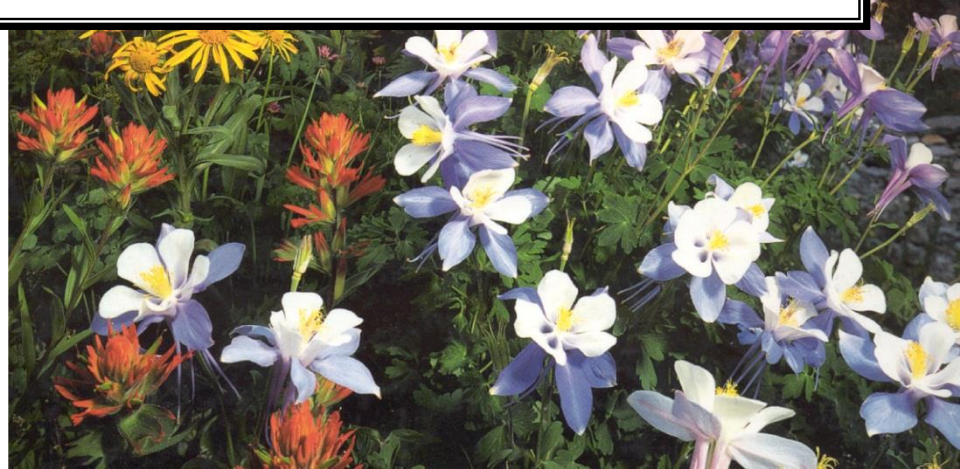




# EMBRYOPHYTES

**CYTOKINESIS:**

**PHRAGMOPLAST SPINDLE**





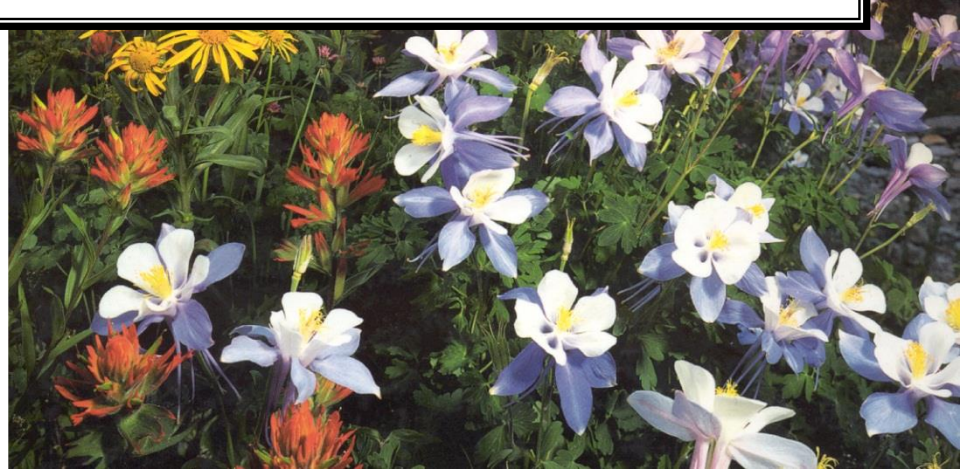
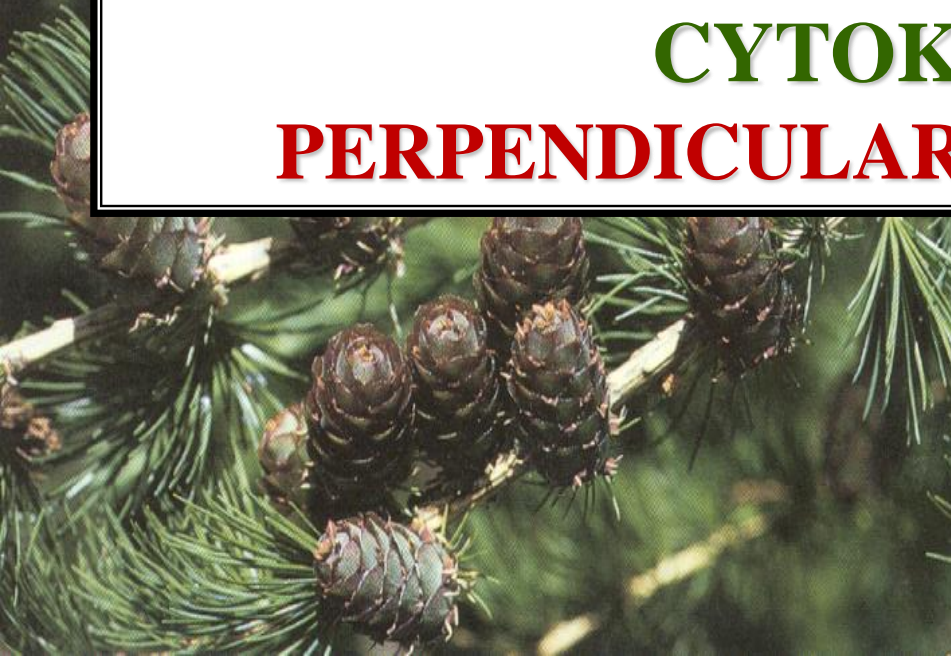
VP

+

# EMBRYOPHYTES

CYTOKINESIS:

**PERPENDICULAR MICROTUBULES**



# VASCULAR PLANT EVOLUTION

# VASCULAR PLANT EVOLUTION

CYANOPHYTA

ENDOSYMBIOTIC  
THEORY

CHLOROPHYTA

PHYCOPLAST ABSENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

ULVOPHYCEAE

PHYCOPLAST PRESENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

CHLOROPHYCEAE

PHYCOPLAST ABSENT  
PHRAGMOPLAST PRESENT  
FLAGELLA SUBAPICAL

CHAROPHYCEAE

CYTOKINESIS  
IDENTICAL WITH  
EMBRYOPHYTES

EMBRYOPHYTES

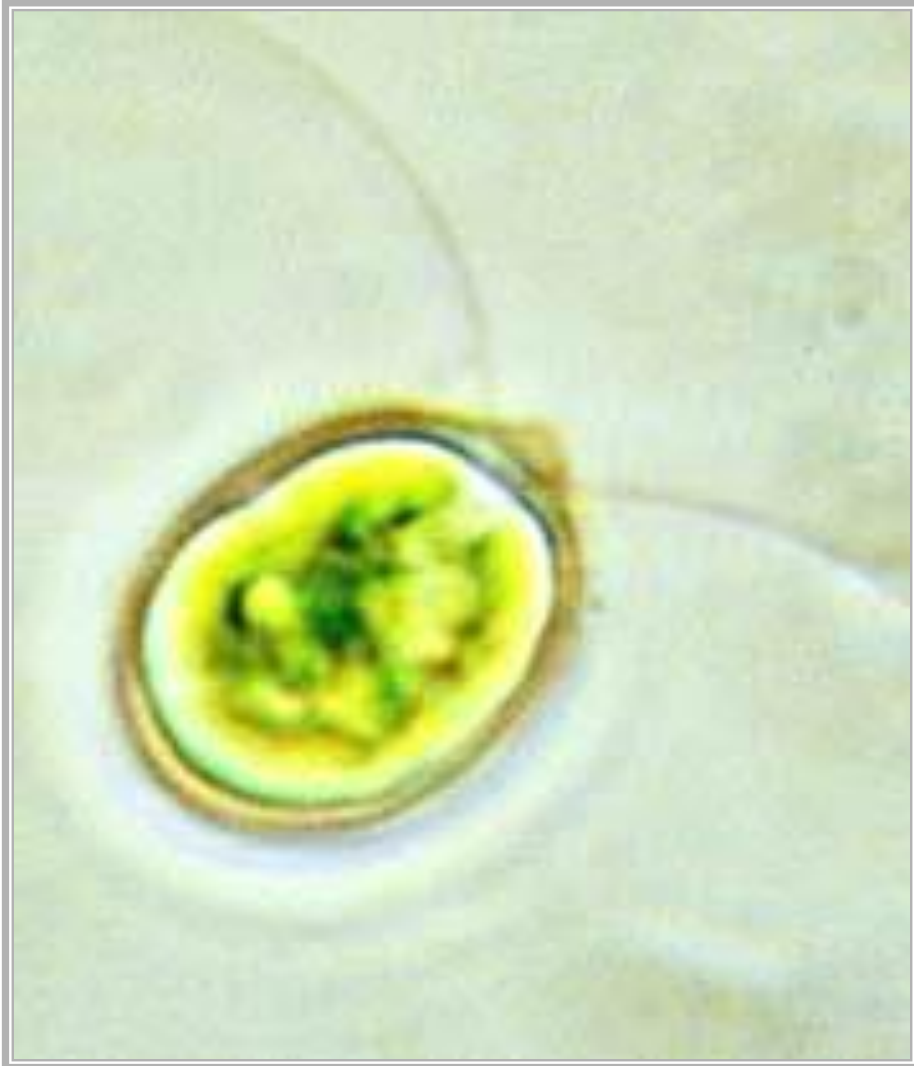




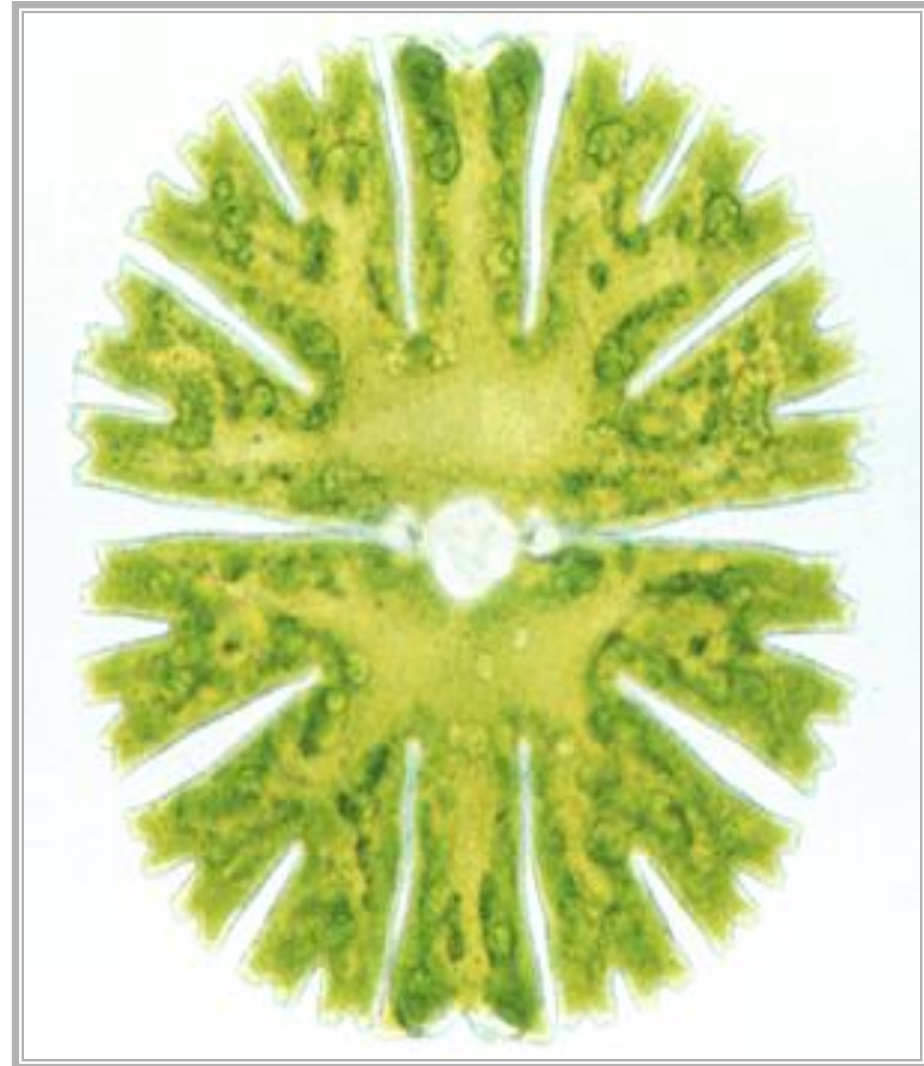
# CHLOROPHYTA

# FLAGELLA

# FLAGELLA

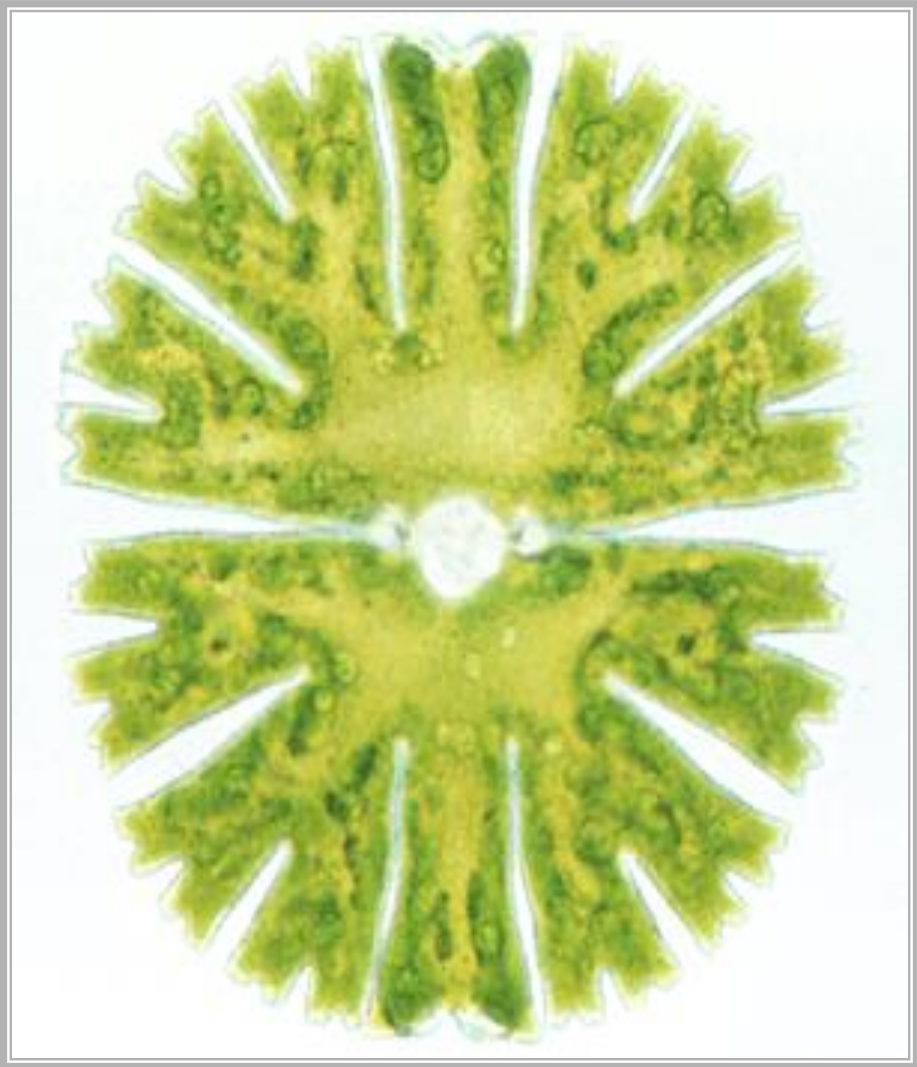
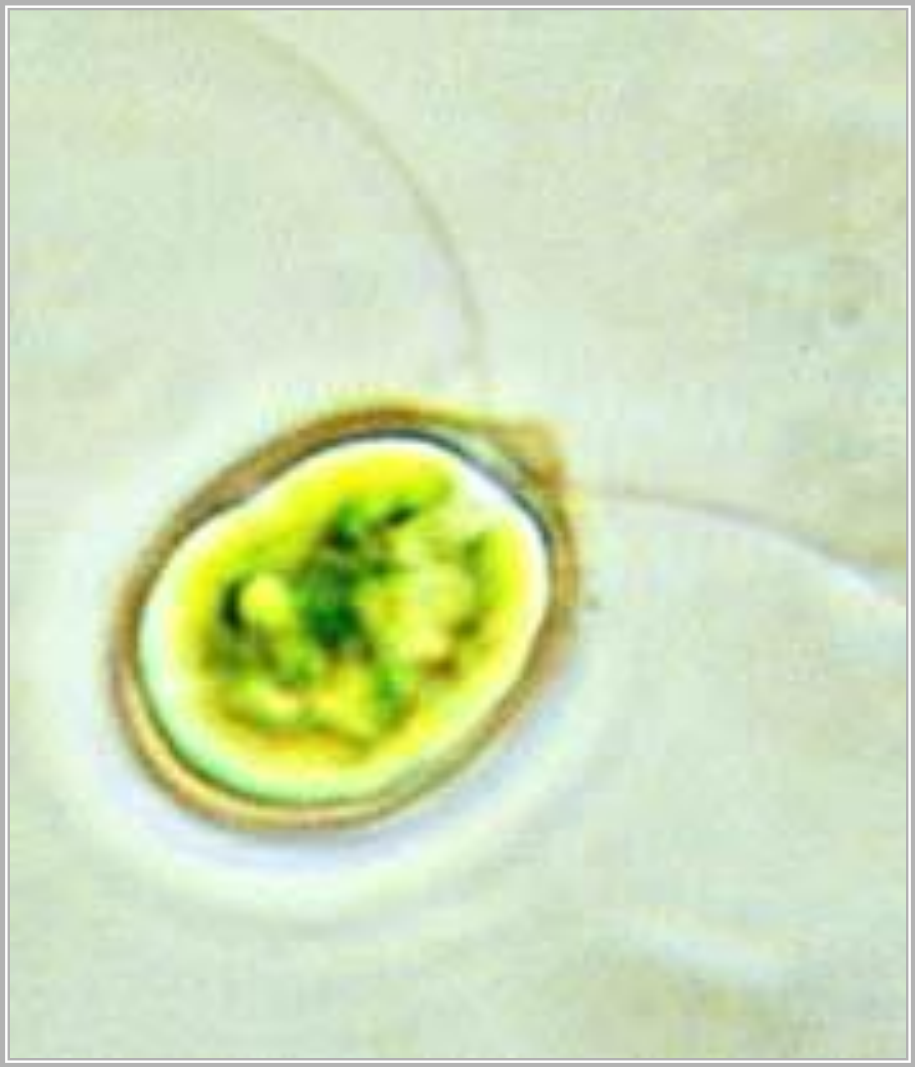


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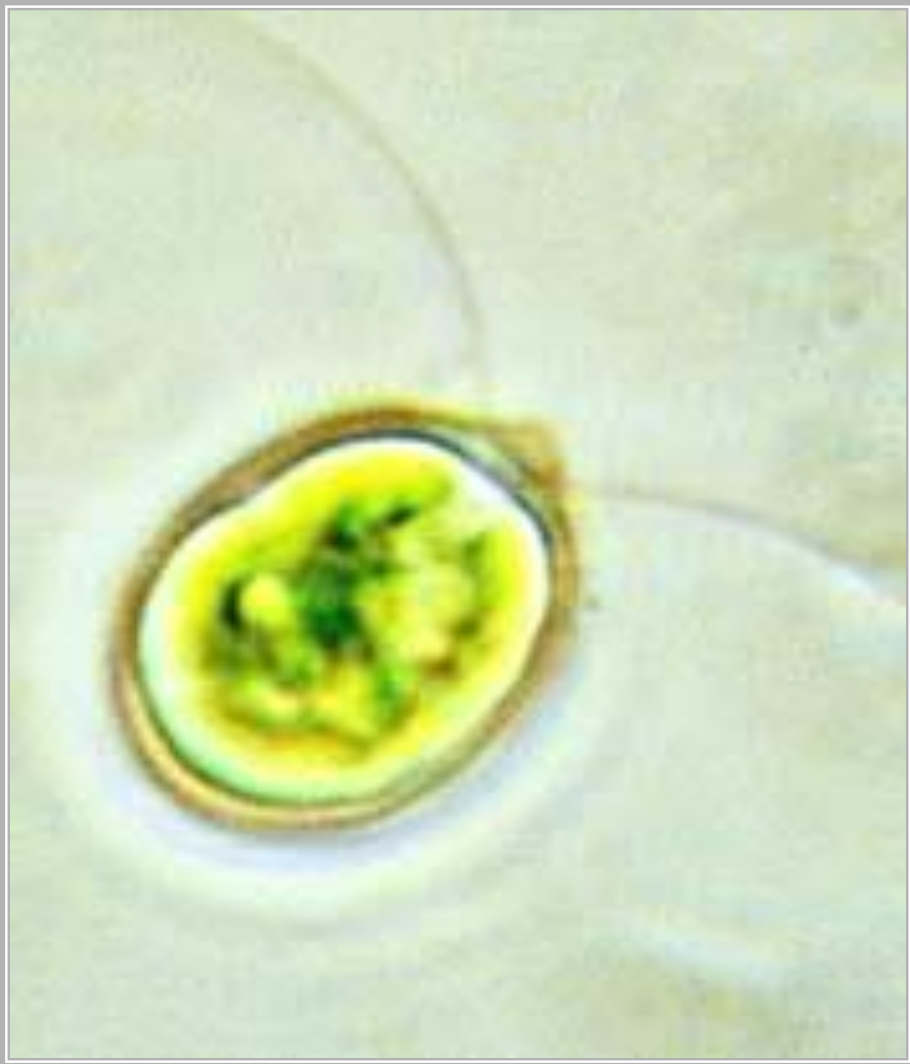


**FLAGELLA: PRESENT**

**FLAGELLA**



**FLAGELLA: PRESENT**

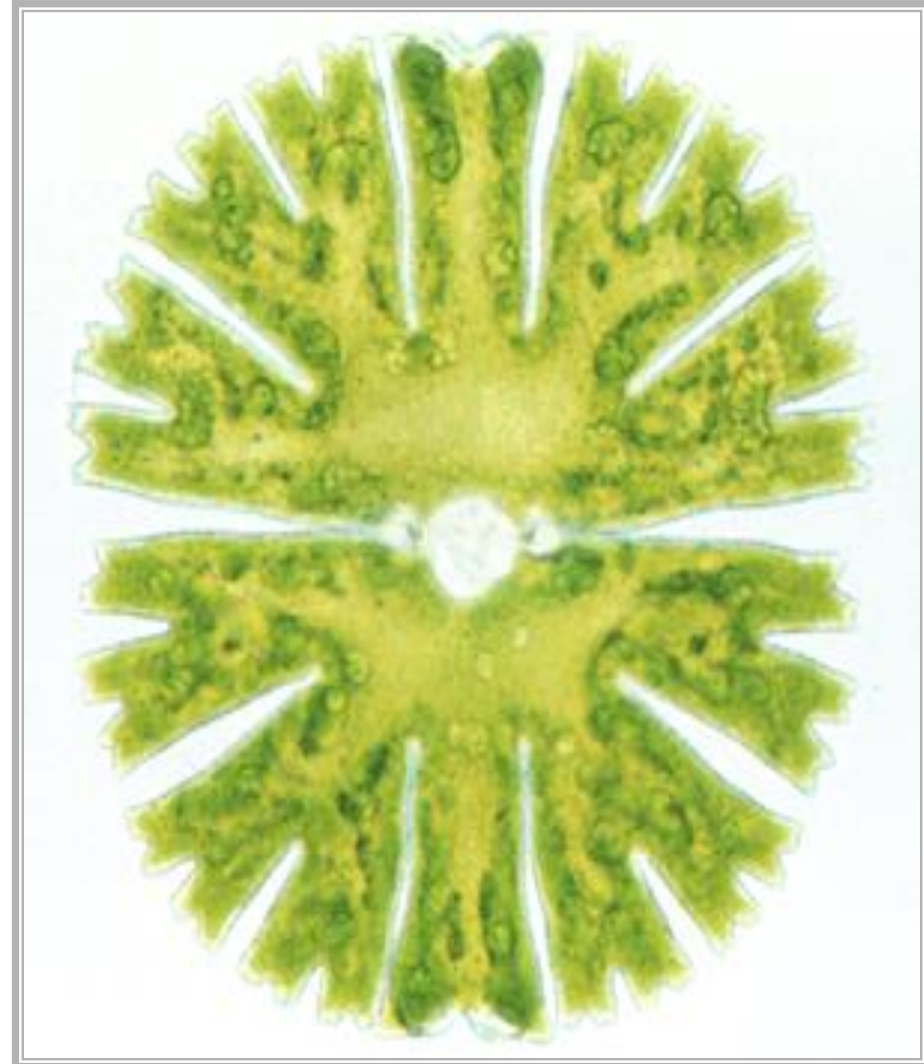
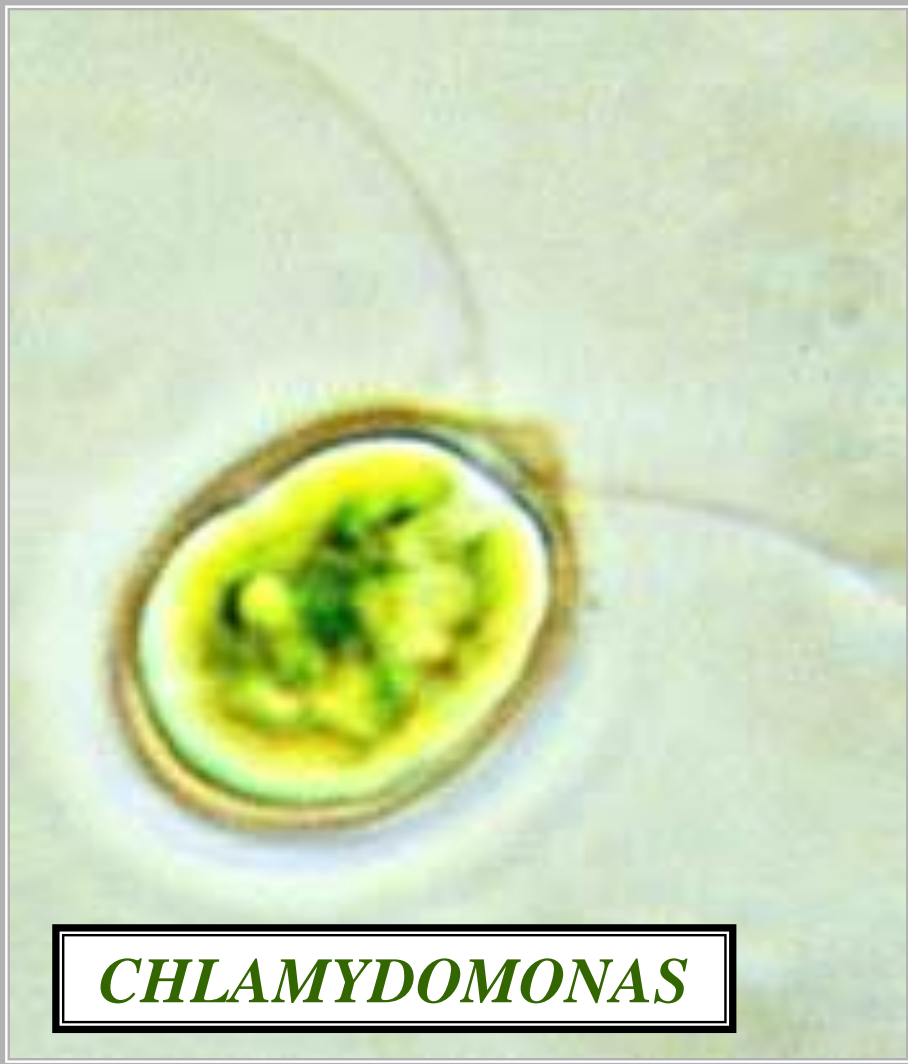


**FLAGELLA: ABSENT**



**FLAGELLA: PRESENT**

**FLAGELLA: ABSENT**

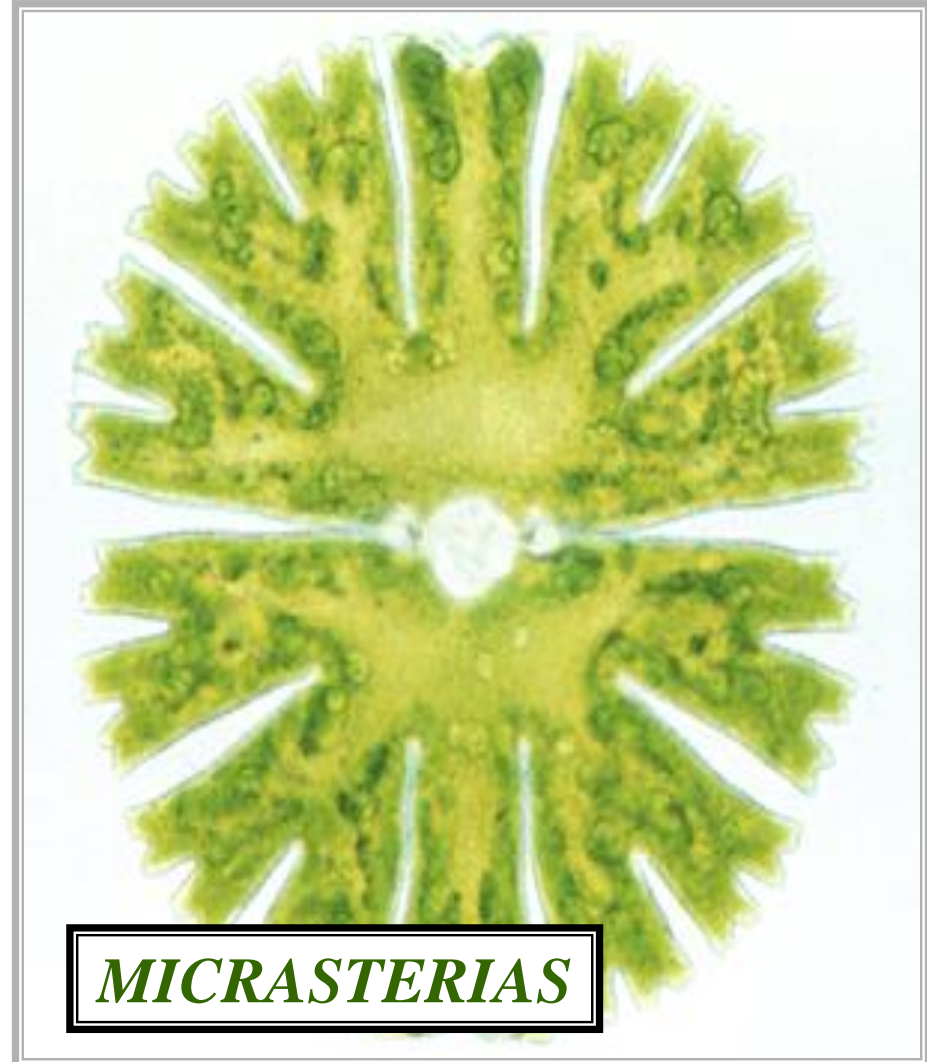
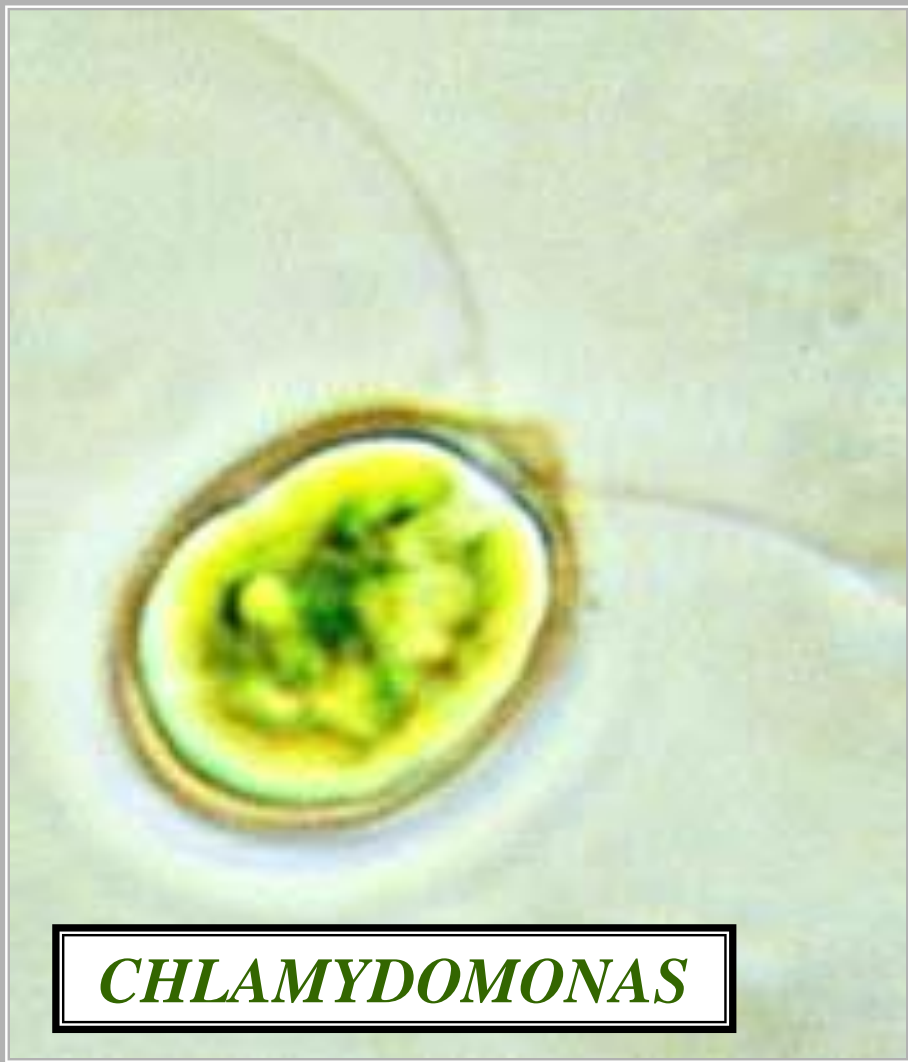






