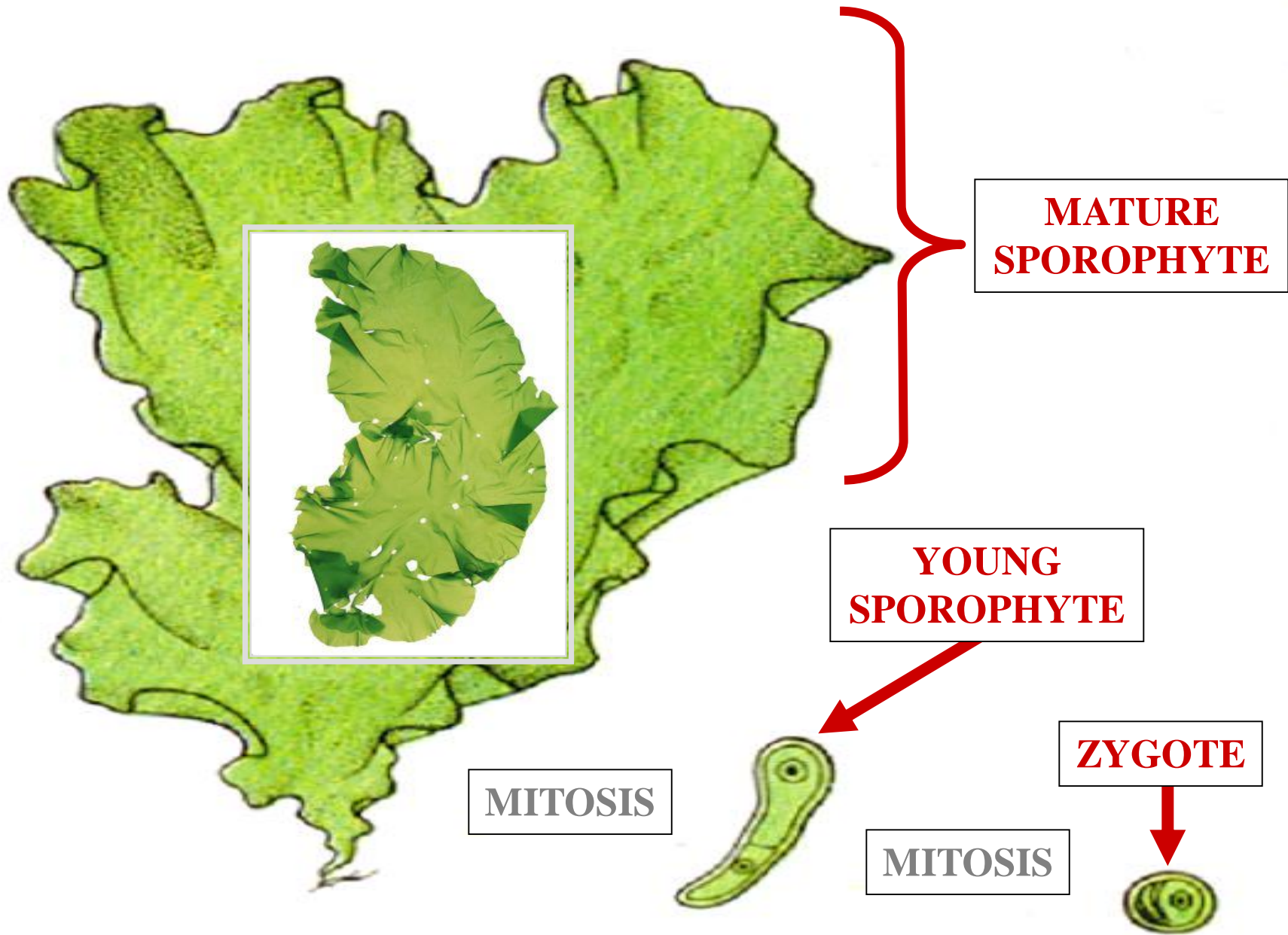
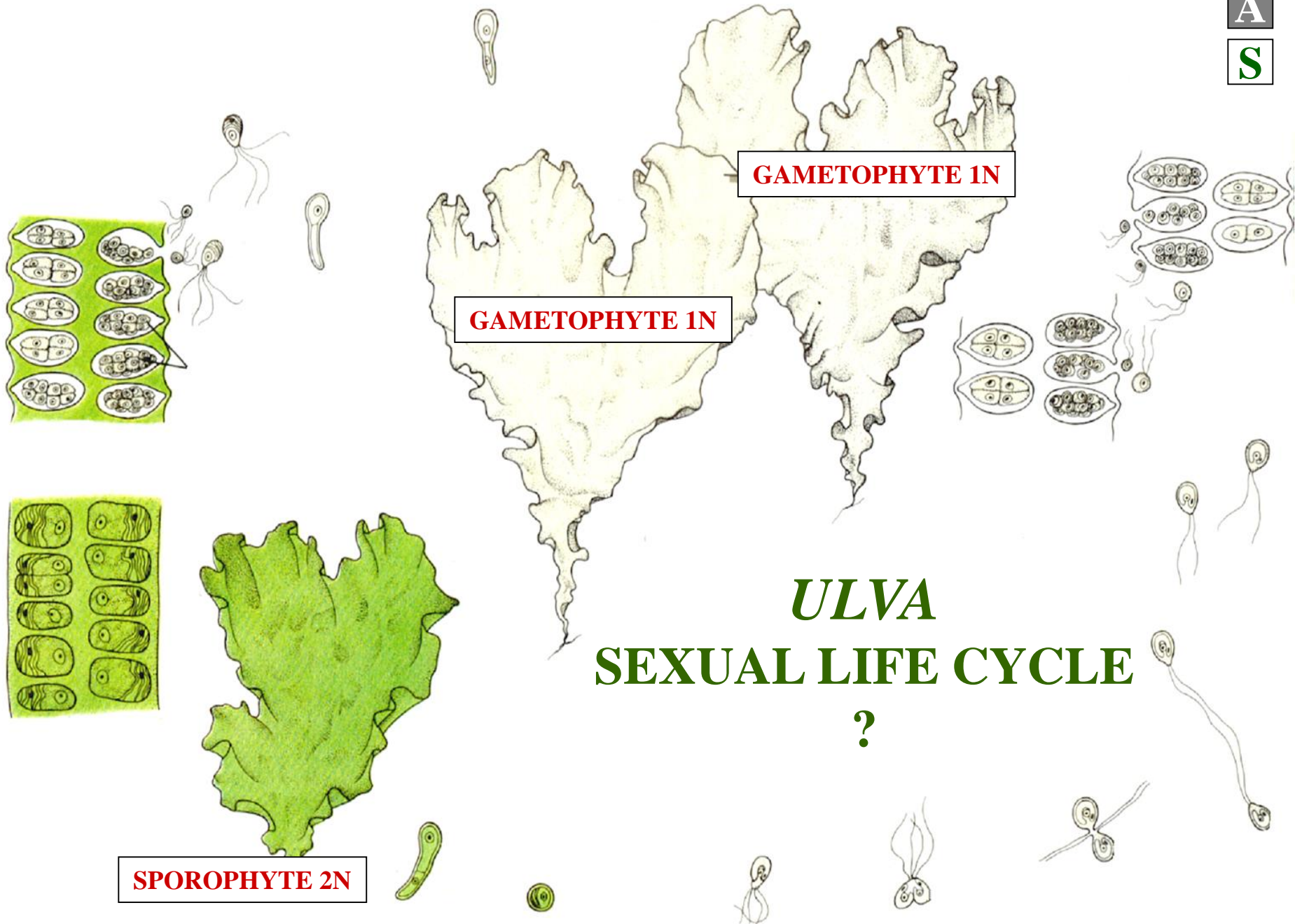


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GAMETOPHYTE 1N

GAMETOPHYTE 1N

SPOROPHYTE 2N

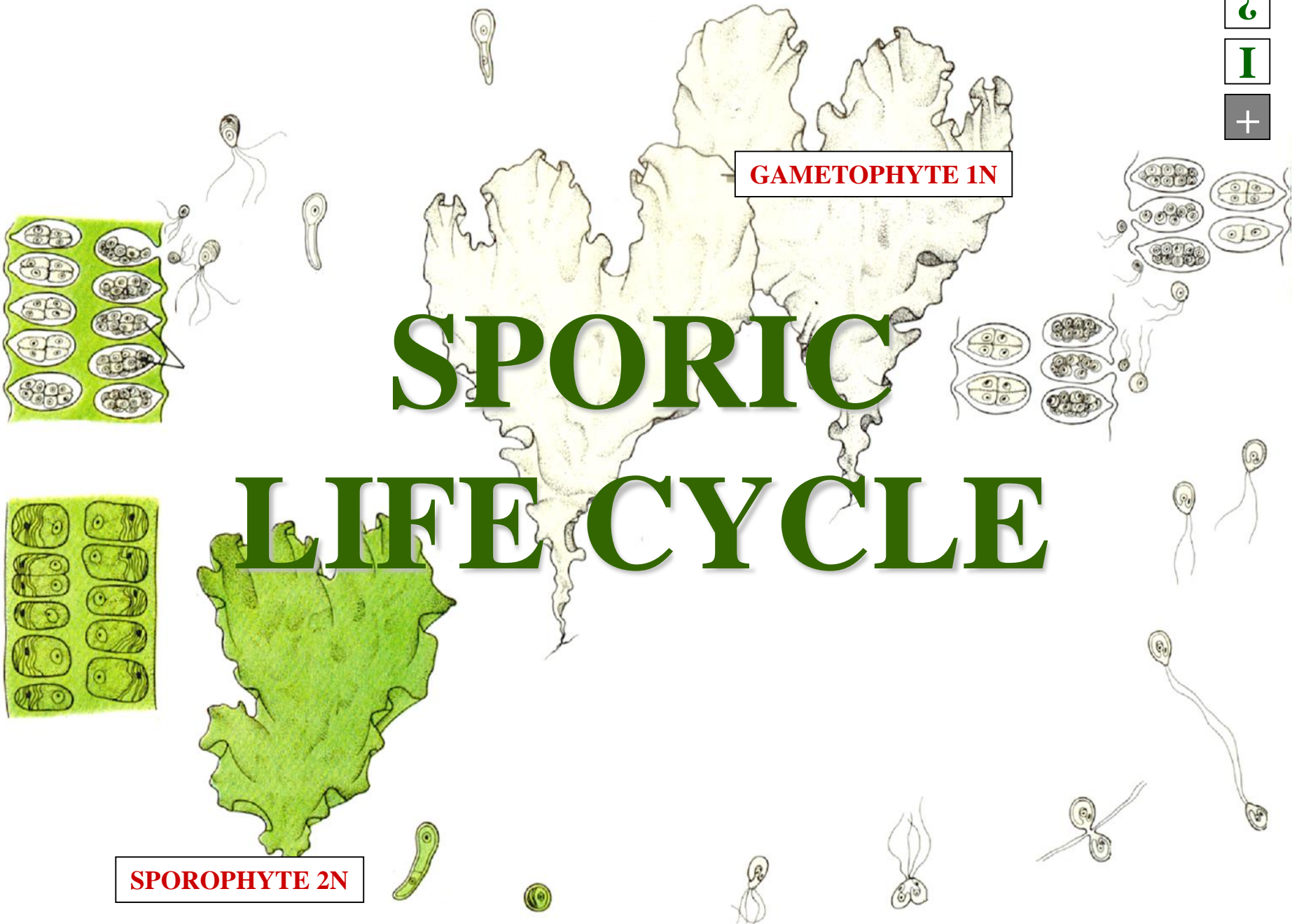
ULVA
SEXUAL LIFE CYCLE
?



GAMETOPHYTE 1N

SPORIC LIFE CYCLE

SPOROPHYTE 2N



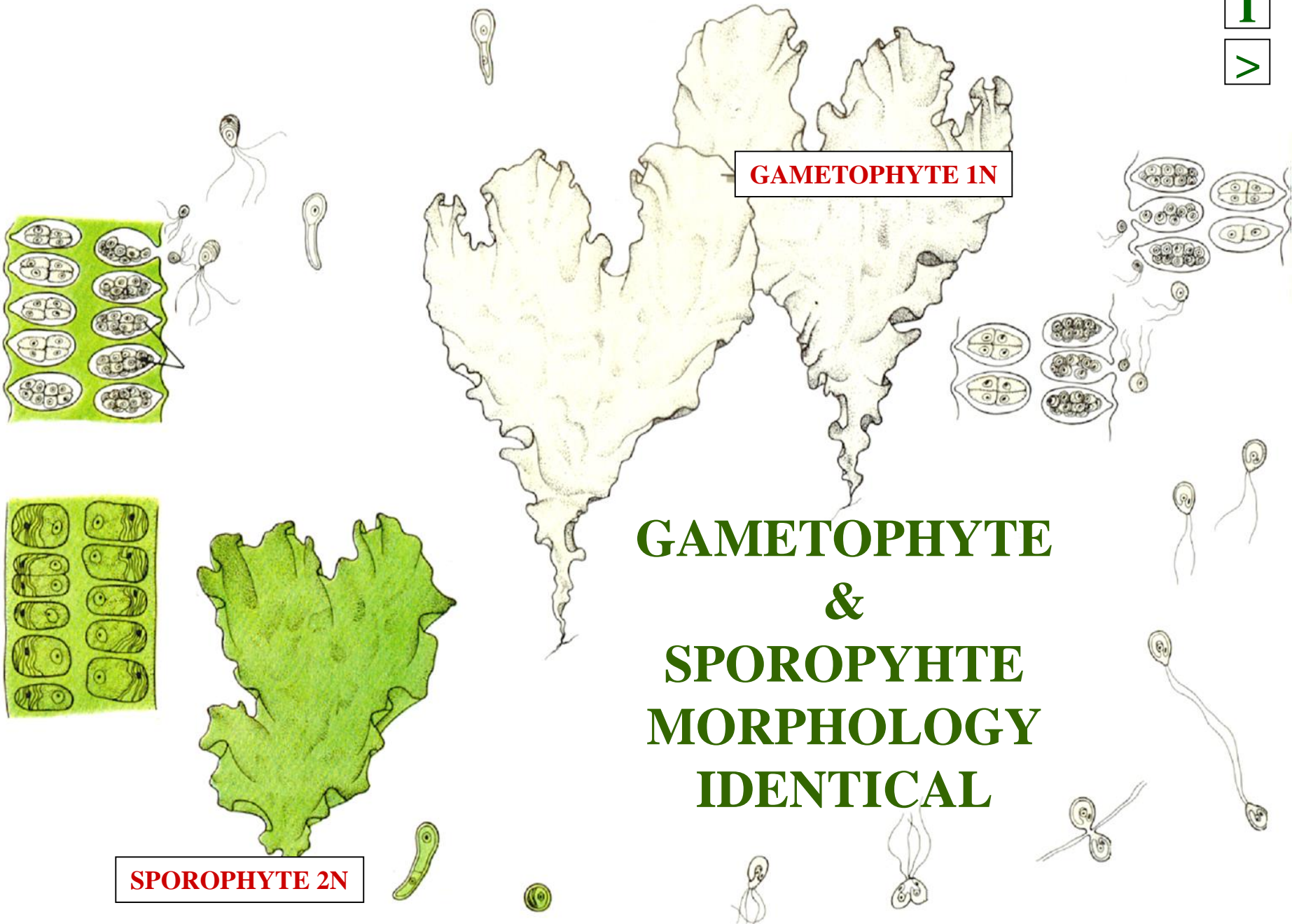
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GAMETOPHYTE 1N

