EUTROPHIC
LENTIC
AQUATIC HABITAT

HIGH
NUTRIENT CONTENT

EUTROPHIC
LENTIC
AQUATIC HABITAT

LENTIC AQUATIC HABITAT

HIGH NUTRIENT CONTENT EUTROPHIC

LENTIC EUTROPHIC AQUATIC HABITAT

AGRICULTURE LANDS

AGRICULTURE LANDS

HIGH CROP YIELD

F

CORN

AGRICULTURE LANDS

FARMERS ADD FERTILIZER

FERTILIZER

CORN

AGRICULTURE LANDS

L

RAINS

CORN

AGRICULTURE LANDS

NUTRIENTS LEACH INTO LAKE

CORN

LAKE / LENTIC AQUATIC HABITAT

E

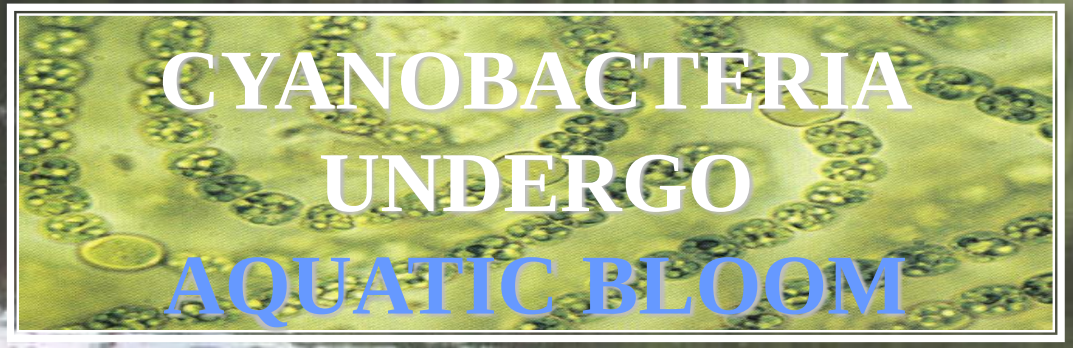
NUTRIENT INCREASE

LAKE / LENTIC AQUATIC HABITAT

AB

EUTROPHIC LAKE

LAKE / LENTIC AQUATIC HABITAT



CYANOBACTERIA AQUATIC BLOOM

CYANOBACTERIA AQUATIC BLOOM

EX

CYANOBACTERIA

CYANOBACTERIA AQUATIC BLOOM

CYANOBACTERIA EXHAUST NUTRIENTS

CYANOBACTERIA

DO

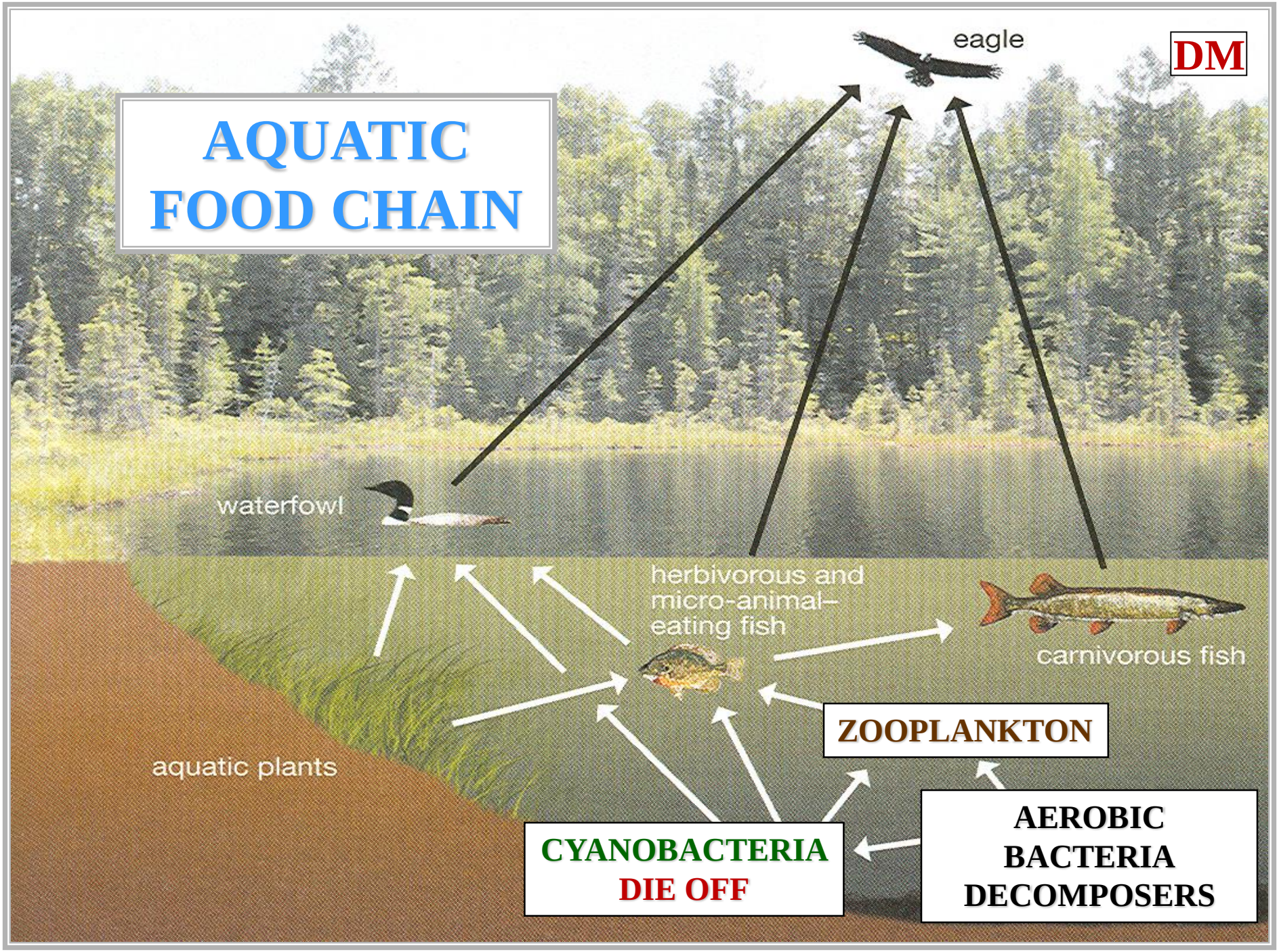
+

CYANOBACTERIA AQUATIC BLOOM

CYANOBACTERIA EXHAUST NUTRIENTS

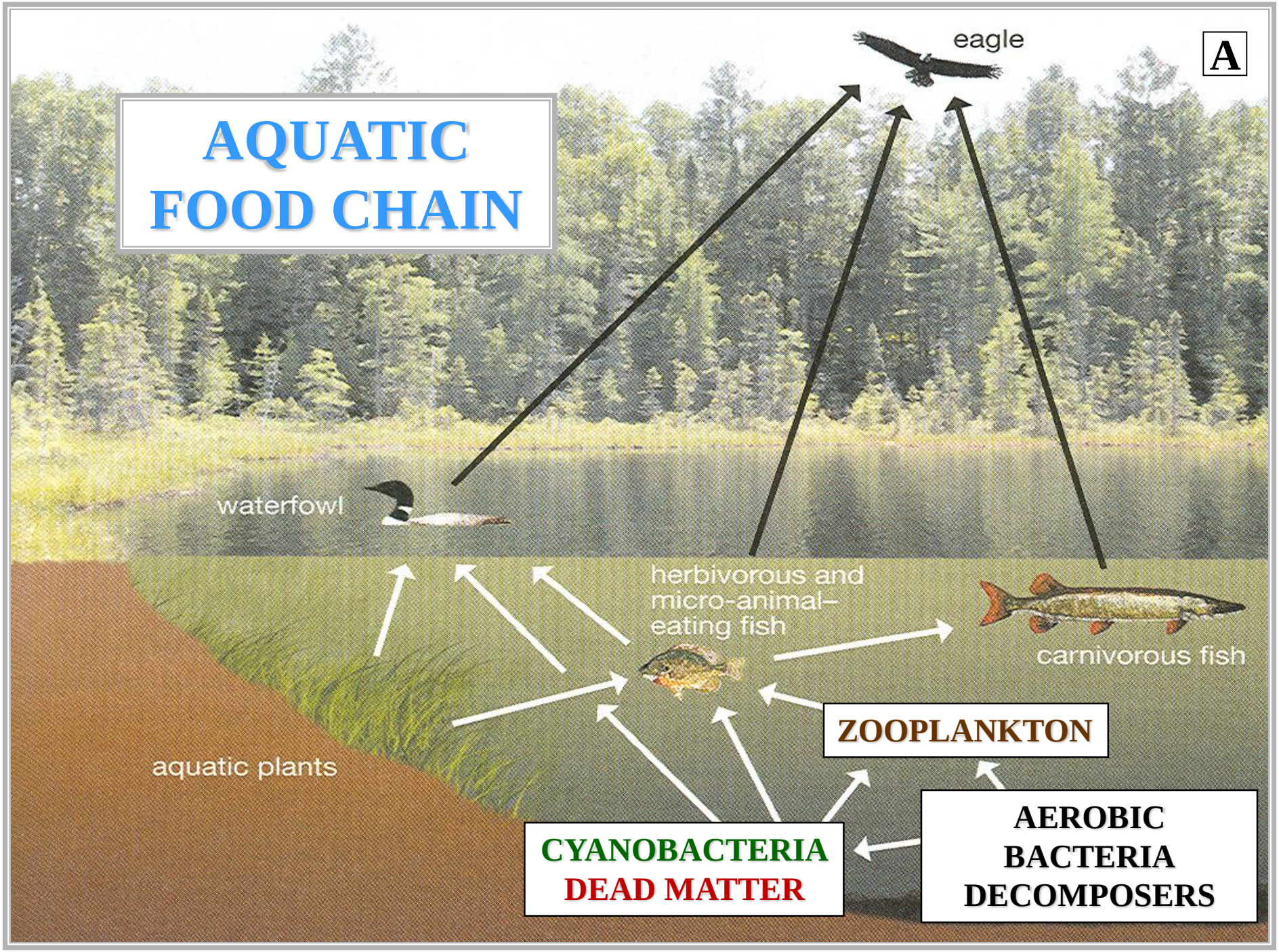
CYANOBACTERIA

CYANOBACTERIA DIE OFF

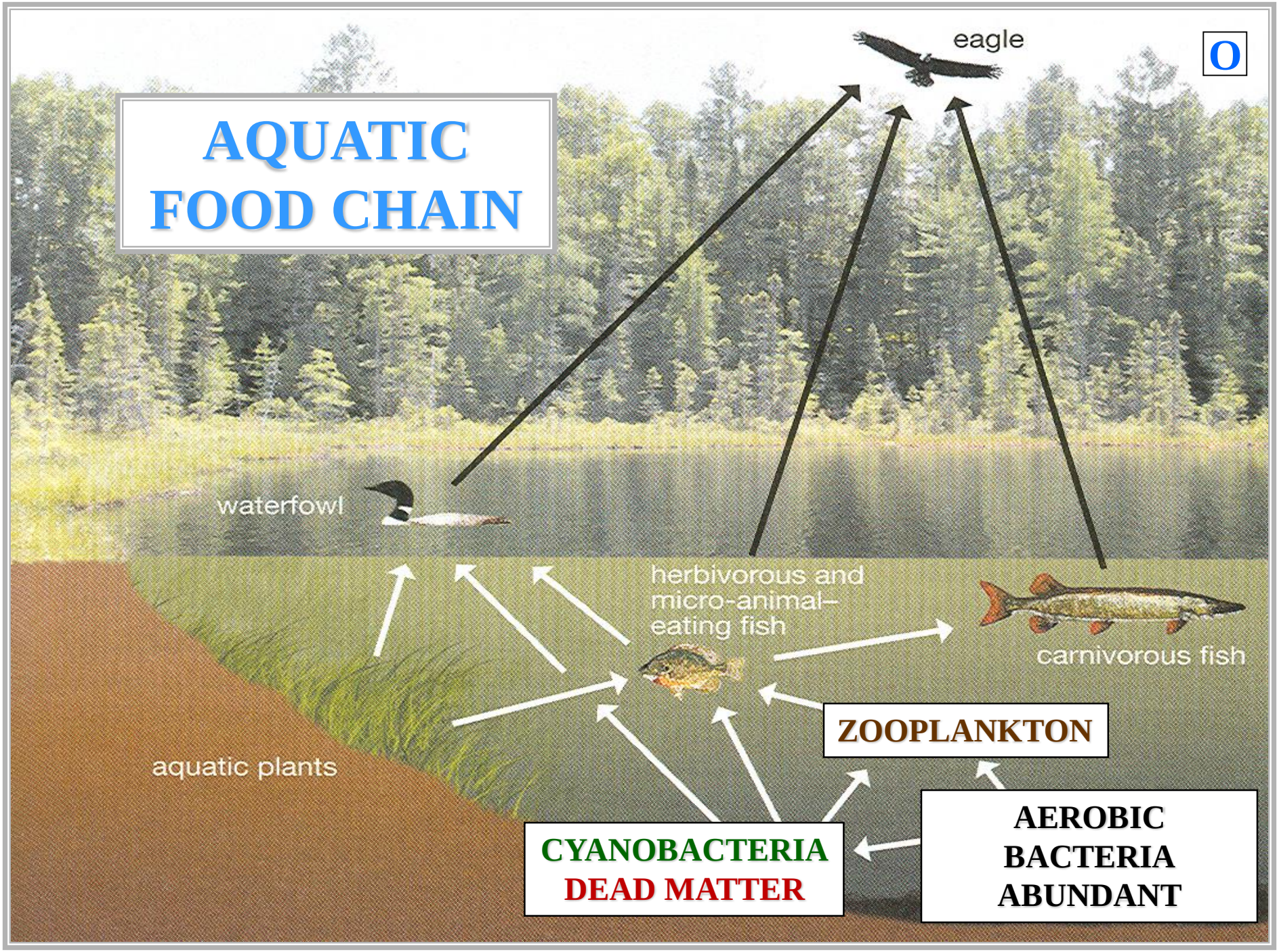

AQUATIC
FOOD CHAIN
DM
eagle
waterfowl
herbivorous and
micro-animal–
eating fish
carnivorous fish
ZOOPLANKTON
aquatic plants
CYANOBACTERIA
DIE OFF
AEROBIC
BACTERIA
DECOMPOSERS