**FLAGELLA: PRESENT**

**FLAGELLA: ABSENT**





**CHLOROPHYCEAE**

**&**

**ULVOPHYCEAE**

**FLAGELLA**

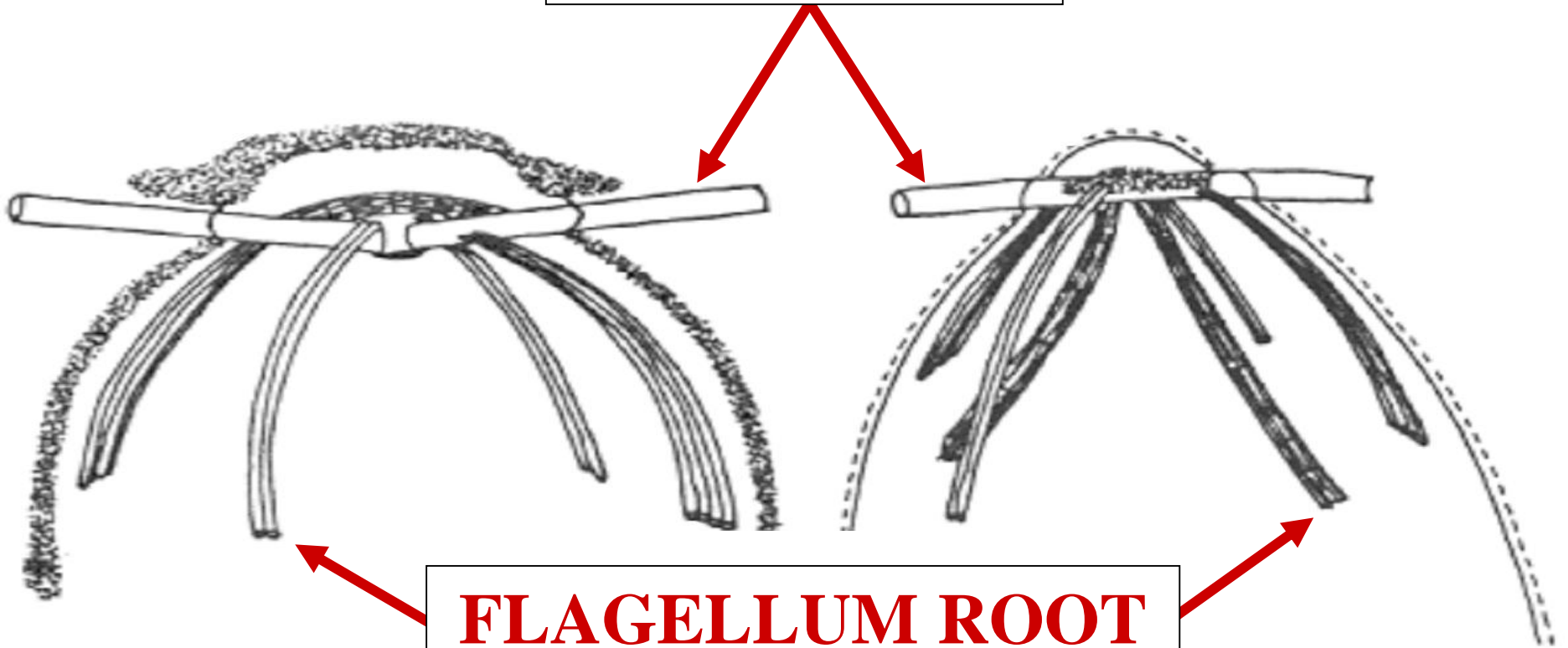
**INSERTION**

# CHLOROPHYCEAE

# ULVOPHYCEAE

A

**FLAGELLUM**



**FLAGELLUM ROOT**

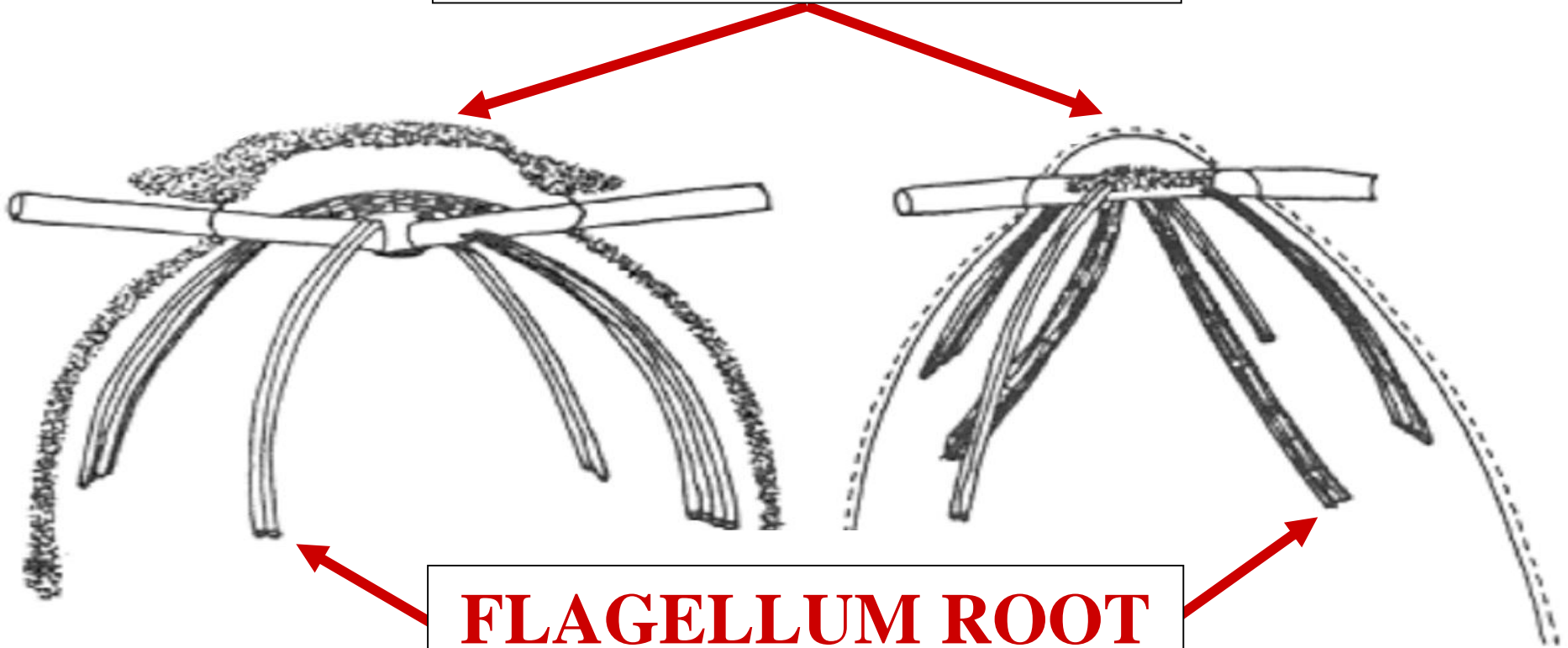
**FLAGELLUM INSERTION**

# CHLOROPHYCEAE

# ULVOPHYCEAE

M

**APICAL INSERTION**



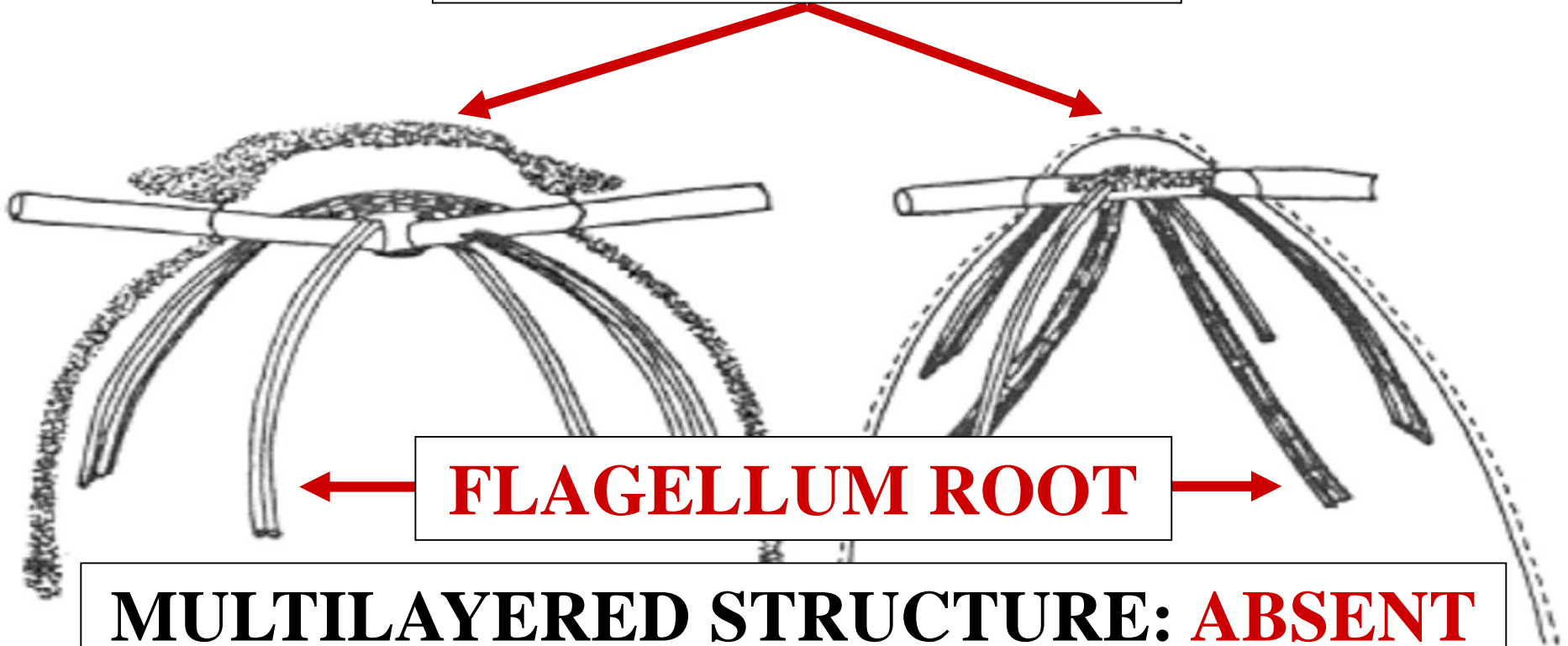
**FLAGELLUM ROOT**

**FLAGELLUM INSERTION**

# CHLOROPHYCEAE

# ULVOPHYCEAE

**APICAL INSERTION**

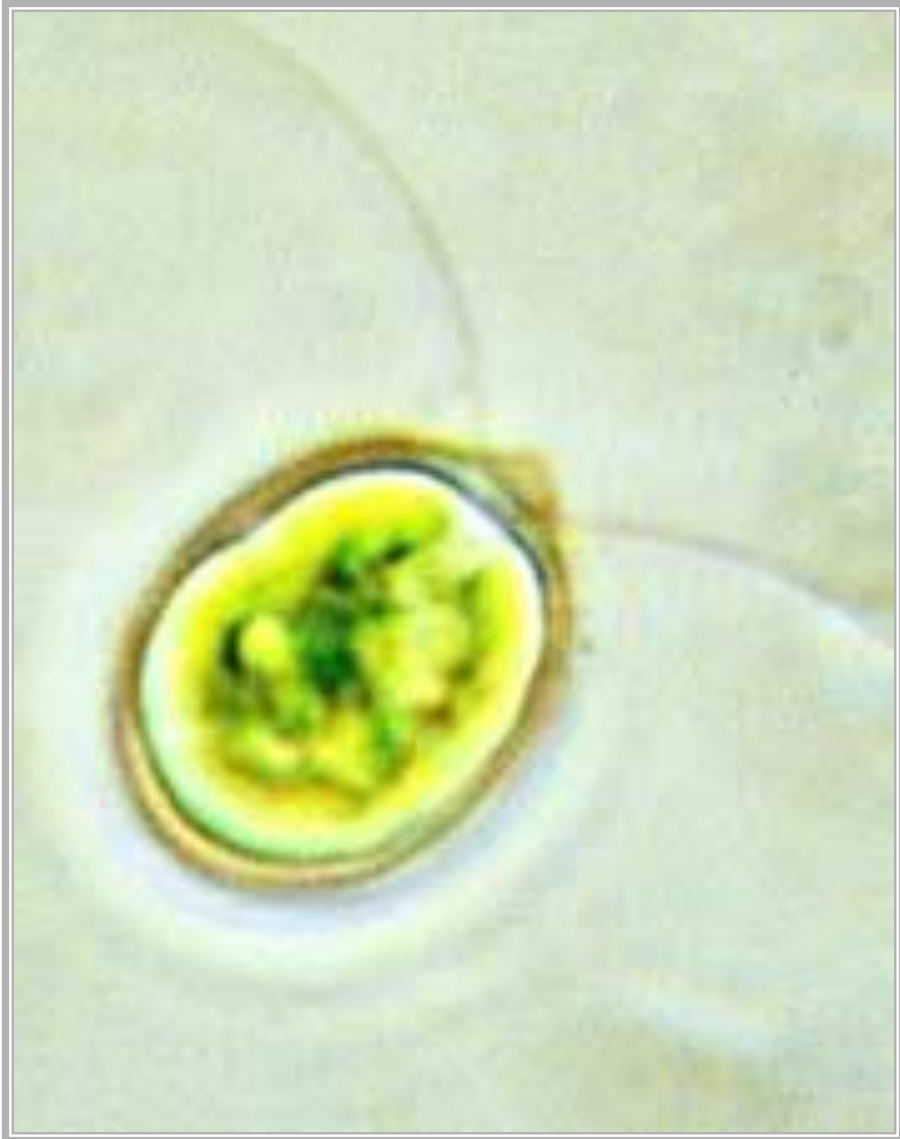


**FLAGELLUM ROOT**

**MULTILAYERED STRUCTURE: ABSENT**

**FLAGELLUM INSERTION**

# CHLOROPHYCEAE



# ULVOPHYCEAE

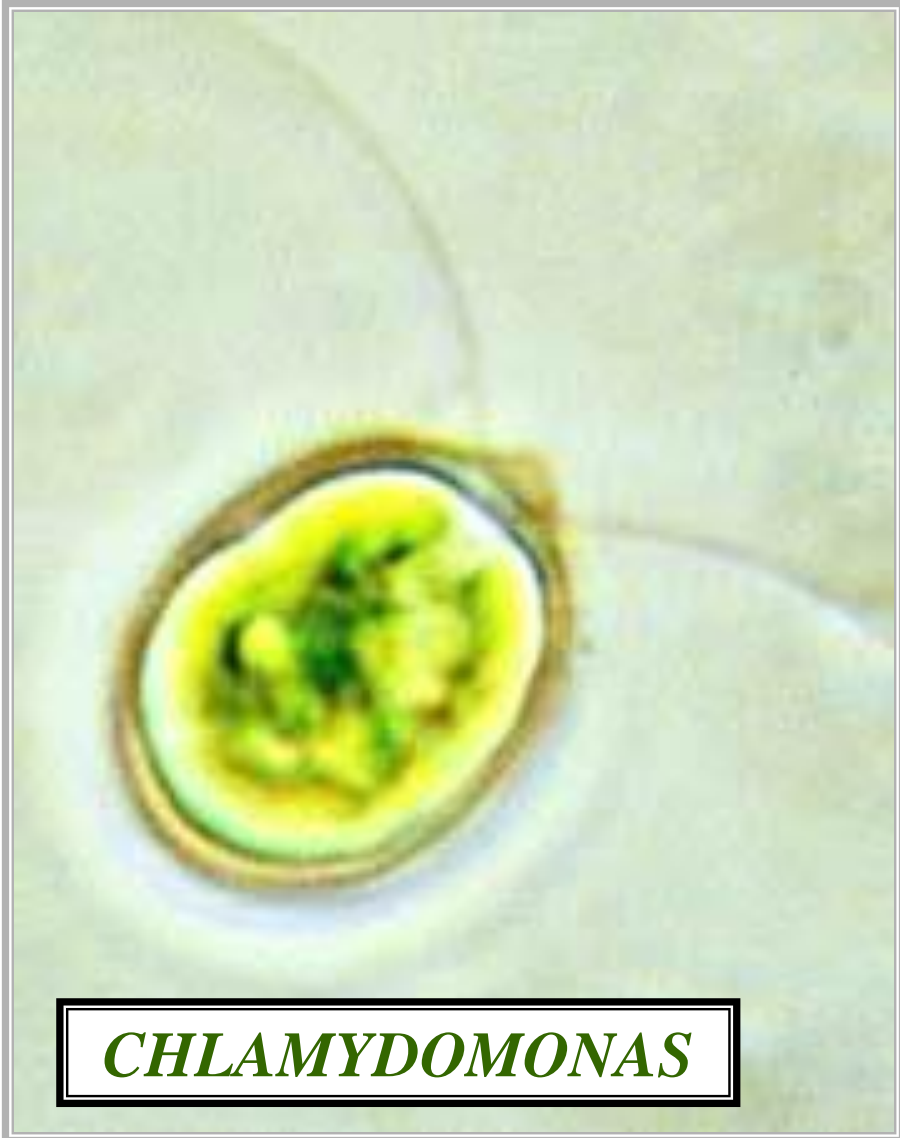
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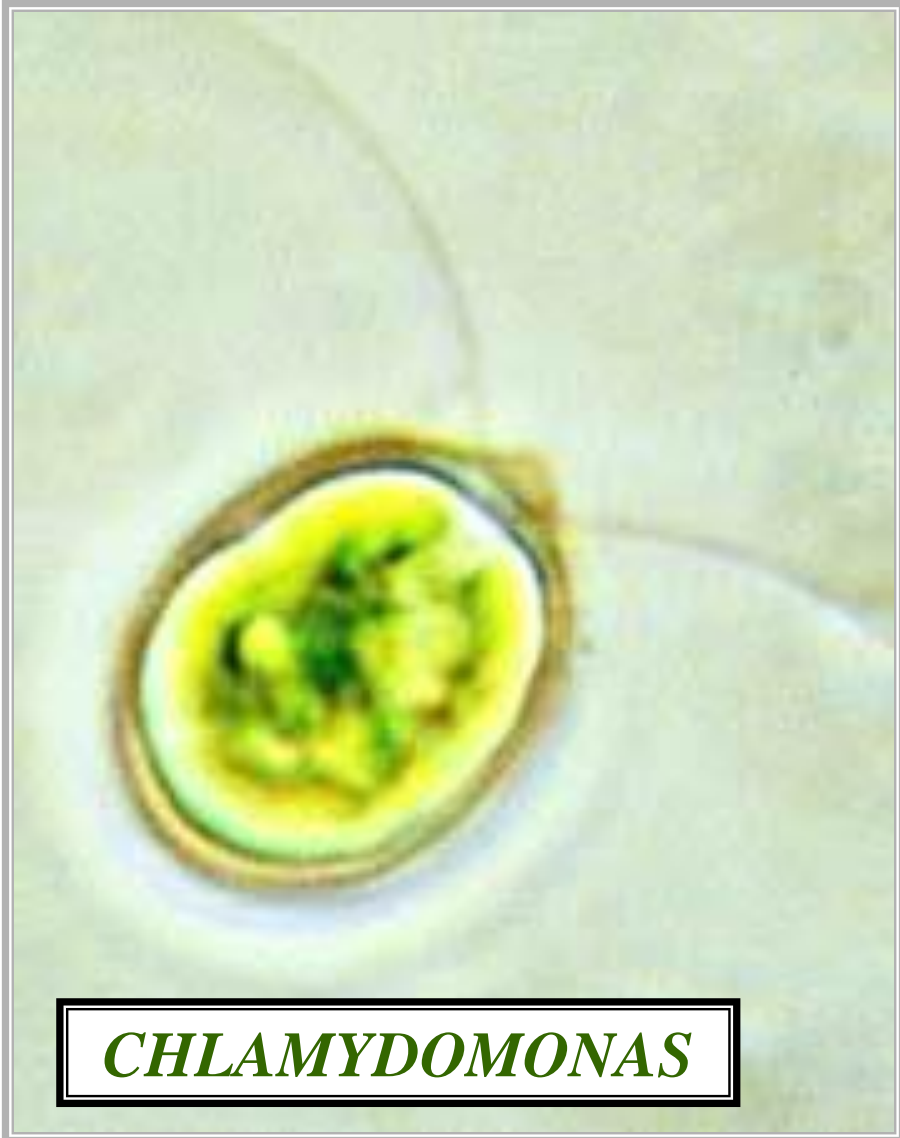
# CHLOROPHYCEAE