**GAMETOPHYTE
&
SPOROPHYTE
MORPHOLOGY
IDENTICAL**

SPOROPHYTE 2N





GAMETOPHYTE 1N

ISOMORPHIC SPORIC LIFE CYCLE



SPOROPHYTE 2N



EMBRYOPHYTE LIFE CYCLE EVOLUTION

**VASCULAR
PLANT
EVOLUTION**

CYANOPHYTA

**ENDOSYMBIOTIC
THEORY**

**VASCULAR
PLANT
EVOLUTION**

CHLOROPHYTA

E
+

ULVOPHYCEAE

CHLOROPHYCEAE

CHAROPHYCEAE

**VASCULAR
PLANT
EVOLUTION**

CYANOPHYTA

**ENDOSYMBIOTIC
THEORY**

**VASCULAR
PLANT
EVOLUTION**

CHLOROPHYTA



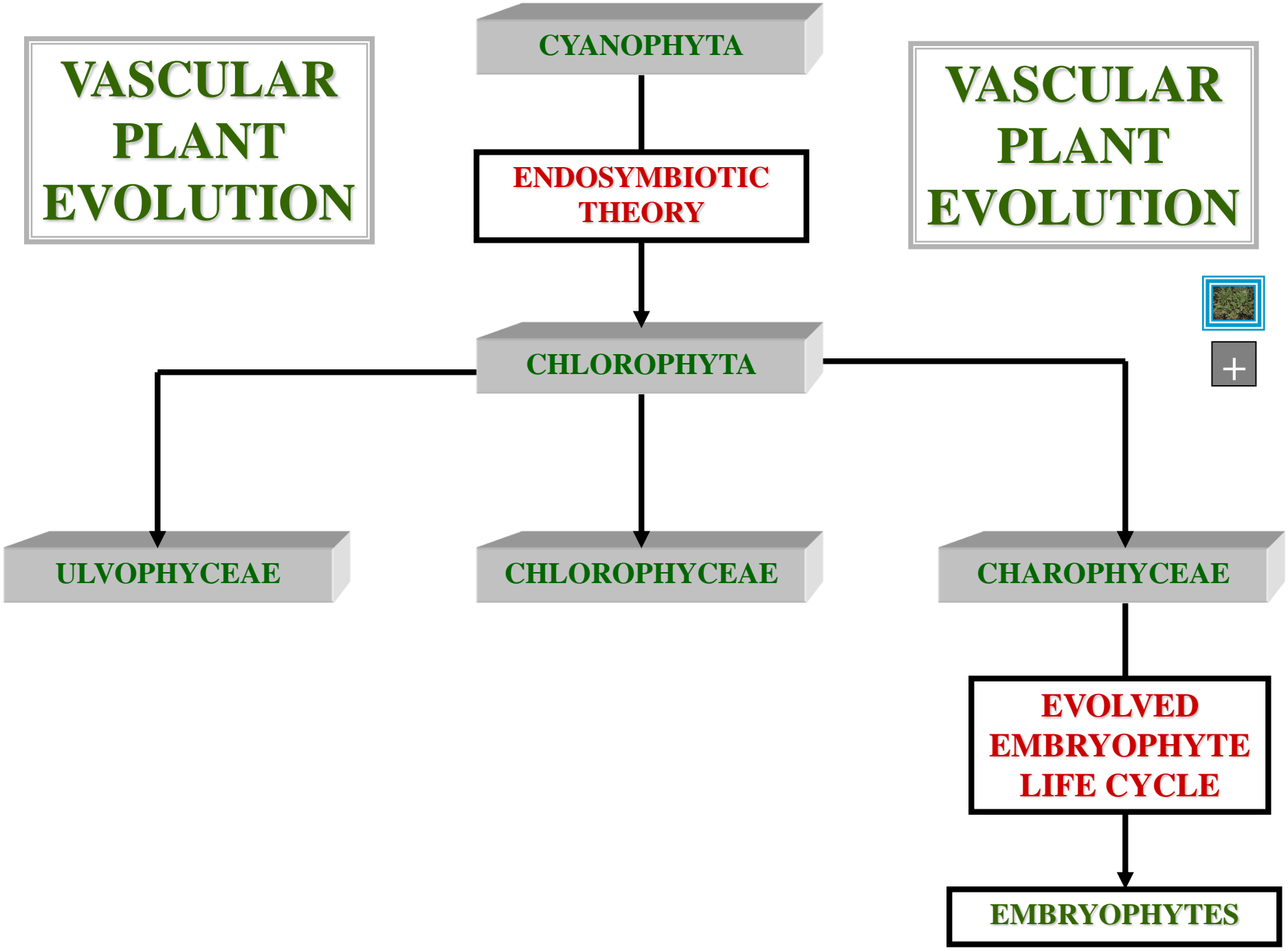
ULVOPHYCEAE

CHLOROPHYCEAE

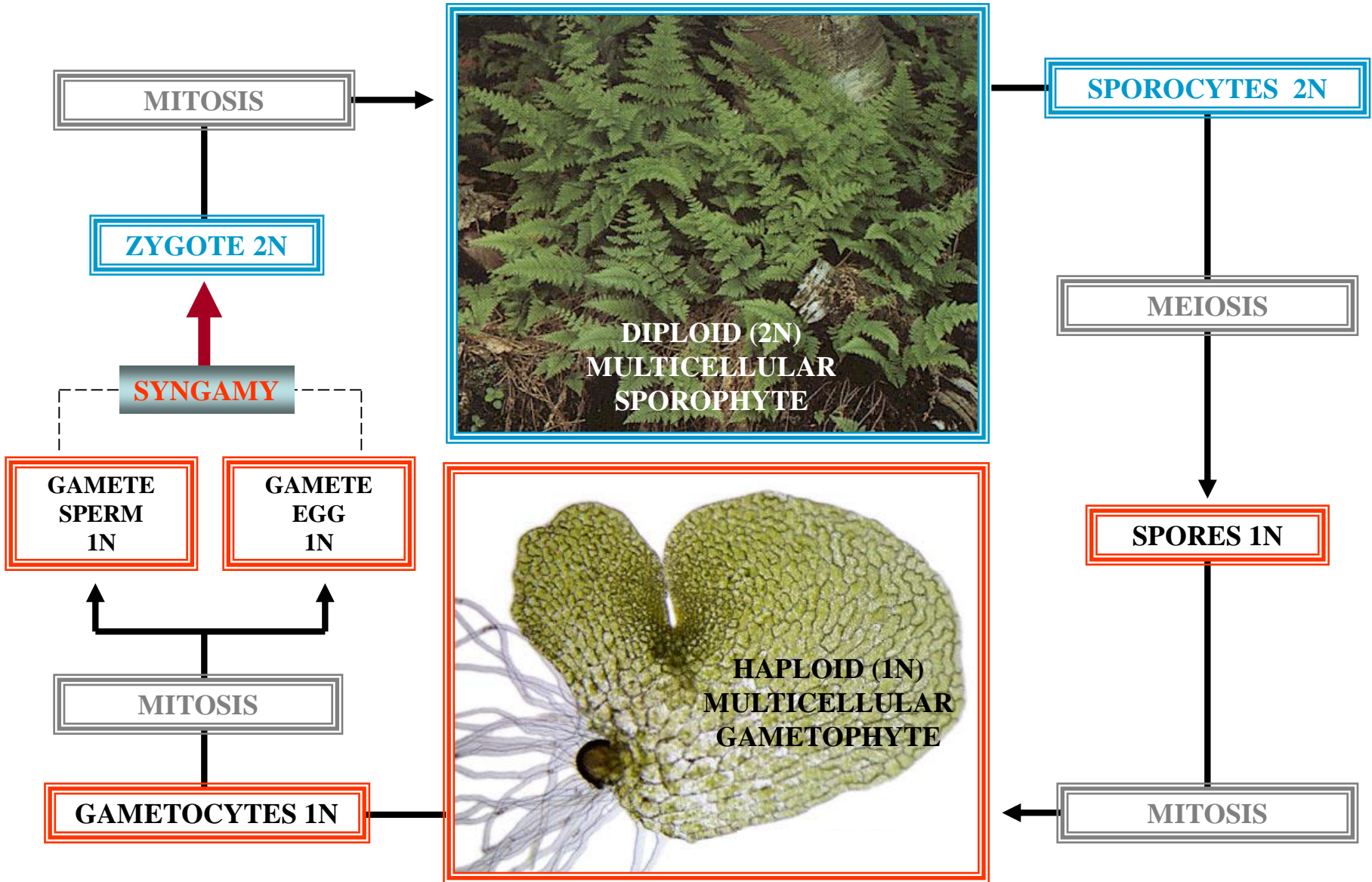
CHAROPHYCEAE

**EVOLVED
EMBRYOPHYTE
LIFE CYCLE**

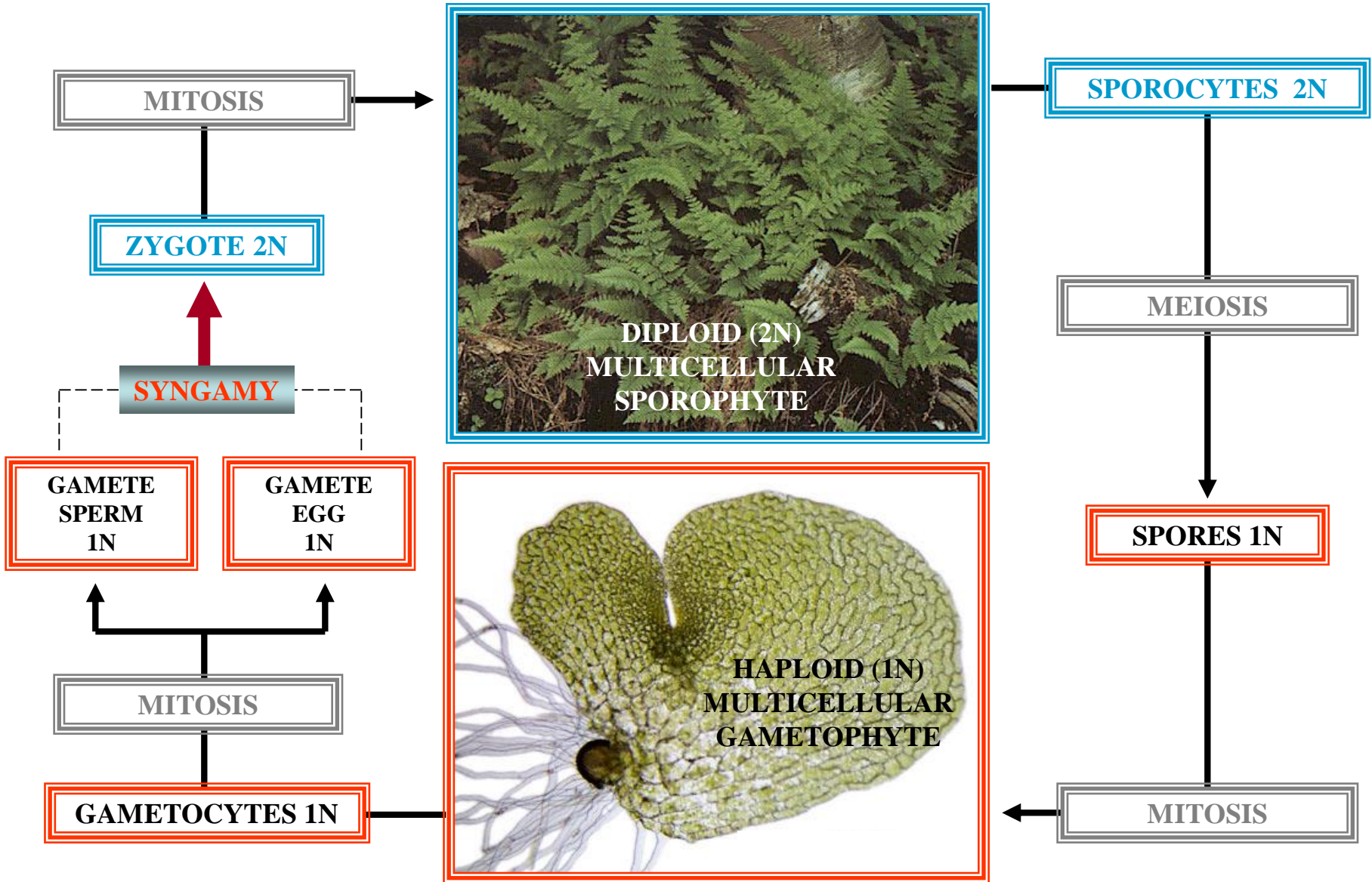
EMBRYOPHYTES



EMBRYOPHYTE LIFE CYCLE

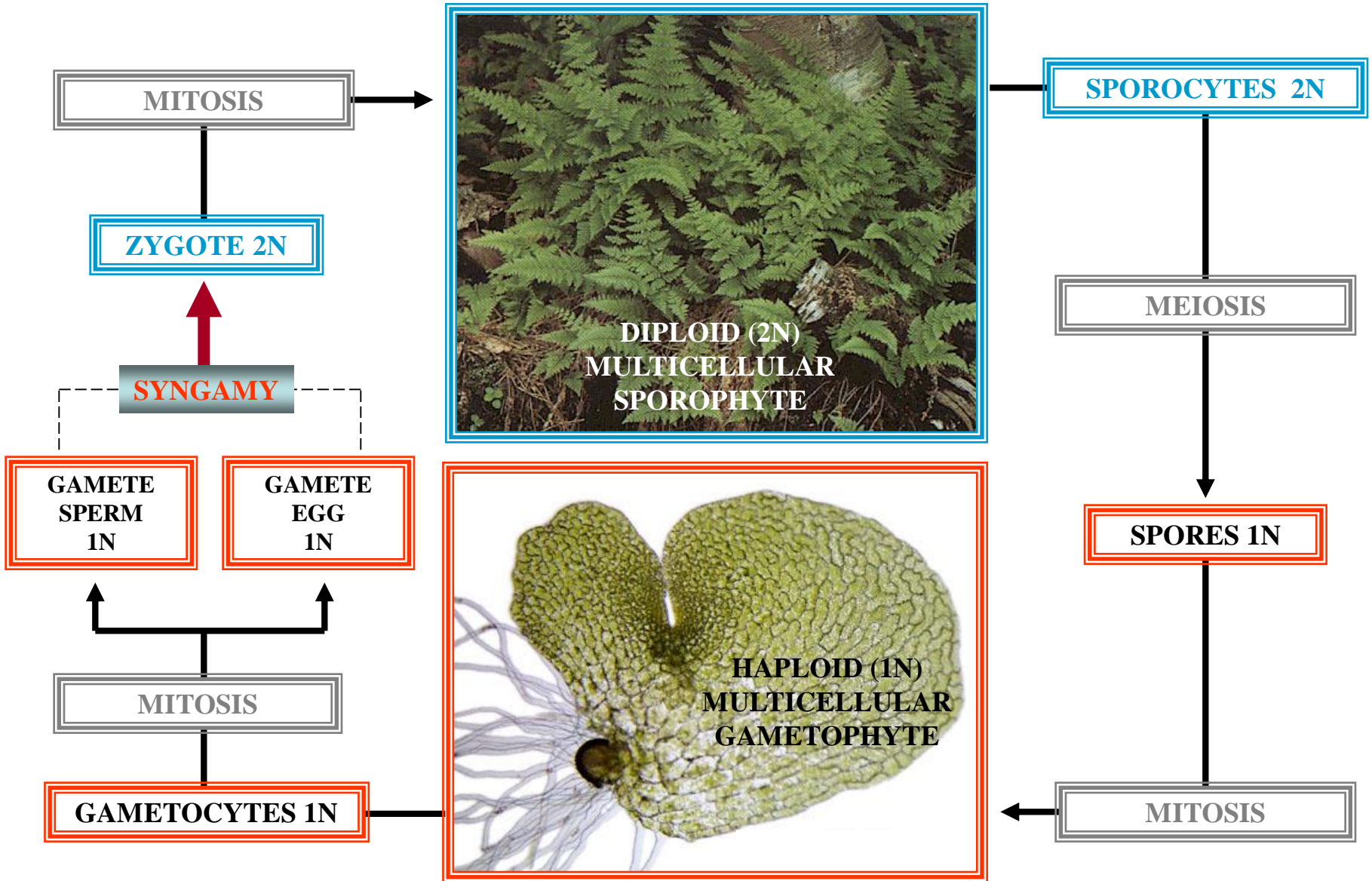


EMBRYOPHYTE SPORIC LIFE CYCLE





EMBRYOPHYTE HETEROMORPHIC SPORIC LIFE CYCLE



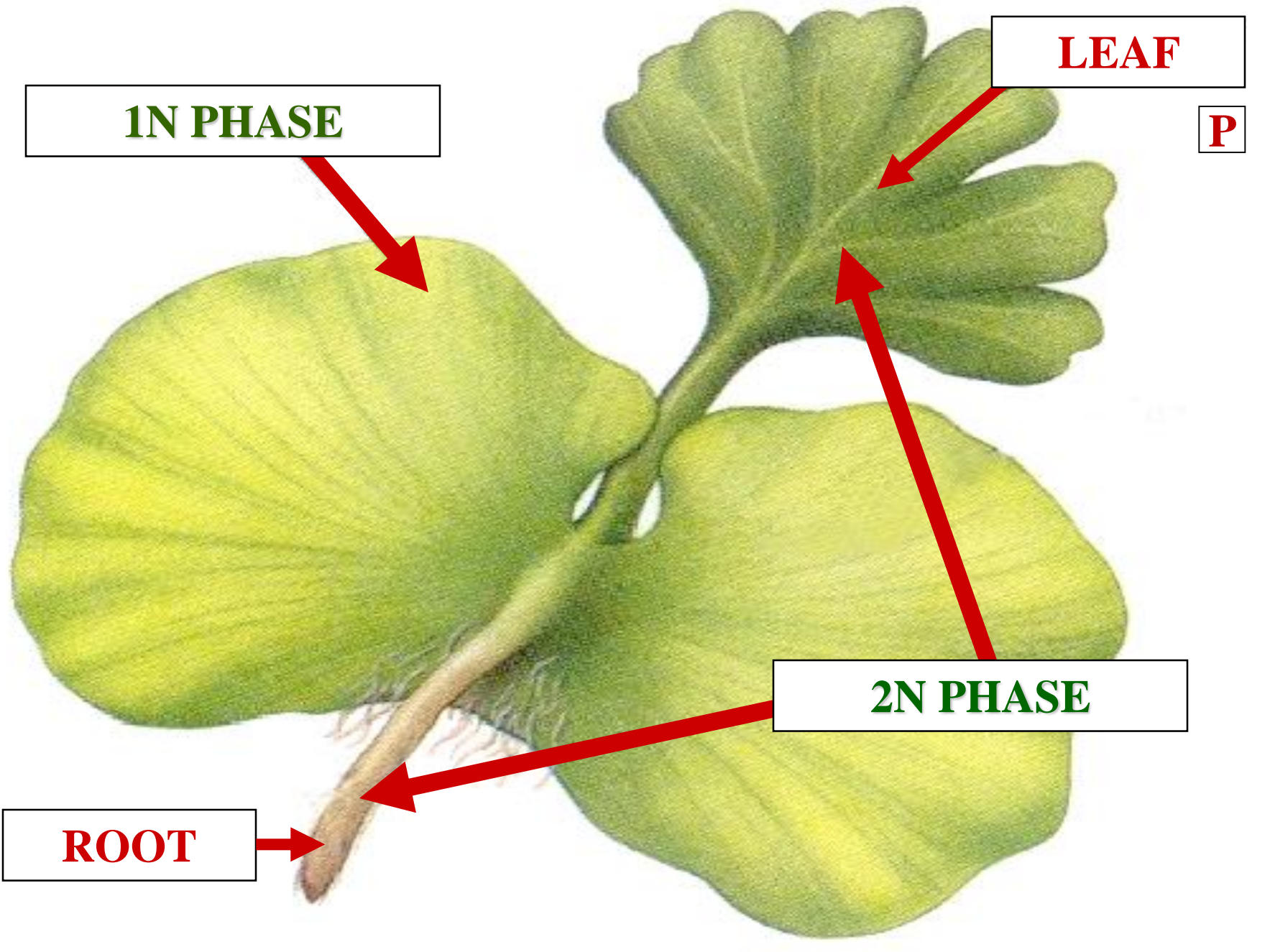
1N PHASE

LEAF

P

2N PHASE

ROOT



1N PHASE

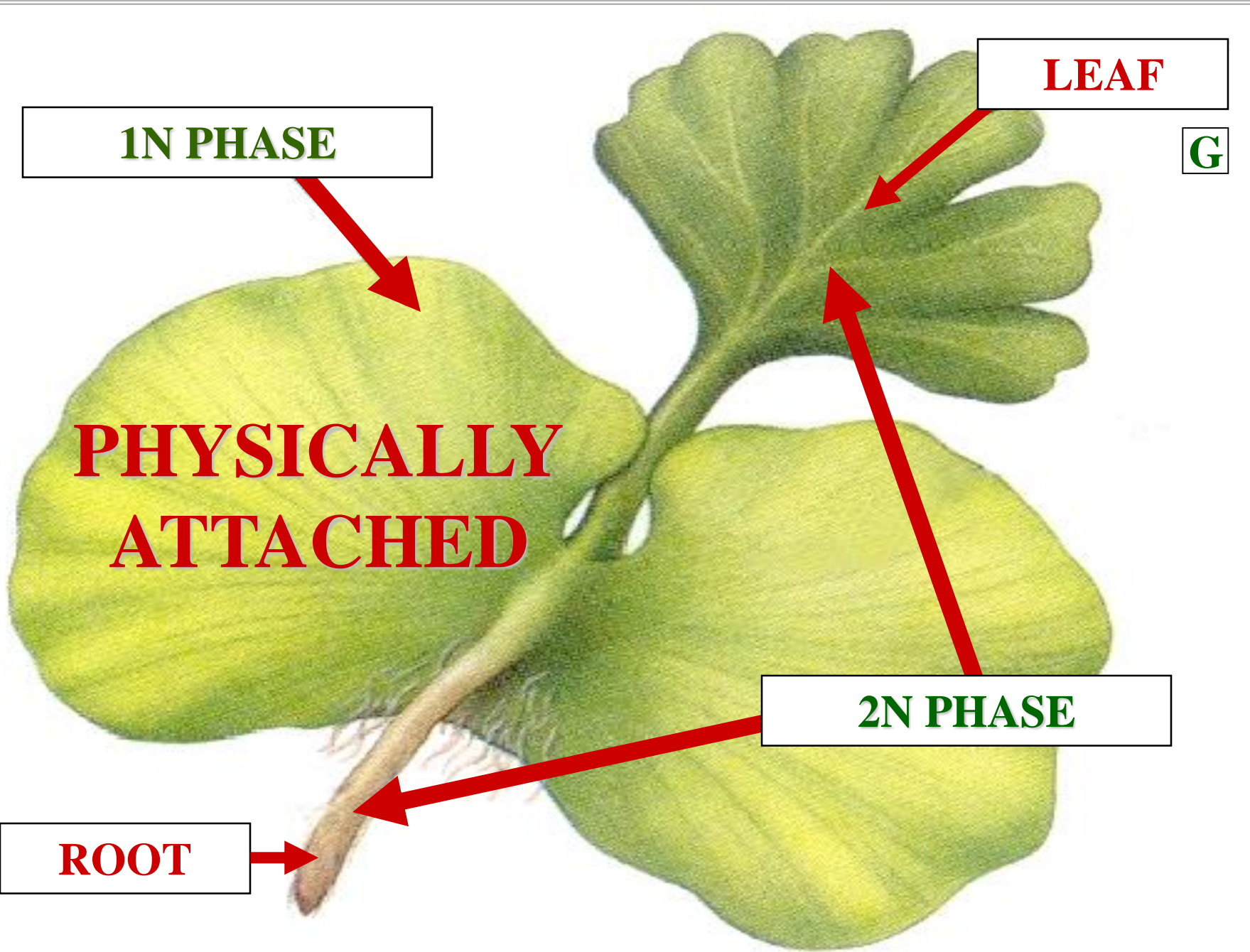
LEAF

G

**PHYSICALLY
ATTACHED**

2N PHASE

ROOT



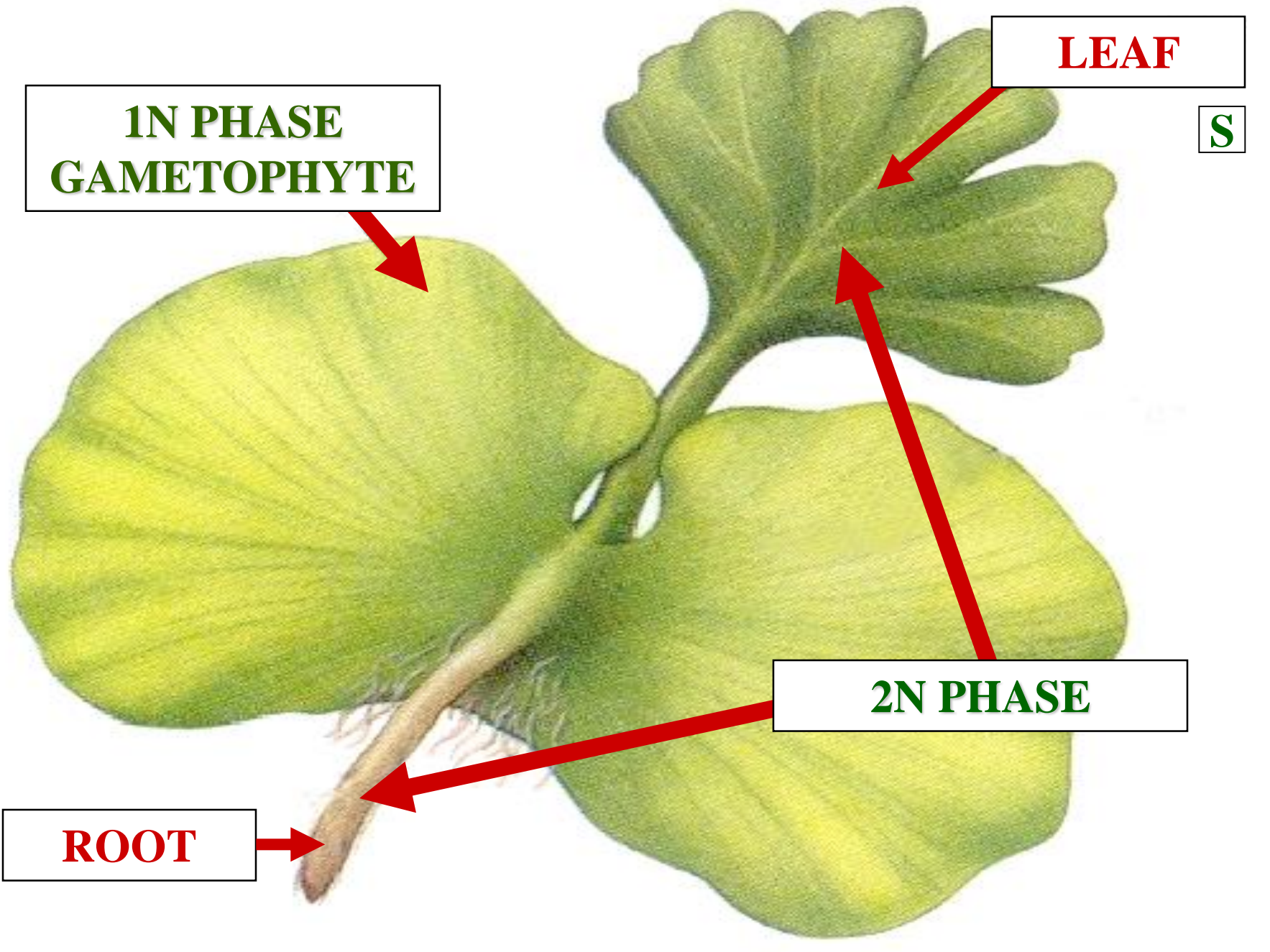
LEAF

S

**1N PHASE
GAMETOPHYTE**

2N PHASE

ROOT



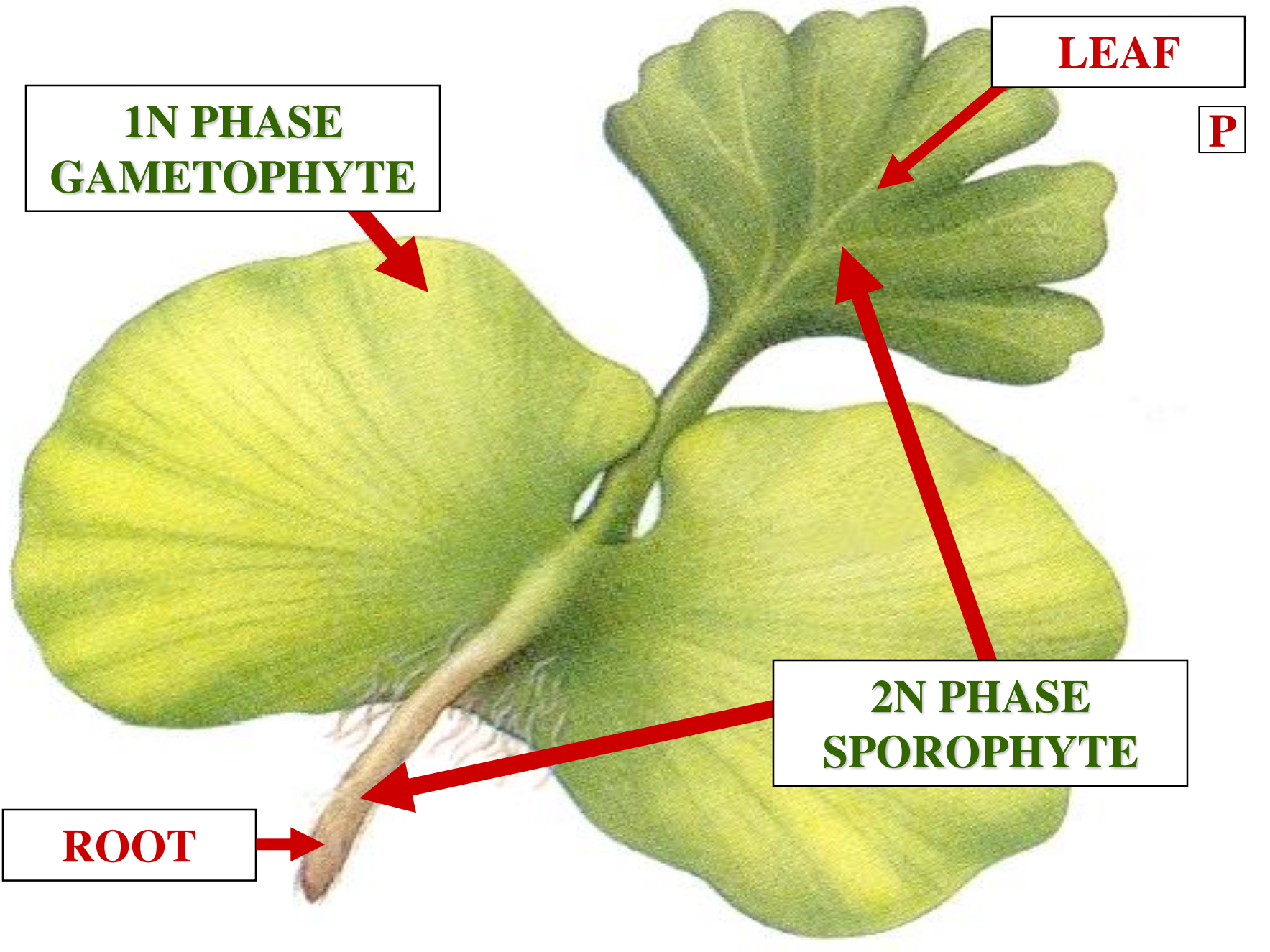
LEAF

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**1N PHASE
GAMETOPHYTE**

**2N PHASE
SPOROPHYTE**

ROOT



LEAF

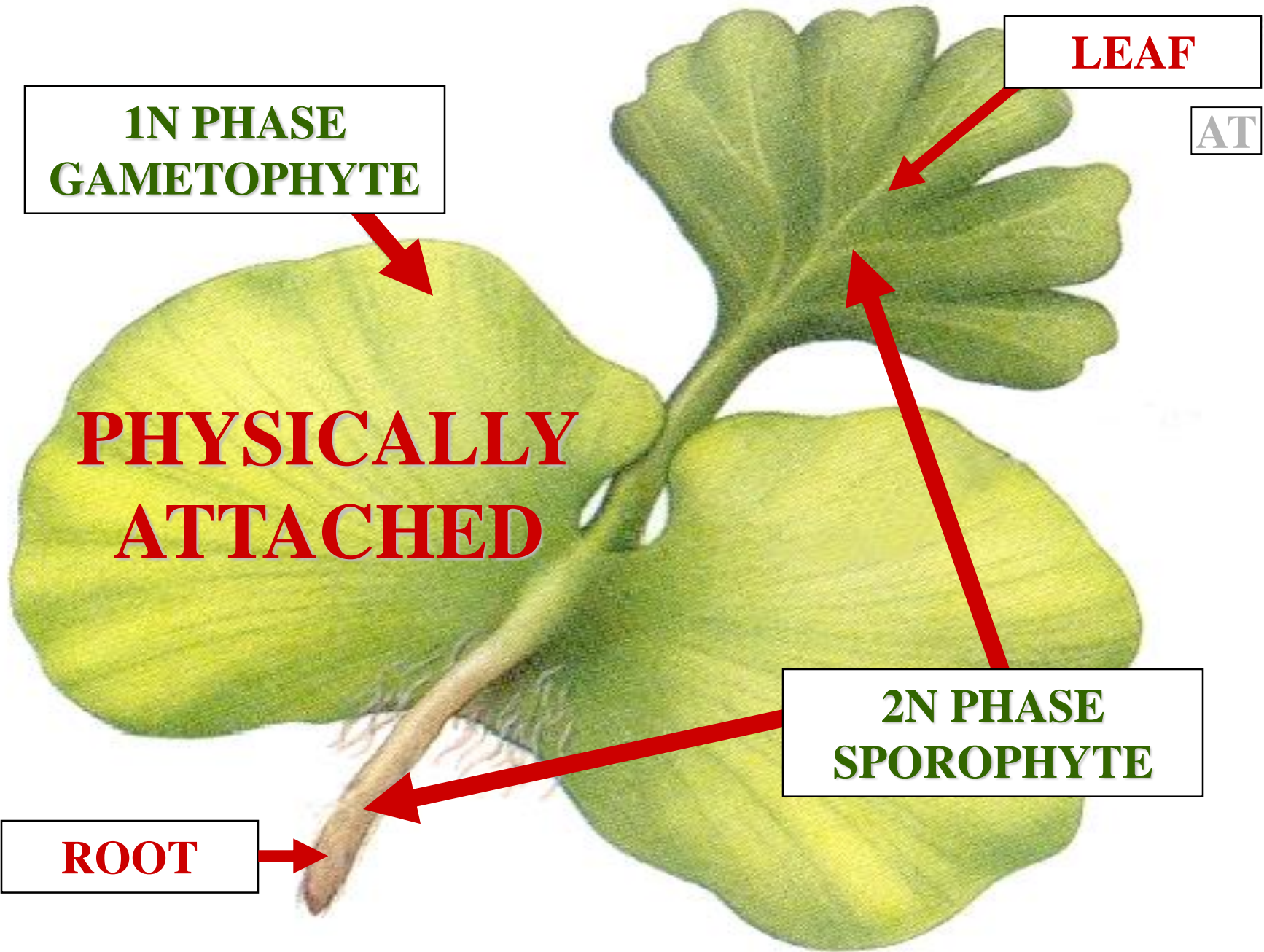
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**1N PHASE
GAMETOPHYTE**