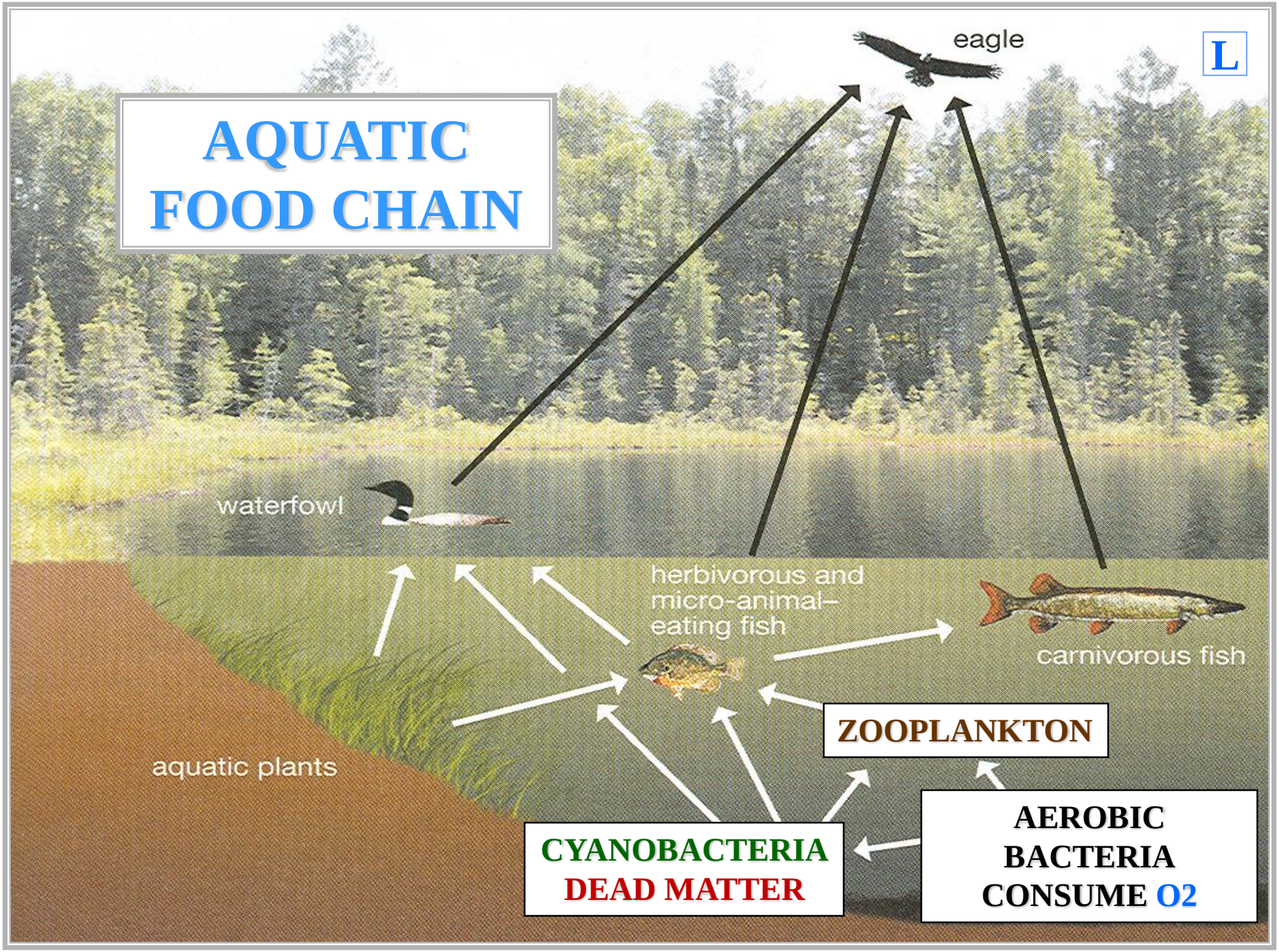
AQUATIC FOOD CHAIN

A

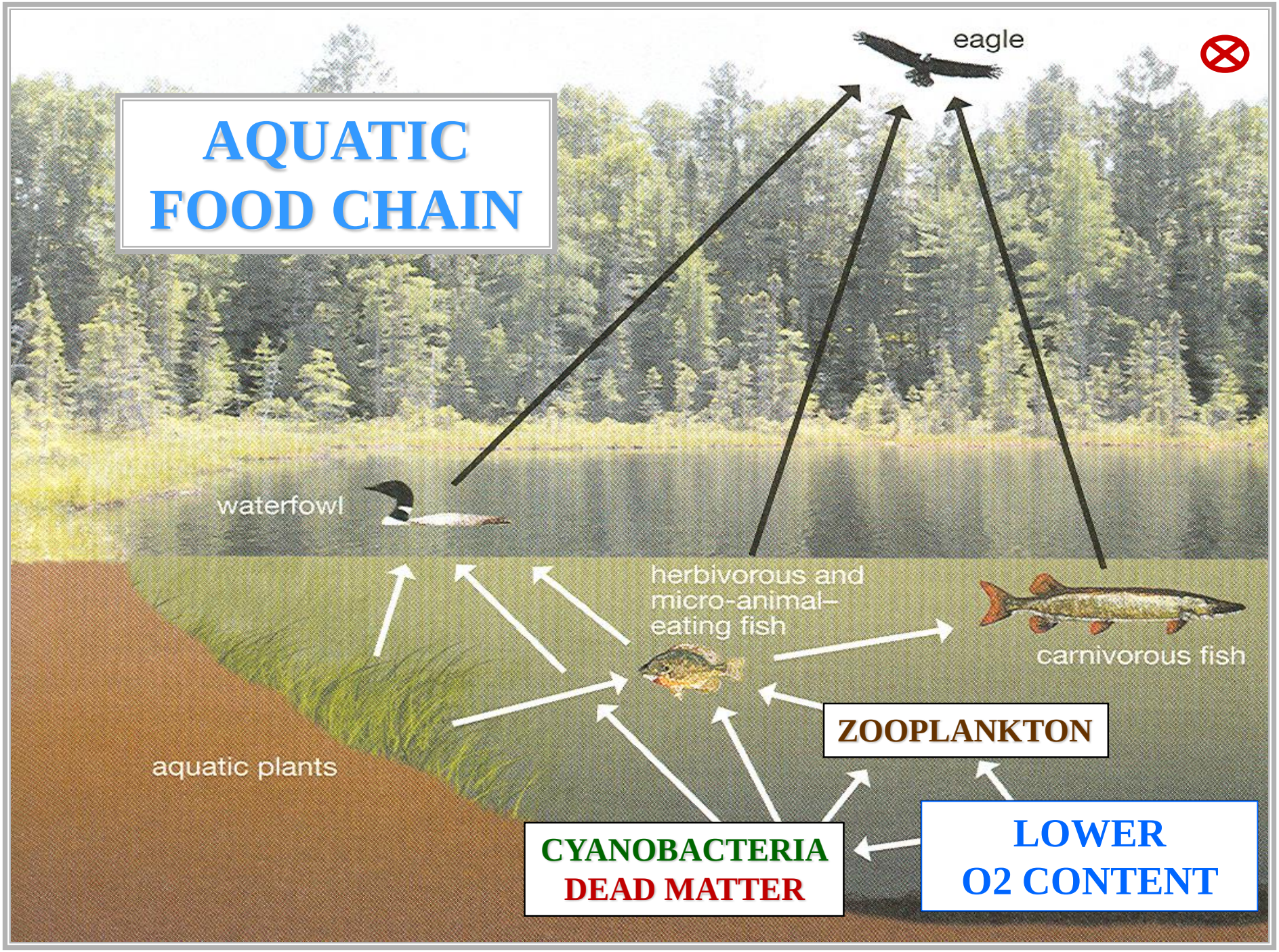


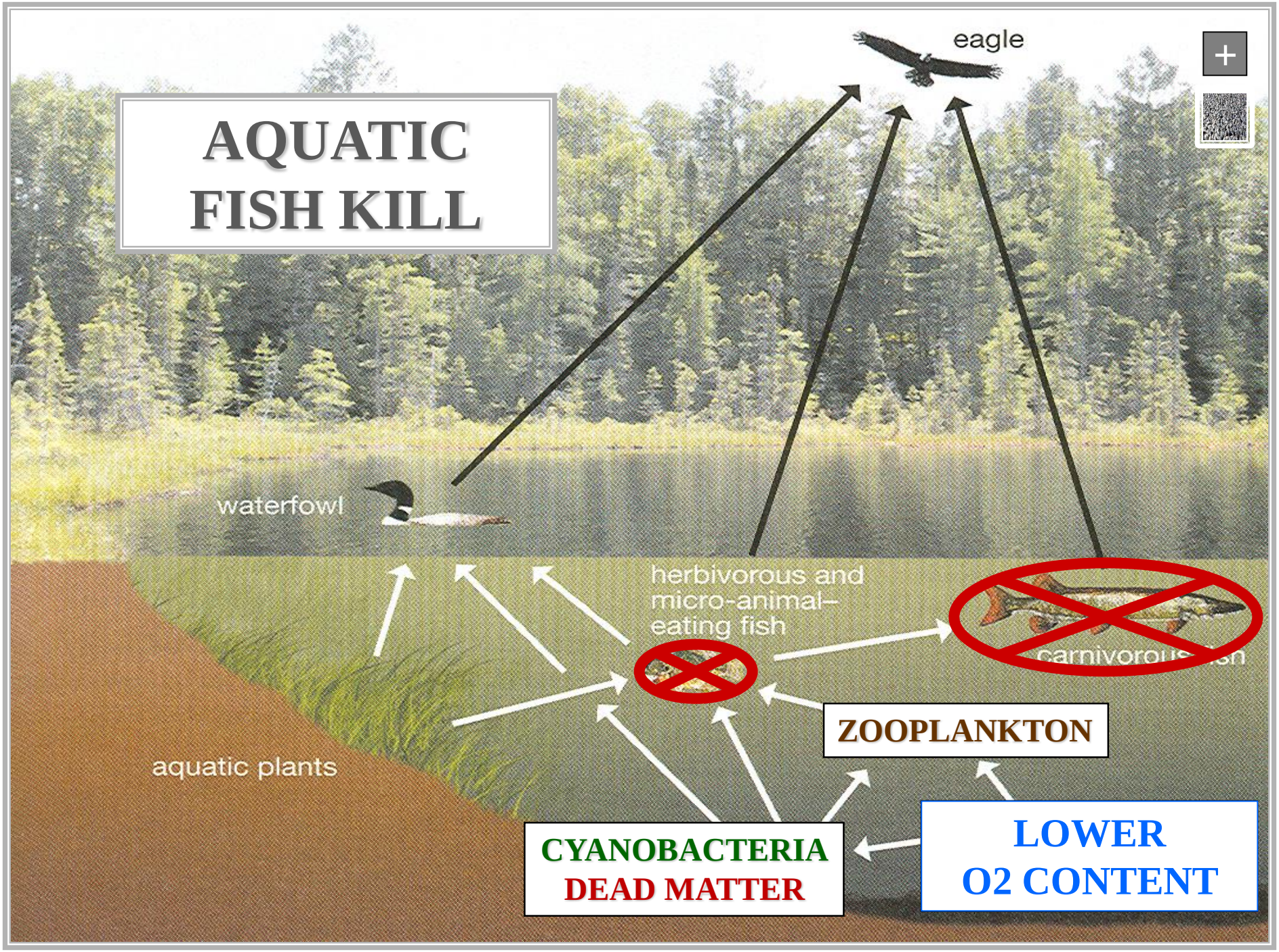
AQUATIC FOOD CHAIN



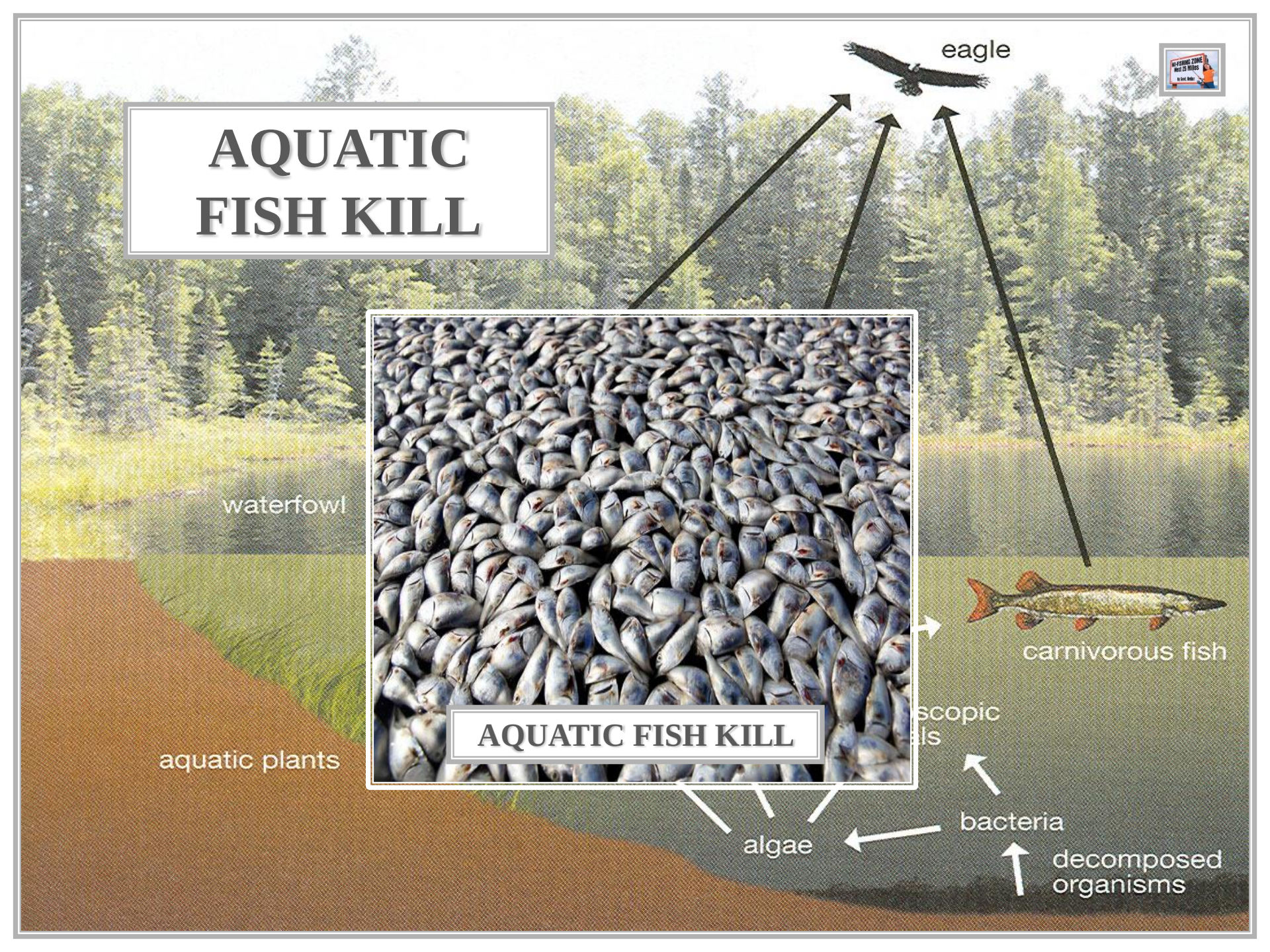

AQUATIC
FOOD CHAIN
eagle
L
waterfowl
herbivorous and
micro-animal–
eating fish
carnivorous fish
aquatic plants
ZOOPLANKTON
CYANOBACTERIA
DEAD MATTER
AEROBIC
BACTERIA
CONSUME O2

AQUATIC FOOD CHAIN



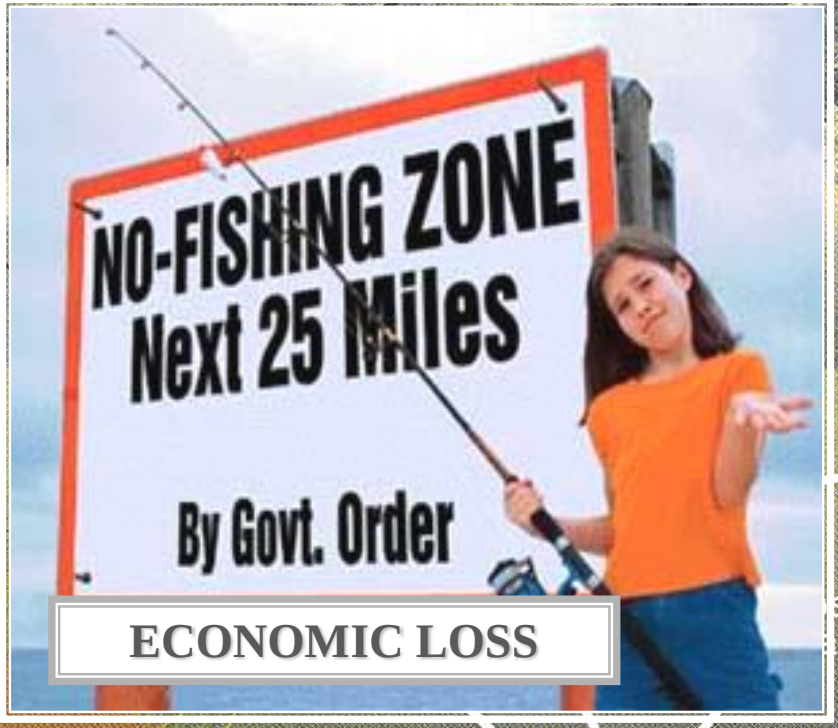

AQUATIC
FISH KILL
eagle
waterfowl
herbivorous and
micro-animal–
eating fish
carnivorous
aquatic plants
ZOOPLANKTON
CYANOBACTERIA
DEAD MATTER
LOWER
O2 CONTENT