# ULVOPHYCEAE

U



# CHLOROPHYCEAE



*CHLAMYDOMONAS*

# ULVOPHYCEAE



*ULVA*





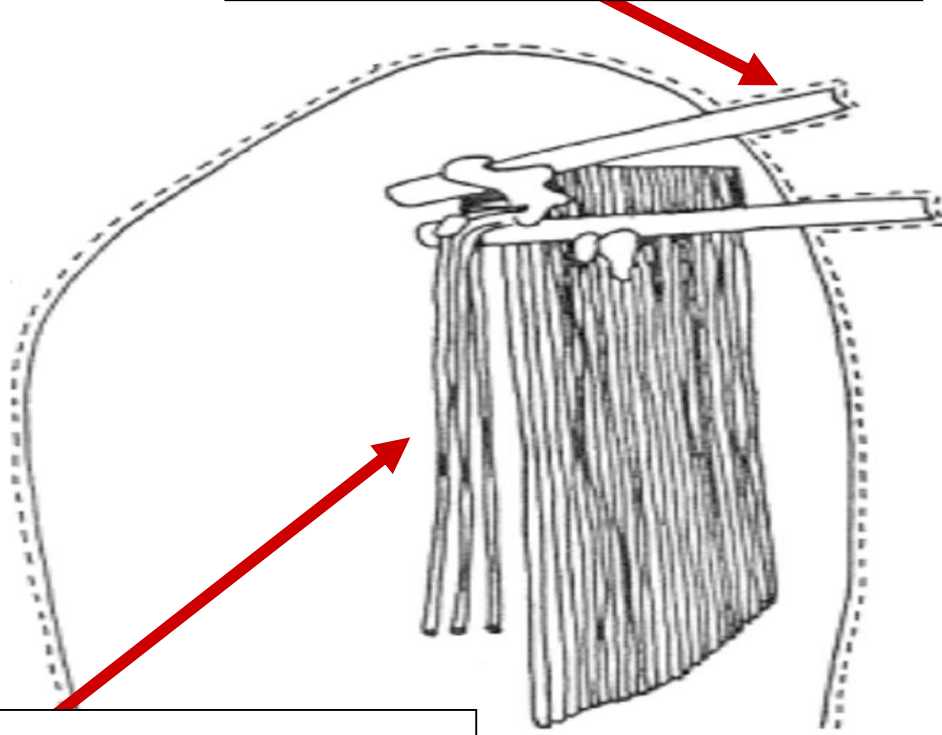
# CHAROPHYCEAE

## FLAGELLA

## INSERTION

# CHAROPHYCEAE

**FLAGELLUM**

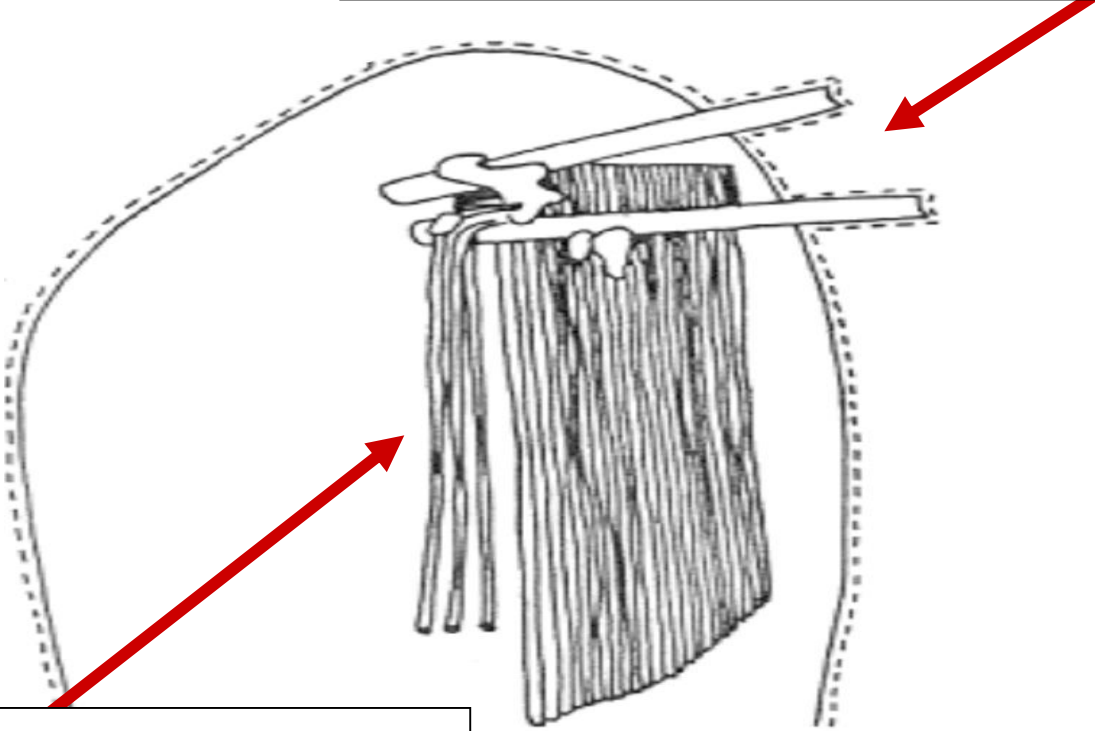


**FLAGELLUM ROOT**

**FLAGELLUM INSERTION**

# CHAROPHYCEAE

**SUBAPICAL INSERTION**



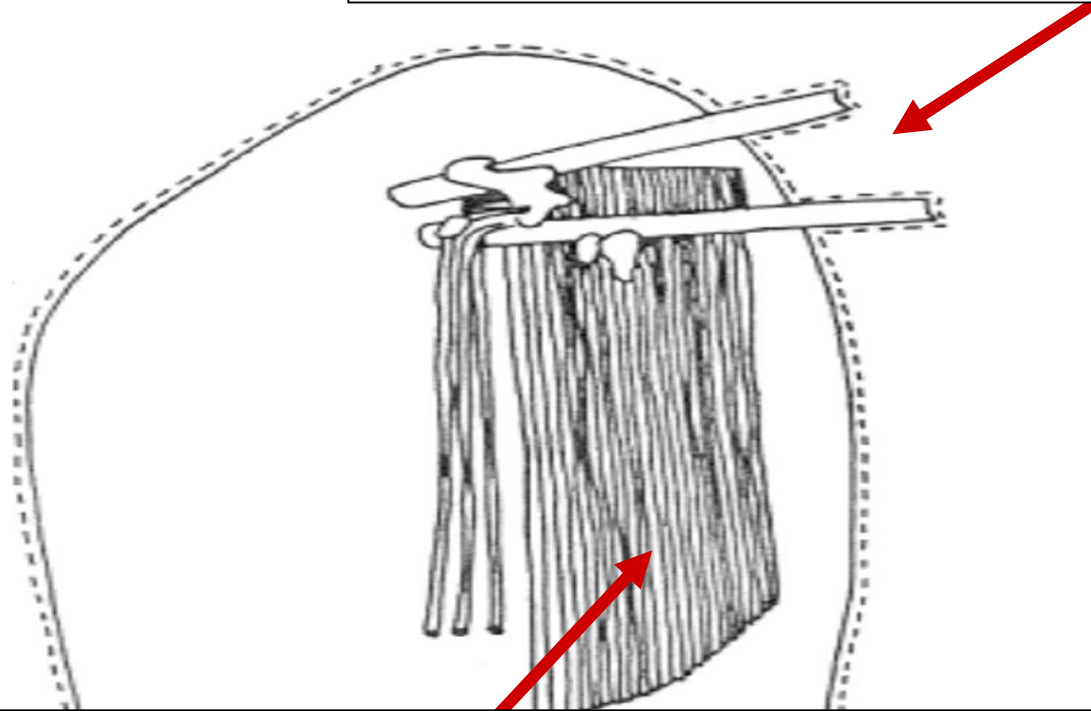
**FLAGELLUM ROOT**

**FLAGELLUM INSERTION**

# CHAROPHYCEAE



**SUBAPICAL INSERTION**



**MULTILAYERED STRUCTURE: PRESENT**

**FLAGELLUM INSERTION**

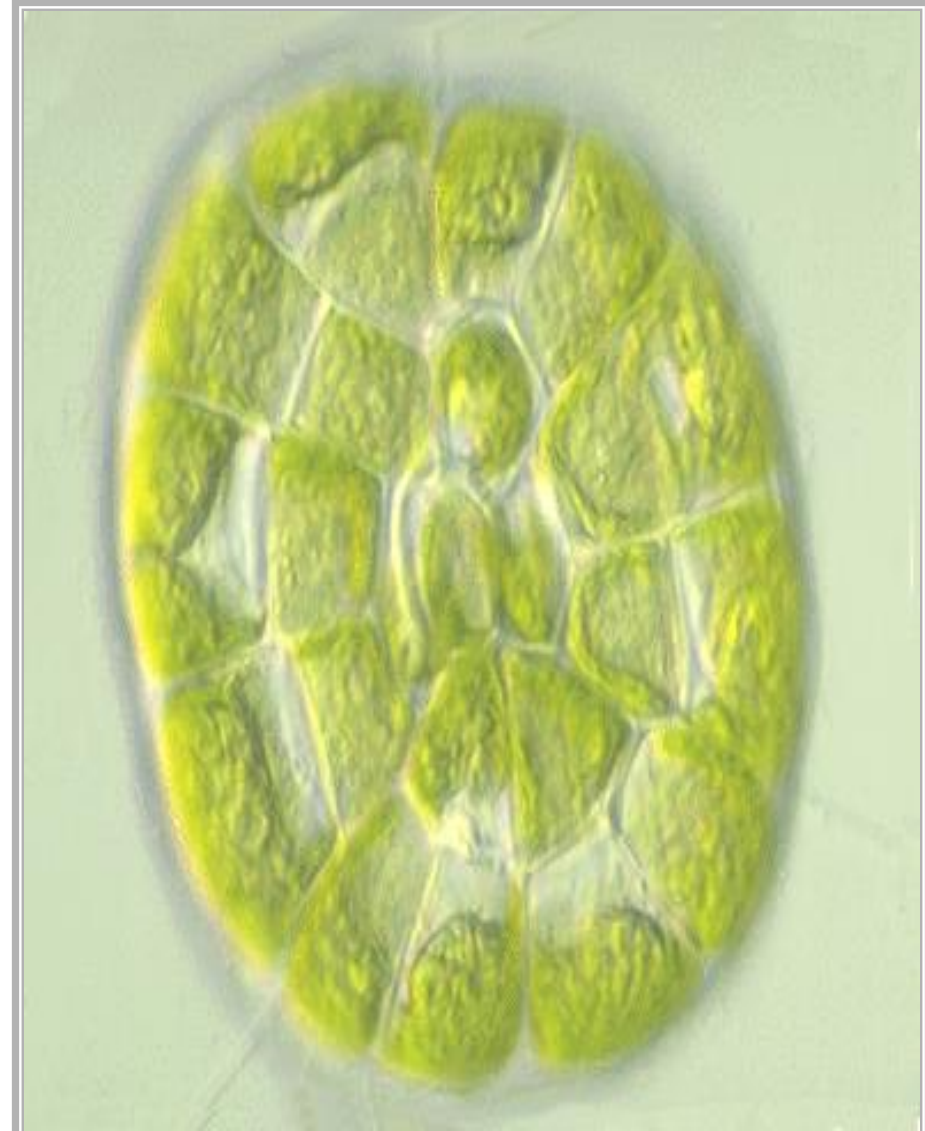
# CHAROPHYCEAE



# CHAROPHYCEAE



*CHARA*



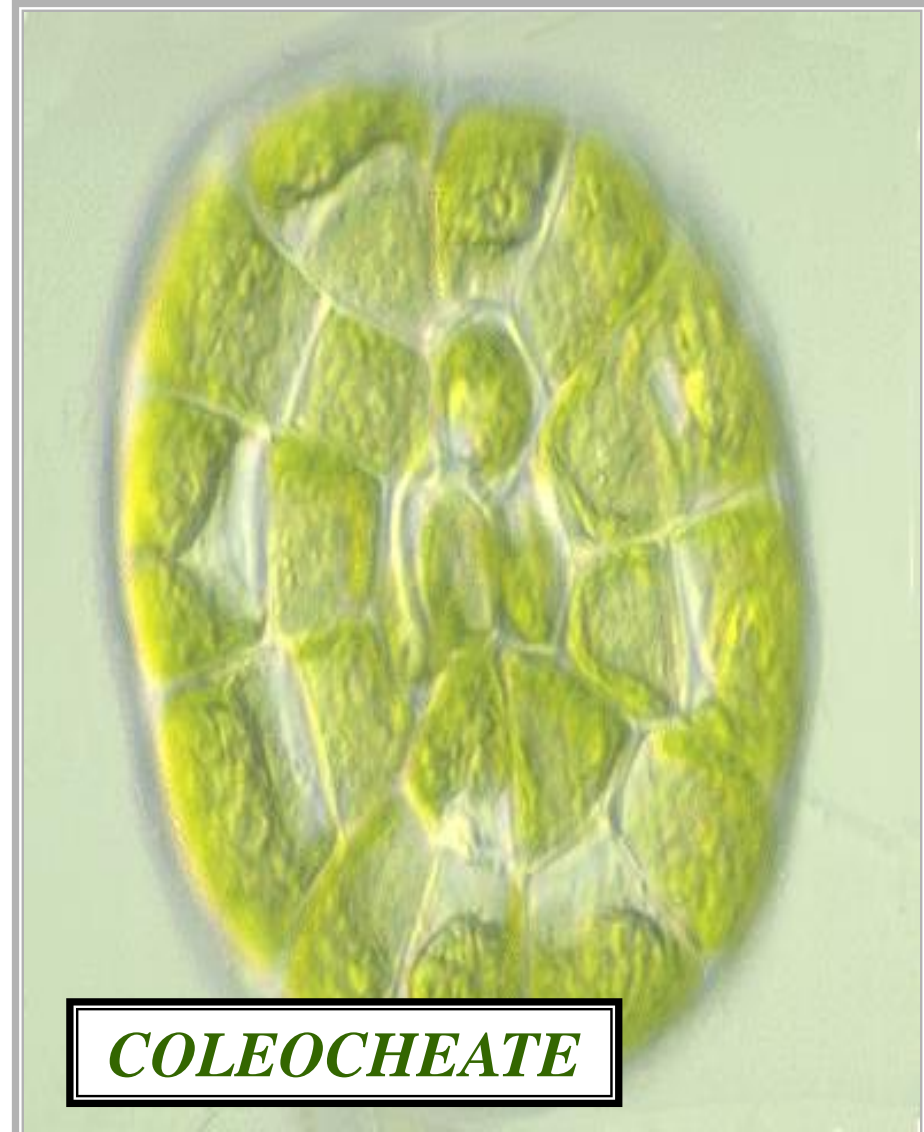
# CHAROPHYCEAE

E

>



*CHARA*

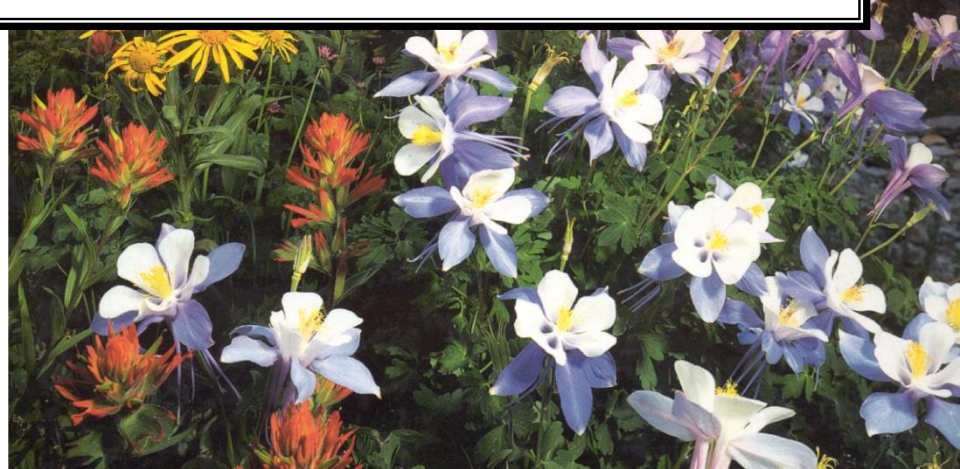


*COLEOCHEATE*



# EMBRYOPHYTES

**FLAGELLUM:  
SUBAPICAL INSERTION**





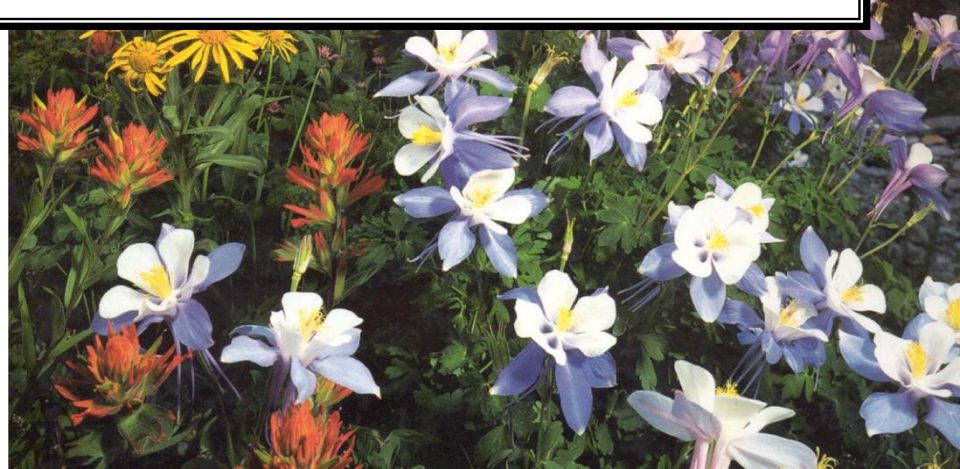


VP

+

# EMBRYOPHYTES

**FLAGELLUM:**  
**MLS PRESENT**



# VASCULAR PLANT EVOLUTION

# VASCULAR PLANT EVOLUTION

CYANOPHYTA

ENDOSYMBIOTIC  
THEORY

CHLOROPHYTA

PHYCOPLAST ABSENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

ULVOPHYCEAE

PHYCOPLAST PRESENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

CHLOROPHYCEAE

PHYCOPLAST ABSENT  
PHRAGMOPLAST PRESENT  
FLAGELLA SUBAPICAL

CHAROPHYCEAE

FLAGELLA  
IDENTICAL WITH  
EMBRYOPHYTES

EMBRYOPHYTES



# CHLOROPHYTA GAMETANGIA

**GAMETANGIA**

**GAMETANGIA**

**GAMETE PRODUCING  
STRUCTURES**

**GAMETANGIA**

**ANTHERIDIUM**

**ANTHERIDIUM**

**SPERM PRODUCING  
GAMETANGIUM**

**ANTHERIDIUM**

**OOGONIUM**



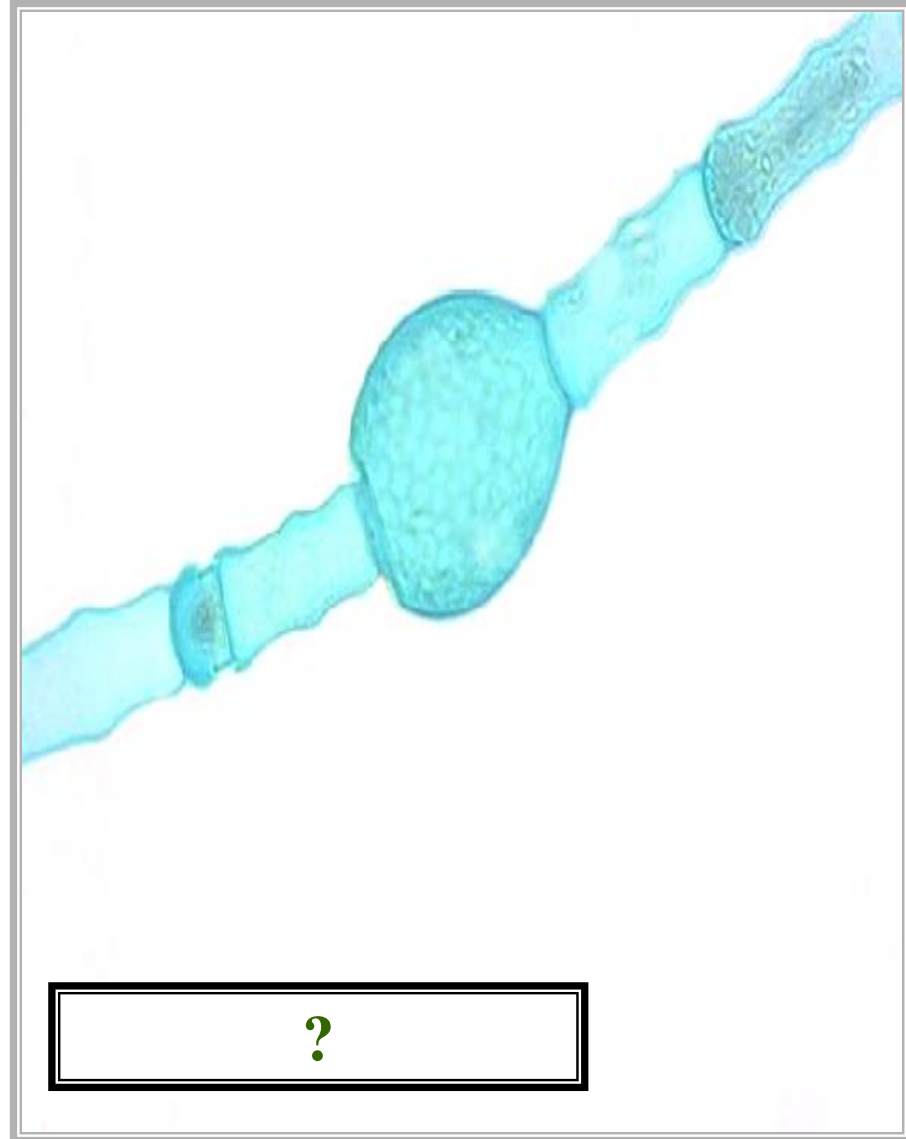
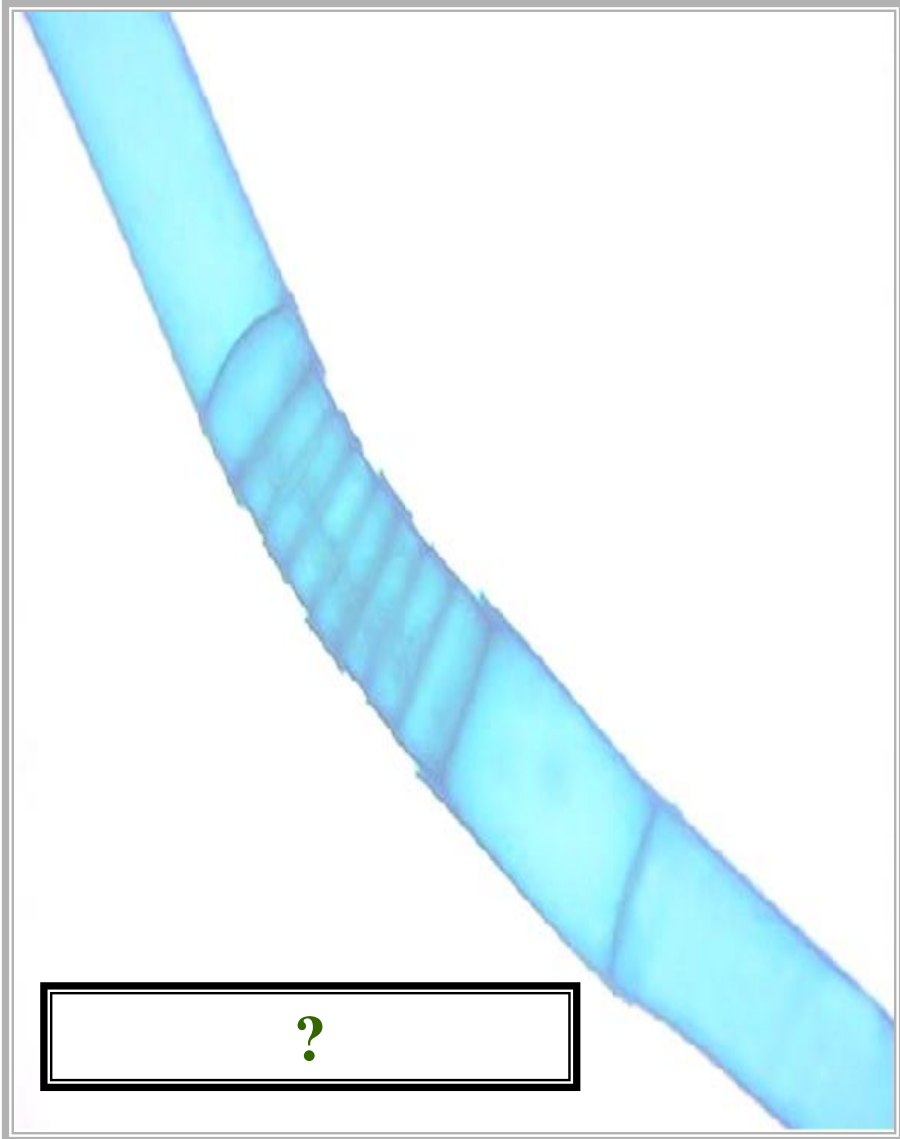


**OOGONIUM**

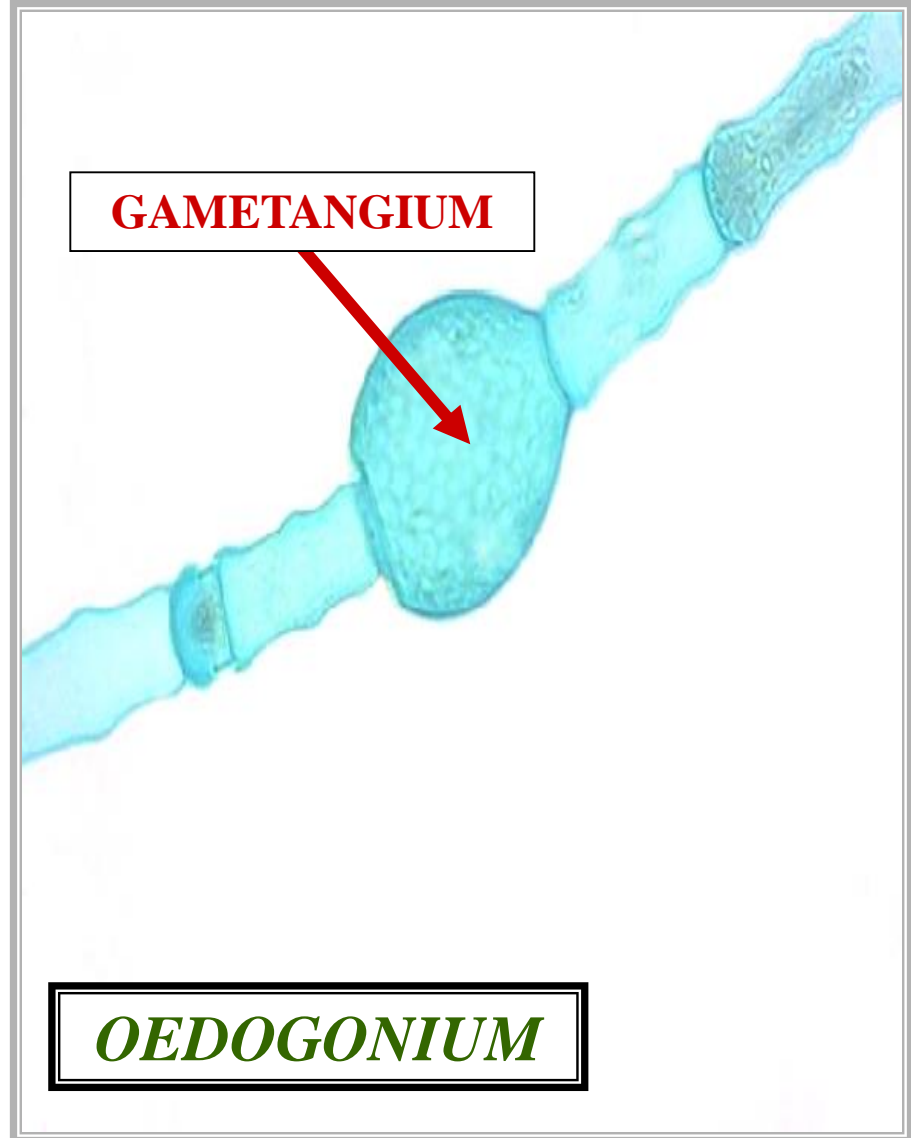
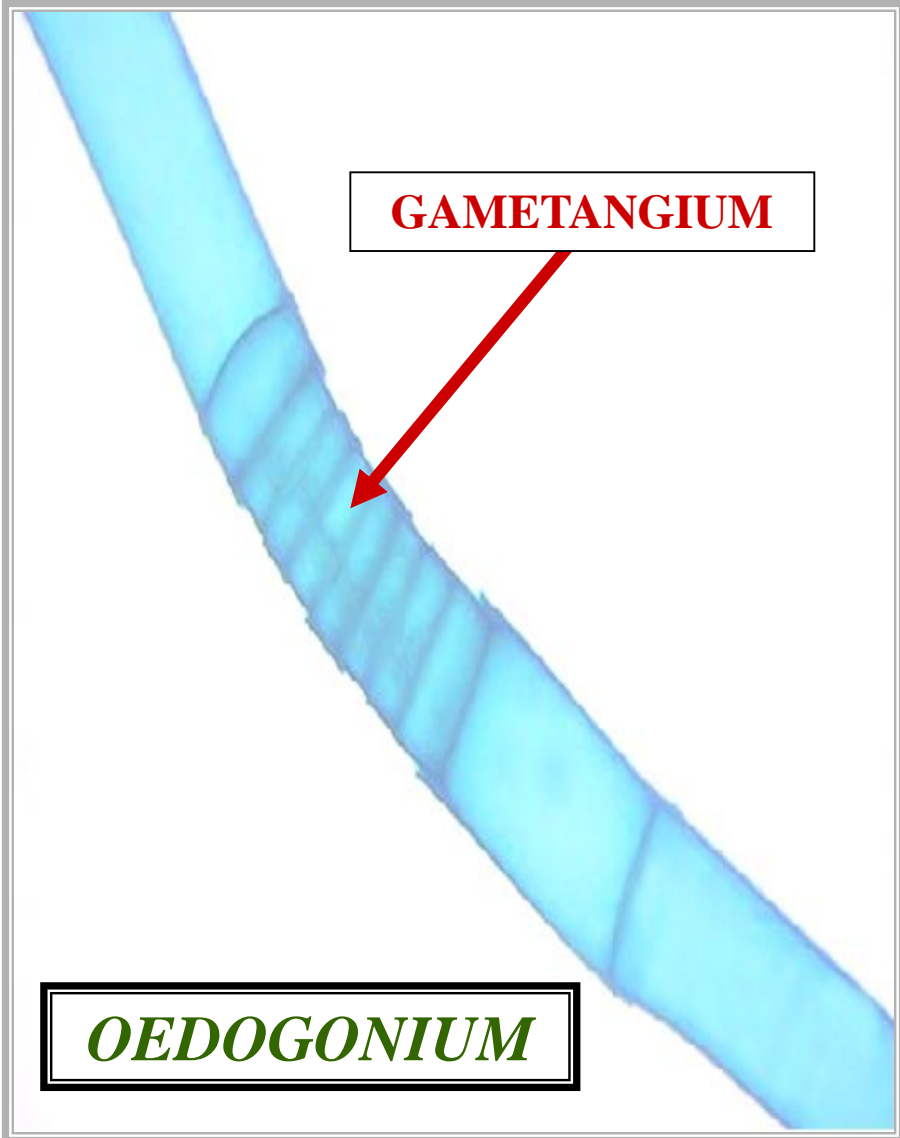
**EGG PRODUCING  
GAMETANGIUM**

