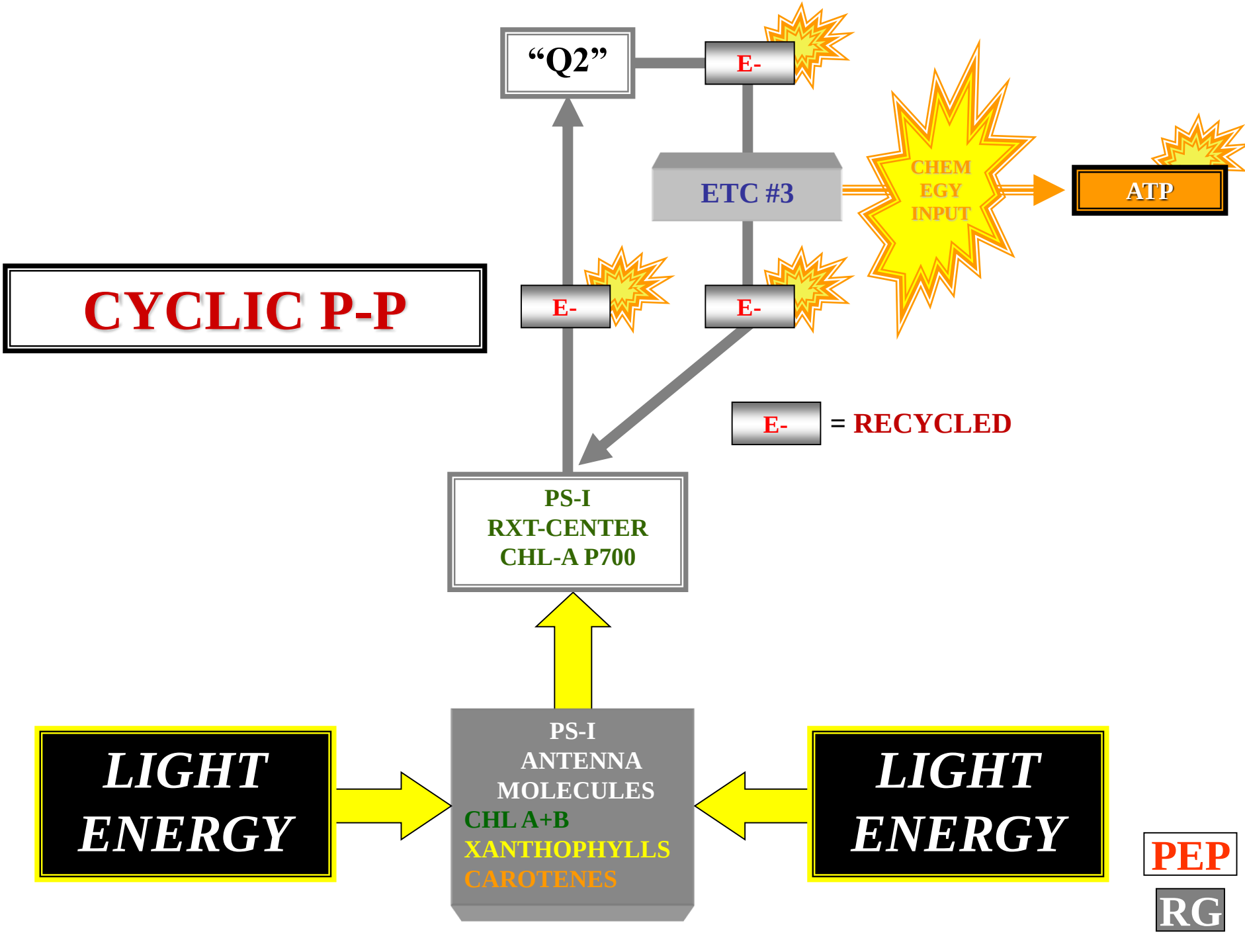
= CHEMICAL ENERGY

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

2 ADP

ENERGY

PEP-ASE

PEP

REGENERATED

PYRUVATE

OXALOACETATE

CO2

MALATE

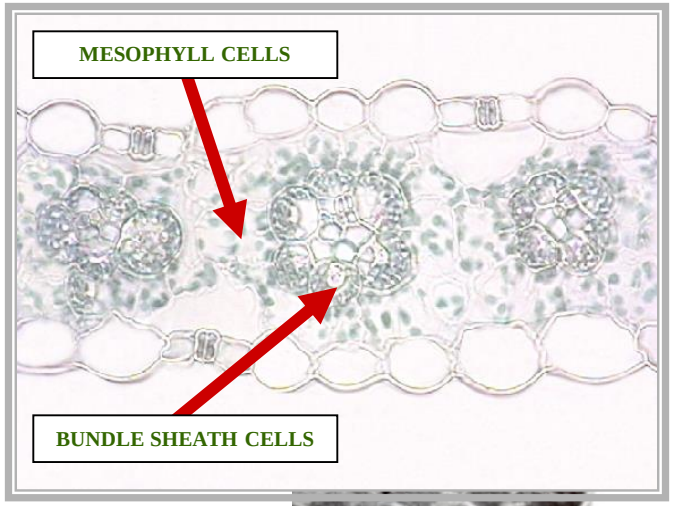
MESOPHYLL CELL CYTOSOL

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

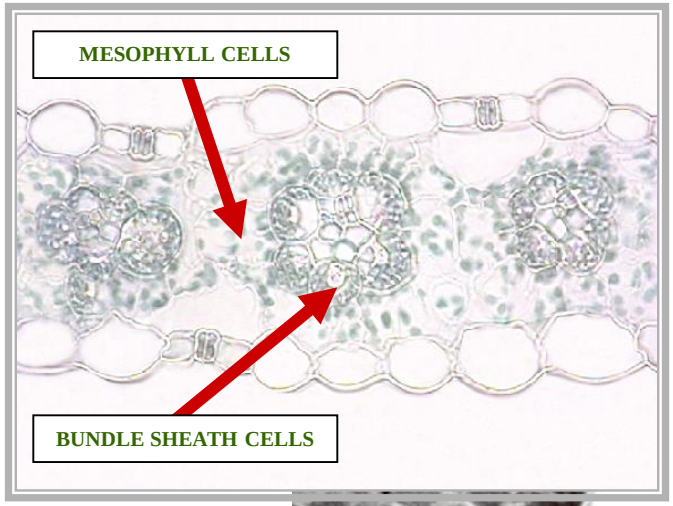
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

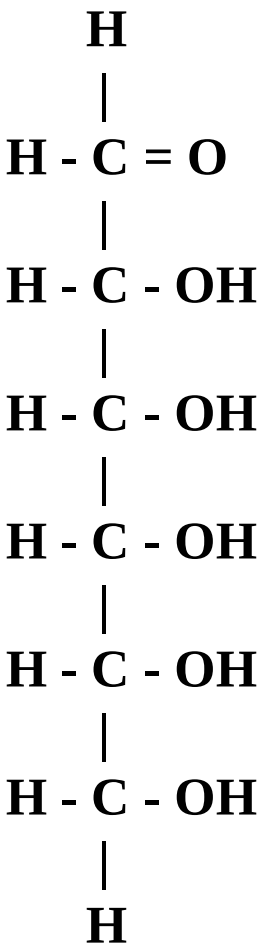
C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

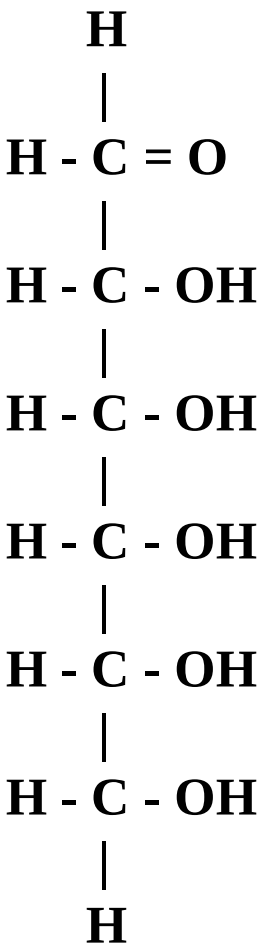
C4 PATHWAY ENERGY COST

GLUCOSE



C6H12O6

GLUCOSE



C6H12O6

GLUCOSE
6C
SUGAR

GLUCOSE
6C
SUGAR

QUESTION

WHAT COMPOUND CONTRIBUTES C ATOMS TO THE SYNTHESIS OF GLUCOSE?

QUESTION

PHOTOSYNTHESIS

WATER

CO2

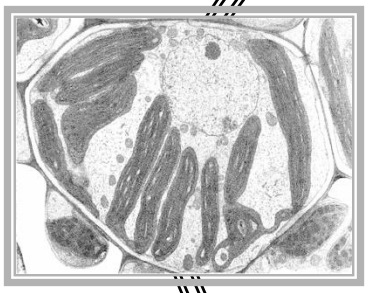
LIGHT EGY

PHOTO

ATMOSPHERE

E-

PHOTOLYSIS



LT RXT

THYLAKOID GRANUM

CHEMICAL ENERGY

DK RXT

STROMA

SYNTHESIS

CHEM EGY INPUT

CHLOROPLAST

ATMOSPHERE

OXYGEN

GLUCOSE

?

HATCH & SLACK CYCLE

CORN

2 ATP

2 ADP

EGY

PEP-ASE

PEP

FEEDSBACK

PYRUVATE

OXALOACETATE

CO2

MALATE

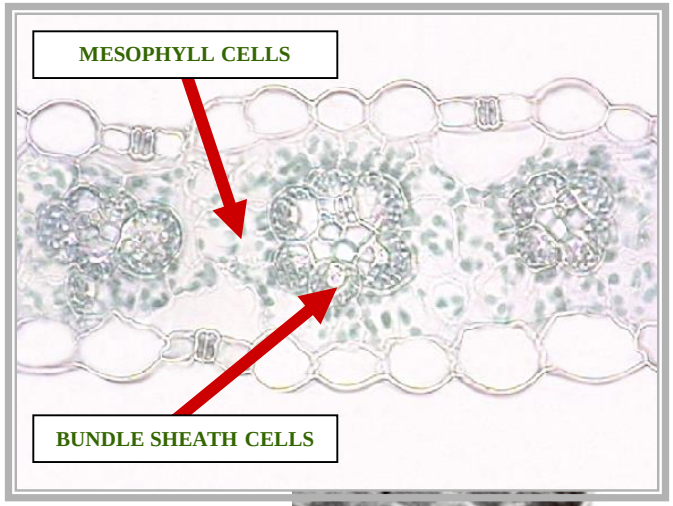
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

QUESTION

A

WHAT COMPOUND CONTRIBUTES C ATOMS TO THE SYNTHESIS OF GLUCOSE?

QUESTION

ANSWER

CO2

ANSWER

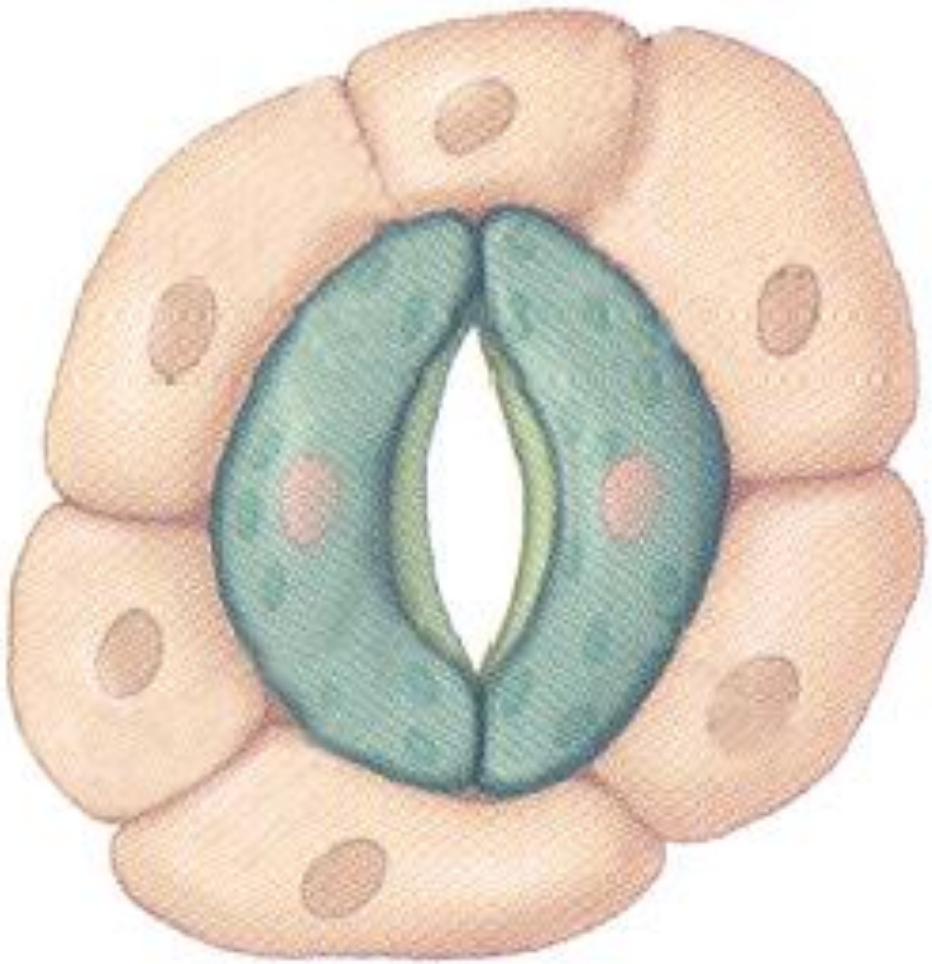
LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO2

