

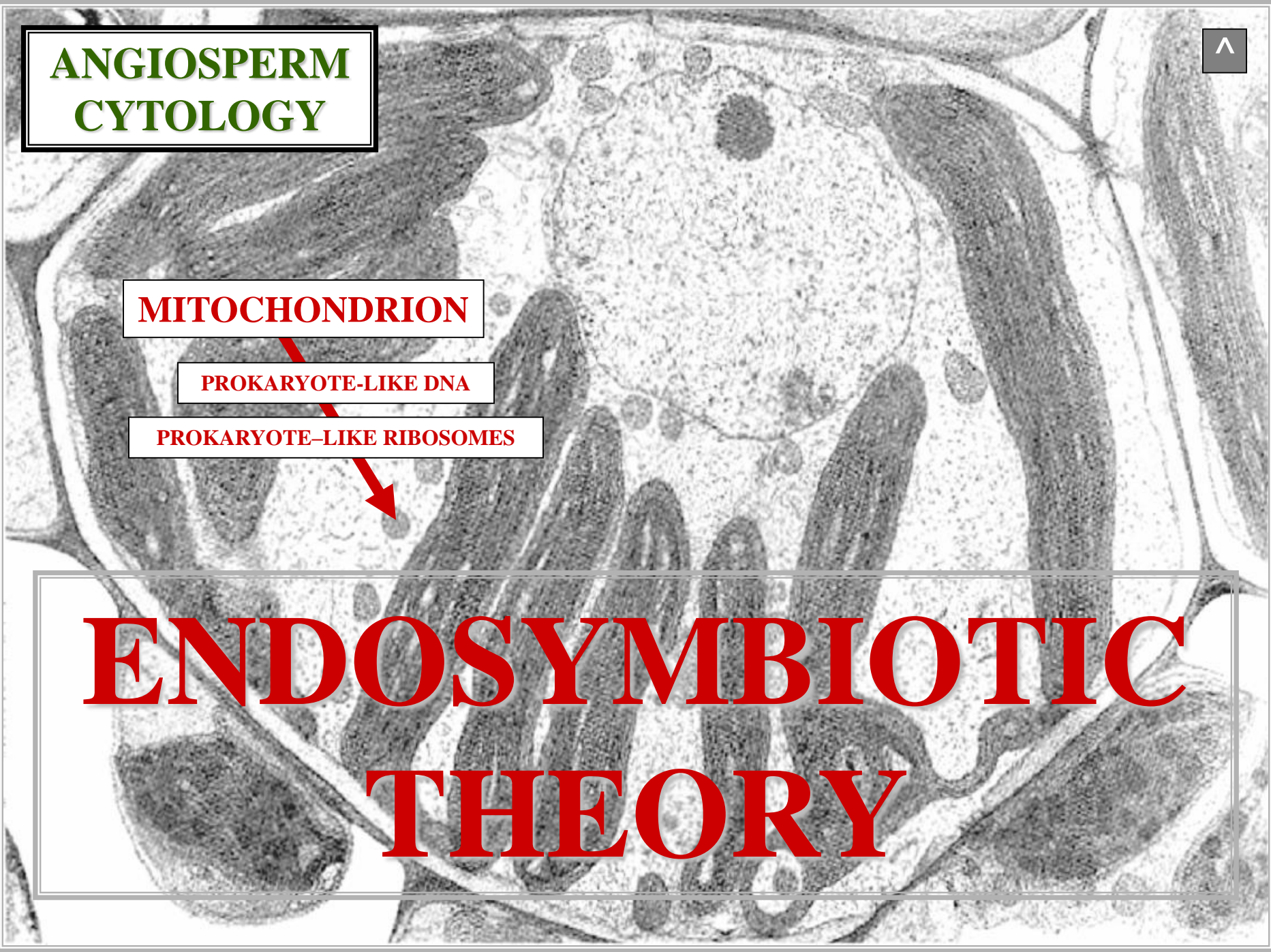
ANGIOSPERM CYTOLOGY

MITOCHONDRION

PROKARYOTE-LIKE DNA

PROKARYOTE-LIKE RIBOSOMES

ENDOSYMBIOTIC THEORY



NUCLEUS

NUCLEUS



NUCLEUS

KNOWN MOST EUKARYOTES

NUCLEUS



NUCLEUS

KNOWN MOST EUKARYOTES

CHROMOSOME LOCATION

NUCLEUS



NUCLEUS

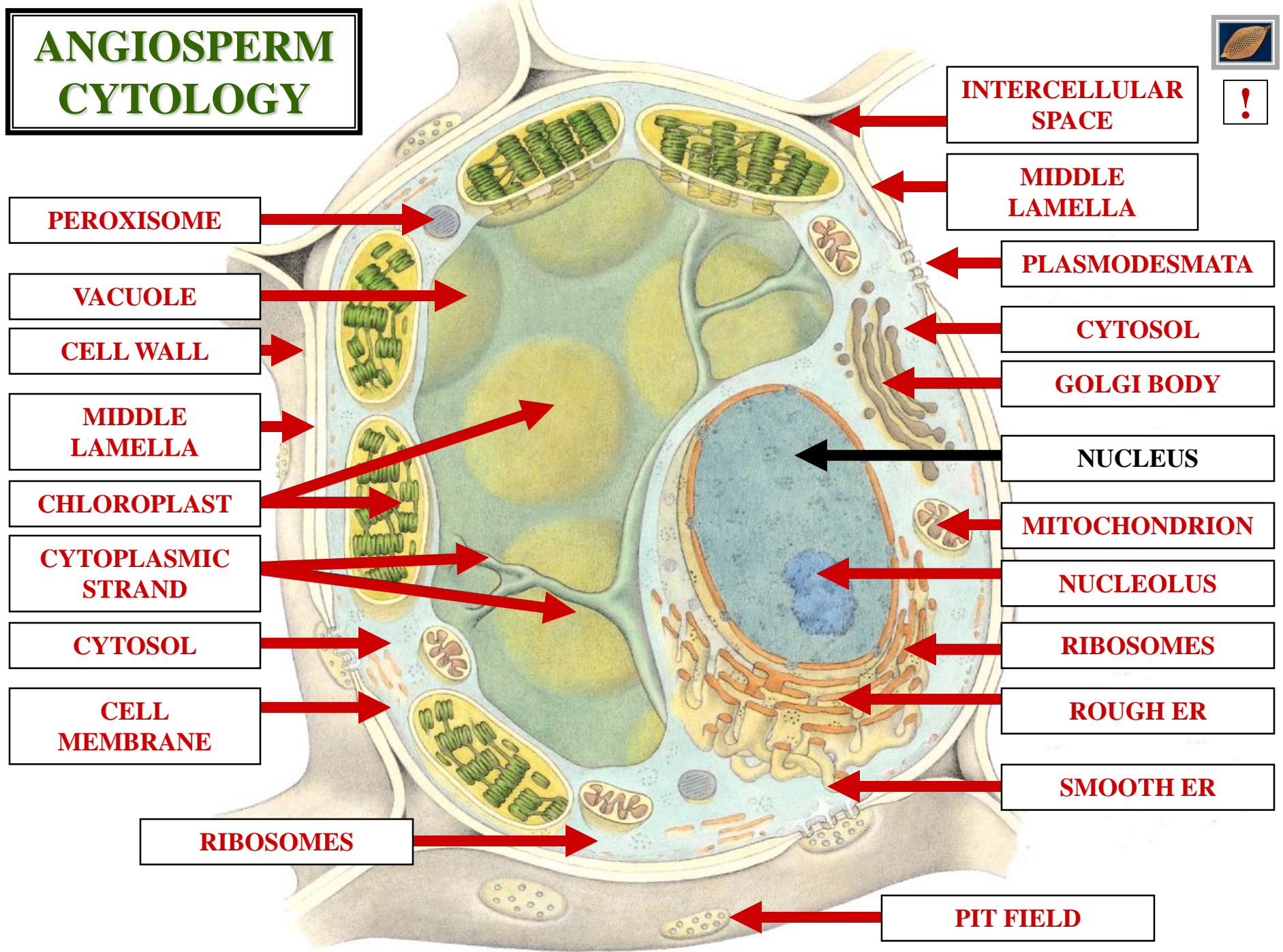
KNOWN MOST EUKARYOTES

CHROMOSOME LOCATION

REGULATES
CELL METABOLISM

NUCLEUS

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

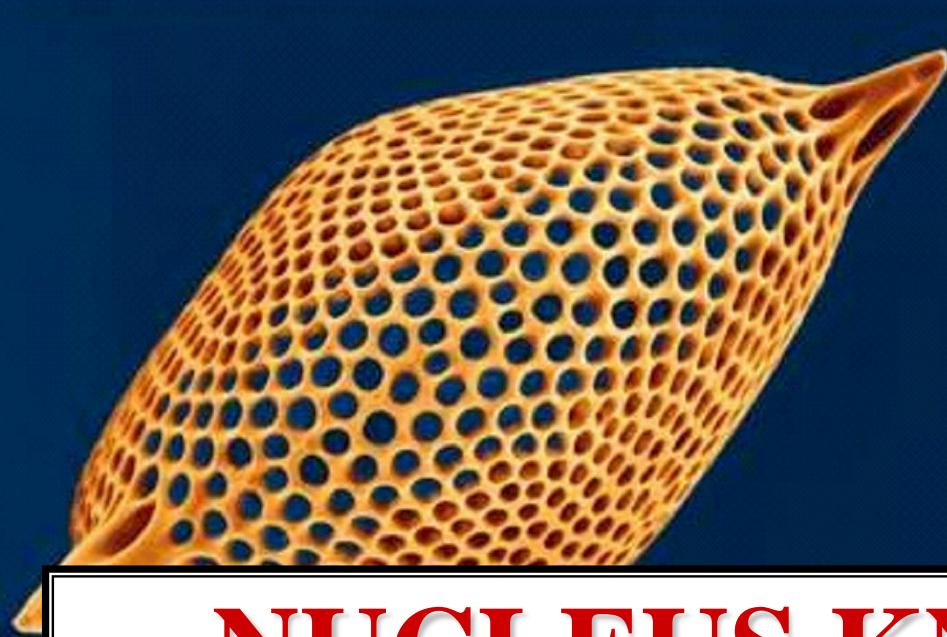
NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

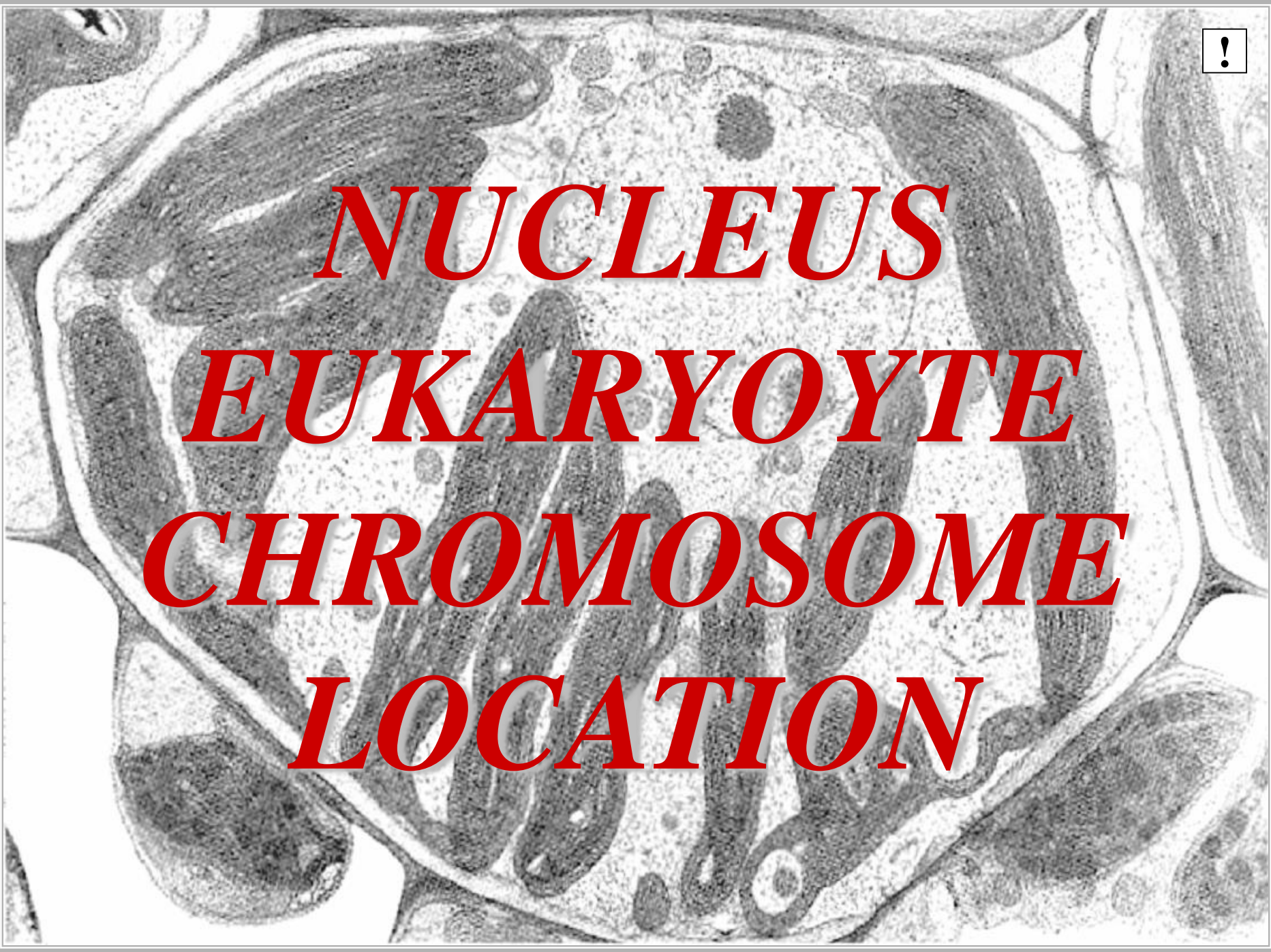


NUCLEUS KNOWN MOST EUKARYOTES





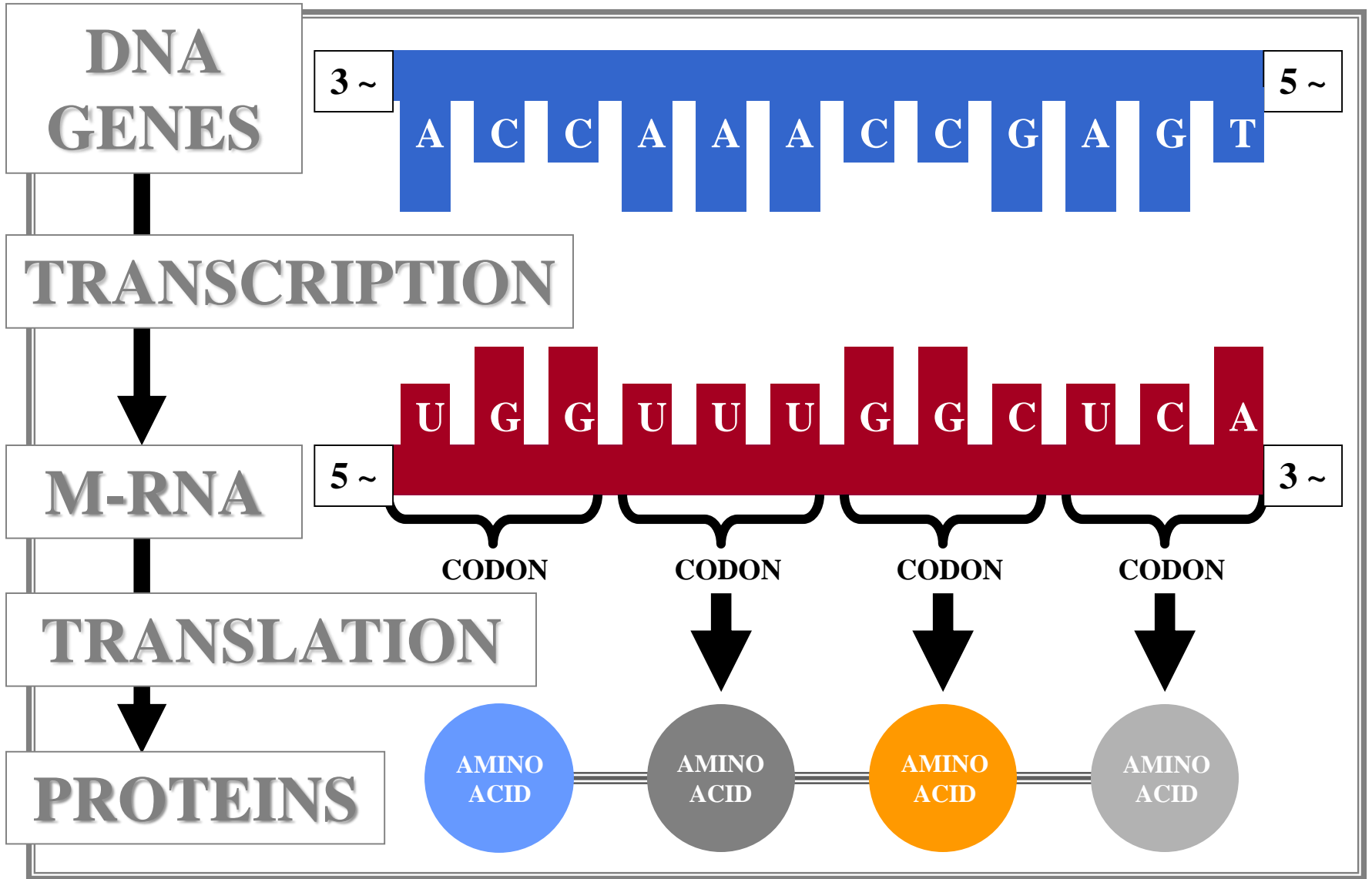
NUCLEUS
EUKARYOYTE
CHROMOSOME
LOCATION



An electron micrograph showing a cross-section of a cell. The image displays various organelles, including a large nucleus with a prominent nucleolus, rough endoplasmic reticulum with ribosomes, and mitochondria with visible cristae. The text is overlaid in the center in a bold, red, italicized font.