**OOGONIUM**

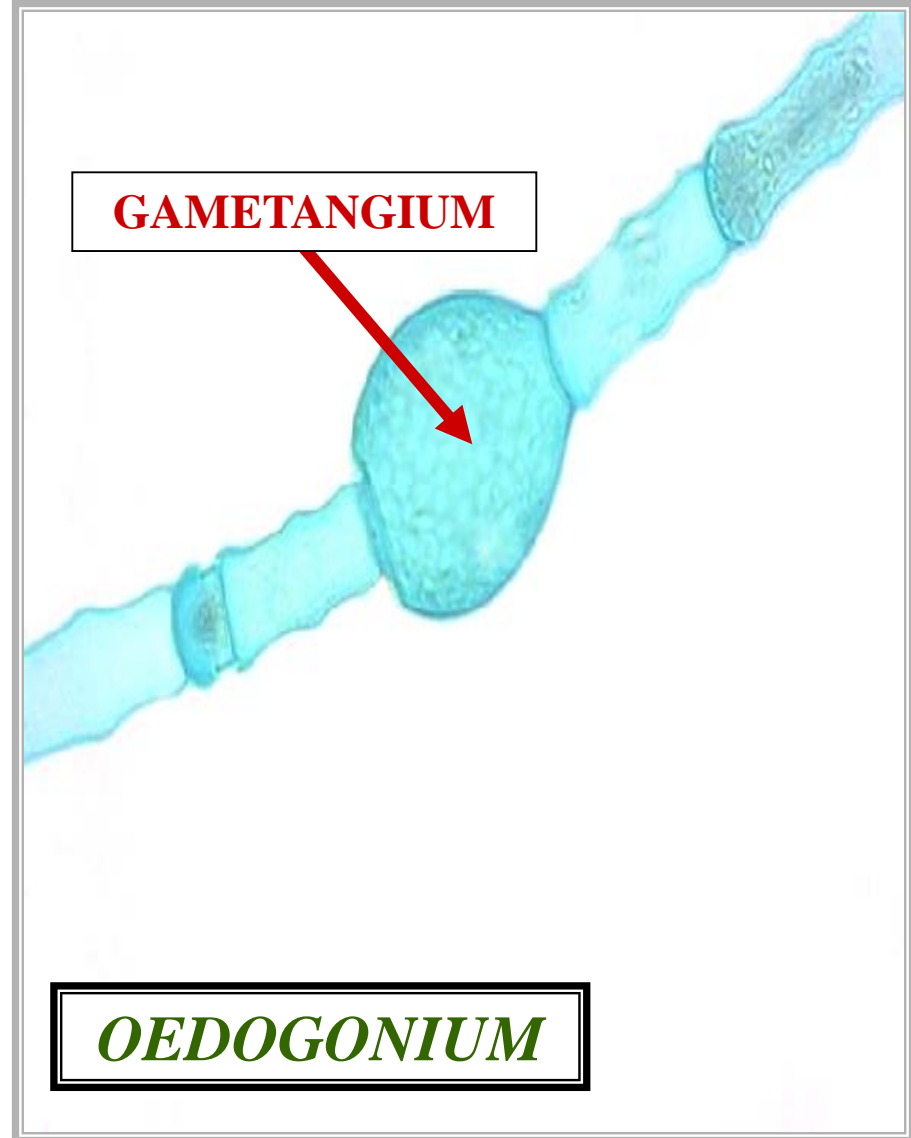
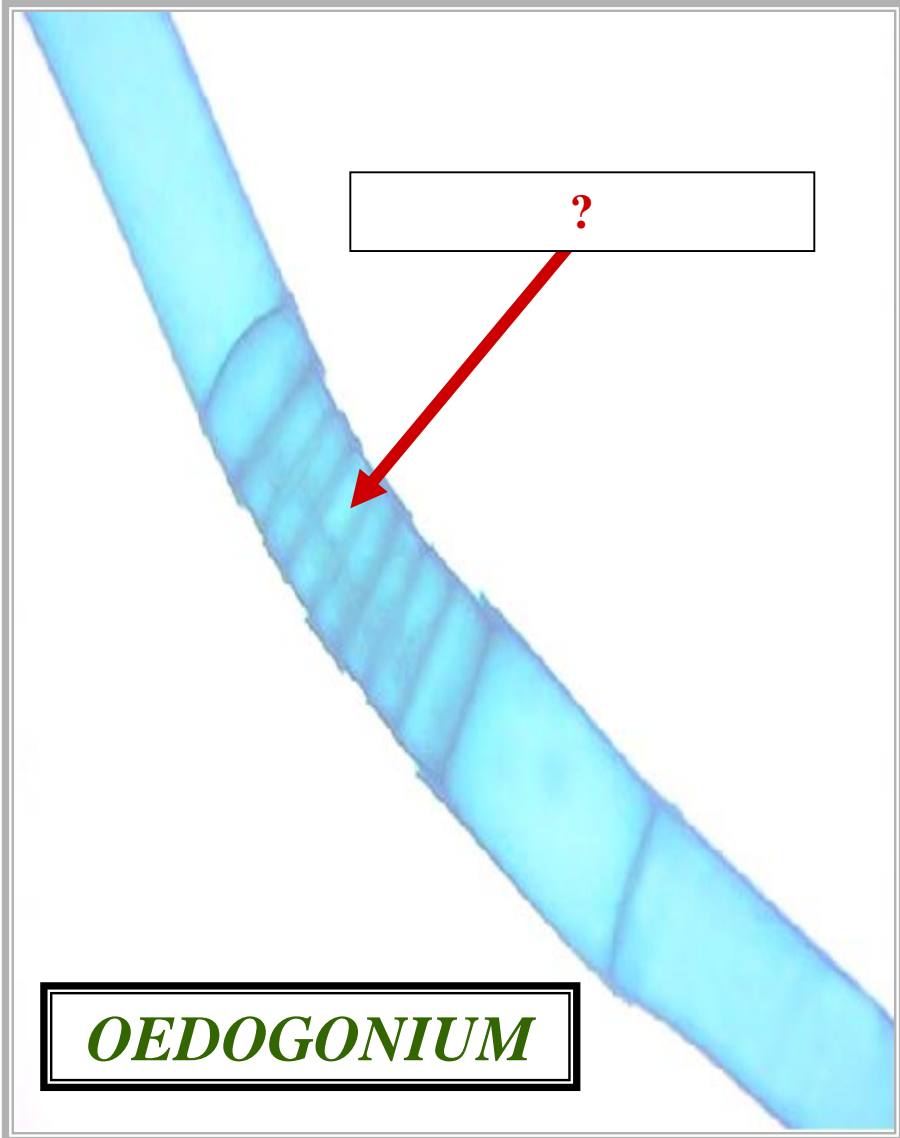
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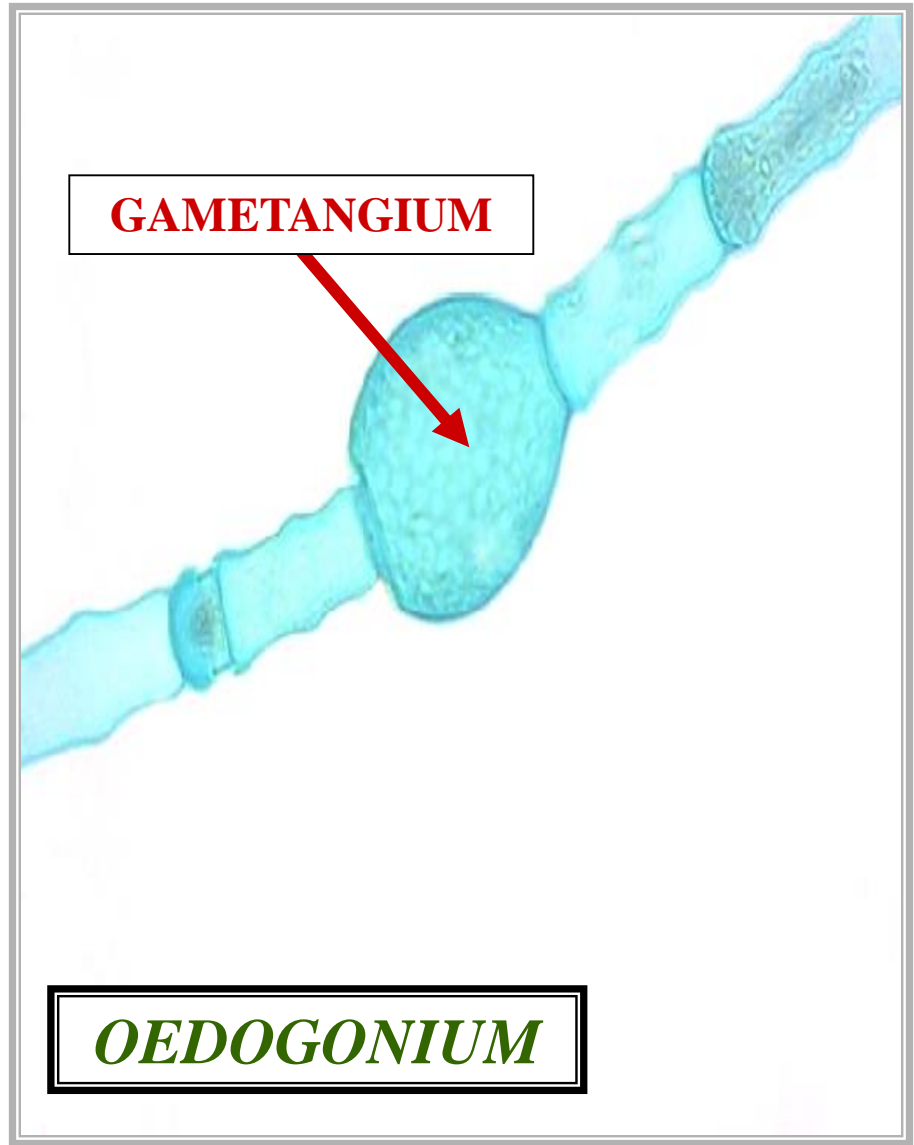
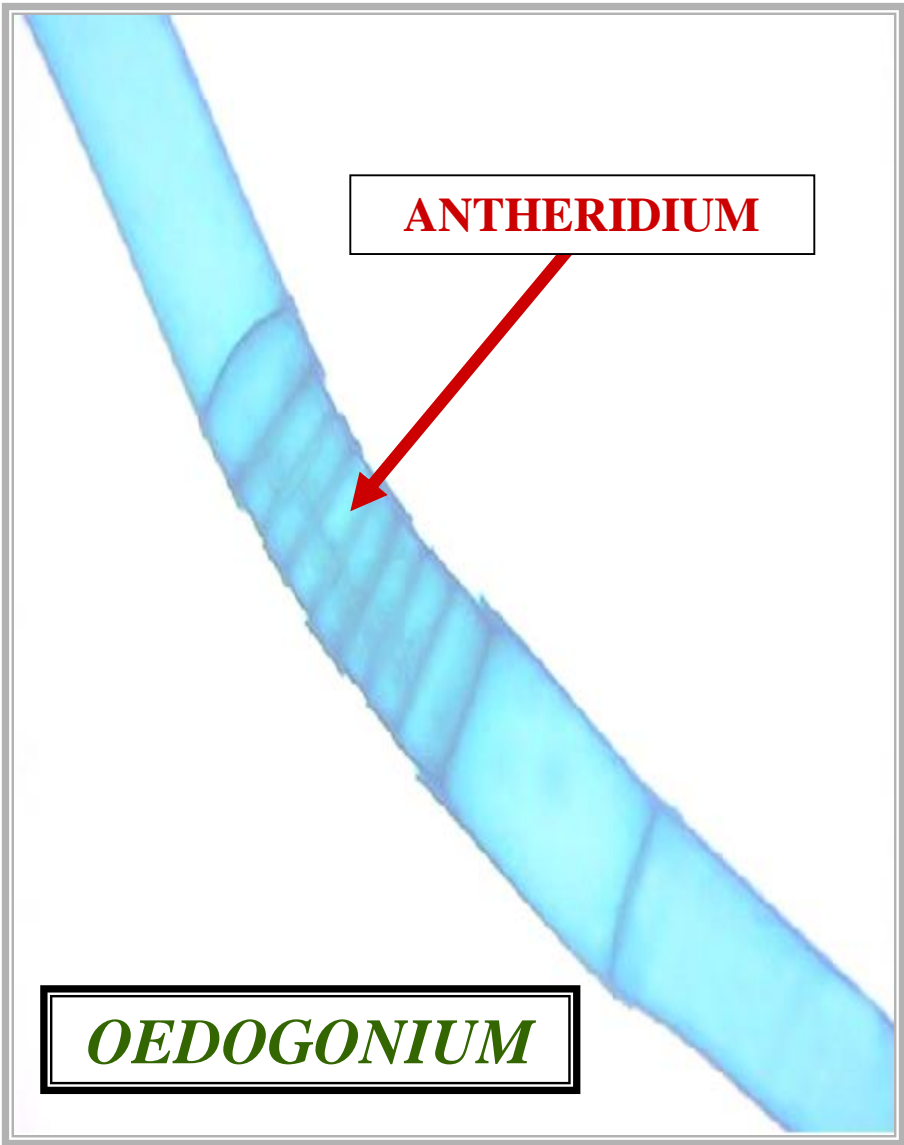
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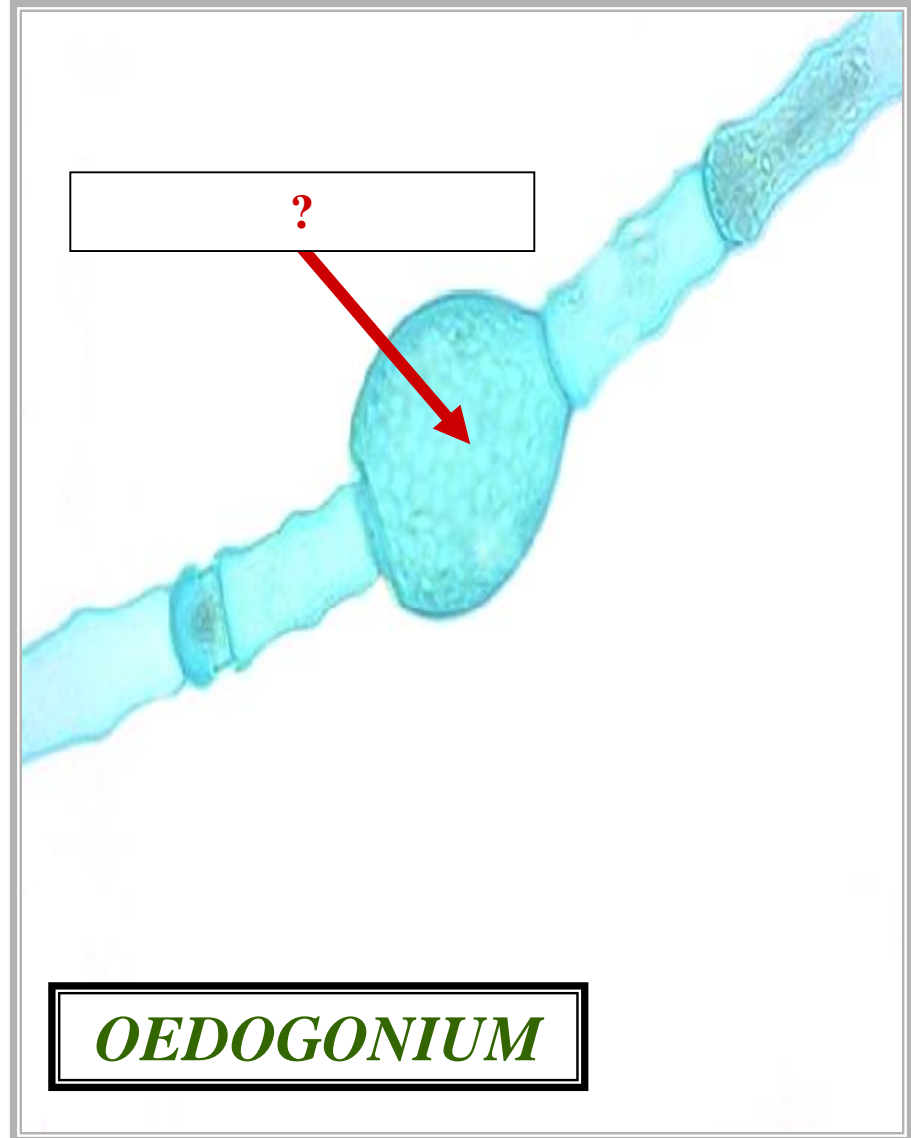
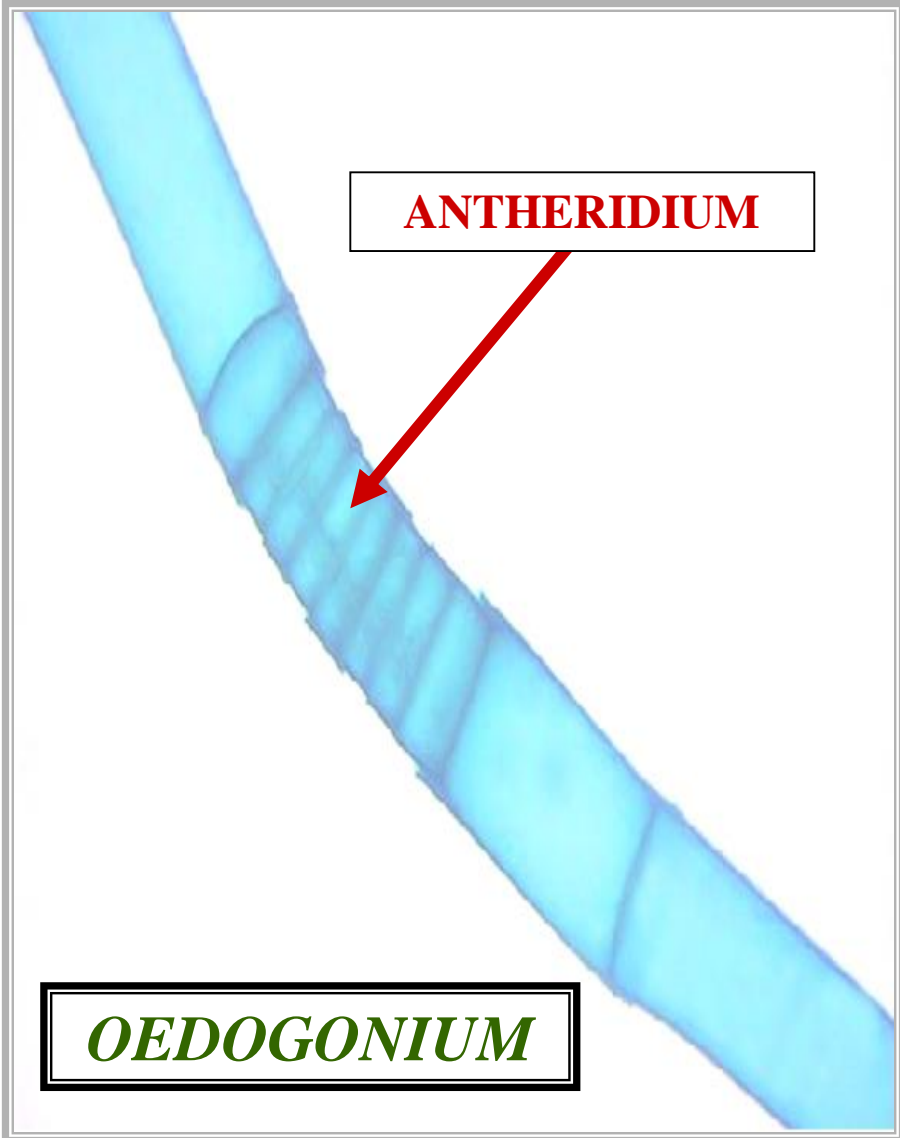
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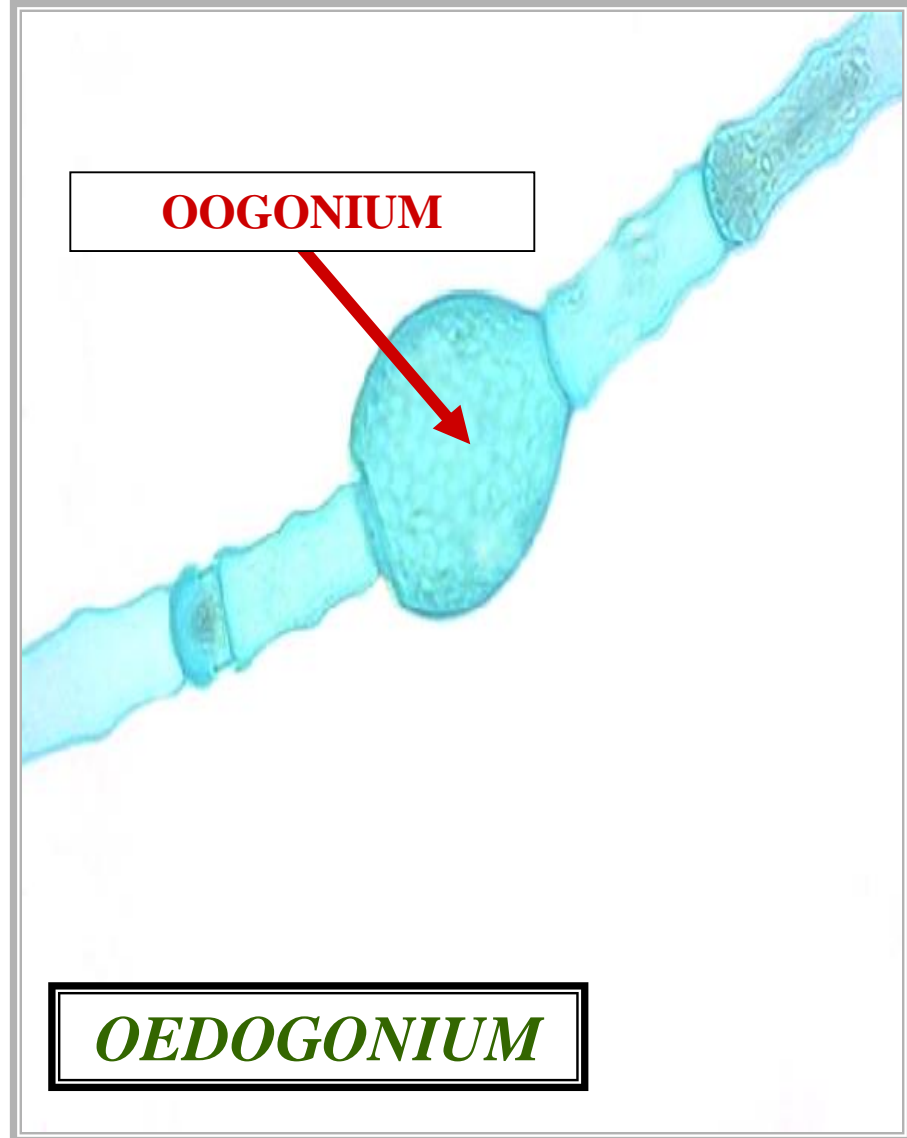
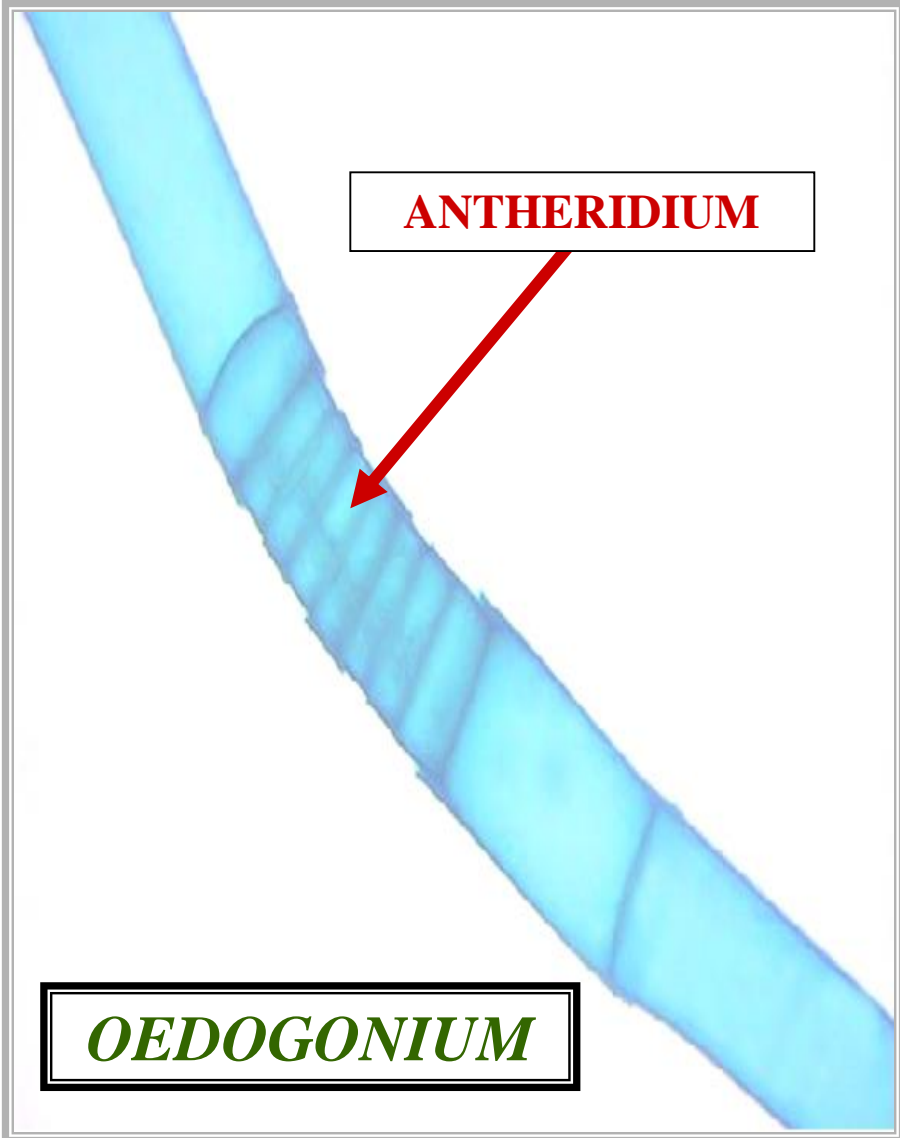
# GAMETANGIA



# GAMETANGIA



# GAMETANGIA



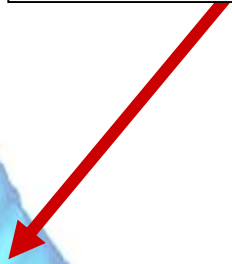


**CHLOROPHYCEAE**  
**&**  
**ULVOPHYCEAE**  
**GAMETANGIA**



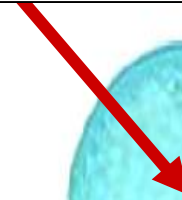
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**ANTHERIDIUM**



***OEDOGONIUM***

**OOGONIUM**

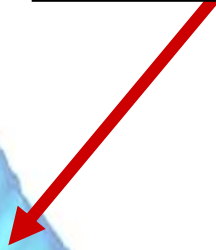


***OEDOGONIUM***

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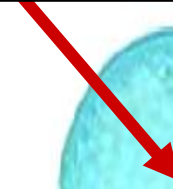


**UNICELLULAR  
GAMETANGIUM  
ANTHERIDIUM**



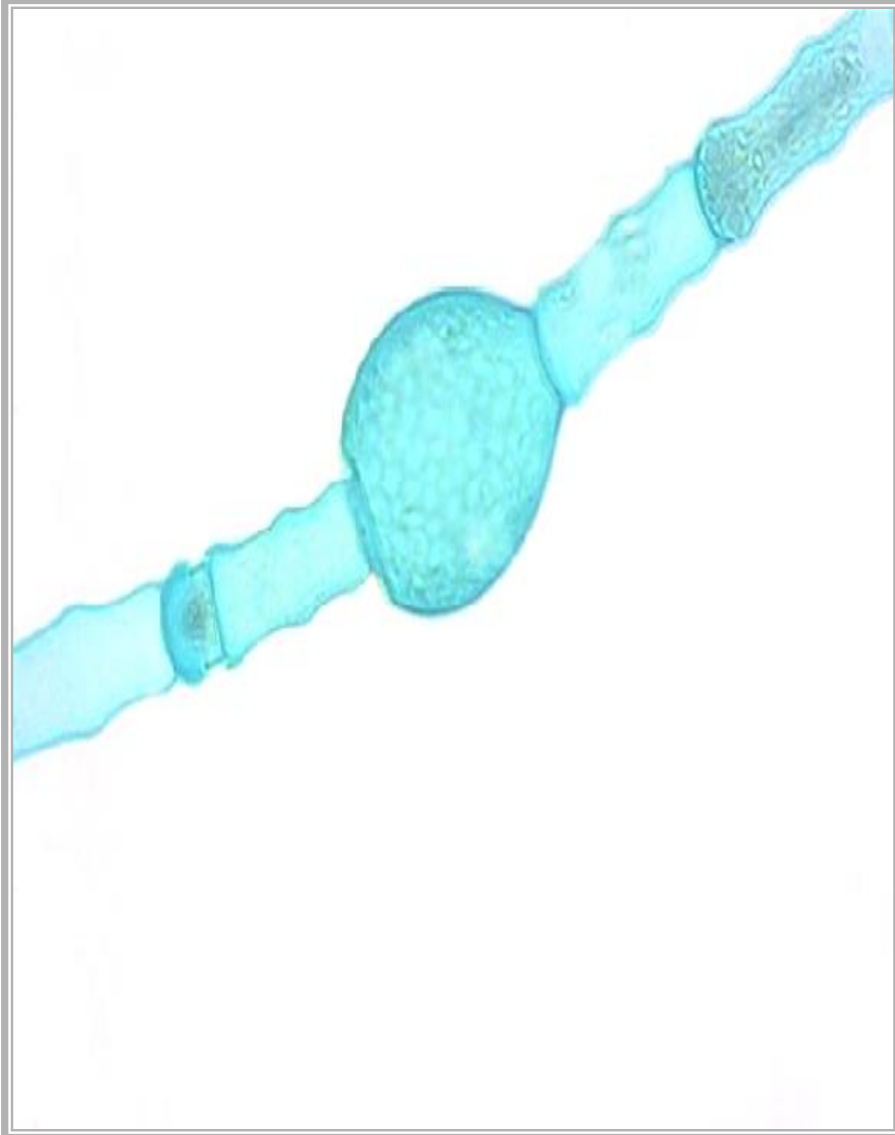
***OEDOGONIUM***

**UNICELLULAR  
GAMETANGIUM  
OOGONIUM**



***OEDOGONIUM***

# CHLOROPHYCEAE



# ULVOPHYCEAE

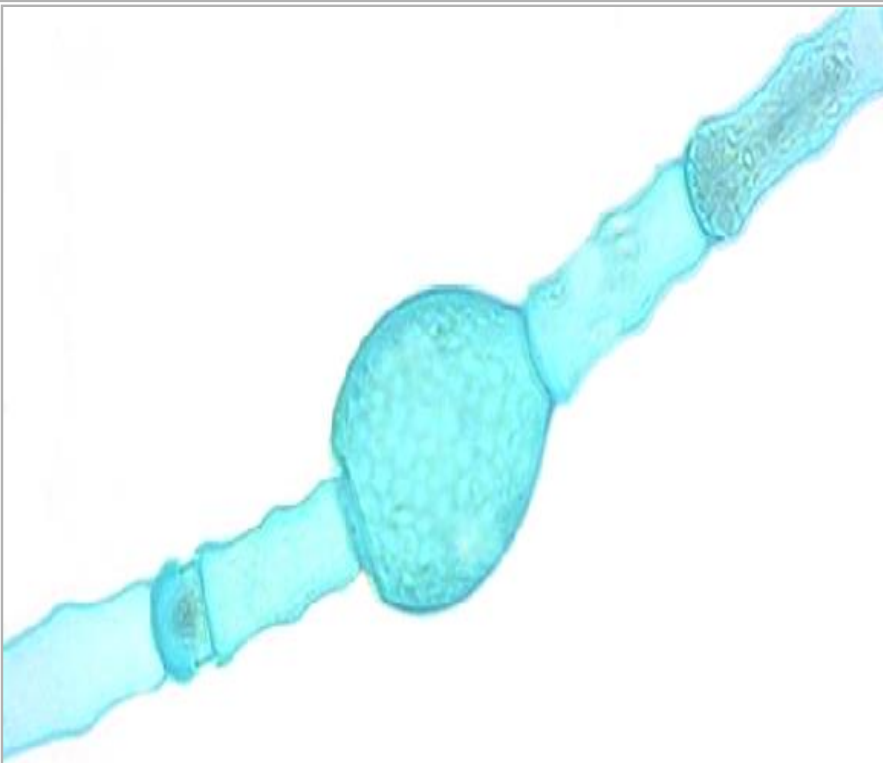
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# CHLOROPHYCEAE

# ULVOPHYCEAE

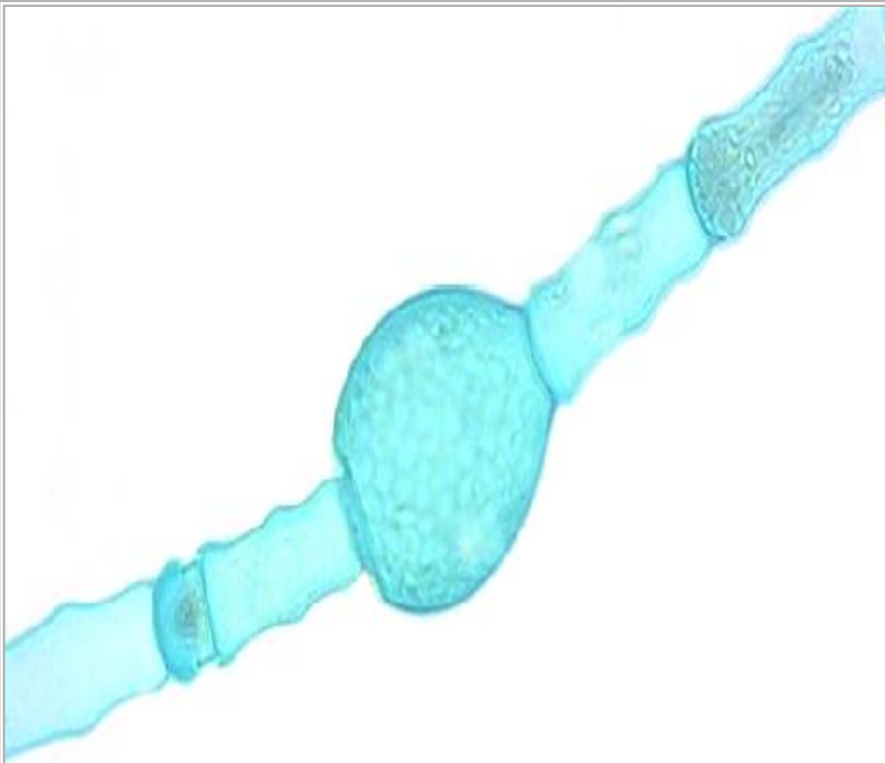
*U*



*OEDOGONIUM*



# CHLOROPHYCEAE



*OEDOGONIUM*

# ULVOPHYCEAE



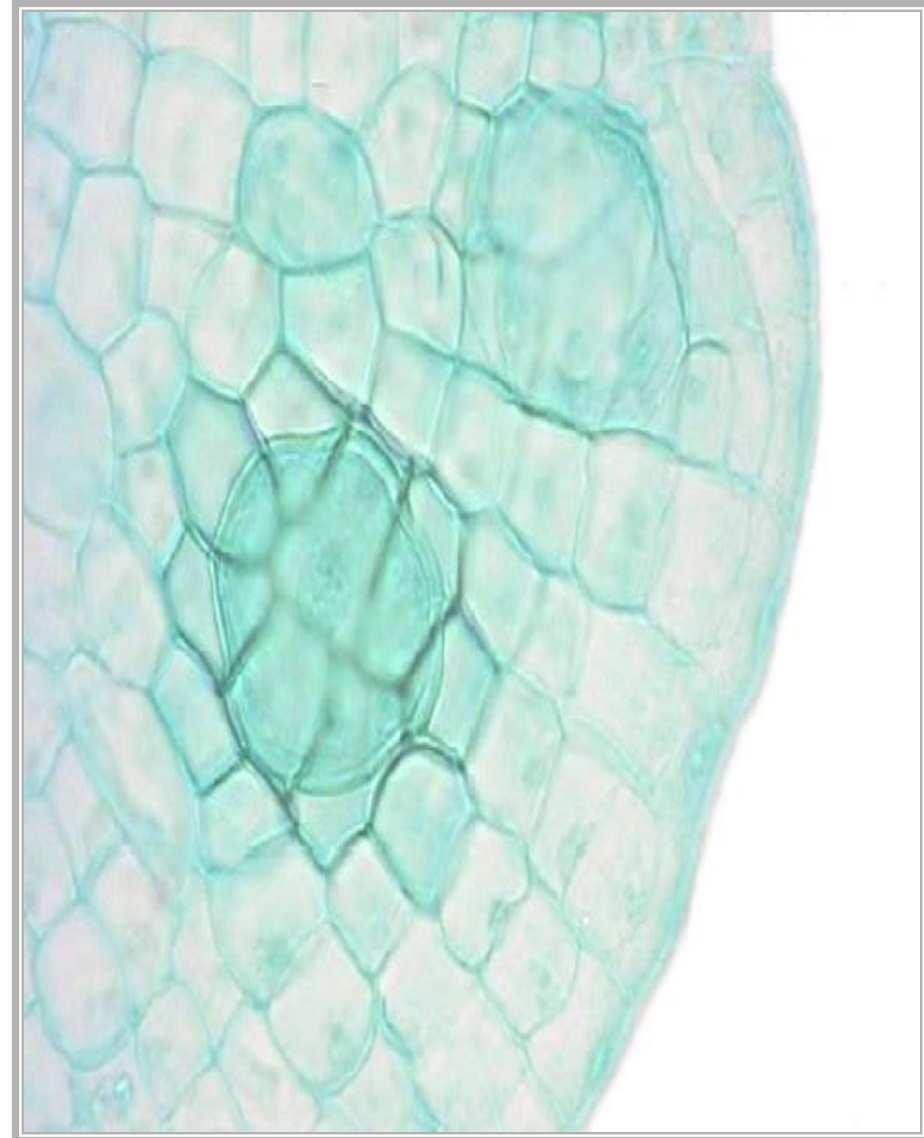
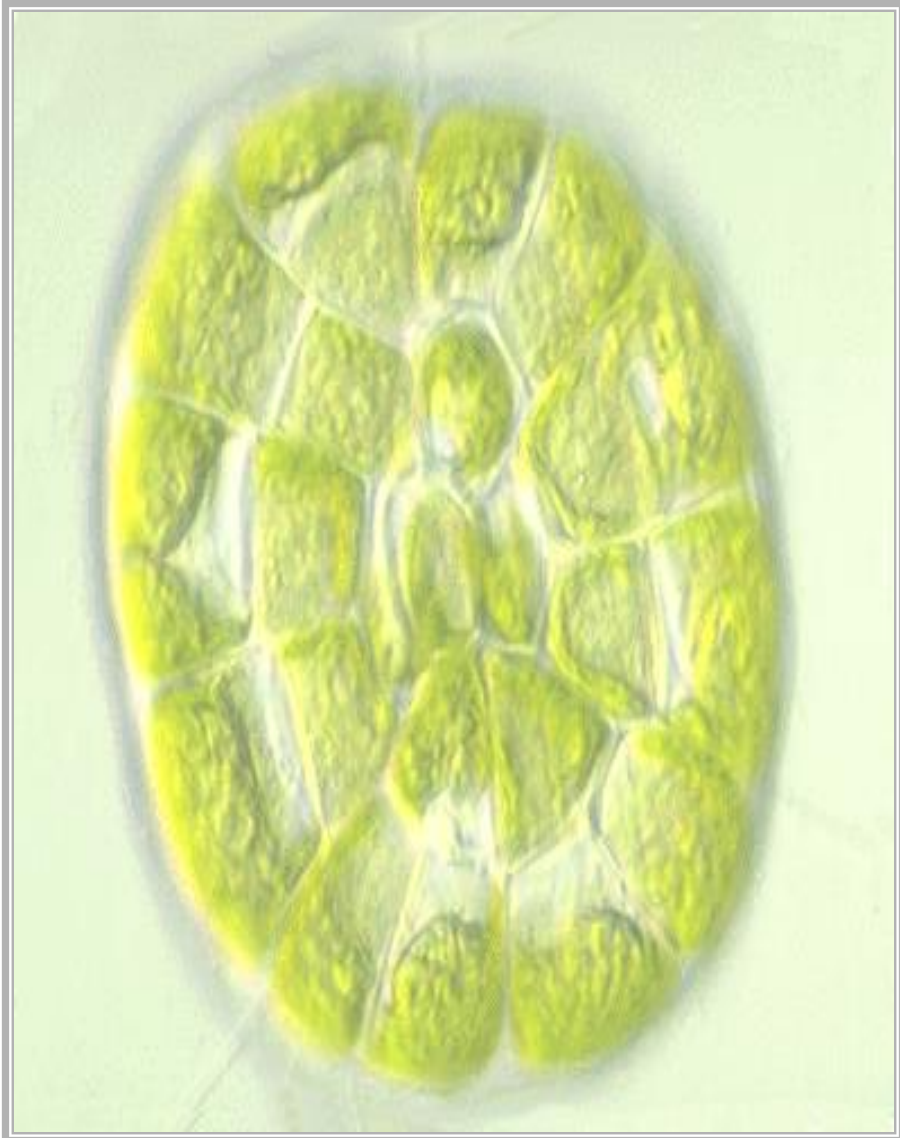
*ULVA*