CO2



CO2

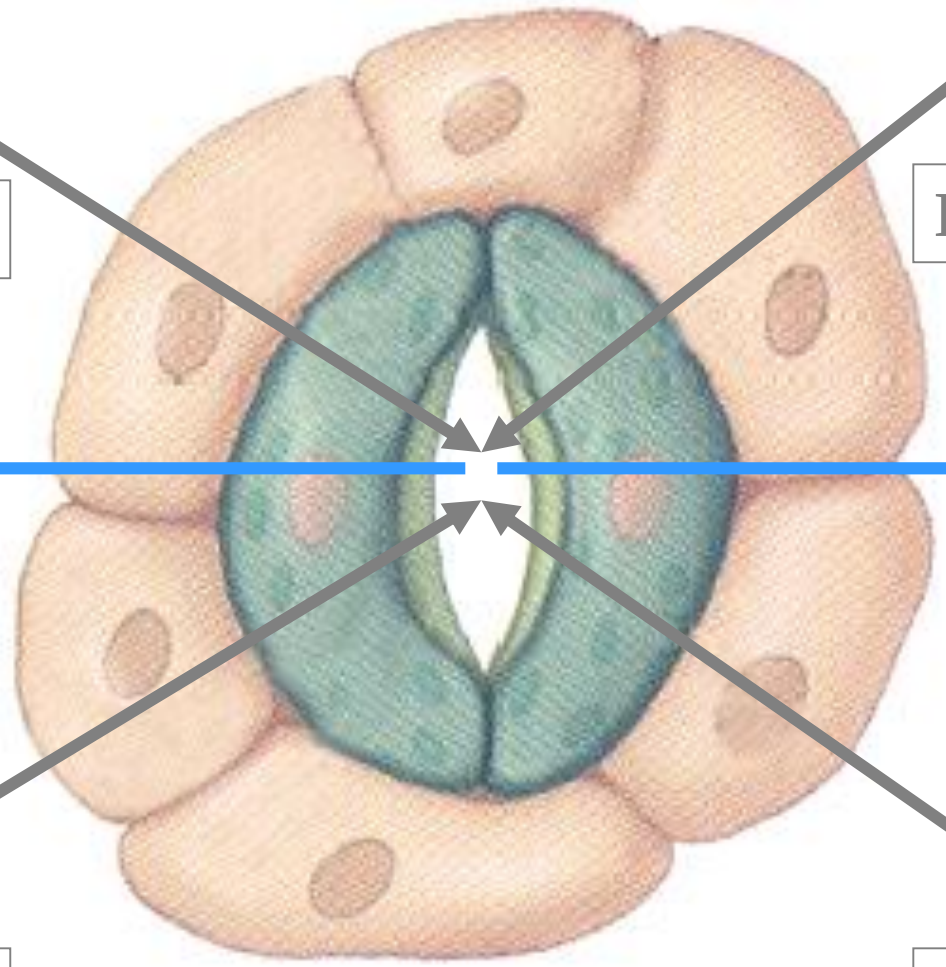
CO2

LEAF STOMATE

CO2

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

H2O

DIFFUSION

CO2

DIFFUSION

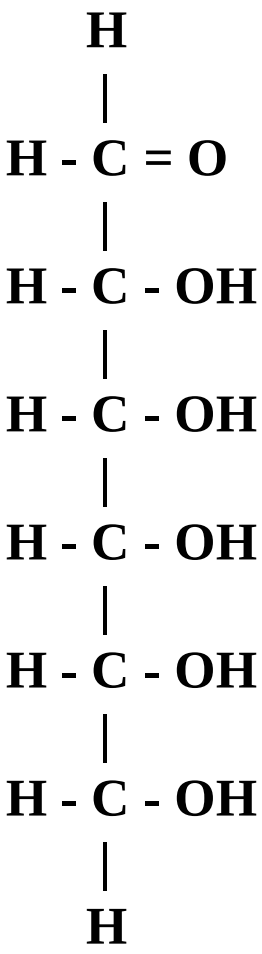
CO2

DIFFUSION

PHOTOSYNTHESIS

CO2
CO2
CO2
CO2
CO2
CO2

SYNTHESIZE



CARBON DIOXIDE

BUILDING BLOCK

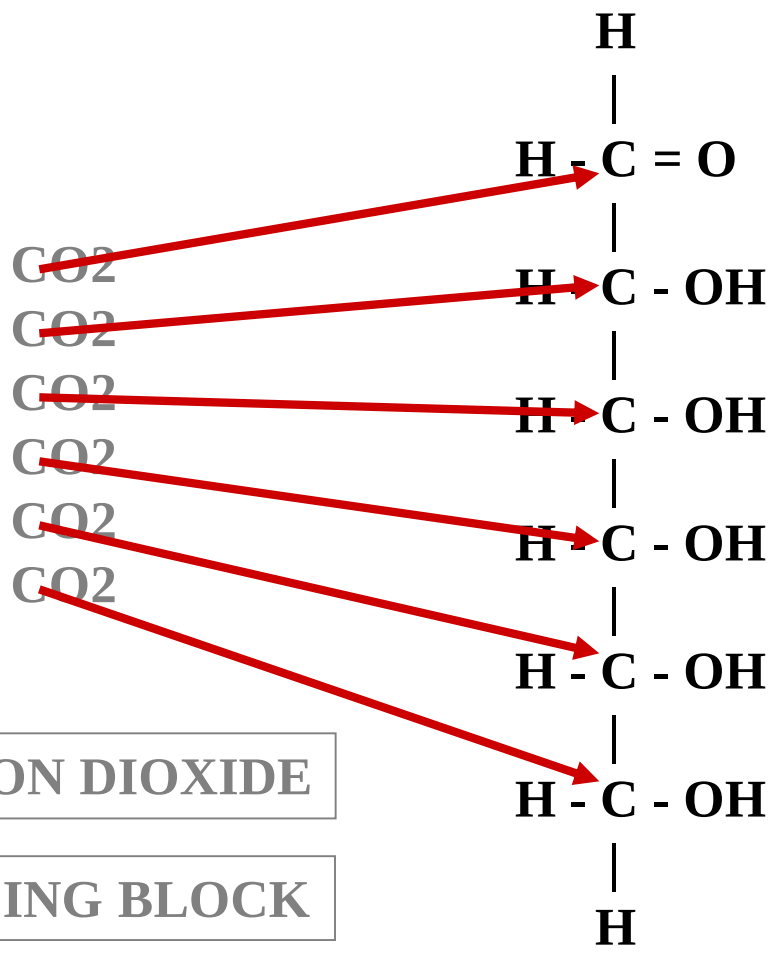
C6H12O6

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

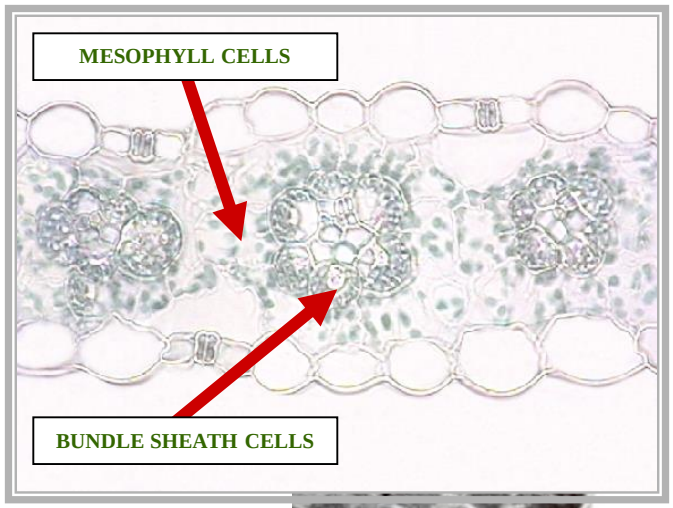
MESOPHYLL CELL CYTOSOL

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

2 ADP

EGY

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

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MALATE

MESOPHYLL CELL CYTOSOL

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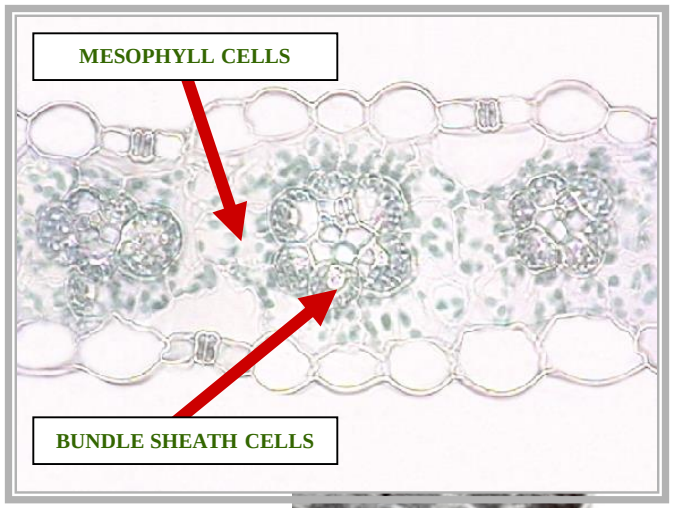
GLUCOSE 6 CARBON SUGAR

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

2 ADP

ENERGY

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

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MESOPHYLL CELL CYTOSOL

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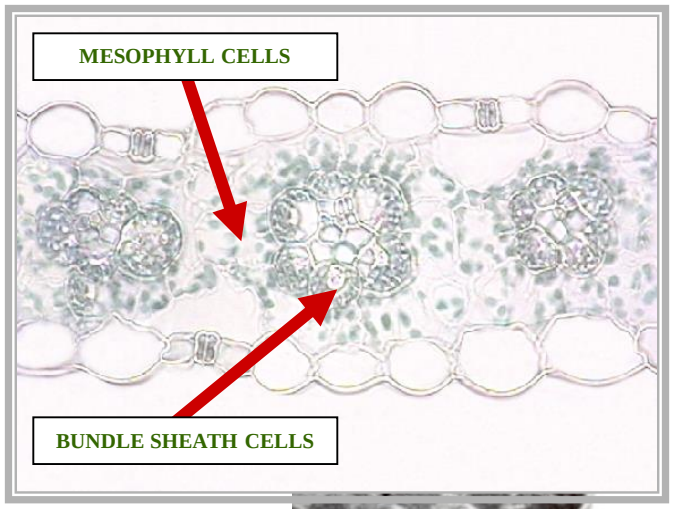
GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C4 LEAF

C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

1 C ATOM ADDED EACH C4 CYCLE

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

6X

HATCH & SLACK CYCLE
C4 PATHWAY

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

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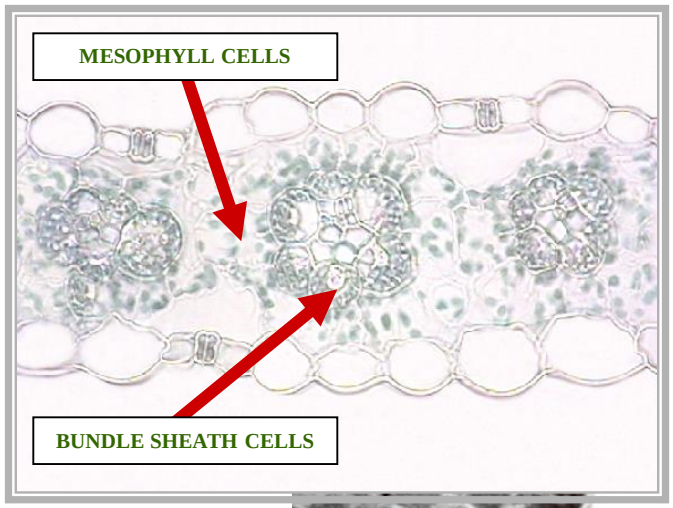
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

6X

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

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE

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PYRUVATE

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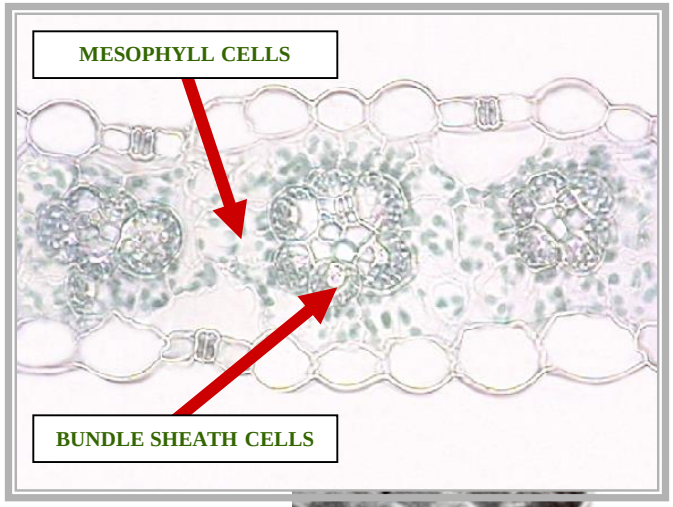
MALATE

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

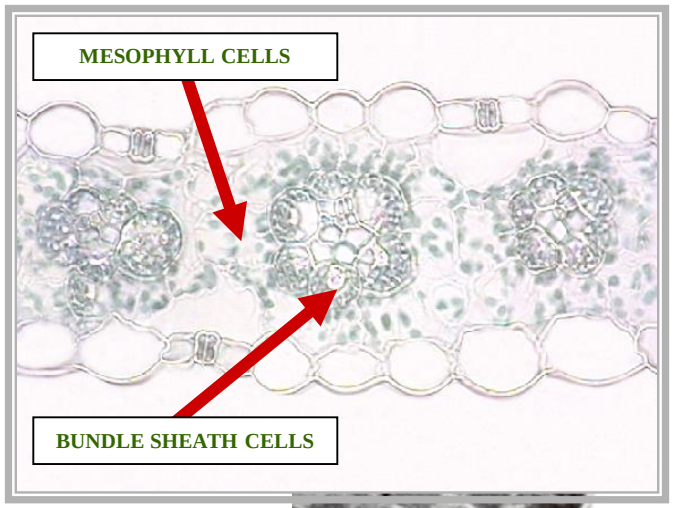
MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE



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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

C3

C3 PATHWAY

CALVIN CYCLE

= CHEMICAL ENERGY

PHOSPHOGLYCERATE / (PGA)

ATP

BISPHOSPHOGLYCERATE / (BIPGA)

NADPH

PHOSPHOGLYCERALDEHYDE / (PGAL)

COMPLEX SERIES CHEMICAL RXTS (CSCR)

ATP

RIBULOSE BISPHOSPHATE / (RUBP)

ENERGY EXPENSE

PHOTOSYNTHESIS

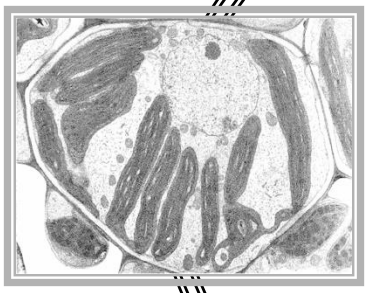
A

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID
GRANUM

?

DK RXT

STROMA

CHLOROPLAST

ATMOSPHERE

OXYGEN

PHOTOSYNTHESIS

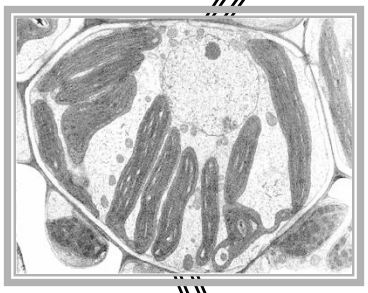
N

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID GRANUM

ATP

DK RXT

STROMA

NON-CYCLIC P-P

CYCLIC P-P

CHLOROPLAST

ATMOSPHERE

OXYGEN

PHOTOSYNTHESIS

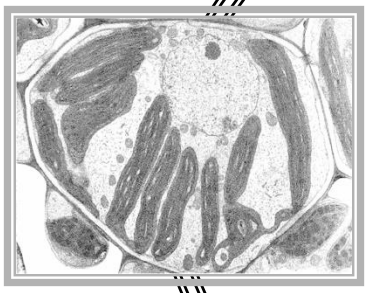
A

WATER

LIGHT EGY

E-

PHOTOLYSIS



LT RXT

THYLAKOID GRANUM

ATP NADPH

DK RXT

STROMA

NON-CYCLIC P-P

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

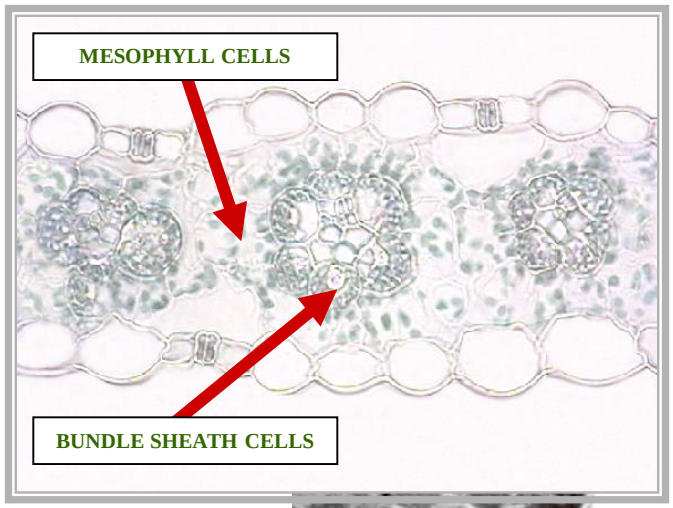
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