**PHYSICALLY
ATTACHED**

**2N PHASE
SPOROPHYTE**

ROOT



LEAF

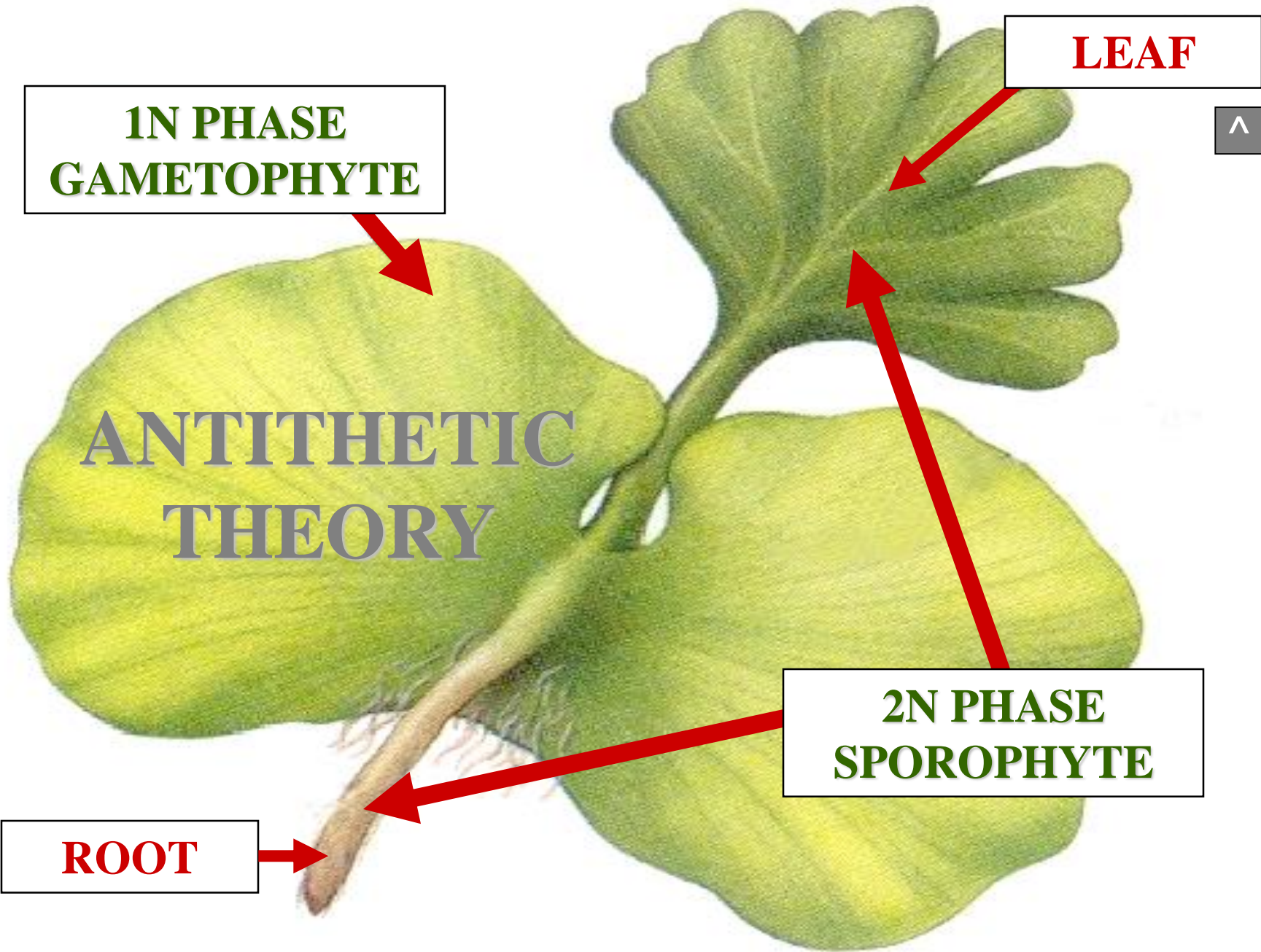
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**1N PHASE
GAMETOPHYTE**

**ANTITHETIC
THEORY**

**2N PHASE
SPOROPHYTE**

ROOT





ANTITHETIC THEORY



ANTITHETIC THEORY START



**GREEN ALGA
ANCESTOR
MULTICELLULAR
1N PHASE**



CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE



GAMETANGIA

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



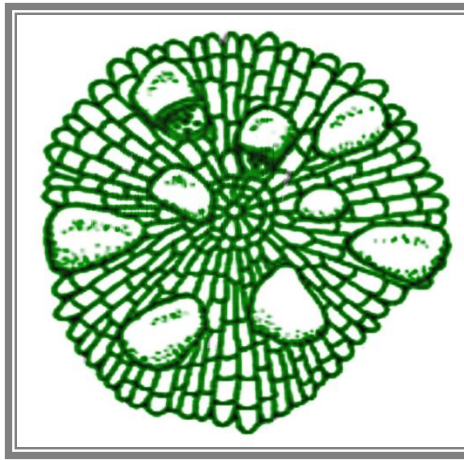
GAMETANGIUM

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



GAMETOCYTES

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



GAMETOCYTES 1N

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE



GAMETOCYTES 1N

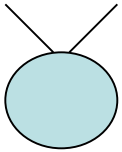


MITOSIS



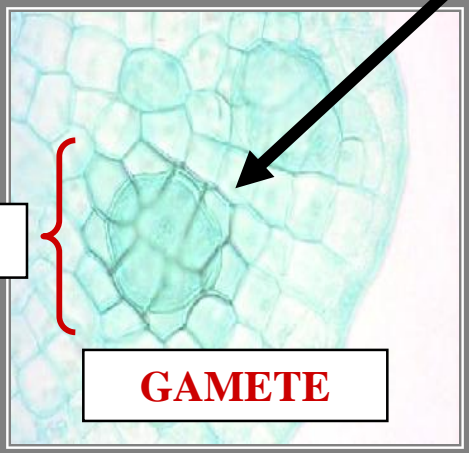
GAMETOCYTES 1N

MITOSIS



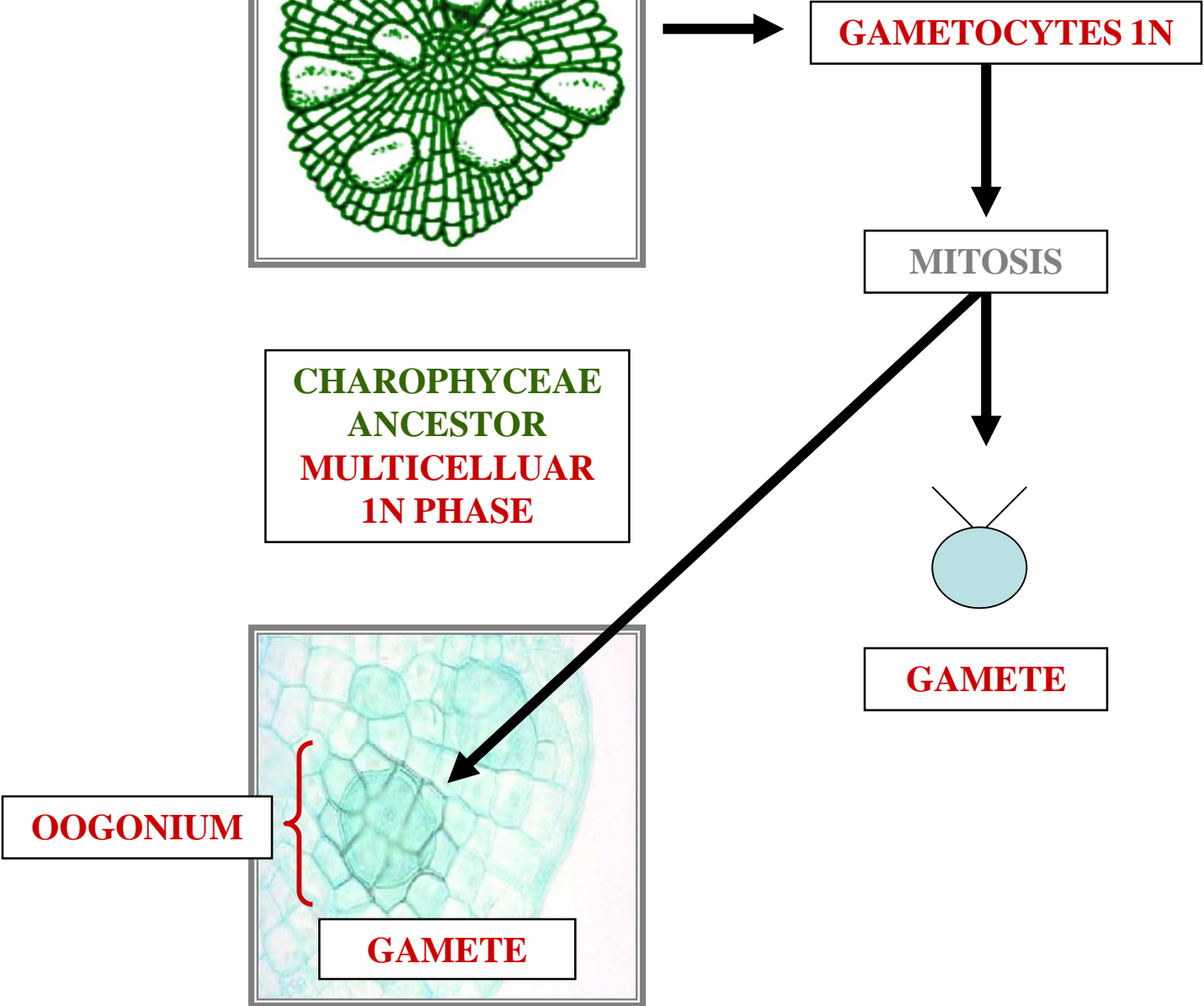
GAMETE

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



OOGONIUM

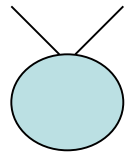
GAMETE





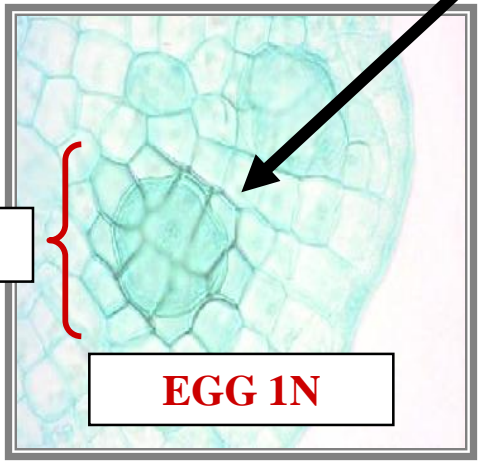
GAMETOCYTES 1N

MITOSIS



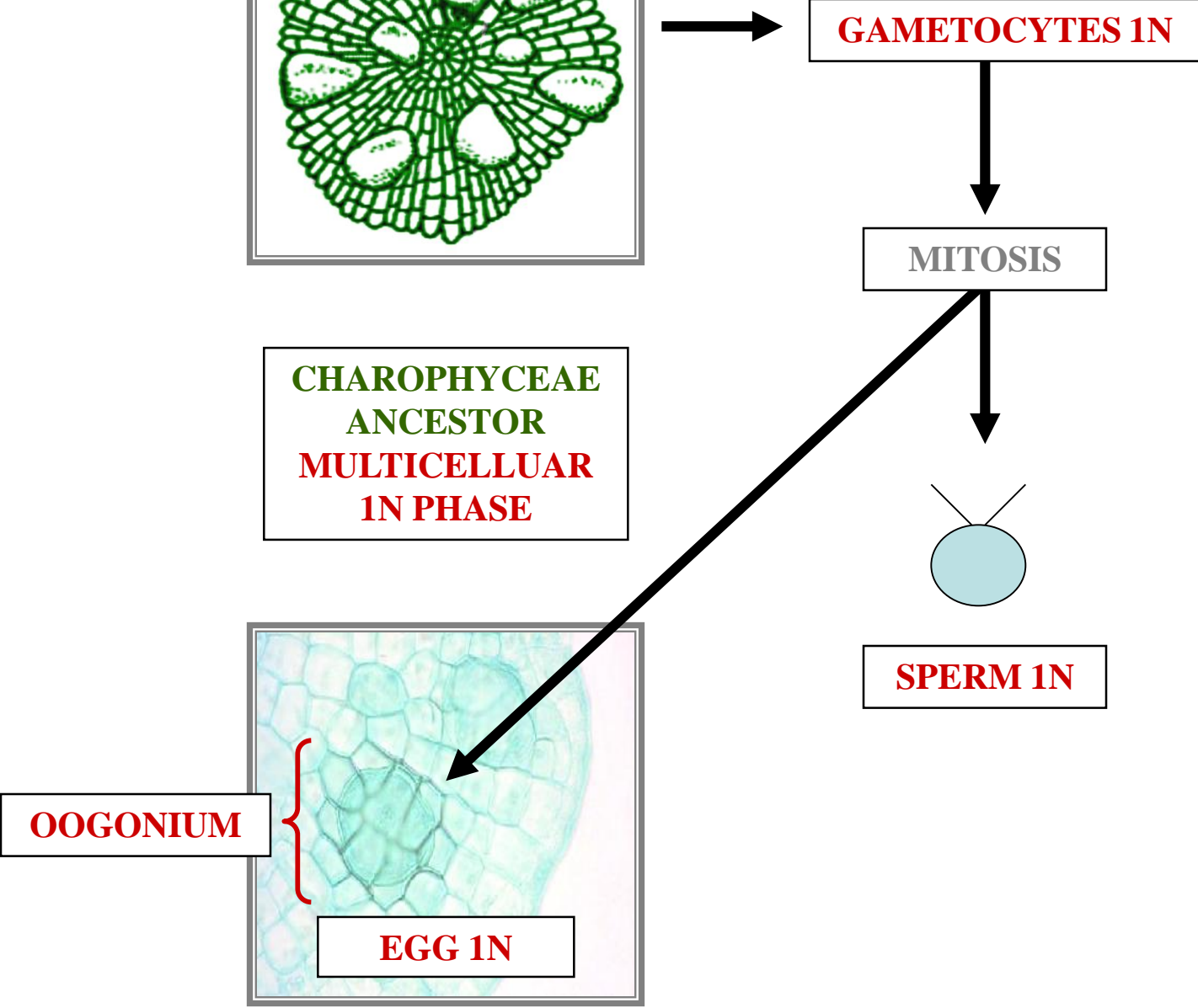
SPERM 1N

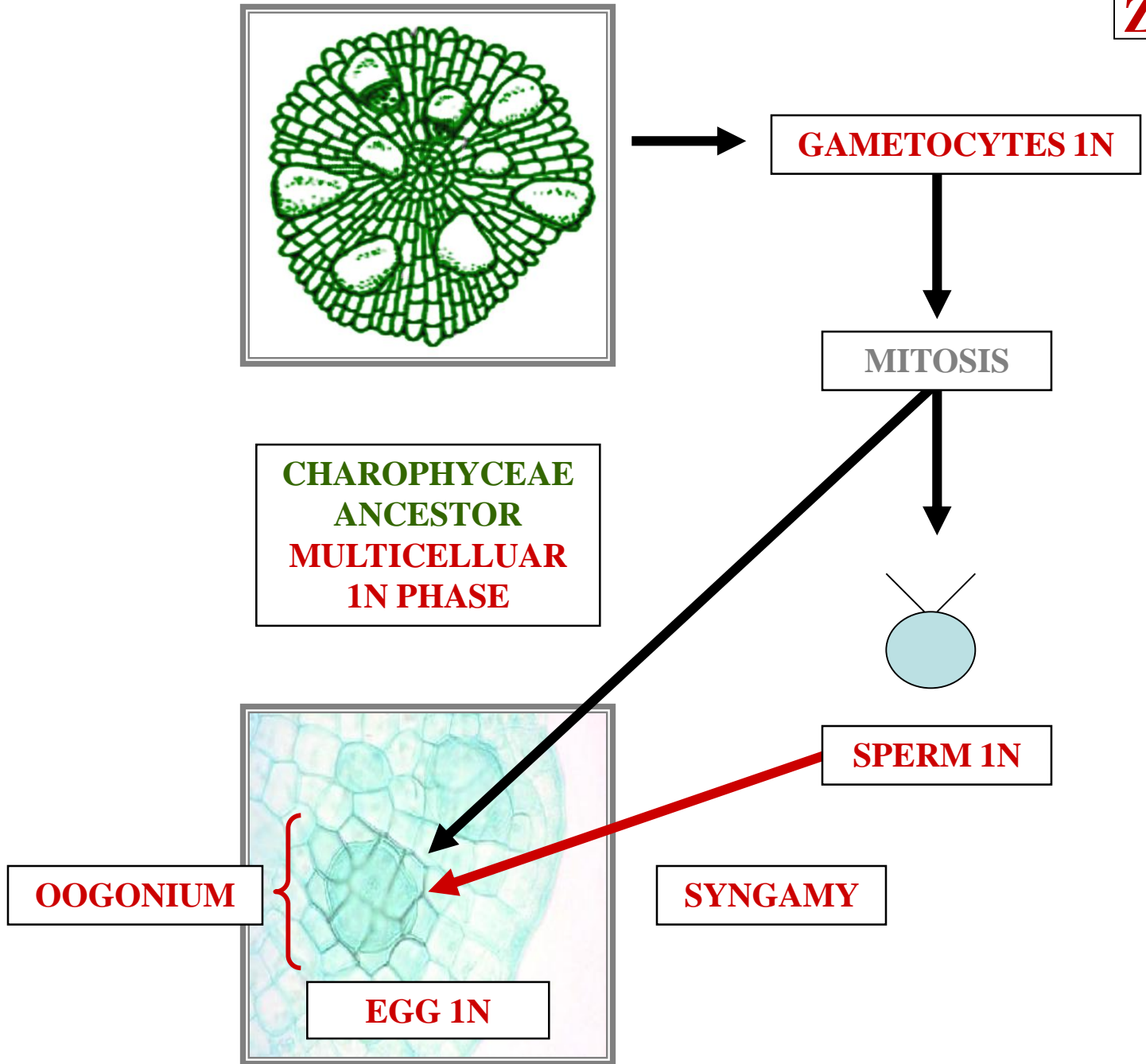
**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



OOGONIUM

EGG 1N

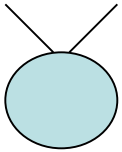






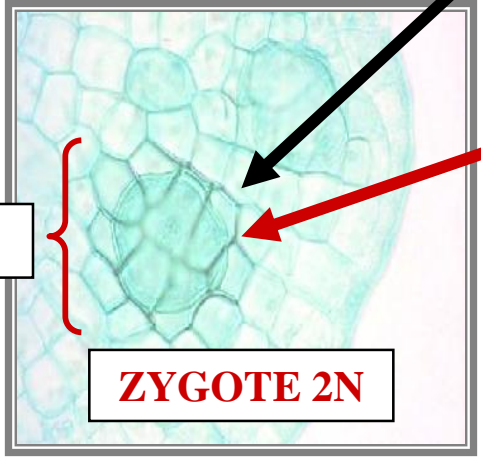
GAMETOCYTES 1N

MITOSIS



SPERM 1N

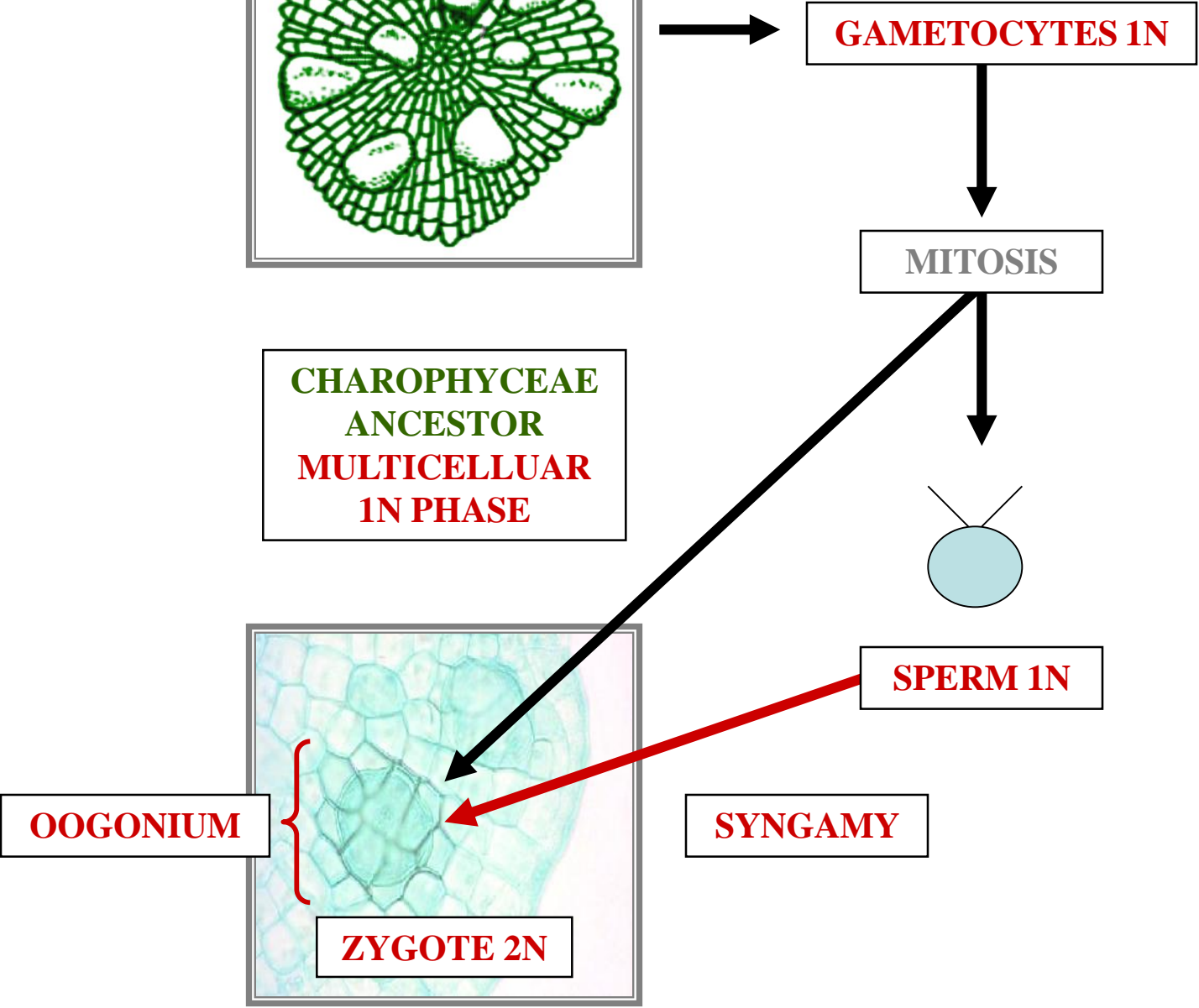
**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**