***NUCLEUS
REGULATES
EUKARYOTE
METABOLISM***

PROTEIN SYNTHESIS



METABOLISM

GLUCOSE

METABOLISM

HEXOKINASE

+

ATP

EGY

ADP

GLUCOSE-6-PHOSPHATE

ENZYMES
VITAL TO METABOLISM

PHOSPHOGLUCOISOMERASE

ENZYMES
VITAL TO METABOLISM

FRUCTOSE-6-PHOSPHATE

PHOSPHOFRUCTOKINASE

ATP

EGY

ADP

FRUCTOSE-1-6-PHOSPHATE

3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE



PYRUVATE

ENZYMES

3-PHOSPHOGLYCERATE - PGA

ENOLASE

3-PHOSPHOENOLPYRUVATE

PYRUVATE KINASE



PYRUVATE

ENZYMES

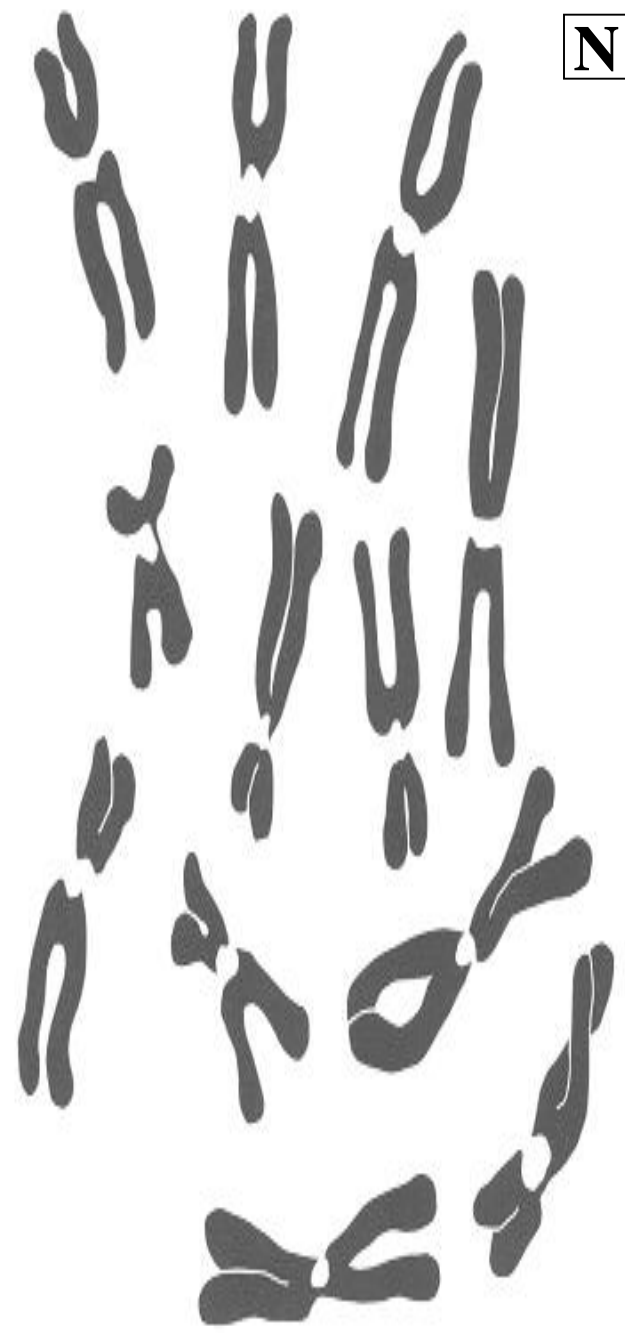
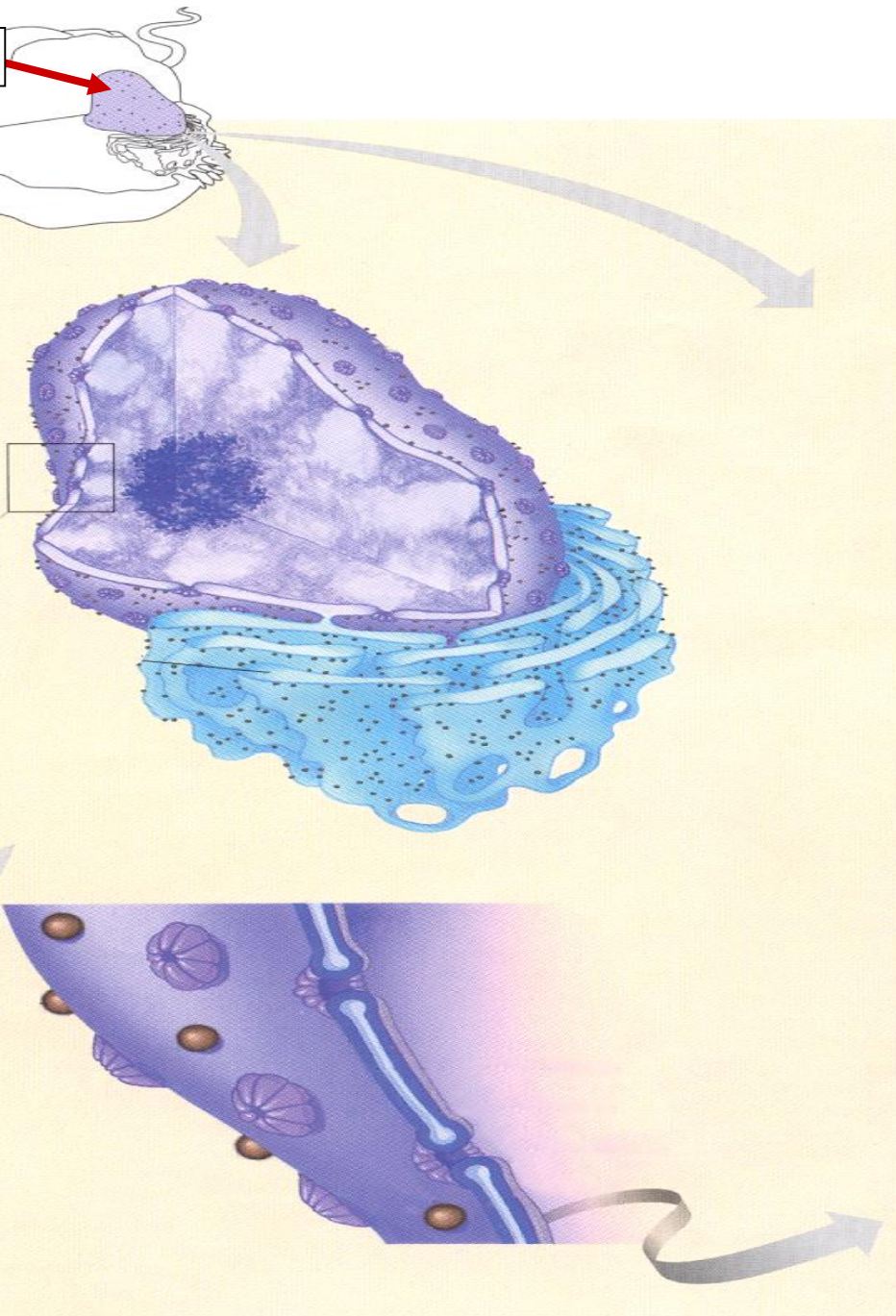
NUCLEUS REGULATES ENZYME SYNTHESIS

NUCLEUS REGULATES CELL METABOLISM



NUCLEUS ULTRASTRUCTURE

NUCLEUS



NUCLEAR ENVELOPE



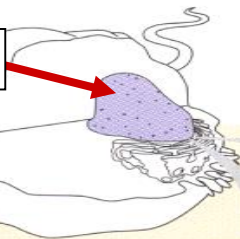
NUCLEAR ENVELOPE

NUCLEUS

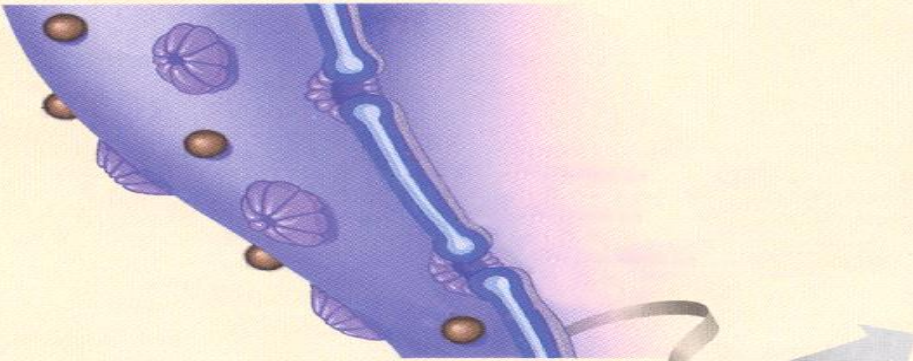
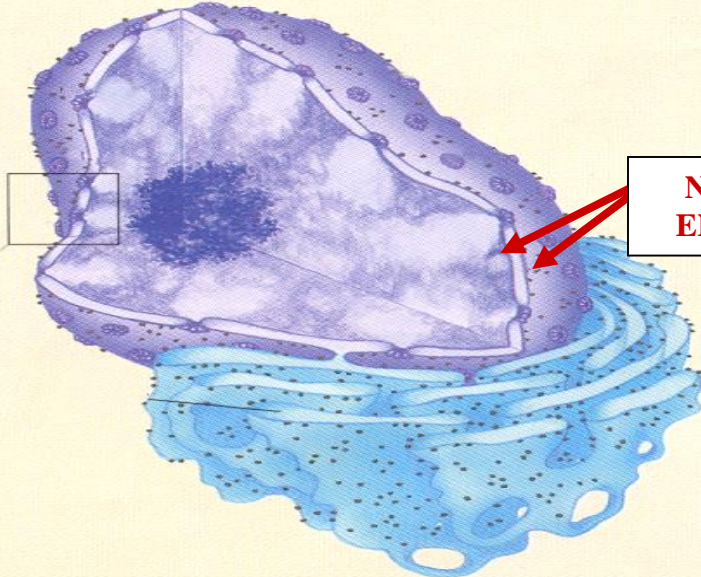
DOUBLE MEMBRANE

NUCLEAR ENVELOPE

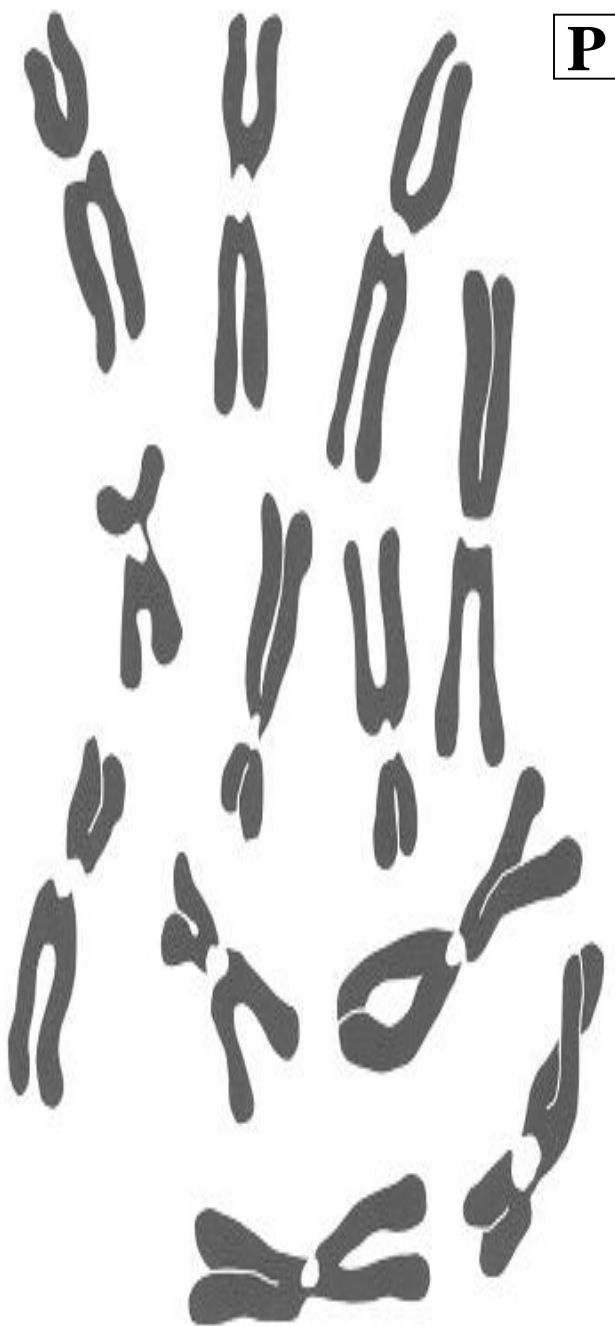
NUCLEUS



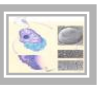
NUCLEAR ENVELOPE



P



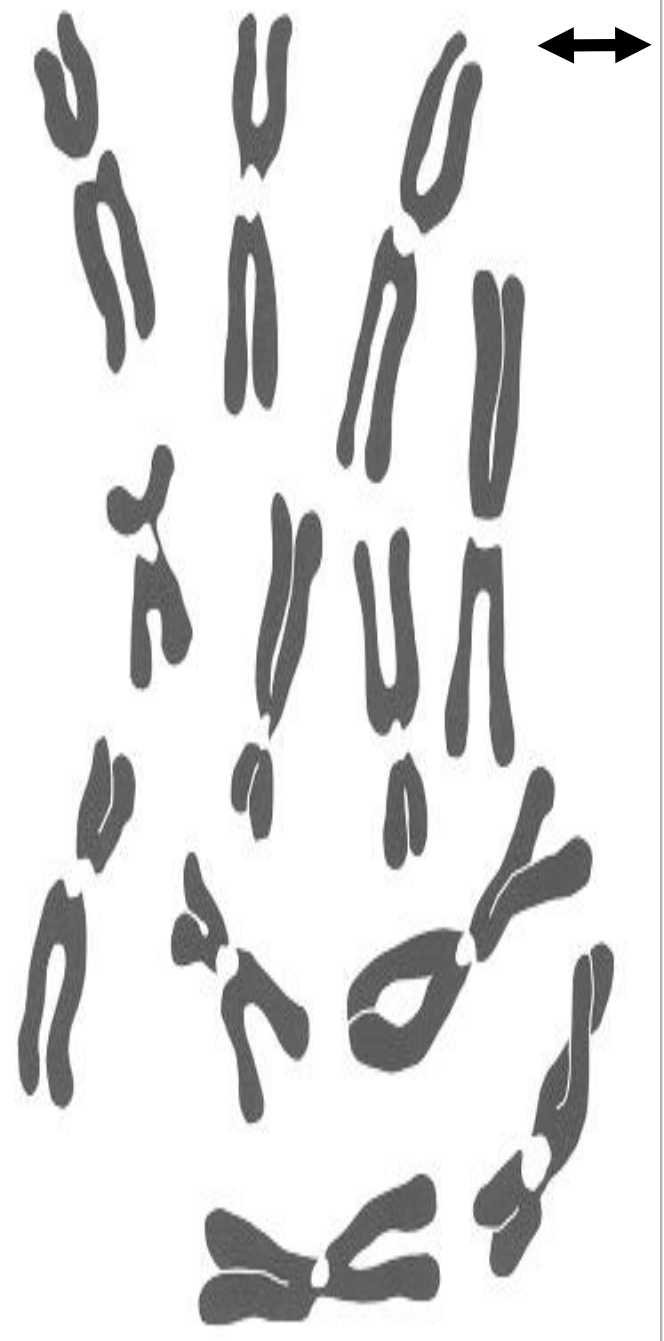
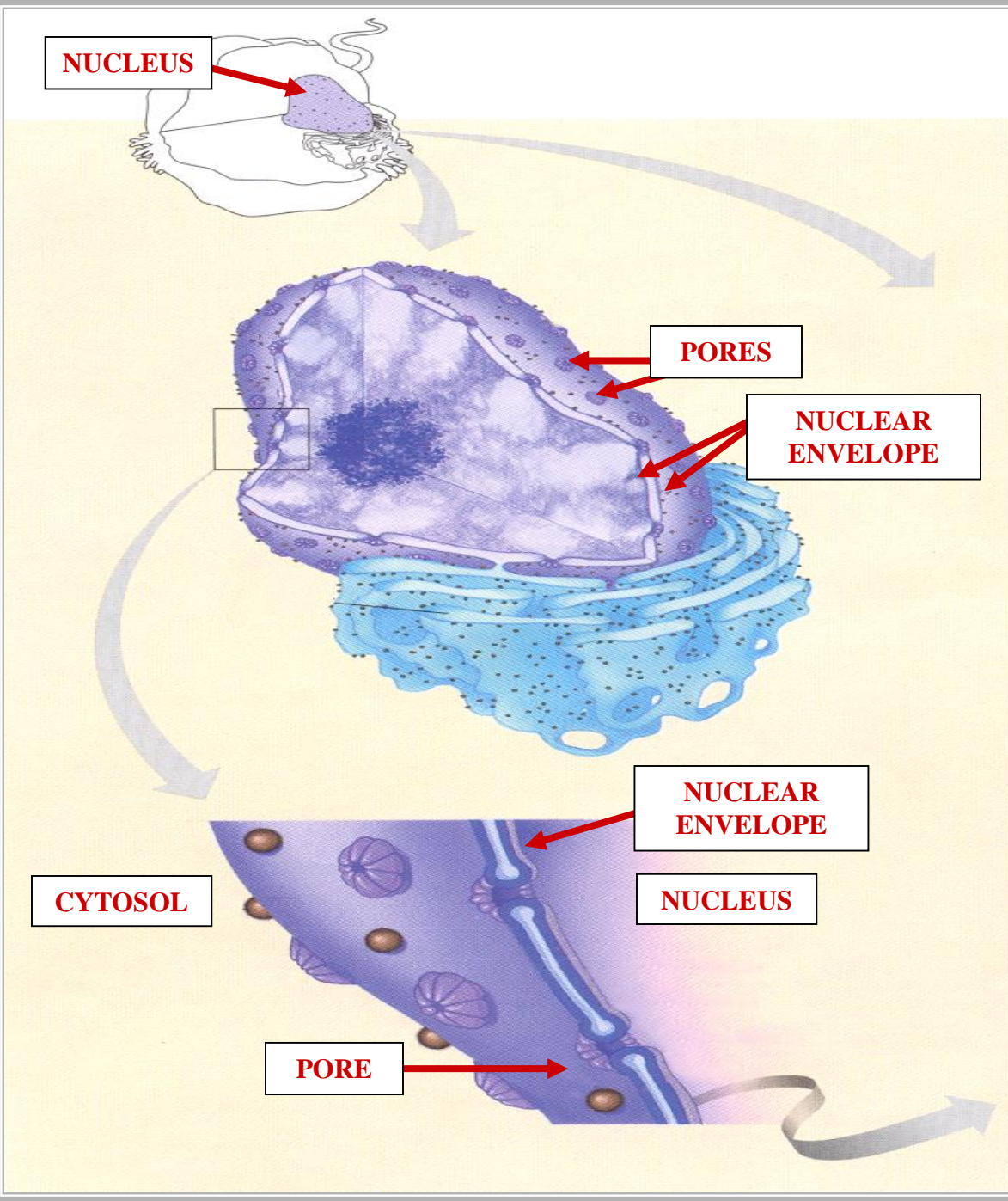
**NUCLEAR
ENVELOPE
PORES**