AQUATIC FISH KILL



AQUATIC FISH KILL

AQUATIC FISH KILL



ECONOMIC LOSS

eagle

waterfowl

carnivorous fish

aquatic plants

algae

bacteria

decomposed organisms

NITROGEN FIXATION

NITROGEN FIXATION

NITROGEN FIXATION

NITROGEN GAS CONVERTED VIA NITROGENASE TO NITRATES

NITROGEN FIXATION

NITROGENASE

NITROGEN FIXATION

NITROGENASE

NITROGEN FIXATION

ENZYME

NITROGEN FIXATION

NITROGENASE

NITRATES

NITROGEN FIXATION
NITRATES

NITROGEN
BASED COMPOUNDS

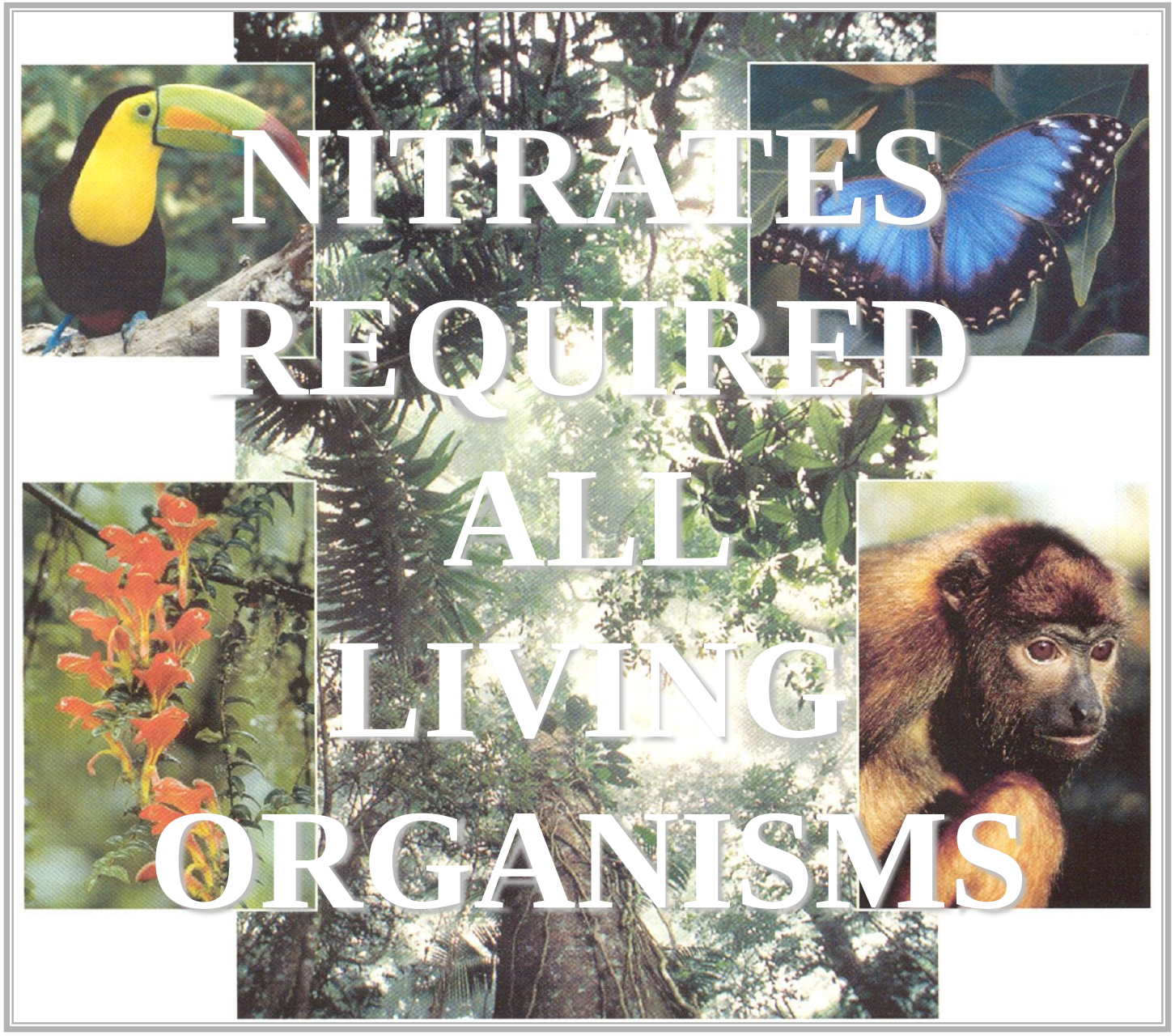
NITROGEN FIXATION
NITRATES

NITROGEN FIXATION
NITRATES

NITROGEN
BASED COMPOUNDS

REQUIRED
ALL ORGANISMS

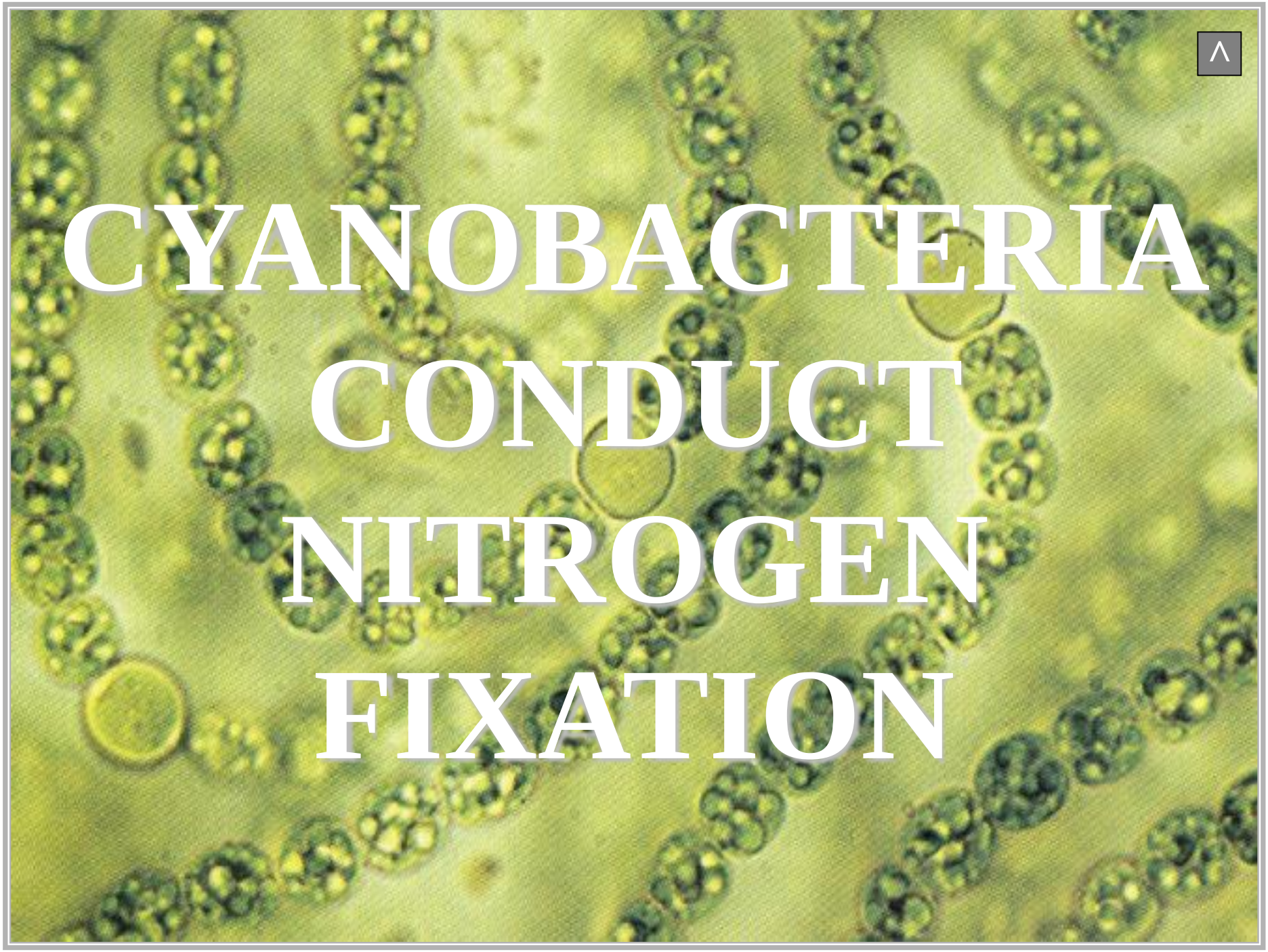
NITROGEN FIXATION
NITRATES


NITRATES
REQUIRED
ALL
LIVING
ORGANISMS

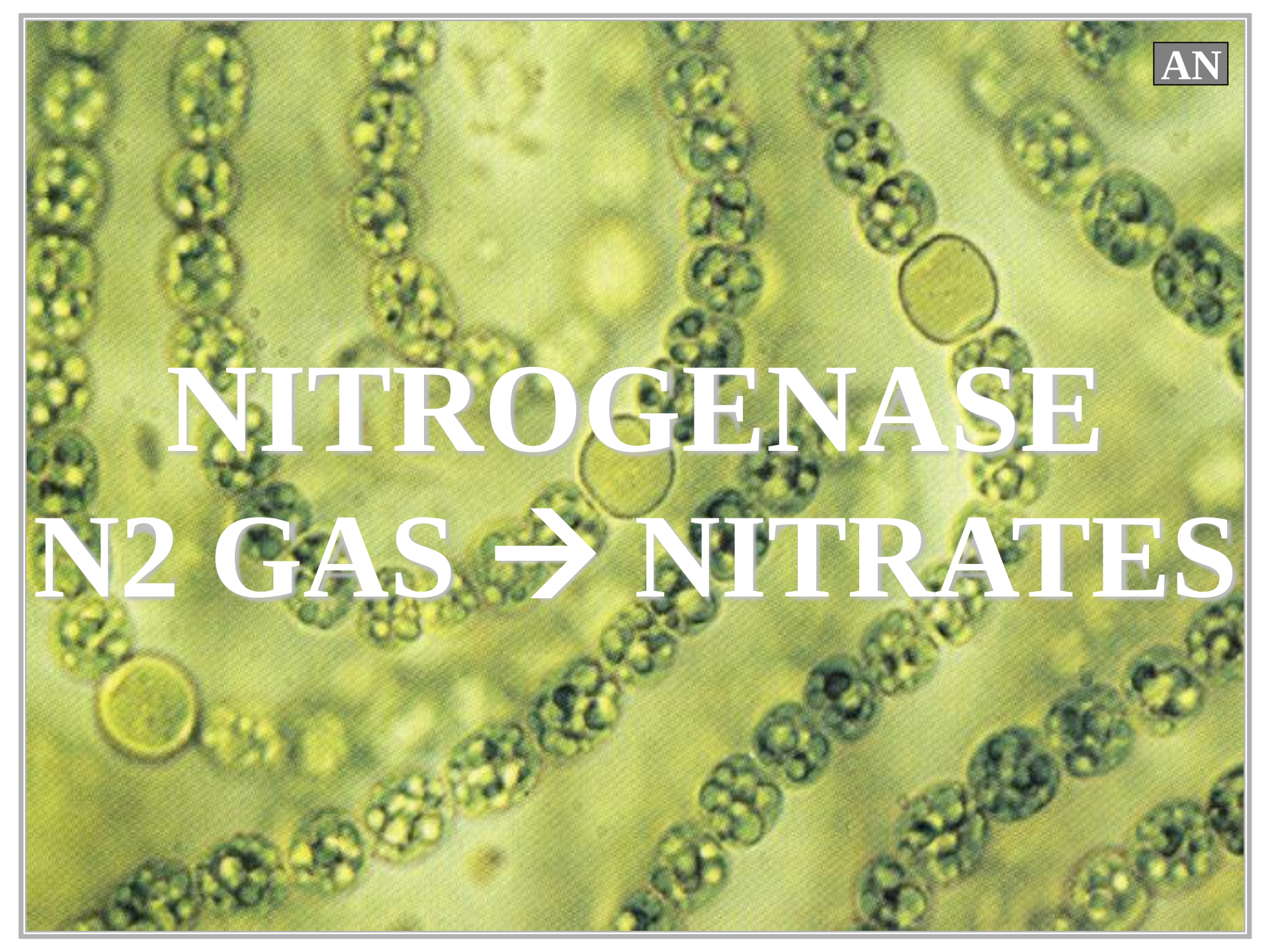

NITRATES
ESSENTIAL
AMINO ACID
SYNTHESIS
NUCLEOTIDE
SYNTHESIS

E

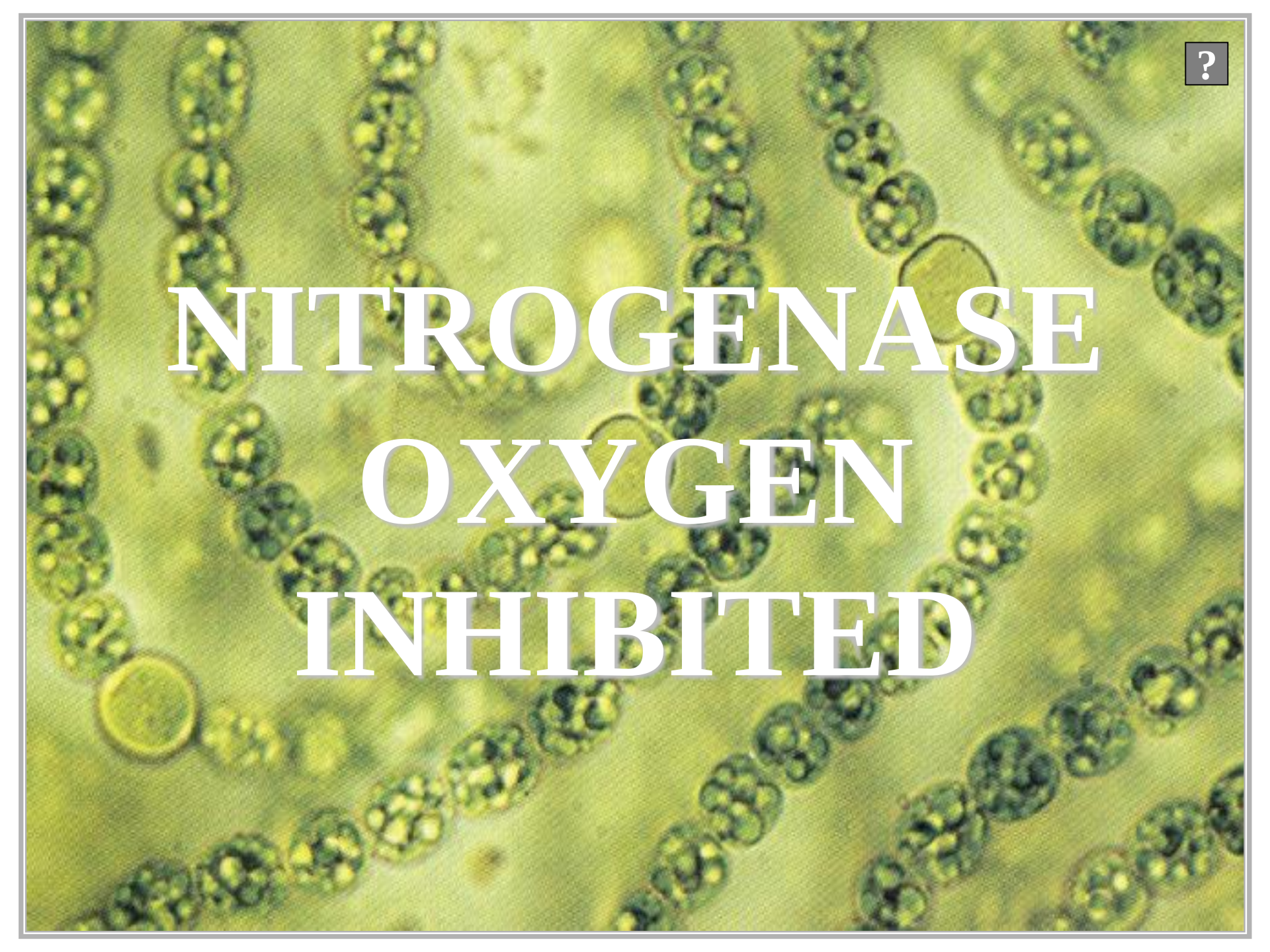

NITRATES
ESSENTIAL
PROTEIN
SYNTHESIS
NUCLEIC ACID
SYNTHESIS

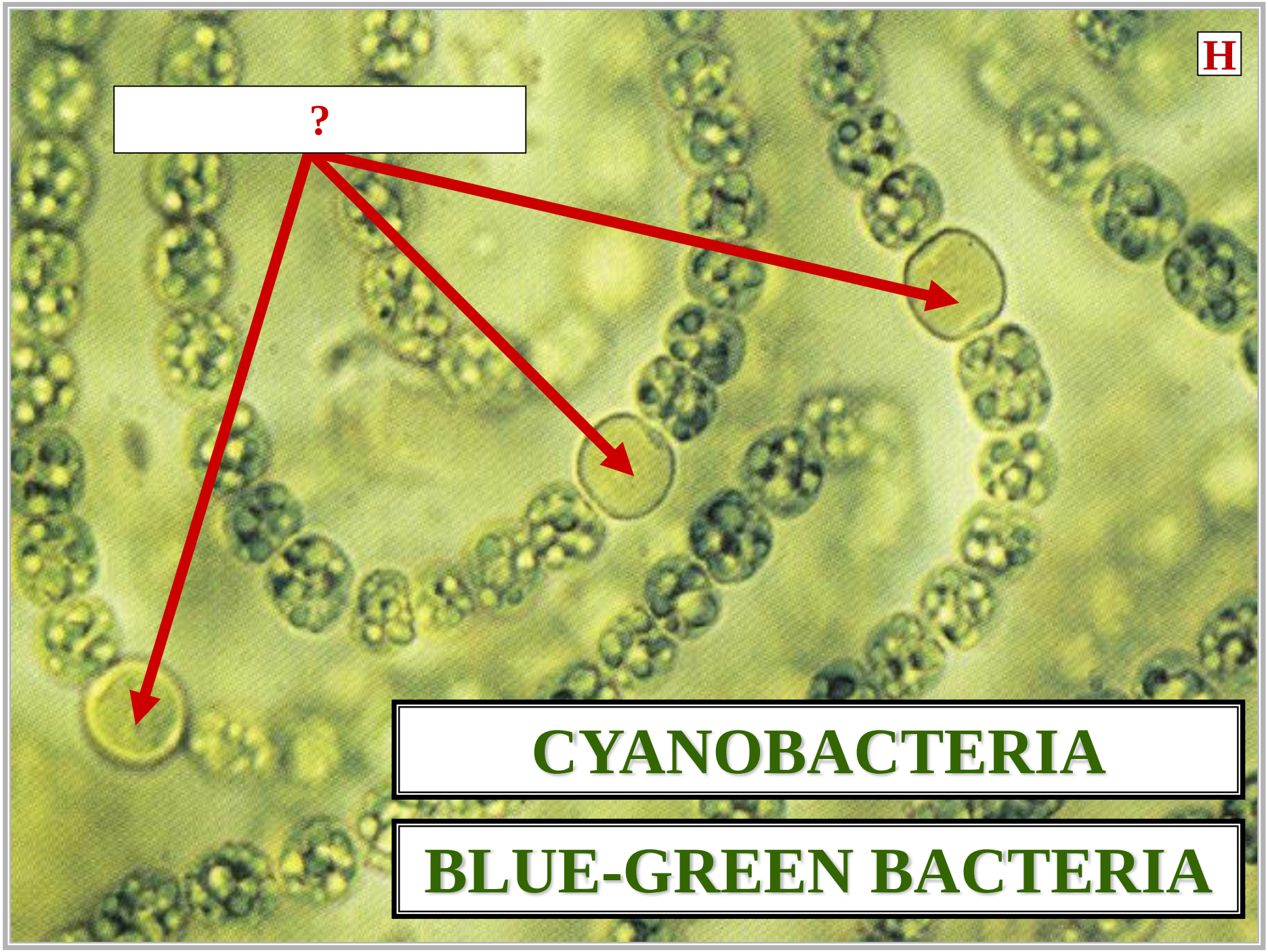

CYANOBACTERIA
CONDUCT
NITROGEN
FIXATION

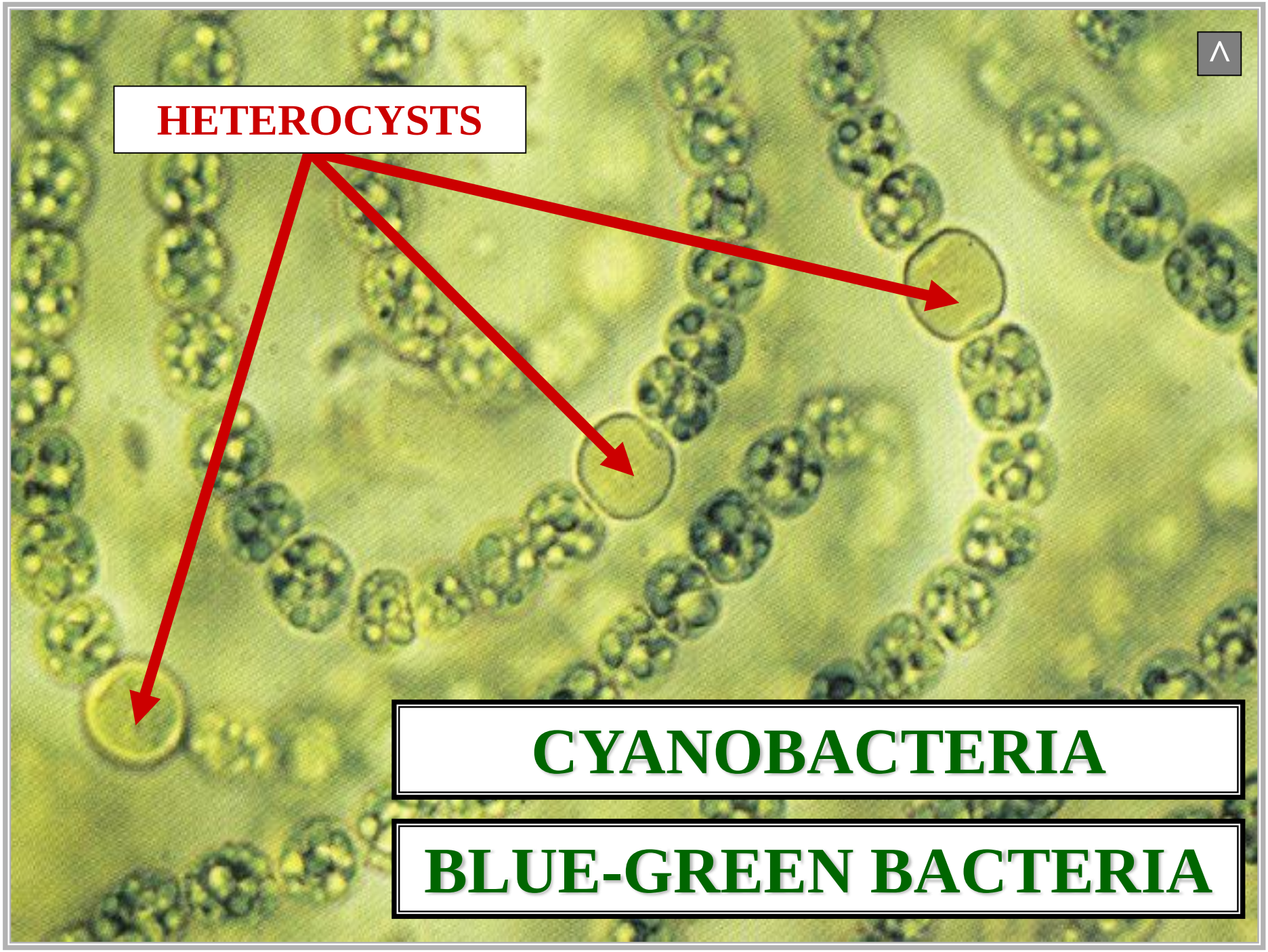
NITROGENASE


AN
NITROGENASE
N2 GAS → NITRATES

NITROGENASE ANAEROBIC ENZYME


?
NITROGENASE
OXYGEN
INHIBITED


H
?
CYANOBACTERIA
BLUE-GREEN BACTERIA


HETEROCYSTS
CYANOBACTERIA
BLUE-GREEN BACTERIA

H

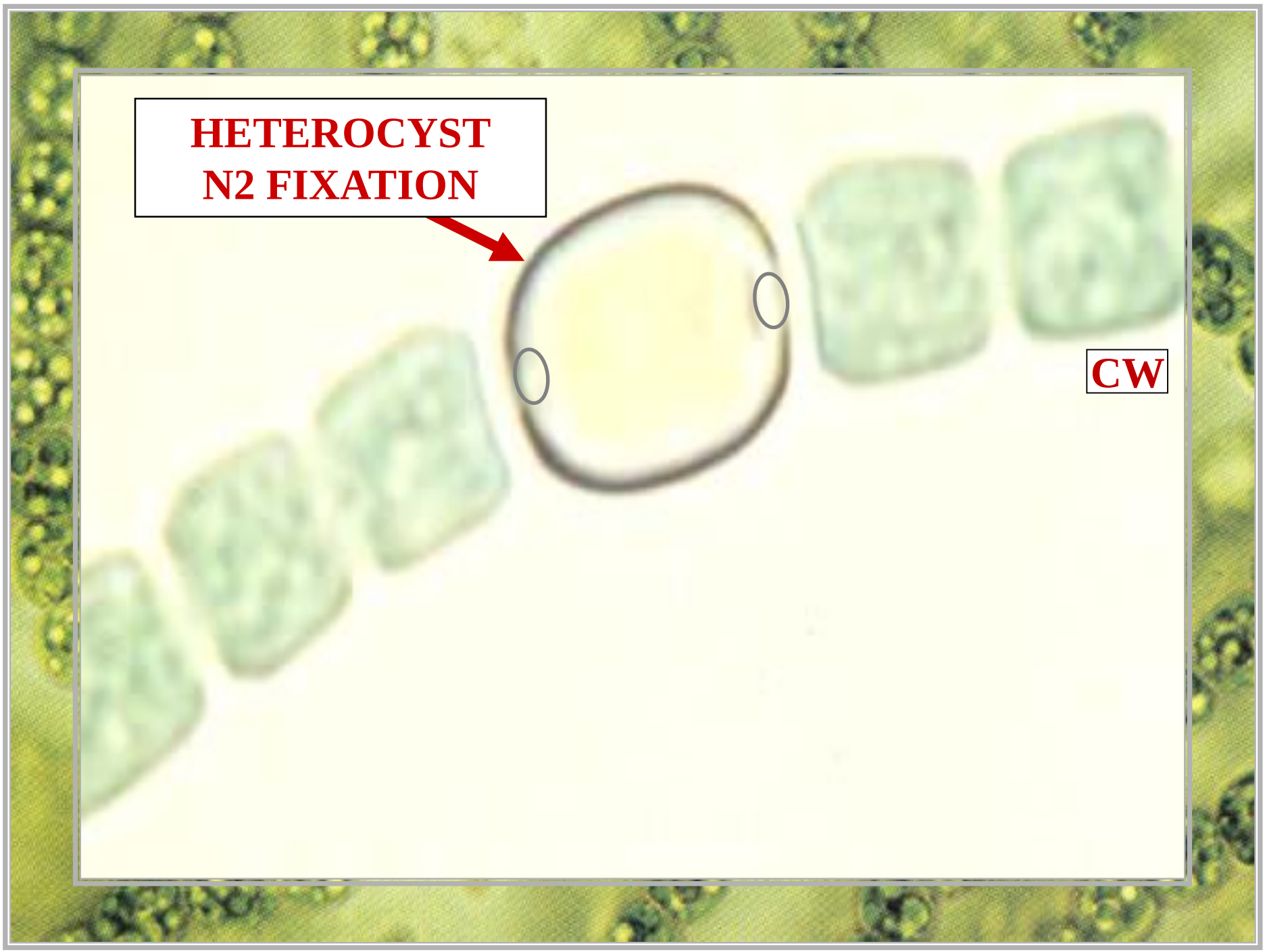
HETEROCYST

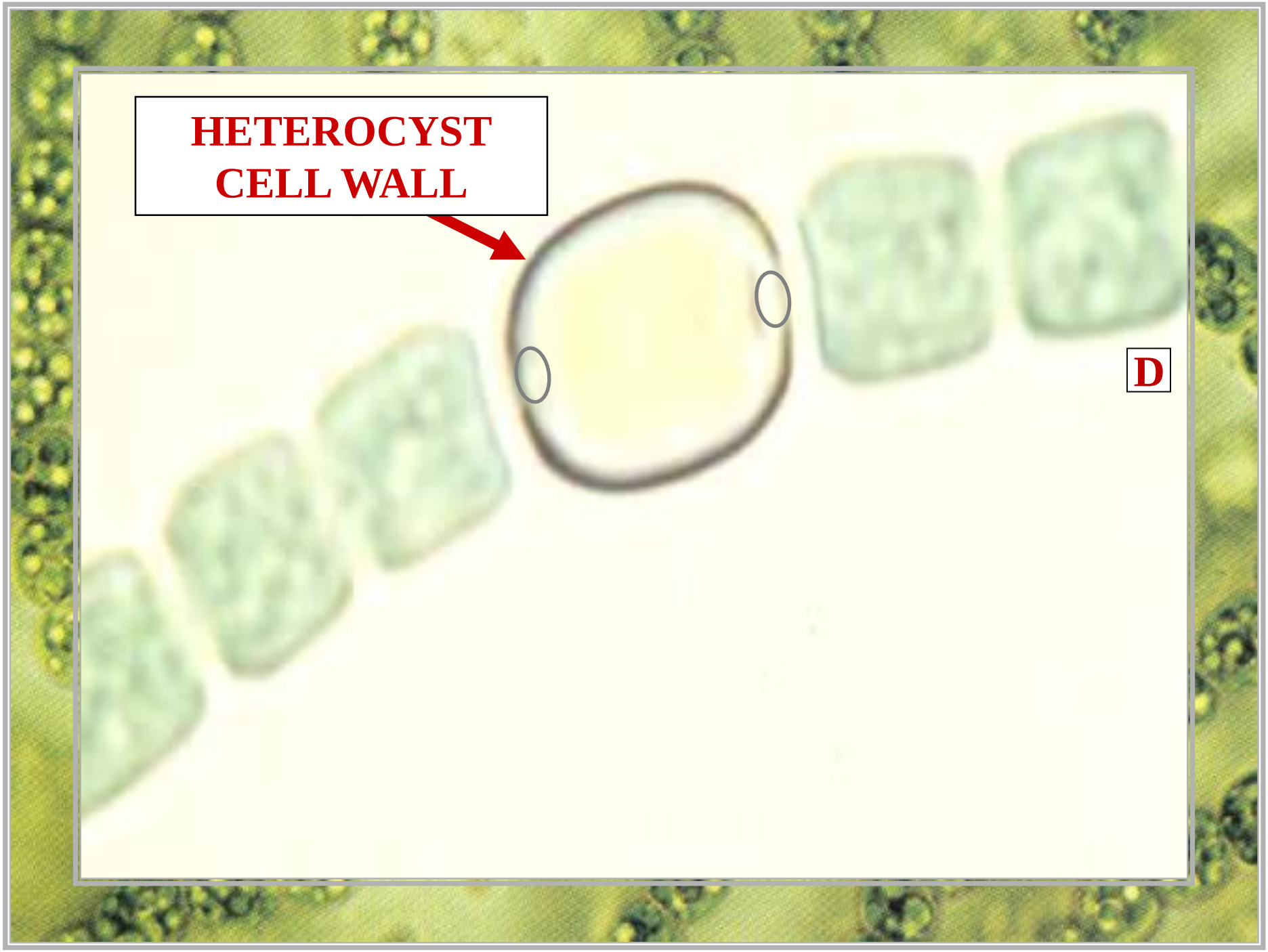
HETEROCYST

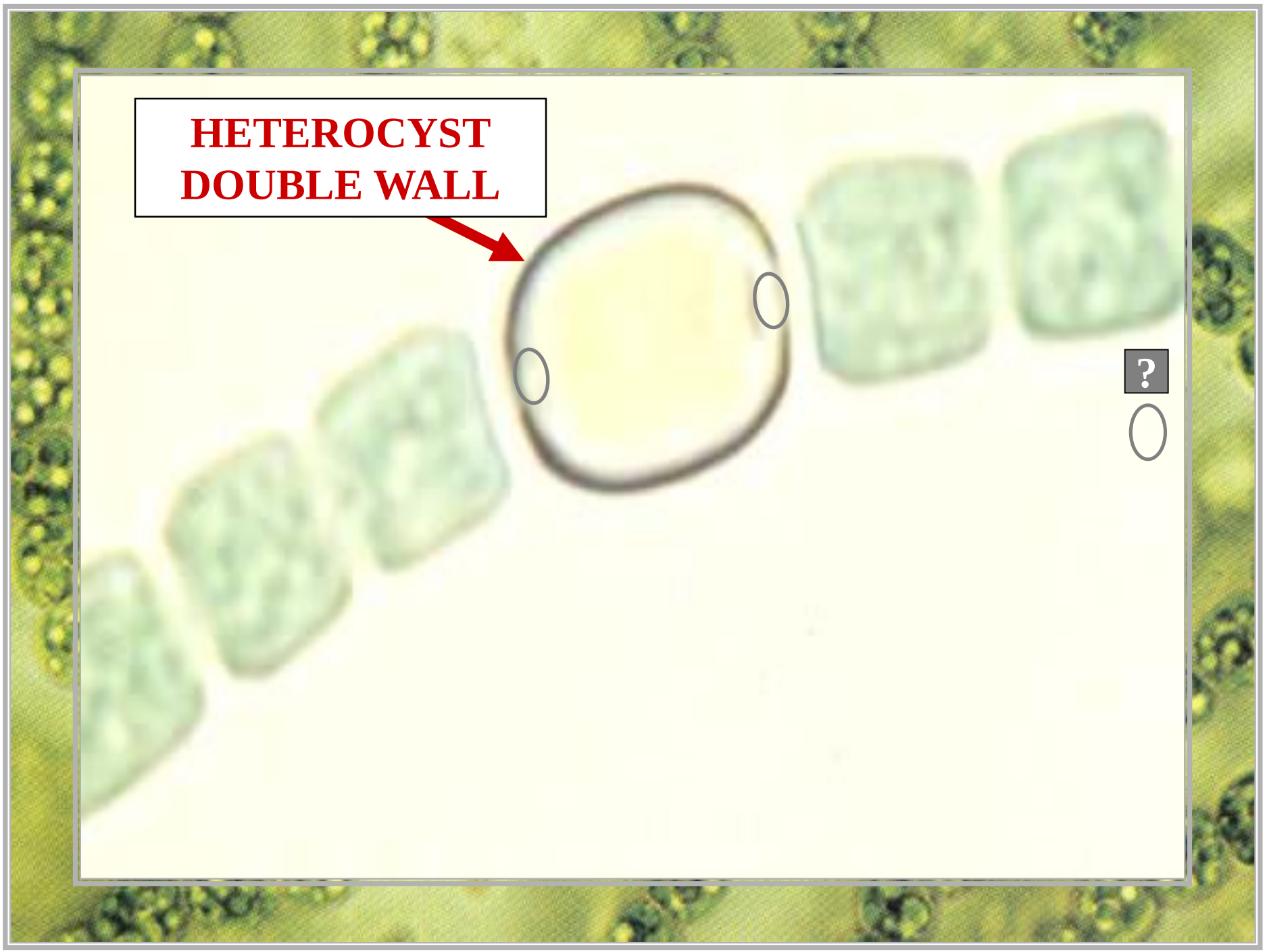
HETEROCYST

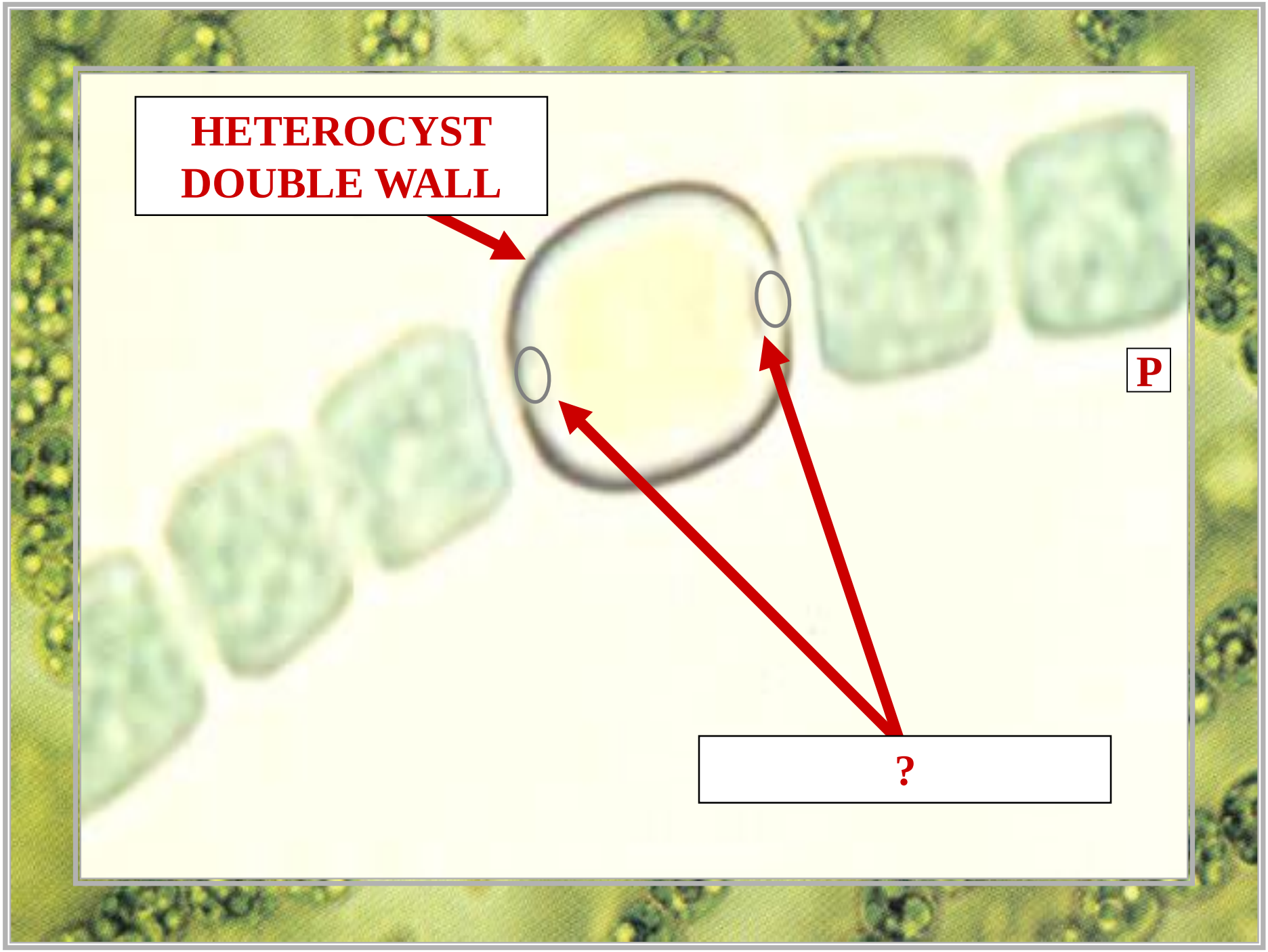
MODIFIED CELL CONDUCTS NITROGEN FIXATION