? C4

HATCH & SLACK CYCLE

CORN

? ATP/CO2/C4

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

MESOPHYLL CELL CHLOROPLAST

GLUCOSE

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

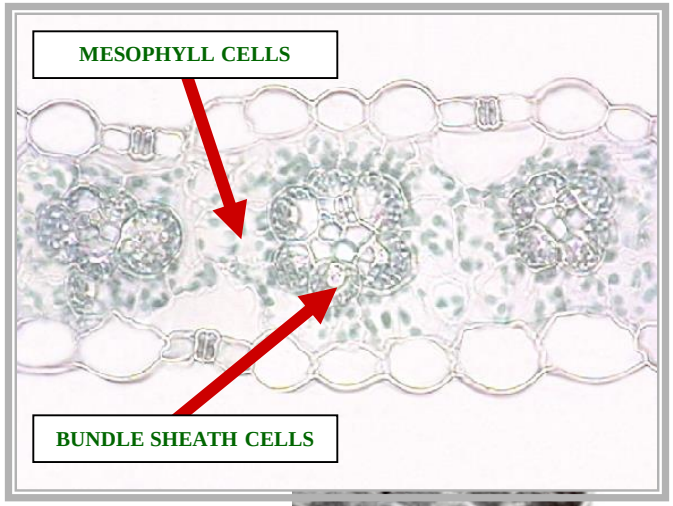
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

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BUNDLE-SHEATH CELL CHLOROPLAST

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HATCH & SLACK CYCLE

CORN

2 ATP

EGY

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OXALOACETATE

CO2

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MESOPHYLL CELL CYTOSOL

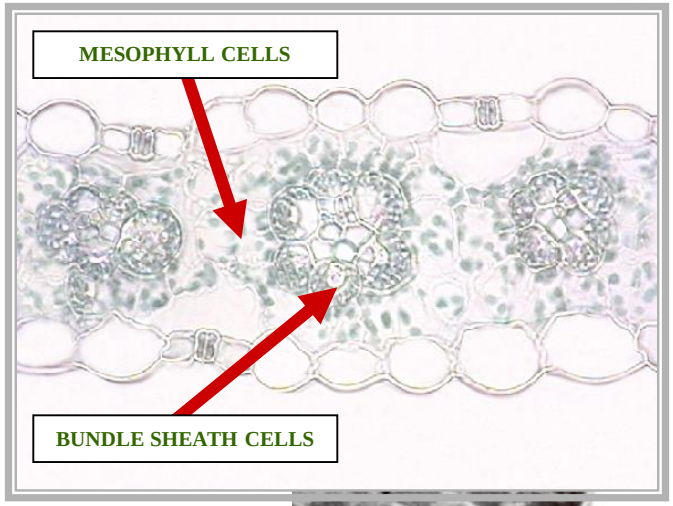
MESOPHYLL CELL CHLOROPLAST

2 ATP/CO2/C4

GLUCOSE

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

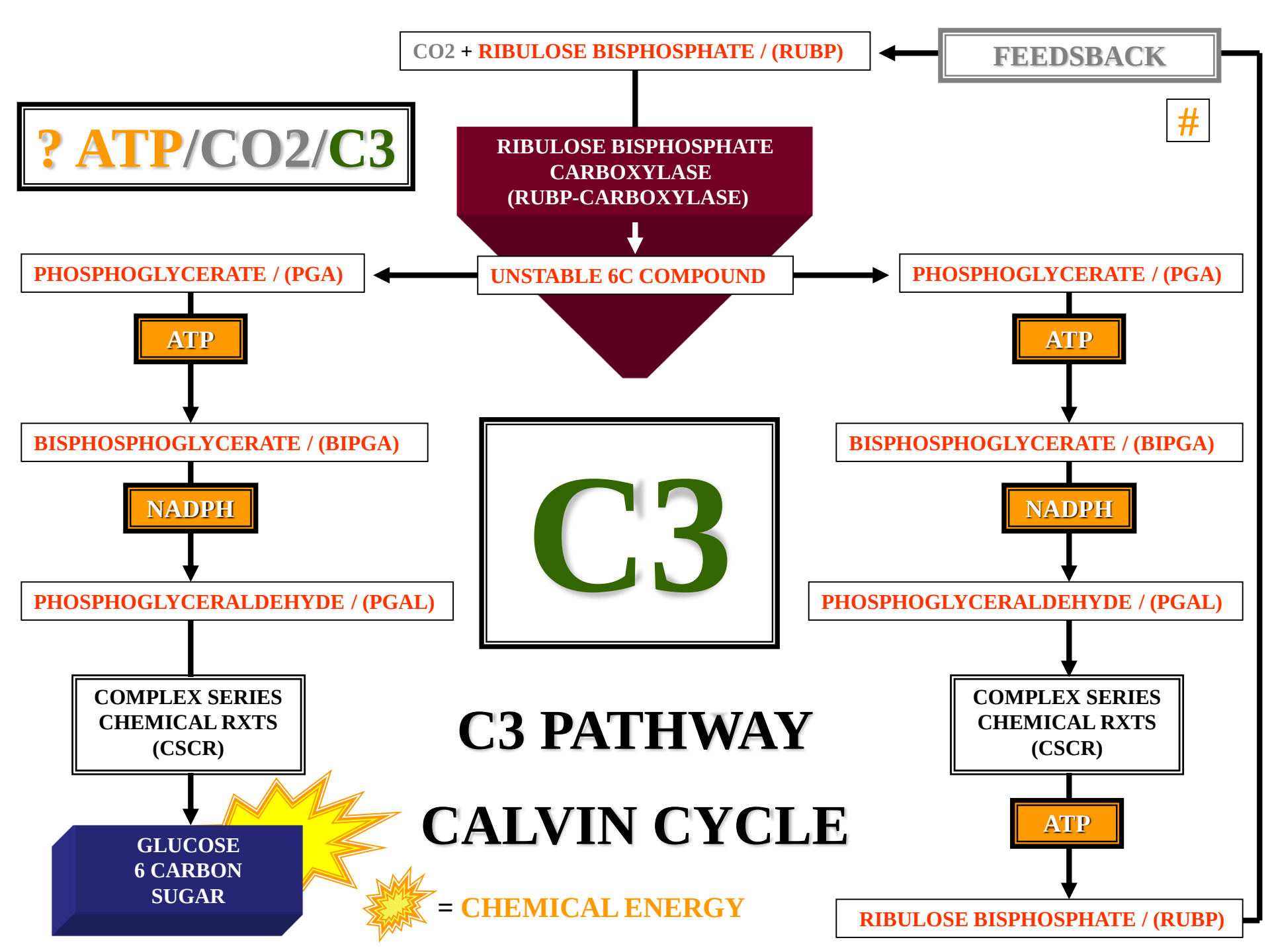
C4

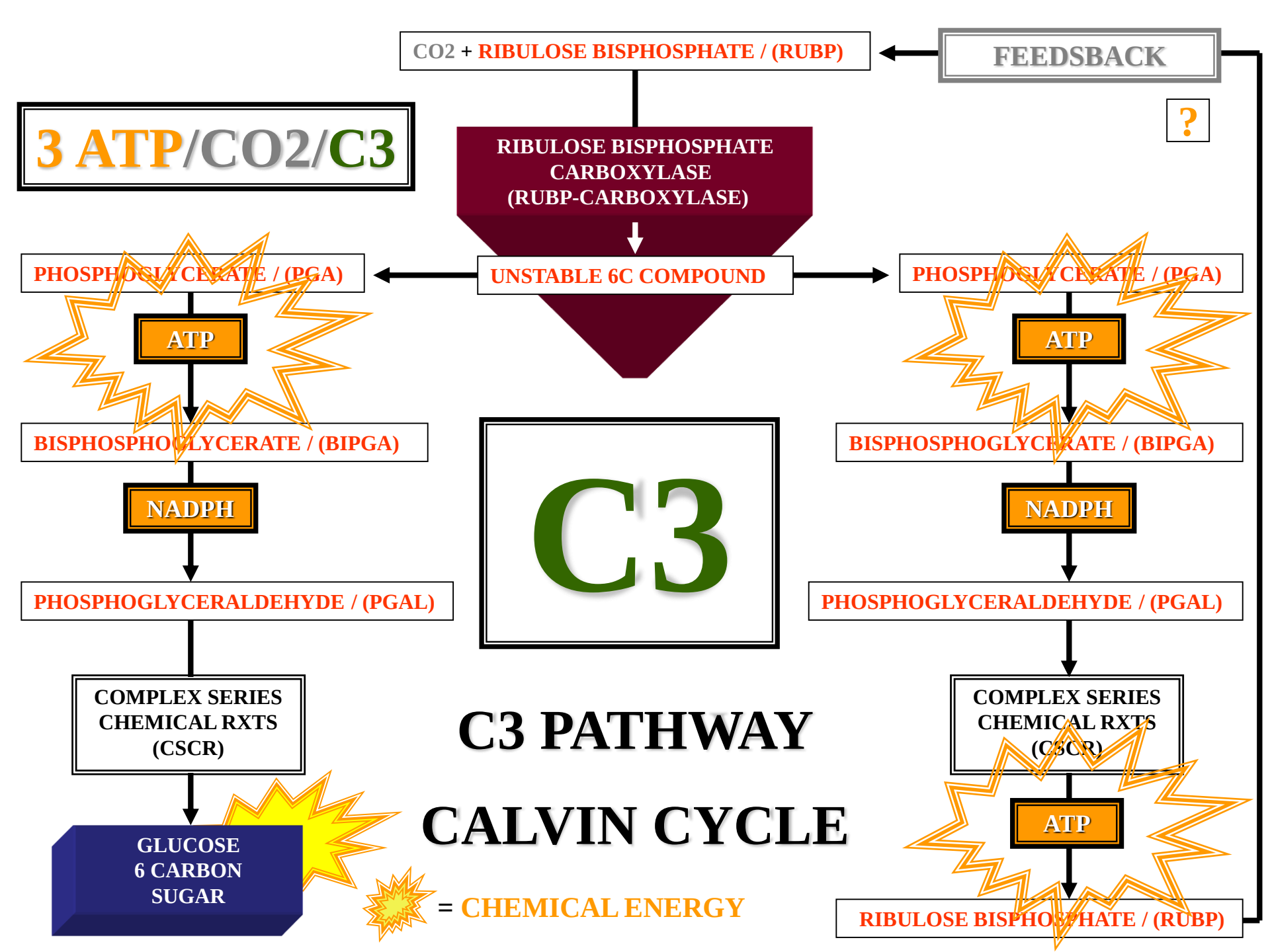
C4 LEAF

= 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

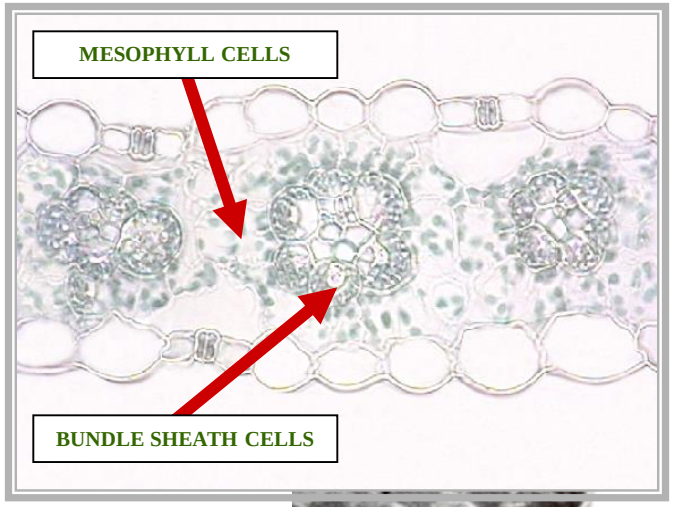
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