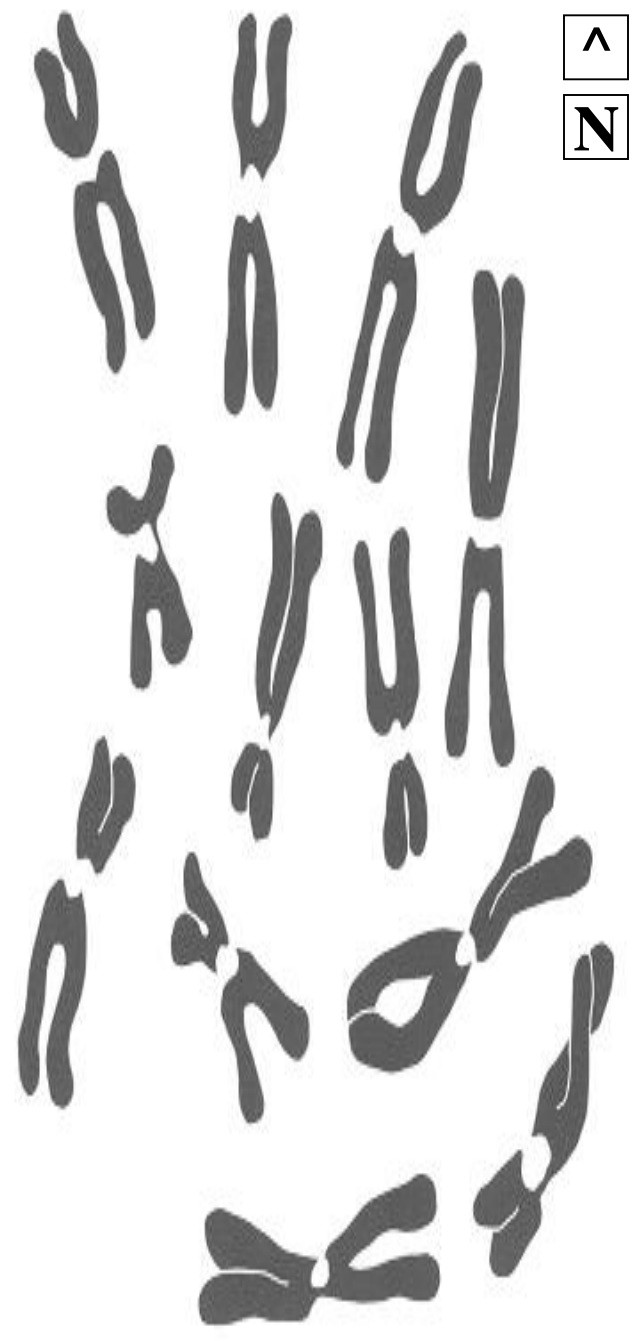
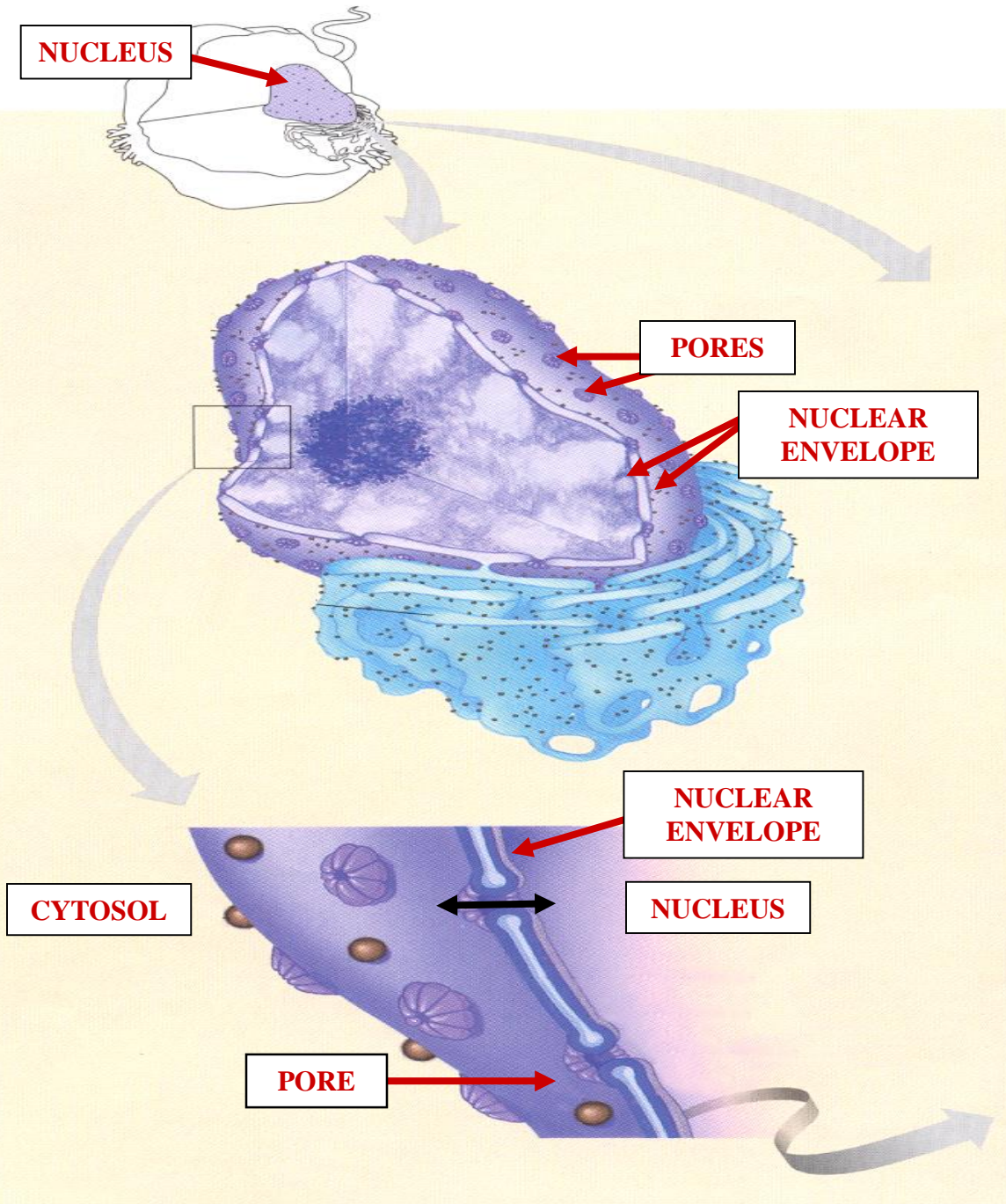


NUCLEAR ENVELOPE PORES

**COMMUNICATION
CONDUITS BETWEEN
NUCLEUS & CYTOSOL**

NUCLEAR ENVELOPE PORES





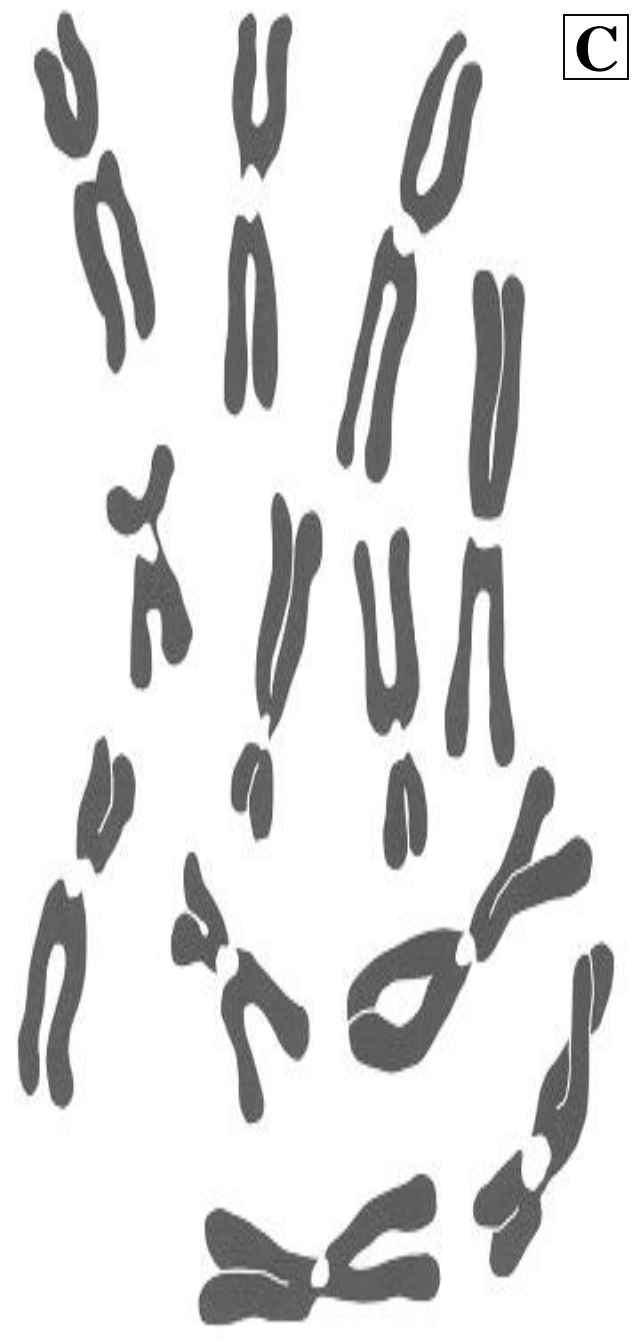
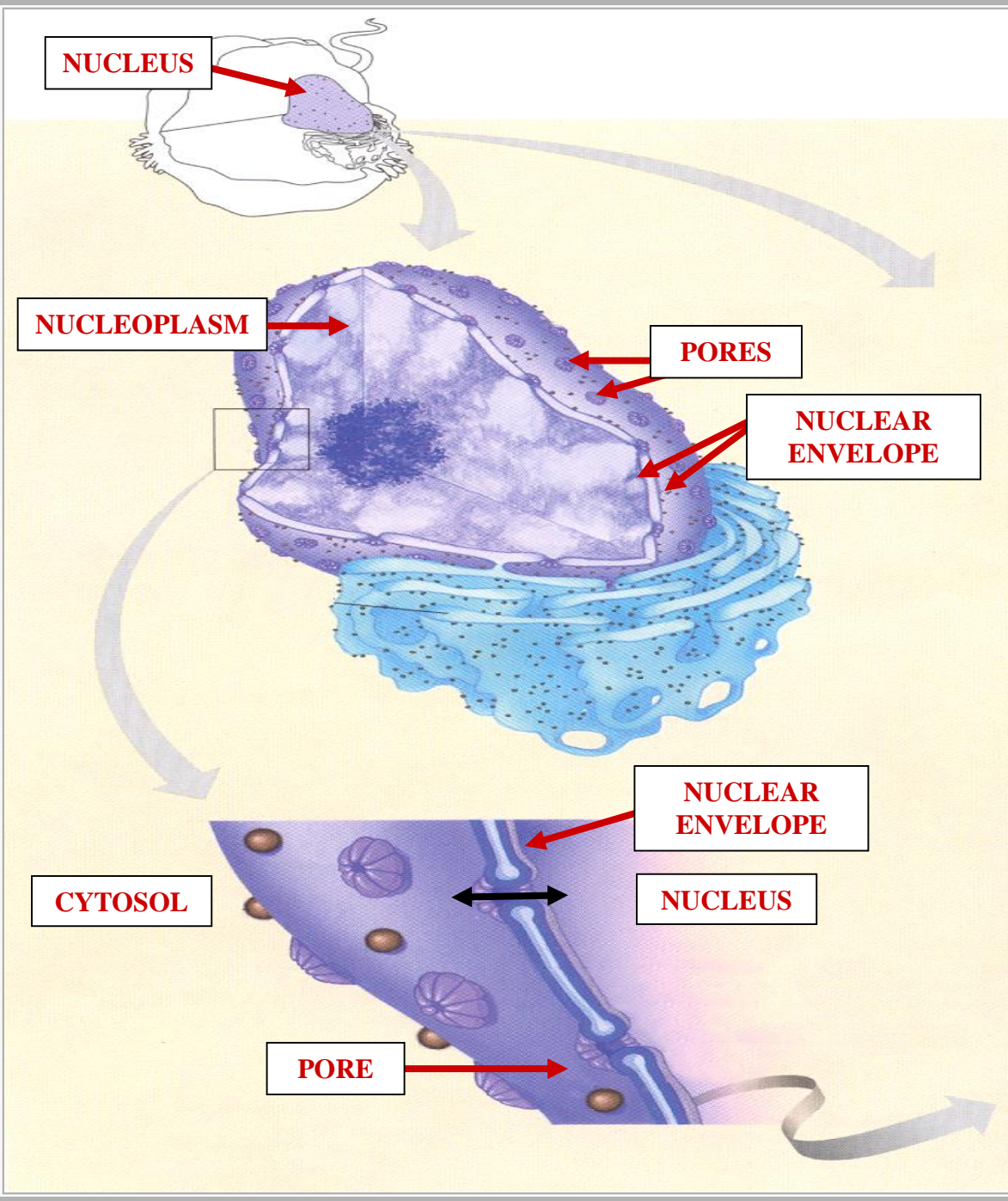
NUCLEOPLASM



NUCLEUS
NUCLEOPLASM

NUCLEUS
FLUID MATRIX

NUCLEUS
NUCLEOPLASM



EUKARYOTE CHROMOSOMES



NUCLEUS
CHROMOSOMES

LINEAR DNA

NUCLEUS
CHROMOSOMES



NUCLEUS
CHROMOSOMES

LINEAR DNA

HISTONE PROTEINS
PRESENT

NUCLEUS
CHROMOSOMES

NUCLEUS

CHROMOSOMES

L

NUCLEOPLASM

PORES

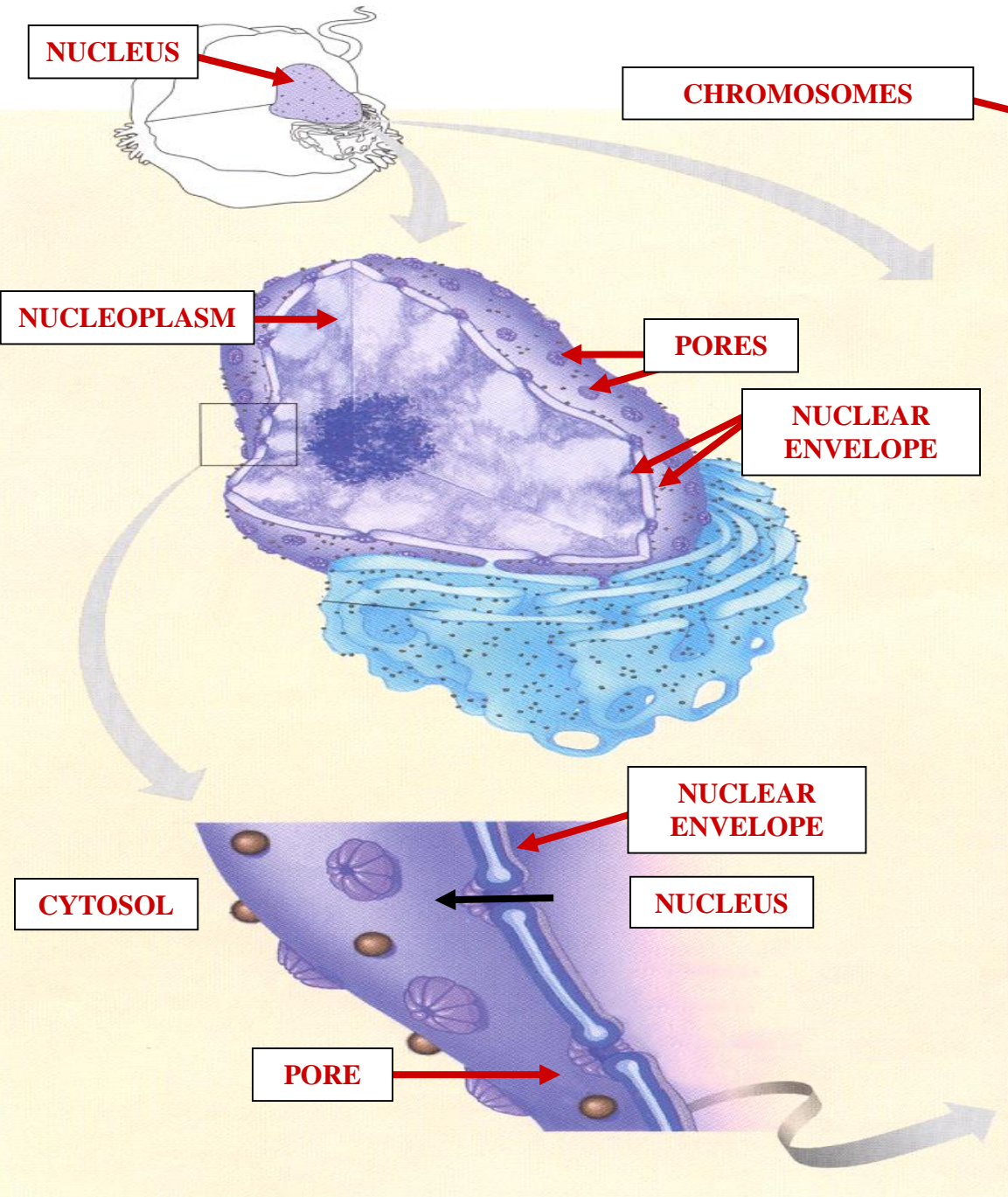
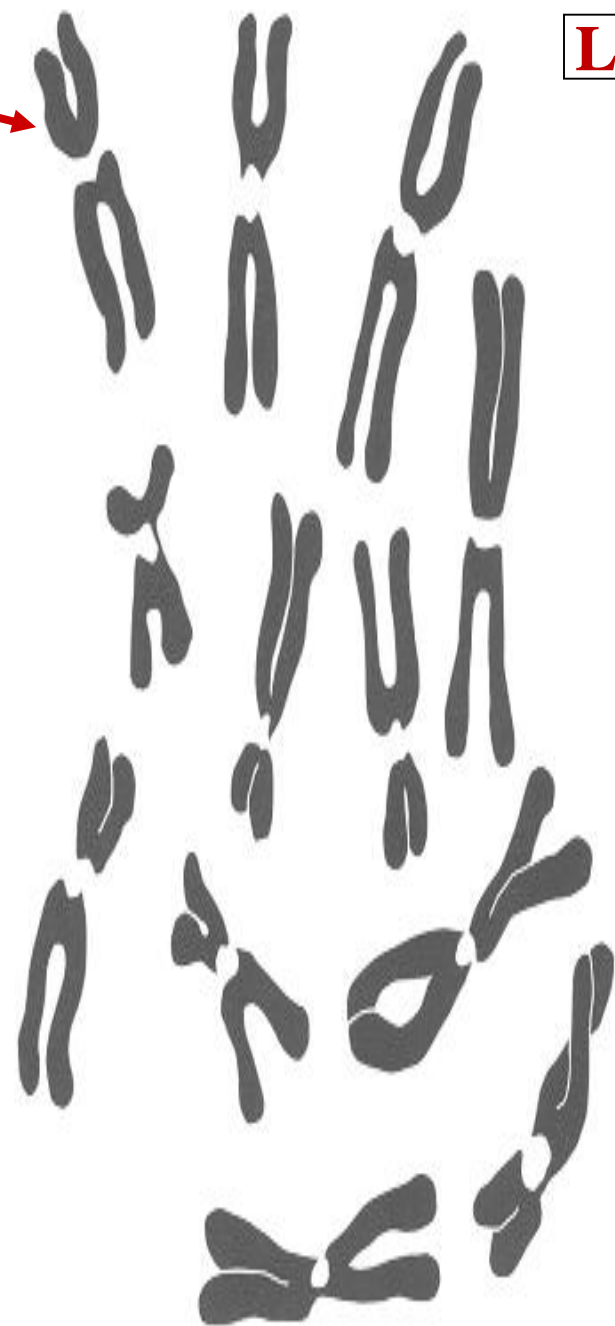
NUCLEAR ENVELOPE