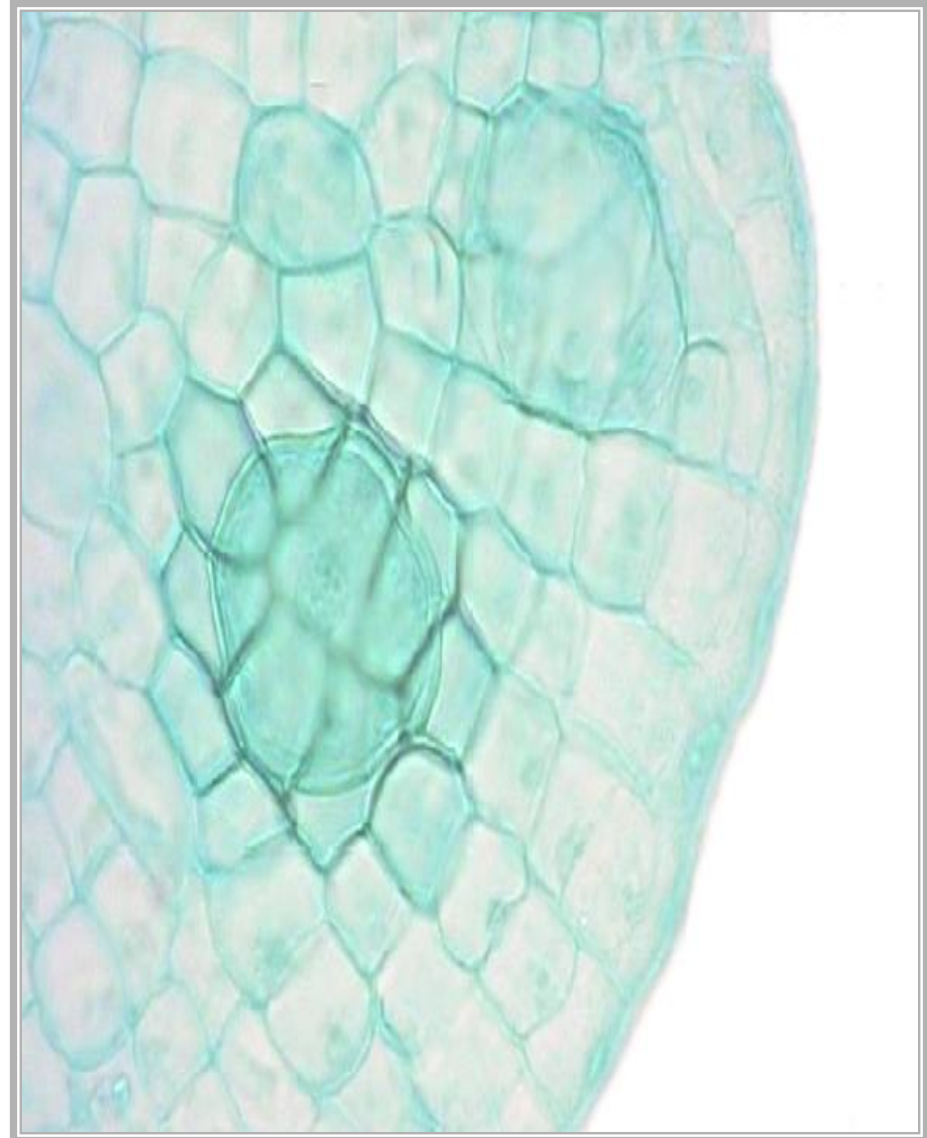
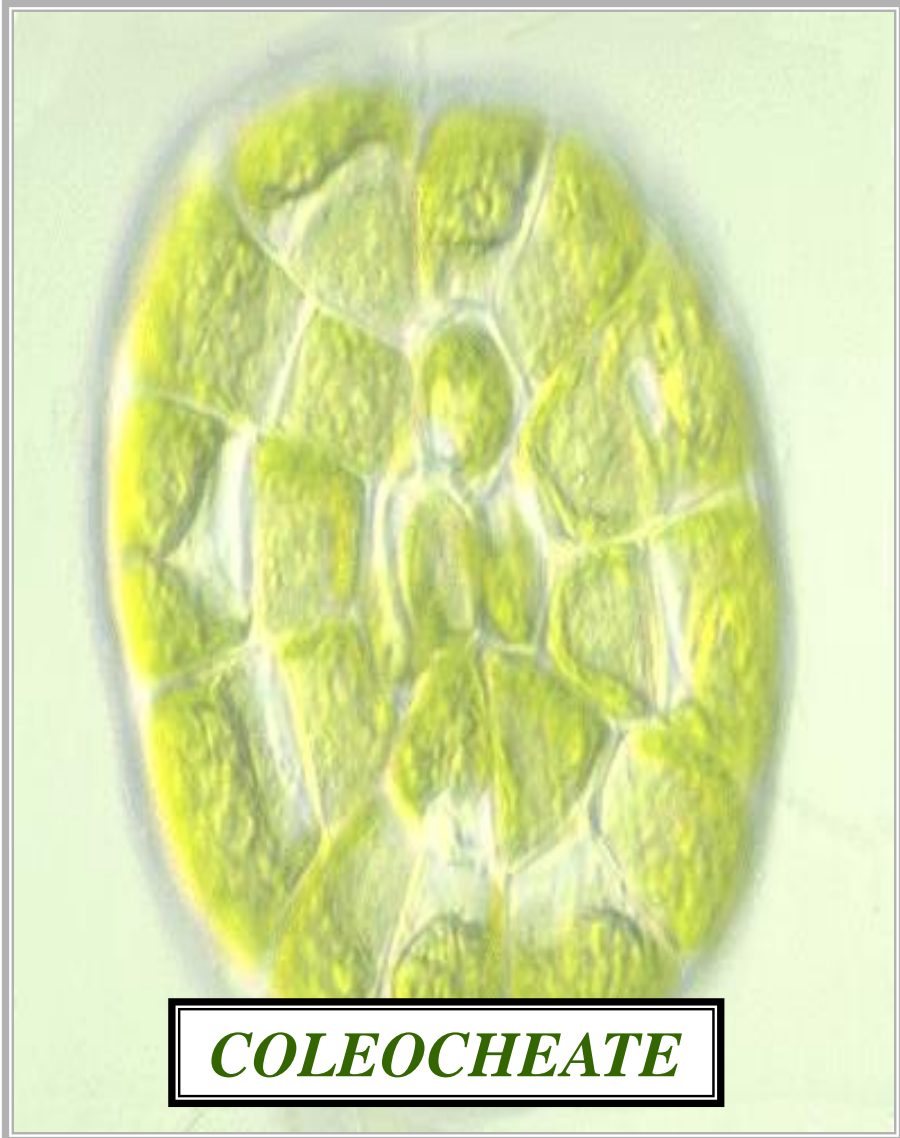
# CHAROPHYCEAE

# GAMETANGIA

# UNICELLULAR GAMETANGIA

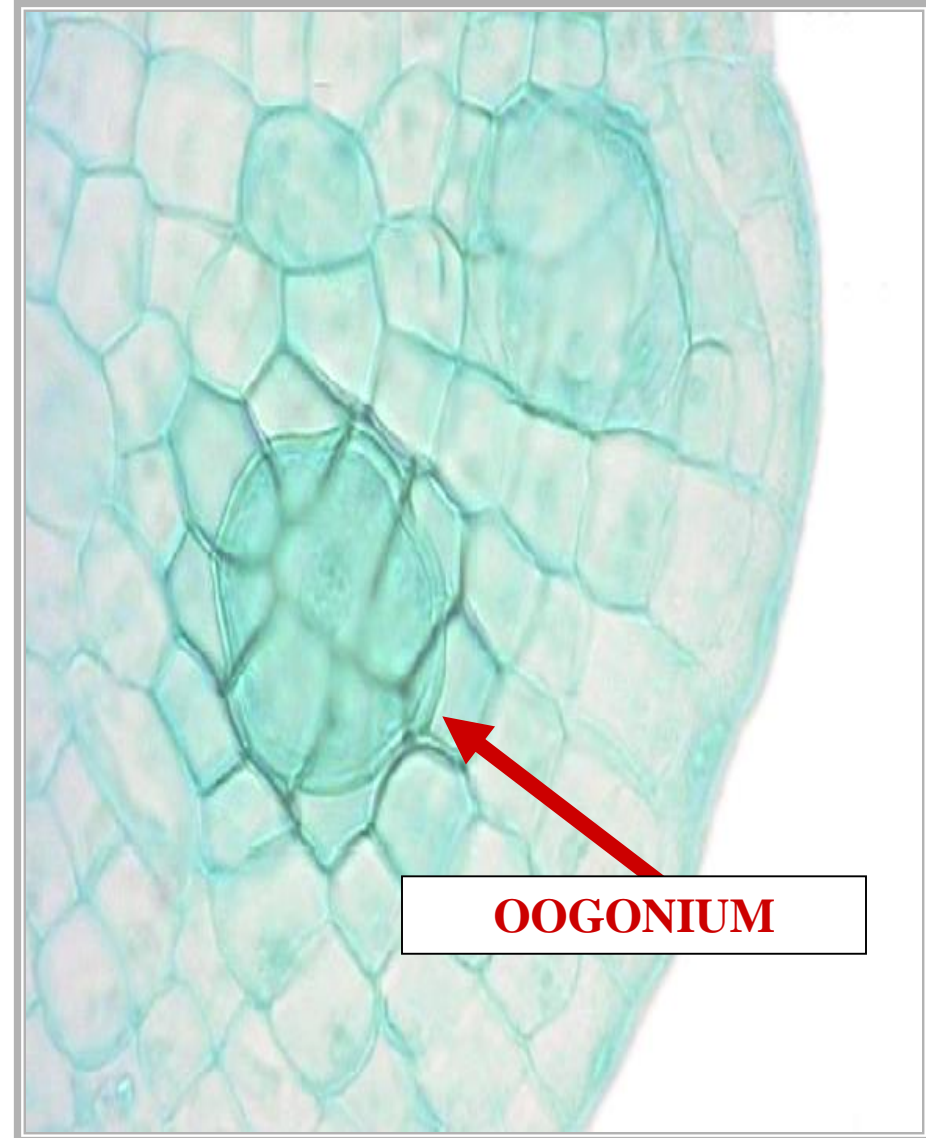
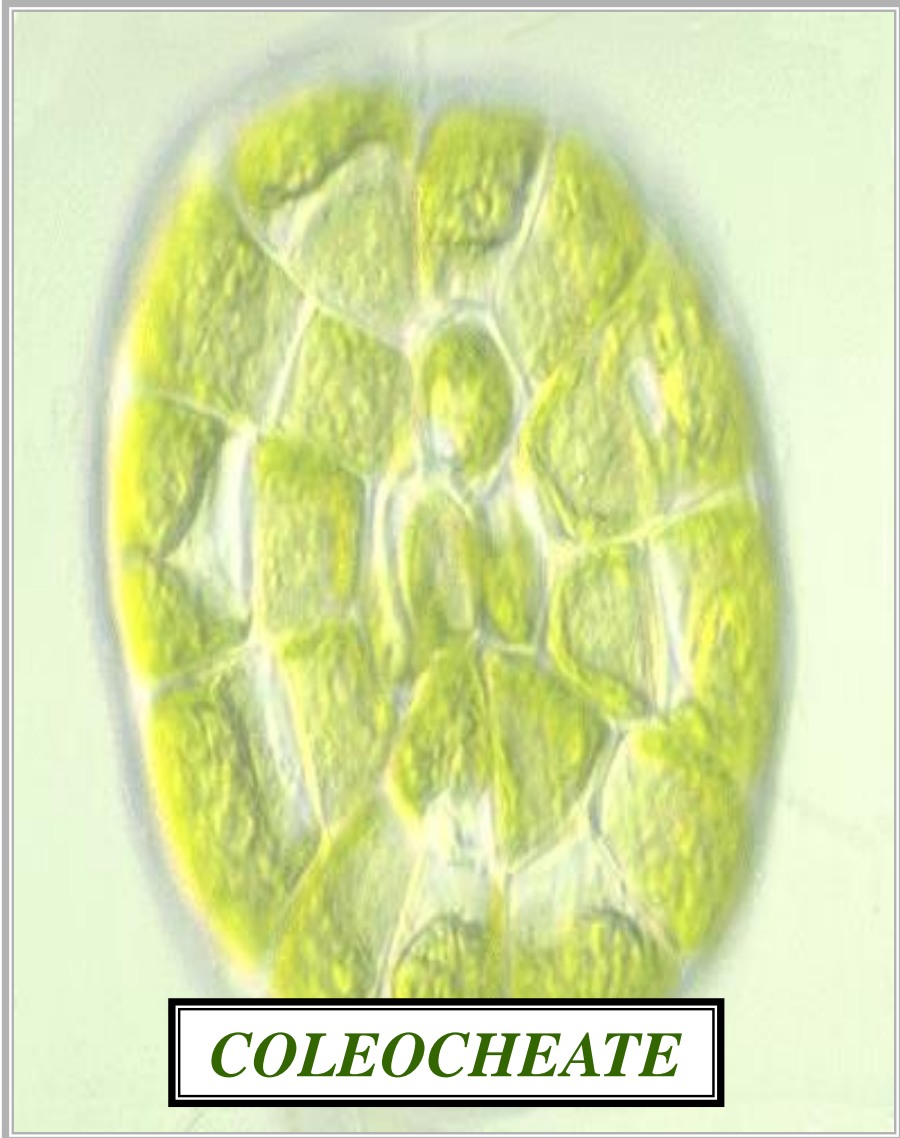


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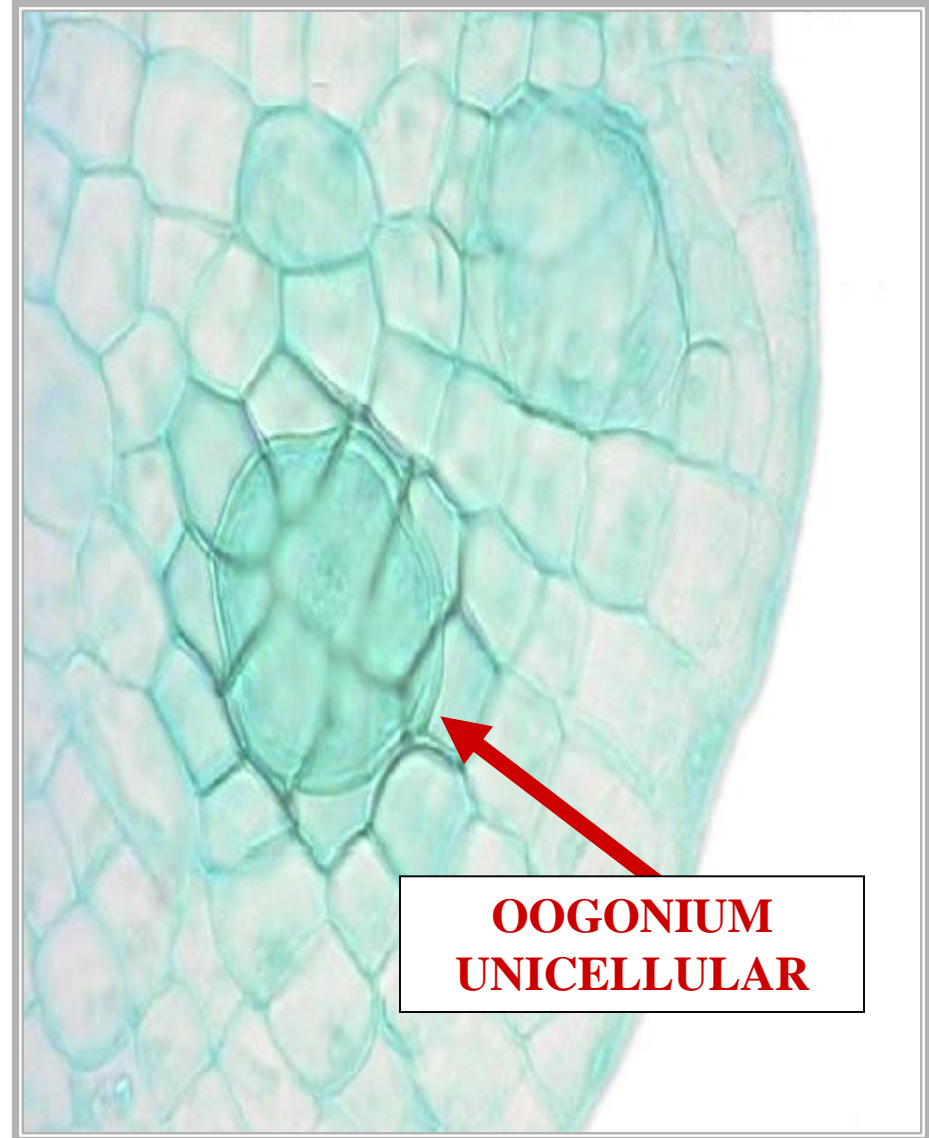
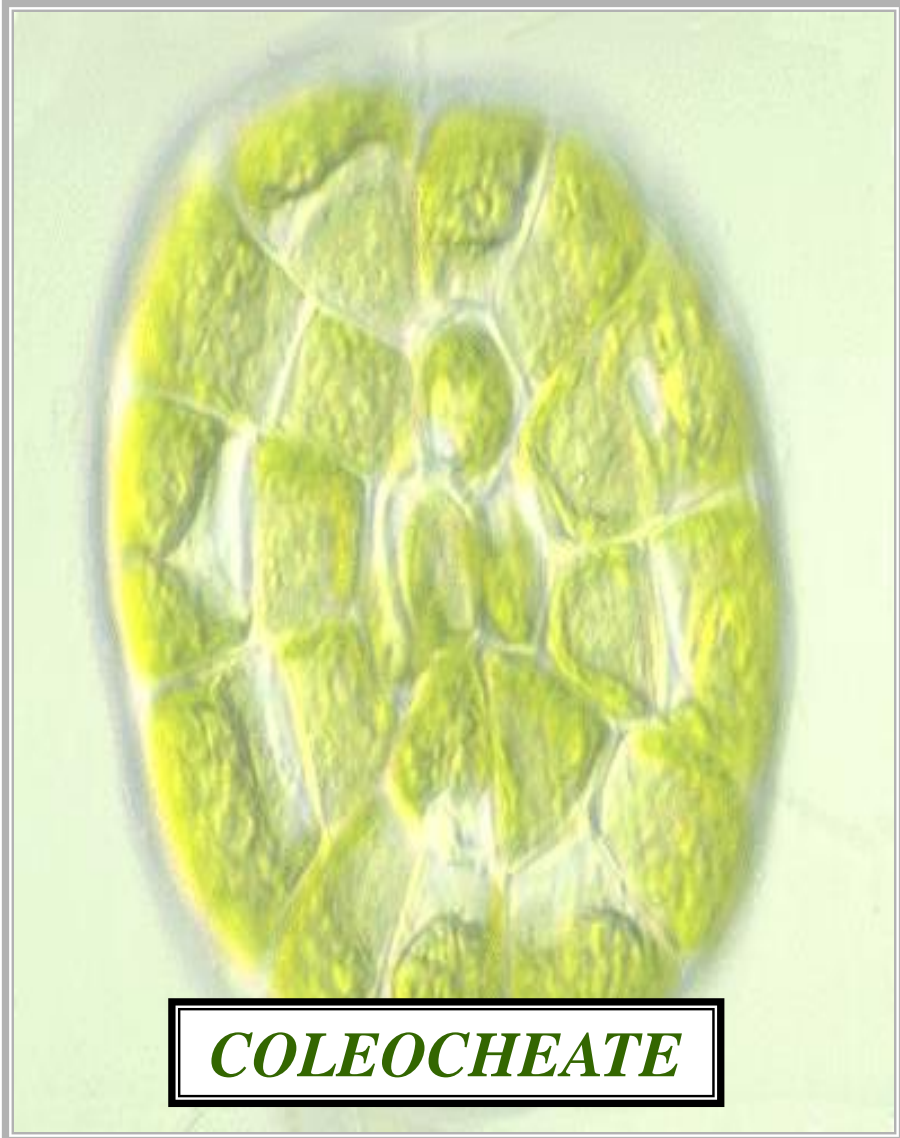




# UNICELLULAR GAMETANGIA



# UNICELLULAR GAMETANGIA



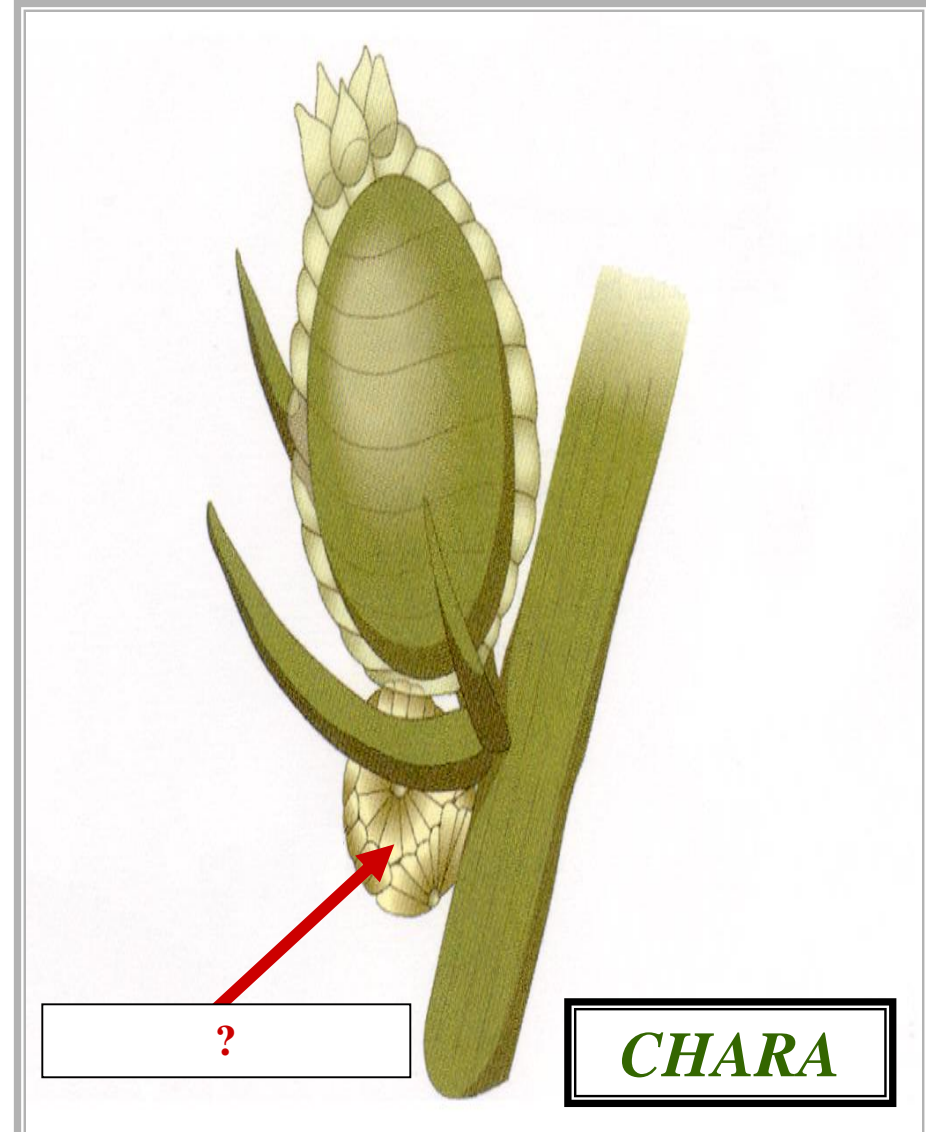
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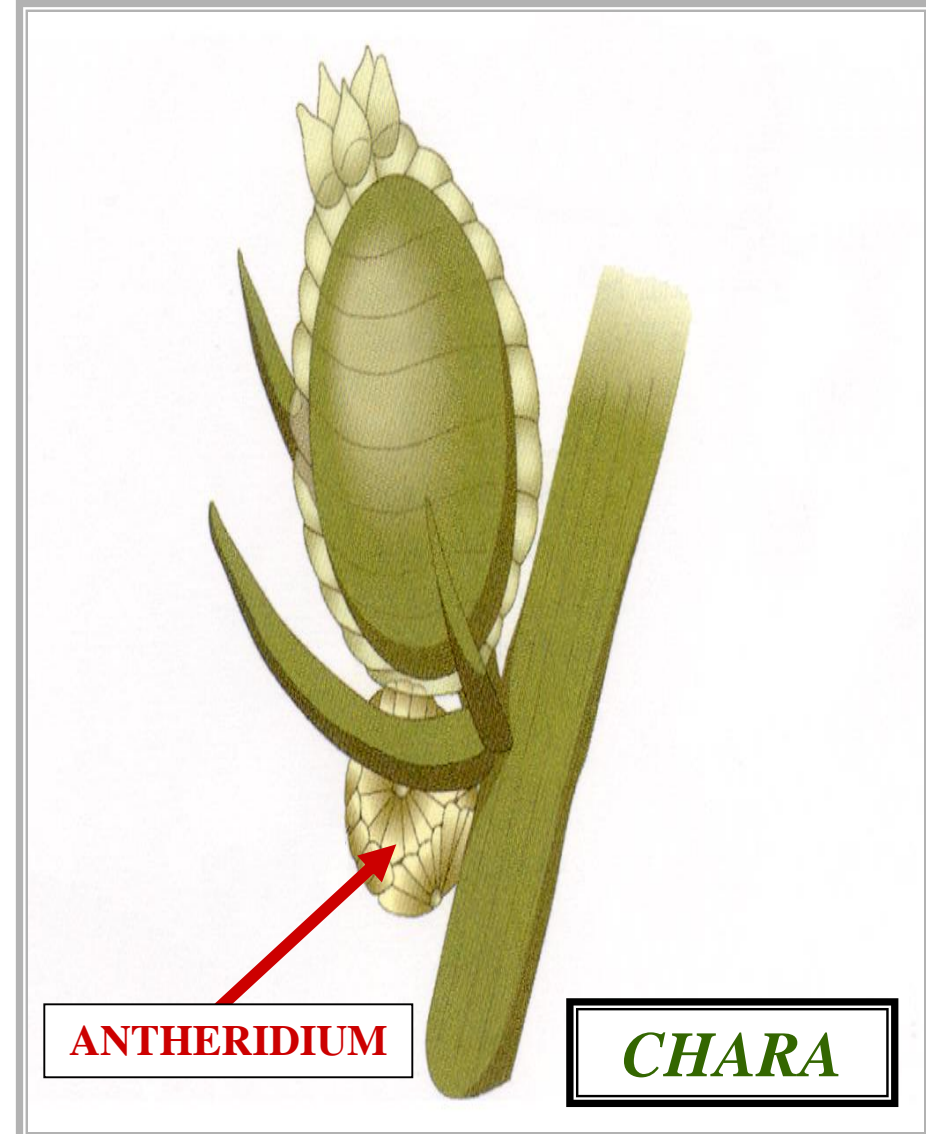
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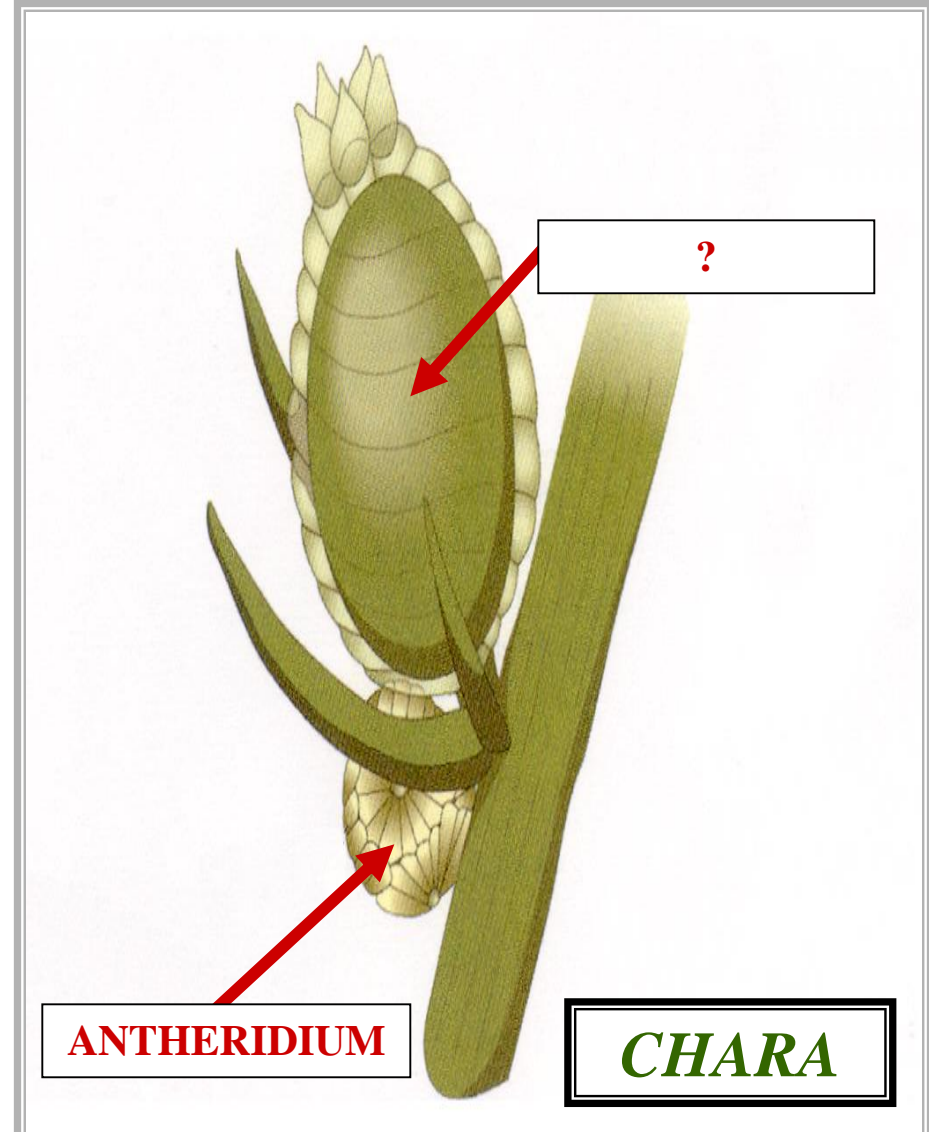
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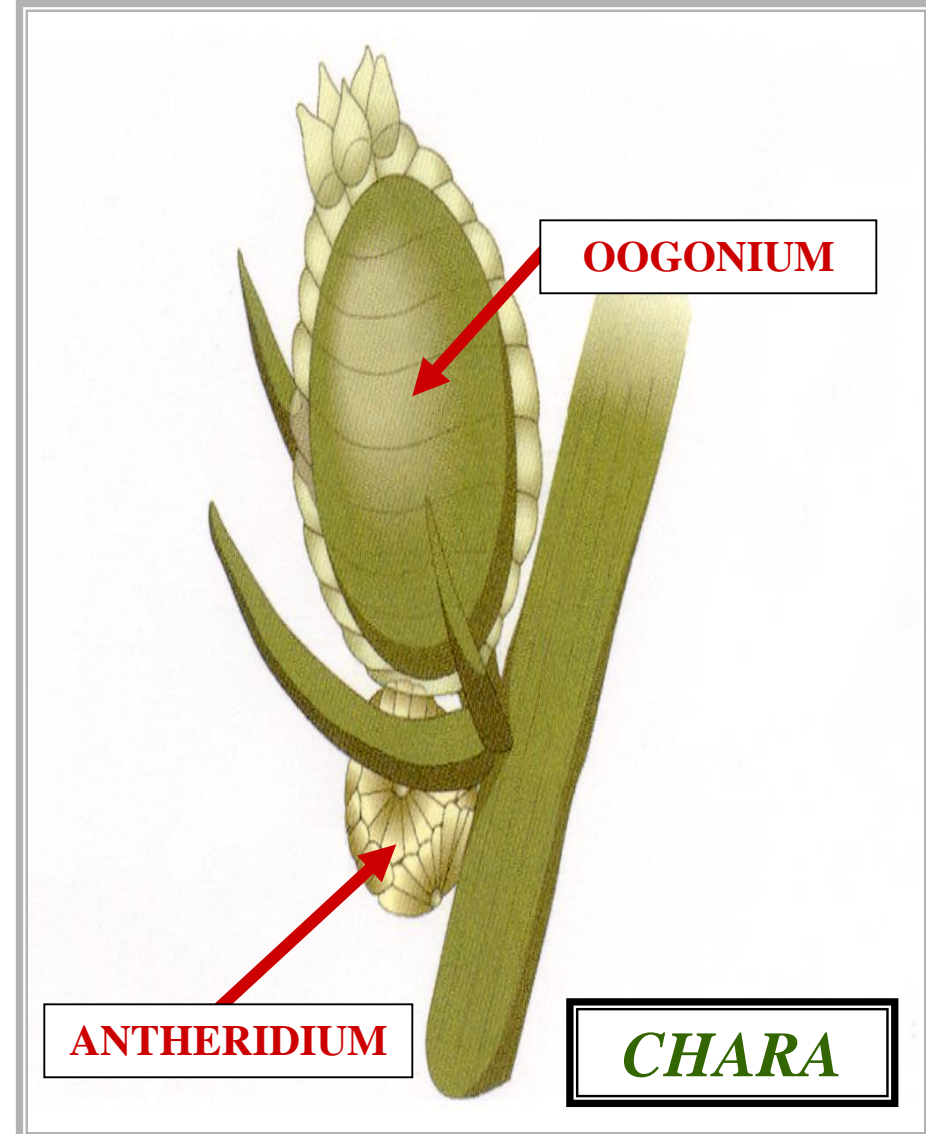
# MULTICELLULAR GAMETANGIA ?