C4

C4 LEAF

= CHEMICAL ENERGY

BUNDLE-SHEATH CELL CHLOROPLAST

#

HATCH & SLACK CYCLE

CORN

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

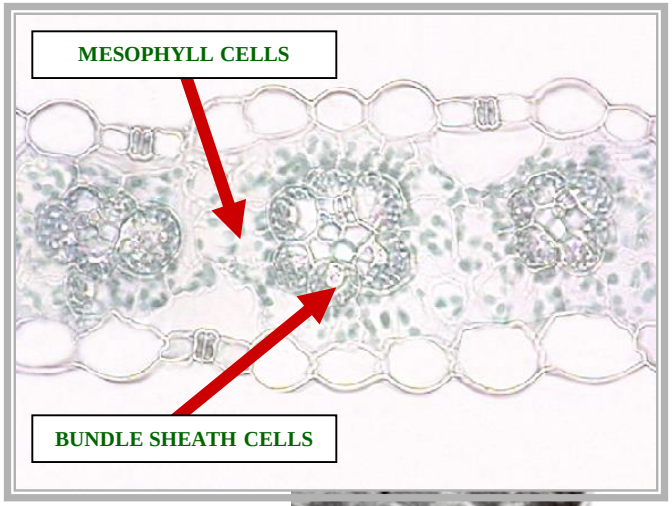
MESOPHYLL CELL CHLOROPLAST

5 ATP/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

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

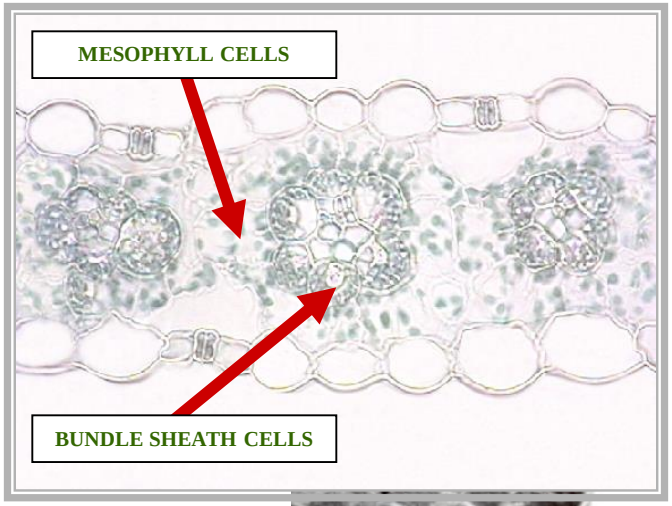
MESOPHYLL CELL CHLOROPLAST

5 ATP/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE



C3

RUBP

PGA

RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED

6X

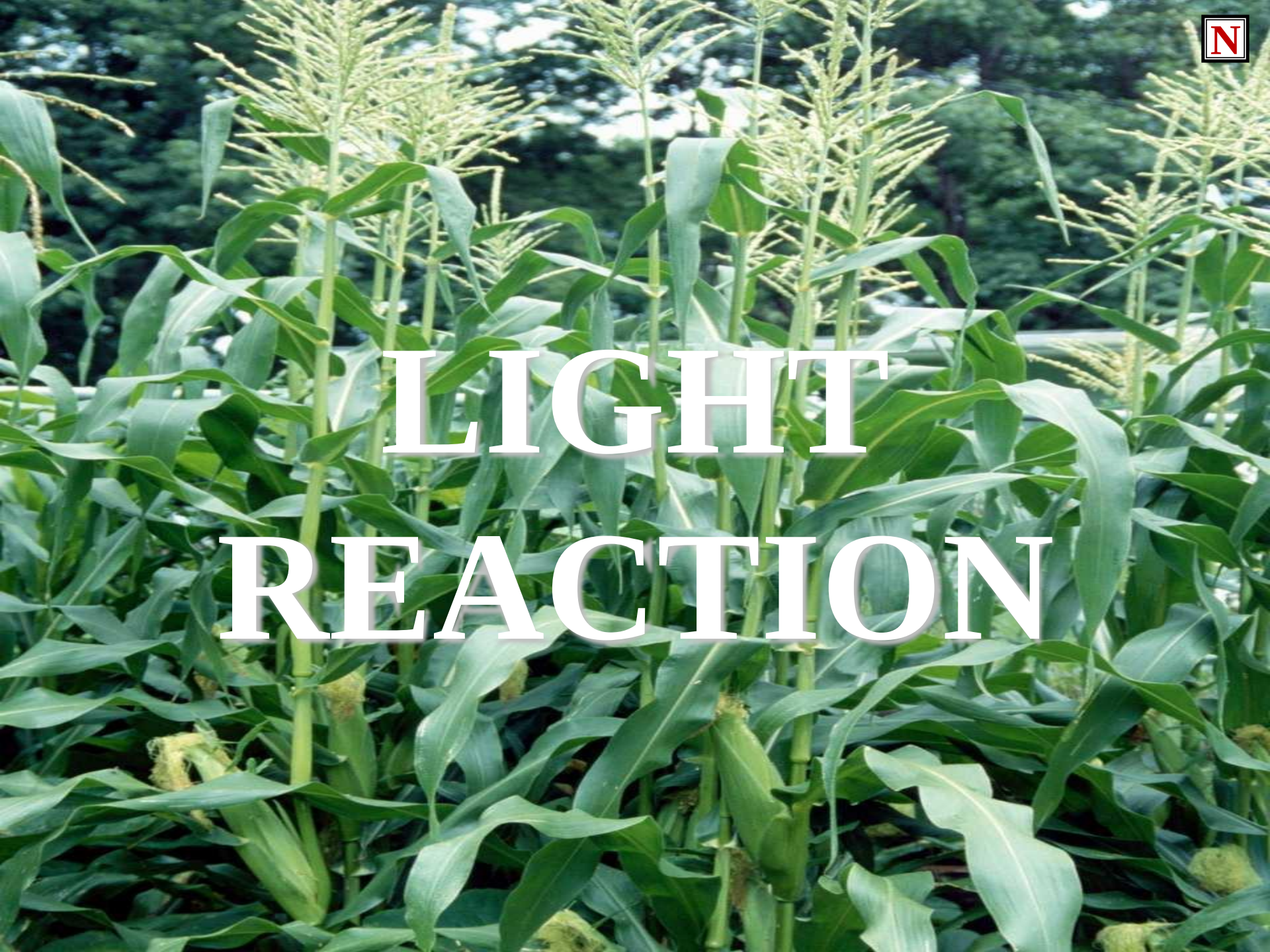
C4 LEAF

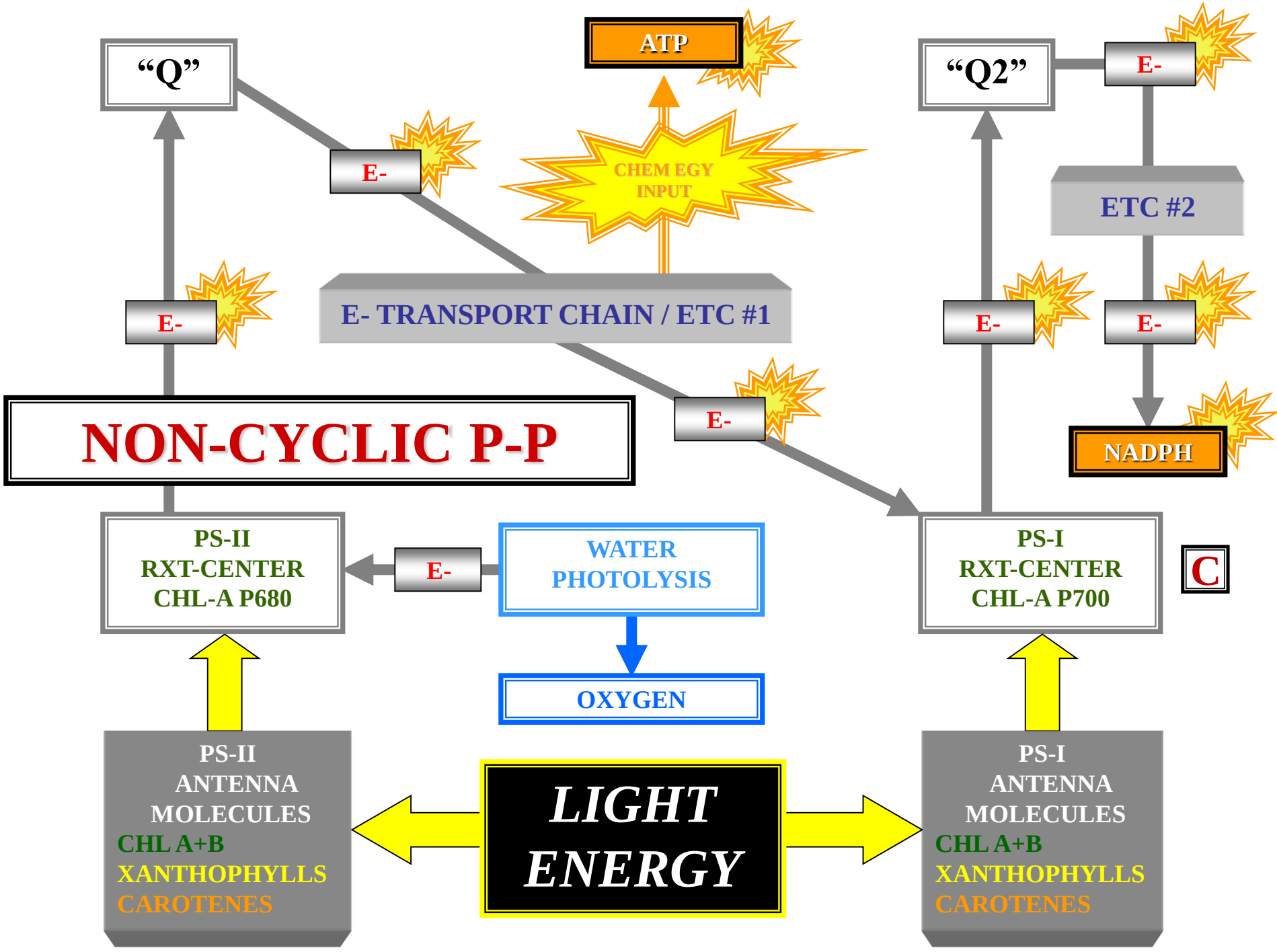
= CHEMICAL ENERGY

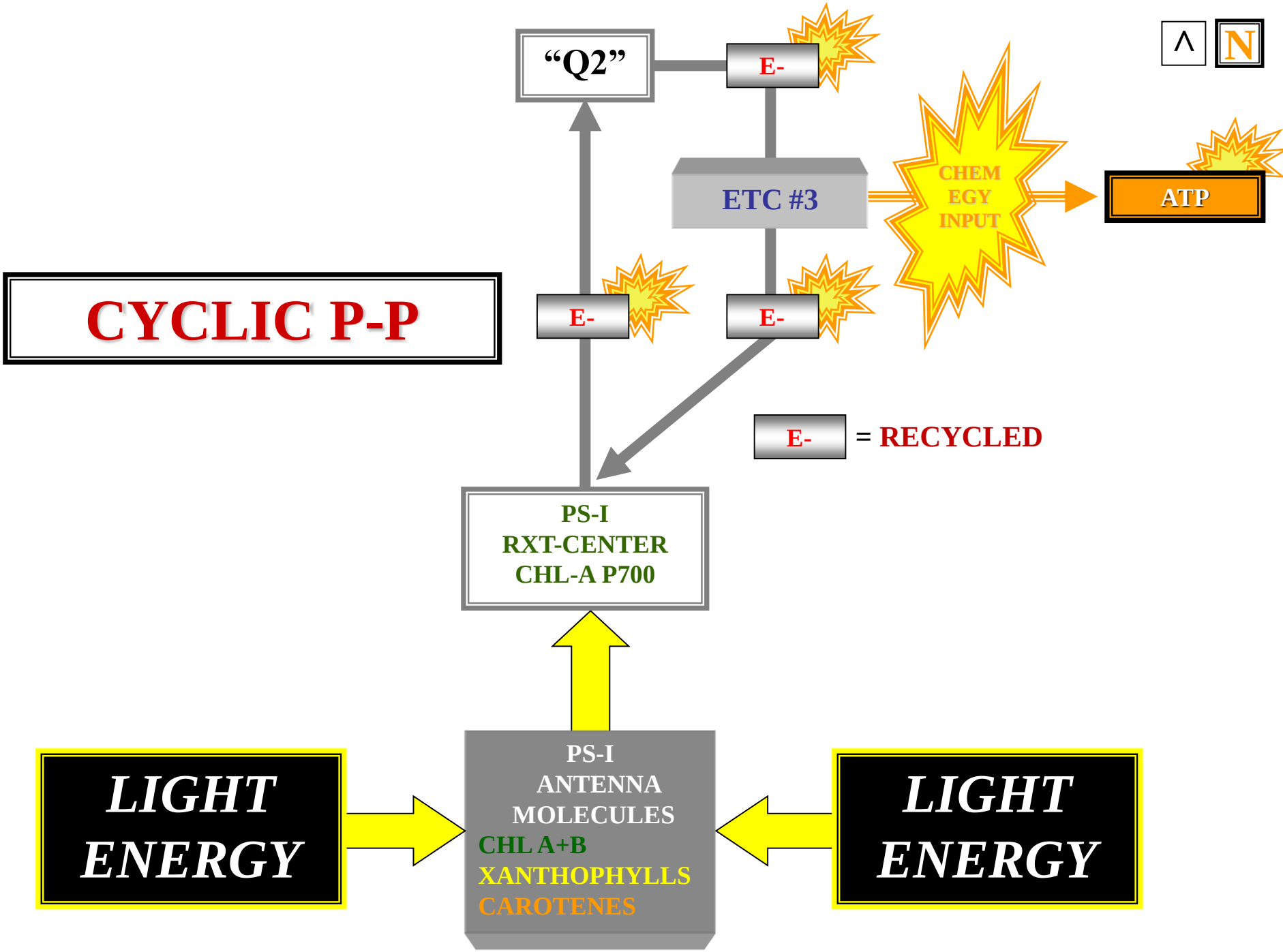
BUNDLE-SHEATH CELL CHLOROPLAST

#


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