CYTOSOL

NUCLEAR ENVELOPE

NUCLEUS

PORE



NUCLEUS

**CHROMOSOMES
LINEAR DNA**

NUCLEOPLASM

PORES

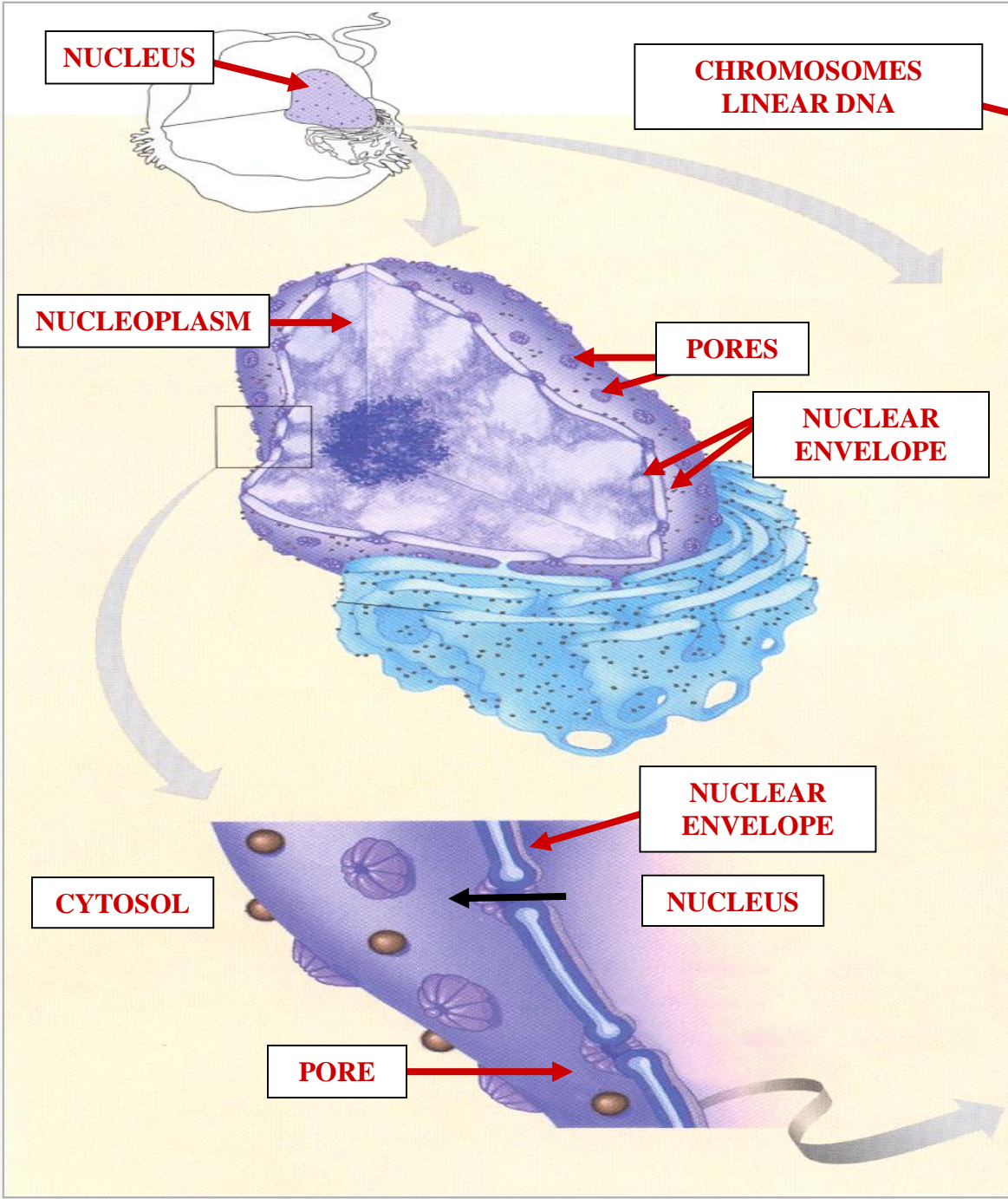
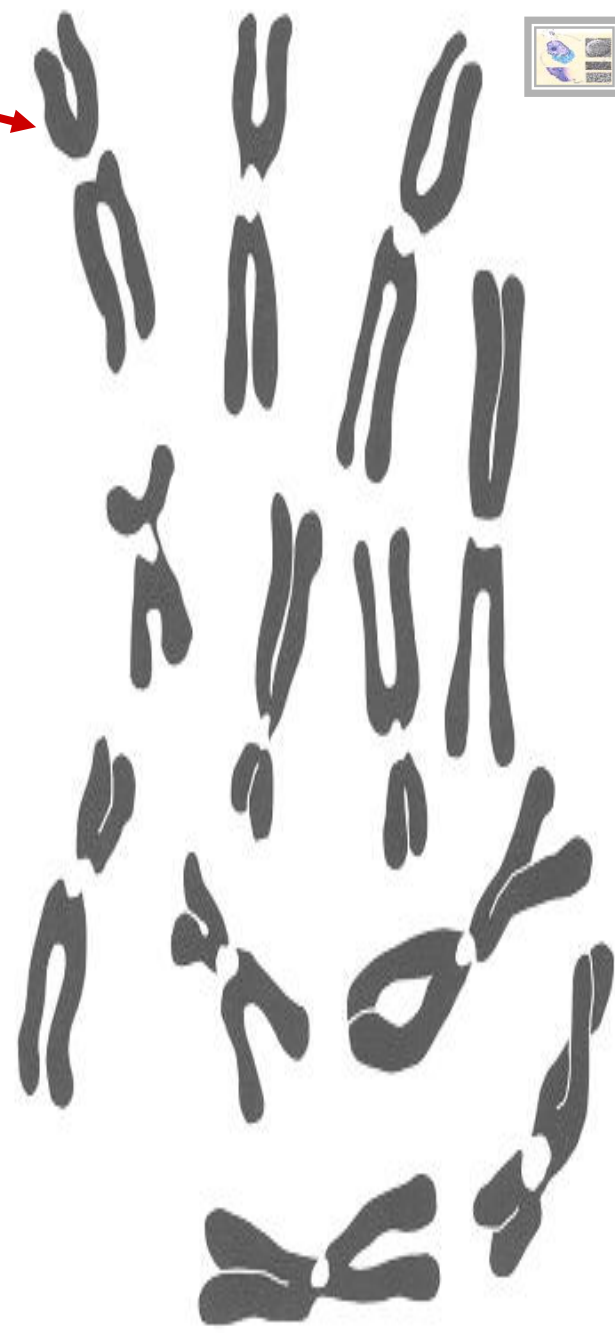
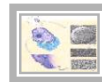
**NUCLEAR
ENVELOPE**

CYTOSOL

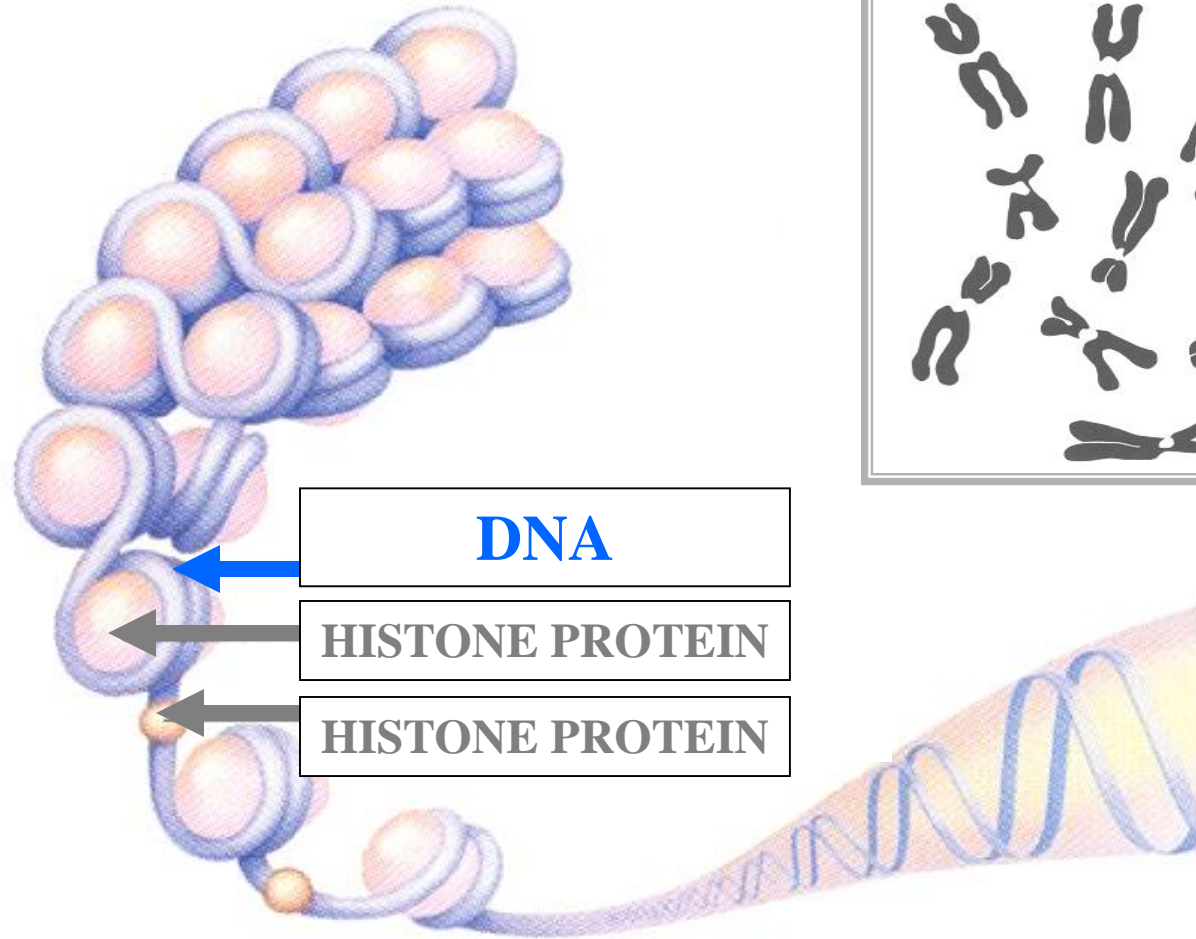
**NUCLEAR
ENVELOPE**

NUCLEUS

PORE



EUKARYOTE CHROMOSOME



EUKARYOTE CHROMOSOME: HISTONE PROTEINS PRESENT

NUCLEOLUS



NUCLEOLUS

SITE: RIBOSOME SYNTHESIS

NUCLEOLUS

NUCLEUS

CHROMOSOME



NUCLEOPLASM

PORES

NUCLEOLUS

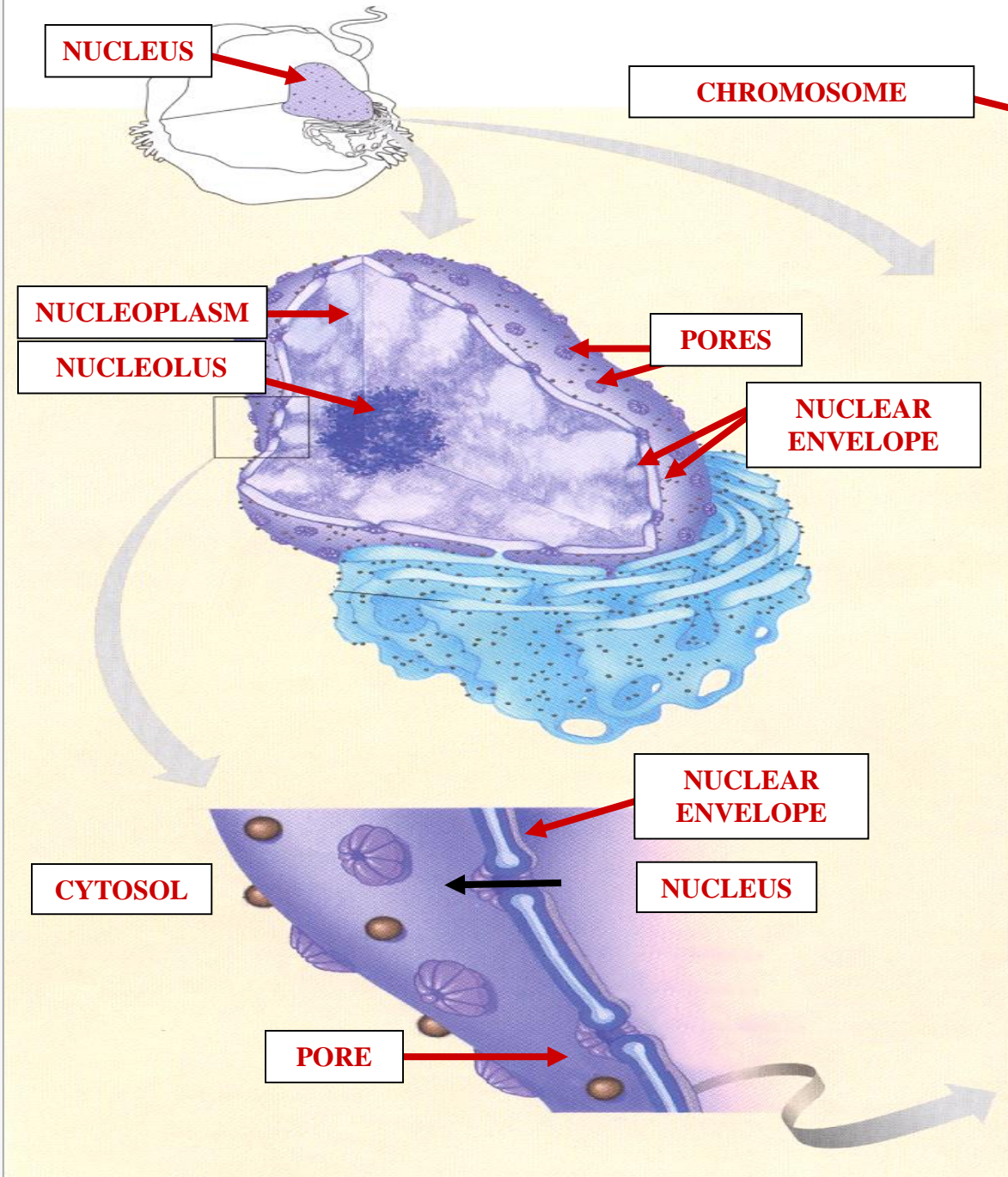
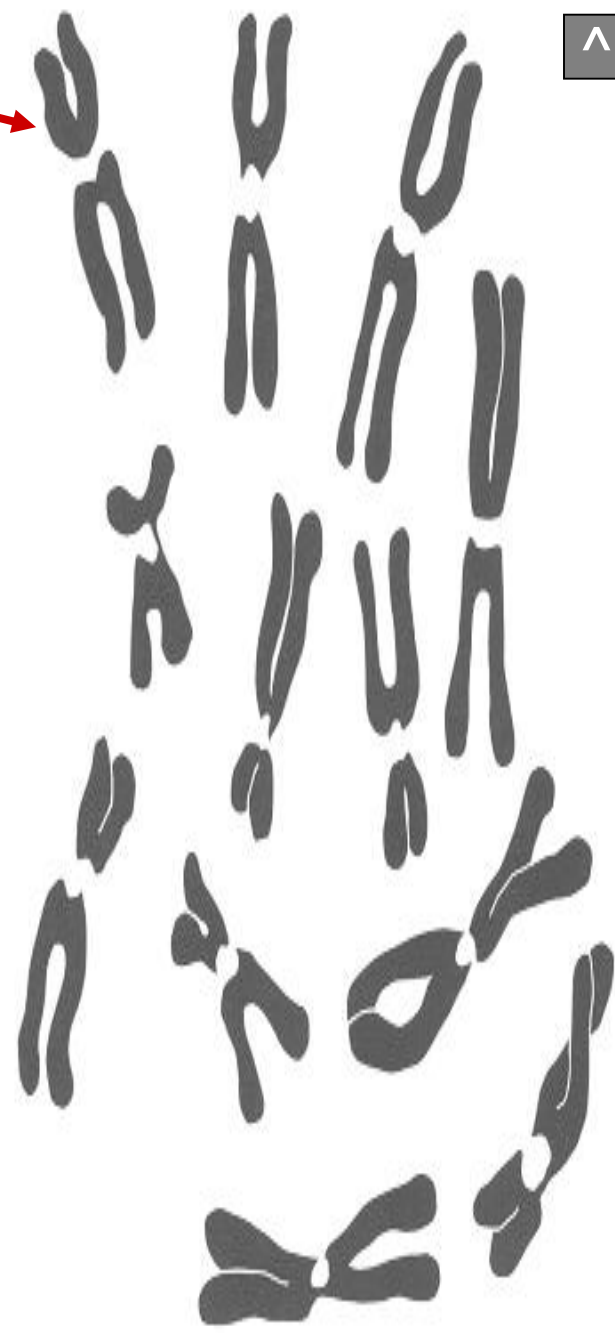
NUCLEAR ENVELOPE

CYTOSOL

NUCLEAR ENVELOPE

NUCLEUS

PORE





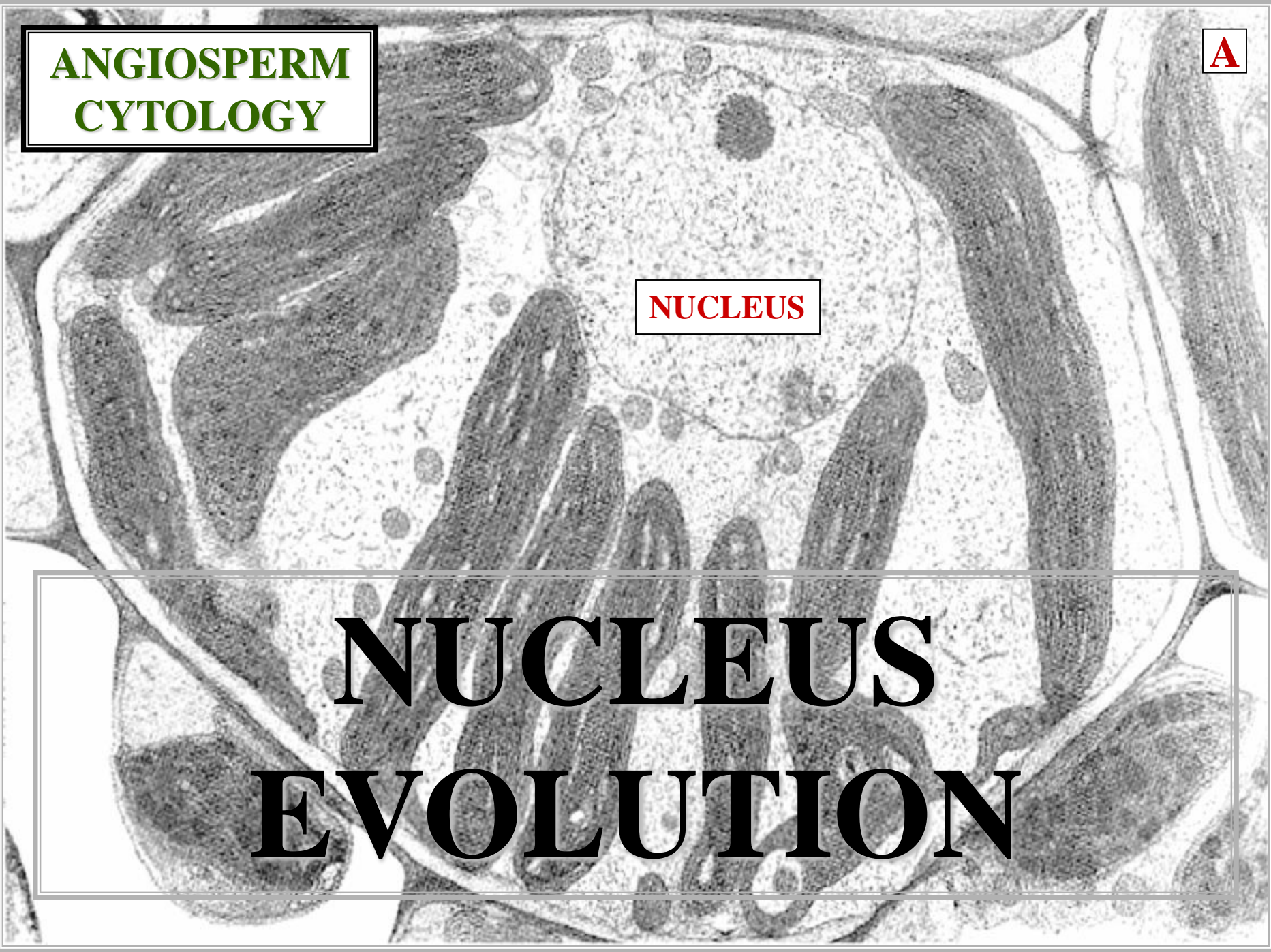
NUCLEUS EVOLUTION

**ANGIOSPERM
CYTOLOGY**

A

NUCLEUS

**NUCLEUS
EVOLUTION**



An electron micrograph of a plant cell. A large, centrally located nucleus is visible, surrounded by cytoplasm containing several chloroplasts with distinct internal membranes (grana). The cell wall is visible at the periphery. A small grey square with a white upward-pointing arrow is in the top right corner.