# MULTICELLULAR GAMETANGIA <sup>0</sup>

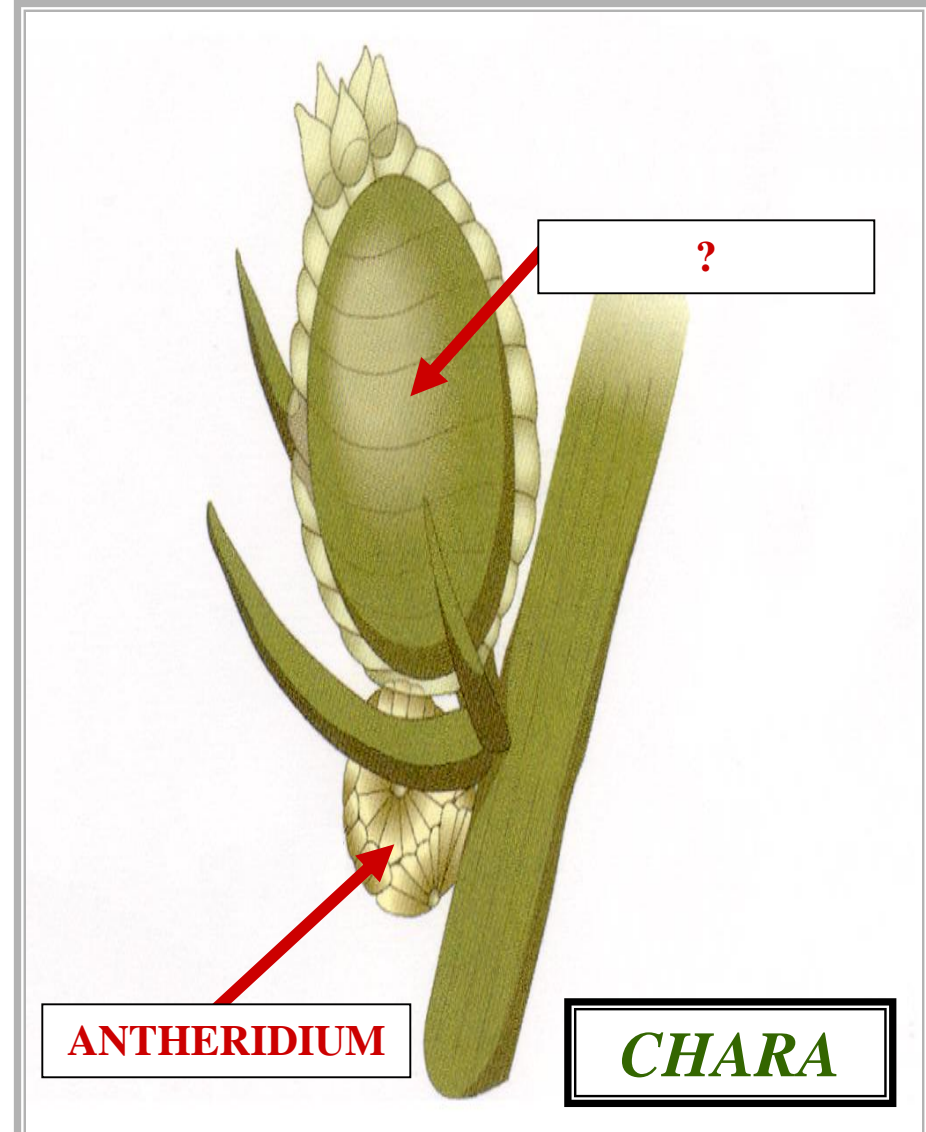


# MULTICELLULAR GAMETANGIA ?

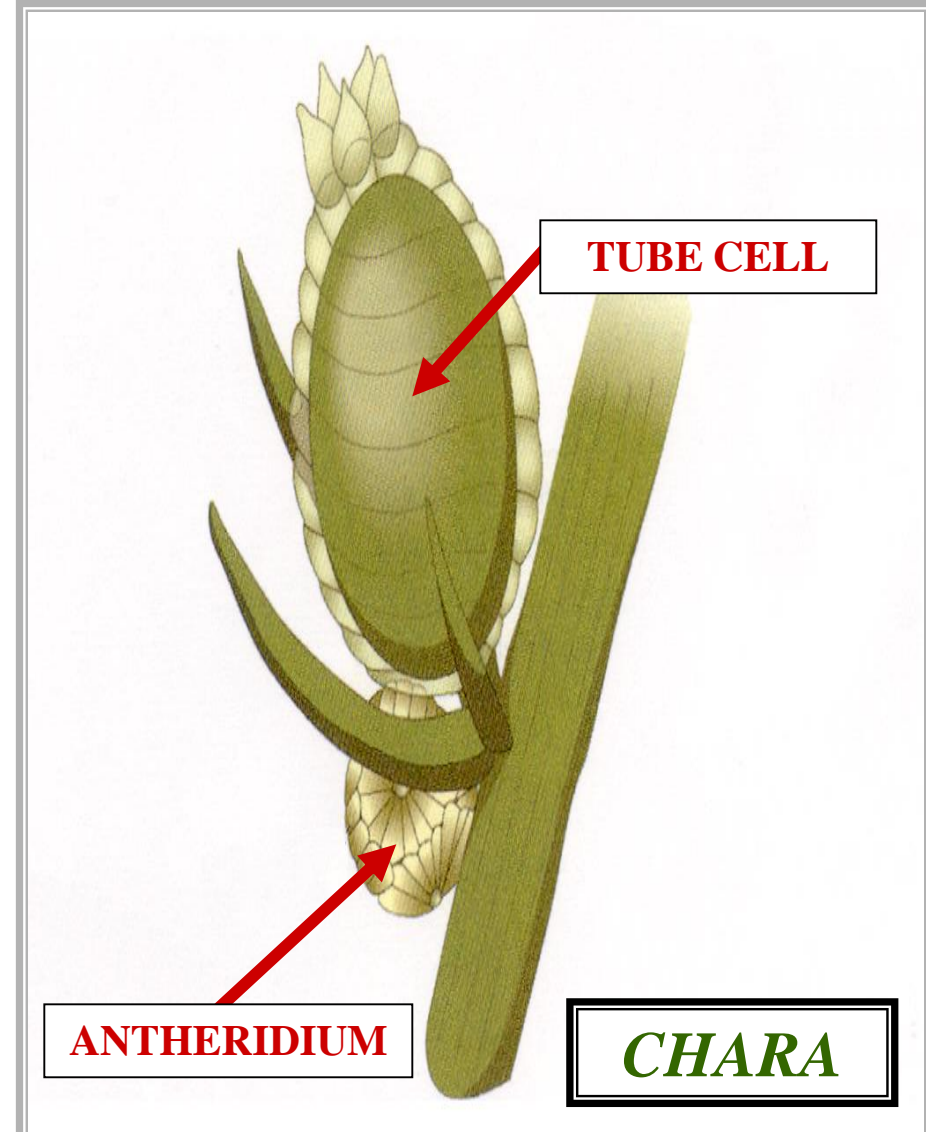




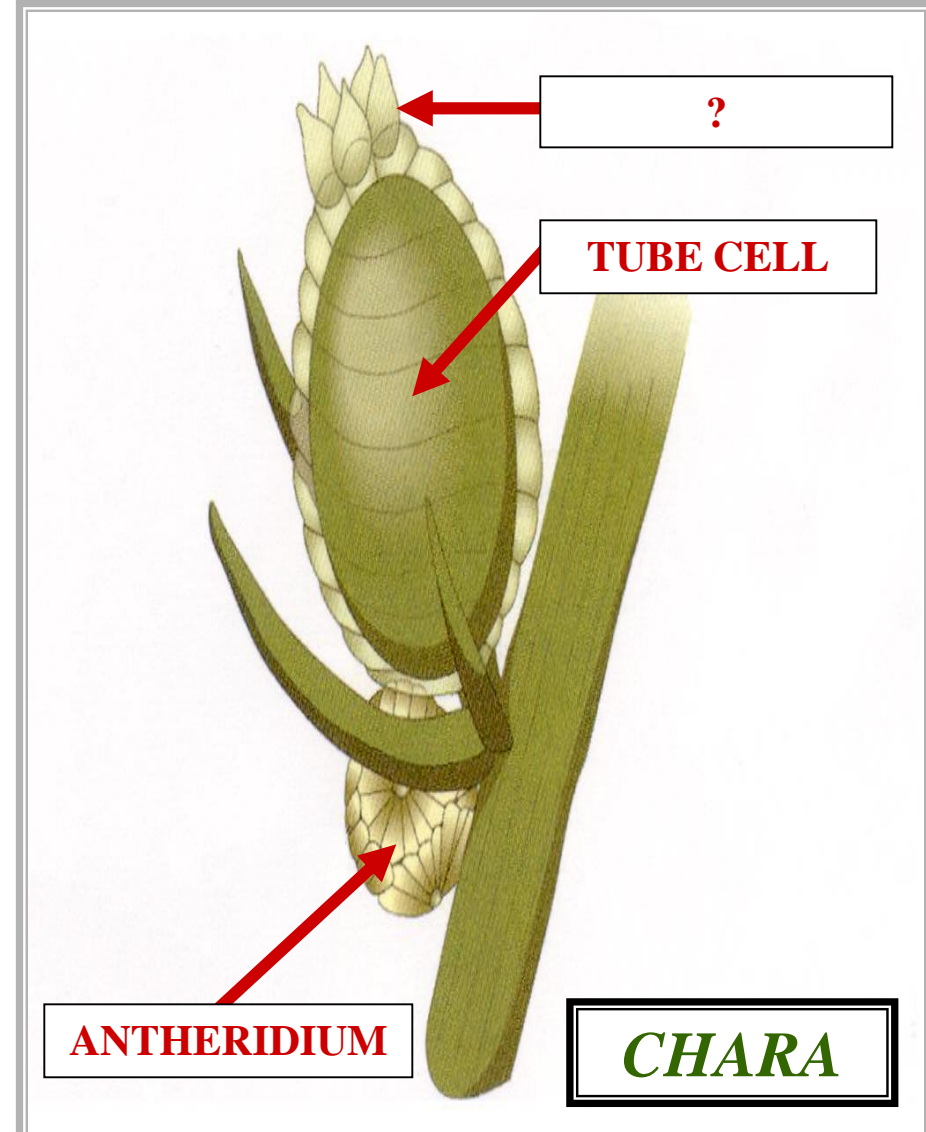
# MULTICELLULAR GAMETANGIA <sup>T</sup>



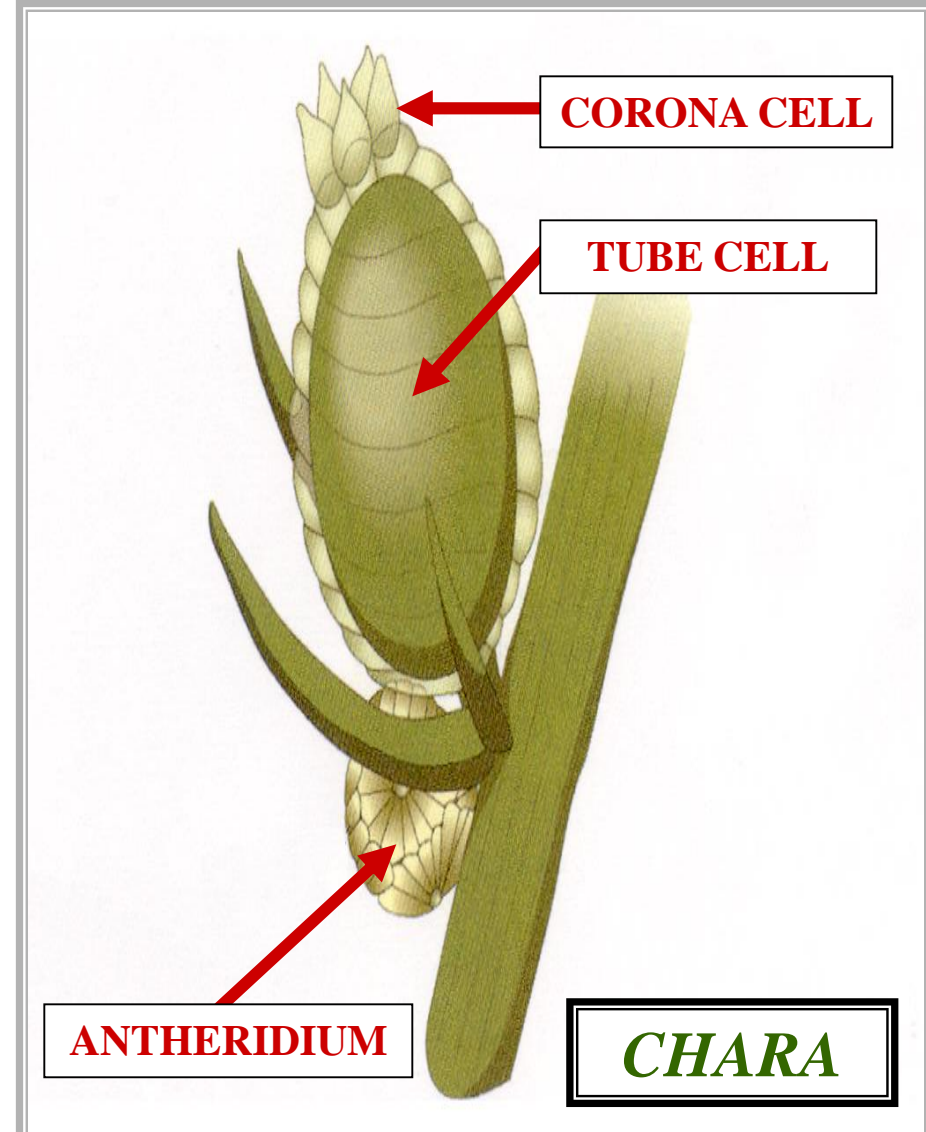
# MULTICELLULAR GAMETANGIA ?



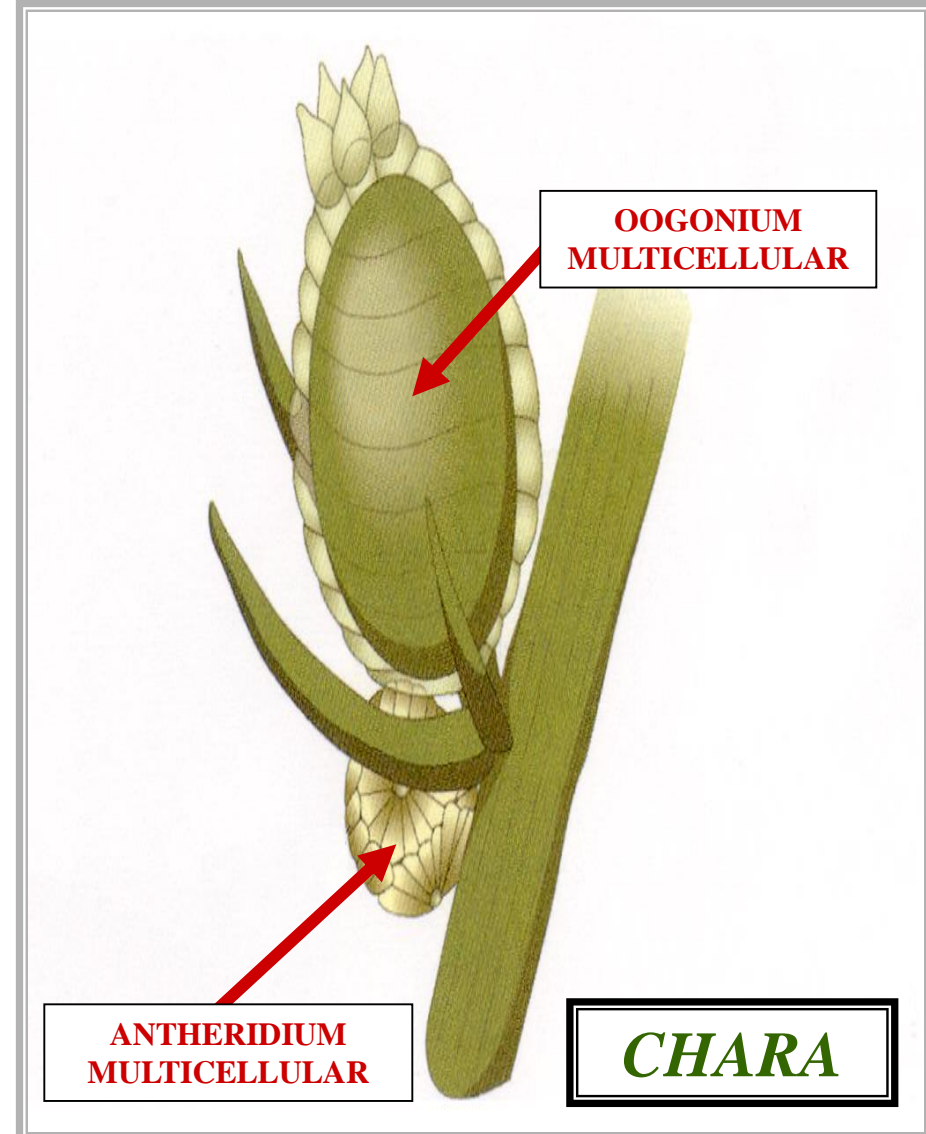
# MULTICELLULAR GAMETANGIA <sup>C</sup>



# MULTICELLULAR GAMETANGIA <sup>M</sup>



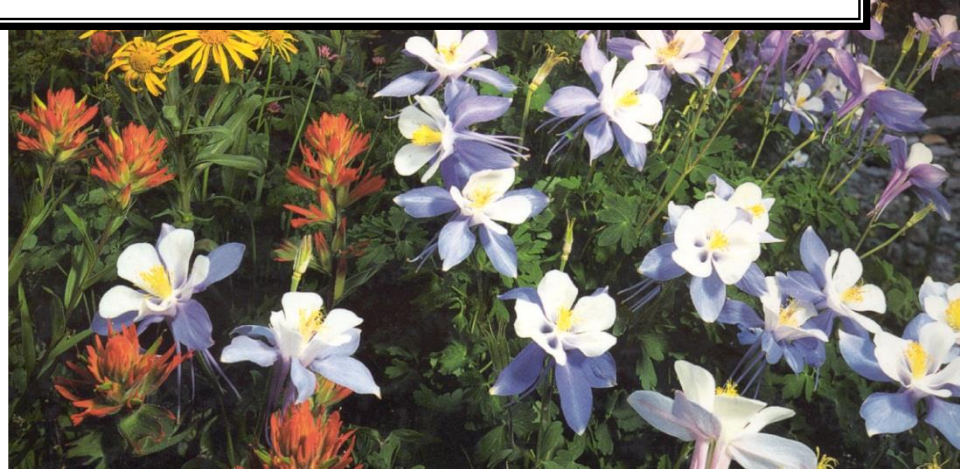
# MULTICELLULAR GAMETANGIA E >





# EMBRYOPHYTES

**GAMETANGIA:  
MULTICELLULAR**



# VASCULAR PLANT EVOLUTION

# VASCULAR PLANT EVOLUTION

CYANOPHYTA

ENDOSYMBIOTIC THEORY

CHLOROPHYTA

PHYCOPLAST ABSENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

PHYCOPLAST PRESENT  
PHRAGMOPLAST ABSENT  
FLAGELLA APICAL

PHYCOPLAST ABSENT  
PHRAGMOPLAST PRESENT  
FLAGELLA SUBAPICAL

ULVOPHYCEAE

CHLOROPHYCEAE

CHAROPHYCEAE

GAMETANGIA  
IDENTICAL WITH  
EMBRYOPHYTES

EMBRYOPHYTES





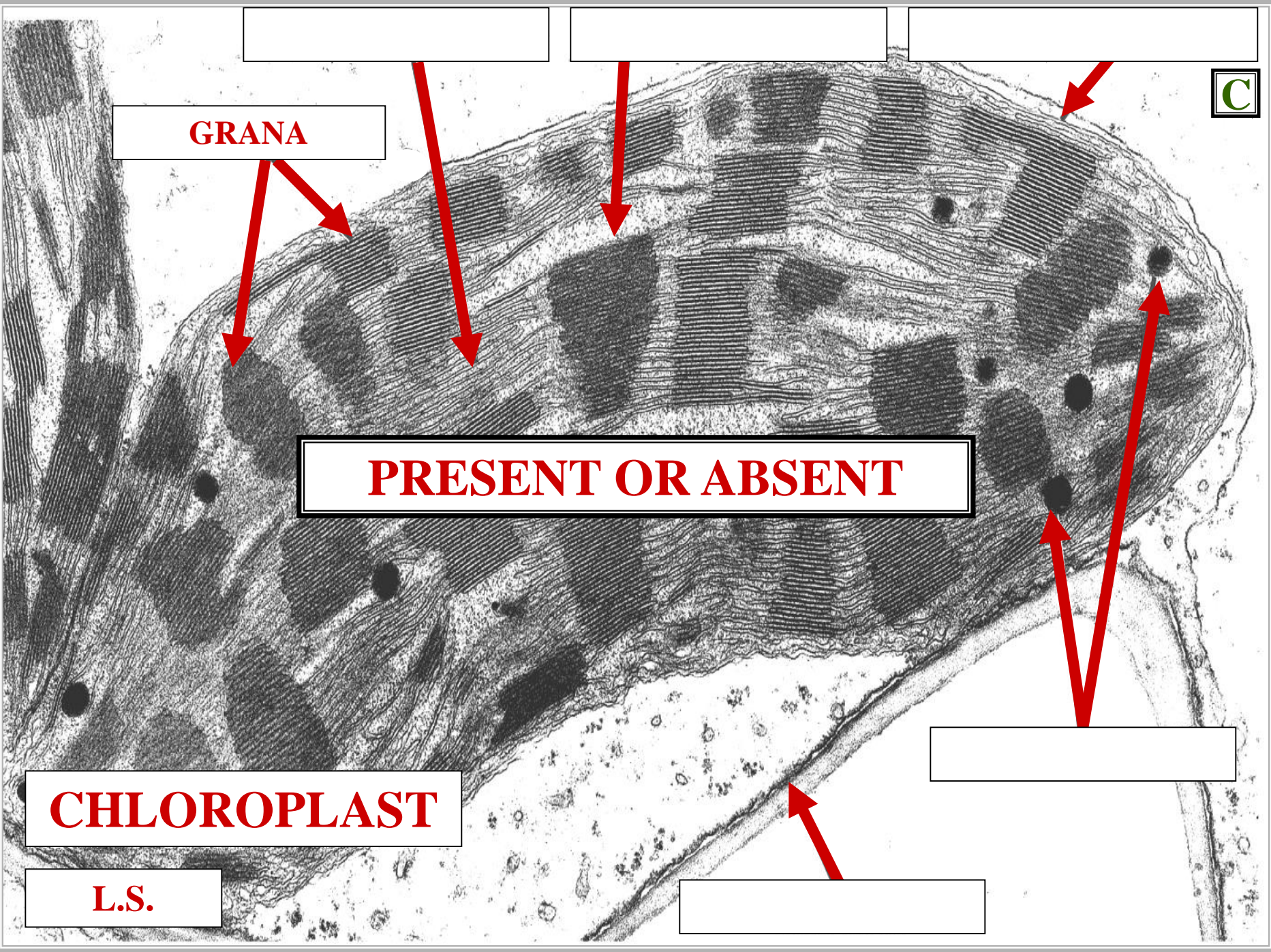
# **CHLOROPHYTA CLASS CHARACTERS HANDOUT**



**SHARED  
CHAROPHYCEAE  
&  
EMBRYOPHYTE  
CHARACTERS**



# CHLOROPLAST



C

GRANA

PRESENT OR ABSENT

CHLOROPLAST

L.S.