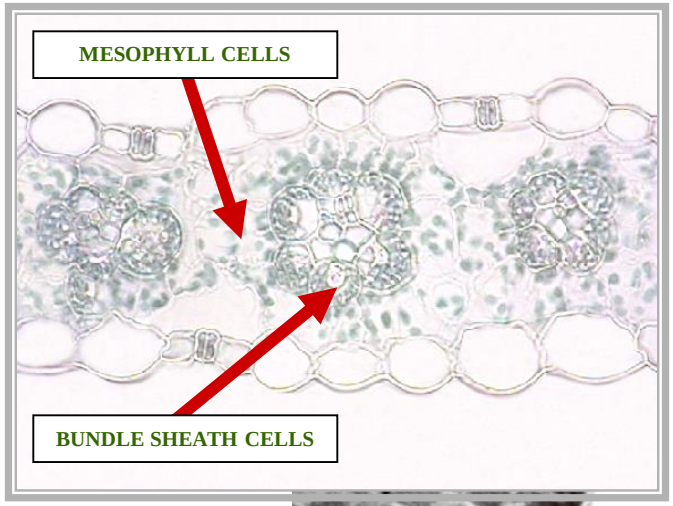
MESOPHYLL CELL CHLOROPLAST

? 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

2 ATP

EGY

2 ADP

PEP-ASE

PEP

PYRUVATE

OXALOACETATE

CO2

MALATE

MESOPHYLL CELL CYTOSOL

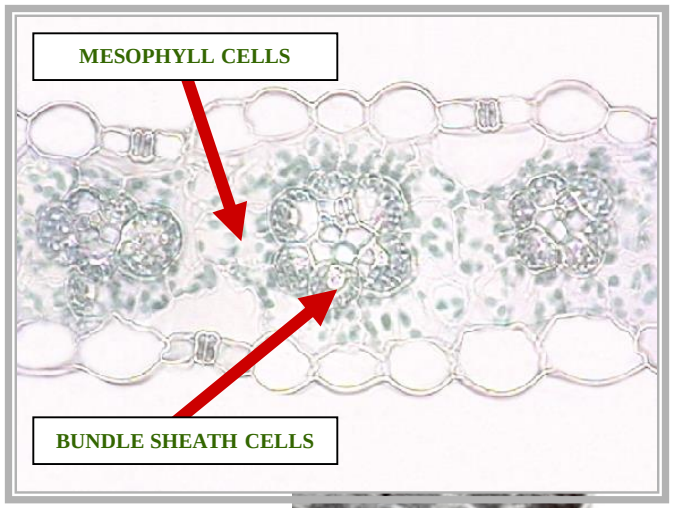
MESOPHYLL CELL CHLOROPLAST

? NADPH/CO2/C4

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

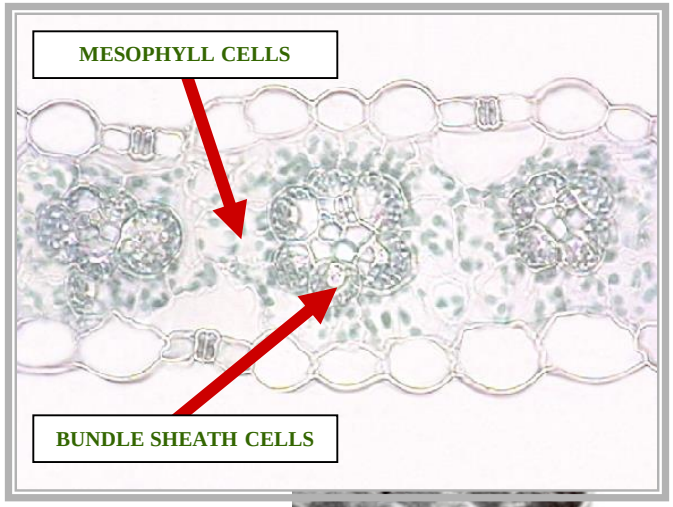
RUBP-ASE

PYRUVATE

CO2

MALATE

DECARBOXYLATED



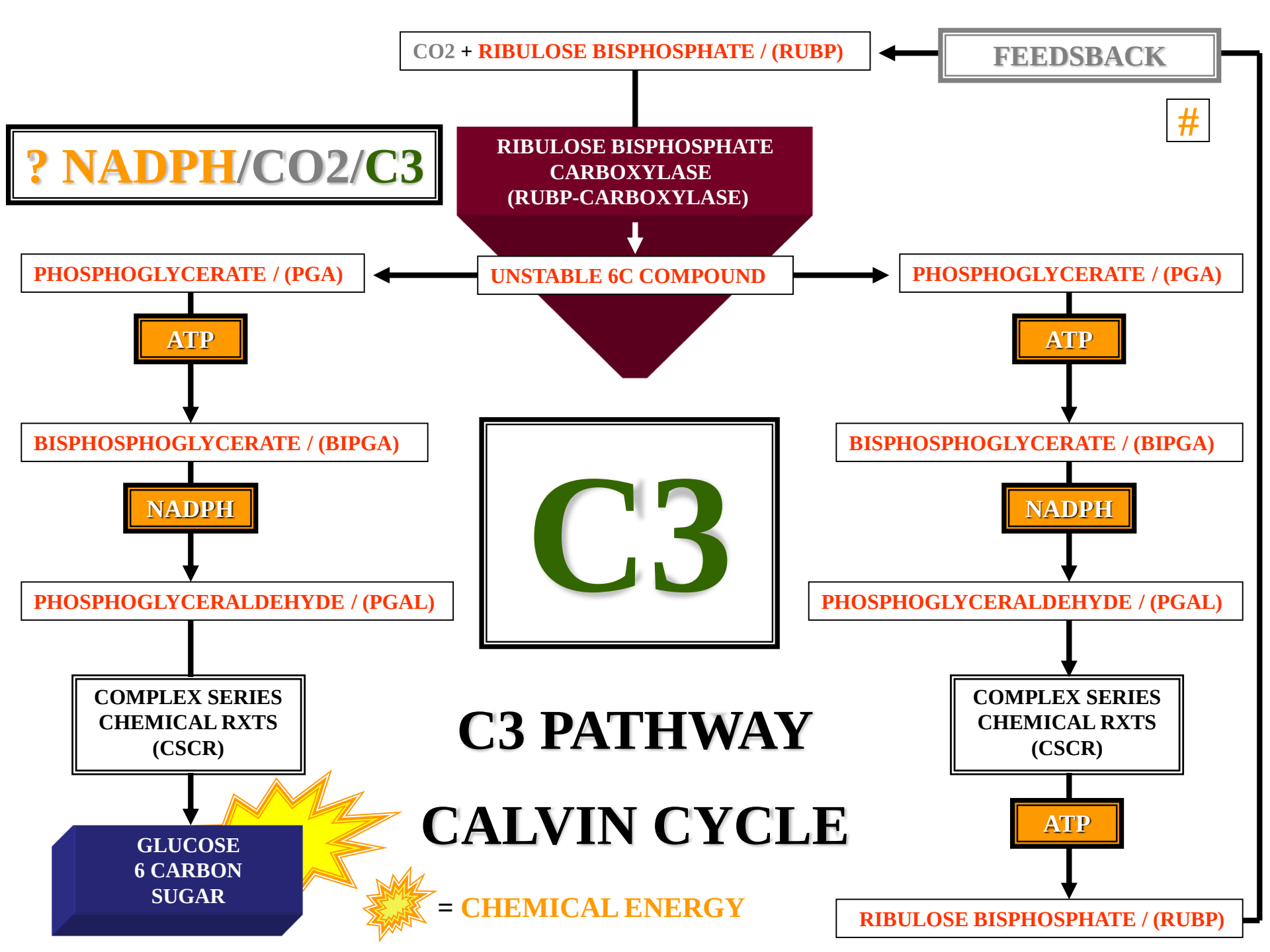
C4

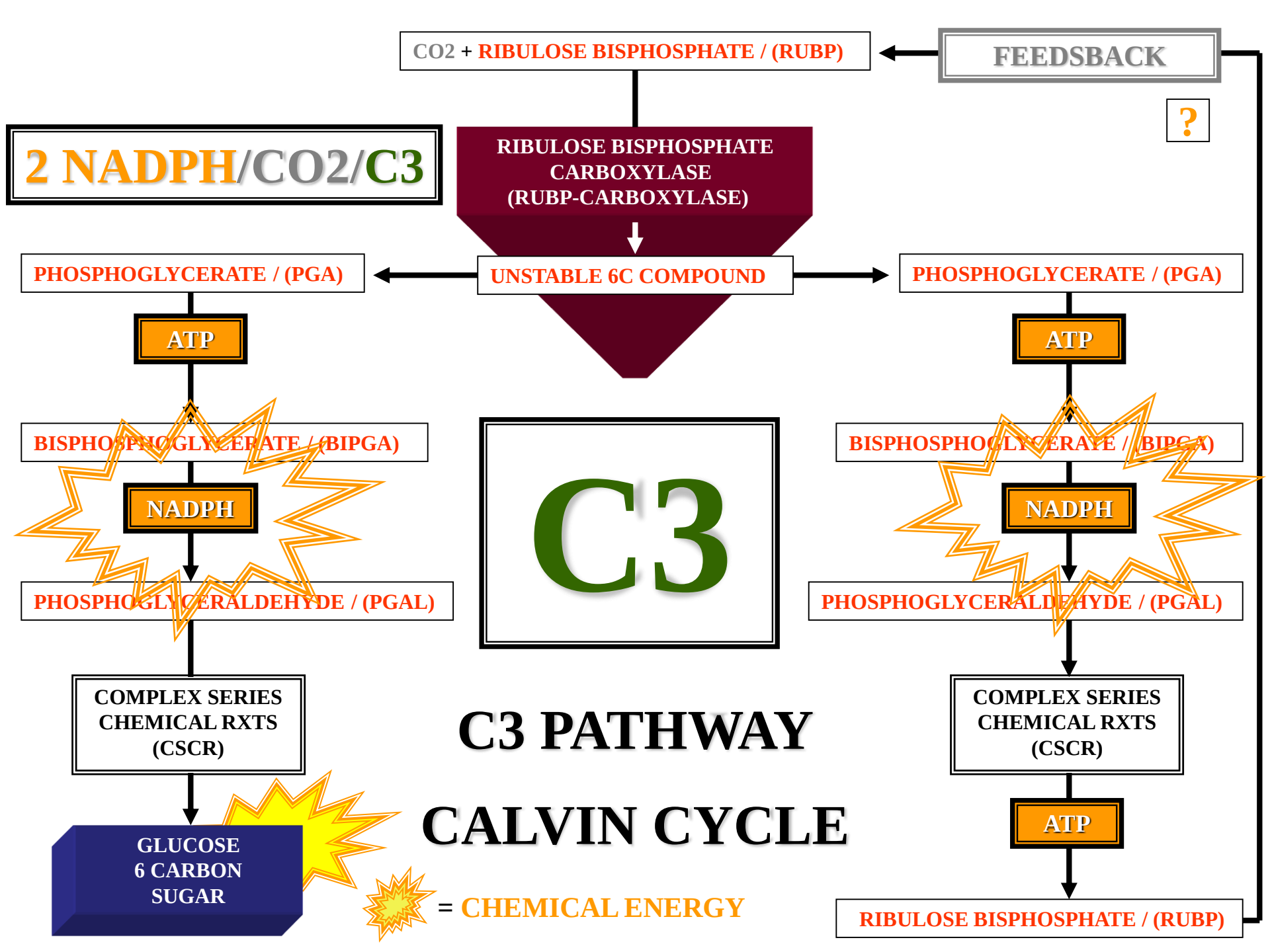
C4 LEAF

= 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

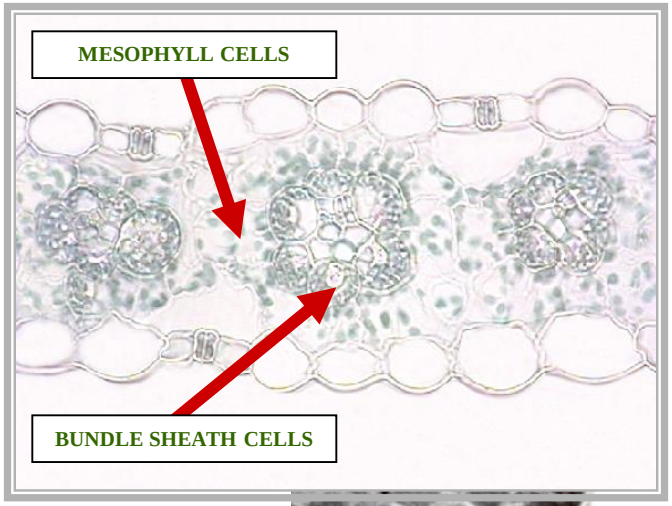
MESOPHYLL CELL CHLOROPLAST

? 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

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MESOPHYLL CELL CHLOROPLAST