**ANGIOSPERM
CYTOLOGY**

NUCLEUS

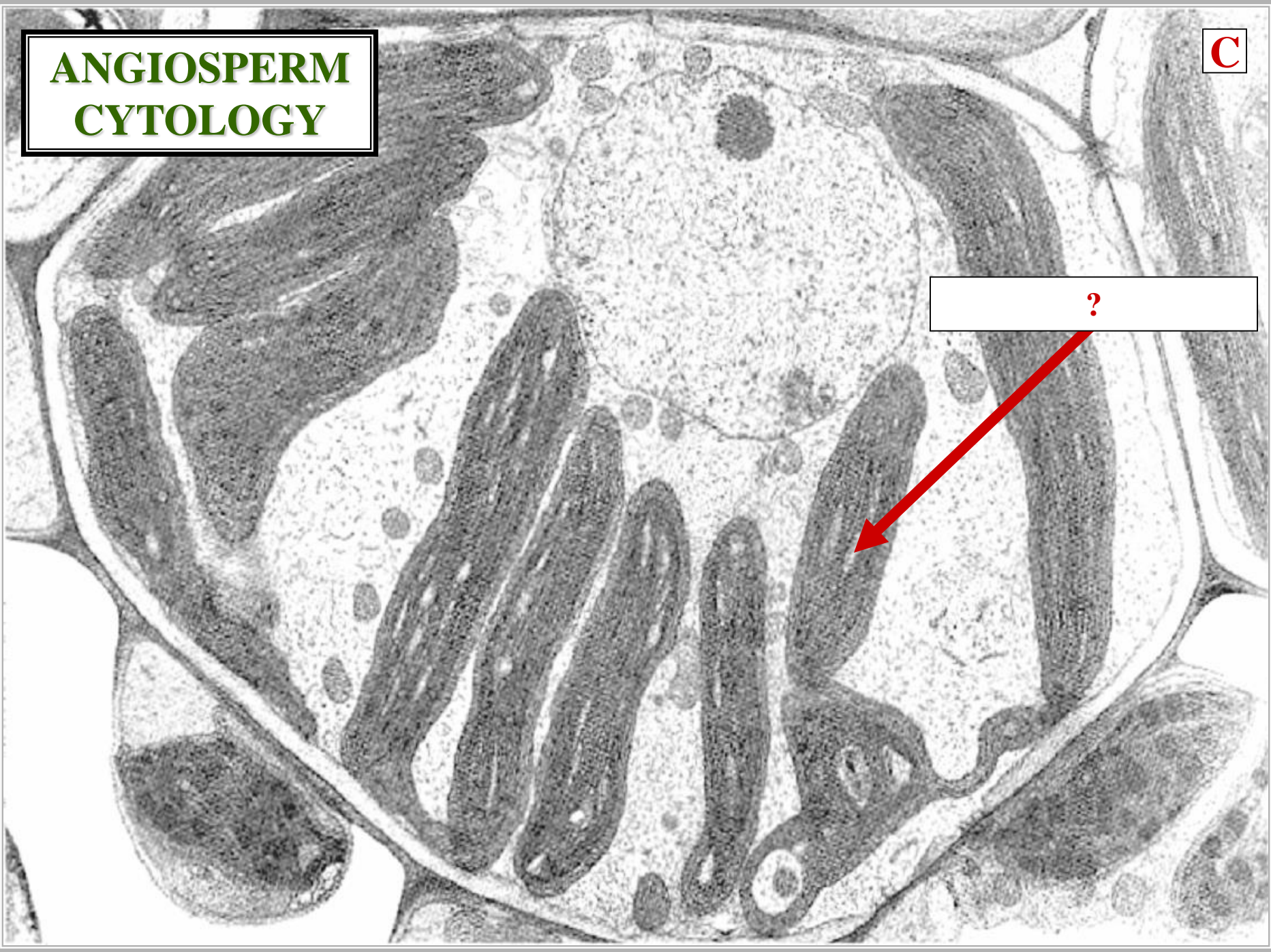
**AUTOGENOUS
THEORY**



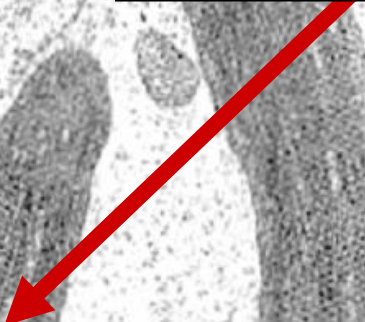
DOUBLE MEMBRANE BOUND ORGANELLES SUMMARY

ANGIOSPERM CYTOLOGY

C



?



**ANGIOSPERM
CYTOLOGY**

E

CHLOROPLAST

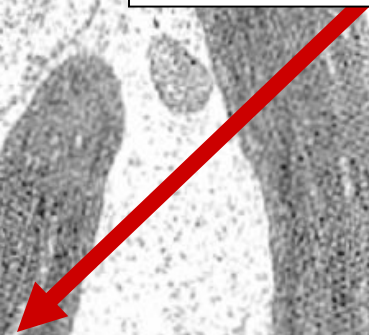
An electron micrograph showing the internal structure of a cell, likely a chloroplast, with various organelles and membranes visible. A red arrow points from a label 'CHLOROPLAST' to one of the organelles.

**CHLOROPLAST
EVOLUTION**

**ANGIOSPERM
CYTOLOGY**

?

CHLOROPLAST

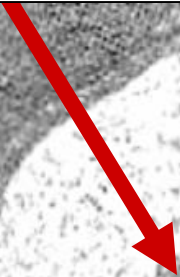


**ENDOSYMBIOTIC
THEORY**

ANGIOSPERM CYTOLOGY

M

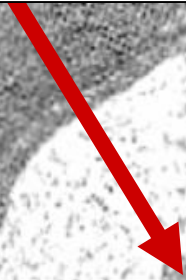
?



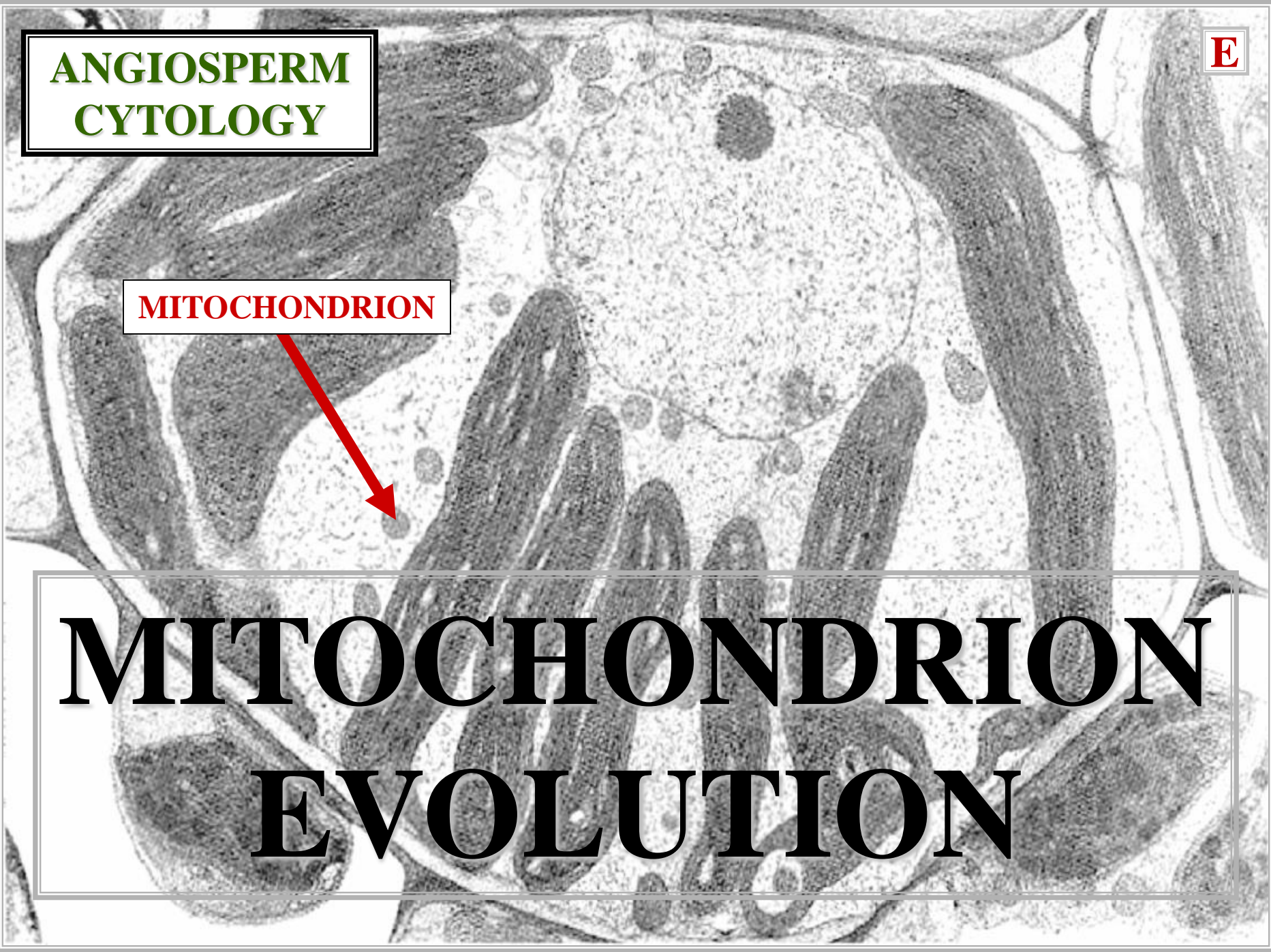
**ANGIOSPERM
CYTOLOGY**

E

MITOCHONDRION



**MITOCHONDRION
EVOLUTION**



An electron micrograph of a plant cell. The image shows several large, dark, oval-shaped chloroplasts with internal membrane structures (grana). A large, light-colored nucleus is visible in the upper central region. The cytoplasm is filled with various organelles and granules. In the top right corner, there is a small black square containing a white question mark.

**ANGIOSPERM
CYTOLOGY**

MITOCHONDRION

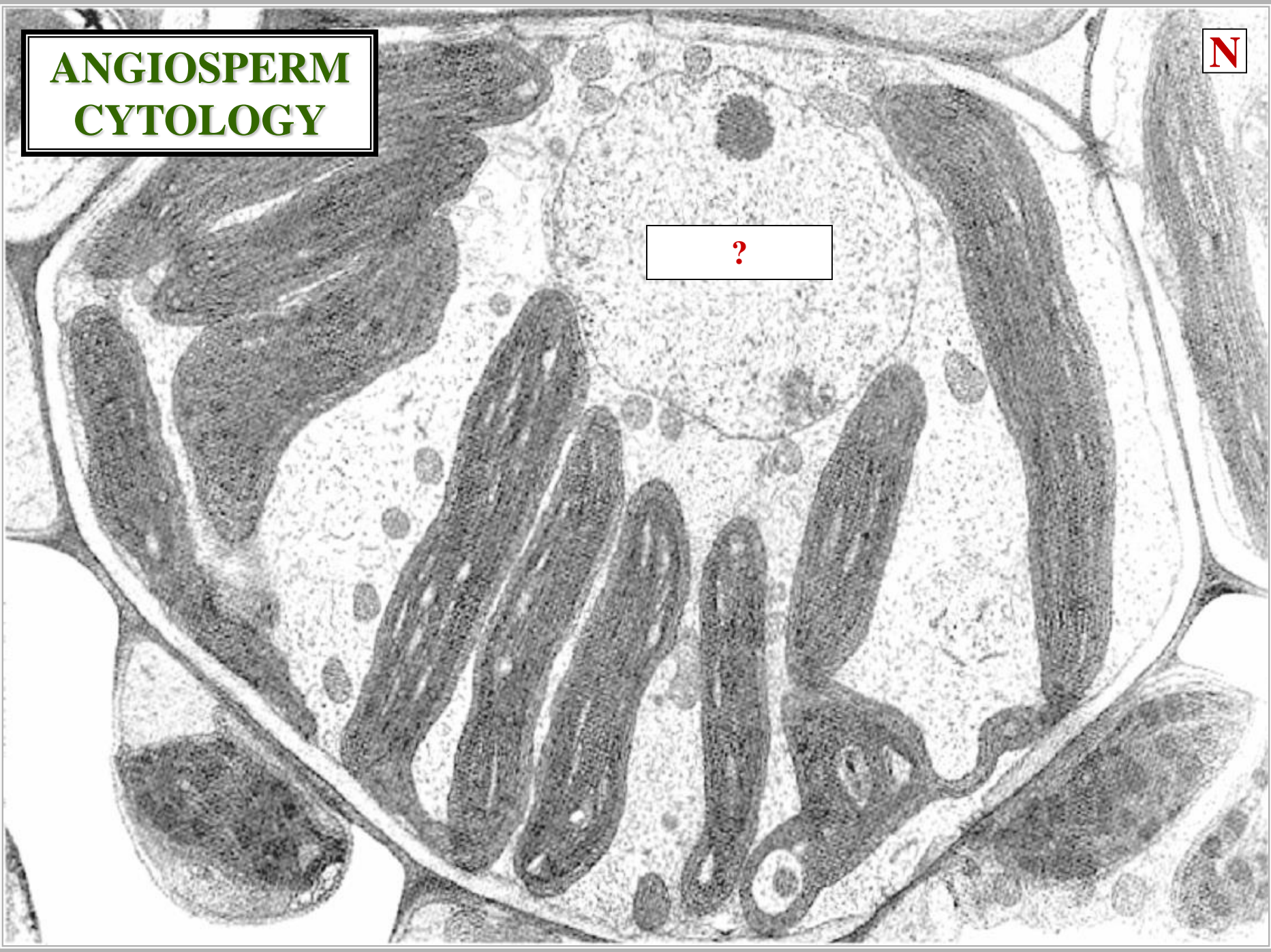
A red arrow originates from the text label 'MITOCHONDRION' and points to a small, dark, bean-shaped organelle with internal folds (cristae) located in the lower-left quadrant of the cell.

**ENDOSYMBIOTIC
THEORY**

ANGIOSPERM CYTOLOGY

N

?