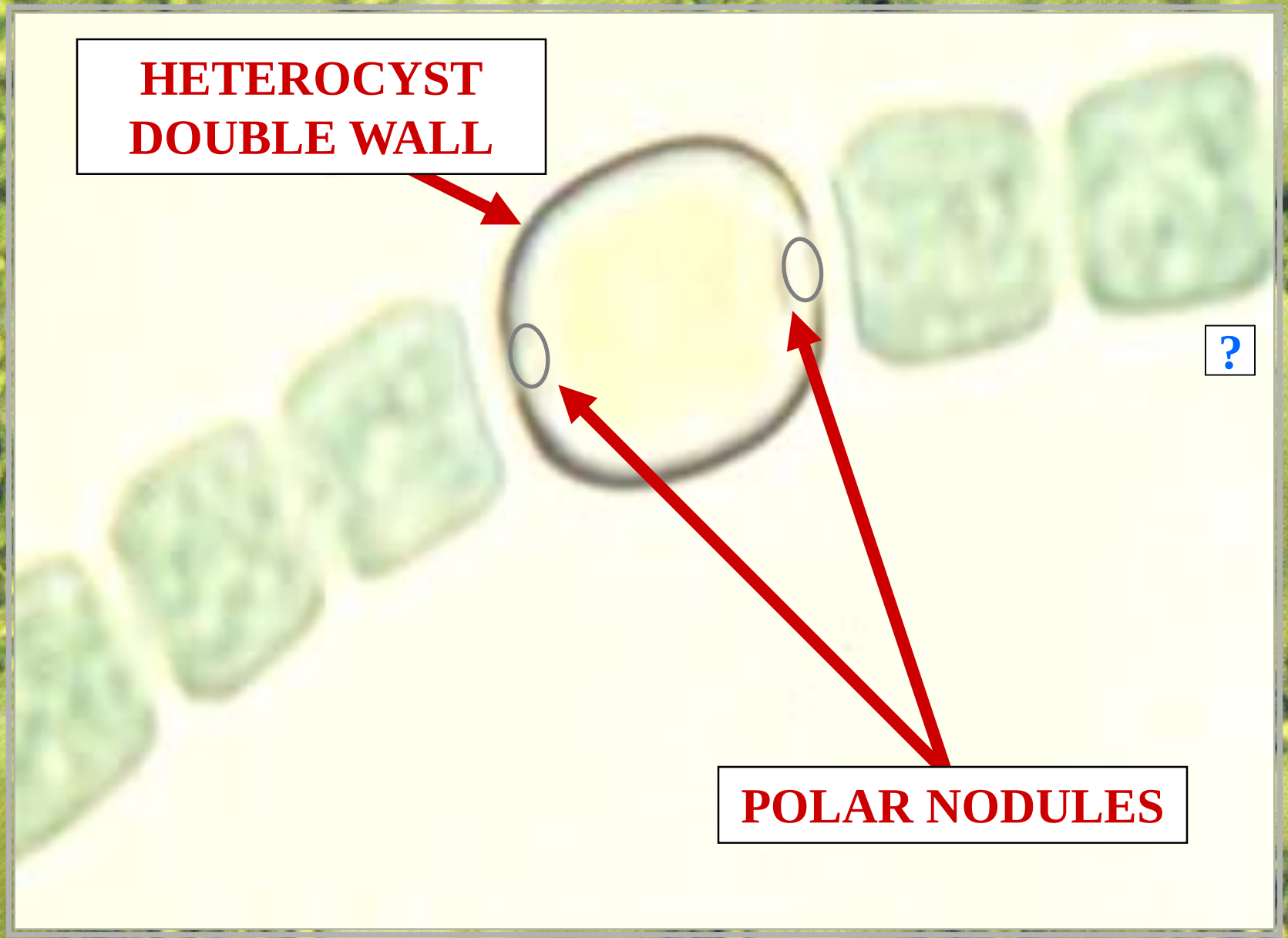
HETEROCYST

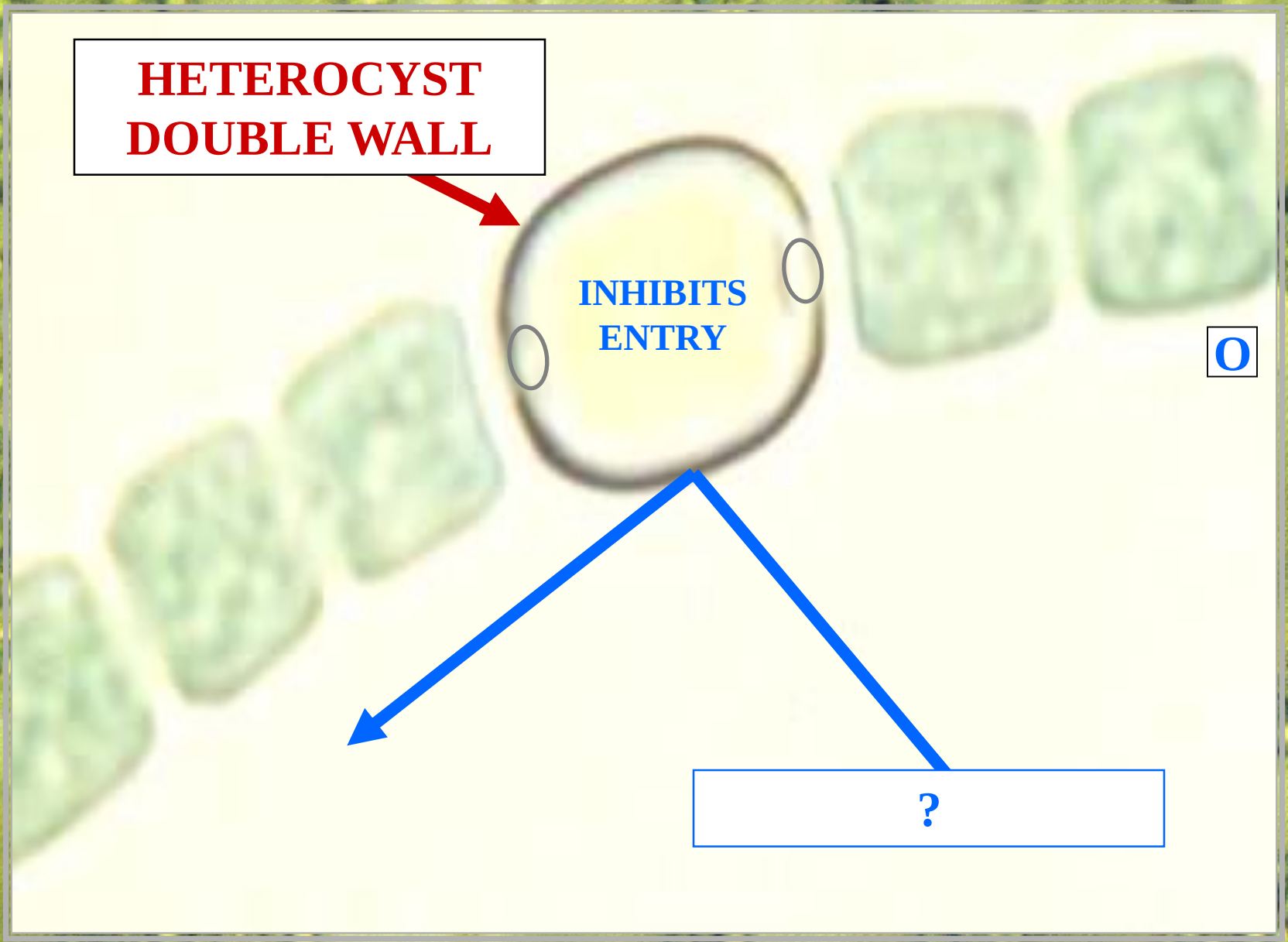

HETEROCYST
N2 FIXATION
CW

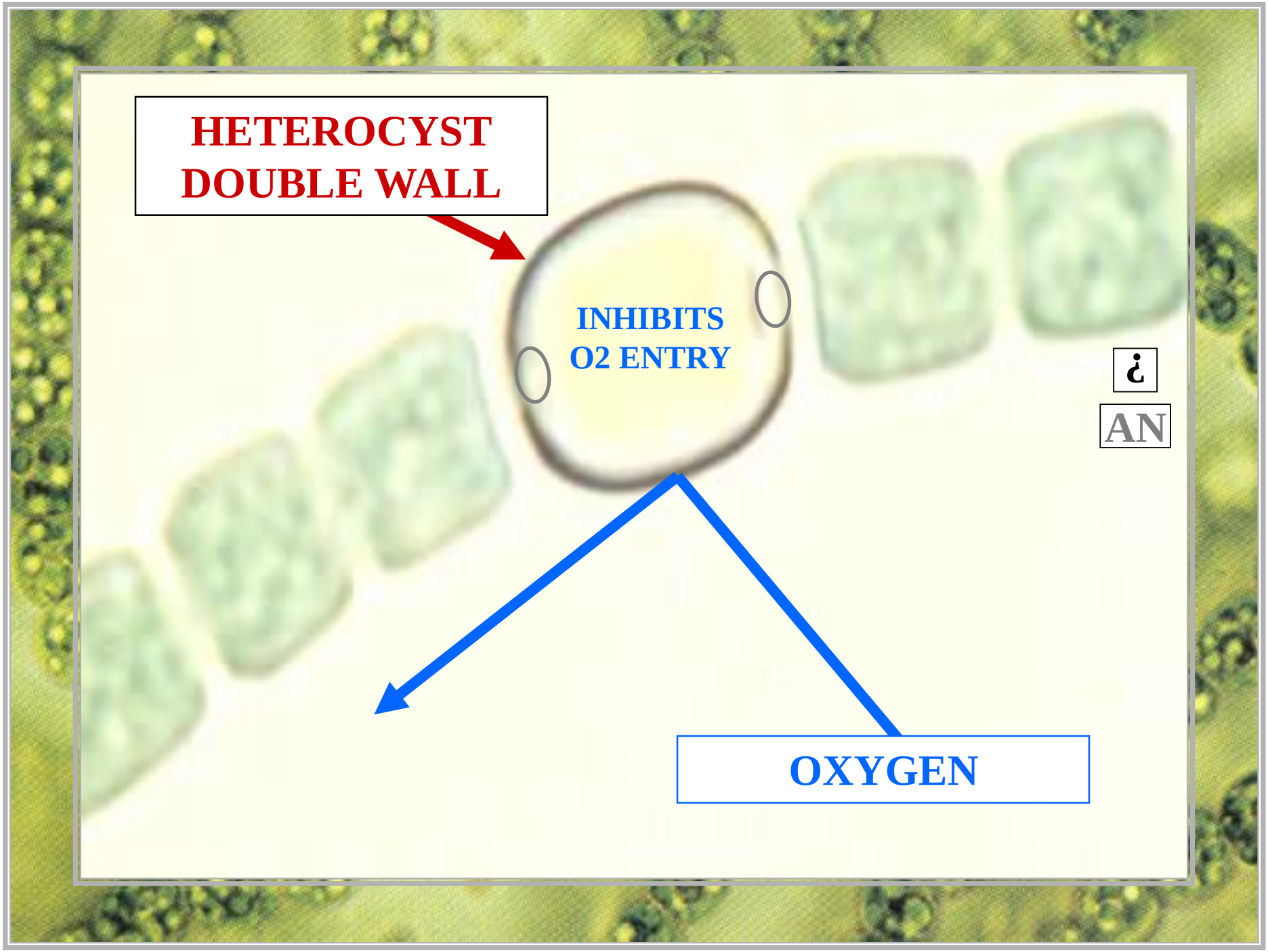

HETEROCYST
CELL WALL
D

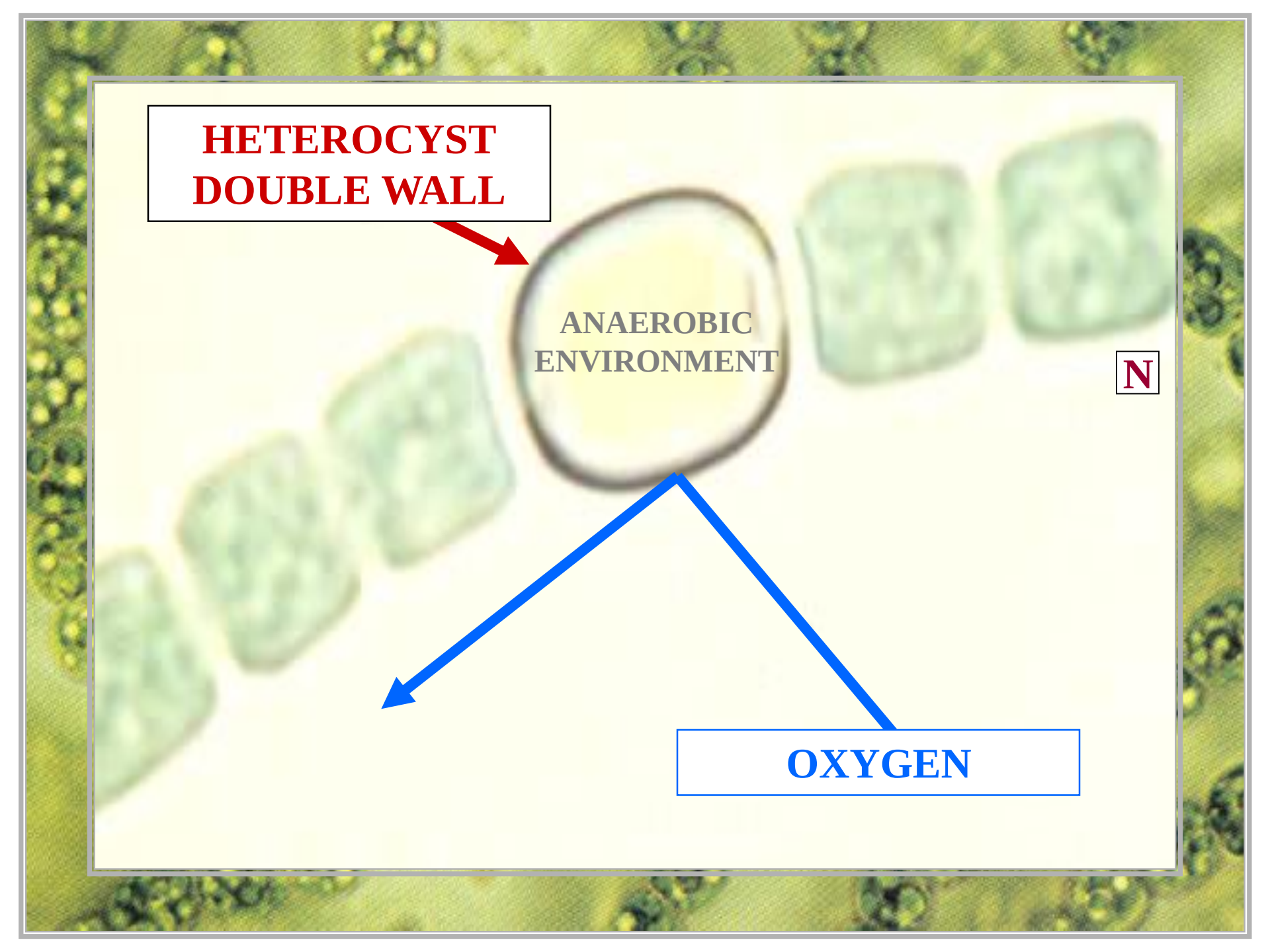

HETEROCYST
DOUBLE WALL
?

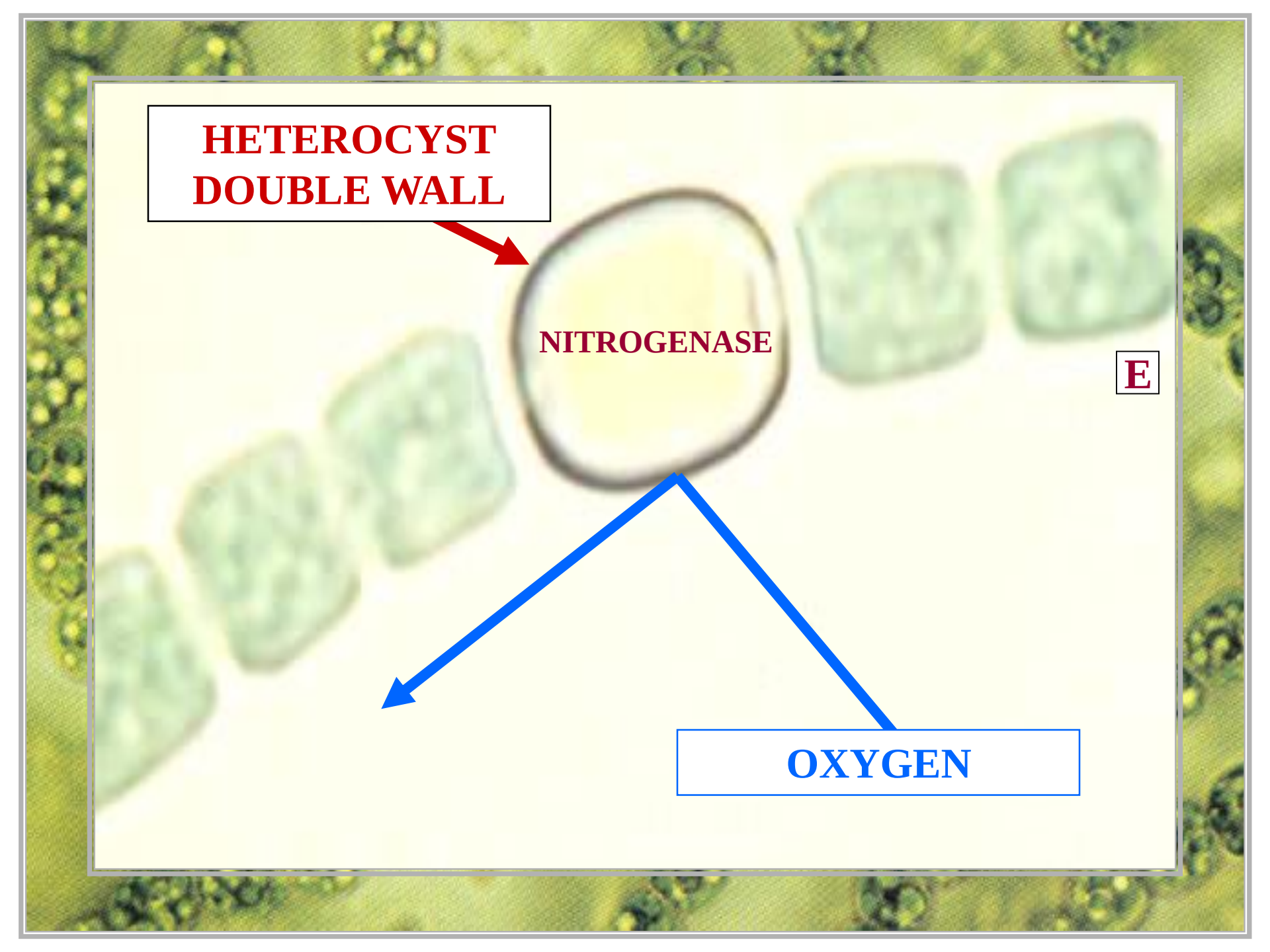

HETEROCYST
DOUBLE WALL
P
?