2 NADPH/CO2

GLUCOSE 6 CARBON SUGAR

METABOLISM

ATMOSPHERE

C3

RUBP

PGA

RUBP-ASE

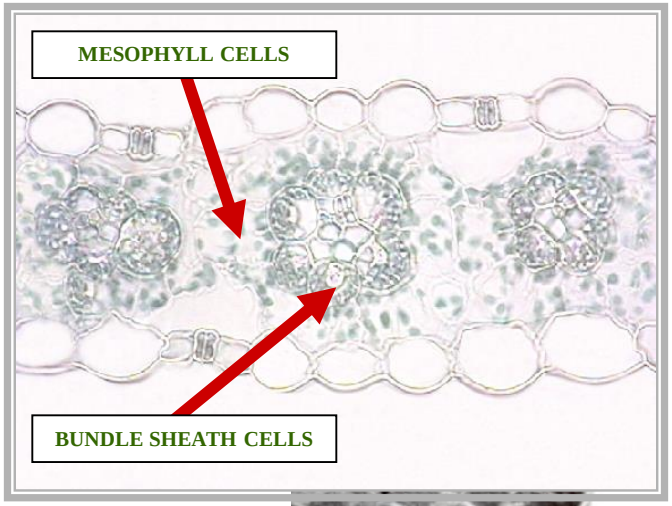
PYRUVATE

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

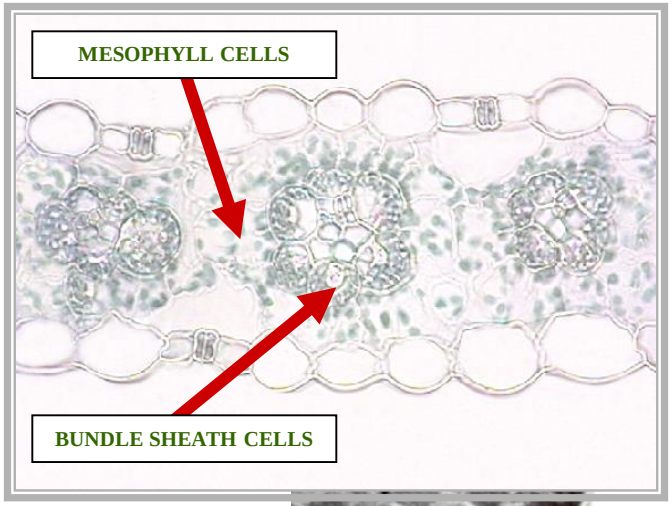
MESOPHYLL CELL CHLOROPLAST

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

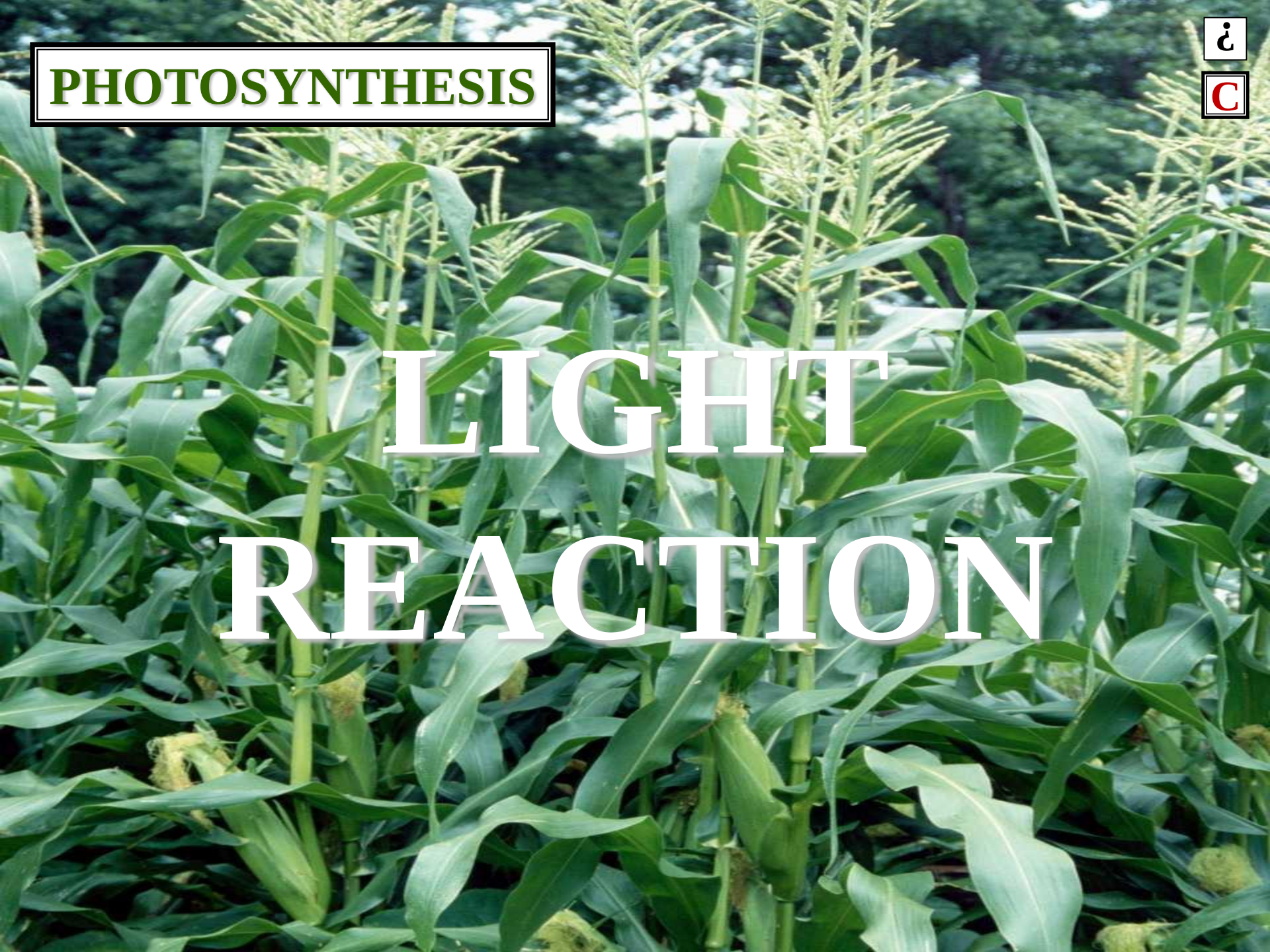
NADPH

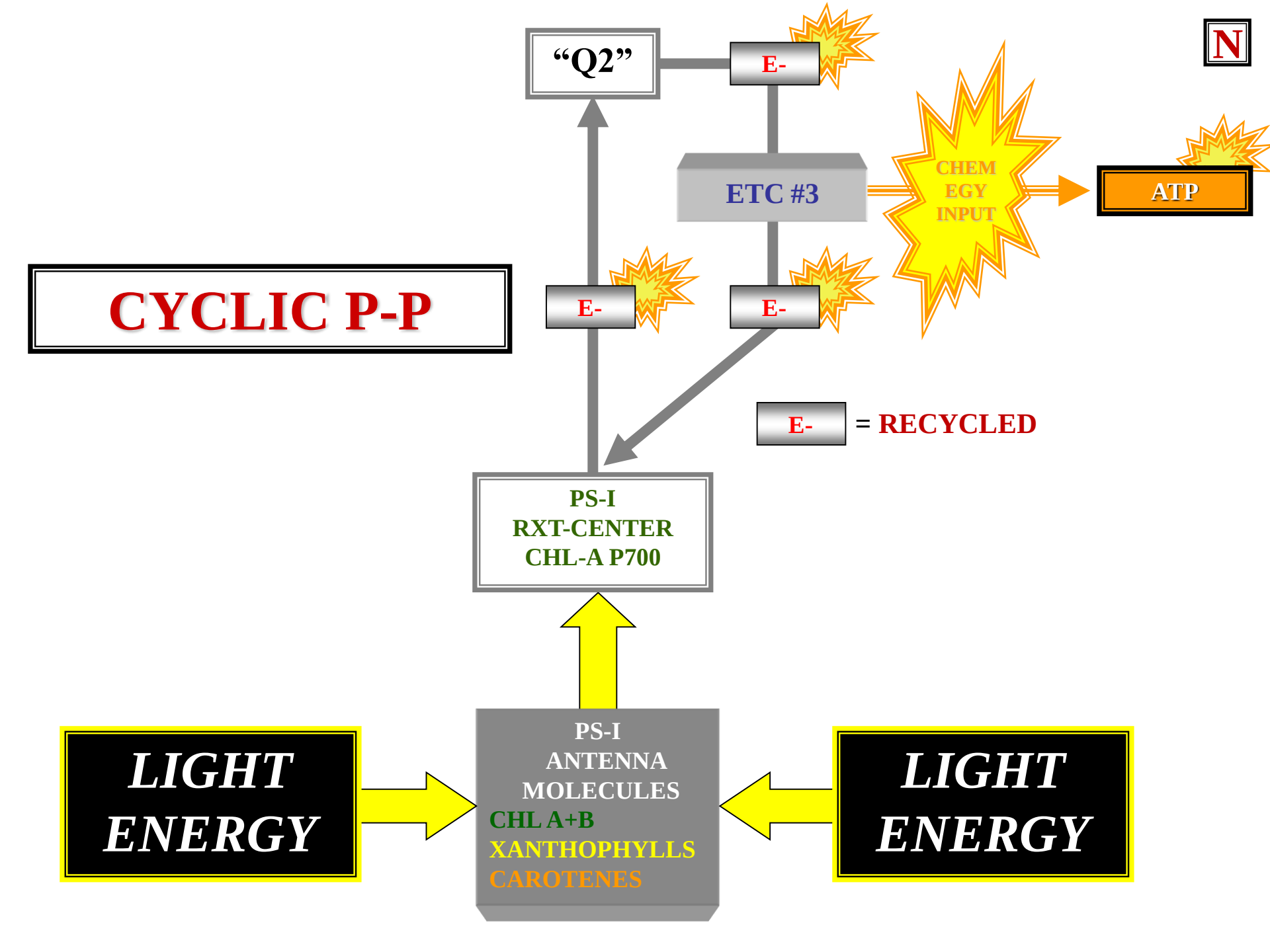
ENERGY EXPENSE

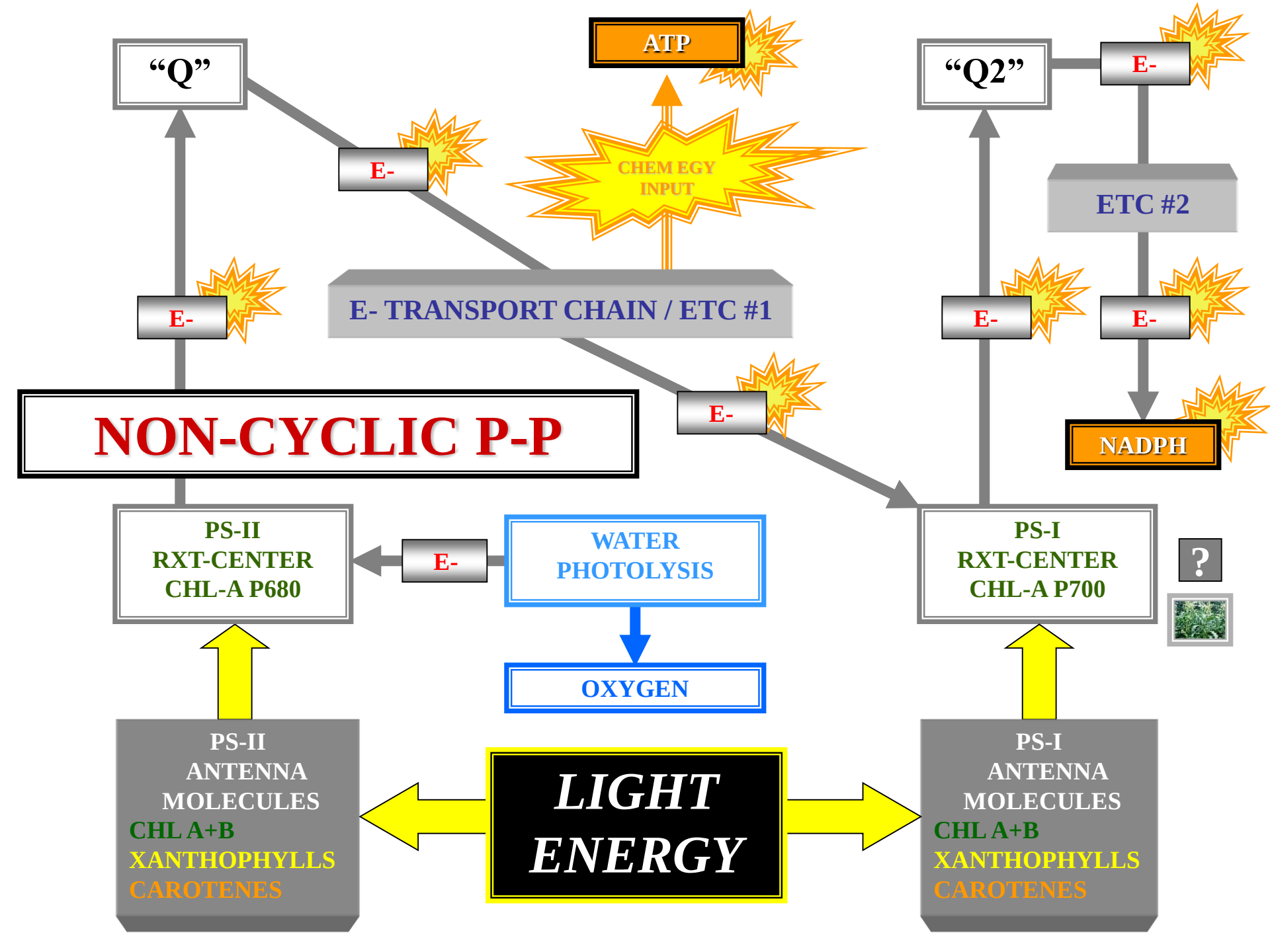
12 NADPH

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

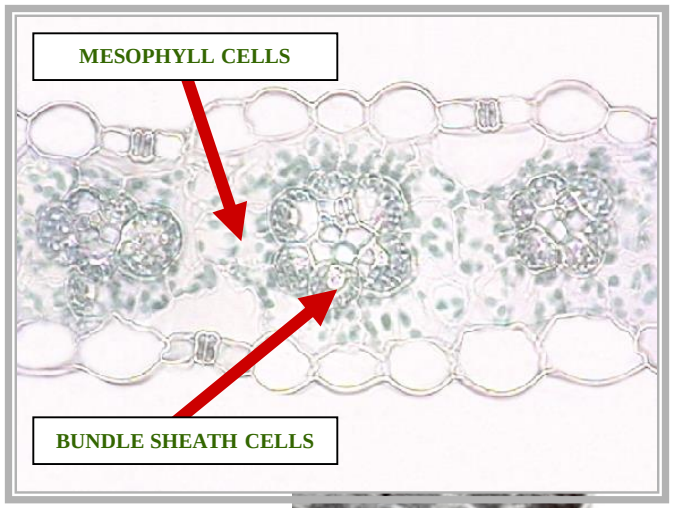
MESOPHYLL CELL CYTOSOL

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

A

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

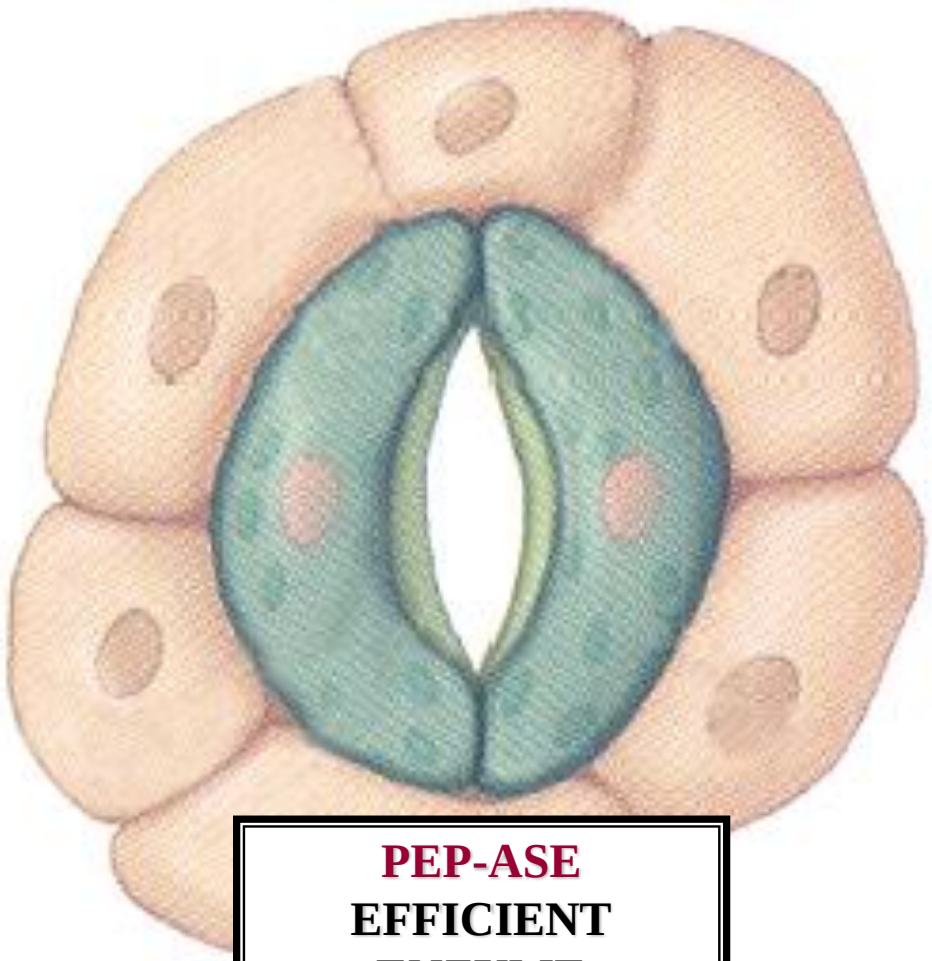