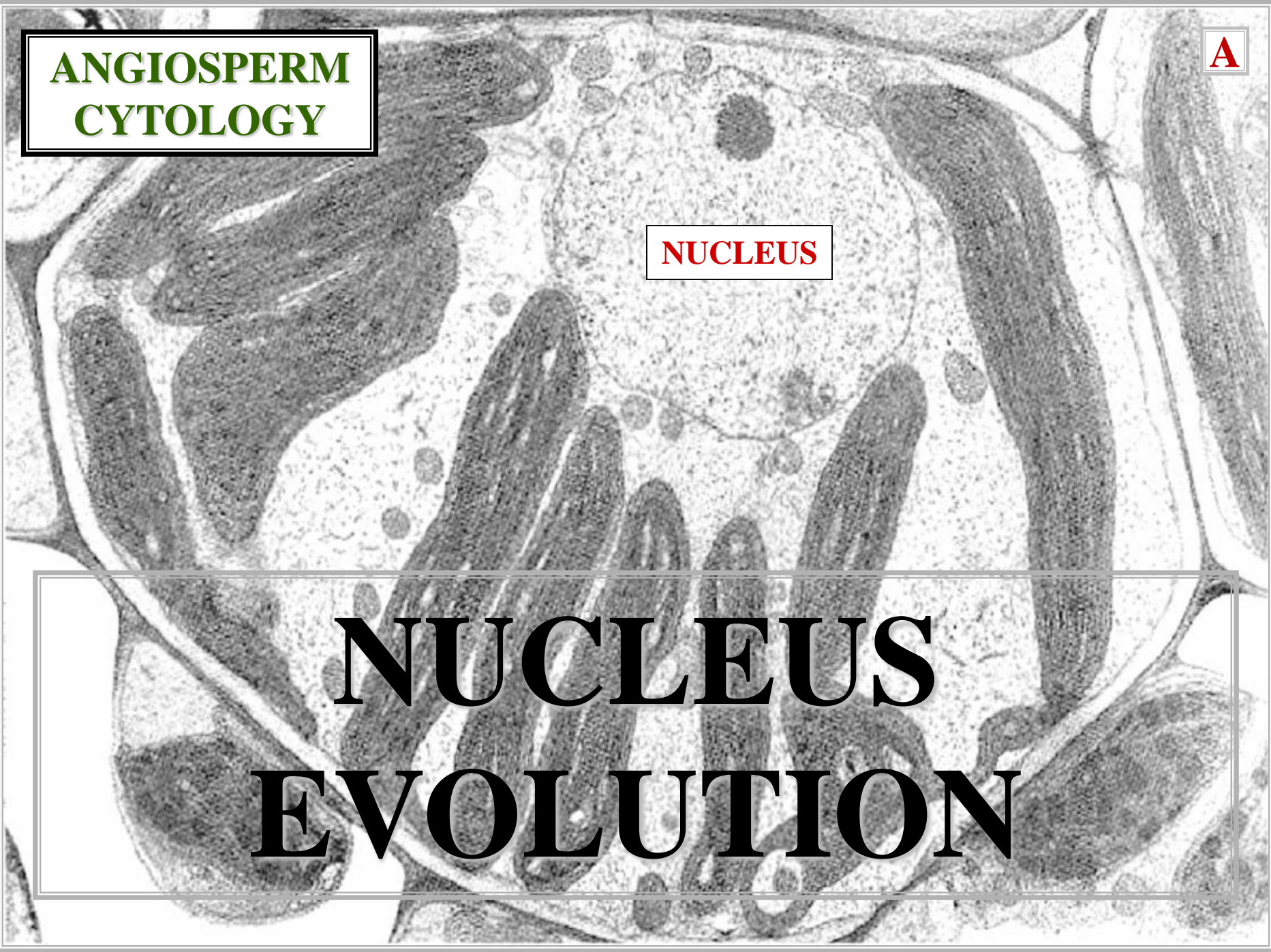


**ANGIOSPERM
CYTOLOGY**

A

NUCLEUS

**NUCLEUS
EVOLUTION**





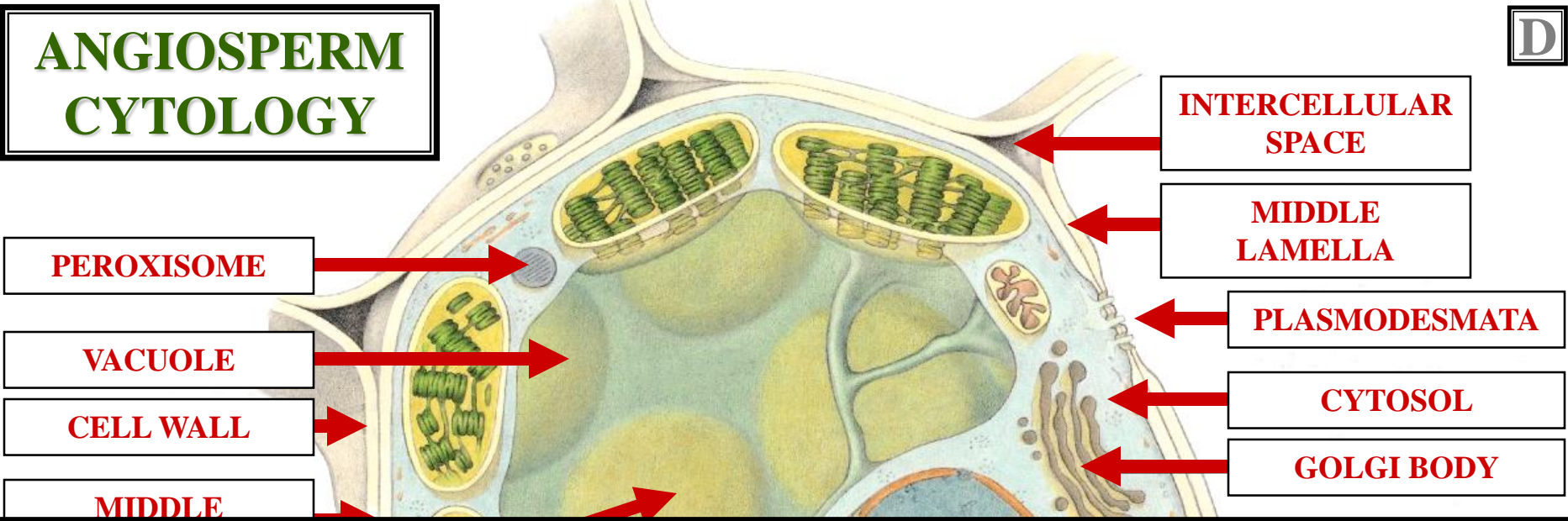
**ANGIOSPERM
CYTOLOGY**

NUCLEUS

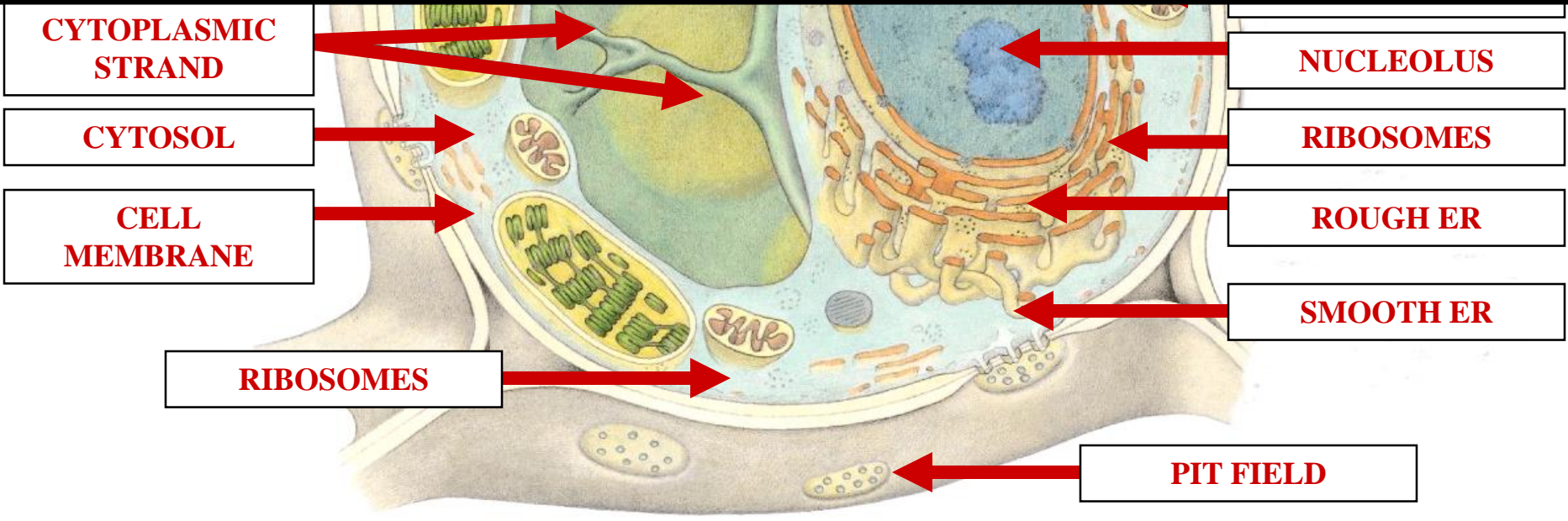
**AUTOGENOUS
THEORY**



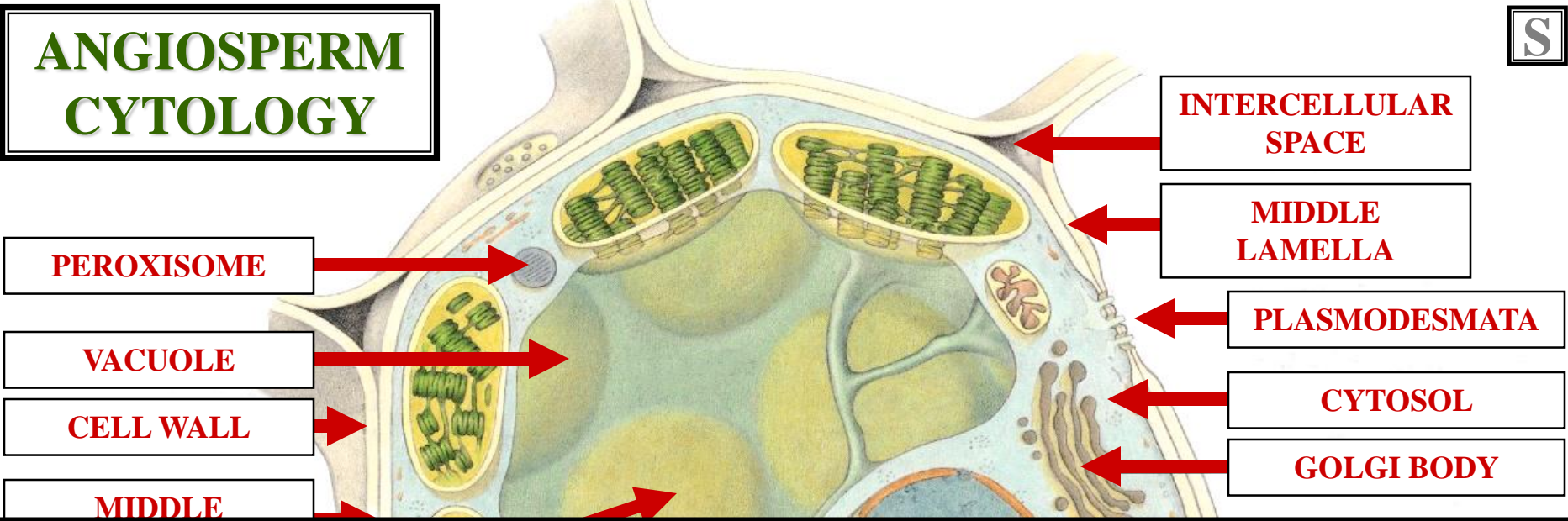
ANGIOSPERM CYTOLOGY



SUMMARY



ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

DOUBLE-MB ORGANELLES

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

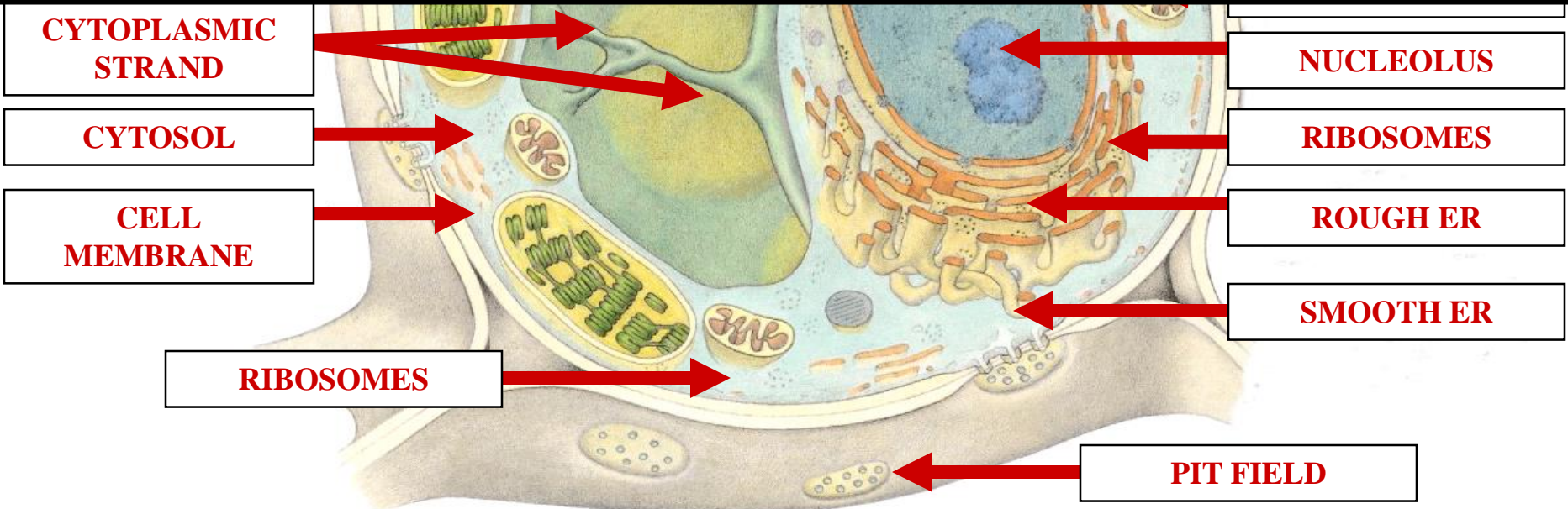
NUCLEOLUS

RIBOSOMES

ROUGH ER

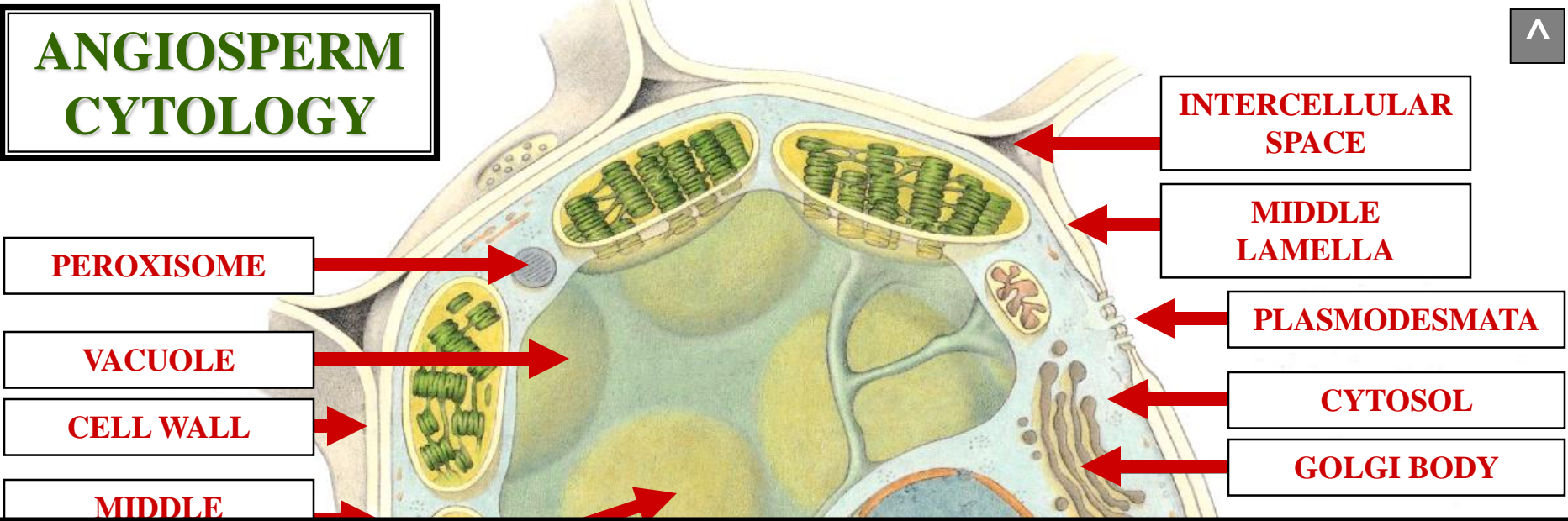
SMOOTH ER

PIT FIELD

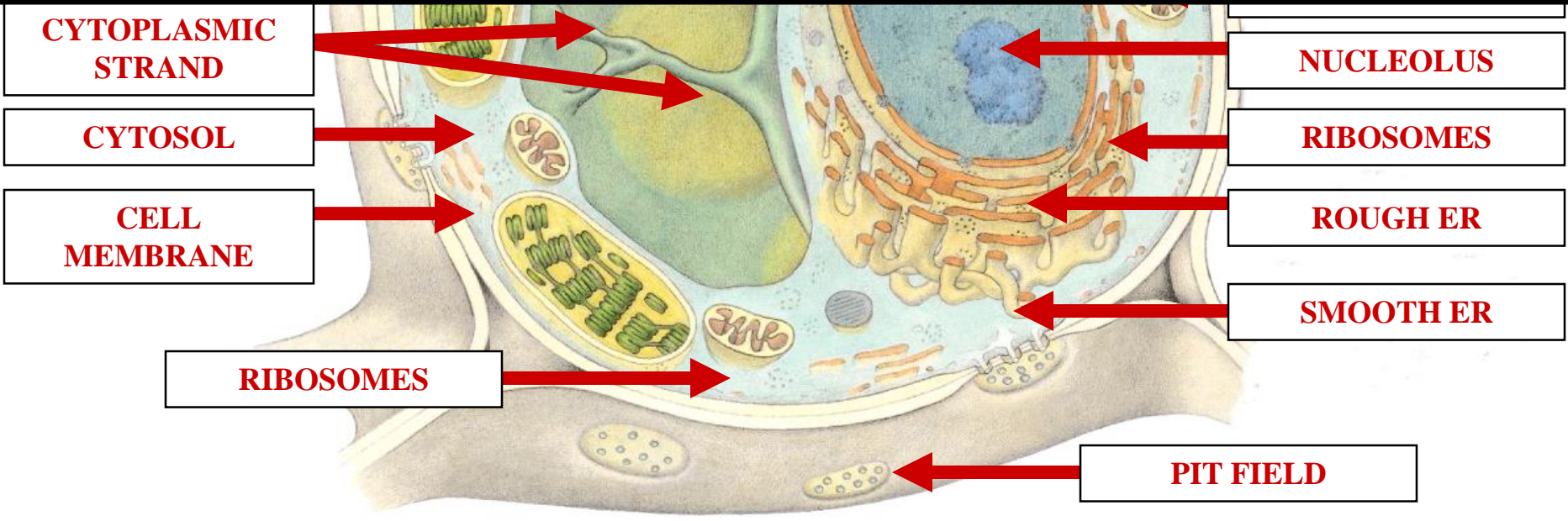




ANGIOSPERM CYTOLOGY



SINGLE-MB ORGANELLES





SINGLE MEMBRANE BOUND ORGANELLES

**SINGLE
MEMBRANE
BOUND
ORGANELLE
TYPES**

SMBO
ORGANELLE TYPES

VACUOLE

SMBO
ORGANELLE TYPES



SMBO
ORGANELLE TYPES

VACUOLE
PEROXISOME

SMBO
ORGANELLE TYPES

VACUOLE

VACUOLE

VACUOLE



PLANT CELLS ONLY

VACUOLE

VACUOLE



PLANT CELLS ONLY

LARGEST ORGANELLE

VACUOLE

VACUOLE



PLANT CELLS ONLY

LARGEST ORGANELLE

STORAGE ORGANELLE

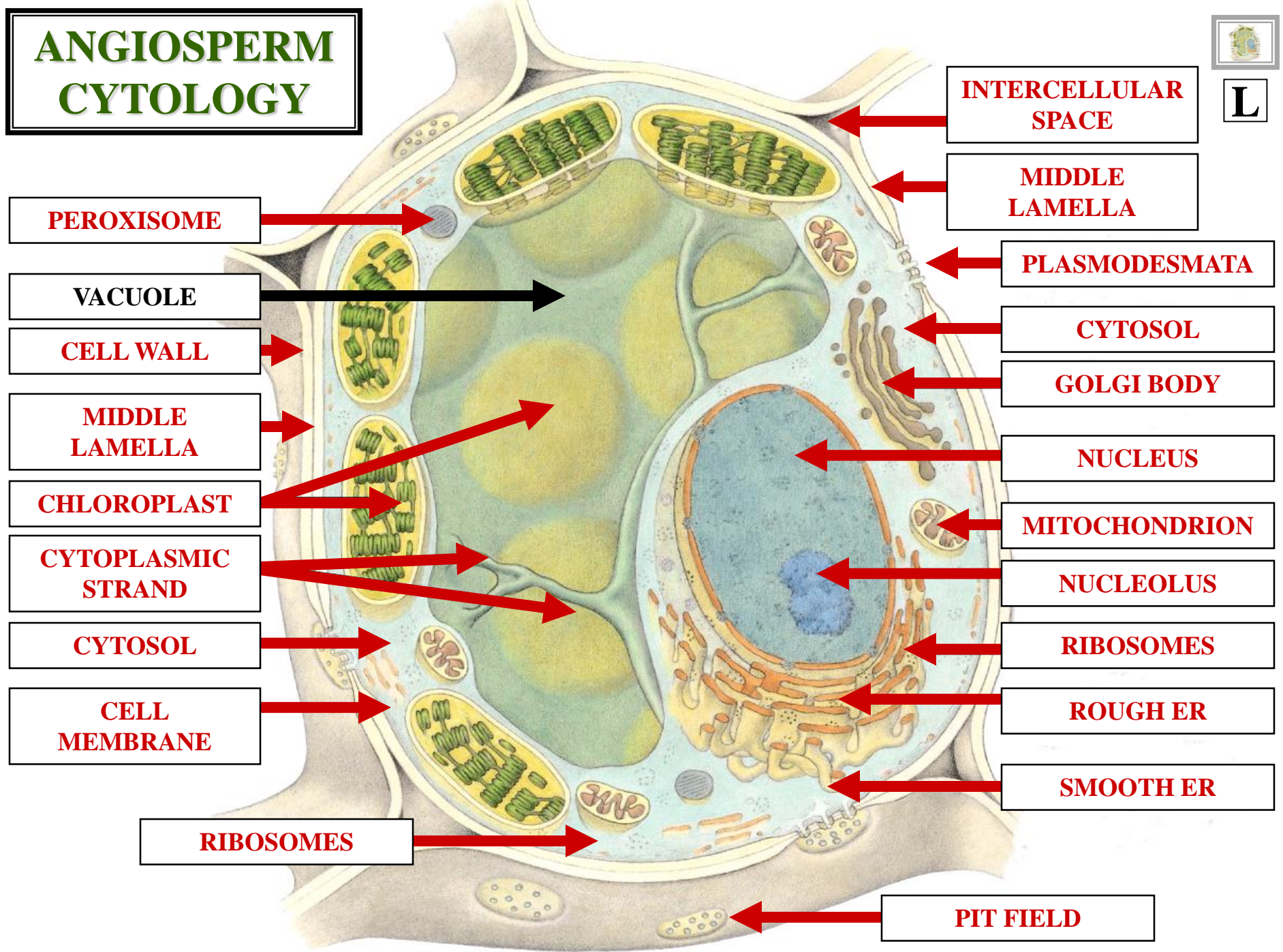
VACUOLE



PLANT CELLS ONLY



ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

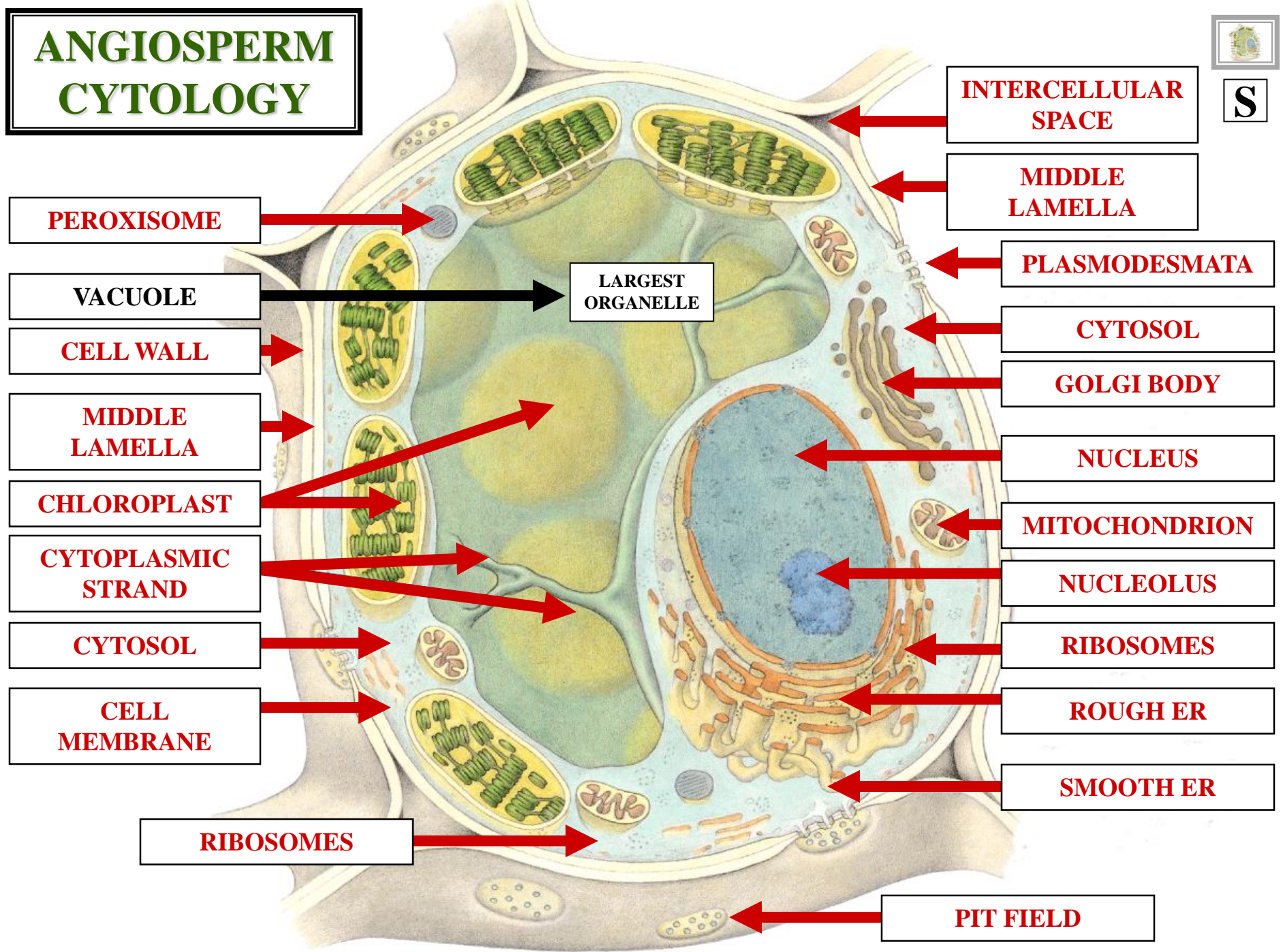
RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