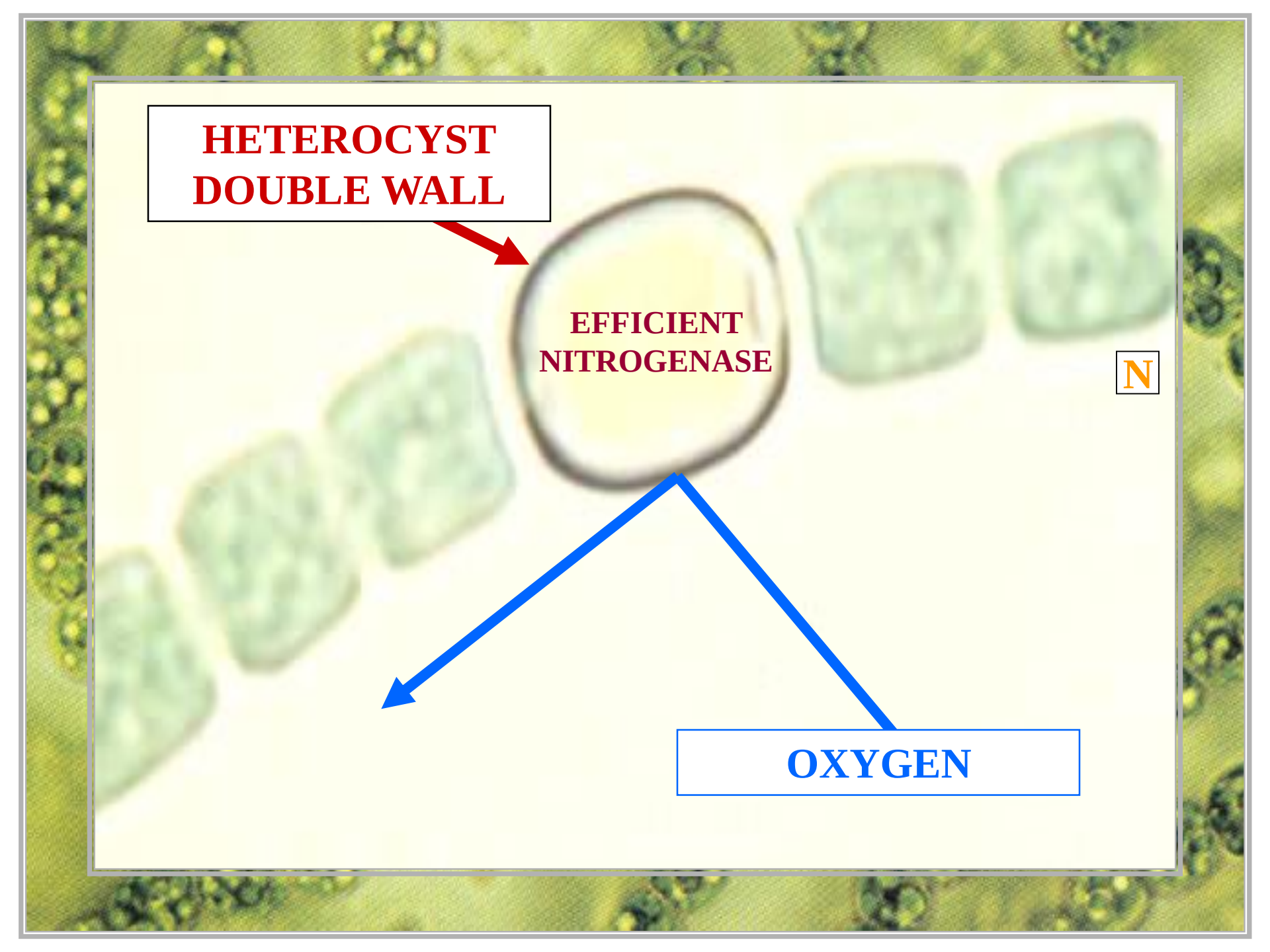

HETEROCYST
DOUBLE WALL
?
POLAR NODULES


HETEROCYST
DOUBLE WALL
INHIBITS
ENTRY
O
?


HETEROCYST
DOUBLE WALL
INHIBITS
O2 ENTRY
¿
AN
OXYGEN


HETEROCYST
DOUBLE WALL
ANAEROBIC
ENVIRONMENT
N
OXYGEN


HETEROCYST
DOUBLE WALL
NITROGENASE
E
OXYGEN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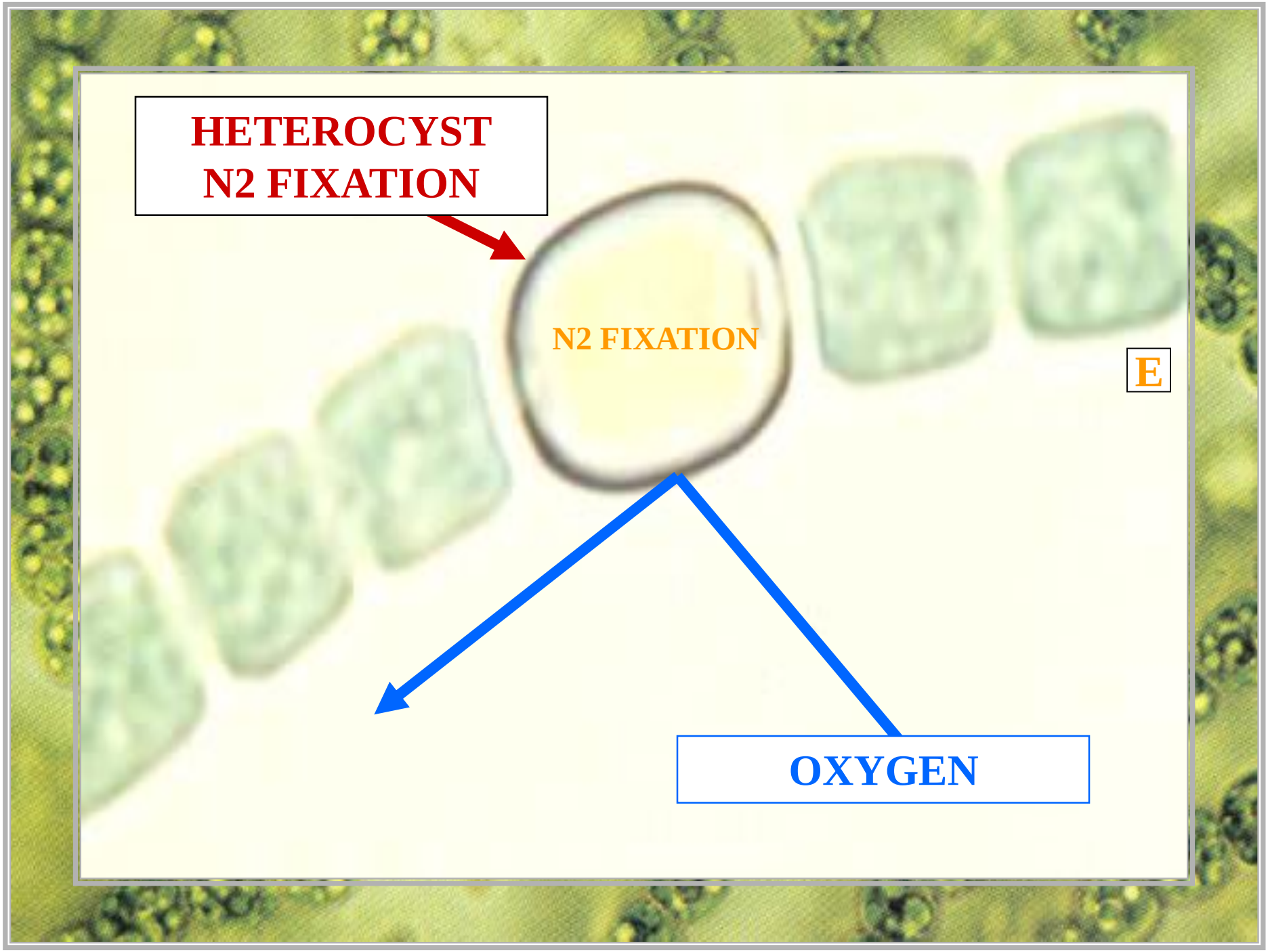
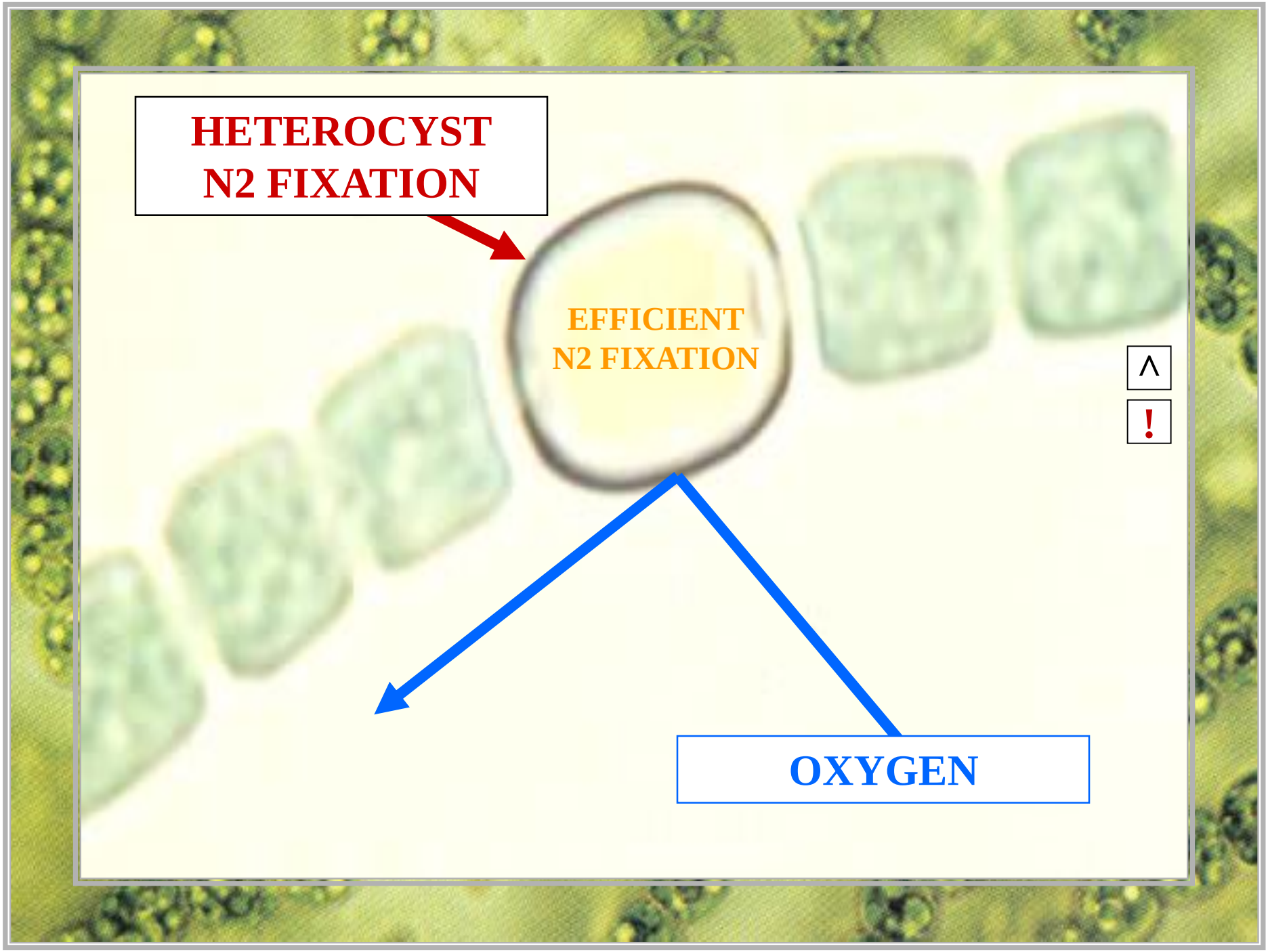
DOUBLE WALL
EFFICIENT
NITROGENASE
N
OXYGEN


HETEROCYST
N2 FIXATION
N2 FIXATION
E
OXYGEN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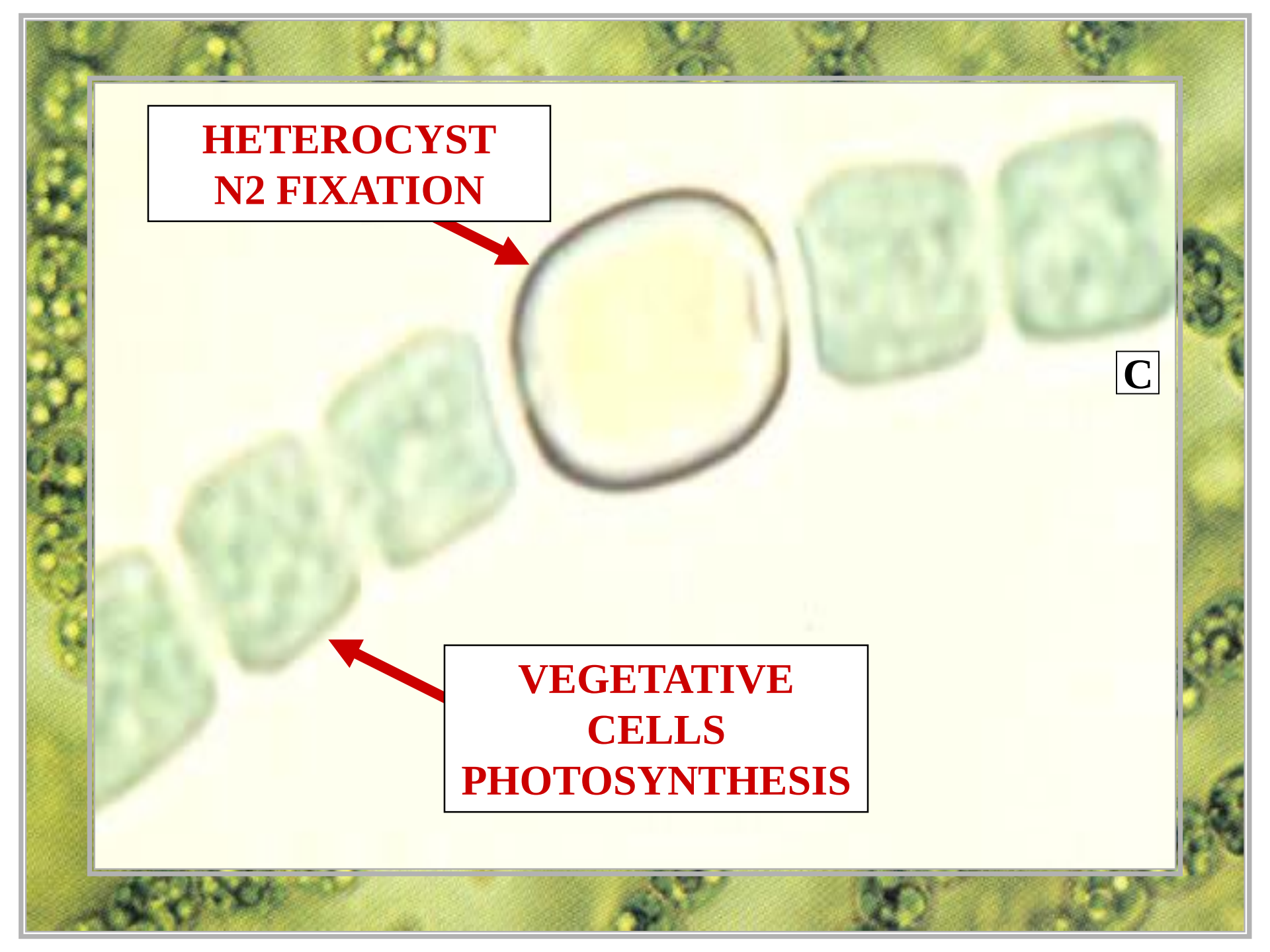
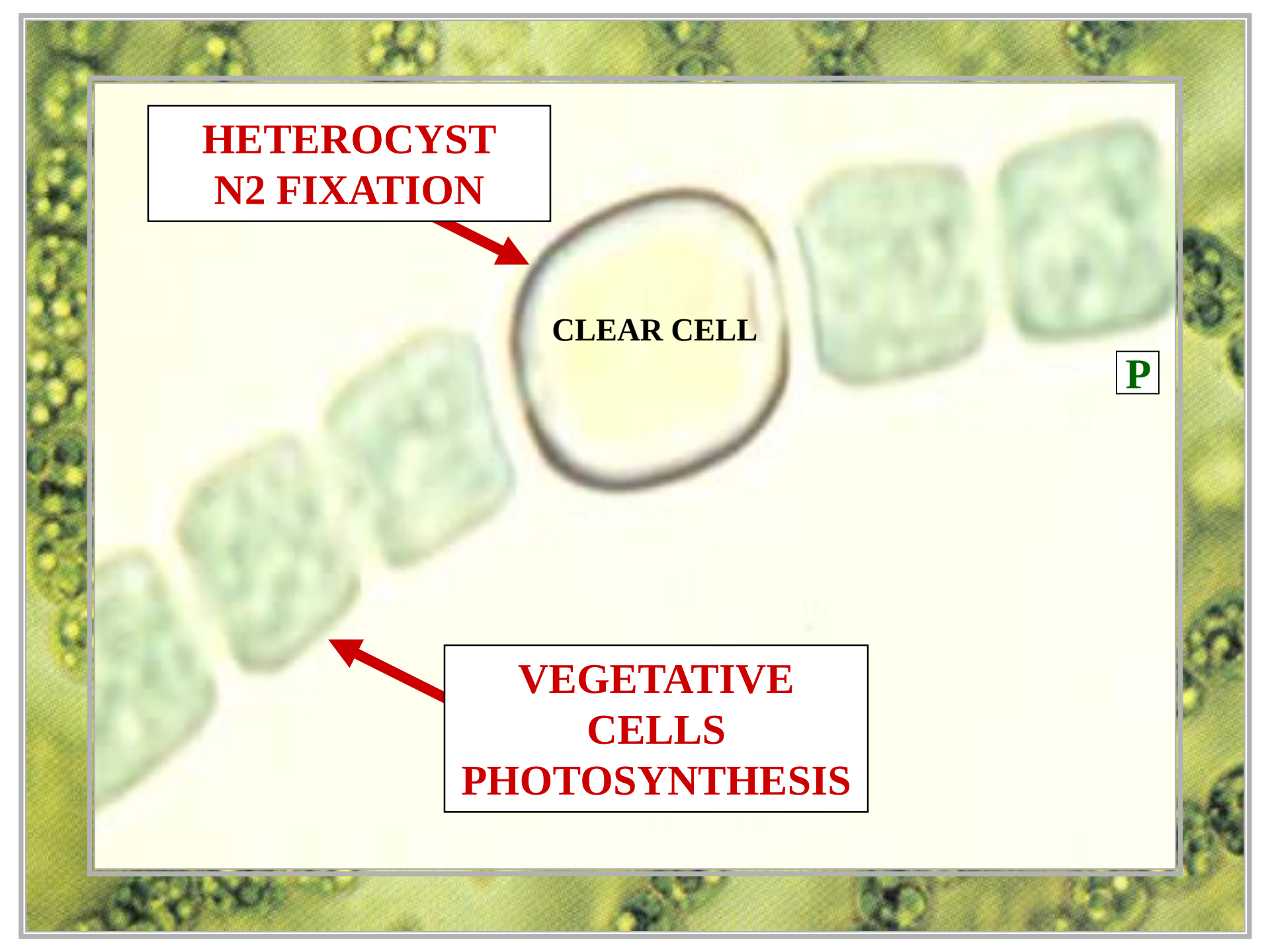
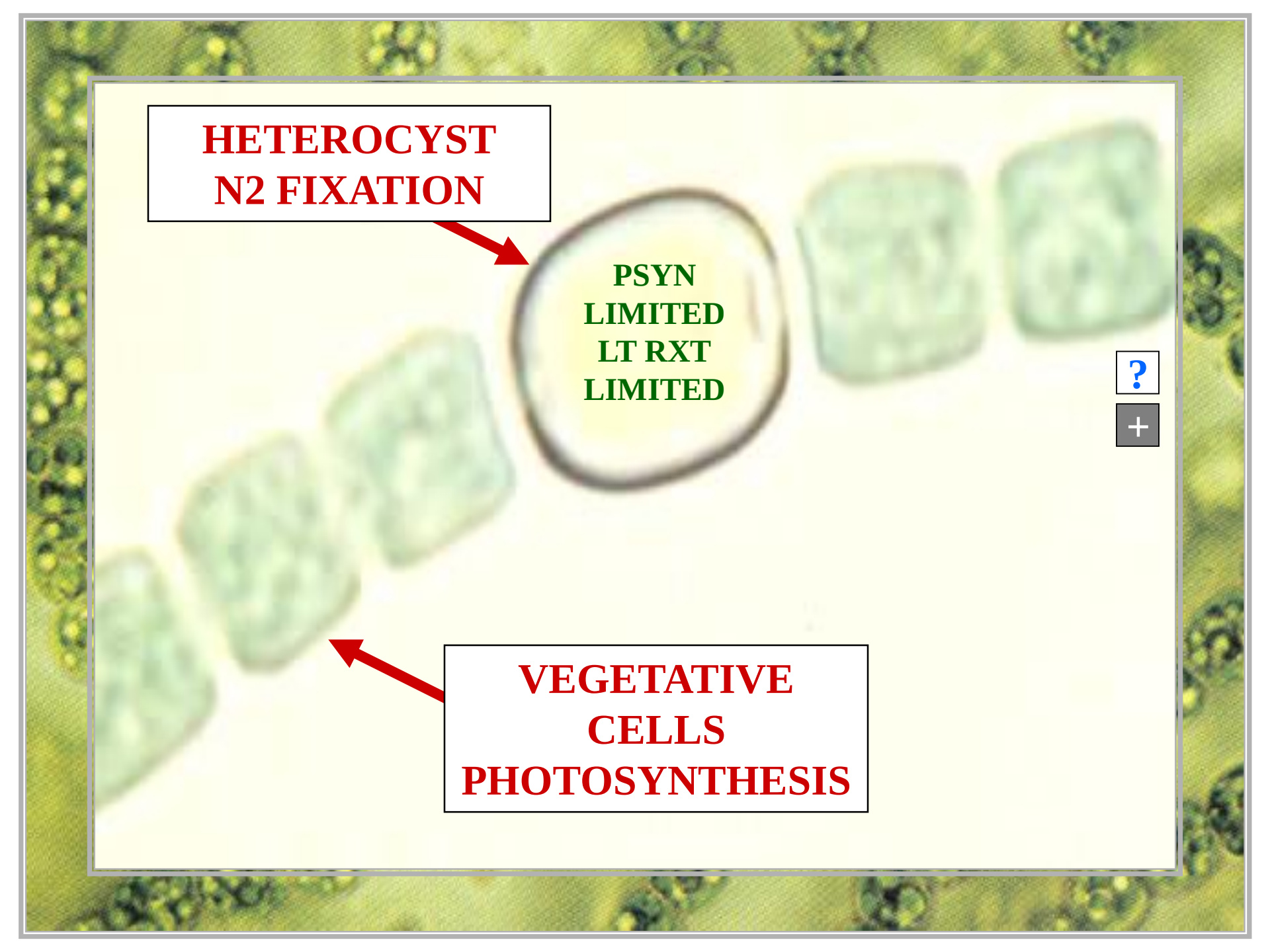
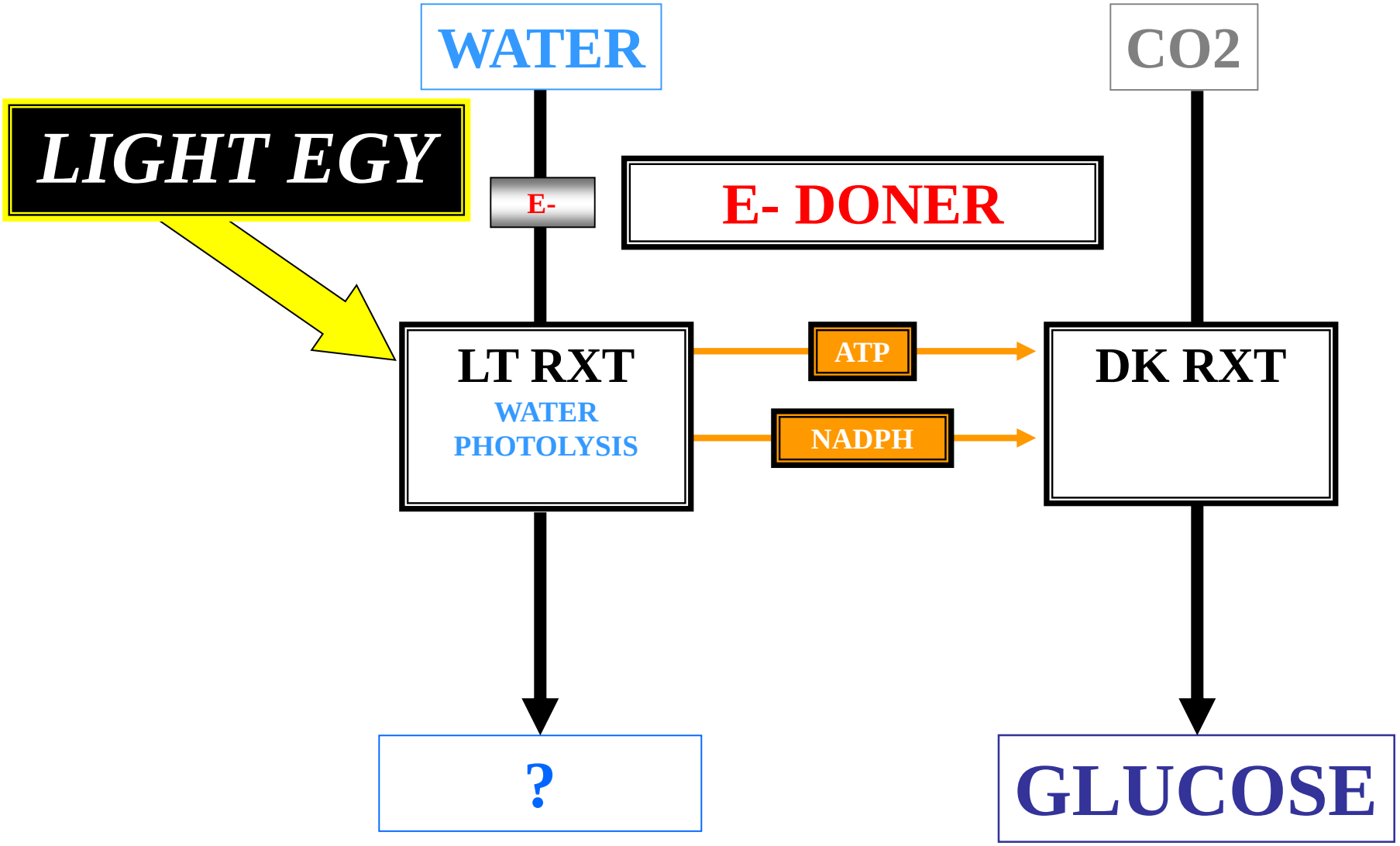
N2 FIXATION
EFFICIENT
N2 FIXATION
OXYGEN