LEAF STOMATE

ATMOSPHERE

ATMOSPHERE

CO2

CO2



CO2

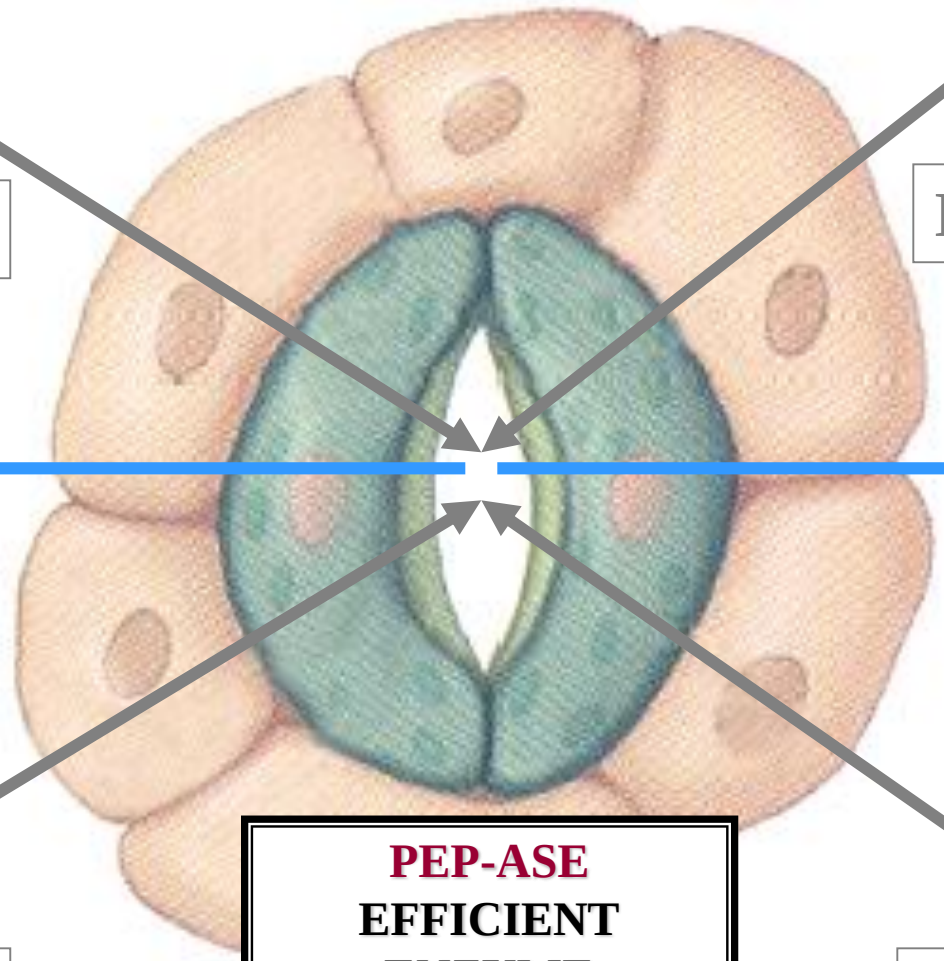
CO2

PEP-ASE
EFFICIENT
ENZYME

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

H2O

DIFFUSION

CO2

DIFFUSION

CO2

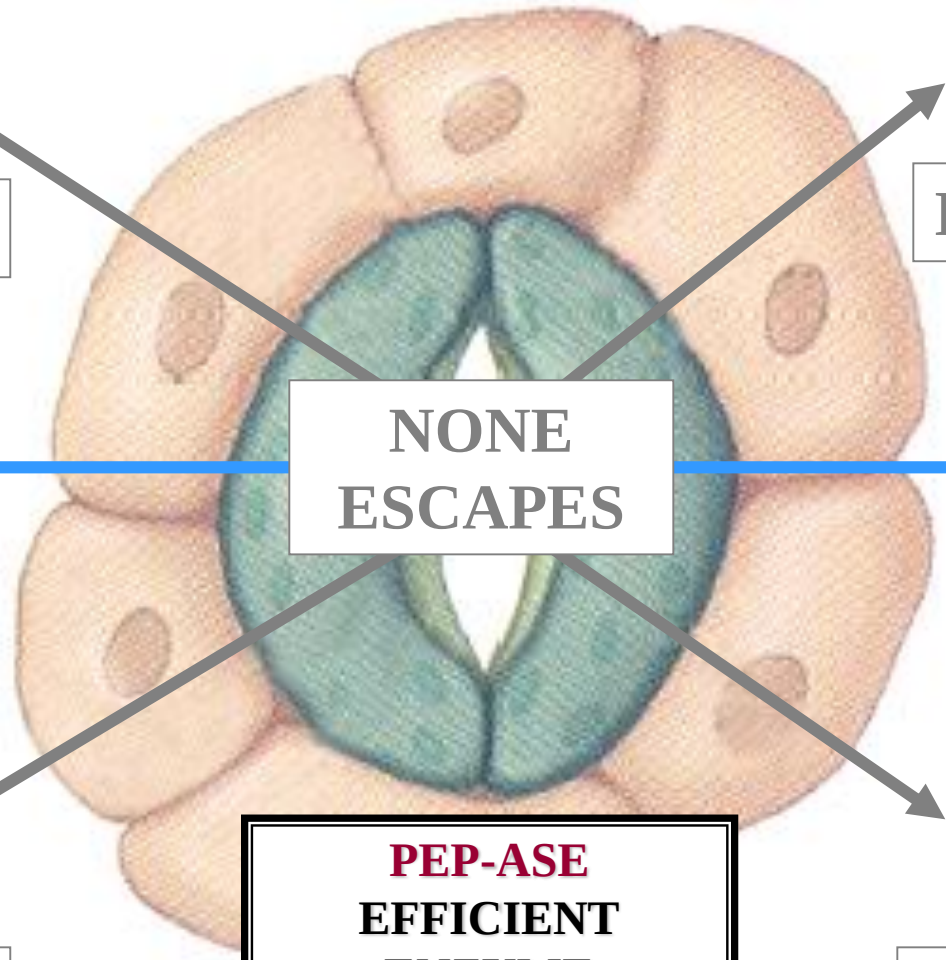
DIFFUSION

PEP-ASE
EFFICIENT
ENZYME

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

DIFFUSION

NONE ESCAPES

H2O

DIFFUSION

CO2

DIFFUSION

PEP-ASE
EFFICIENT
ENZYME

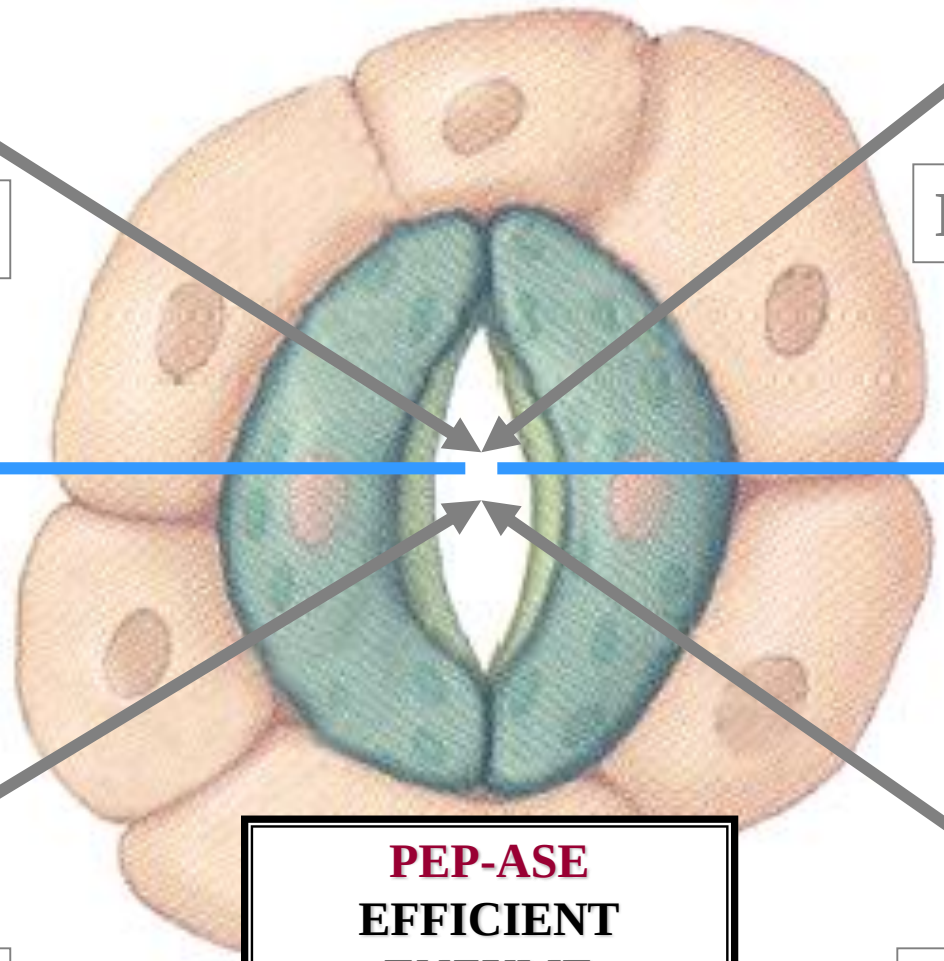
CO2

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

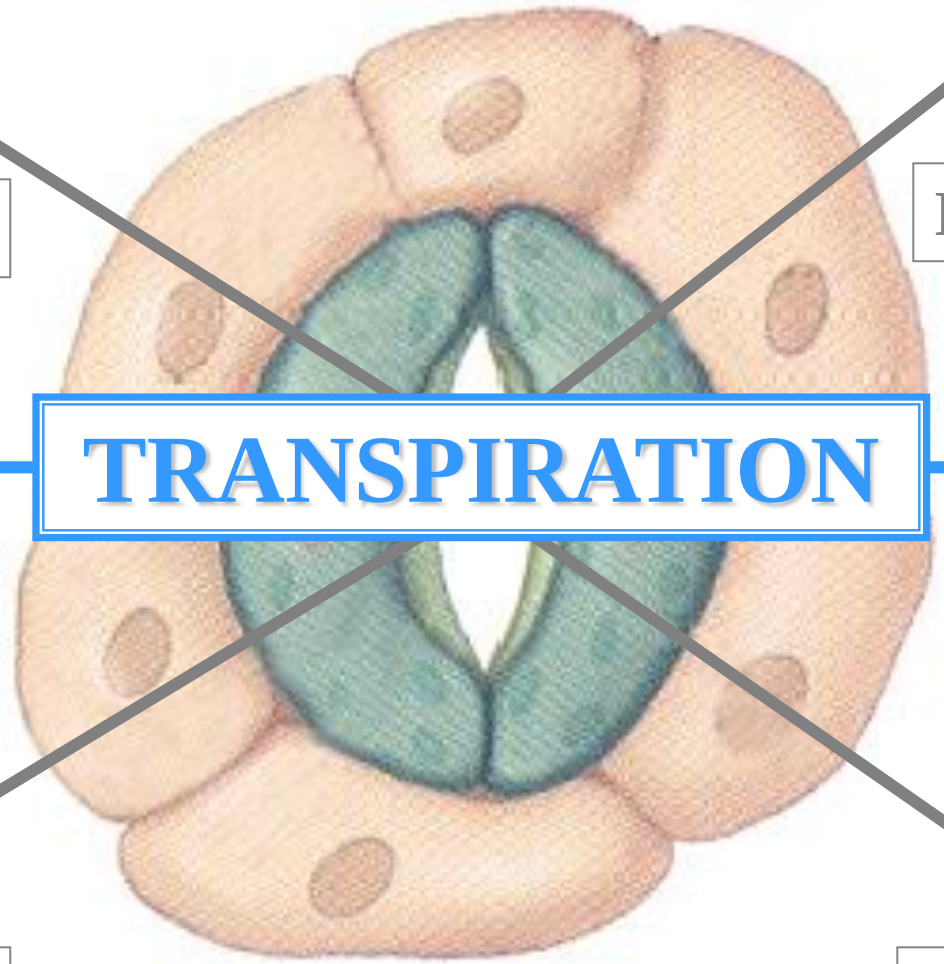
CO2

CO2

LEAF STOMATE

ATMOSPHERE

ATMOSPHERE



CO2

DIFFUSION

CO2

DIFFUSION

H2O

TRANSPIRATION

H2O

DIFFUSION

DIFFUSION

CO2

DIFFUSION

CO2

DIFFUSION

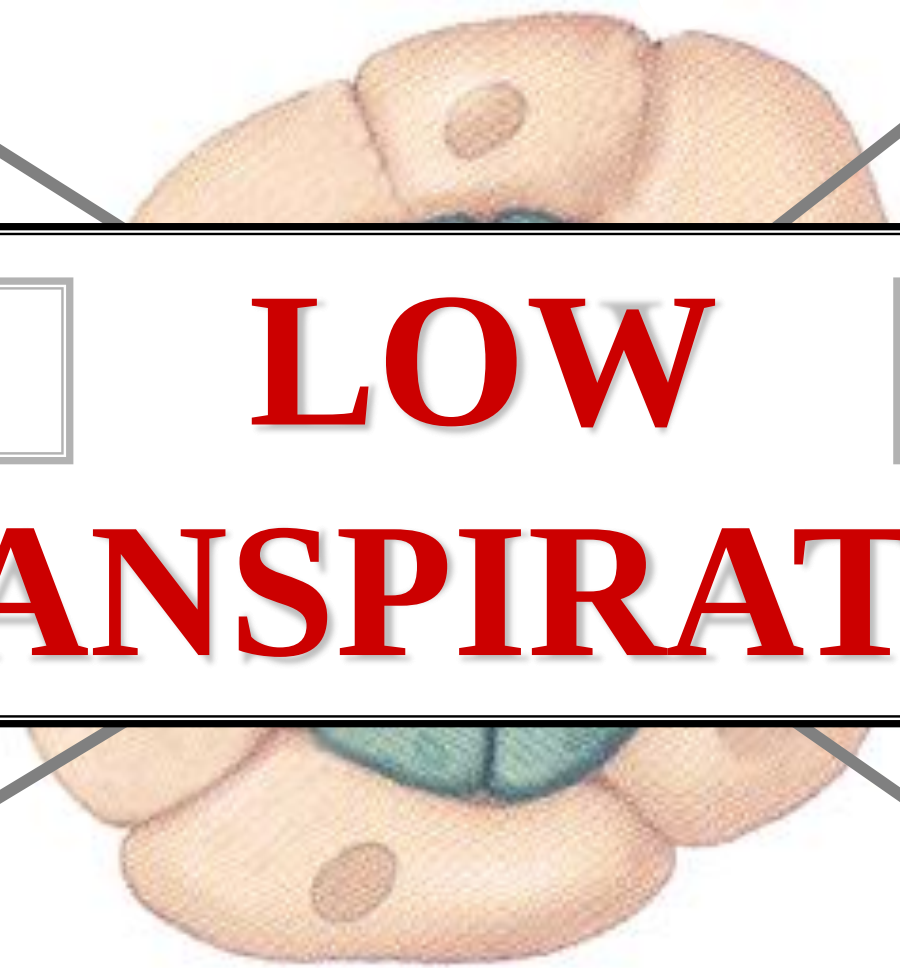