OOGONIUM

SYNGAMY

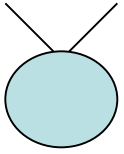
ZYGOTE 2N





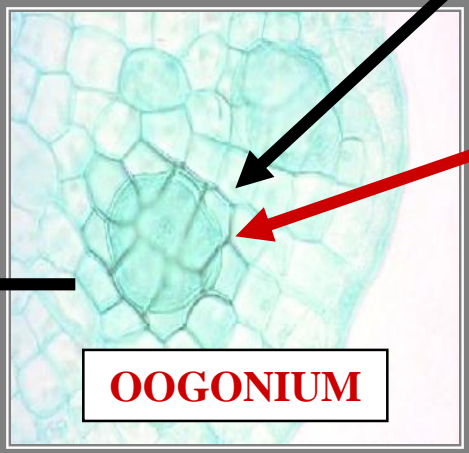
GAMETOCYTES 1N

MITOSIS



SPERM 1N

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**

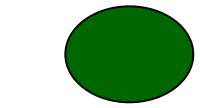


OOGONIUM

SYNGAMY

**2N ZYGOTE
RELEASED
FROM
OOGONIUM**

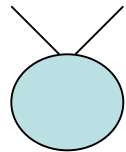
ZYGOTE 2N





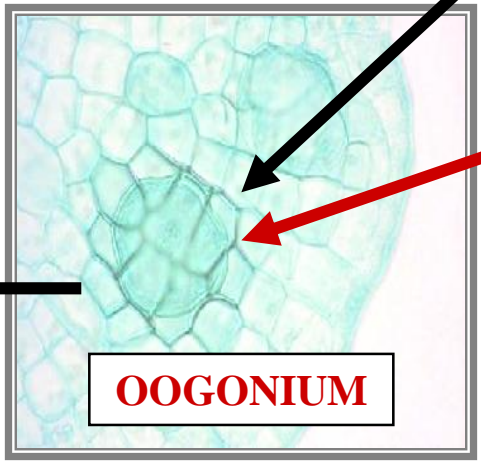
GAMETOCYTES 1N

MITOSIS



SPERM 1N

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**

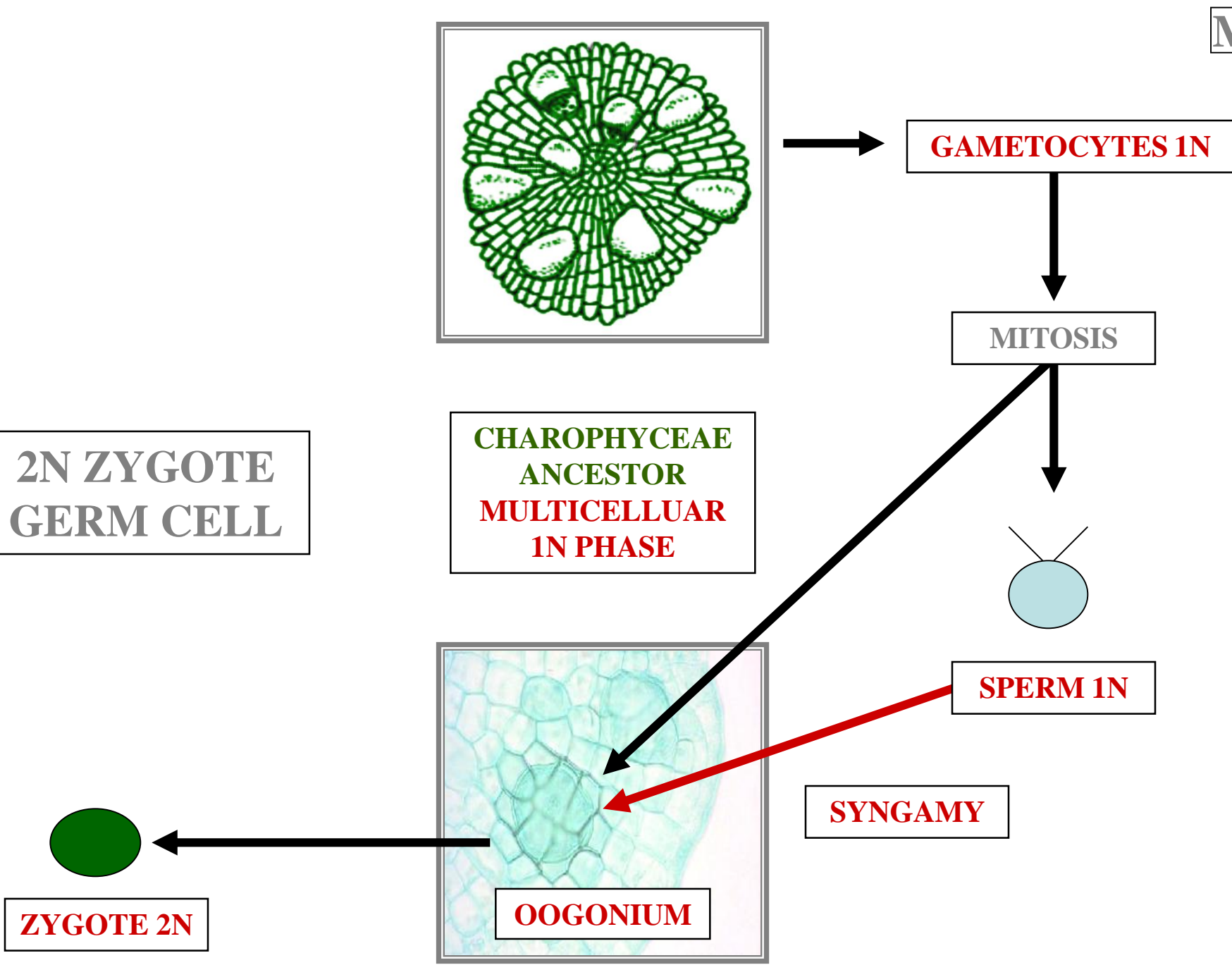


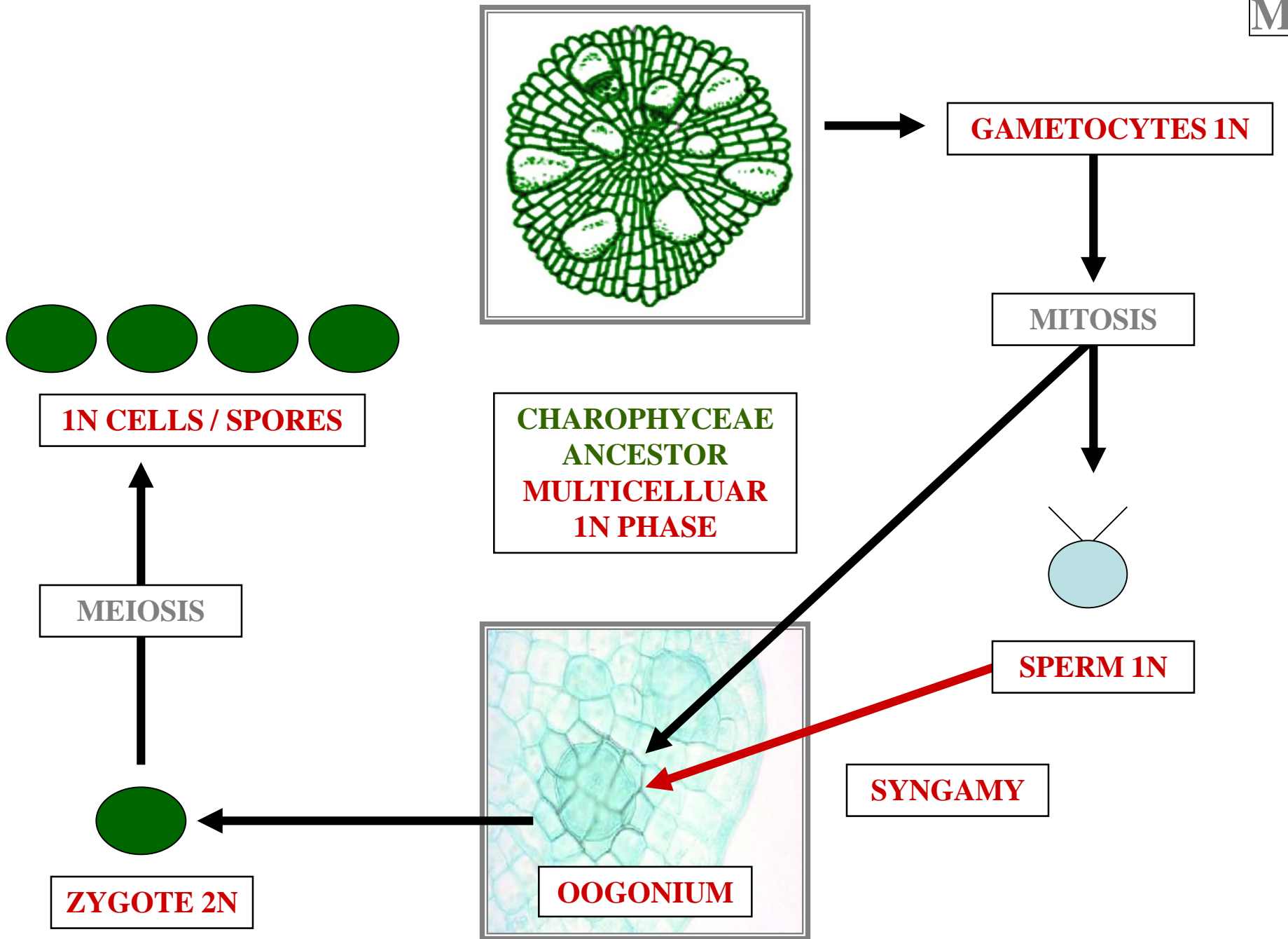
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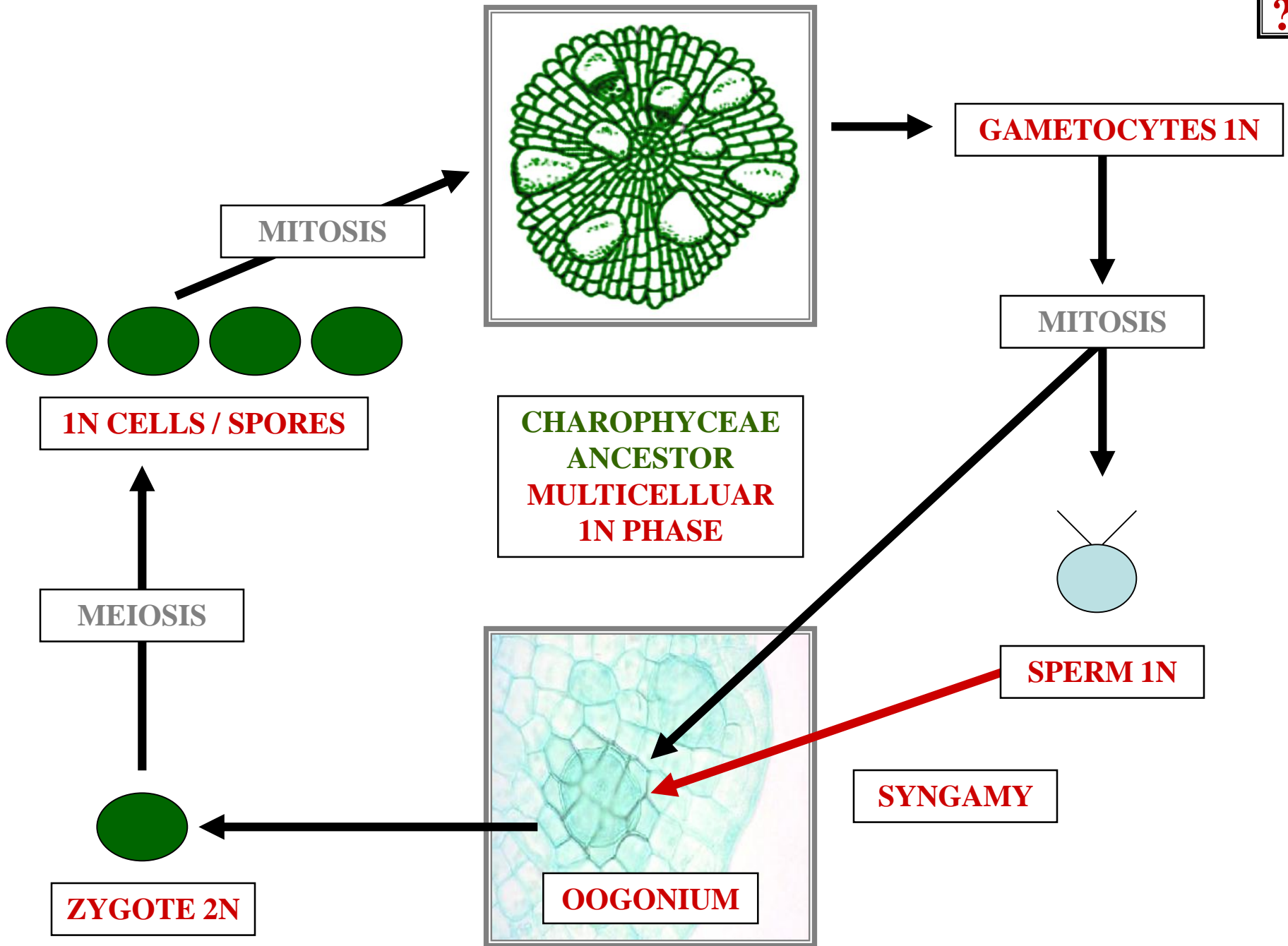
SYNGAMY

**2N ZYGOTE
GERM CELL**

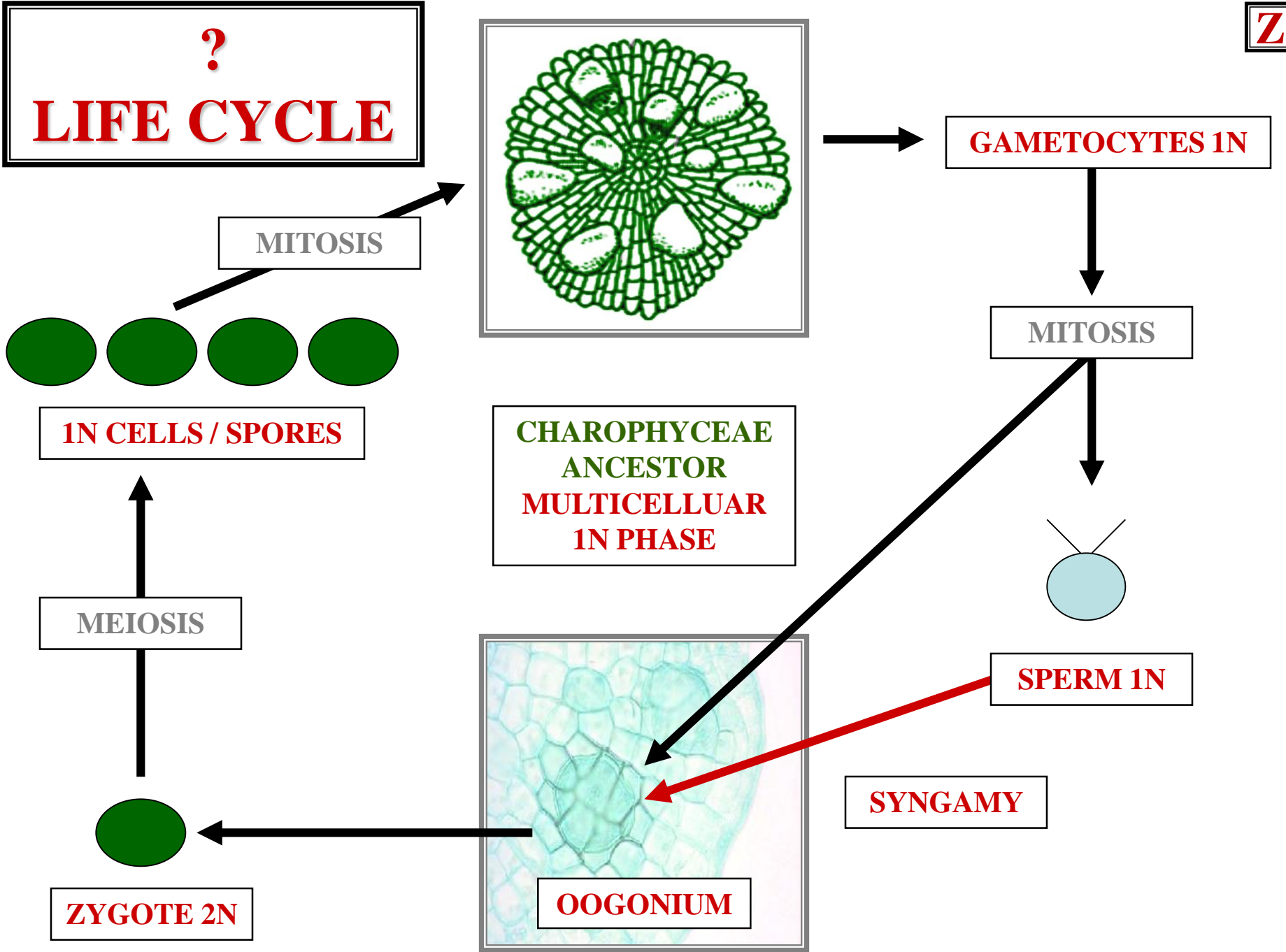
ZYGOTE 2N





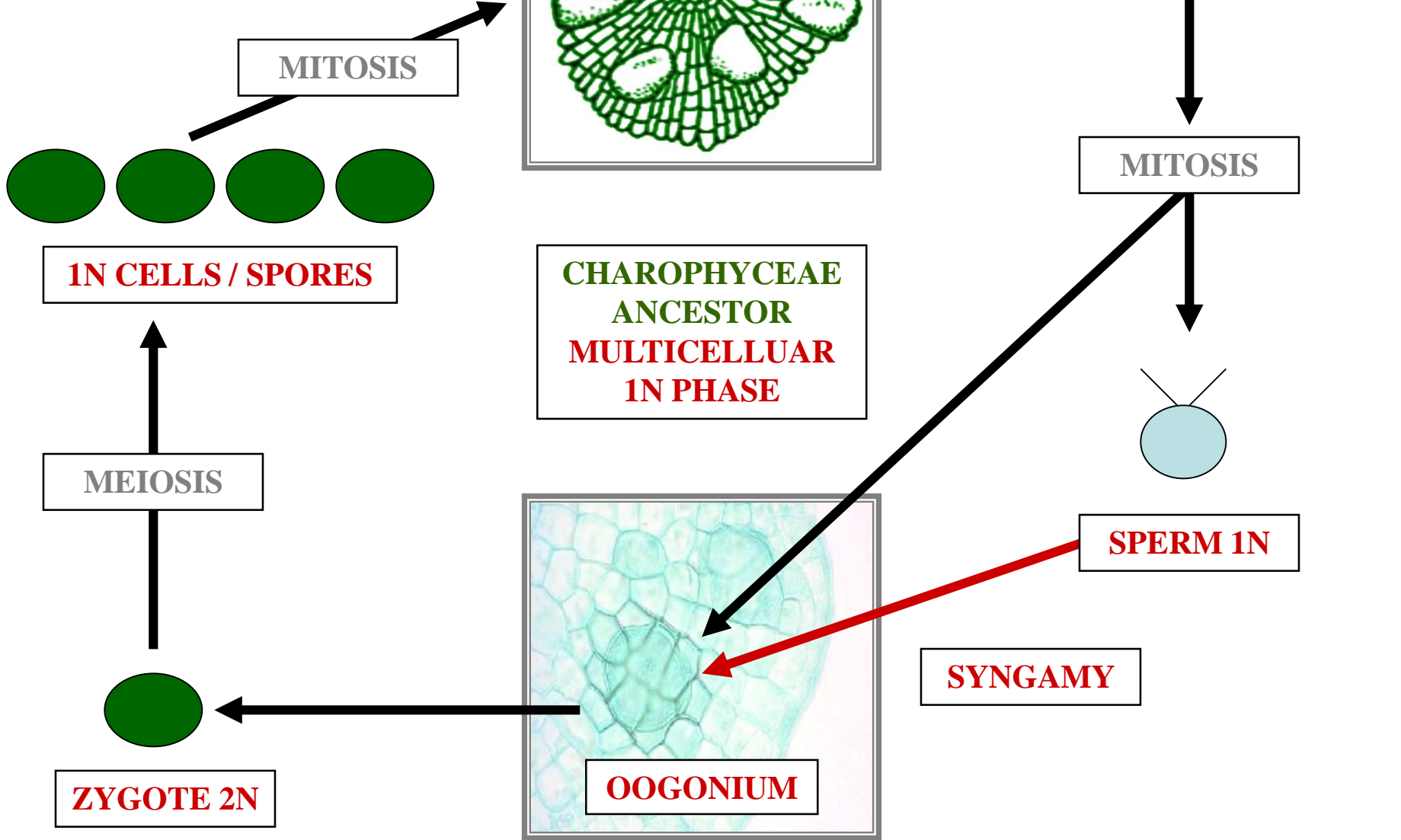


? LIFE CYCLE





ZYGOTIC LIFE CYCLE





ANTITHETIC THEORY DURING

ANTITHETIC THEORY

RT



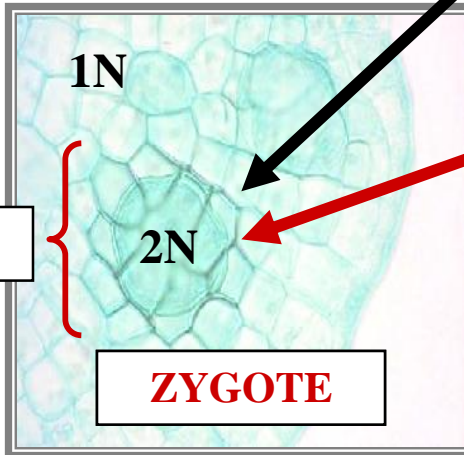
GAMETOCYTES 1N

MITOSIS



SPERM

CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE



OOGONIUM

1N

2N

ZYGOTE

SYNGAMY



ANTITHETIC THEORY

DM



GAMETOCYTES 1N

MITOSIS

1N

SPERM

SYNGAMY

2N ZYGOTE
RETAINED
WITHIN
OOGONIUM

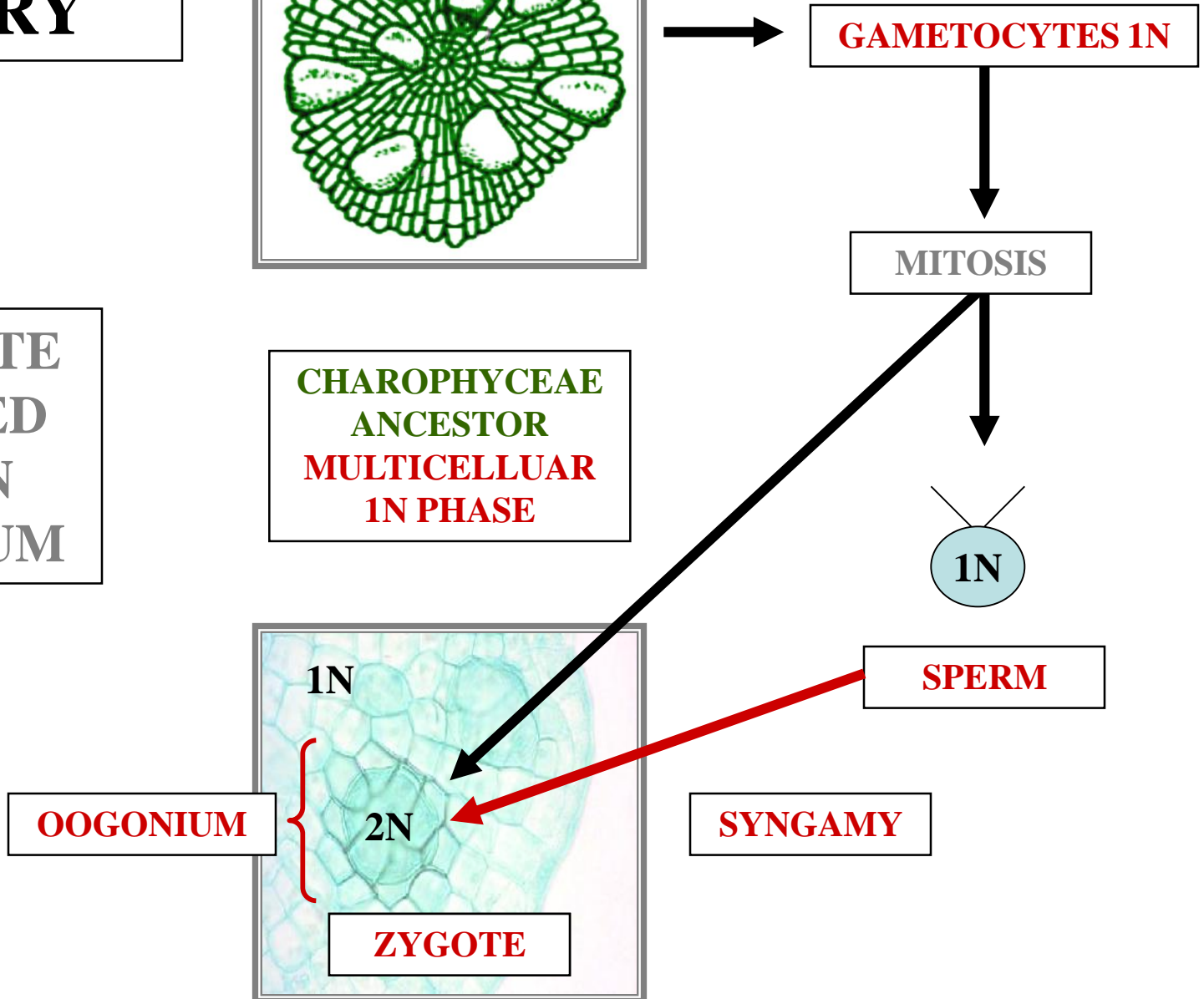
CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE

OOGONIUM

1N

2N

ZYGOTE



ANTITHETIC THEORY

UM



GAMETOCYTES 1N

MITOSIS



SPERM

SYNGAMY

2N ZYGOTE
DELAYES
MEIOSIS

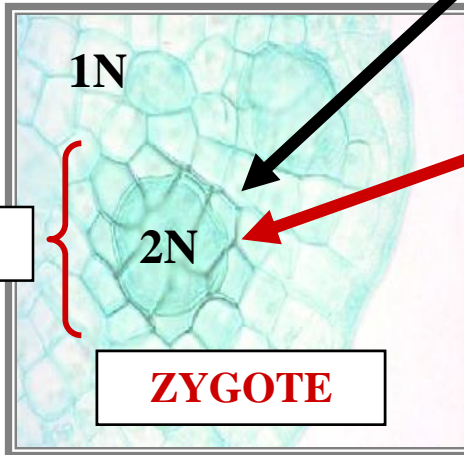
CHAROPHYCEAE
ANCESTOR
MULTICELLUAR
1N PHASE

OOGONIUM

1N

2N

ZYGOTE



ANTITHETIC THEORY



GAMETOCYTES 1N

MITOSIS

1N

SPERM

**2N ZYGOTE
UNDERGOES
REPEATED
MITOSIS**

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**

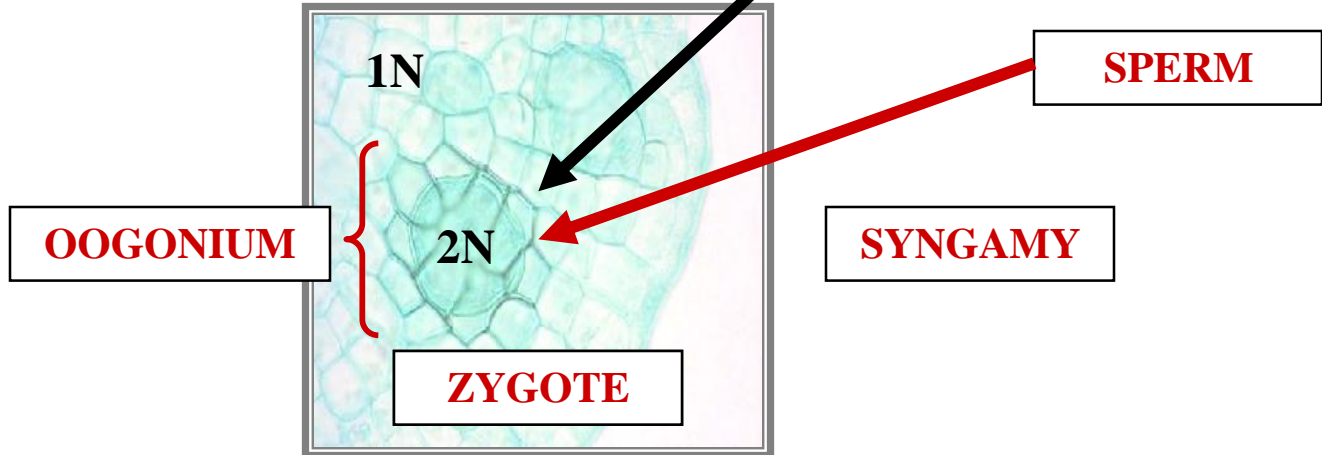
OOGONIUM

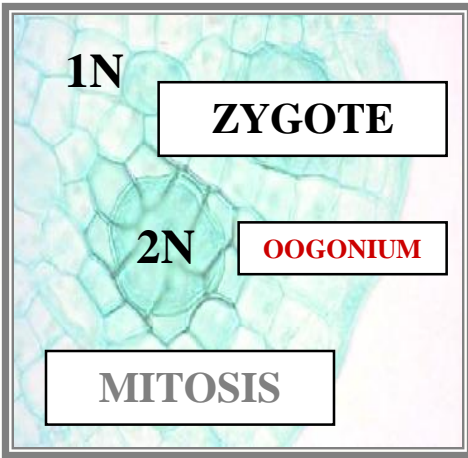
1N

2N

ZYGOTE

SYNGAMY





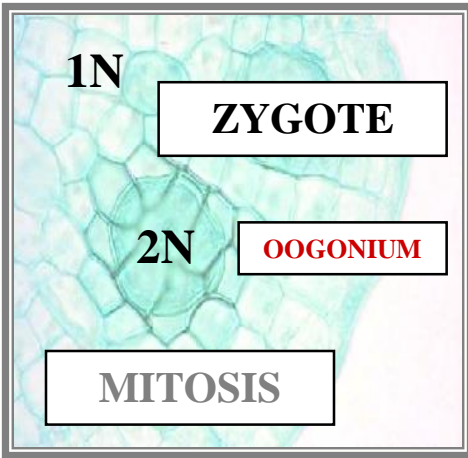
MULTICELLULAR

2N PHASE

OOGONIUM

MULTICELLULAR

1N PHASE



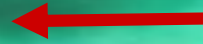
MULTICELLULAR

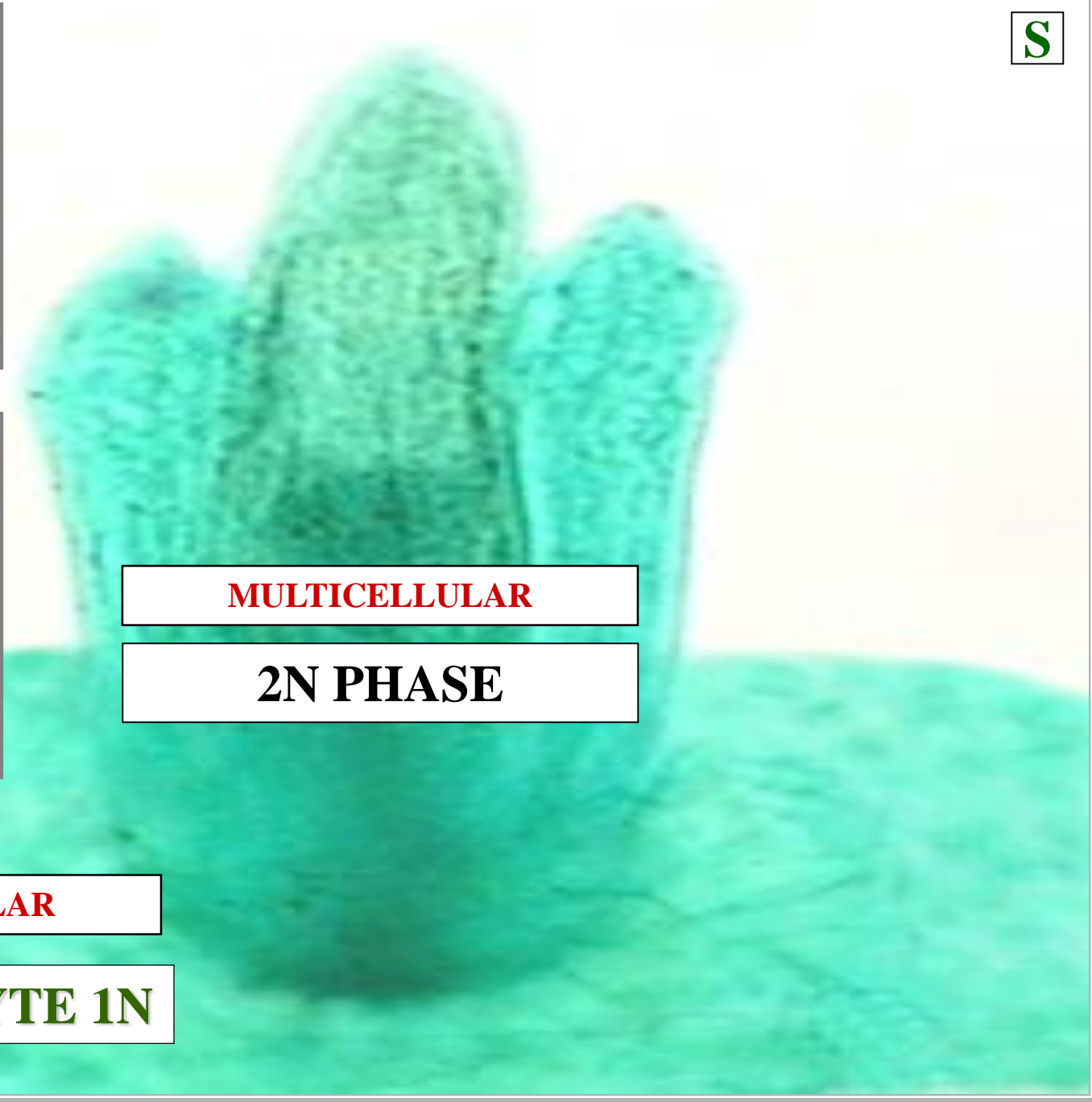
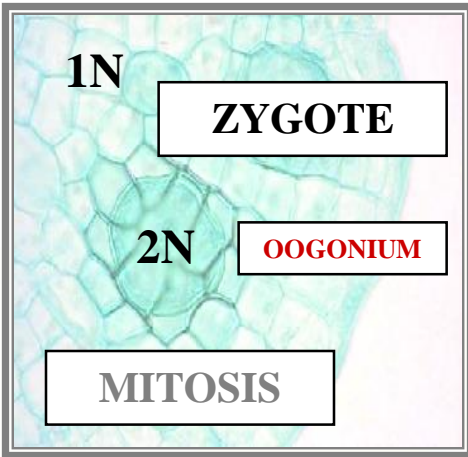
2N PHASE

MULTICELLULAR

1N PHASE

PHYSICALLY ATTACHED



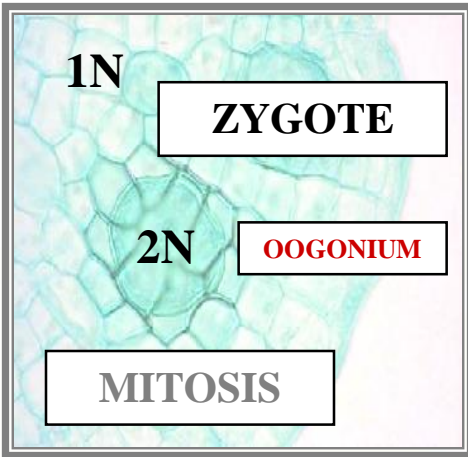


MULTICELLULAR

2N PHASE

MULTICELLULAR

GAMETOPHYTE 1N



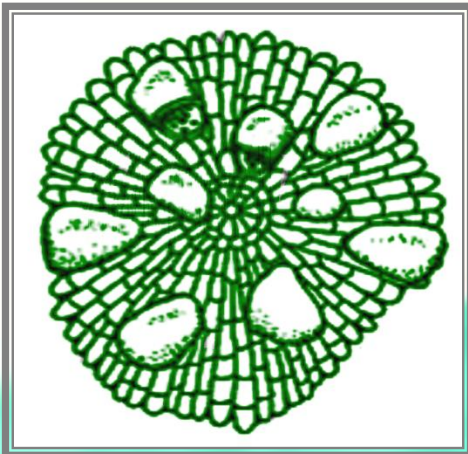
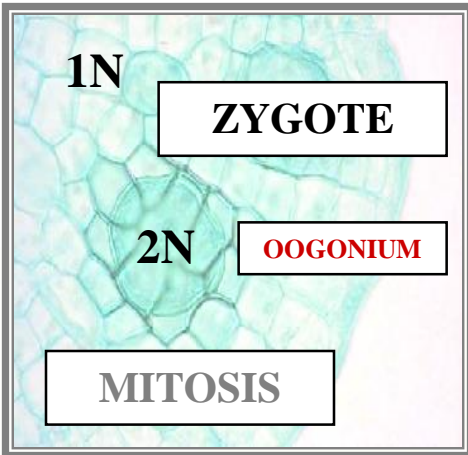
MULTICELLULAR

SPOROPHYTE 2N

MULTICELLULAR

GAMETOPHYTE 1N





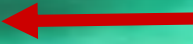
MULTICELLULAR

SPOROPHYTE 2N

MULTICELLULAR

GAMETOPHYTE 1N

PHYSICALLY ATTACHED

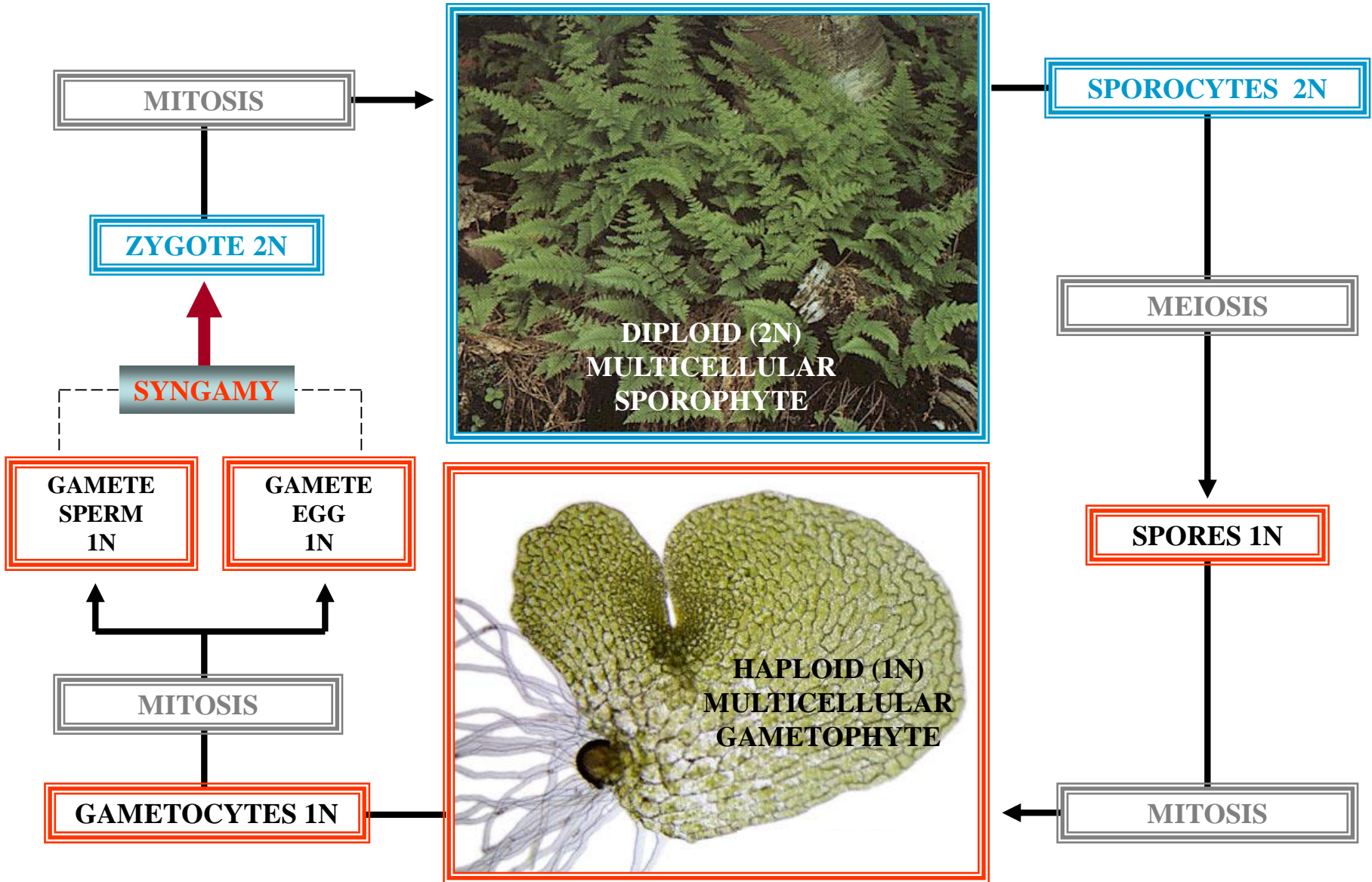




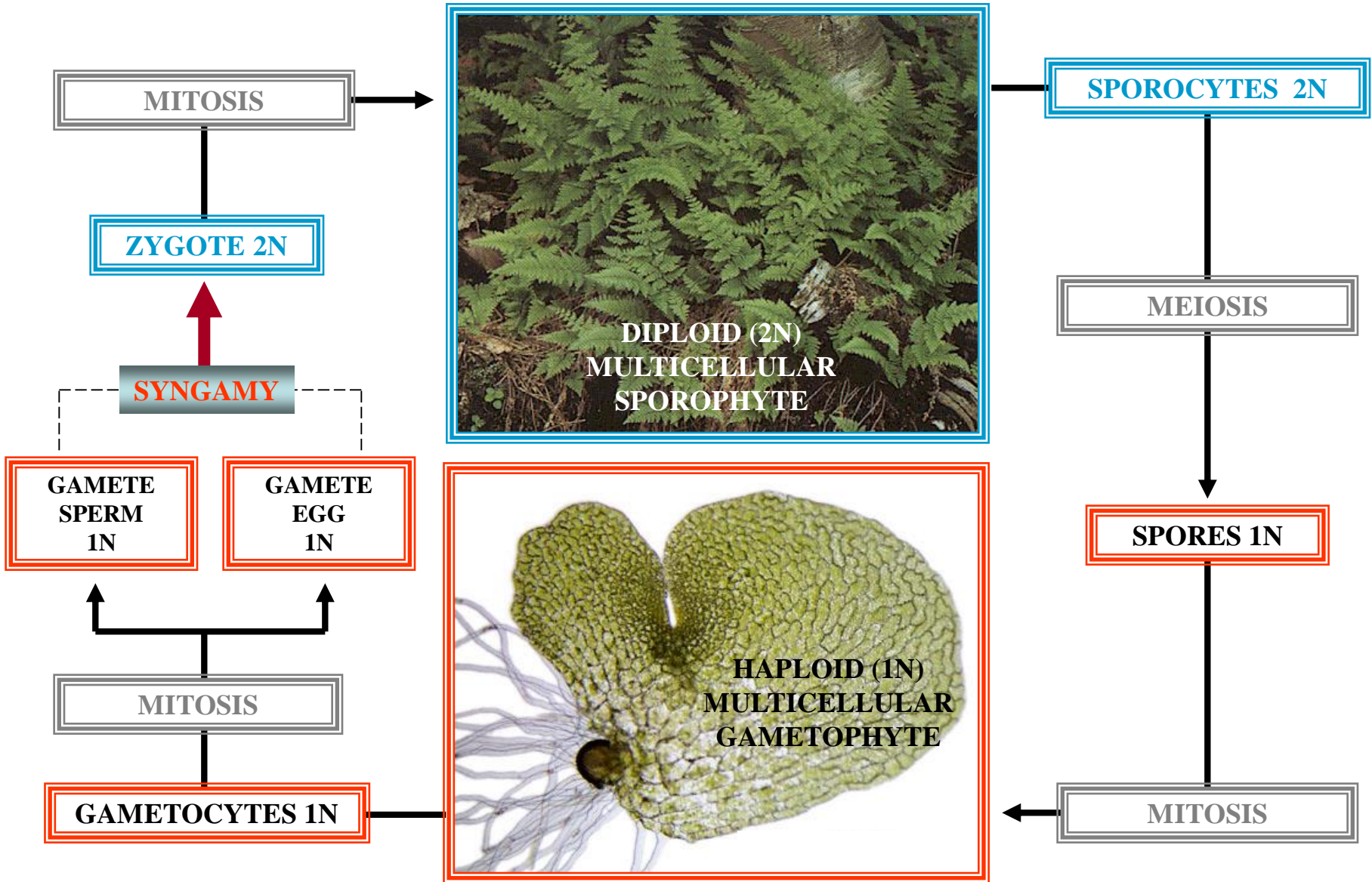
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ANTITHETIC THEORY END