LARGEST ORGANELLE

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

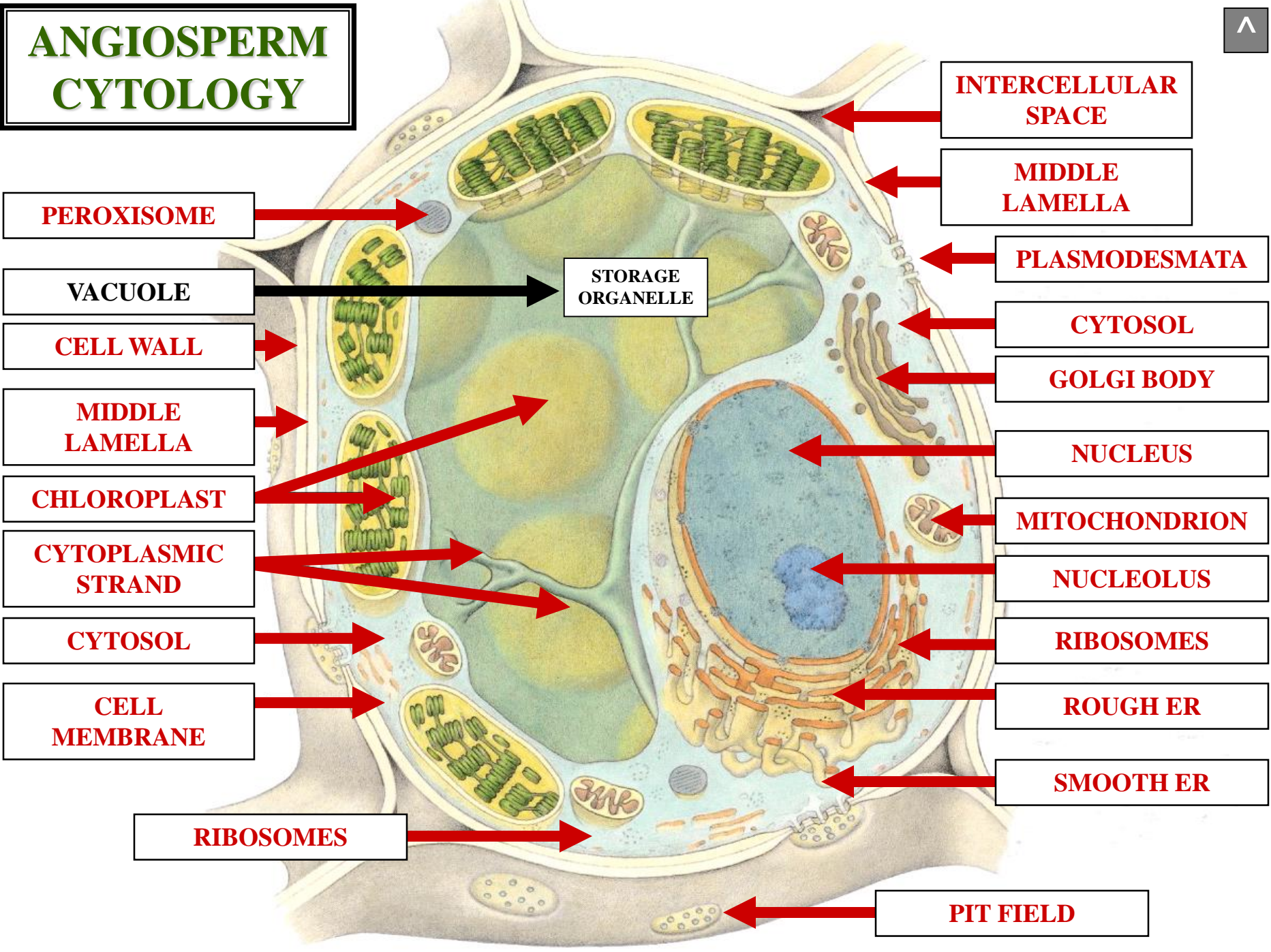
ROUGH ER

SMOOTH ER

PIT FIELD



ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

STORAGE ORGANELLE

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

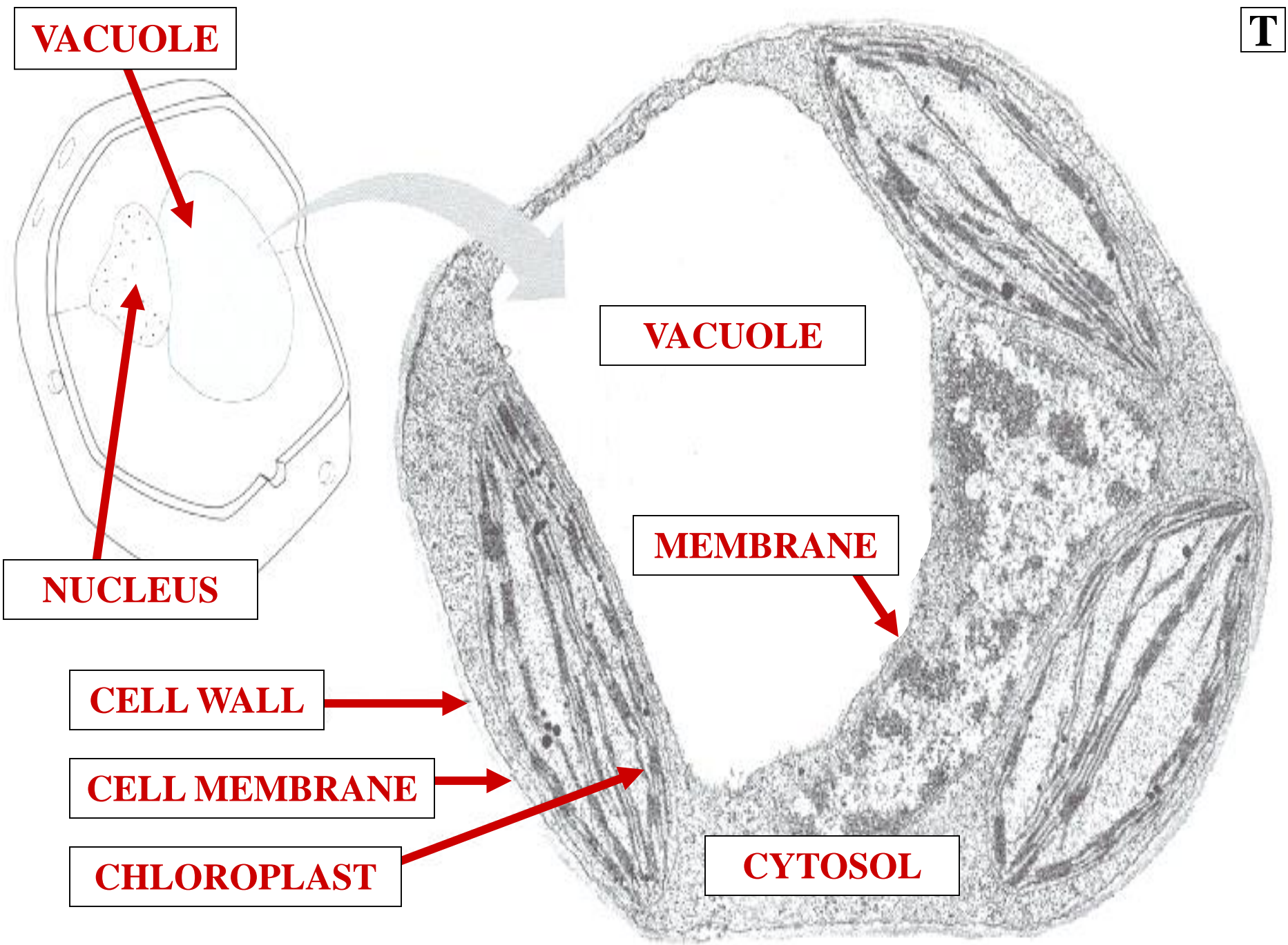
SMOOTH ER

PIT FIELD



VACUOLE

ULTRASTRUCTURE



TONOPLAST MEMBRANE



TONOPLAST

VACUOLE MEMBRANE

TONOPLAST



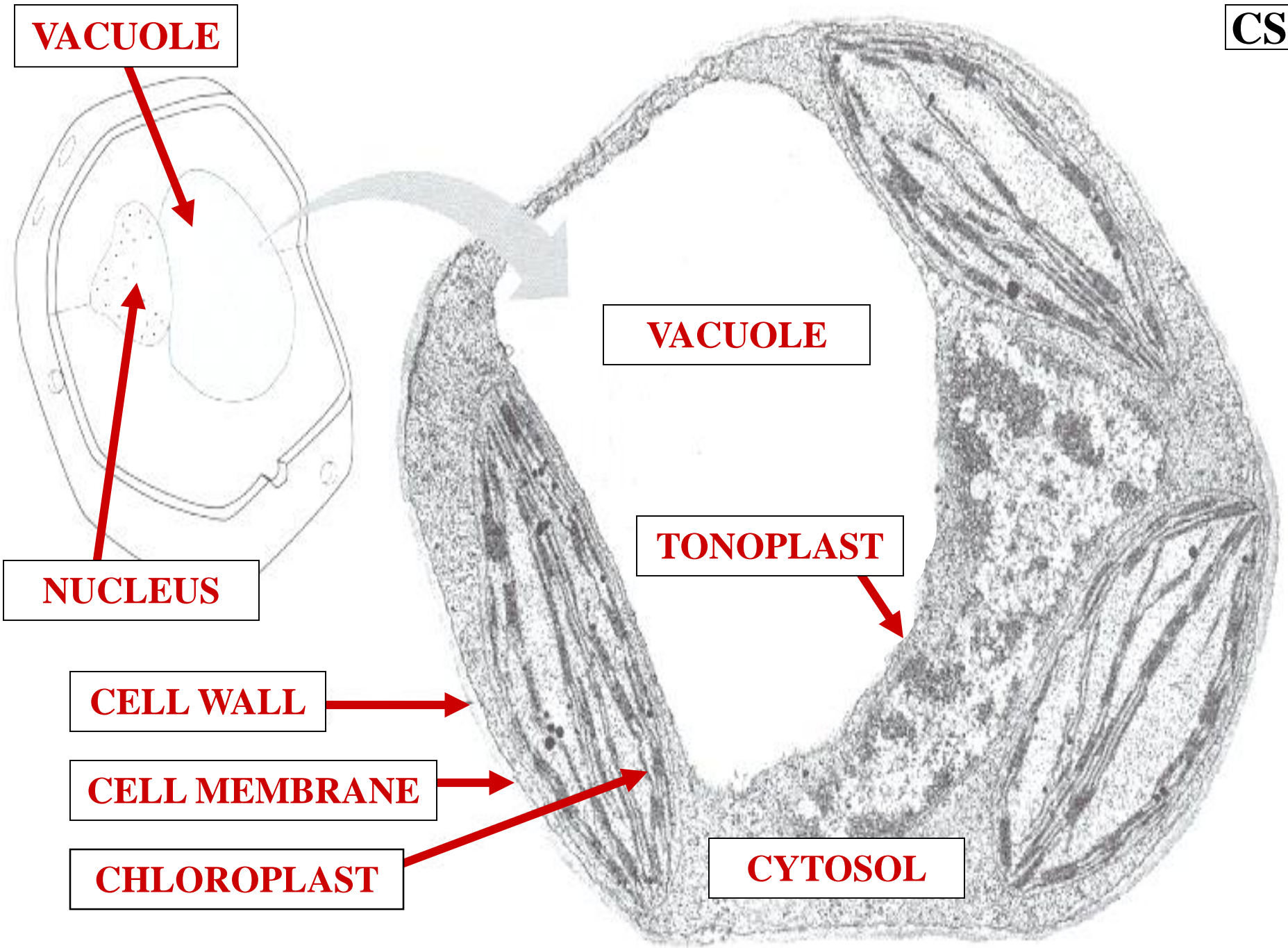
T

TONOPLAST

VACUOLE MEMBRANE

**MEDIATES TRANSPORT
INTO & OUT OF VACUOLE**

TONOPLAST



VACUOLE

VACUOLE

NUCLEUS

TONOPLAST

CELL WALL

CELL MEMBRANE

CHLOROPLAST

CYTOSOL

CELL SAP



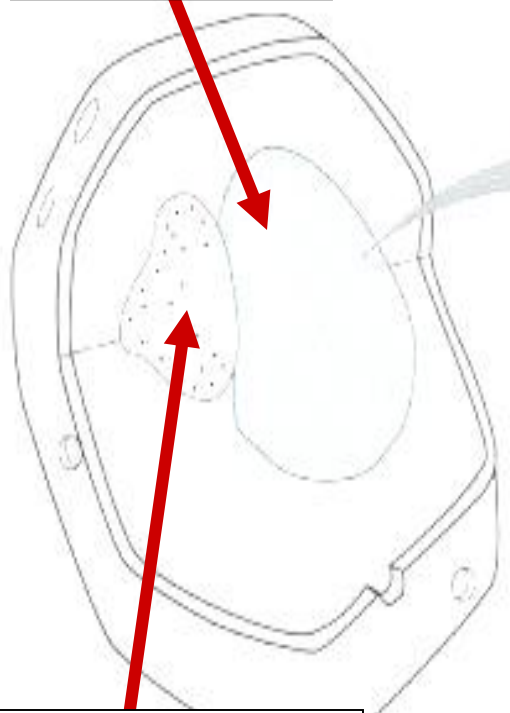
CELL SAP

VACUOLE CONTENT

CELL SAP



VACUOLE



NUCLEUS

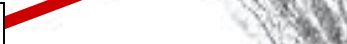
CELL WALL



CELL MEMBRANE



CHLOROPLAST



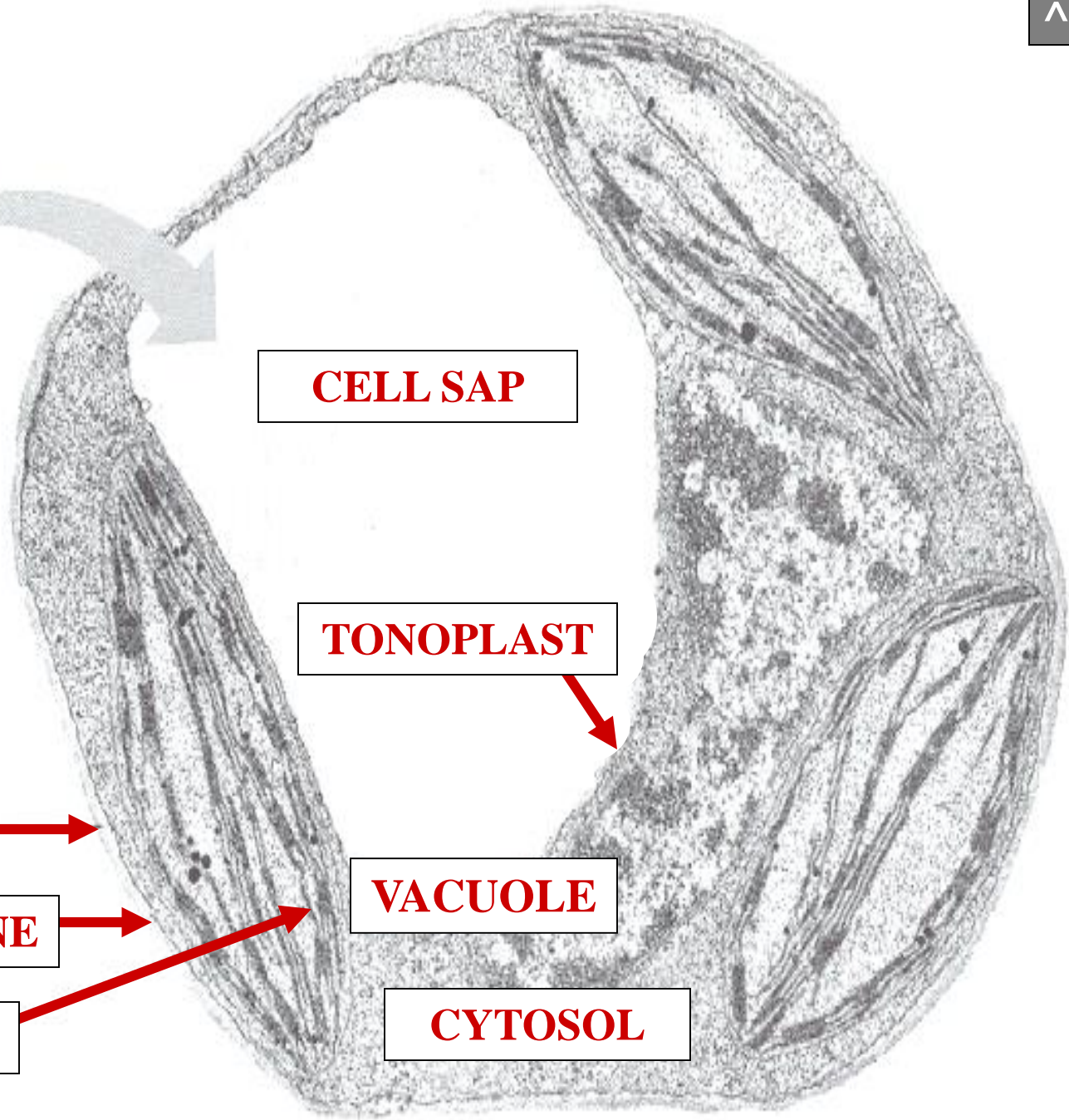