HETEROCYST
N2 FIXATION
C
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
CLEAR CELL
P
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
PSYN
LIMITED
LT RXT
LIMITED
?
+
VEGETATIVE
CELLS
PHOTOSYNTHESIS

TRUE CHLOROPHYLL PHOTOSYNTHESIS



TRUE CHLOROPHYLL PHOTOSYNTHESIS

LT
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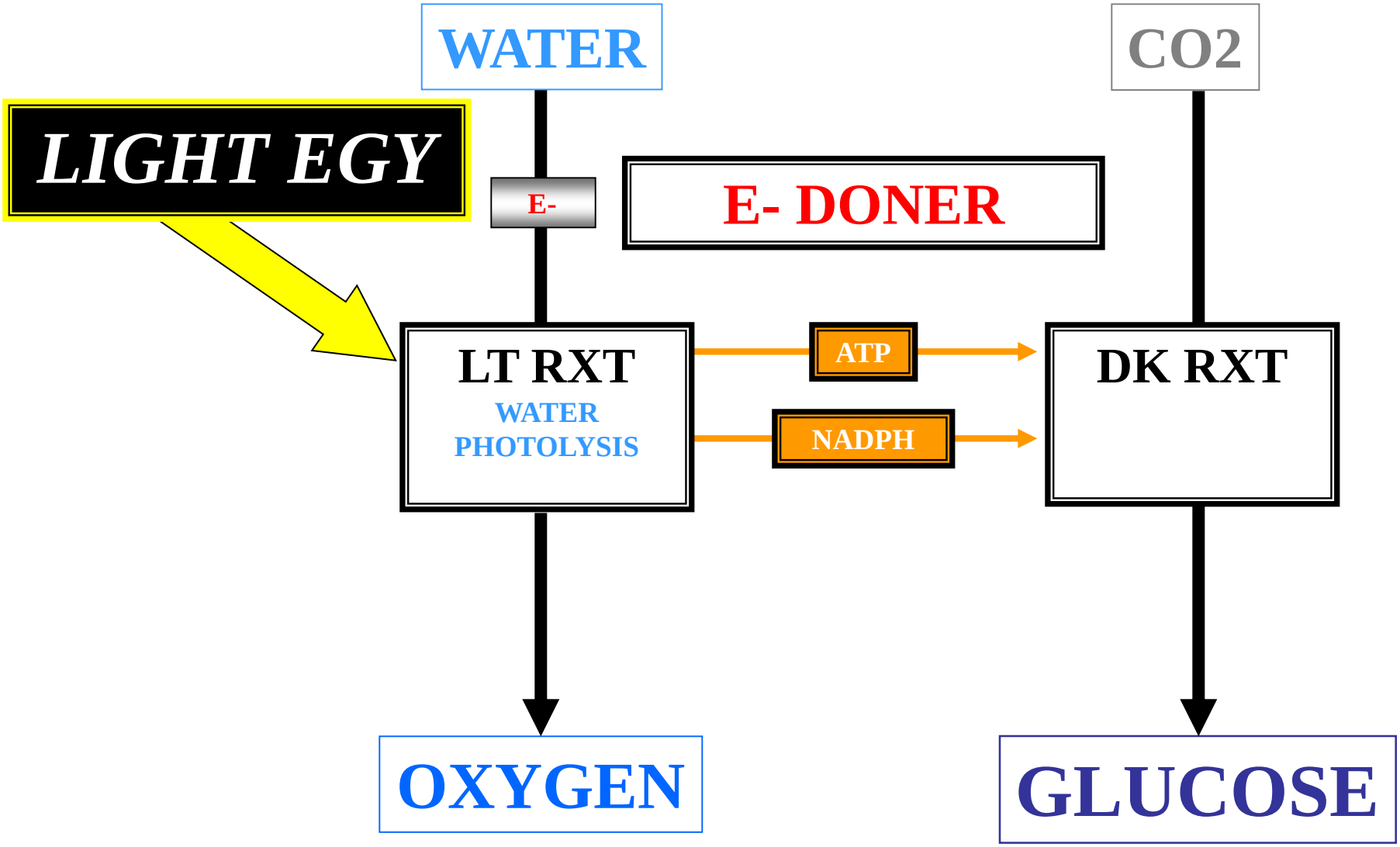
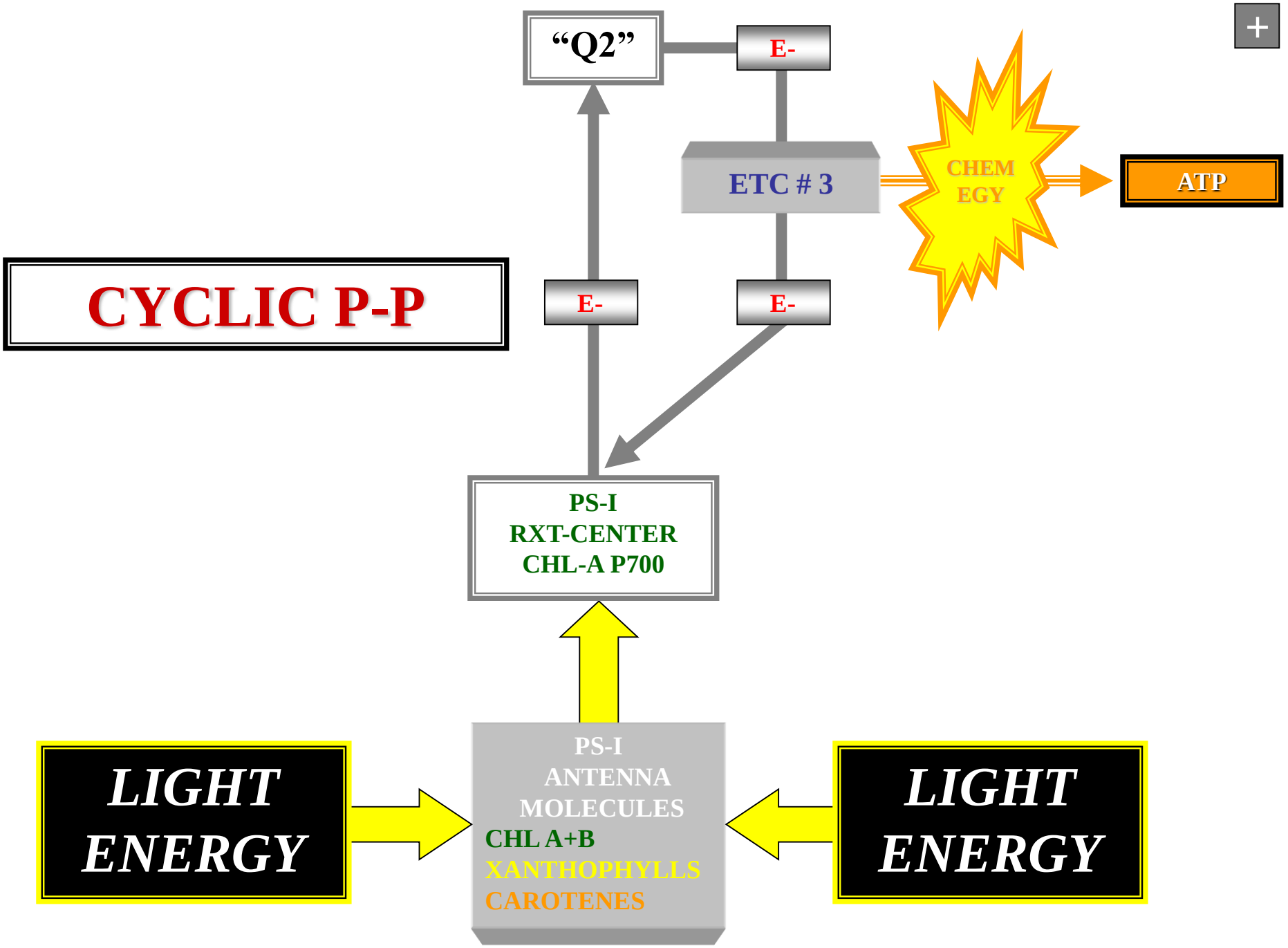
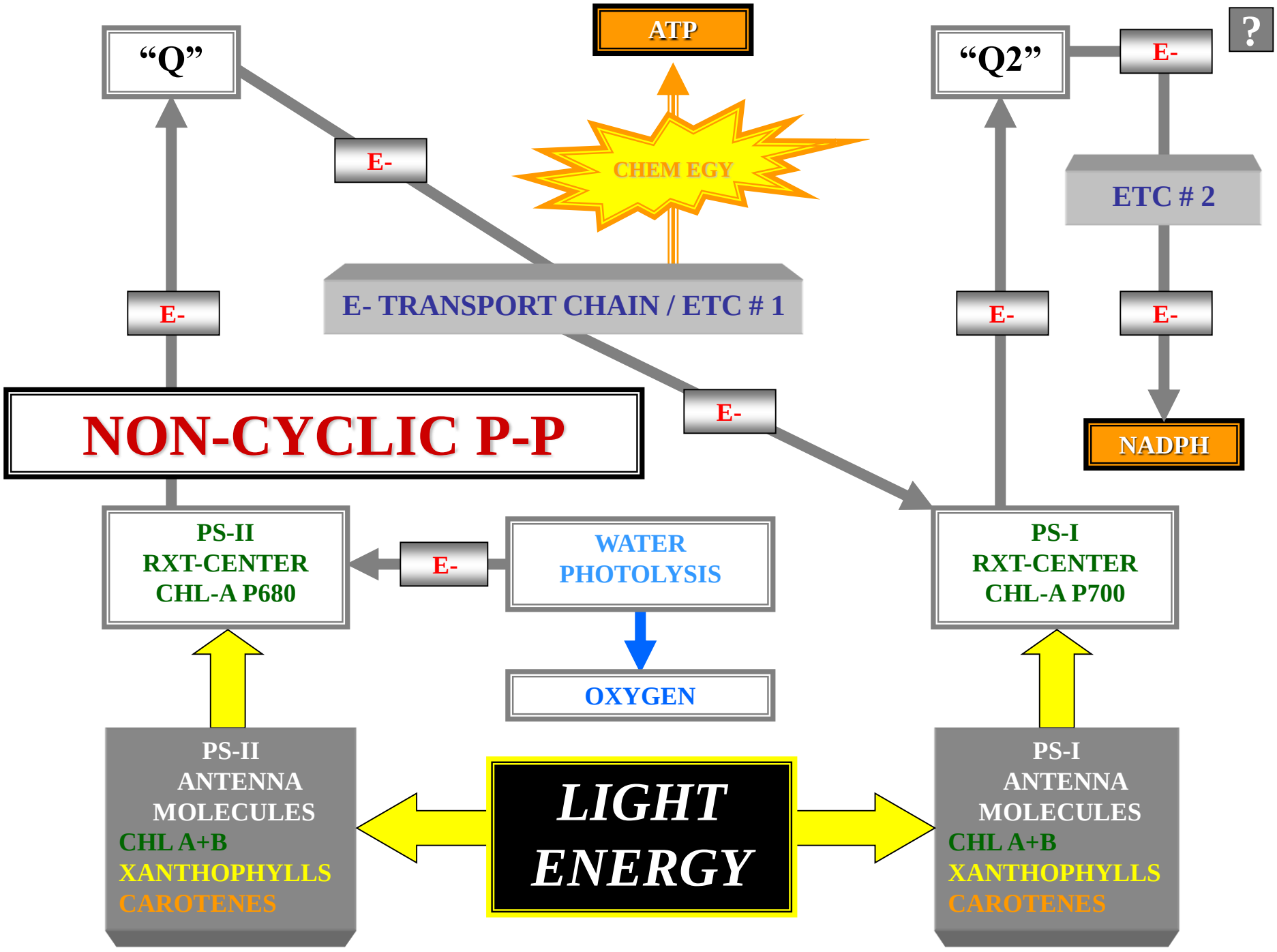
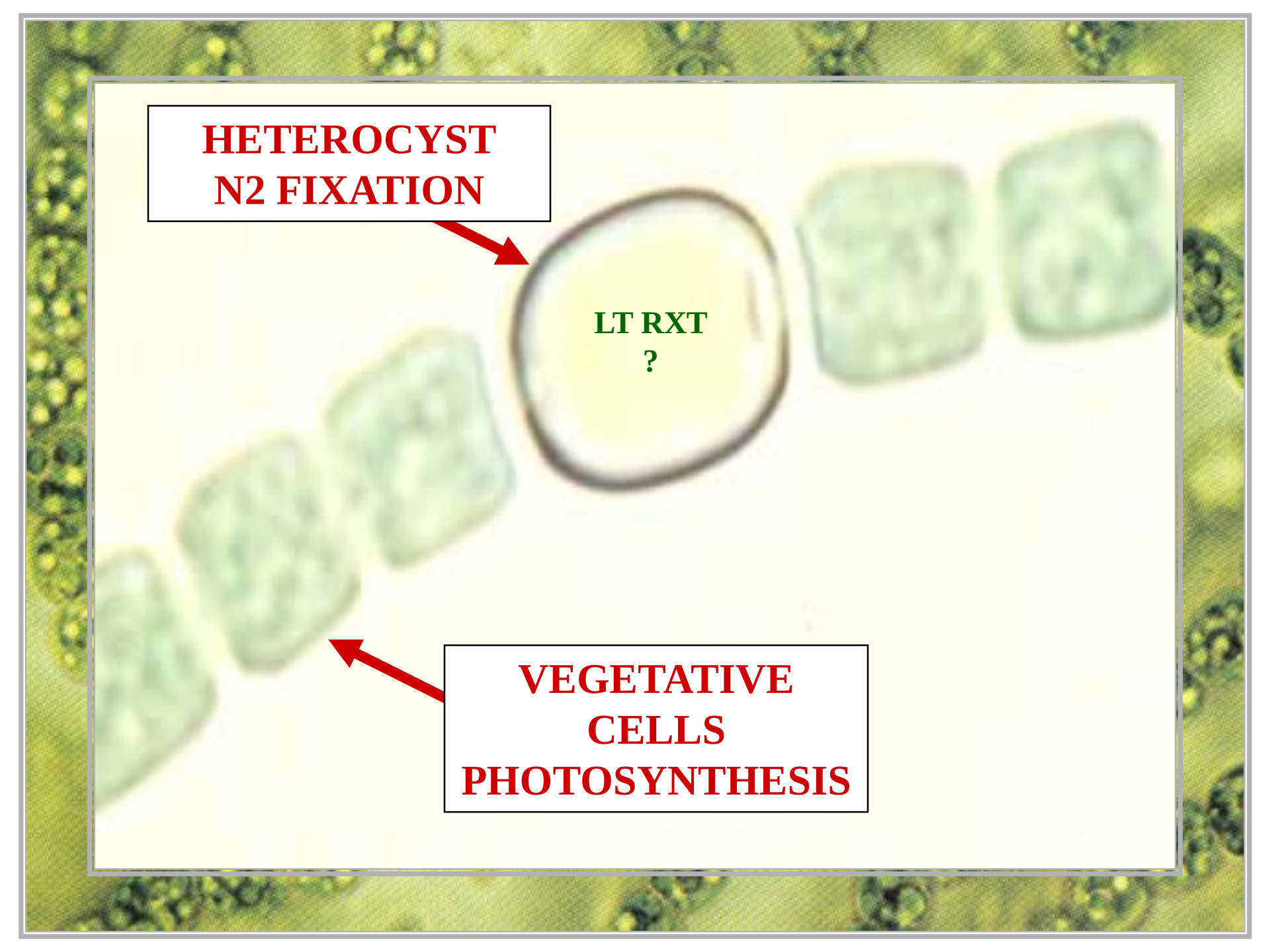
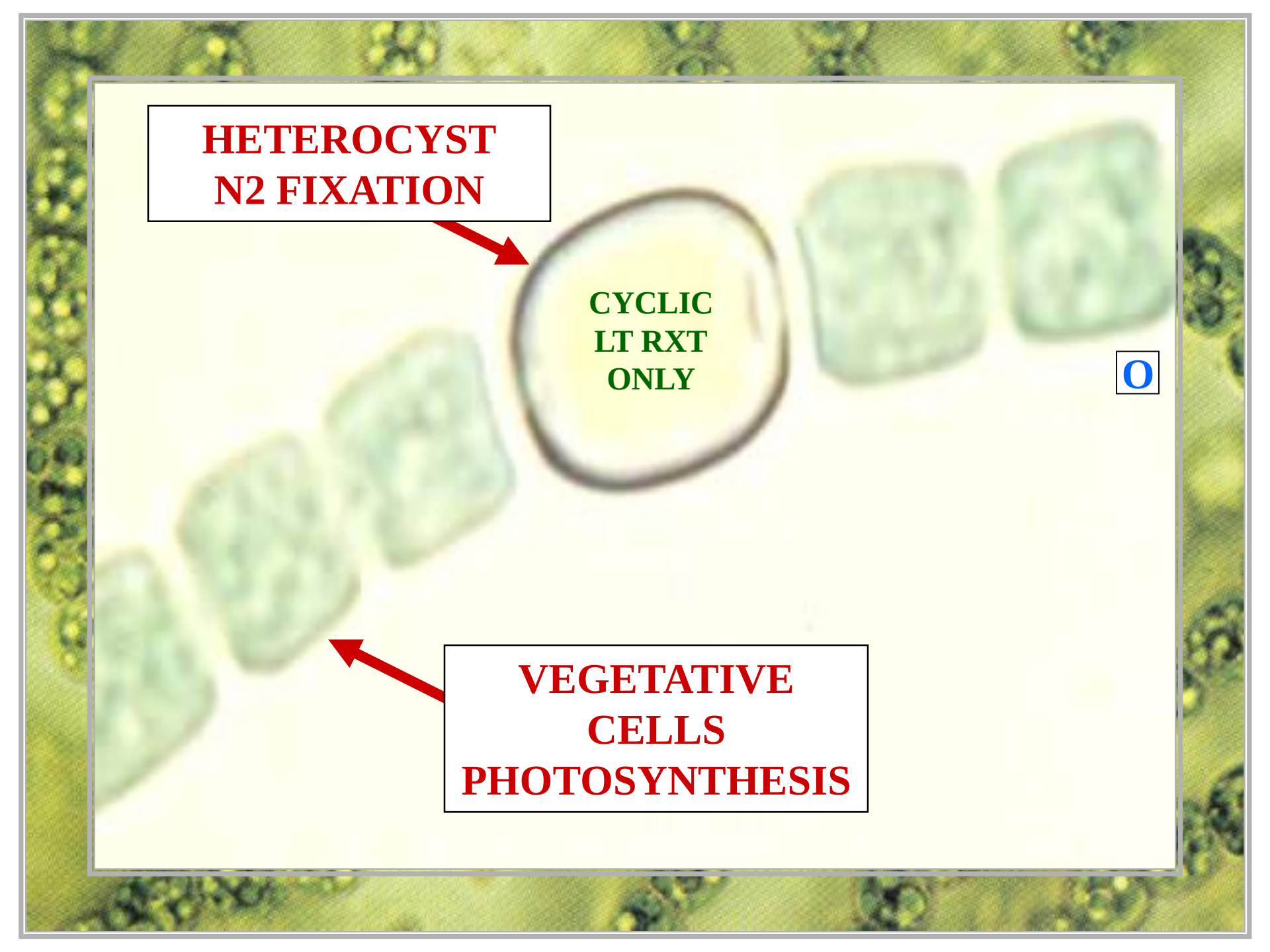
2