EMBRYOPHYTE LIFE CYCLE



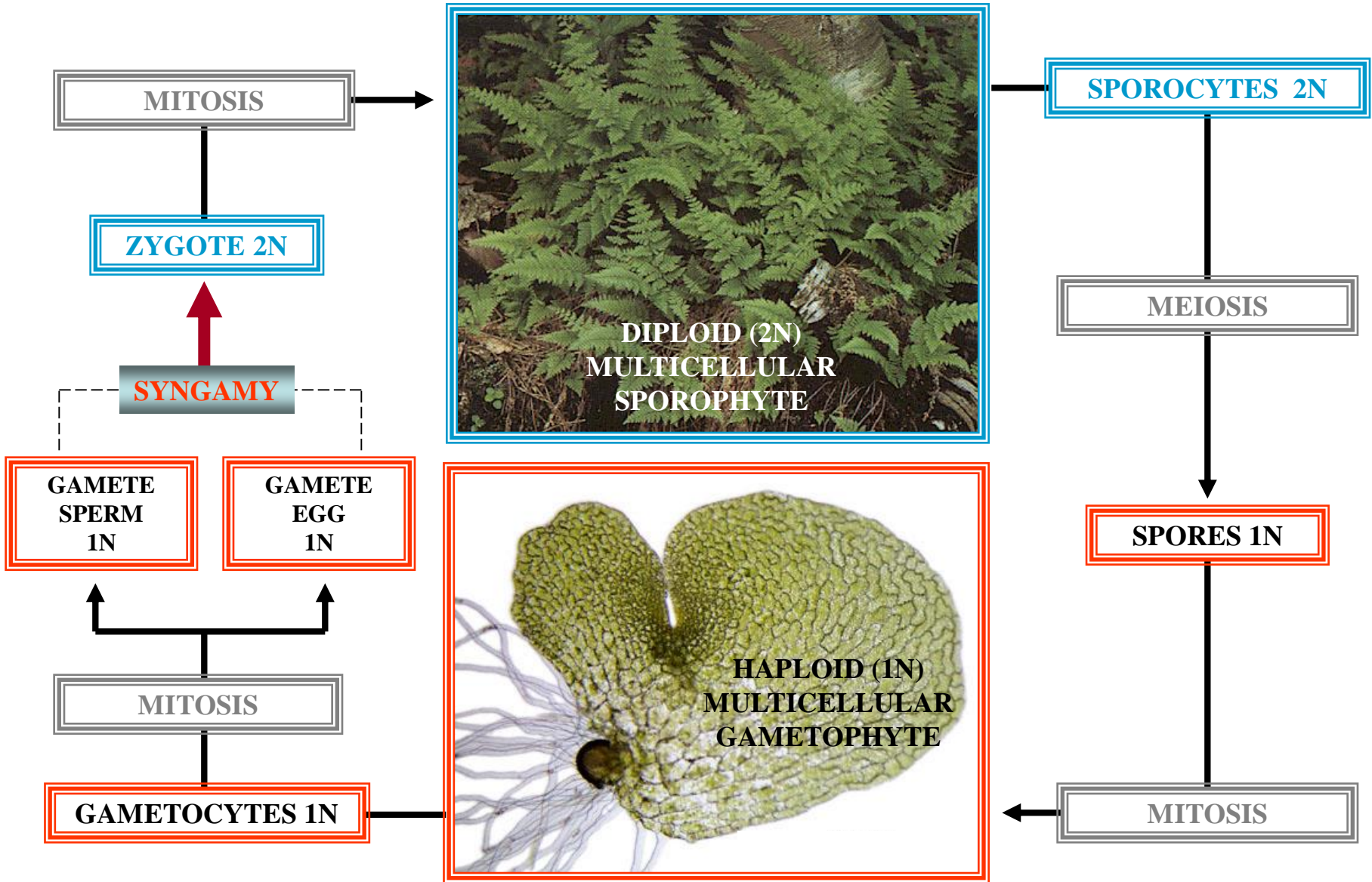
EMBRYOPHYTE SPORIC LIFE CYCLE



EMBRYOPHYTE



HETEROMORPHIC SPORIC LIFE CYCLE



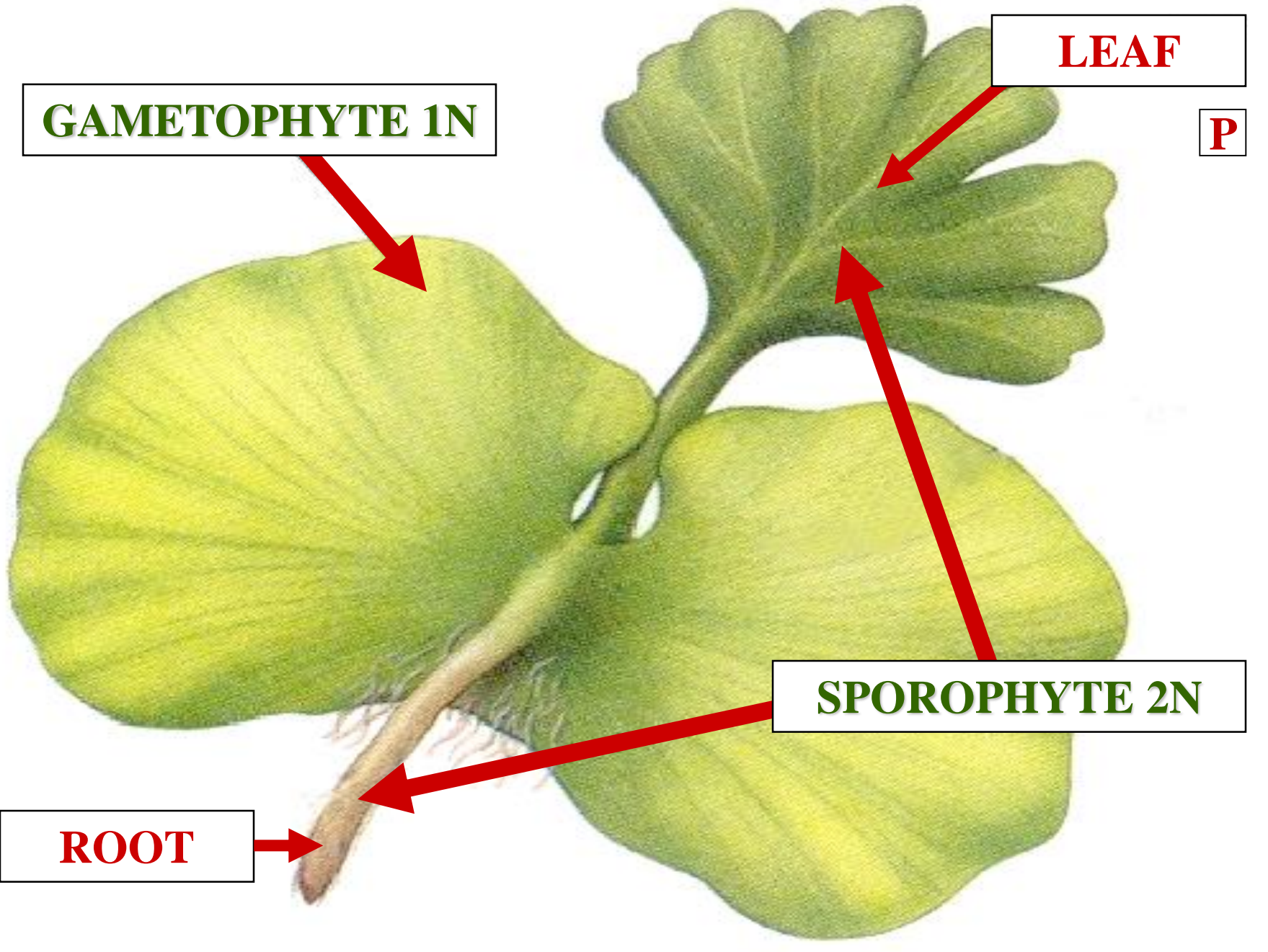
GAMETOPHYTE 1N

LEAF

P

SPOROPHYTE 2N

ROOT



GAMETOPHYTE 1N

LEAF

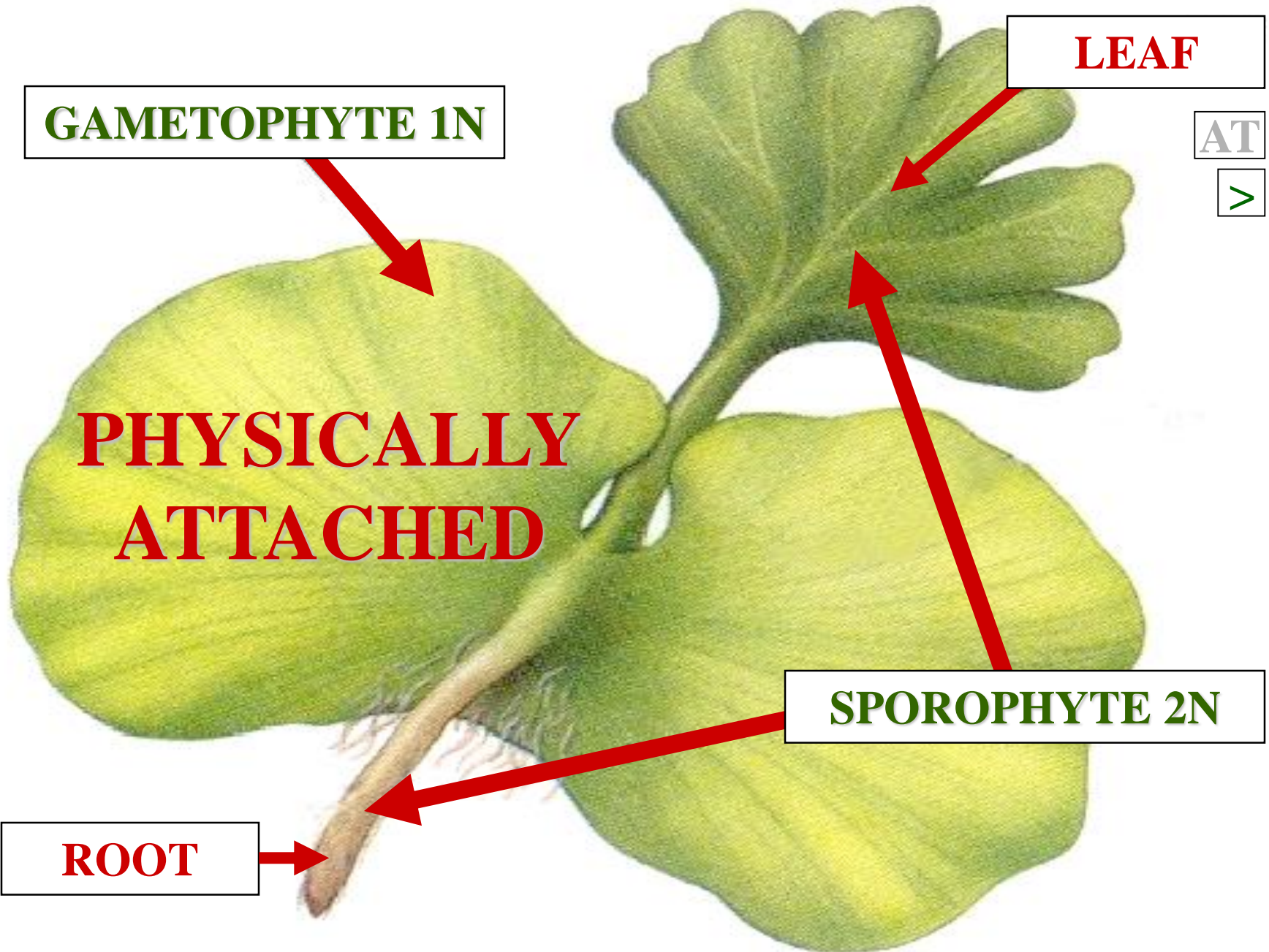
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**PHYSICALLY
ATTACHED**

SPOROPHYTE 2N

ROOT



GAMETOPHYTE 1N

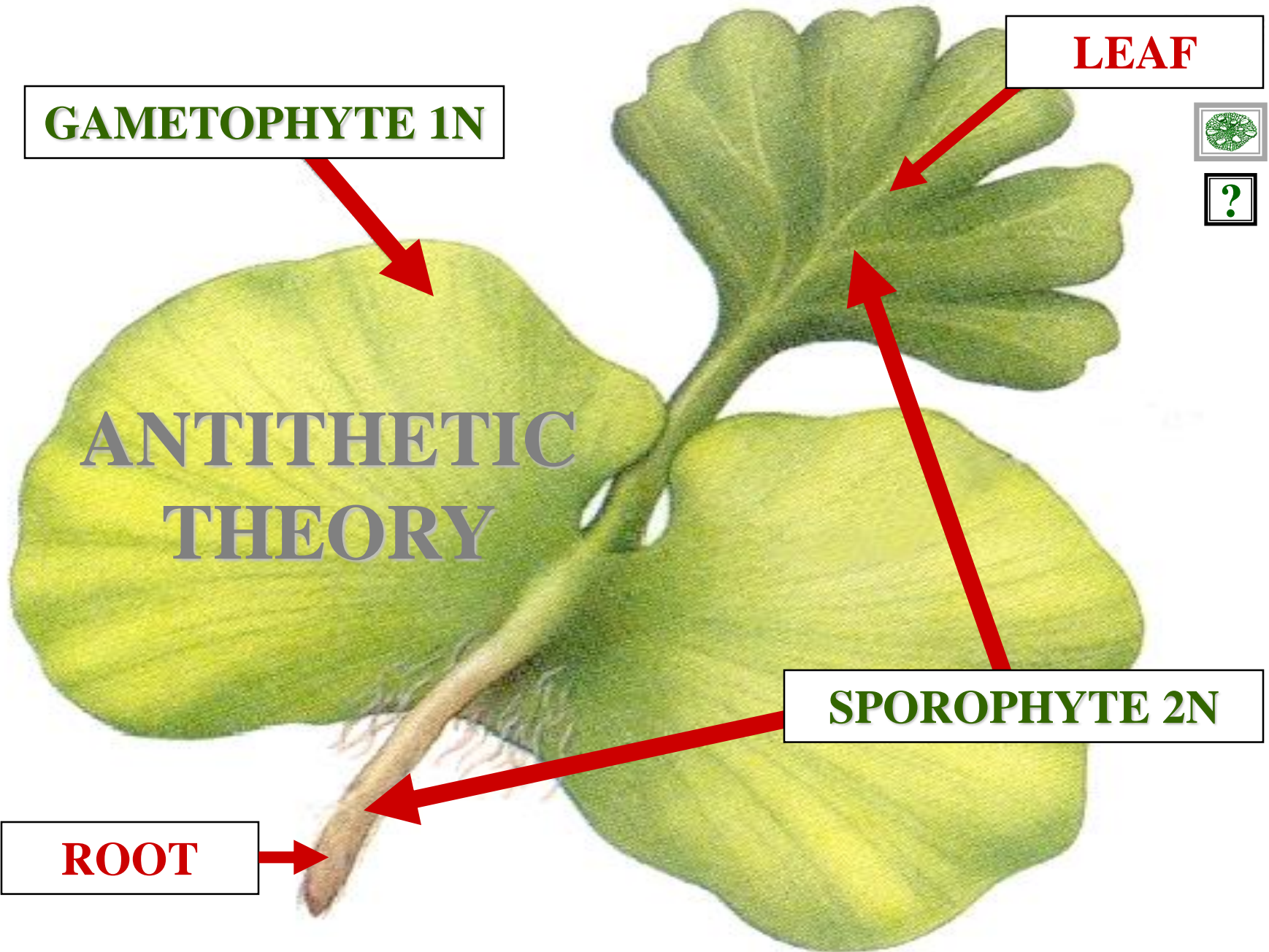
LEAF



**ANTITHETIC
THEORY**

SPOROPHYTE 2N

ROOT

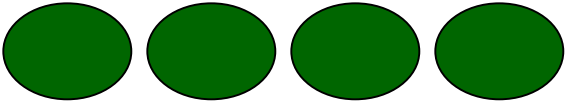


?
ANCESTOR



GAMETOCYTES 1N

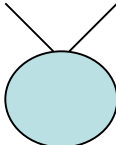
MITOSIS



1N CELL

**CHAROPHYCEAE
ANCESTOR
MULTICELLULAR
1N PHASE**

MITOSIS

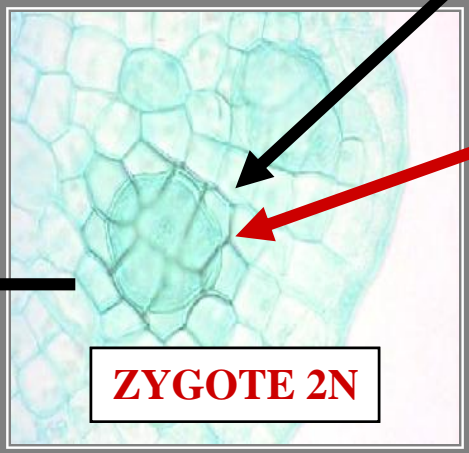


SPERM 1N

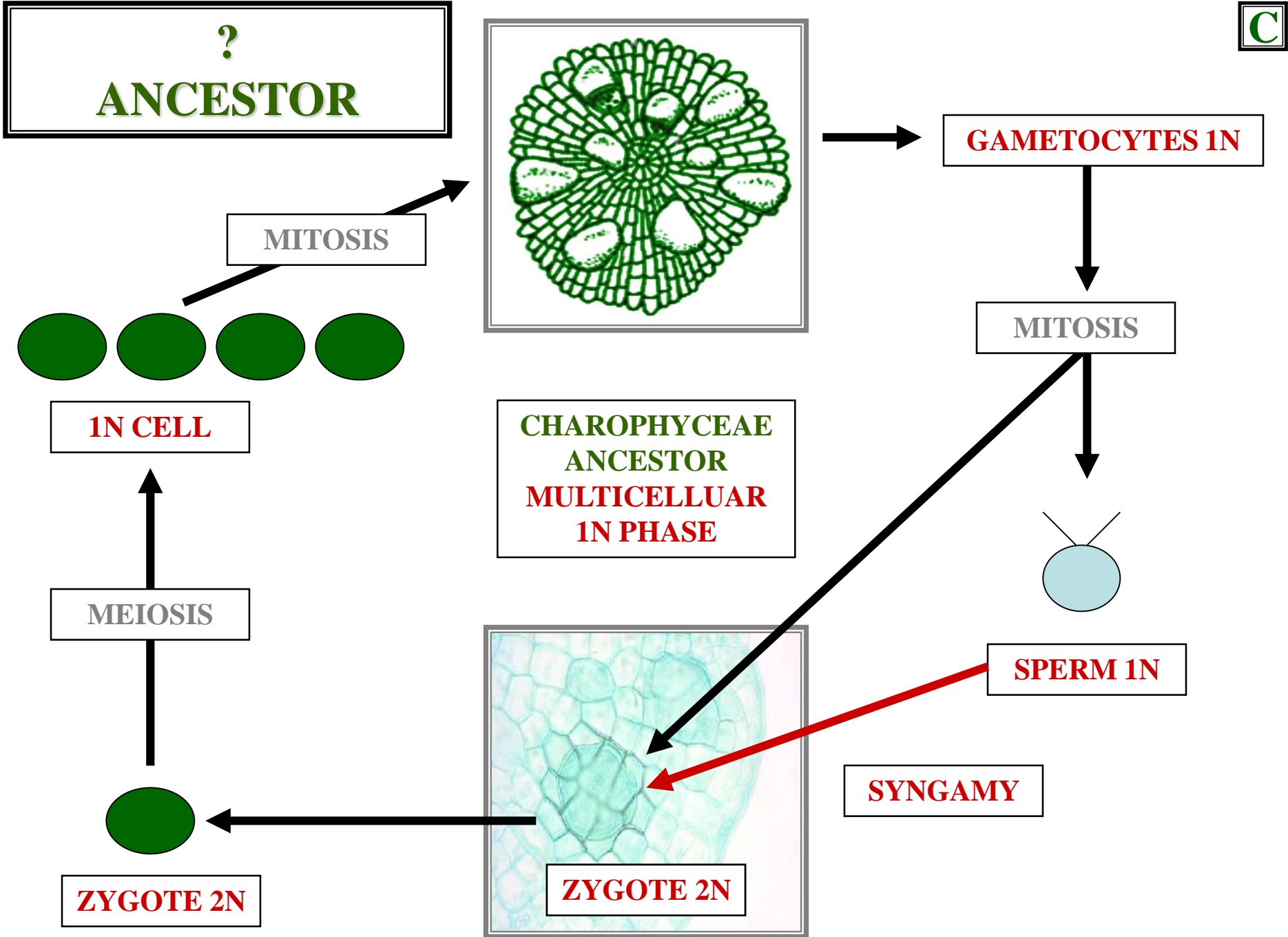
MEIOSIS

SYNGAMY

ZYGOTE 2N

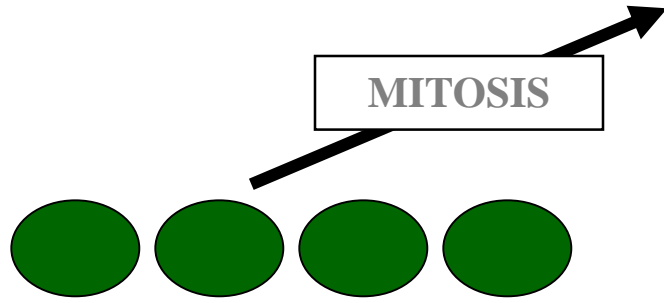


ZYGOTE 2N



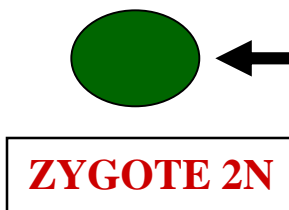


CHAROPHYCEAE ANCESTOR



1N CELL

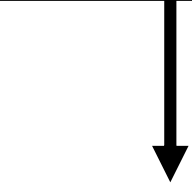
MEIOSIS



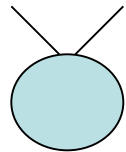
CHAROPHYCEAE ANCESTOR MULTICELLUAR 1N PHASE