ATMOSPHERE

LEAF STOMATE

ATMOSPHERE

CO2

CO2



C4

LOW TRANSPIRATION

C4

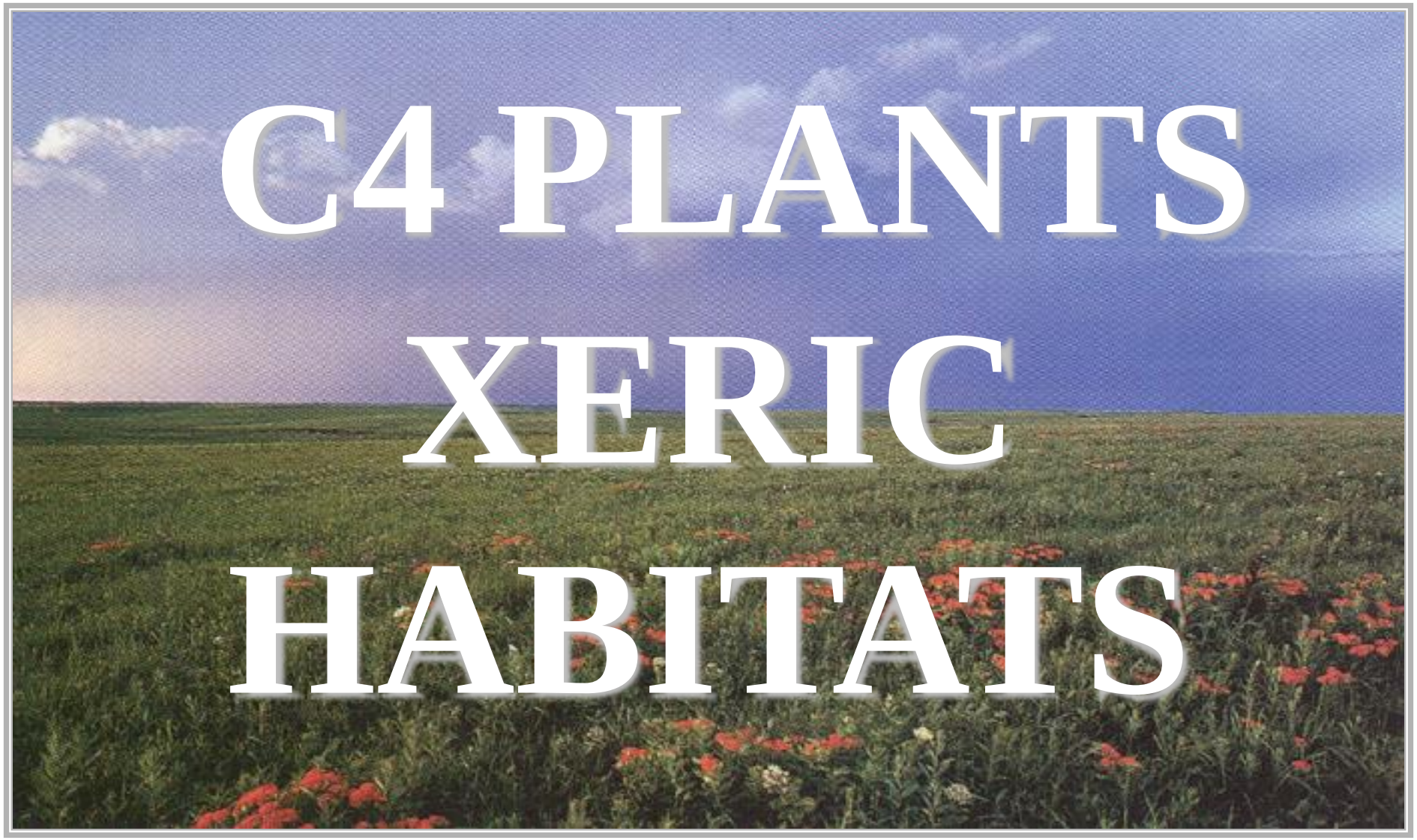
CO2

CO2


C4 ADVANTAGE
LESS
TRANSPIRATION
PER GLUCOSE
THAN C3

C4 PATHWAY ECOLOGY

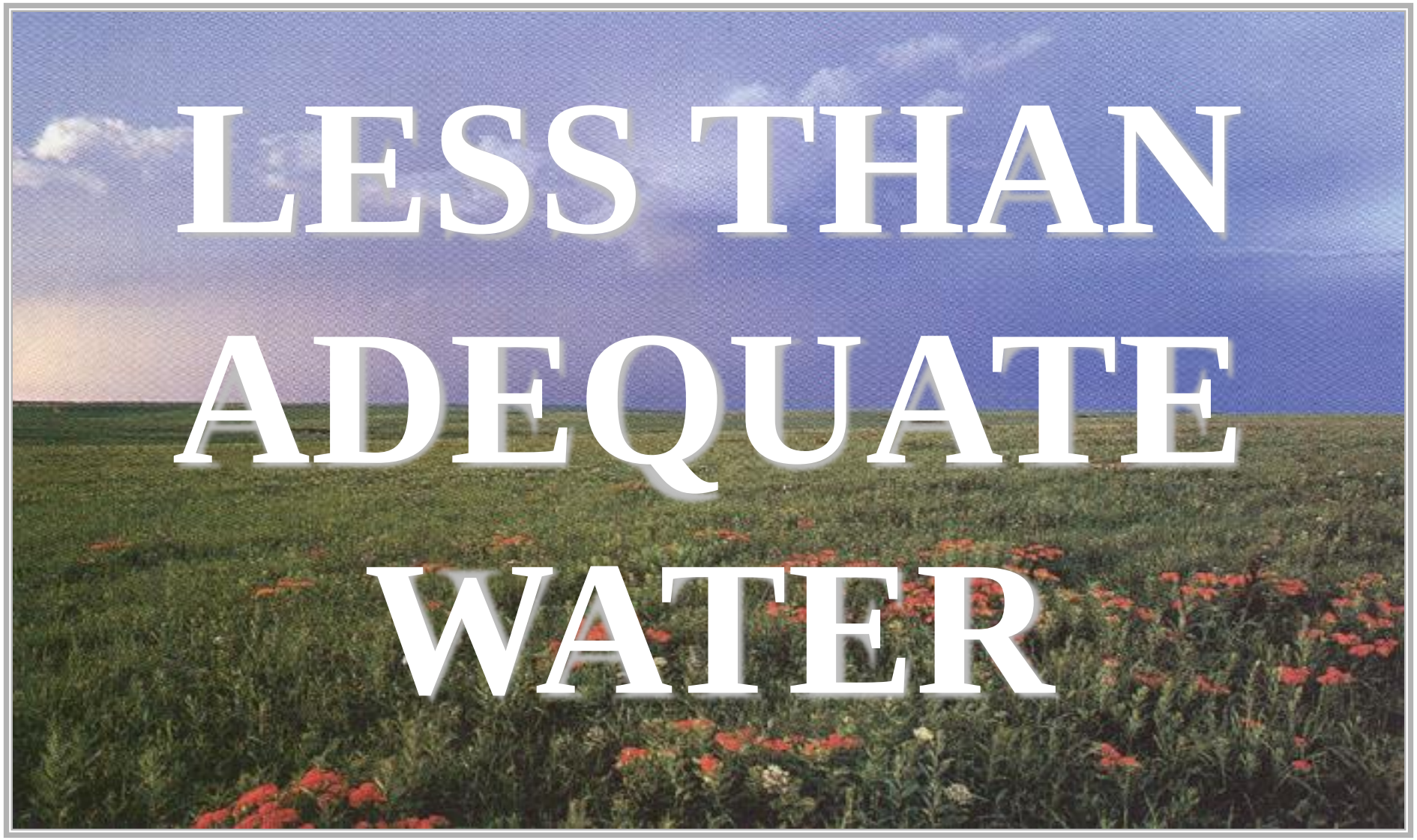
C4 ECOLOGY



XERIC HABITATS

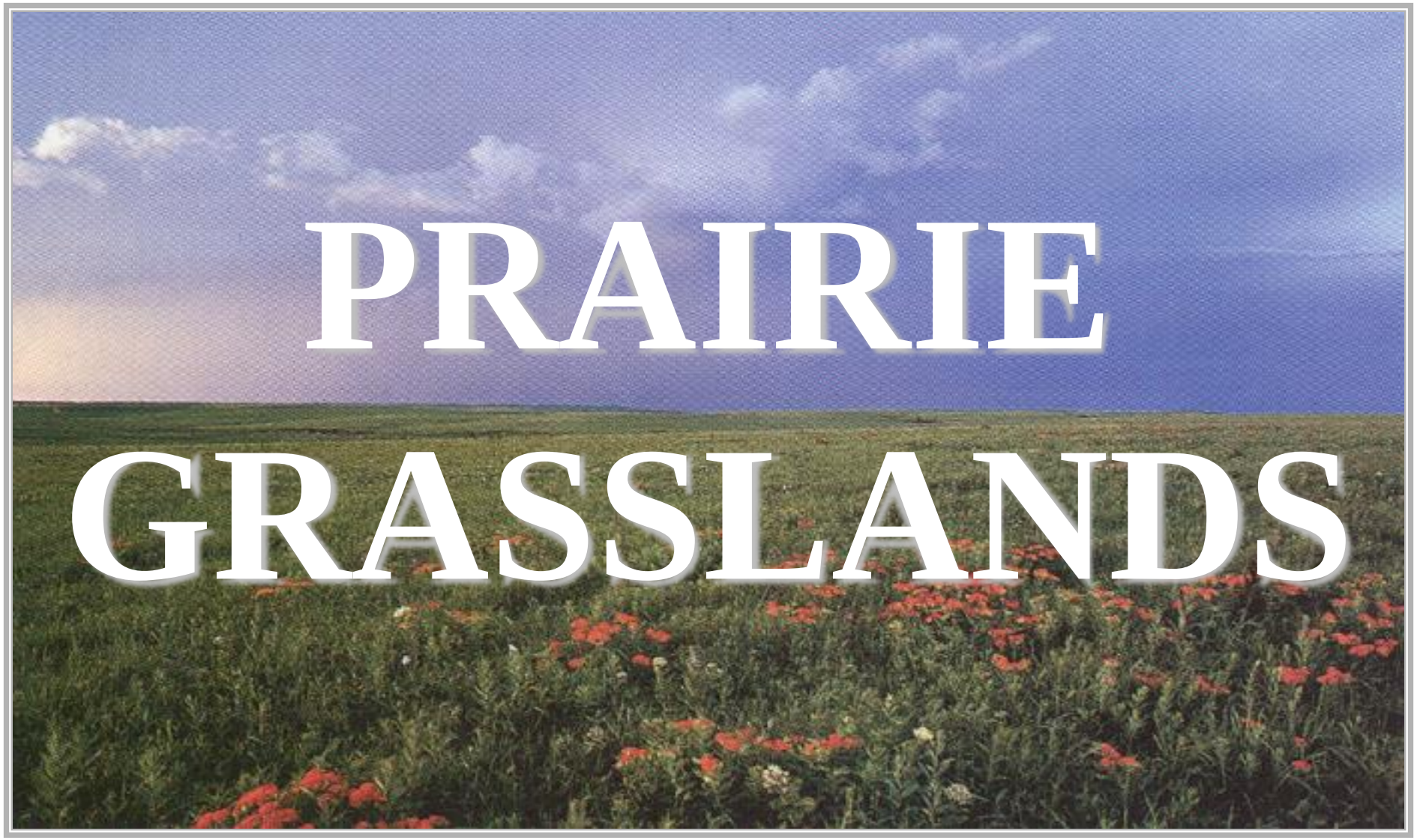
C4 ECOLOGY

EG



XERIC HABITATS

C4 ECOLOGY



XERIC HABITATS

DARK REACTION

CRASSULACEAN ACID METABOLISM

CRASSULACEAN ACID METABOLISM

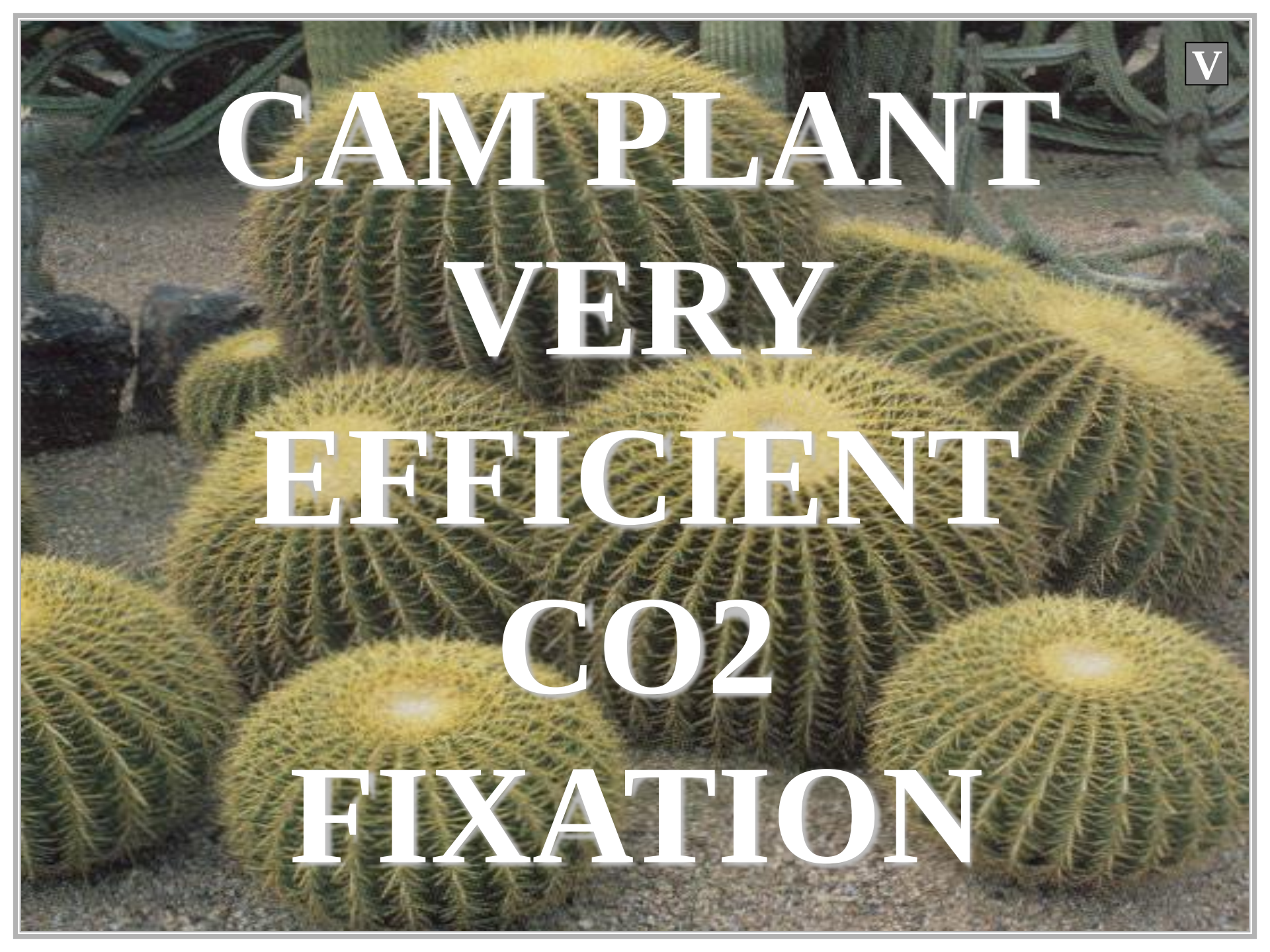
SYNONYMOUS

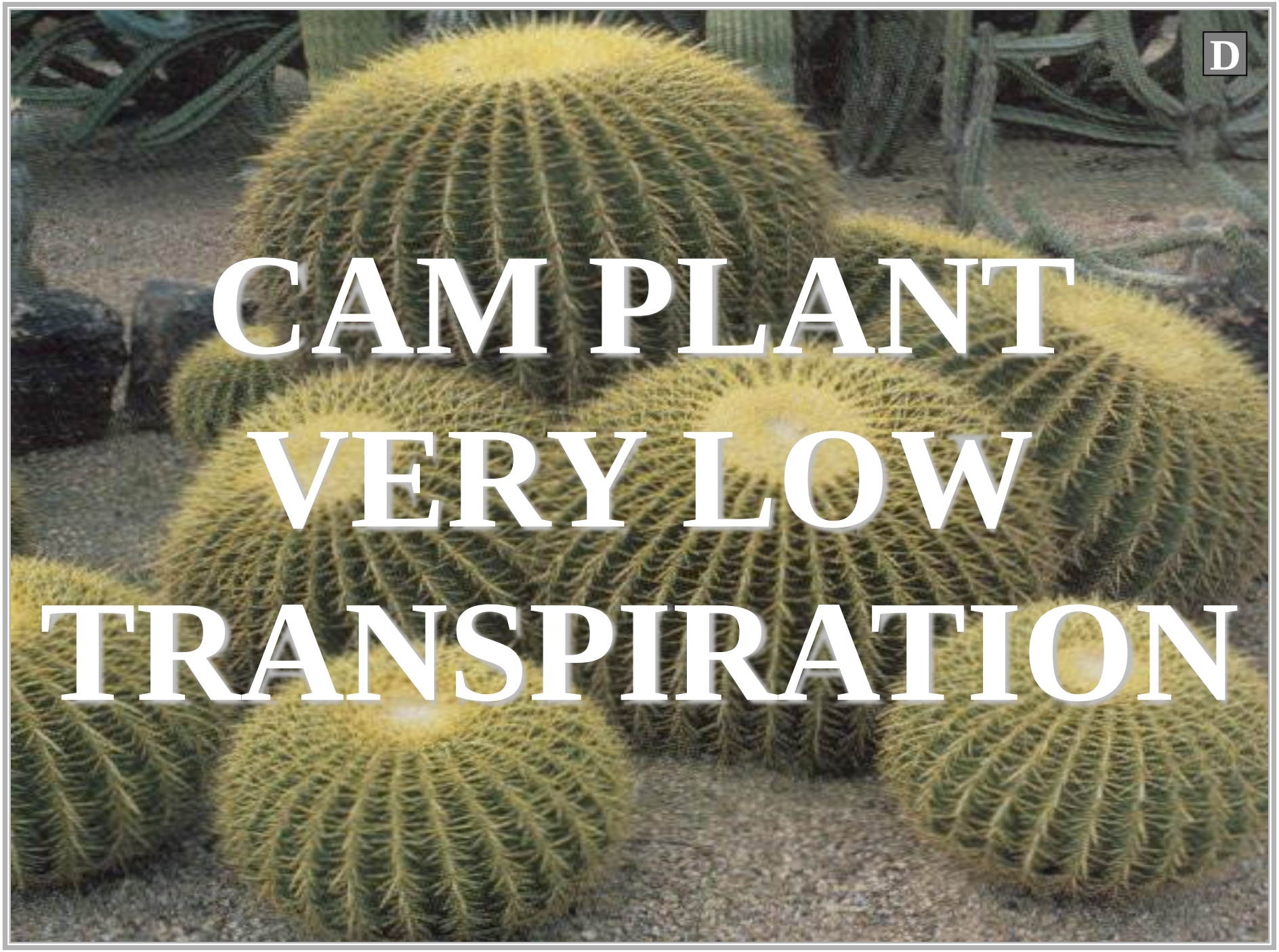
CAM PATHWAY

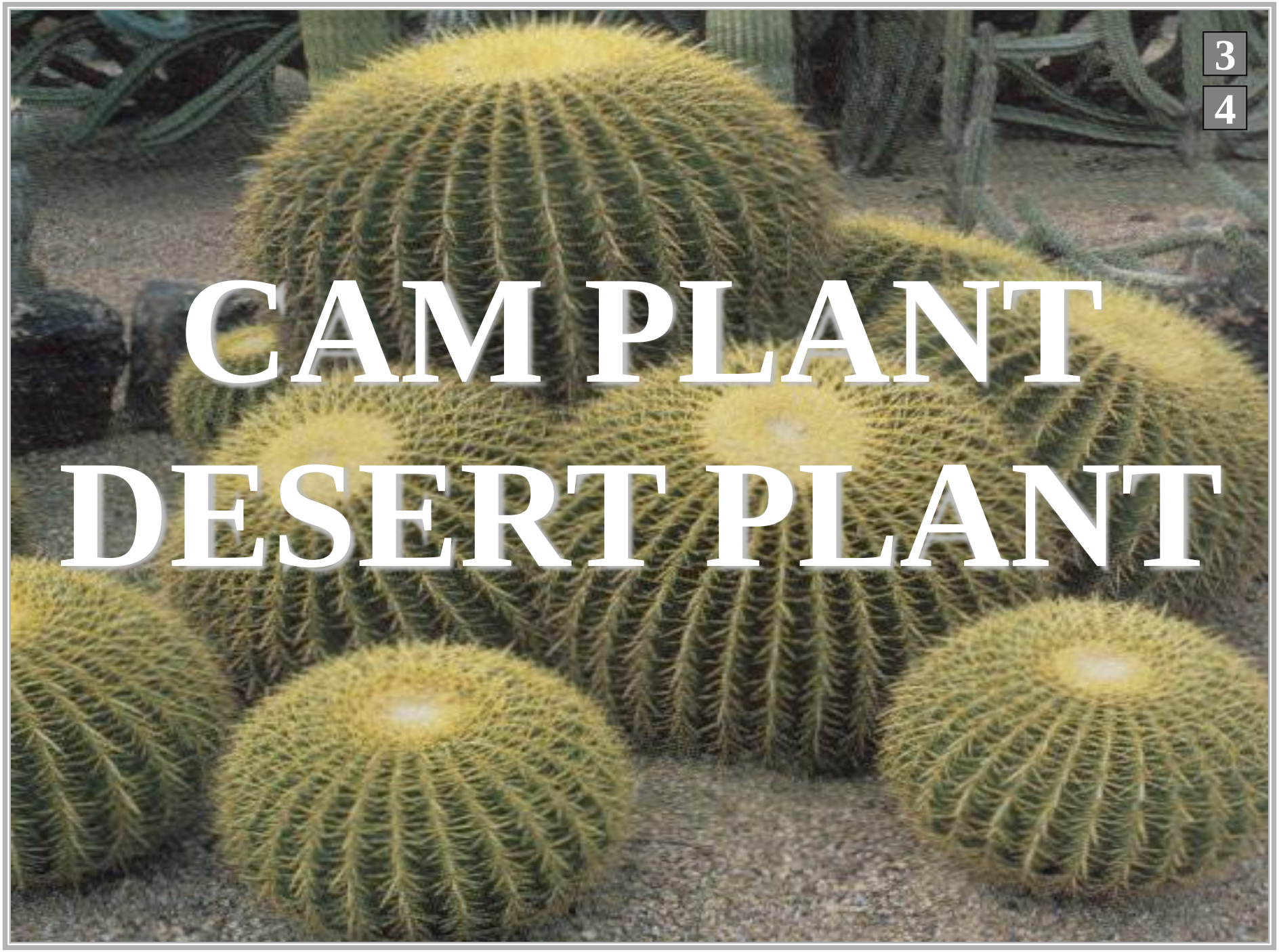

EL
CRASSULACEAN
PLANT FAMILY

CRASSULACEAN PLANT FAMILY

ELICITATED CAM PATHWAY


V
CAM PLANT
VERY
EFFICIENT
CO2
FIXATION


D
CAM PLANT
VERY LOW
TRANSPIRATION



CAM PLANT
DESERT PLANT