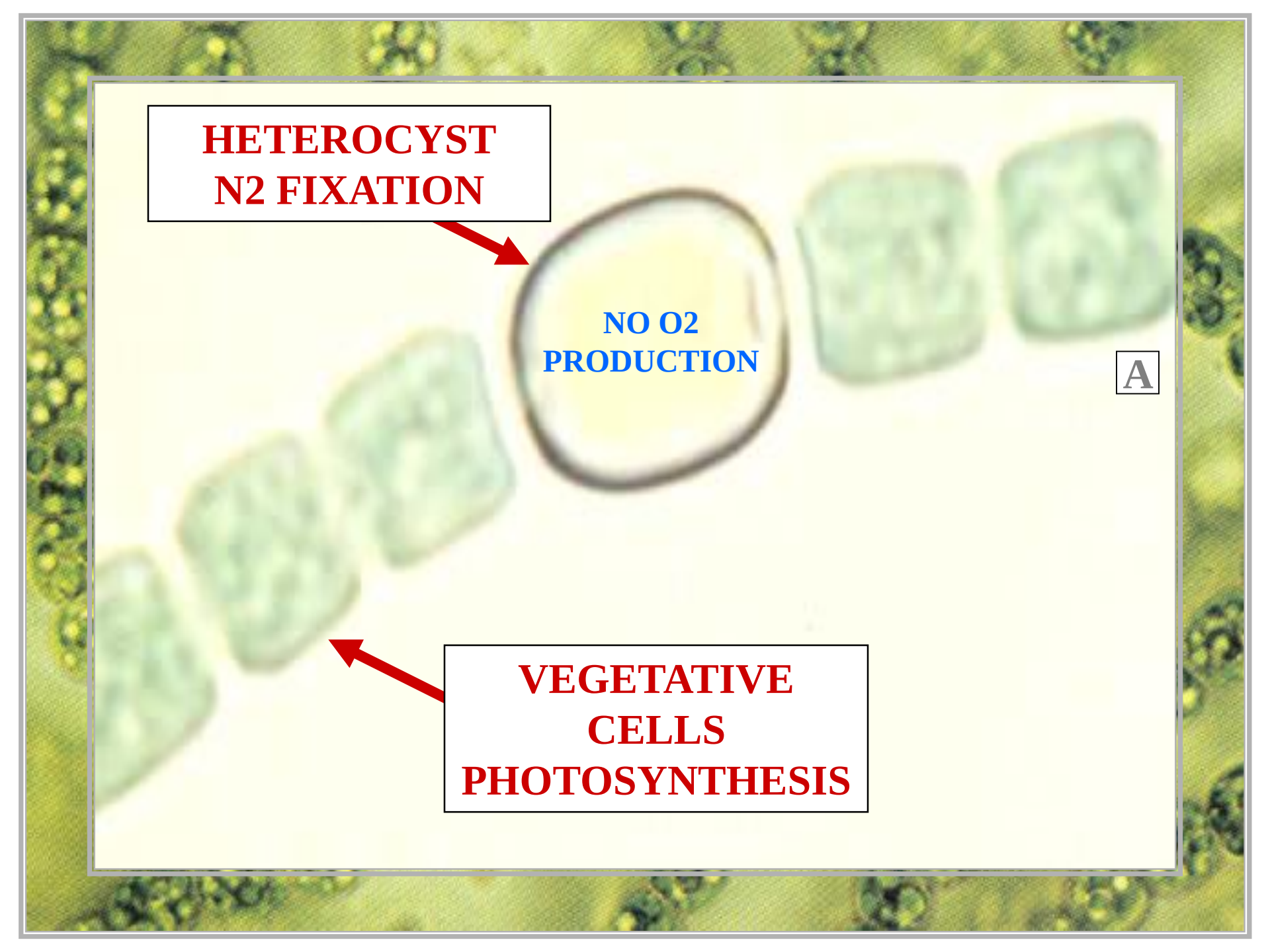


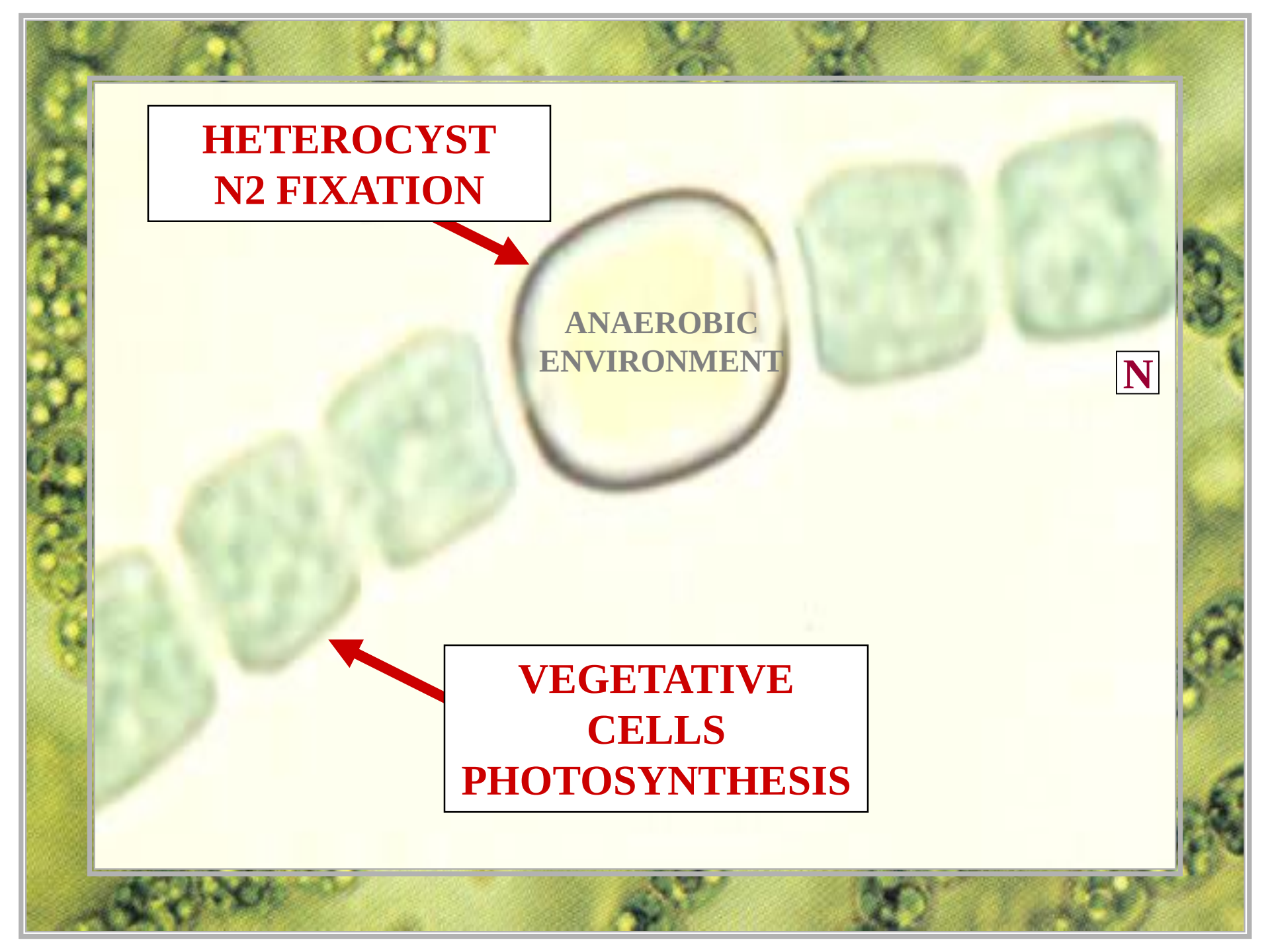

"Q2"
E-
ETC # 3
CHEM EGY
ATP
CYCLIC P-P
E-
E-
PS-I
RXT-CENTER
CHL-A P700
PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT ENERGY
LIGHT ENERGY

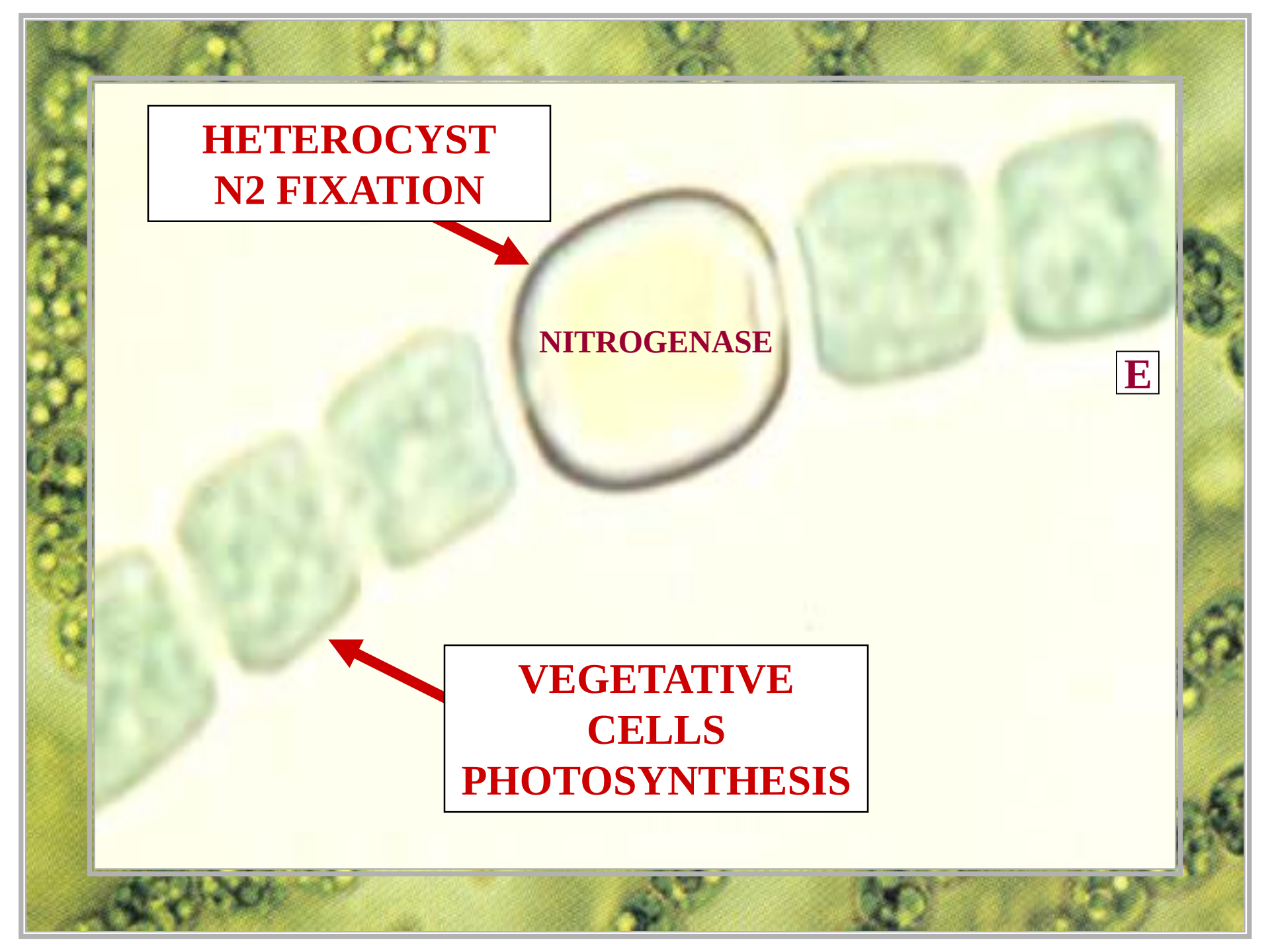

ATP
"Q"
"Q2"
?
E-
CHEM EGY
ETC # 2
E- TRANSPORT CHAIN / ETC # 1
E-
E-
E-
E-
NON-CYCLIC P-P
NADPH
PS-II
RXT-CENTER
CHL-A P680
E-
WATER
PHOTOLYSIS
PS-I
RXT-CENTER
CHL-A P700
OXYGEN
PS-II
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES
LIGHT
ENERGY
PS-I
ANTENNA
MOLECULES
CHL A+B
XANTHOPHYLLS
CAROTENES

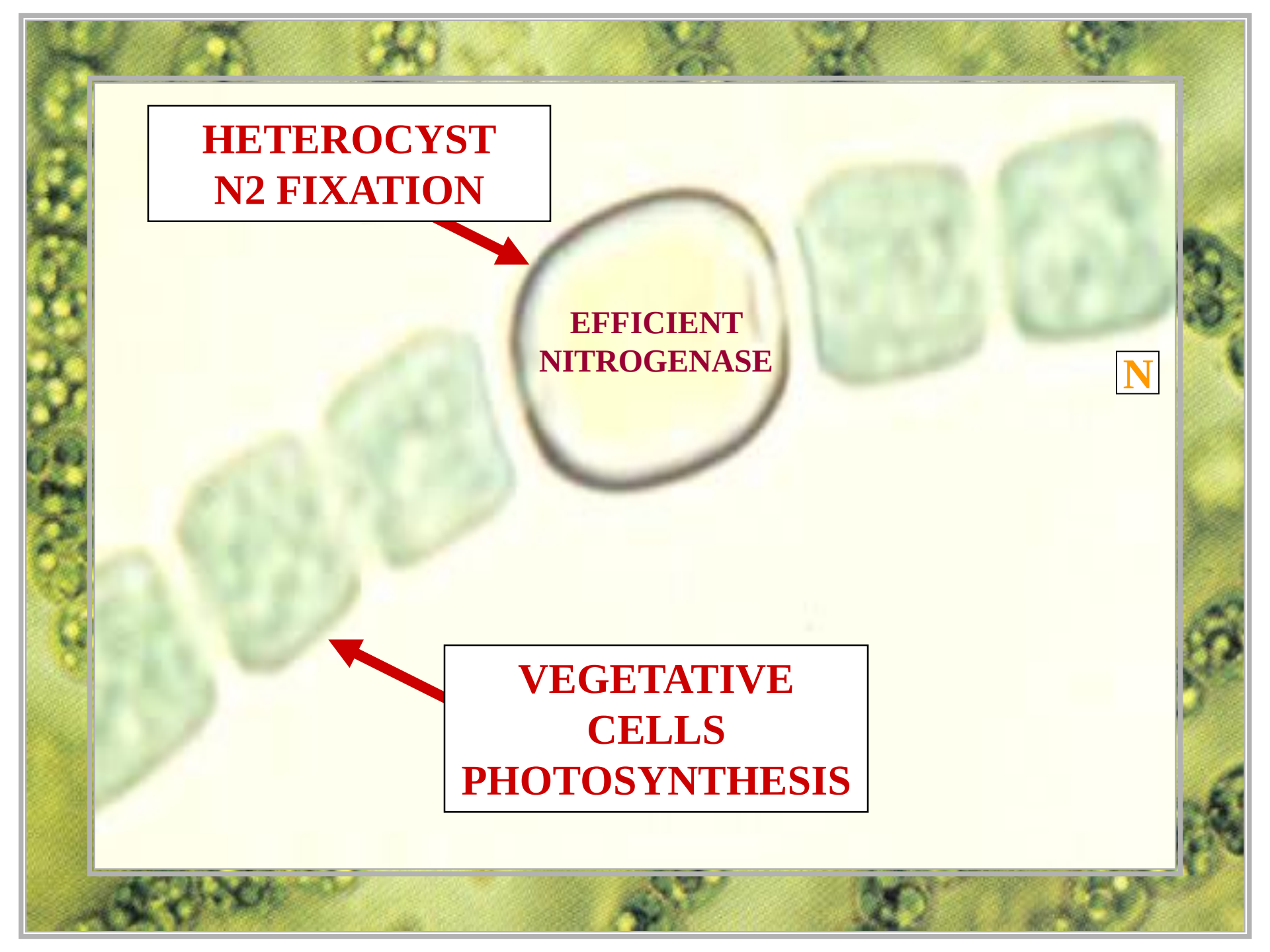

HETEROCYST
N2 FIXATION
LT RXT
?
VEGETATIVE
CELLS
PHOTOSYNTHESIS

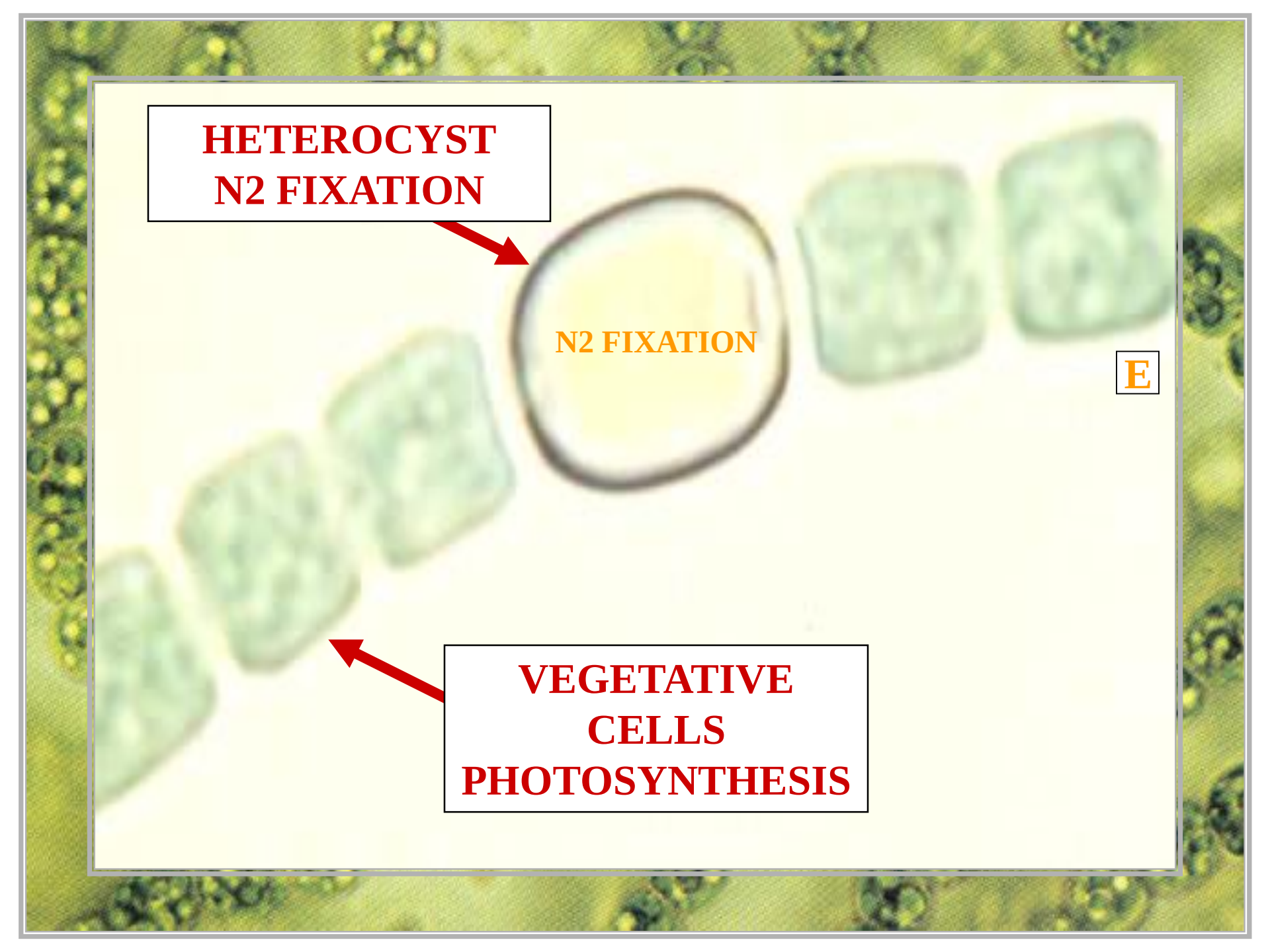

HETEROCYST
N2 FIXATION
CYCLIC
LT RXT
ONLY
O
VEGETATIVE
CELLS
PHOTOSYNTHESIS

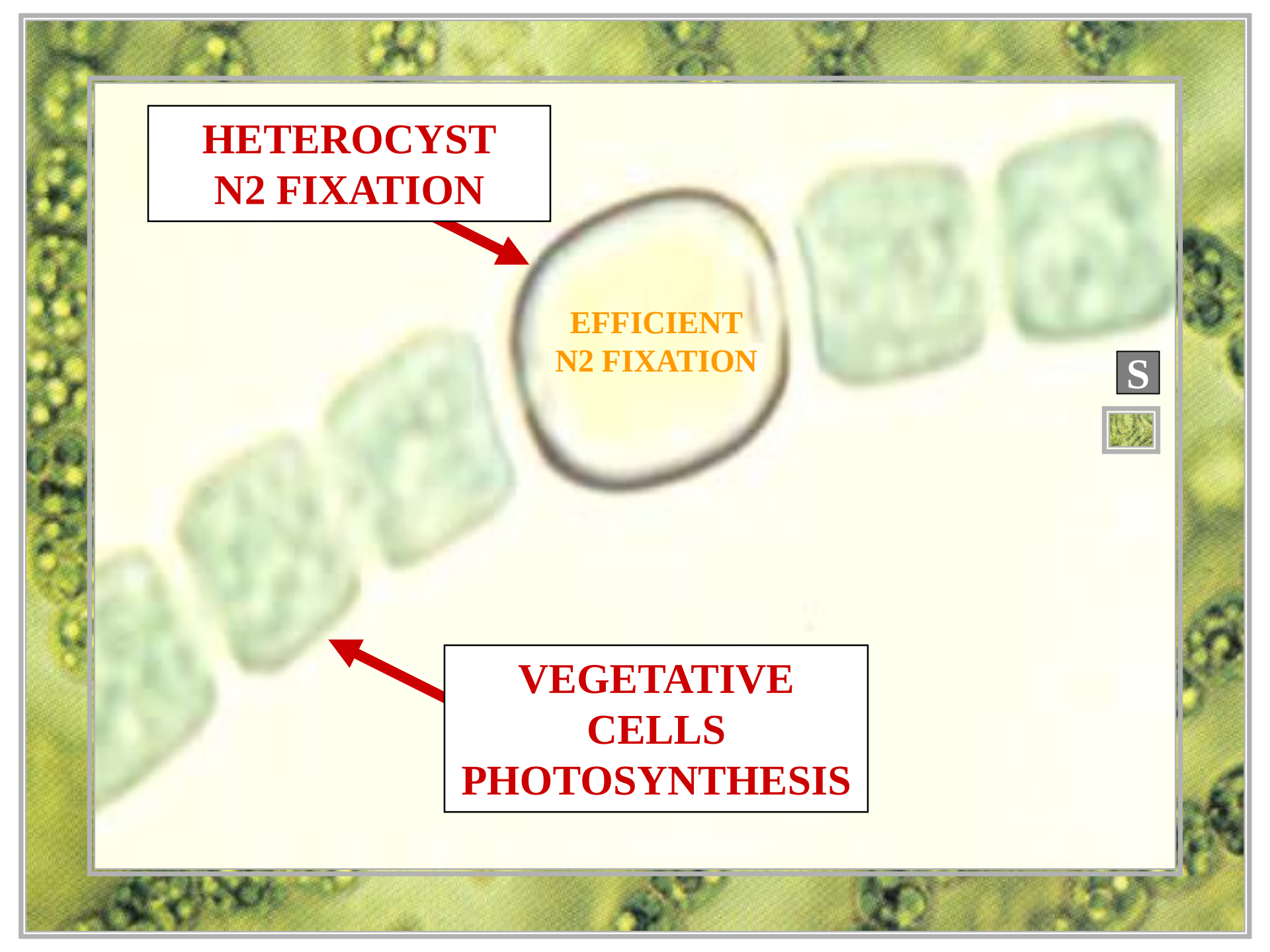

HETEROCYST
N2 FIXATION
NO O2
PRODUCTION
A
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
ANAEROBIC
ENVIRONMENT
N
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
NITROGENASE
E
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
EFFICIENT
NITROGENASE
N
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
N2 FIXATION
E
VEGETATIVE
CELLS
PHOTOSYNTHESIS