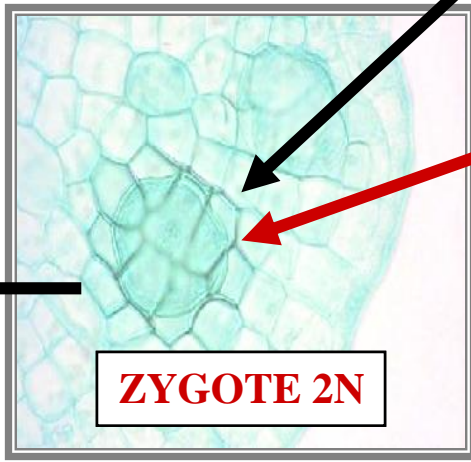
GAMETOCYTES 1N



MITOSIS



SPERM 1N

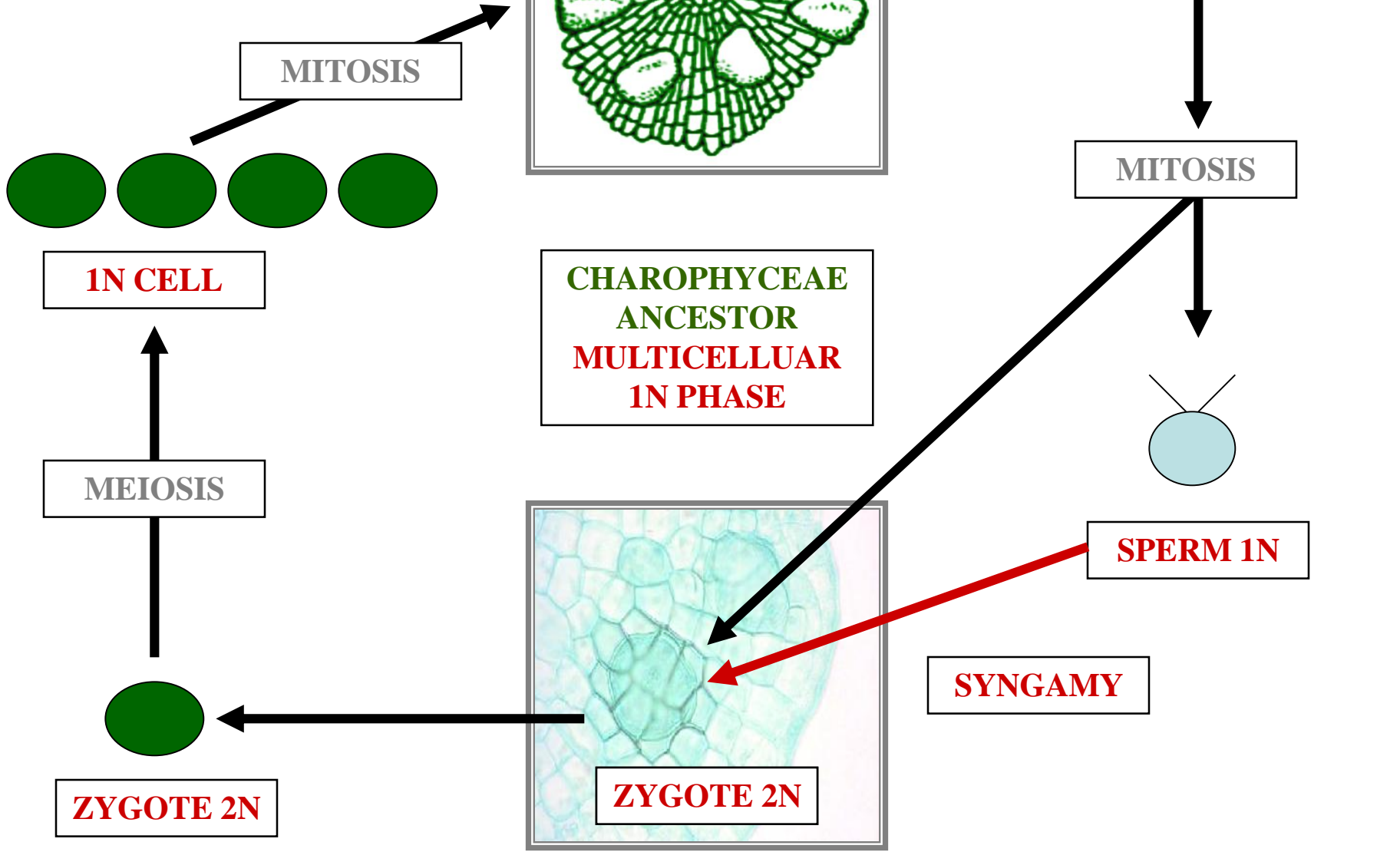


ZYGOTE 2N

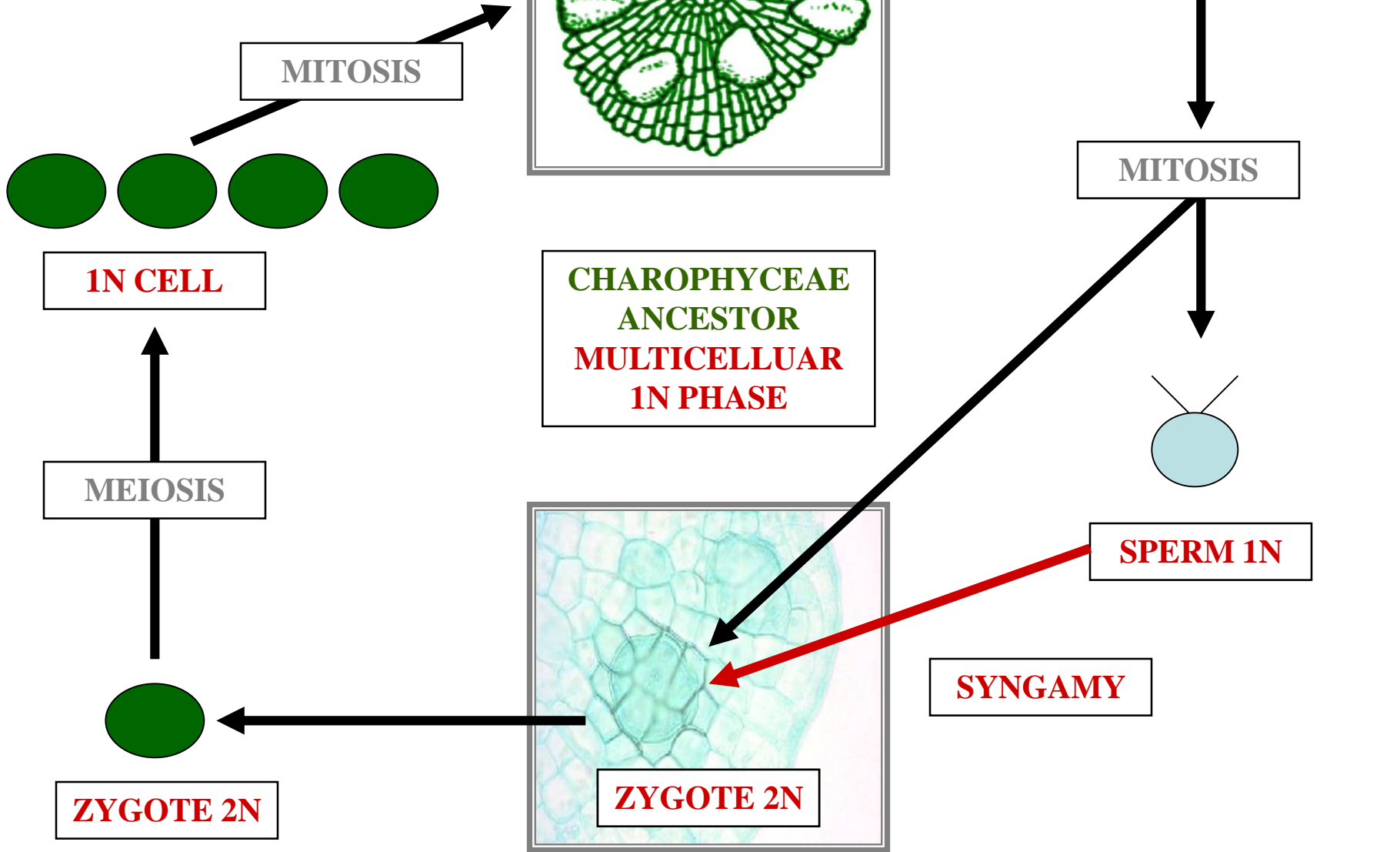
SYNGAMY



? LIFE CYCLE

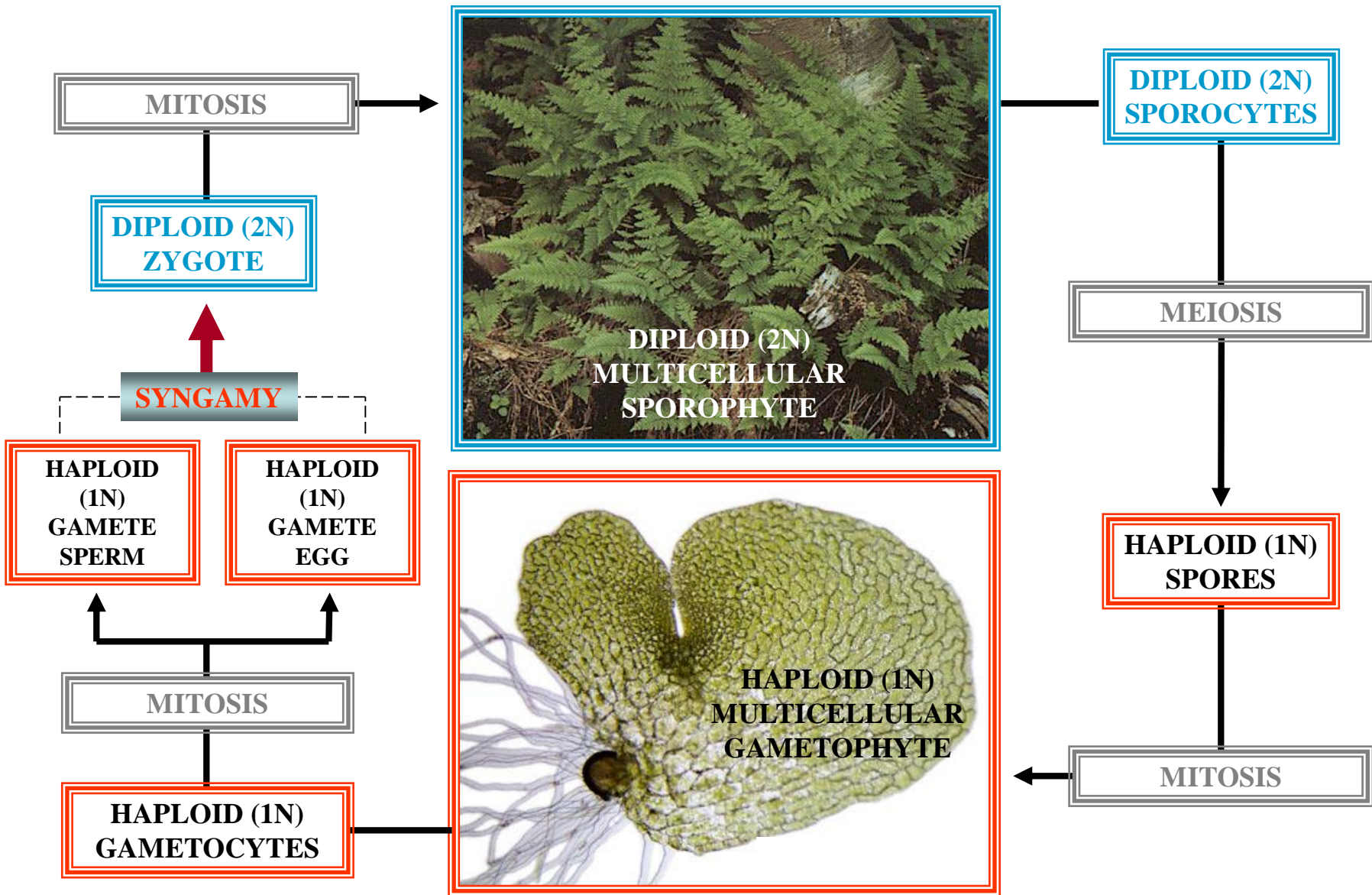


ZYGOTIC LIFE CYCLE



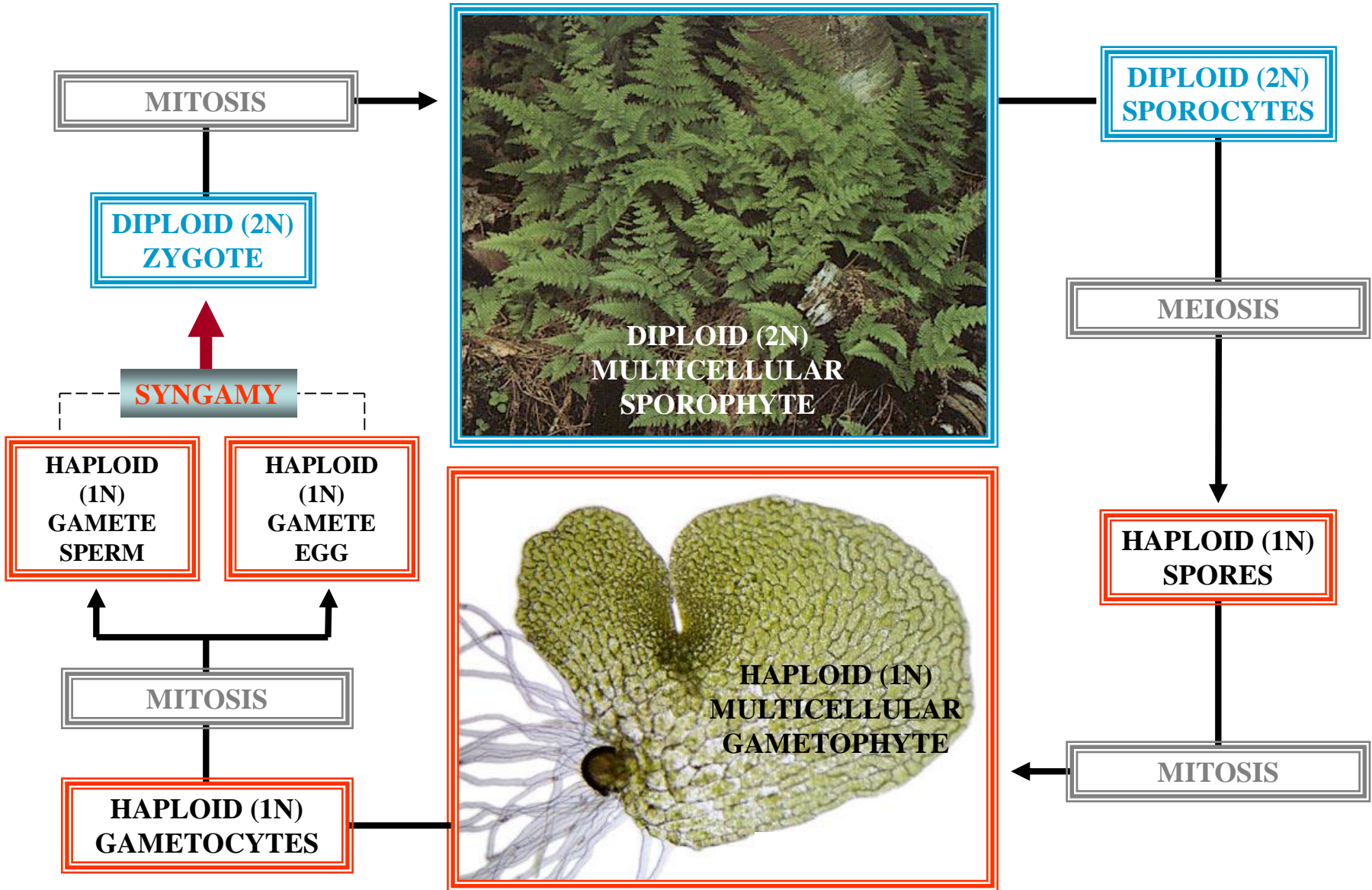
EMBRYOPHYTE LIFE CYCLE

?