[Empty box]

[Empty box]

[Empty box]

[Empty box]

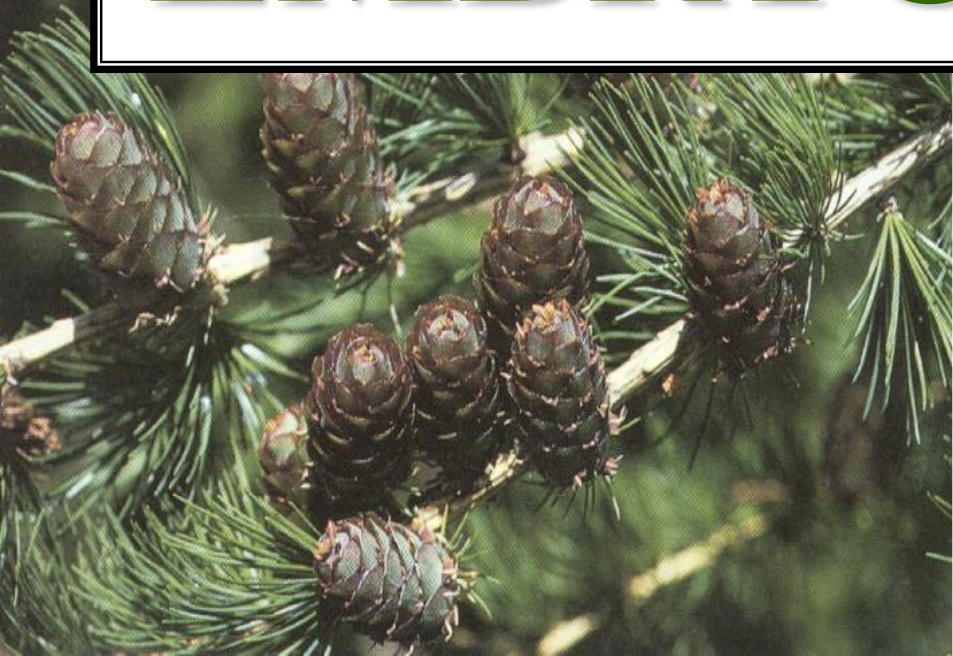
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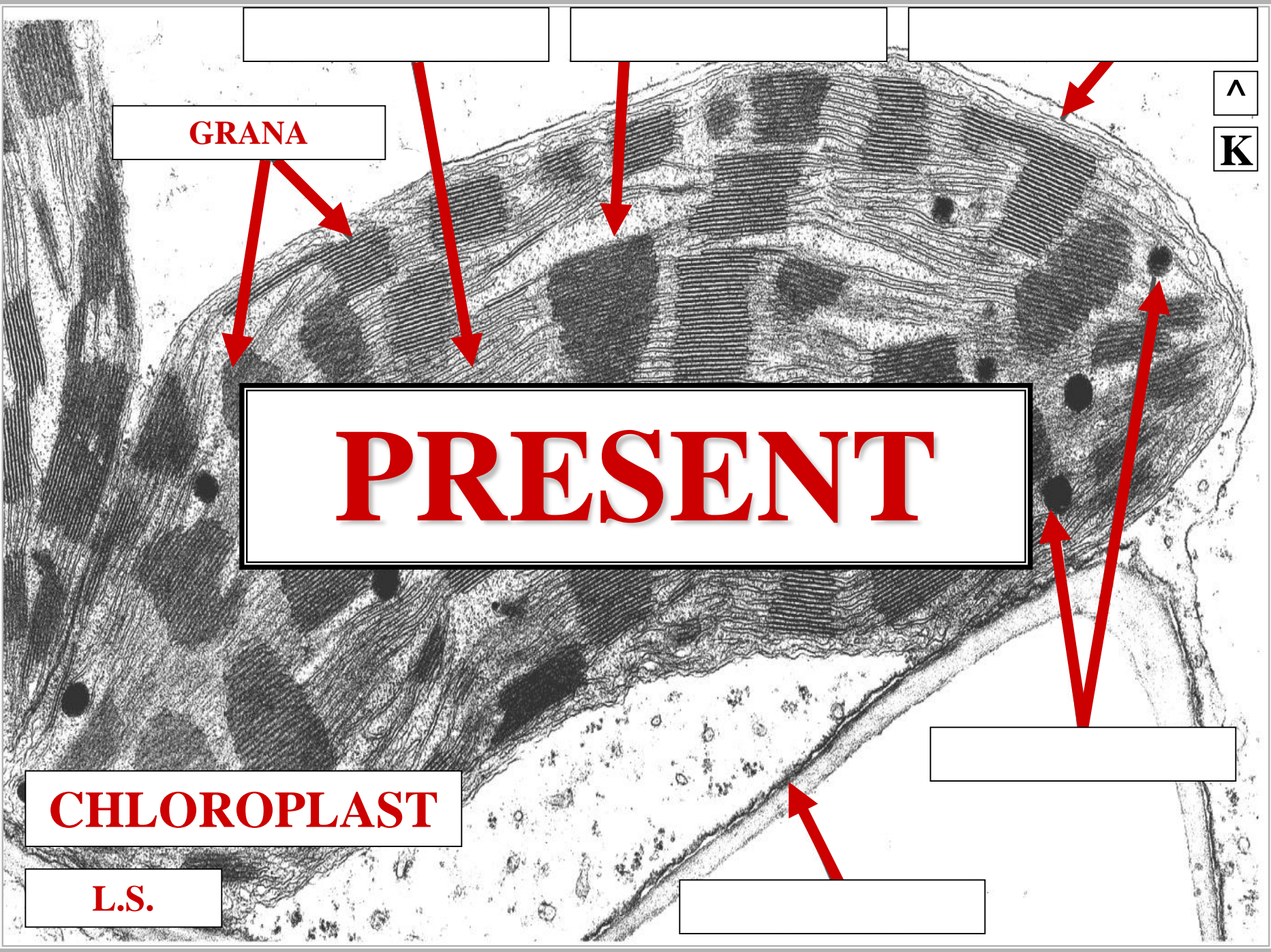


# CHAROPHYCEAE



# EMBRYOPHYTES





**GRANA**

**PRESENT**

**CHLOROPLAST**

**L.S.**

^

K

[Empty box]

[Empty box]

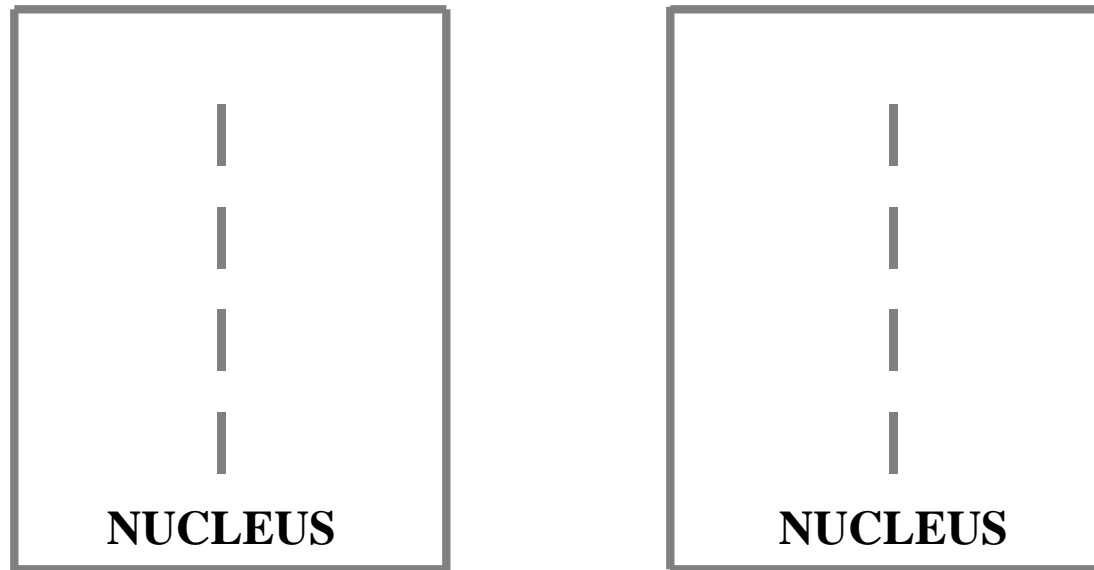


# KARYOKINESIS

# KARYOKINESIS

## SPINDLE **ABSENT**

PR



PERSISTENT NUCLEAR MEMBRANE  
KARYOKINESIS SPINDLE ABSENT  
DAUGHTER NUCLEI CLOSE

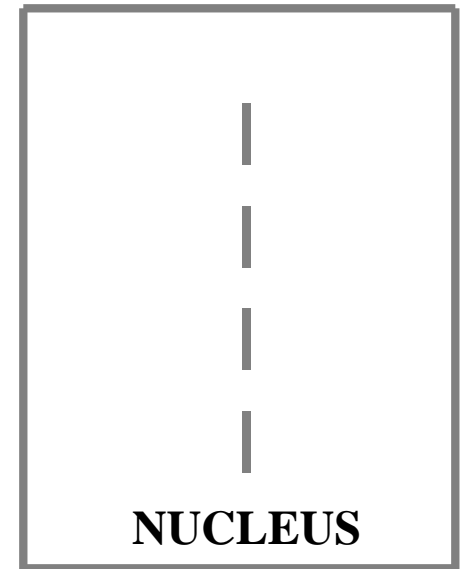
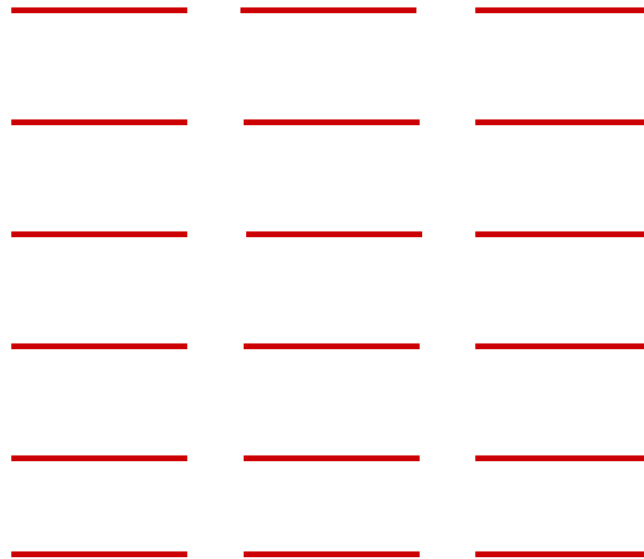
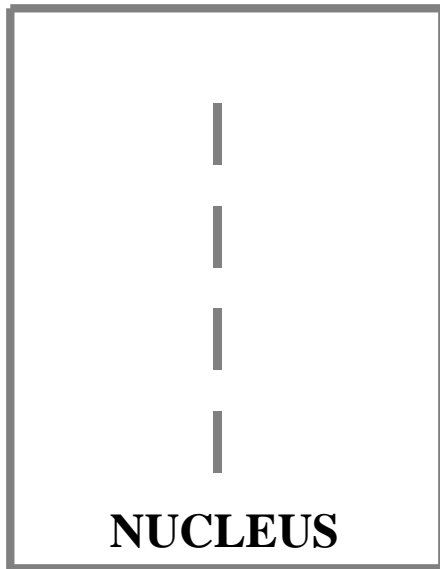
 = CELL MEMBRANE  
 = NUCLEAR MEMBRANE  
 = MICROTUBULE



# KARYOKINESIS

## SPINDLE PRESENT

CELL CYTOSOL



NON-PERSISTENT NUCLEAR MEMBRANE  
KARYOKINESIS SPINDLE PRESENT  
DAUGHTER NUCLEI SEPARATED

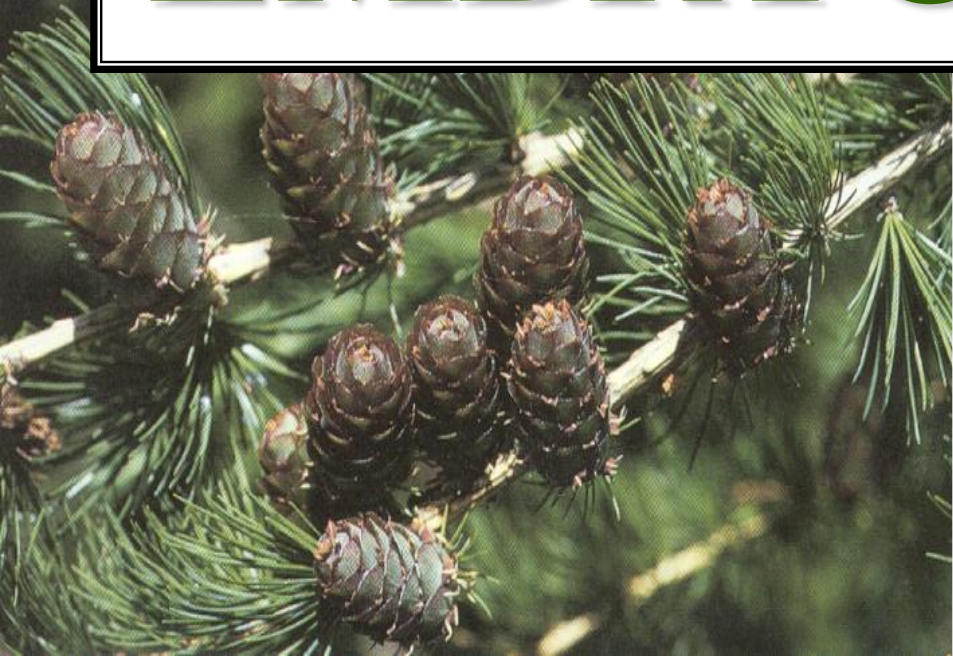
-  = CELL MEMBRANE
-  = NUCLEAR MEMBRANE
-  = MICROTUBULE



# CHAROPHYCEAE



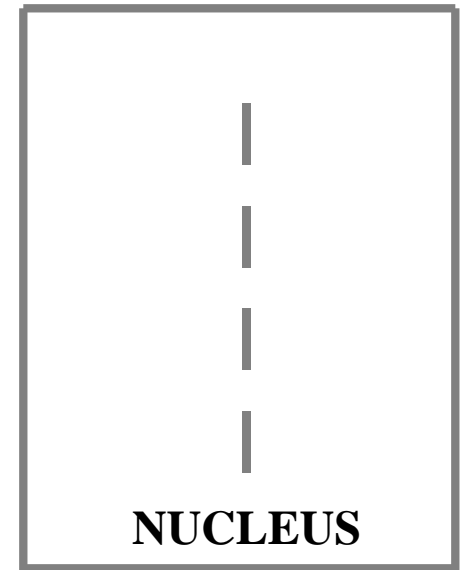
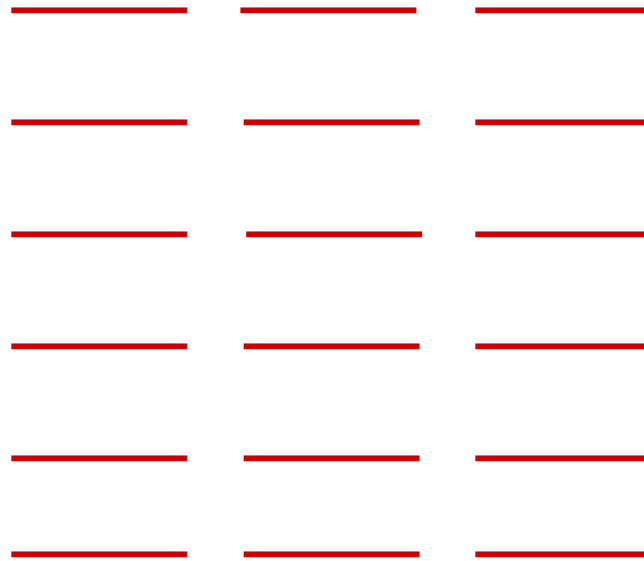
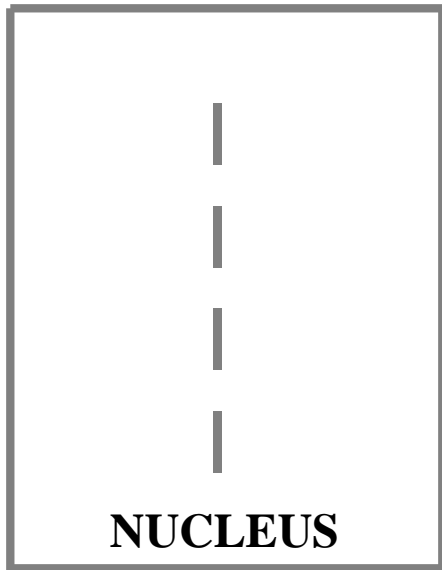
# EMBRYOPHYTES



# KARYOKINESIS

## SPINDLE PRESENT

CELL CYTOSOL



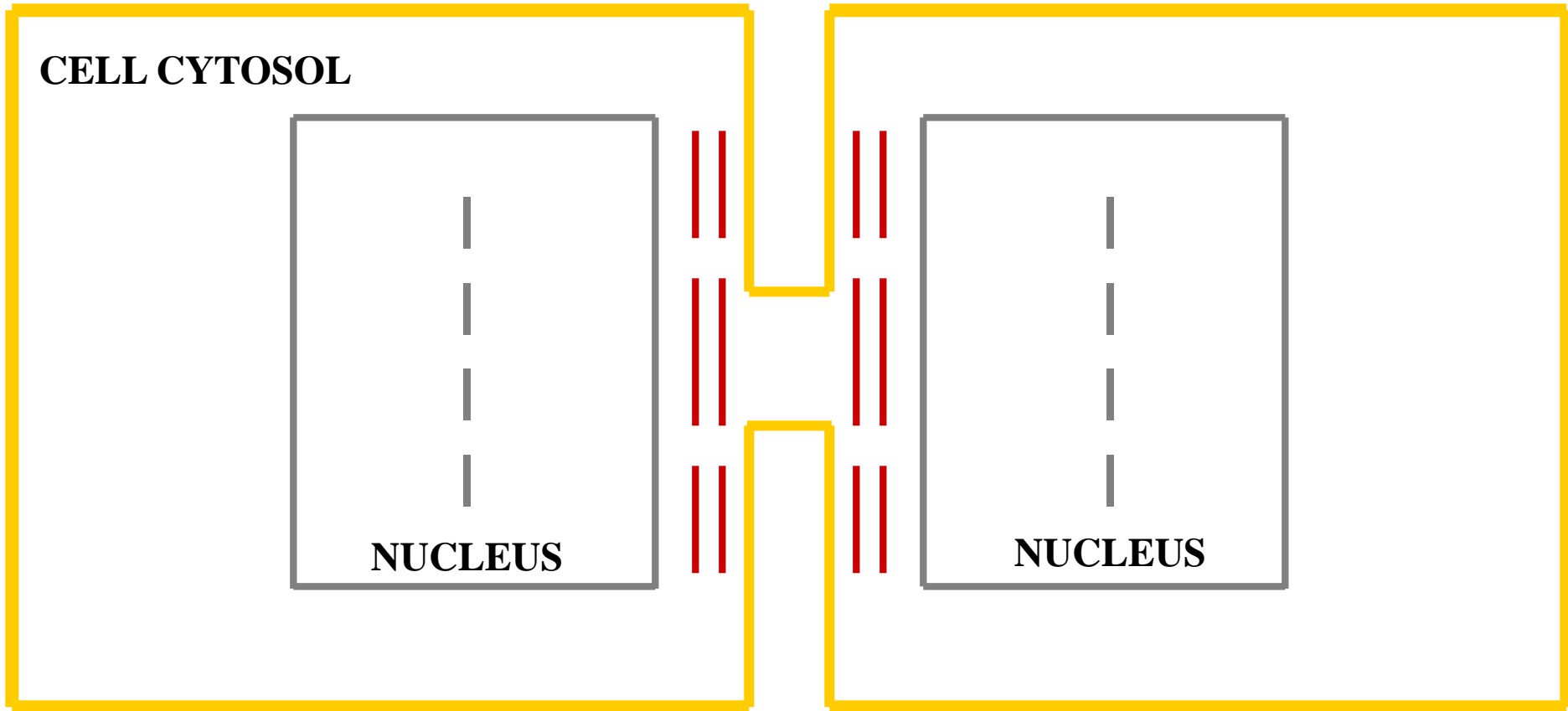
NON-PERSISTENT NUCLEAR MEMBRANE  
KARYOKINESIS SPINDLE PRESENT  
DAUGHTER NUCLEI SEPARATED

 = CELL MEMBRANE  
 = NUCLEAR MEMBRANE  
 = MICROTUBULE

# CYTOKINESIS

# CYTOKINESIS

## SPINDLE PHYCOPLAST

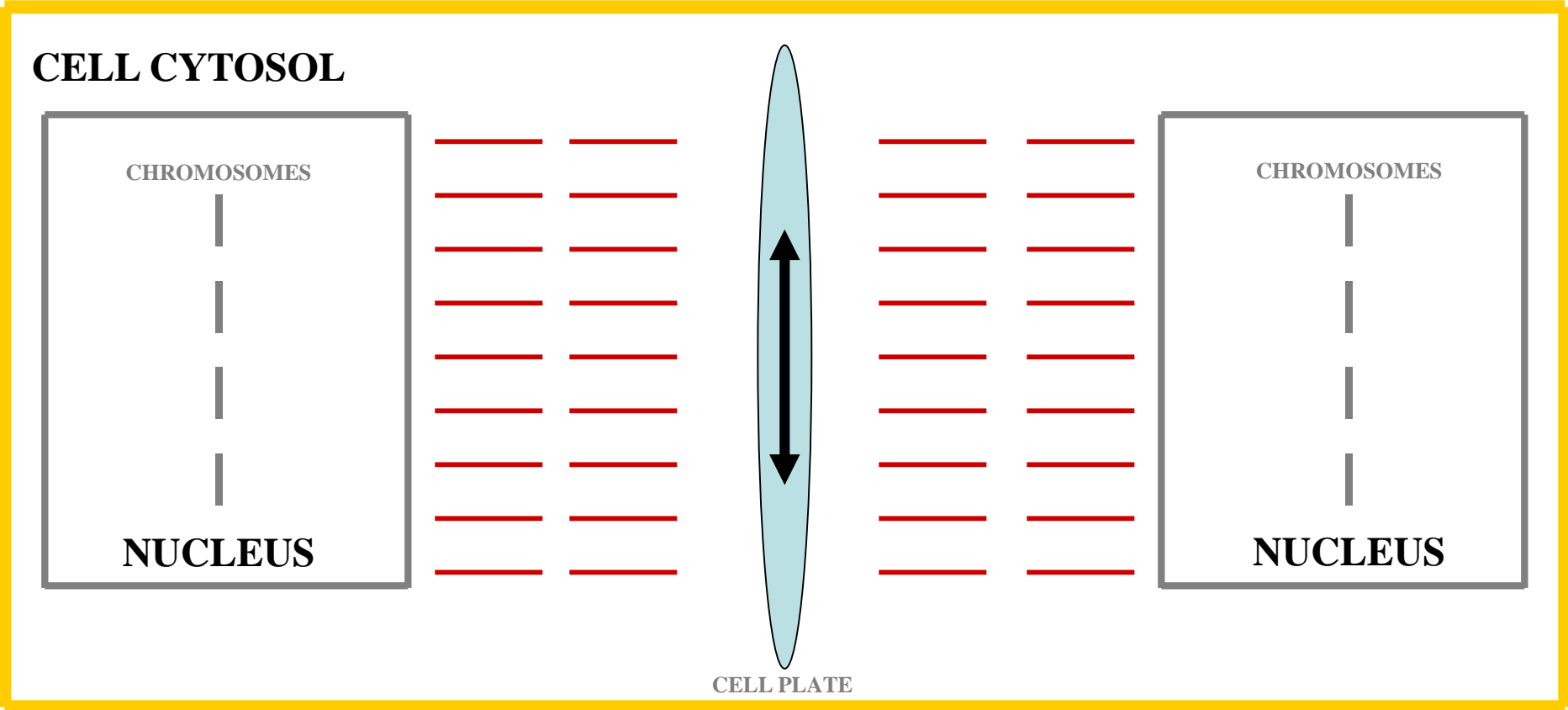


FURROWING  
CYTOKINESIS SPINDLE PRESENT  
PHYCOPLAST SPINDLE

— = CELL MEMBRANE  
— = NUCLEAR MEMBRANE  
— = MICROTUBULE

# CYTOKINESIS

## SPINDLE PHRAGMOPLAST



CELL PLATE

CYTOKINESIS SPINDLE PRESENT

PHRAGMOPLAST SPINDLE

-  = CELL MEMBRANE
-  = NUCLEAR MEMBRANE
-  = MICROTUBULE

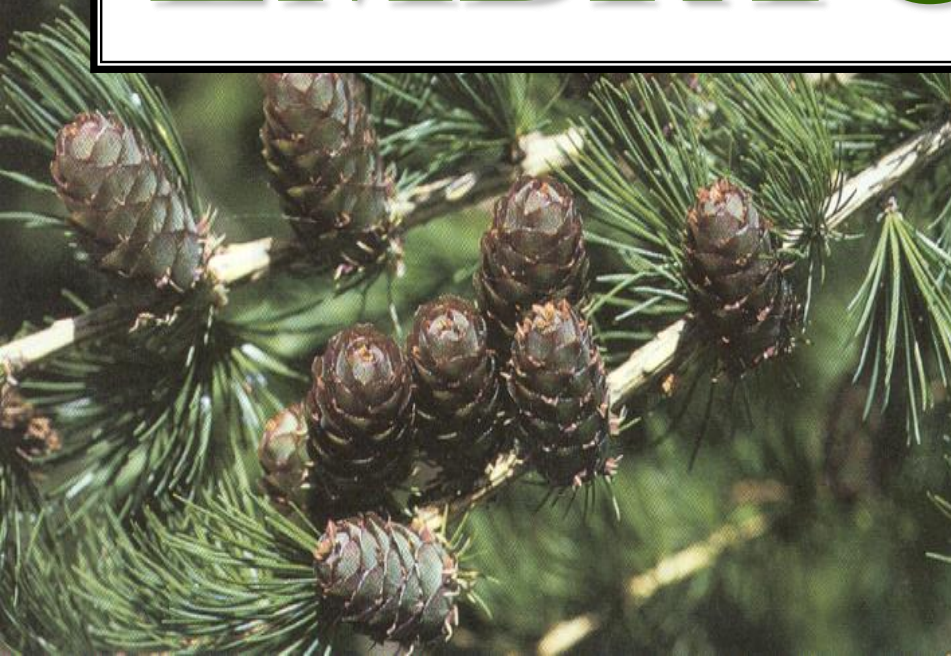


# CHAROPHYCEAE



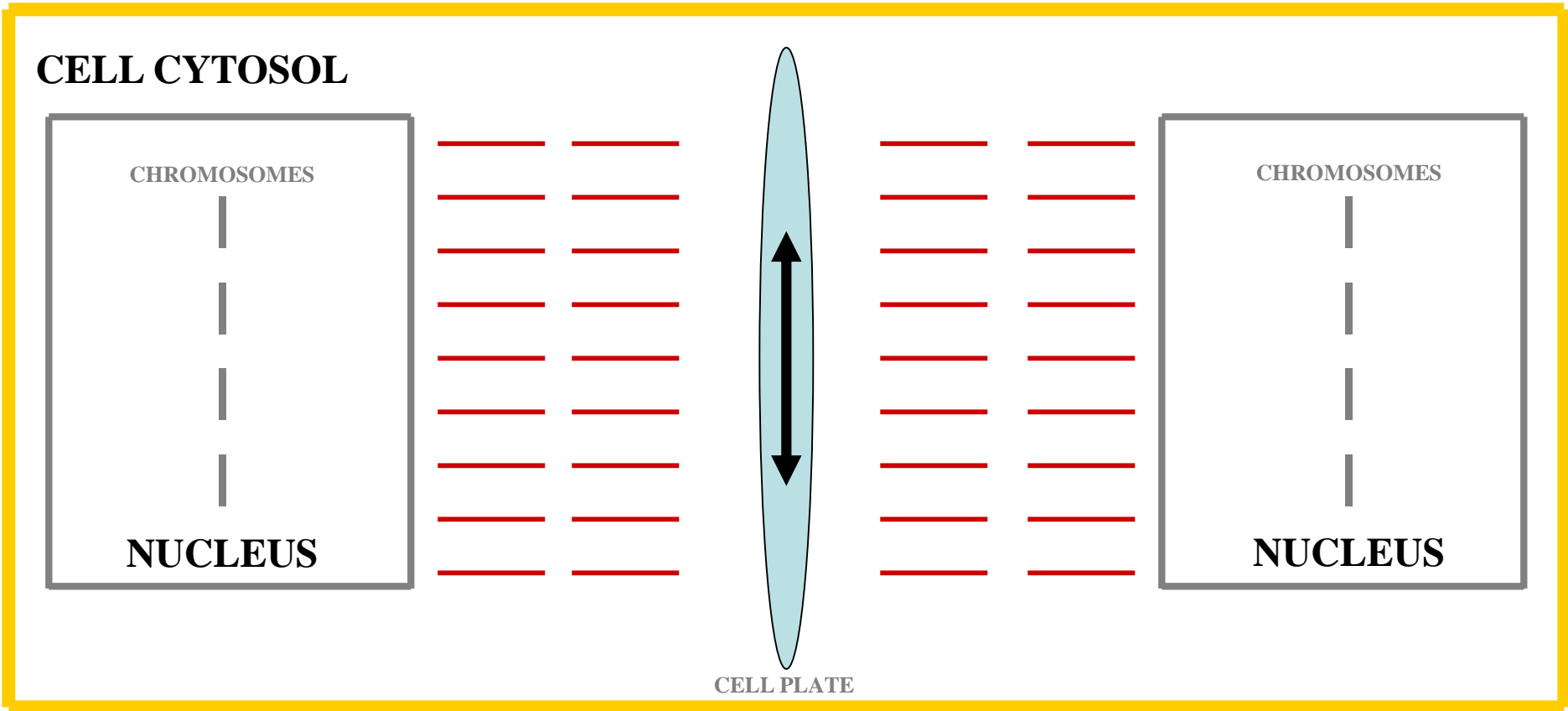


# EMBRYOPHYTES



# CYTOKINESIS

## SPINDLE PHRAGMOPLAST



CELL PLATE  
 CYTOKINESIS SPINDLE PRESENT  
 PHRAGMOPLAST SPINDLE

— = CELL MEMBRANE  
 — = NUCLEAR MEMBRANE  
 — = MICROTUBULE



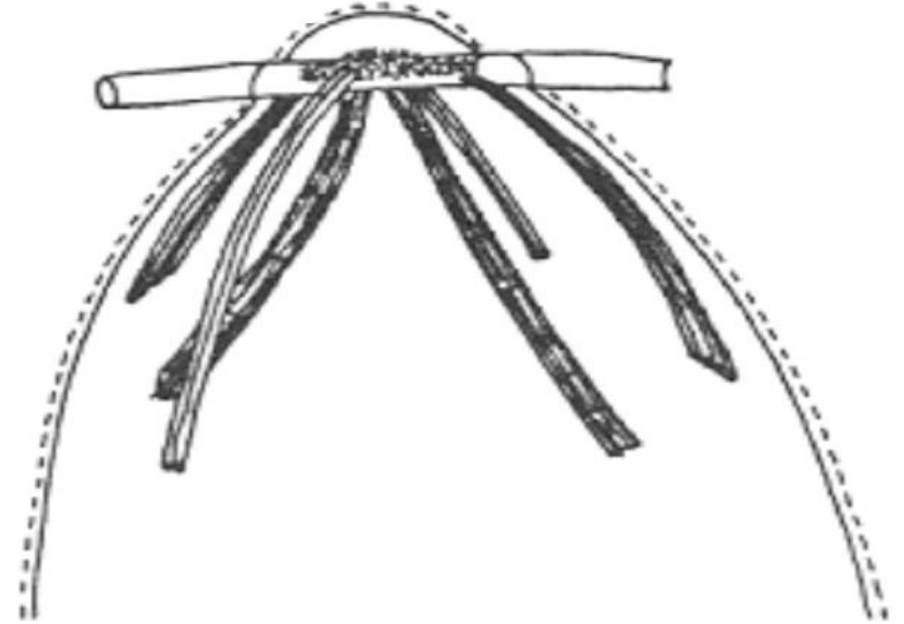
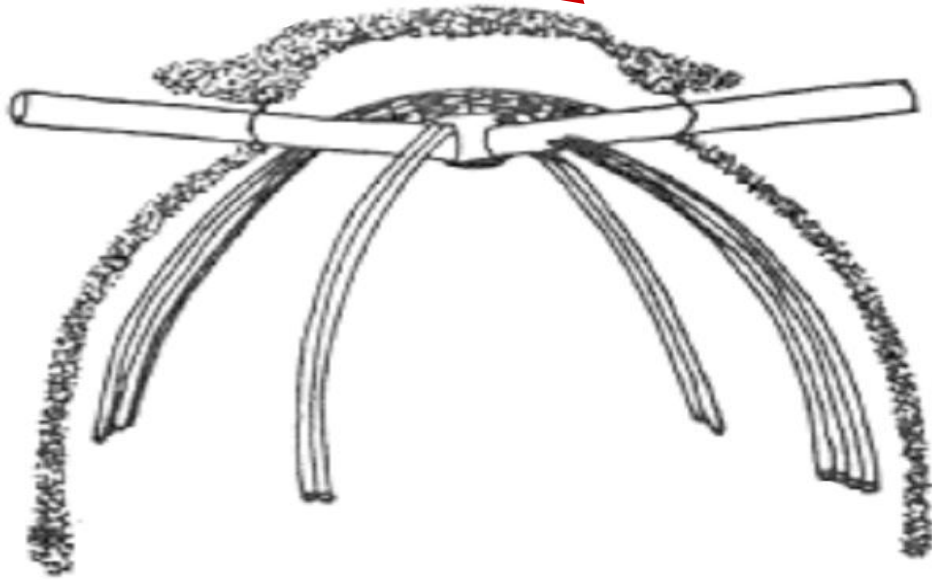
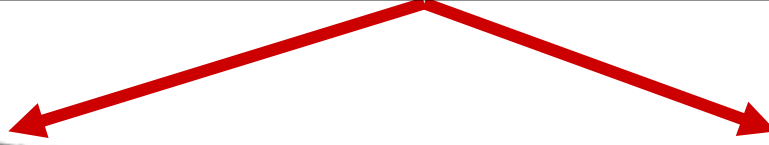
**AI**