HETEROCYST
N2 FIXATION
EFFICIENT
N2 FIXATION
S
VEGETATIVE
CELLS
PHOTOSYNTHESIS

CYANOBACTERIA CONDUCT NITROGEN FIXATION

S

CYANOBACTERIA SYMBIOSIS

SYMBIOSIS

SYMBIOSIS

2 SPECIES LIVING INTRICATE ASSOCIATION

SYMBIOSIS

SYMBIOSIS TYPES

SYMBIOSIS TYPES

PARASITISM

SYMBIOSIS TYPES

SYMBIOSIS TYPES

PARASITISM
COMMENSALISM

SYMBIOSIS TYPES

P

SYMBIOSIS TYPES

PARASITISM
COMMENSALISM
MUTUALISM

SYMBIOSIS TYPES

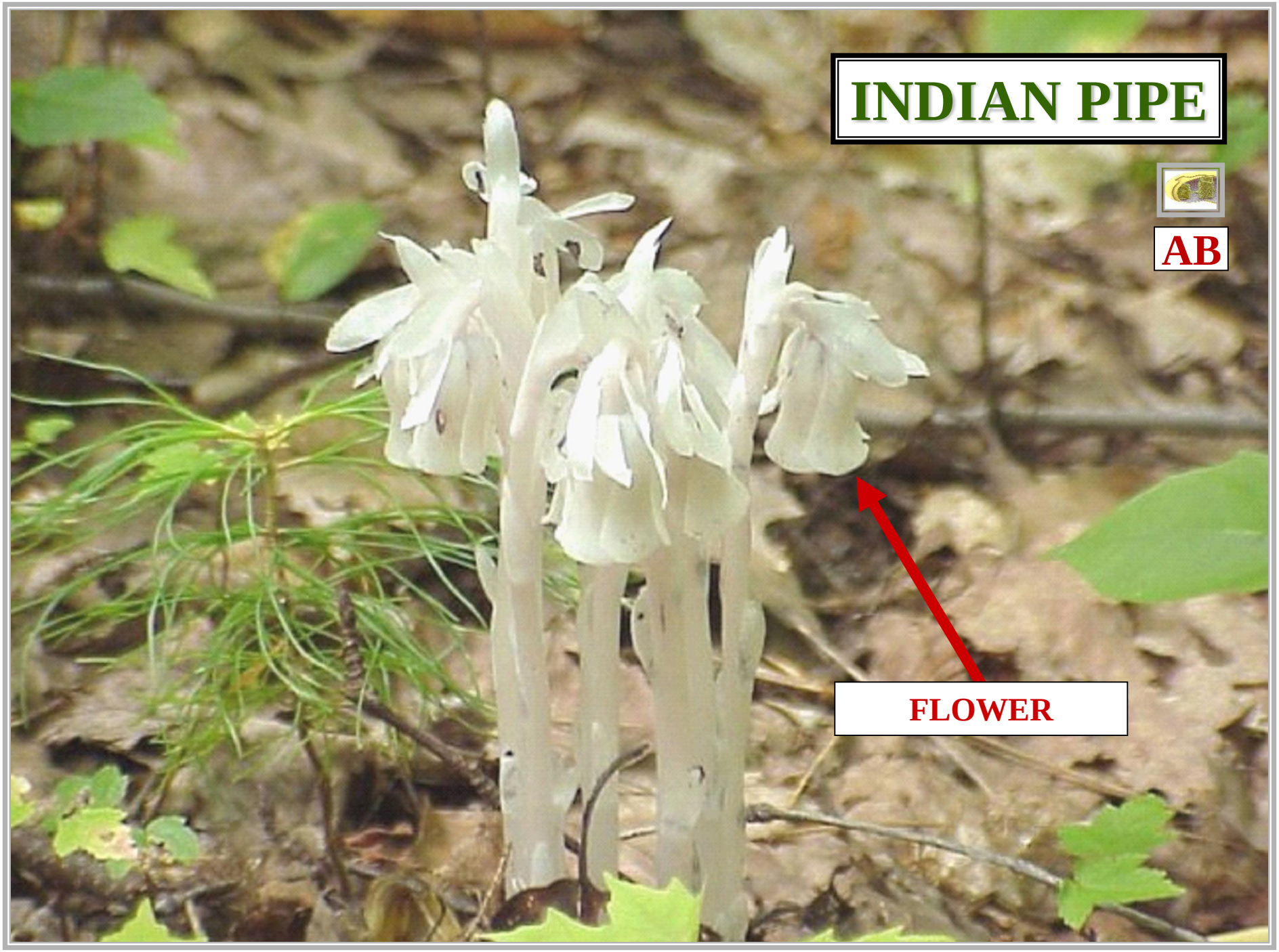
PARASITISM

SYMBIOSIS
PARASITISM

ONE SPECIES BENEFITS
ONE SPECIES ADVERSELY AFFECTED

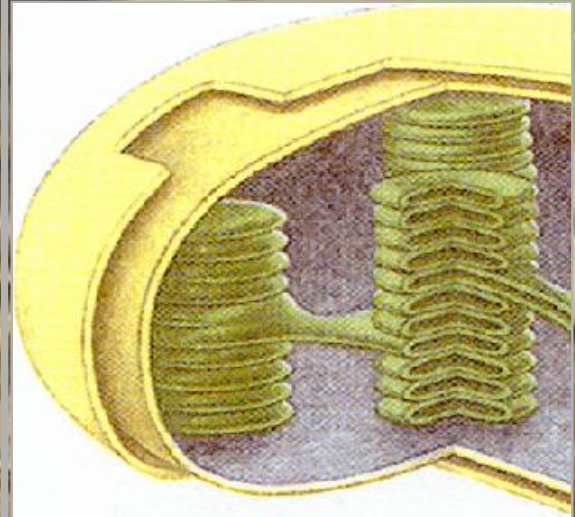
SYMBIOSIS
PARASITISM


INDIAN PIPE
FL


INDIAN PIPE
AB
FLOWER

INDIAN PIPE

P



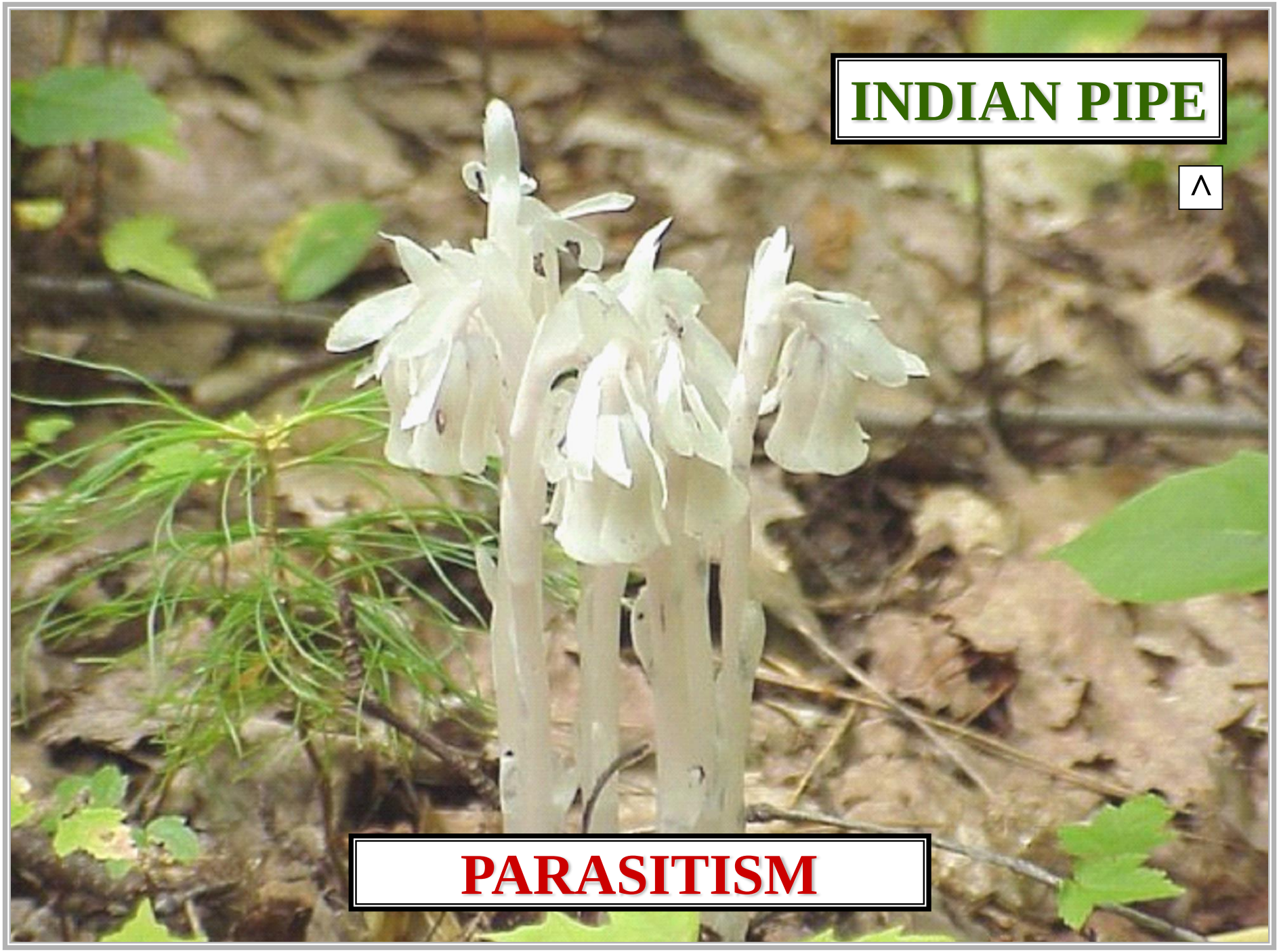
CHLOROPLASTS: ABSENT

INDIAN PIPE

N

PHOTOSYNTHESIS: ABSENT


INDIAN PIPE
P
NON-PSYN PLANT


INDIAN PIPE
PARASITISM

COMMENSALISM

SYMBIOSIS
COMMENSALISM

ONE SPECIES BENEFITS
ONE SPECIES UNAFFECTED

SYMBIOSIS
COMMENSALISM

AFRICAN SAVANNA


C

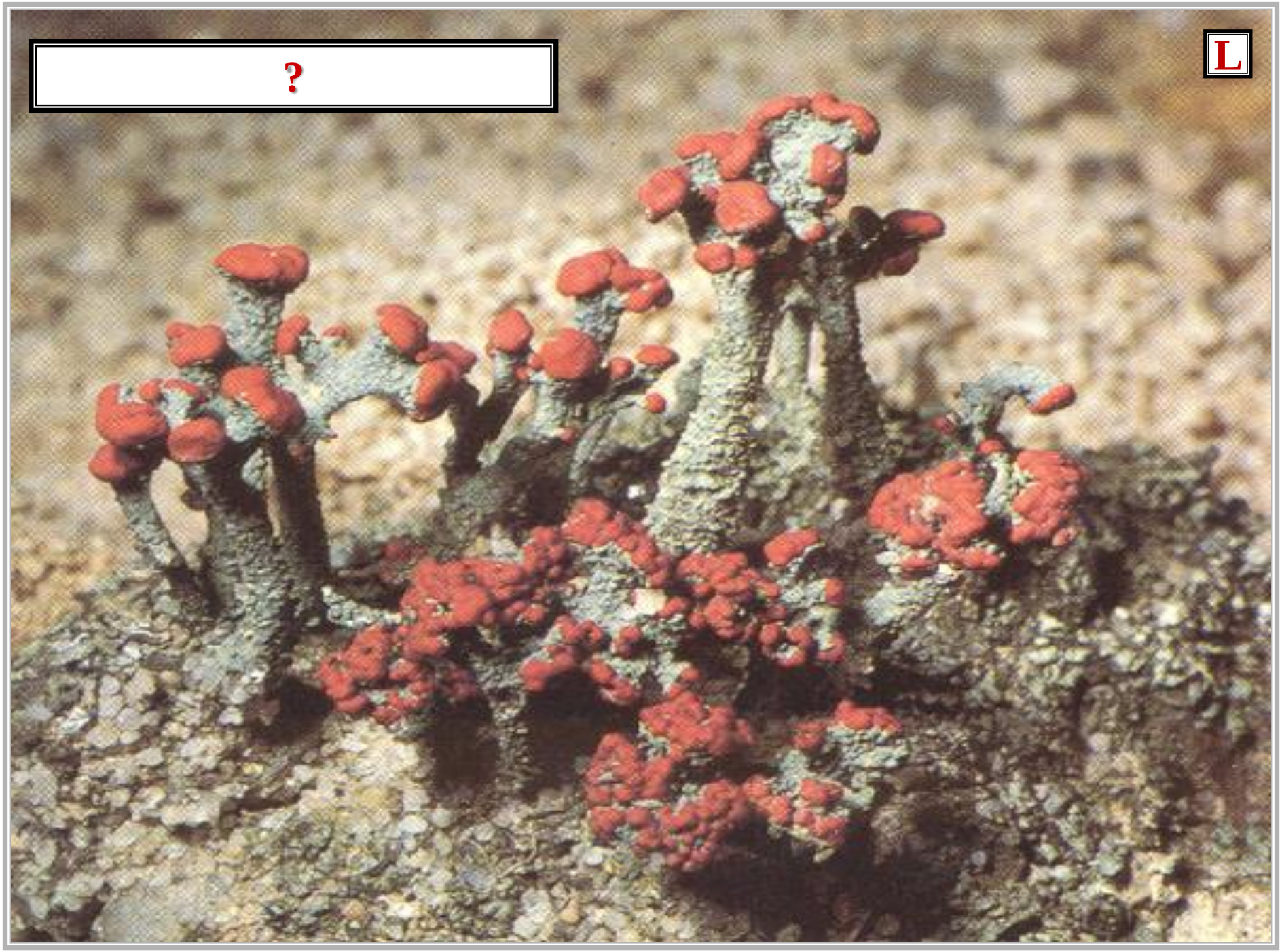

COMMENSALISM

MUTUALISM

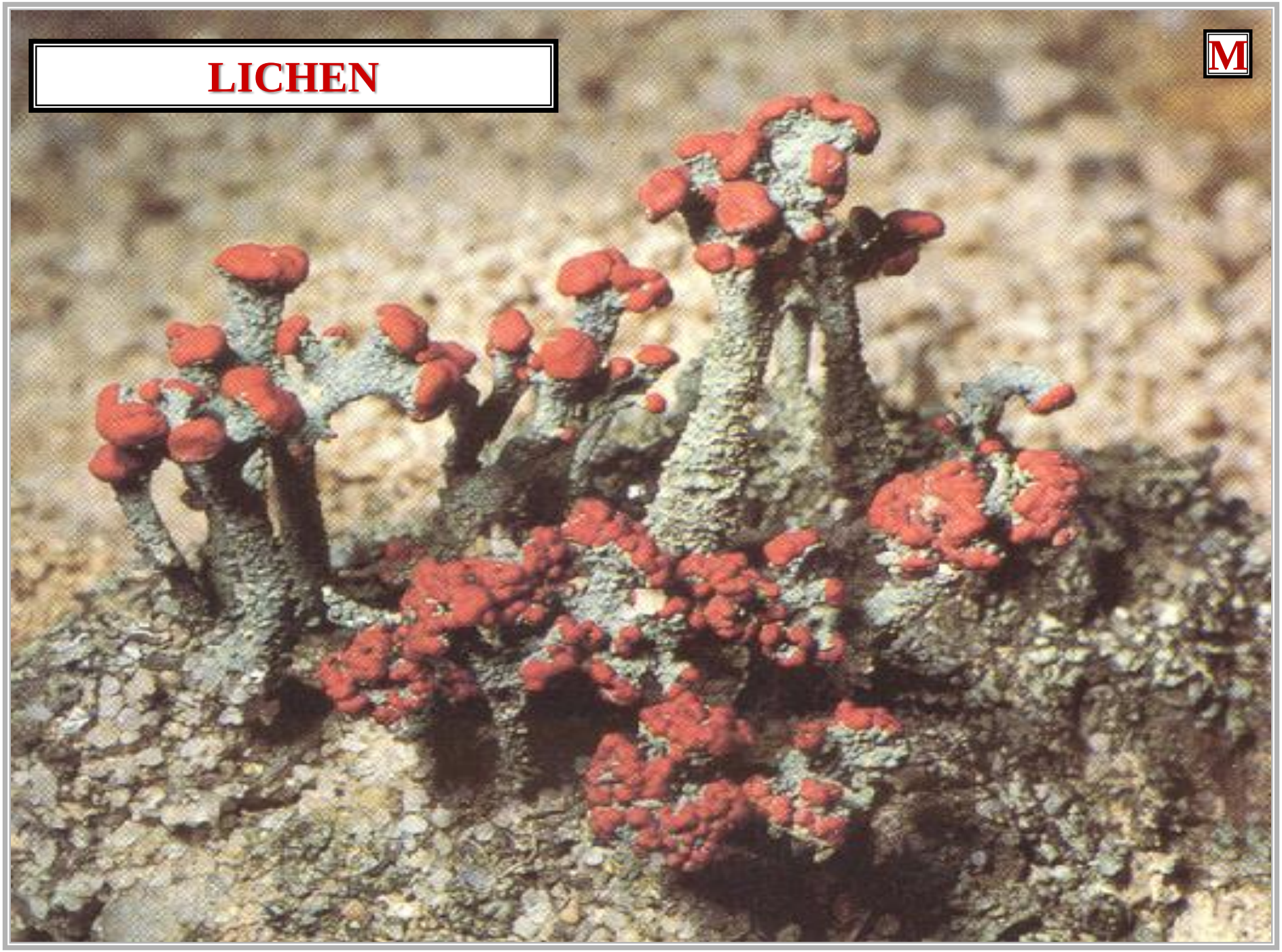
SYMBIOSIS TYPES
MUTUALISM

TWO/BOTH SPECIES BENEFIT

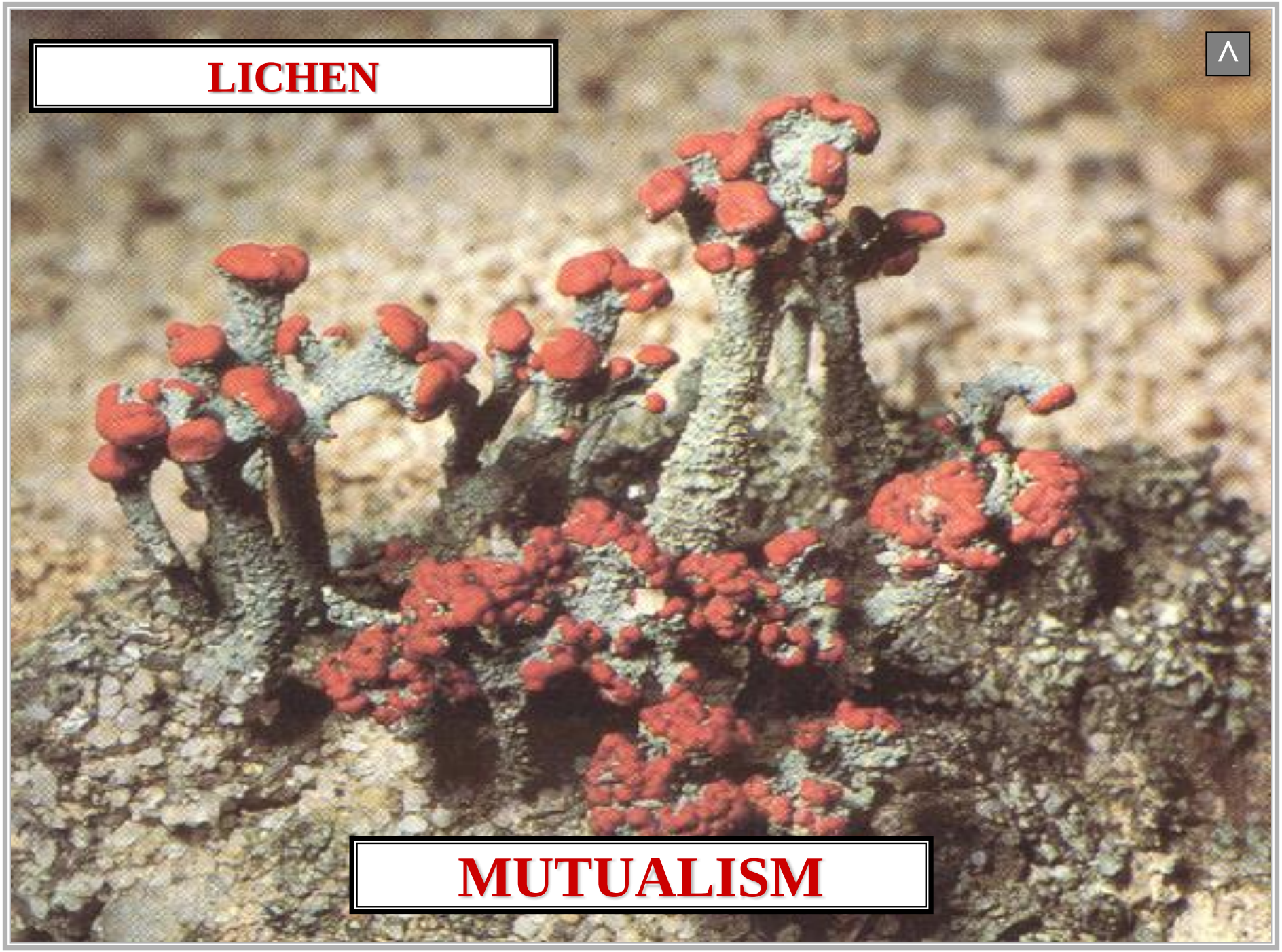
SYMBIOSIS TYPES
MUTUALISM


?
L

LICHEN



LICHEN



MUTUALISM

L

LICHEN

LICHEN

LICHEN

MUTUALISTIC SYMBIOTIC RELATIONSHIP

LICHEN