EMBRYOPHYTE LIFE CYCLE

HETEROMORPHIC SPORIC LIFE CYCLE





VASCULAR PLANT EVOLUTION

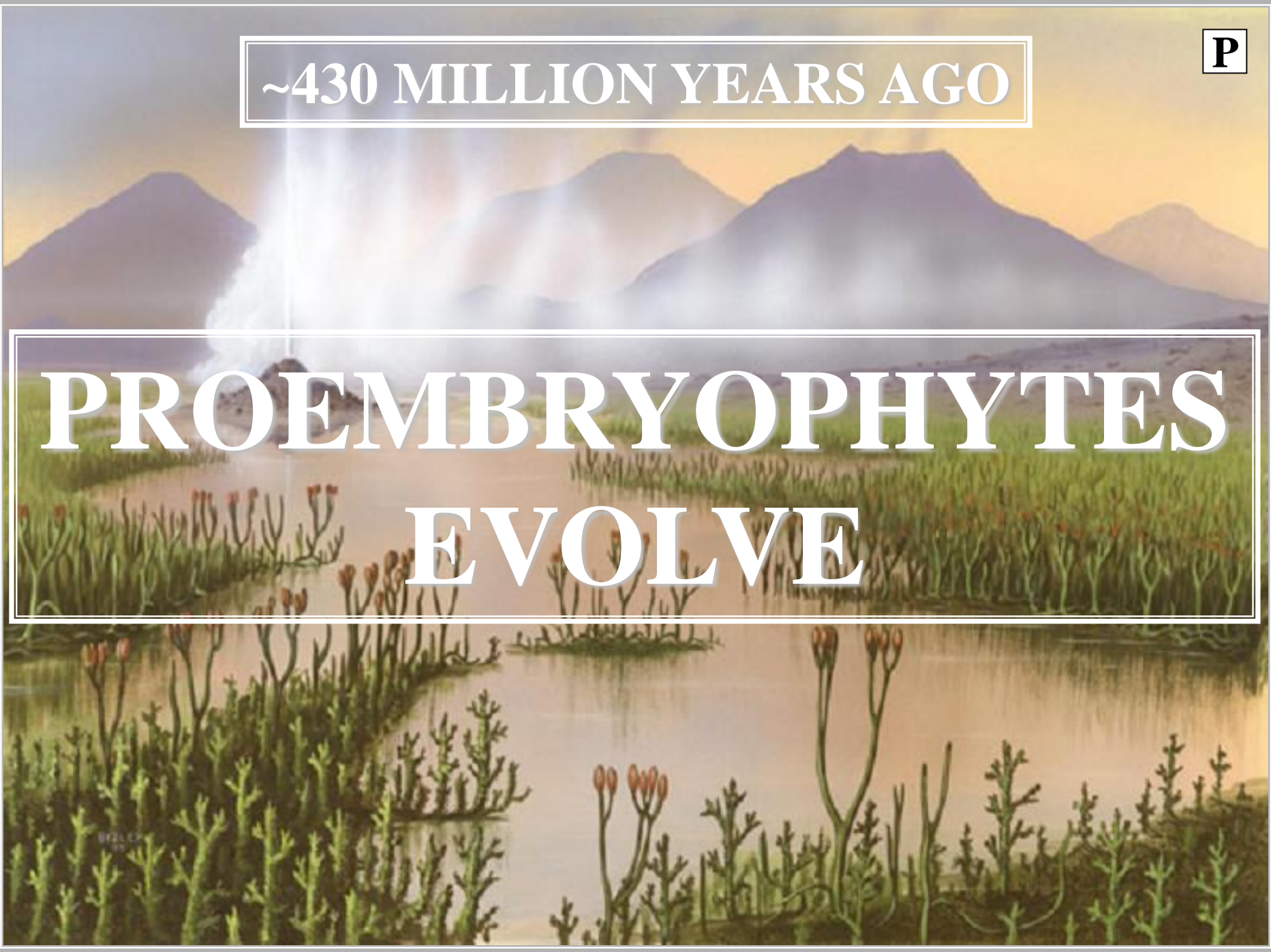


~430
MILLION YEARS

~430 MILLION YEARS AGO

P

PROEMBRYOPHYTES EVOLVE



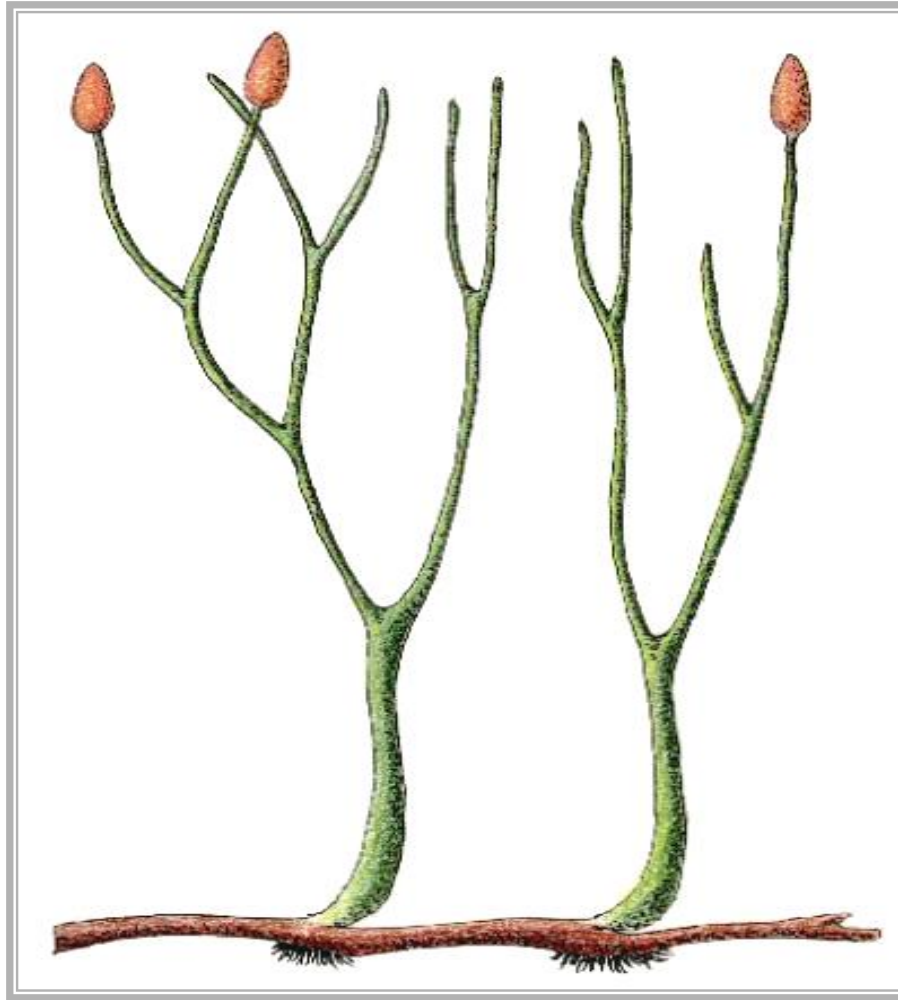
PROEMBRYOPHYTE

PROEMBRYOPHYTE

**PLANT WITH
CHAROPHYCEAE
AND
EMBRYOPHYTE
CHARACTERS**

PROEMBRYOPHYTE

PROEMBRYOPHYTES EVOLVE



AGLAOPHYTON

EMBRYOPHYTE EVOLUTION



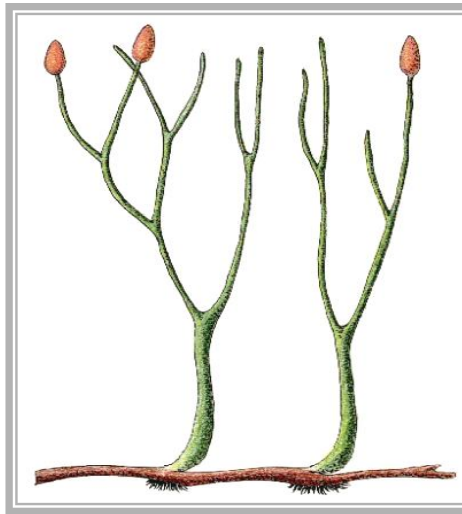
PARKA-LIKE

EMBRYOPHYTE EVOLUTION



CHAROPHYCEAE

EMBRYOPHYTE EVOLUTION

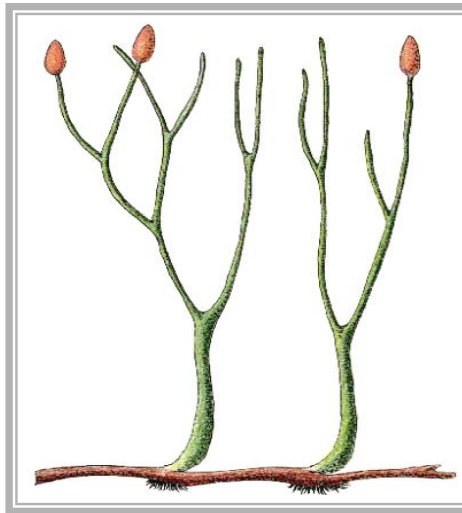


CHAROPHYCEAE

AGLAOPHYTON



EMBRYOPHYTE EVOLUTION



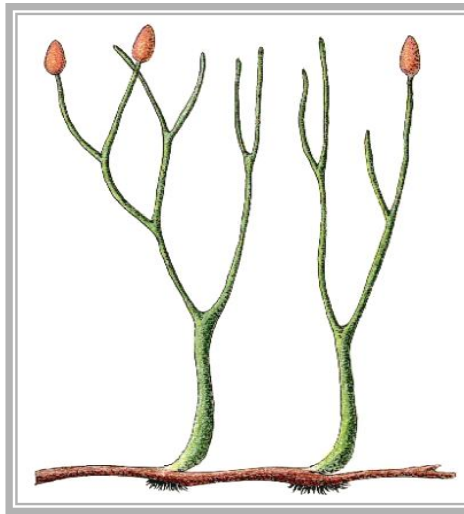
CHAROPHYCEAE

PROEMBRYOPHYTE

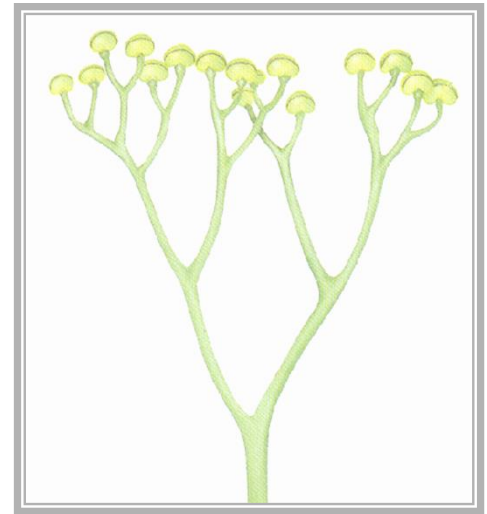
EMBRYOPHYTE EVOLUTION



CHAROPHYCEAE



PROEMBRYOPHYTE



EMBRYOPHYTE



~420

MILLION YEARS

~420 MILLION YEARS AGO



EMBRYOPHYTES EVOLVE



END
LECTURE
MATERIAL
1ST EXAM



VASCULAR PLANT EVOLUTION



VASCULAR PLANT EVOLUTION SUMMARY

FORMAL TAXON

DEFINING CHARACTER

NON-FORMAL TAXON

→ = EVOLVED

QUESTION

**HOW OLD
IS THE UNIVERSE?**

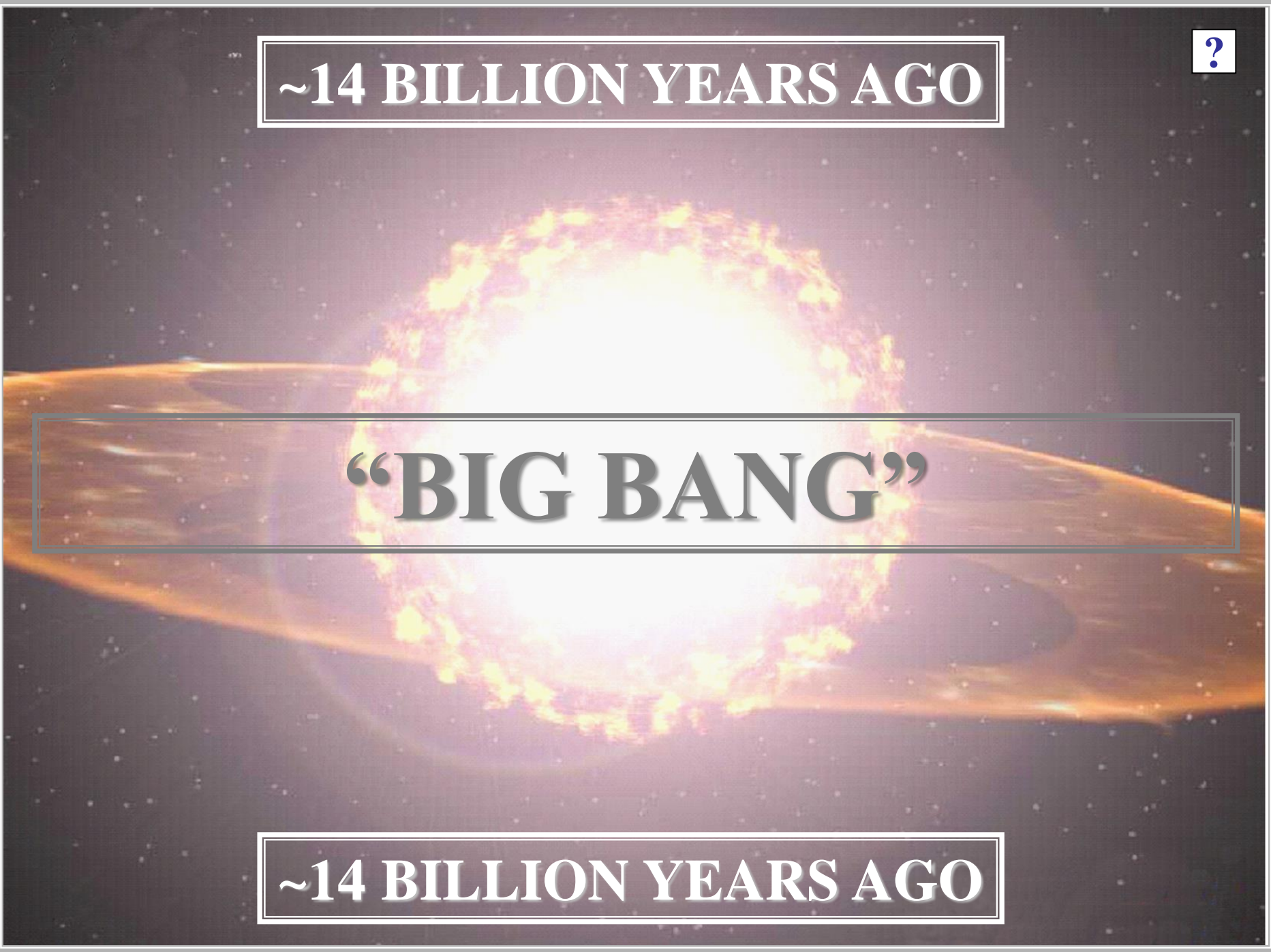
QUESTION



~14 BILLION YEARS AGO

“BIG BANG”

~14 BILLION YEARS AGO



QUESTION

HOW OLD IS OUR STAR?

QUESTION

~5 BILLION YEARS AGO

?

SUN / STAR

~5 BILLION YEARS AGO



QUESTION

HOW OLD IS THE EARTH?

QUESTION

~4.5 BILLION YEARS AGO

?

EARTH

~4.5 BILLION YEARS AGO



QUESTION

HOW OLD IS LIFE?

QUESTION

A black and white electron micrograph showing several rod-shaped, textured structures, likely early life forms, against a light background. The structures are elongated and have a granular, porous appearance. One large rod is oriented diagonally from the top left towards the bottom right. Other smaller rods are scattered around it.

~3.5 BILLION YEARS AGO



FIRST CELLS

~3.5 BILLION YEARS AGO

1ST CELLS

PROKARYOTE CELLS

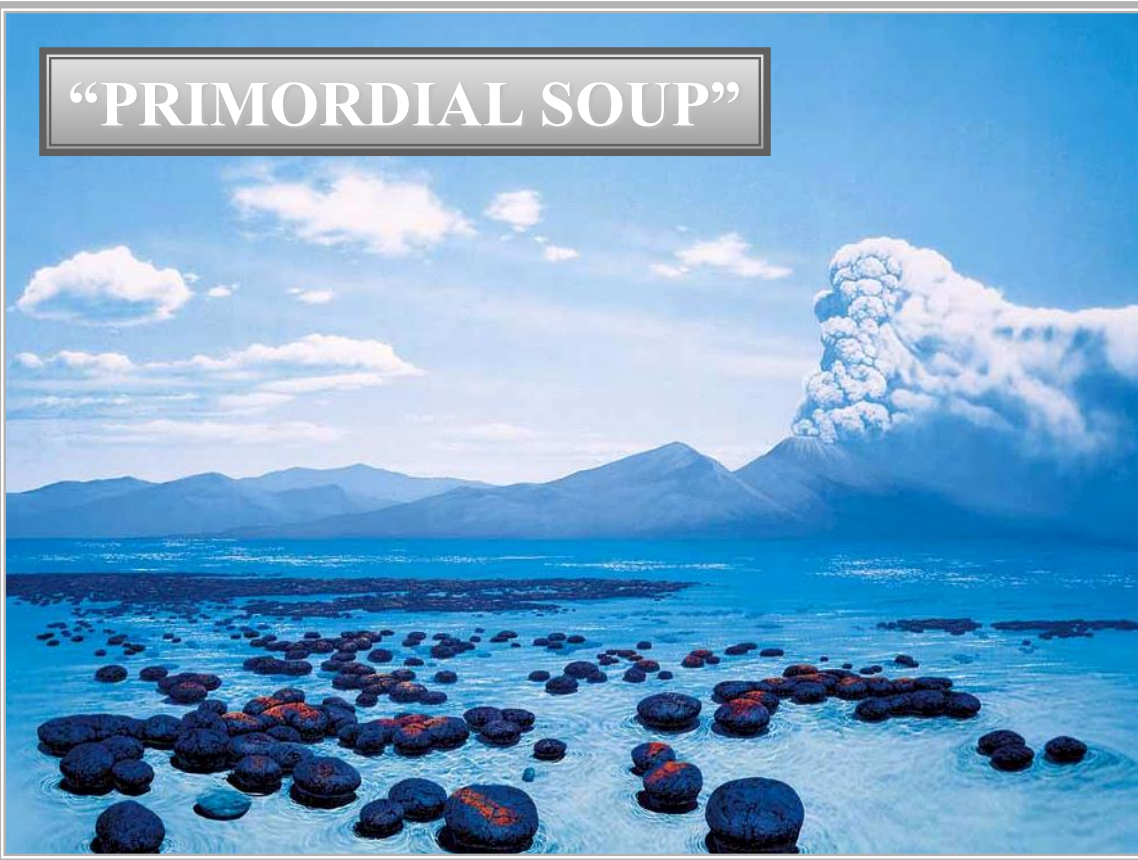
PROKARYOTE CELLS

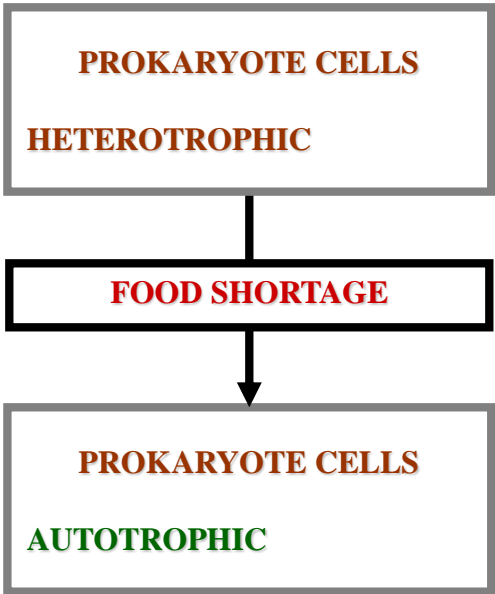
HETEROTROPHIC

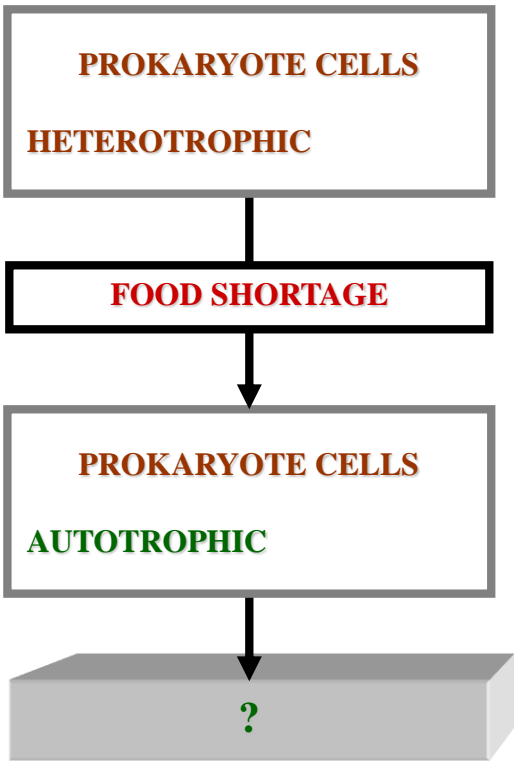
PROKARYOTE CELLS
HETEROTROPHIC

FOOD SHORTAGE

“PRIMORDIAL SOUP”







PROKARYOTE CELLS
HETEROTROPHIC



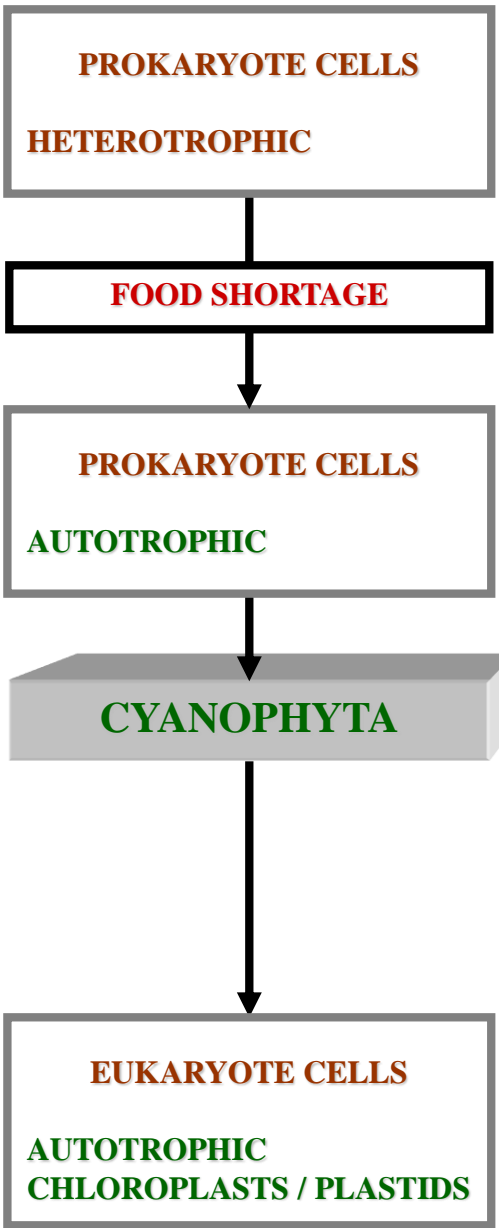
FOOD SHORTAGE

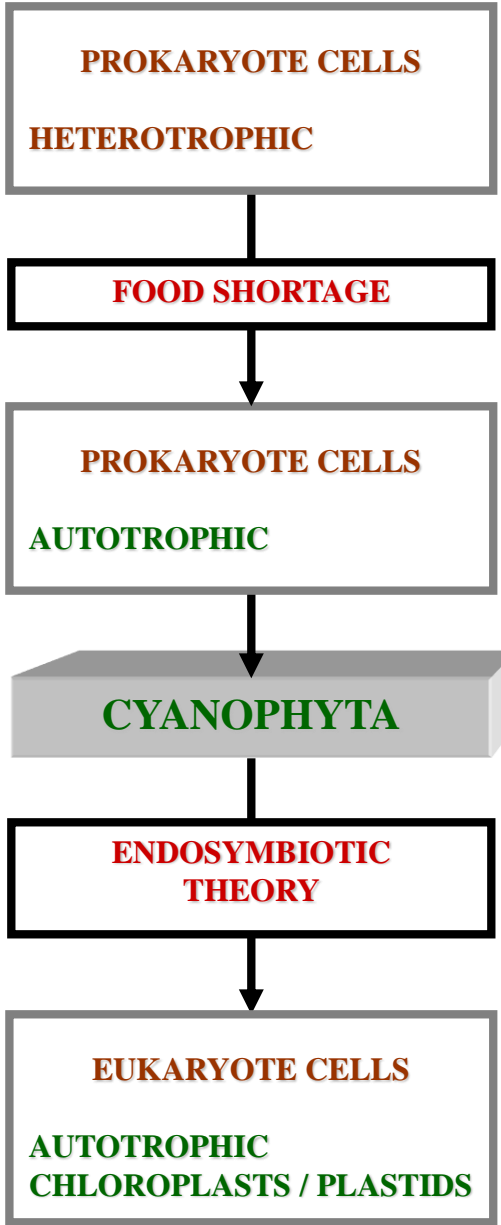


PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA





PROKARYOTE CELLS
HETEROTROPHIC



FOOD SHORTAGE



PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA



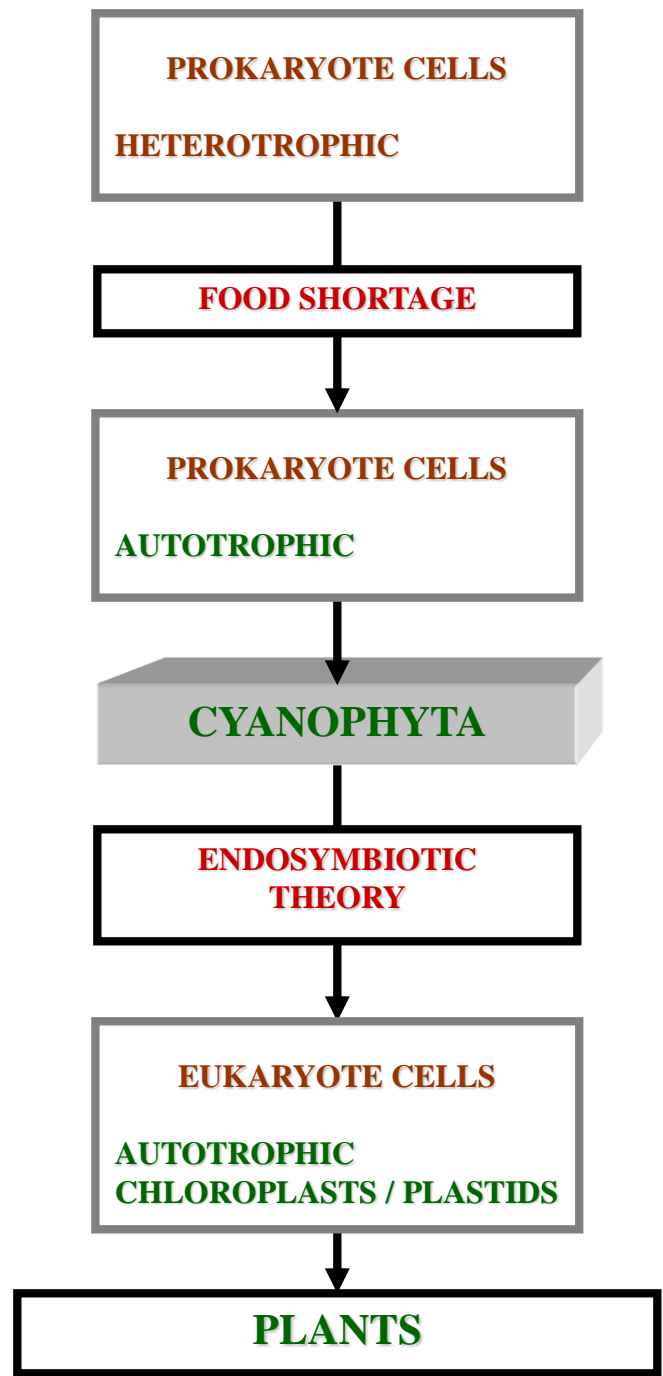
**ENDOSYMBIOTIC
THEORY**



EUKARYOTE CELLS
AUTOTROPHIC
CHLOROPLASTS / PLASTIDS



?



PROKARYOTE CELLS
HETEROTROPHIC



FOOD SHORTAGE



PROKARYOTE CELLS
AUTOTROPHIC



CYANOPHYTA



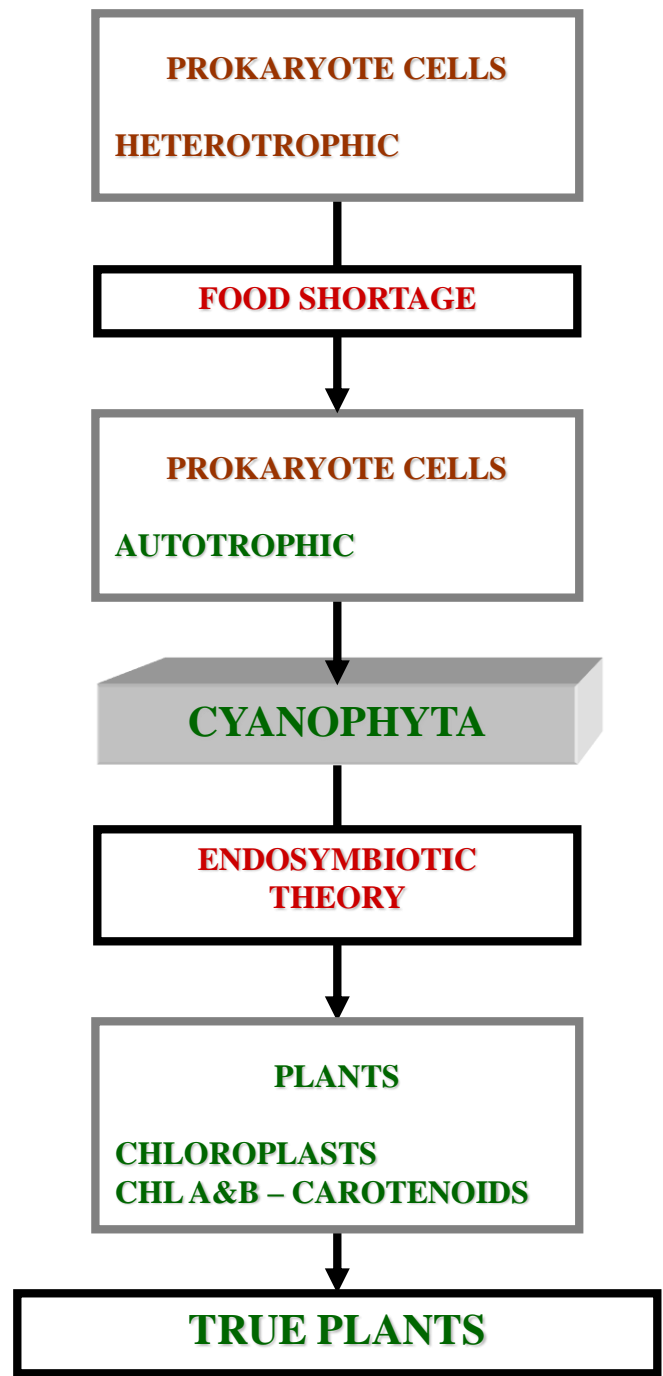
**ENDOSYMBIOTIC
THEORY**



PLANTS
CHLOROPLASTS
CHL A&B – CAROTENOIDS



?



PROKARYOTE CELLS
HETEROTROPHIC

FOOD SHORTAGE

PROKARYOTE CELLS
AUTOTROPHIC

CYANOPHYTA

ENDOSYMBIOTIC
THEORY

PLANTS
CHLOROPLASTS
CHL A&B - CAROTENOIDS

TRUE PLANTS

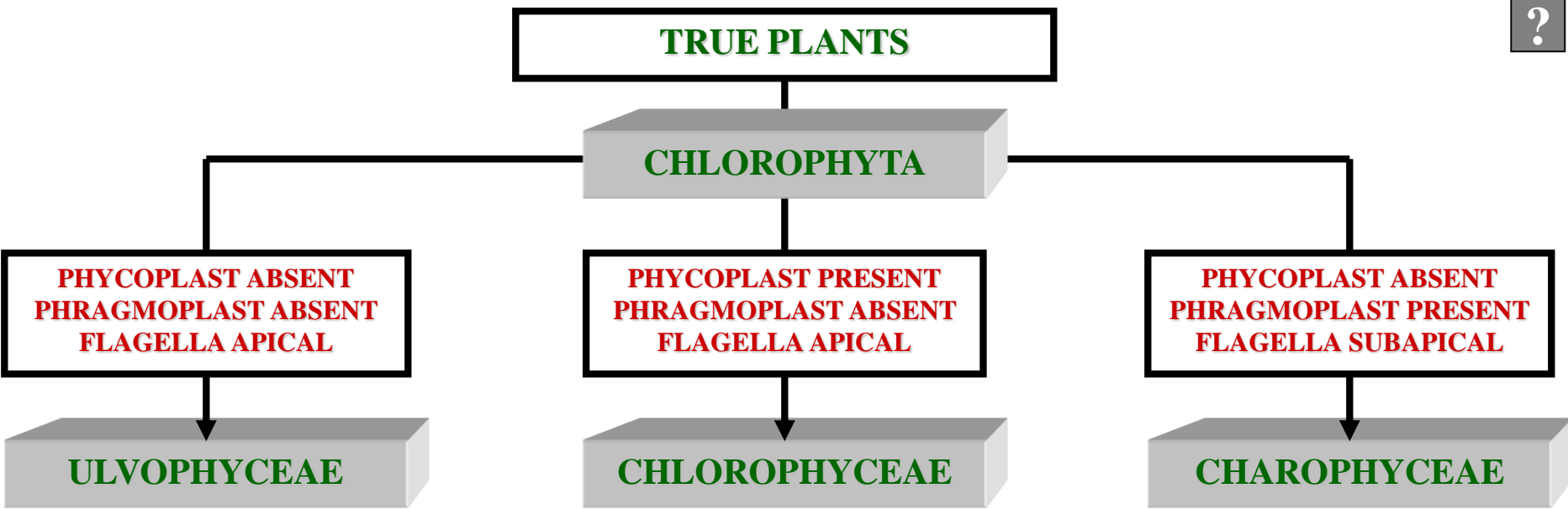
TRUE PLANTS

?

TRUE PLANTS



CHLOROPHYTA



!!!ALGAE CLASS STANDARD ENDING: PHYCEAE!!!

TRUE PLANTS

CHLOROPHYTA

**PHYCOPLAST ABSENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

ULVOPHYCEAE

?

**PHYCOPLAST PRESENT
PHRAGMOPLAST ABSENT
FLAGELLA APICAL**

CHLOROPHYCEAE

?

**PHYCOPLAST ABSENT
PHRAGMOPLAST PRESENT
FLAGELLA SUBAPICAL**

CHAROPHYCEAE

?

“LAND PLANTS”