# FLAGELLA



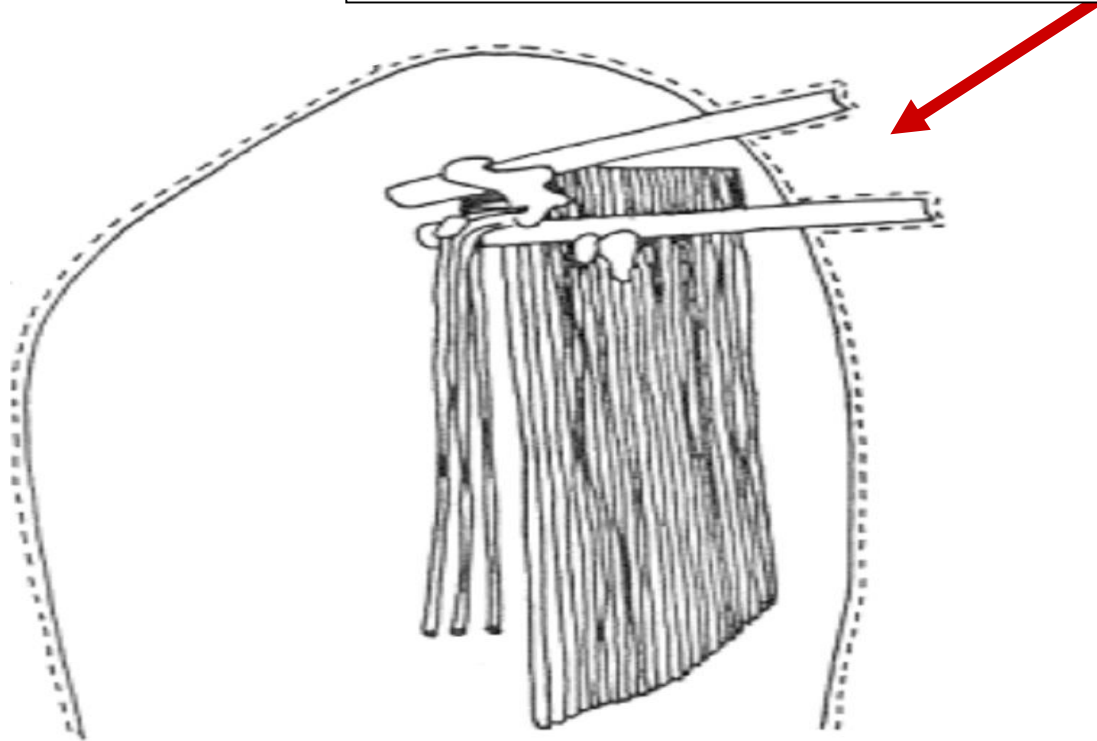
# FLAGELLA

## APICAL INSERTION



# FLAGELLA

**SUBAPICAL INSERTION**

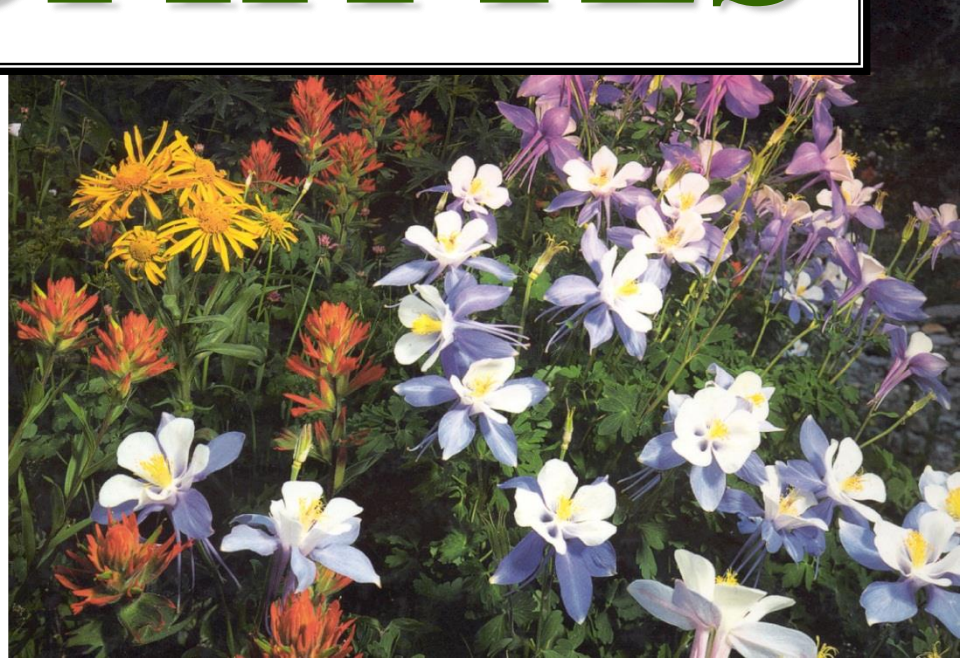
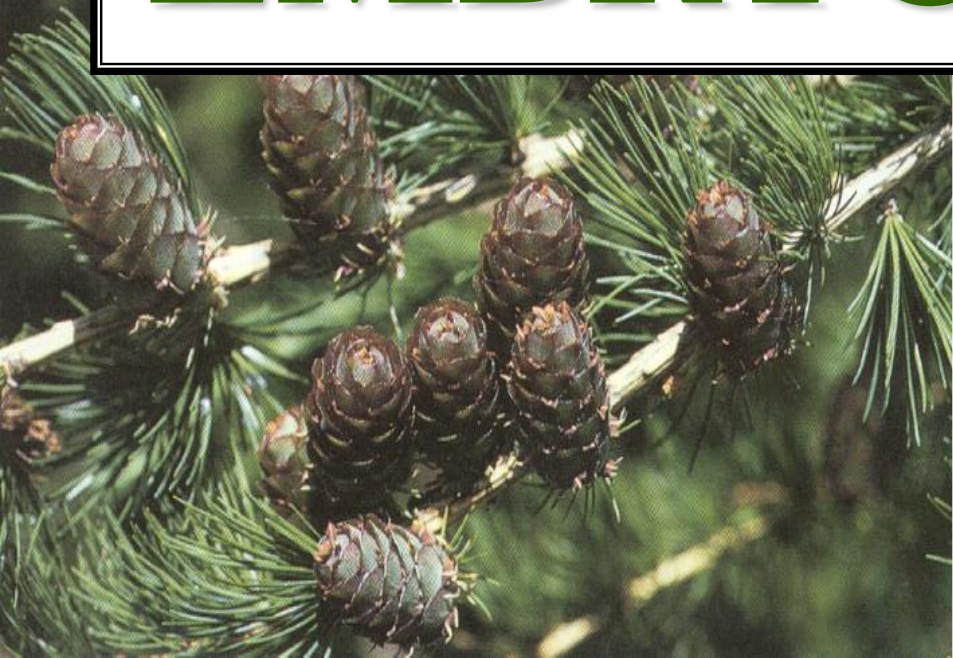


# CHAROPHYCEAE



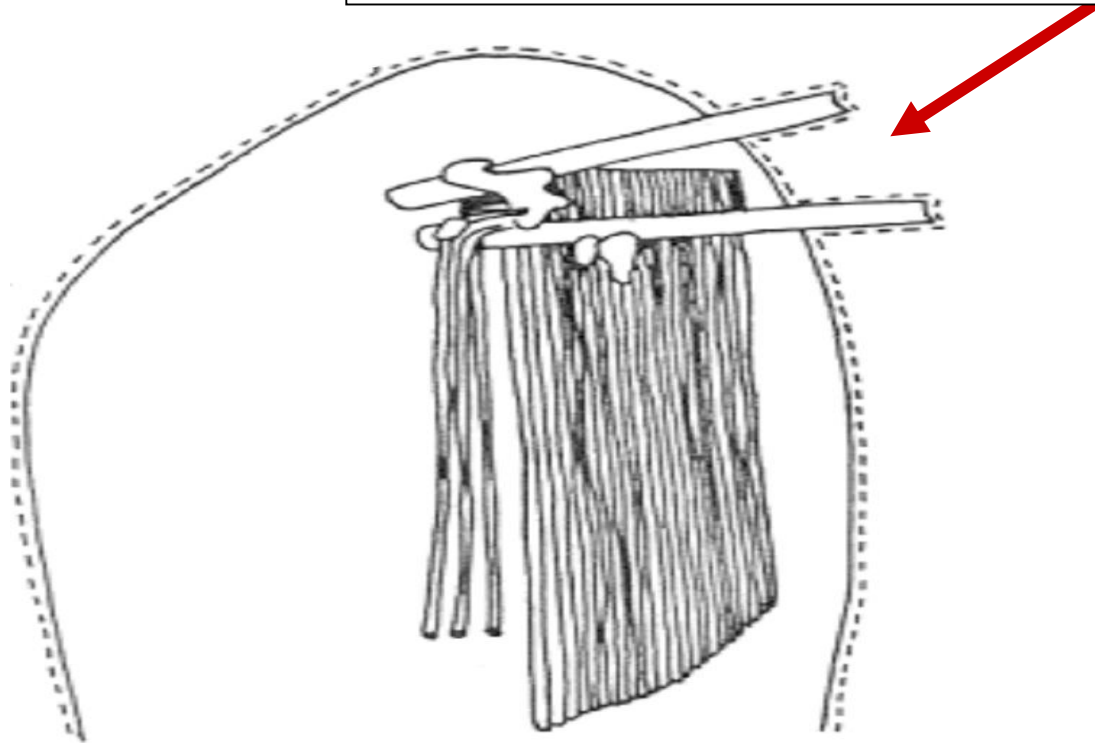


# EMBRYOPHYTES



# FLAGELLA

## SUBAPICAL INSERTION







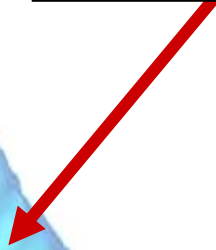
# GAMETANGIA

# UNICELLULAR GAMETANGIA

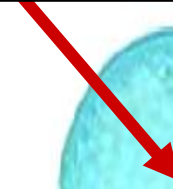


M

UNICELLULAR  
GAMETANGIUM  
ANTHERIDIUM

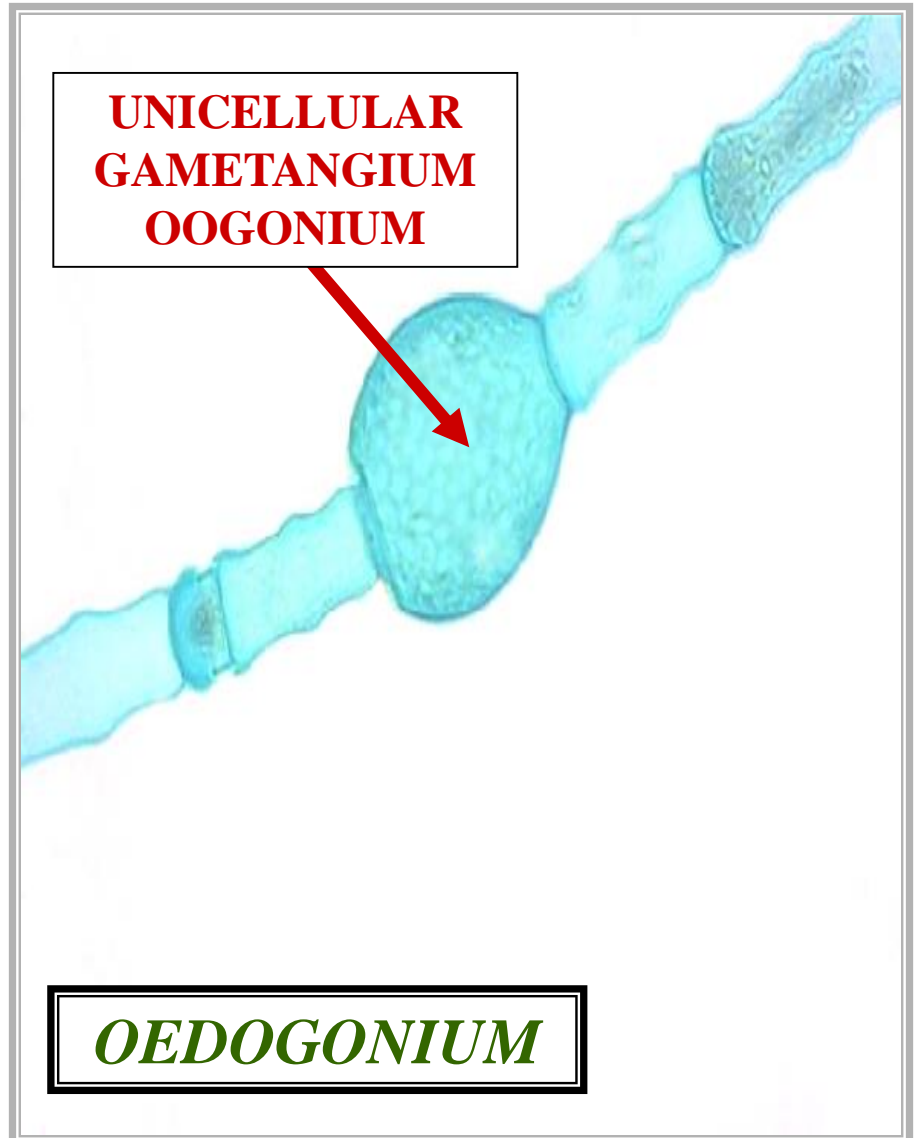
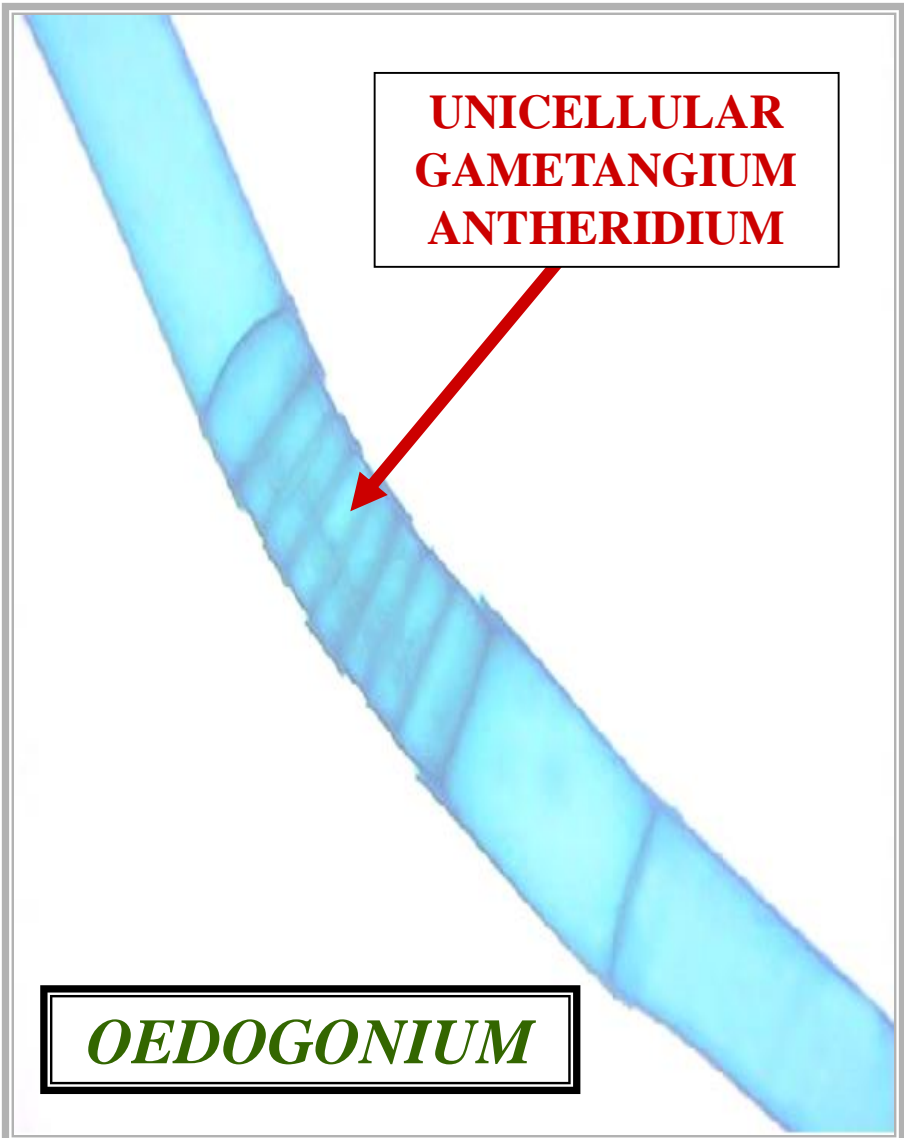


UNICELLULAR  
GAMETANGIUM  
OOGONIUM

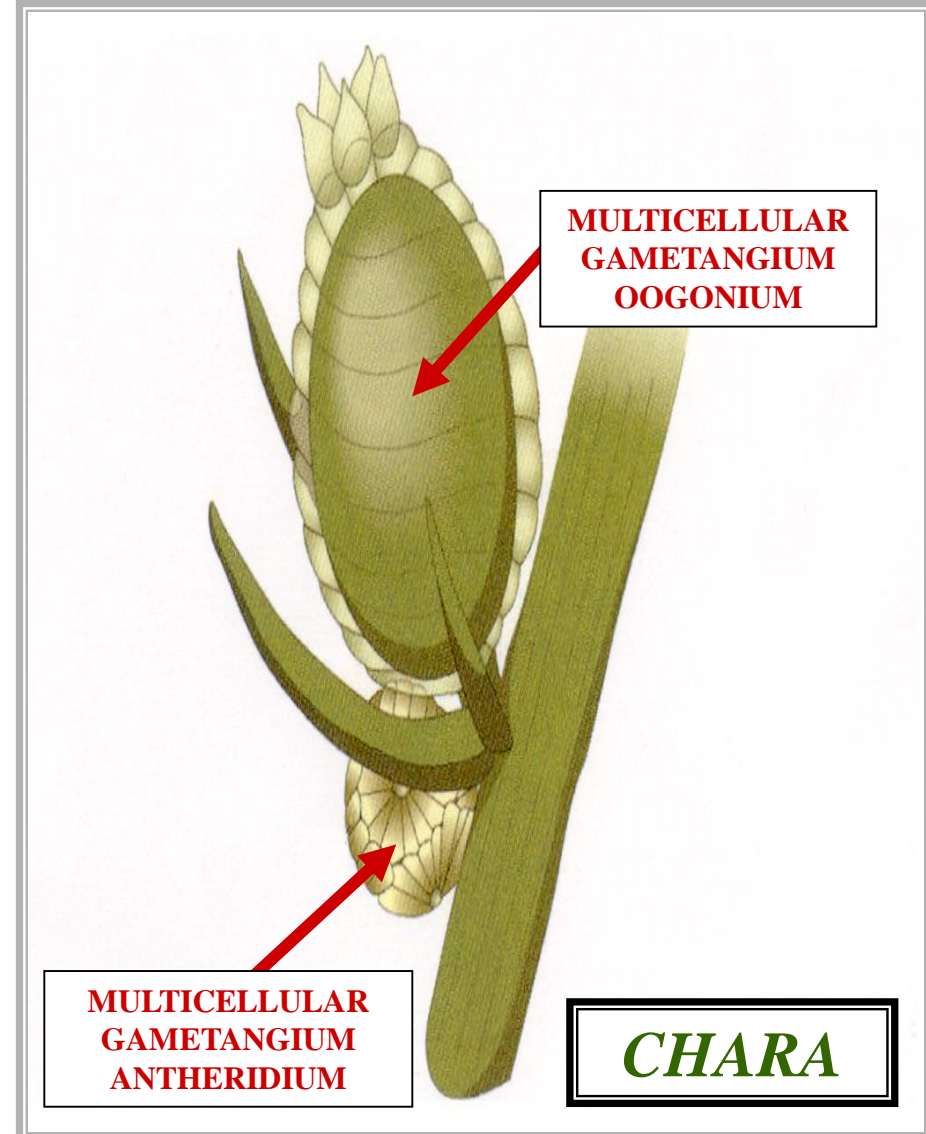


*OEDOGONIUM*

*OEDOGONIUM*



# MULTICELLULAR GAMETANGIA C





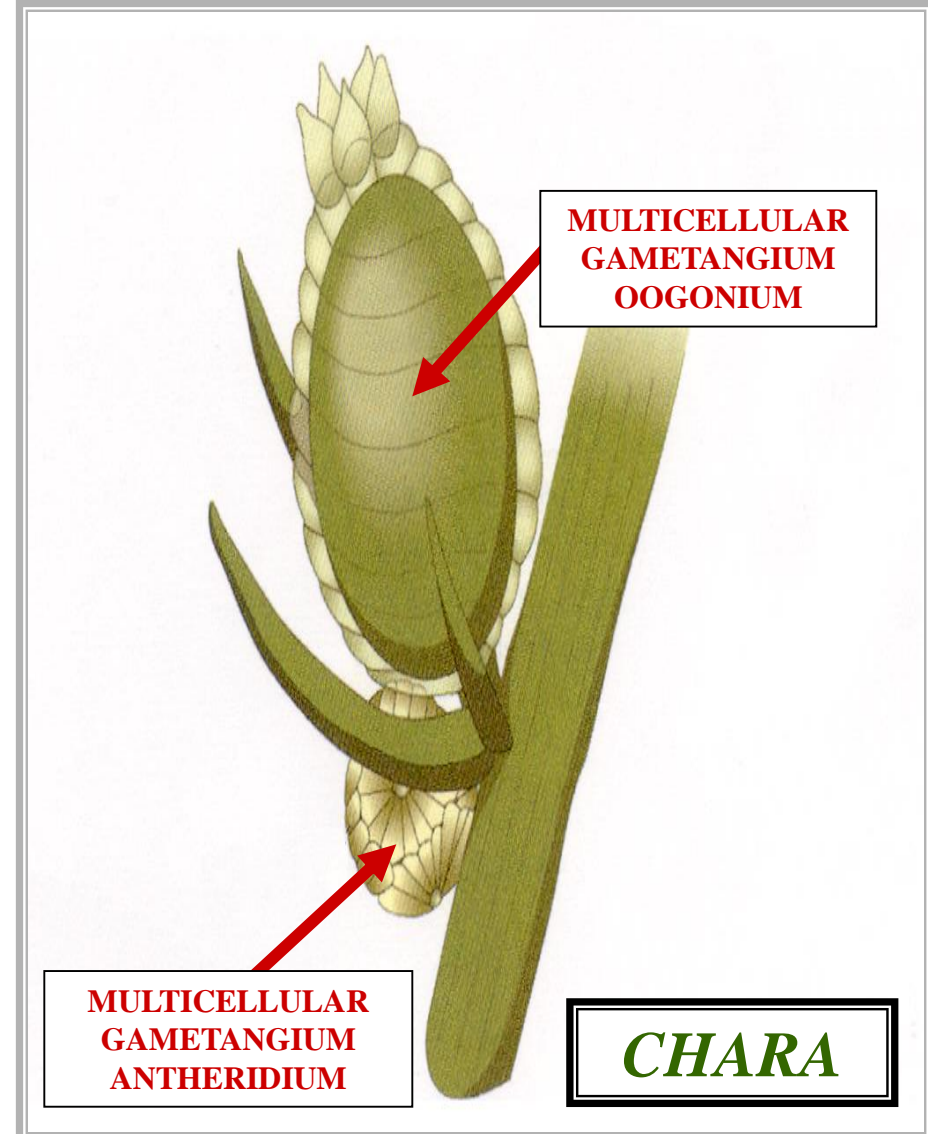
# CHAROPHYCEAE



# EMBRYOPHYTES



# MULTICELLULAR GAMETANGIA



**SHARED**  
**CHAROPHYCEAE**  
**EMBRYOPHYTE**  
**CHARACTERS**  
**CONCLUSION**

**CONCLUSION**

**VASCULAR  
PLANT  
EVOLUTION**

**CYANOPHYTA**

**ENDOSYMBIOTIC  
THEORY**

**CONCLUSION**

**VASCULAR  
PLANT  
EVOLUTION**

**CHLOROPHYTA**

**E**

**ULVOPHYCEAE**

**?**

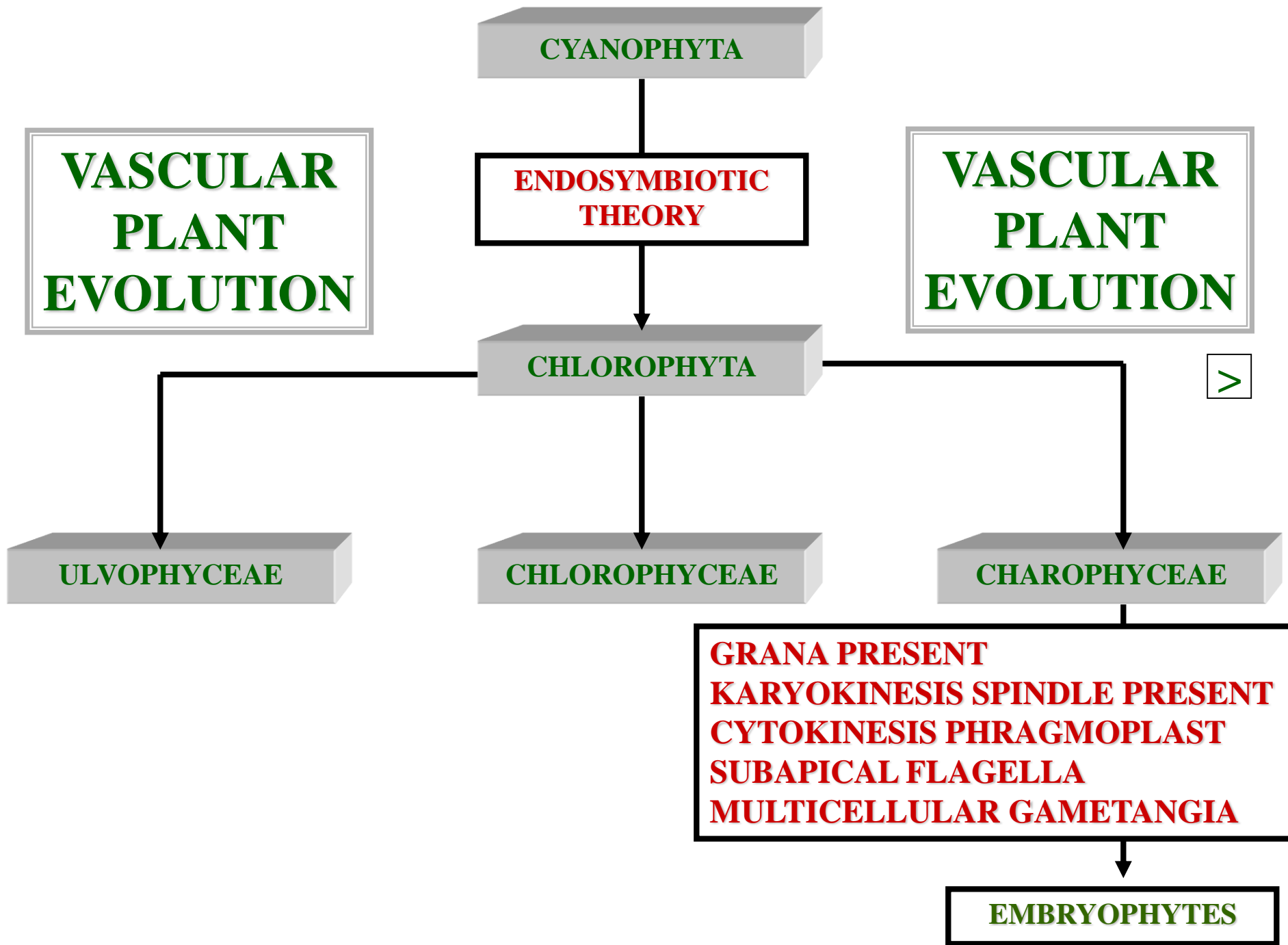
**CHLOROPHYCEAE**

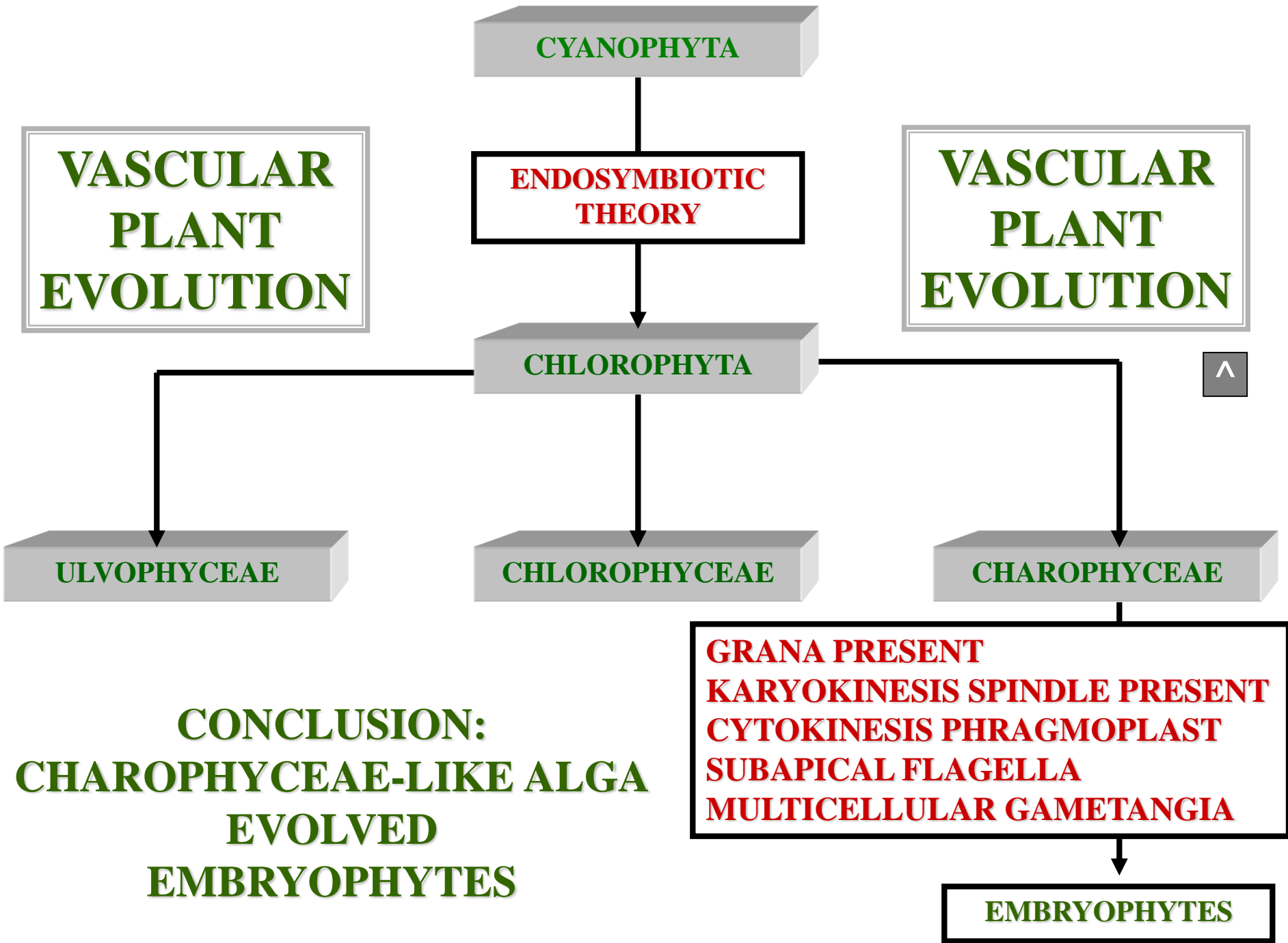
**?**

**CHAROPHYCEAE**

**?**







**FOSSIL  
EVIDENCE  
CHAROPHYCEAE  
EMBRYOPHYTE  
EVOLUTIONARY  
LINK**



# *PARKA DECIPIENS*