CELL SAP

TONOPLAST



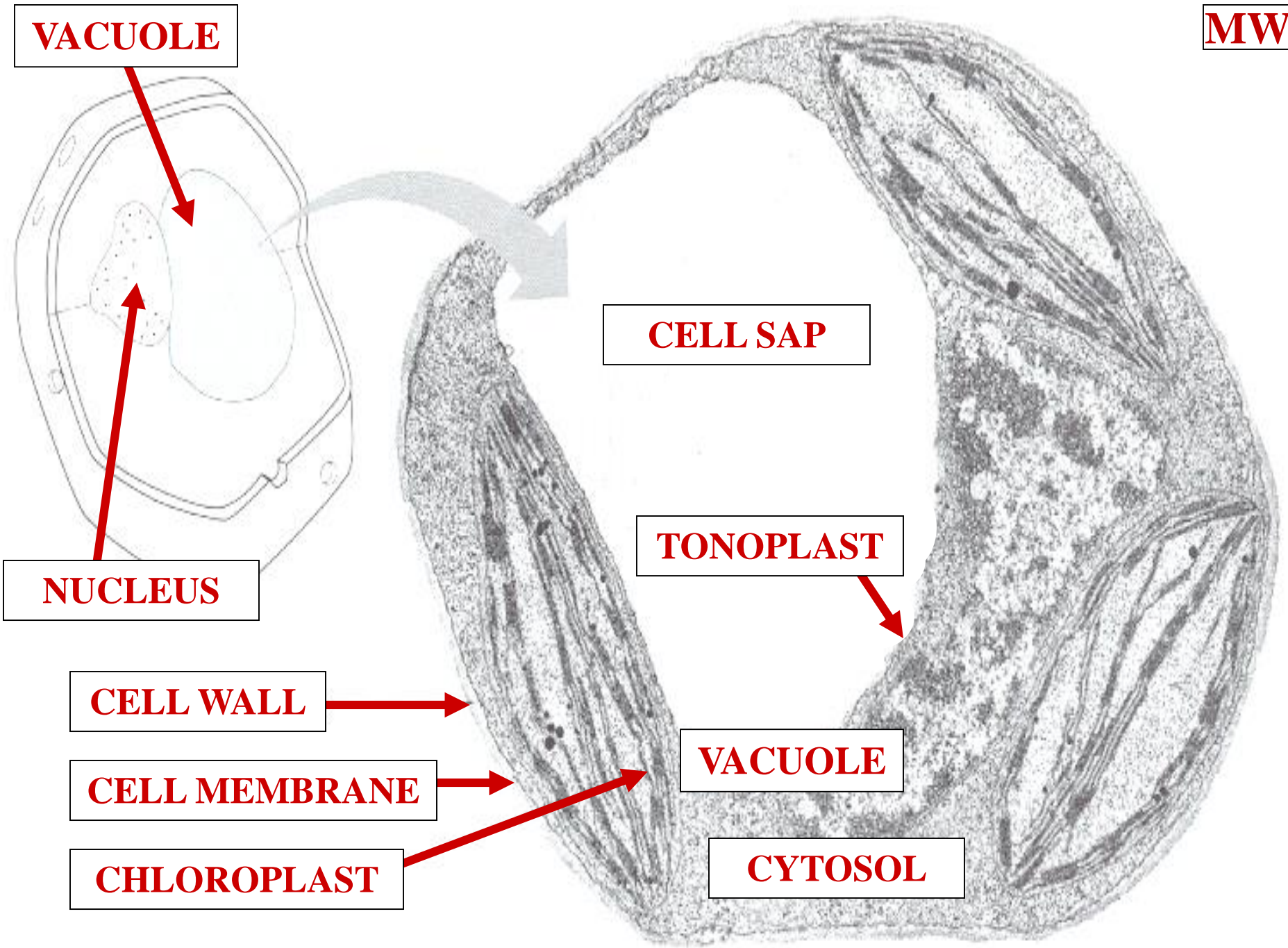
VACUOLE

CYTOSOL





CELL SAP CONTENT



VACUOLE

CELL SAP

TONOPLAST

NUCLEUS

CELL WALL

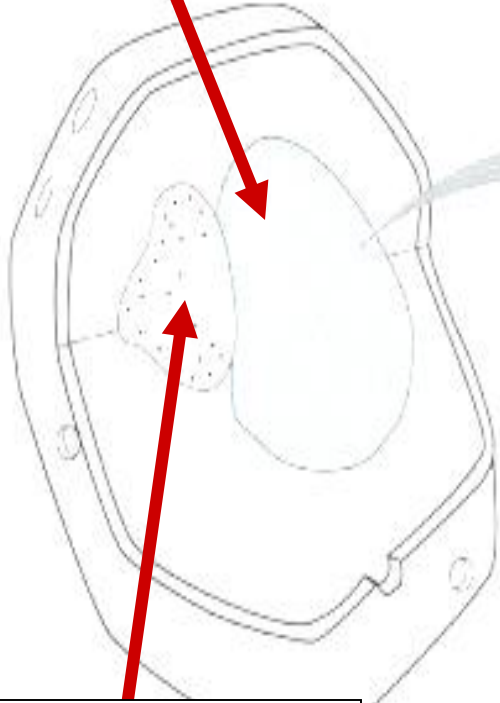
CELL MEMBRANE

CHLOROPLAST

VACUOLE

CYTOSOL

VACUOLE



NUCLEUS

CELL WALL



CELL MEMBRANE



CHLOROPLAST



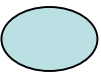
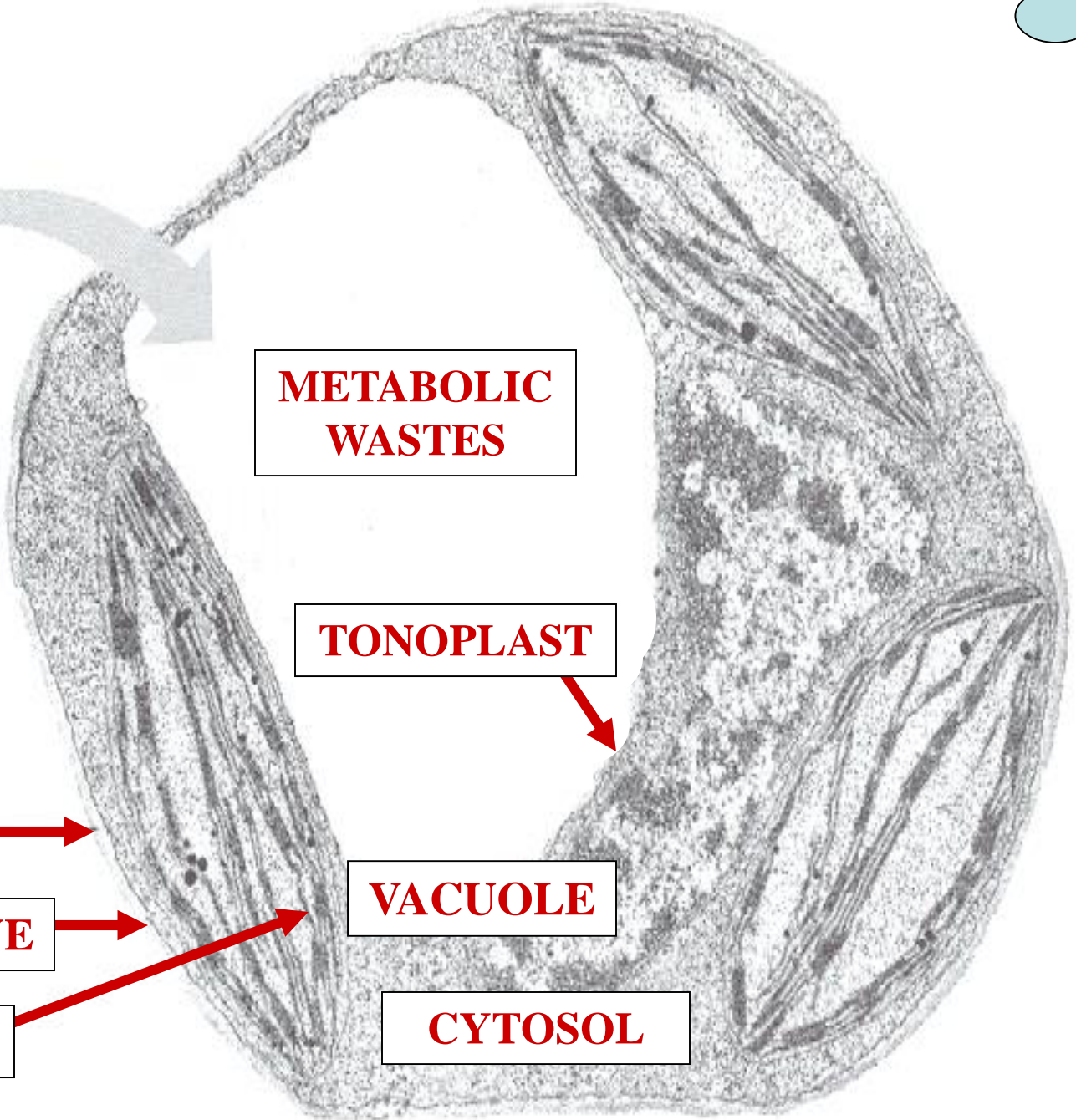
**METABOLIC
WASTES**

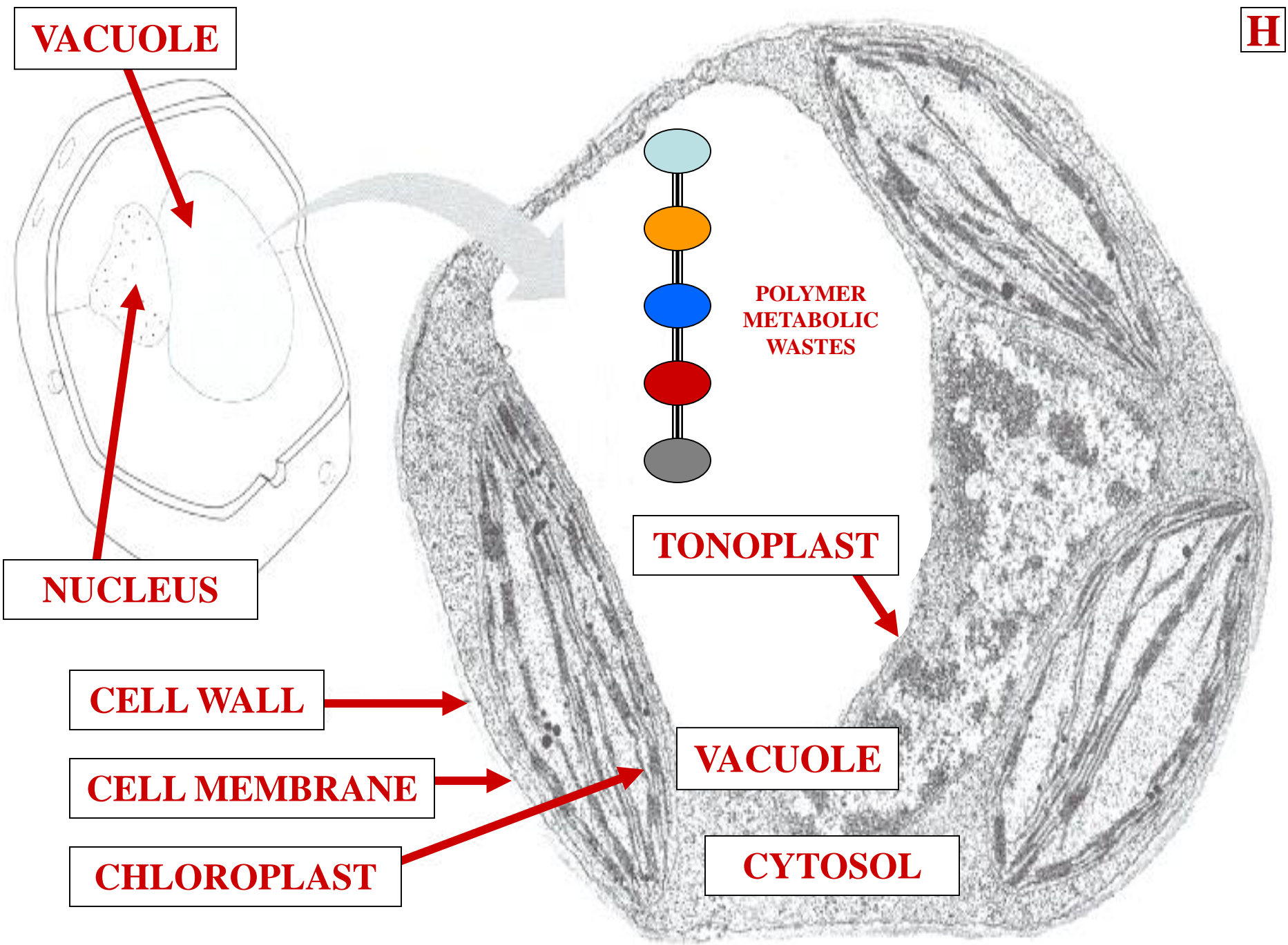
TONOPLAST



VACUOLE

CYTOSOL





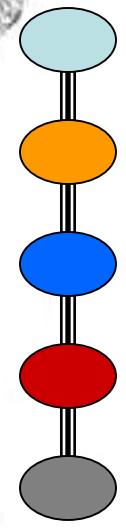
VACUOLE

NUCLEUS

CELL WALL

CELL MEMBRANE

CHLOROPLAST

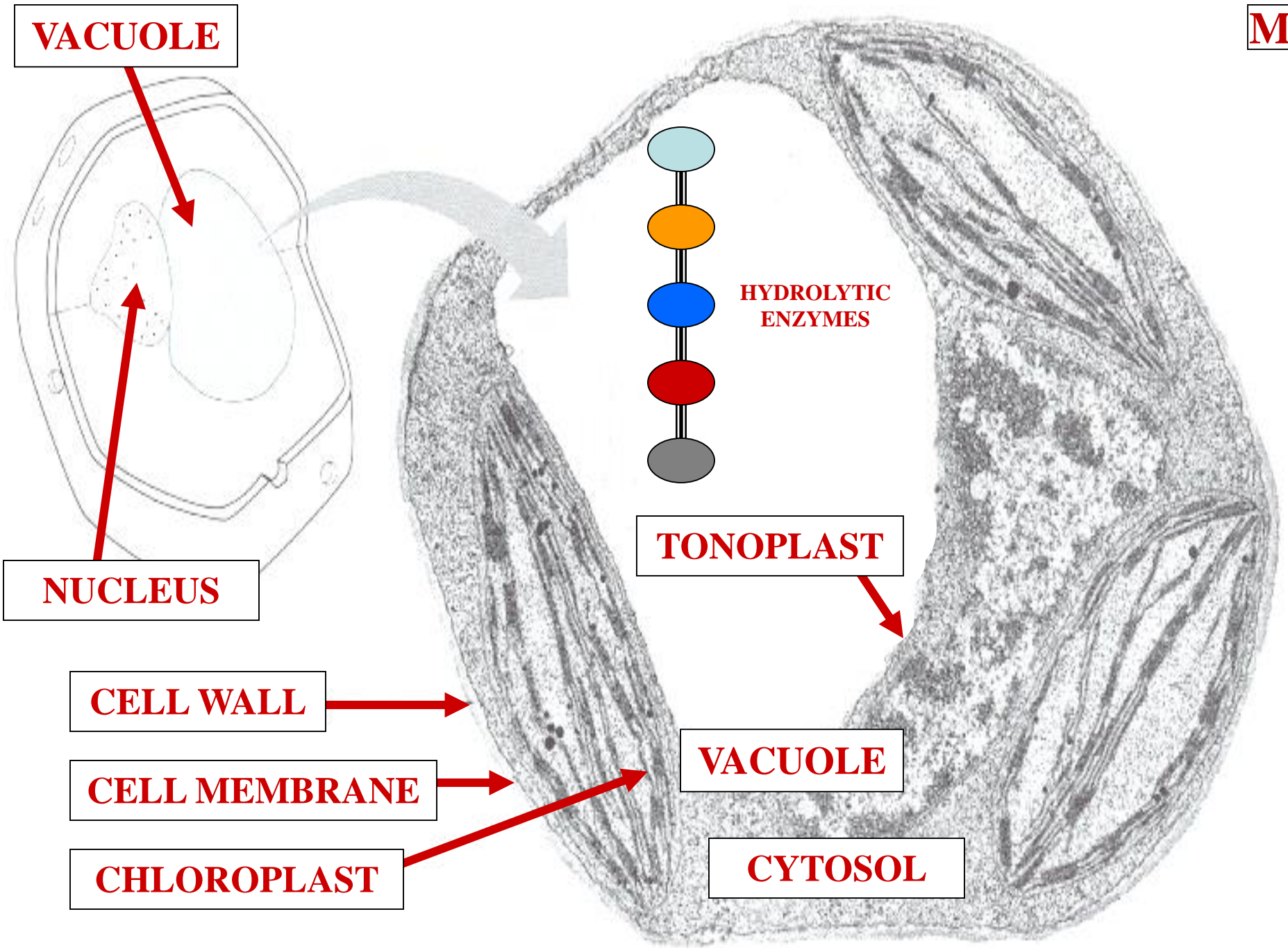


**POLYMER
METABOLIC
WASTES**

TONOPLAST

VACUOLE

CYTOSOL



VACUOLE

NUCLEUS

CELL WALL

CELL MEMBRANE

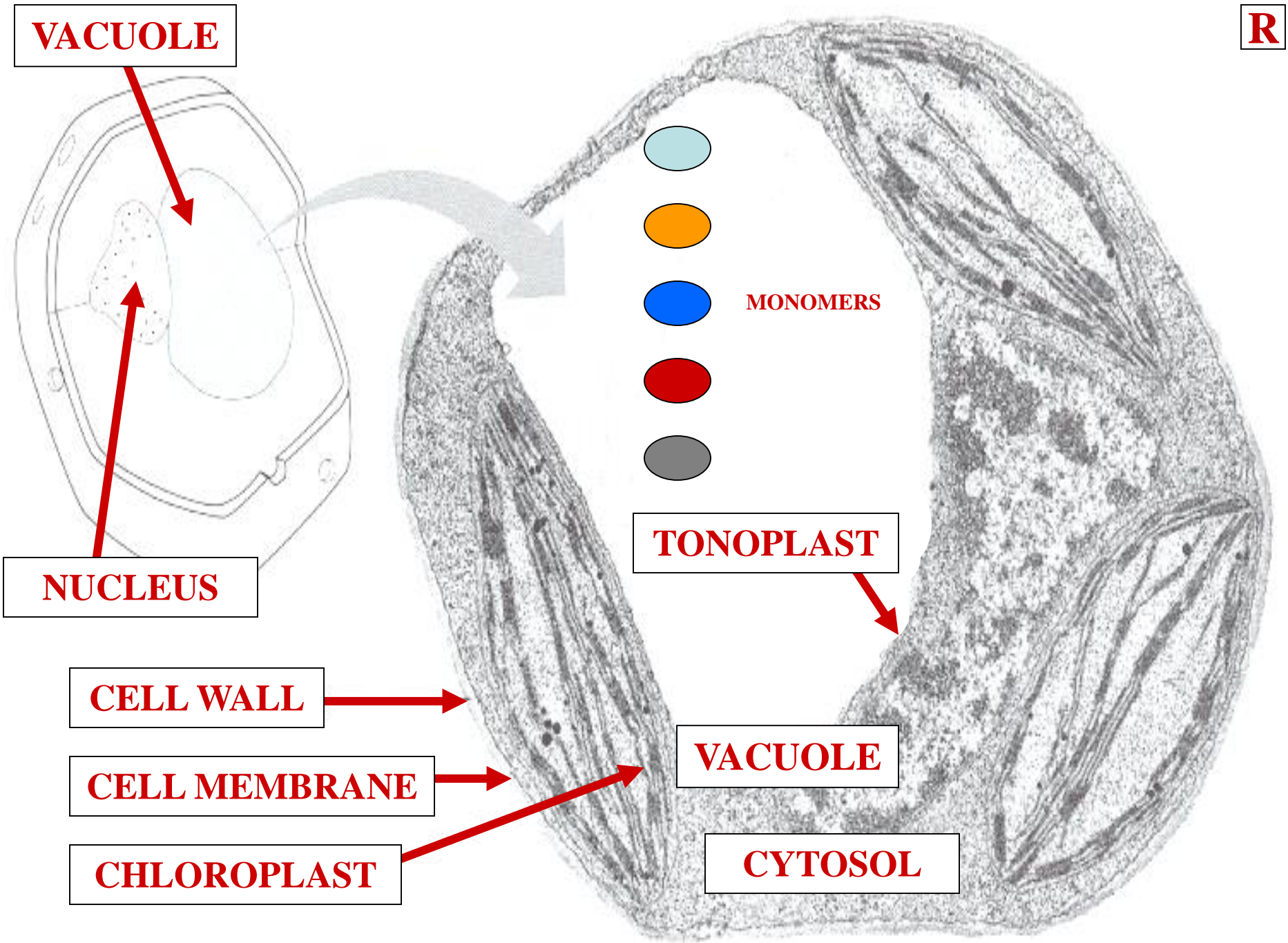
CHLOROPLAST

TONOPLAST

VACUOLE

CYTOSOL

HYDROLYTIC ENZYMES



VACUOLE

NUCLEUS

CELL WALL

CELL MEMBRANE

CHLOROPLAST

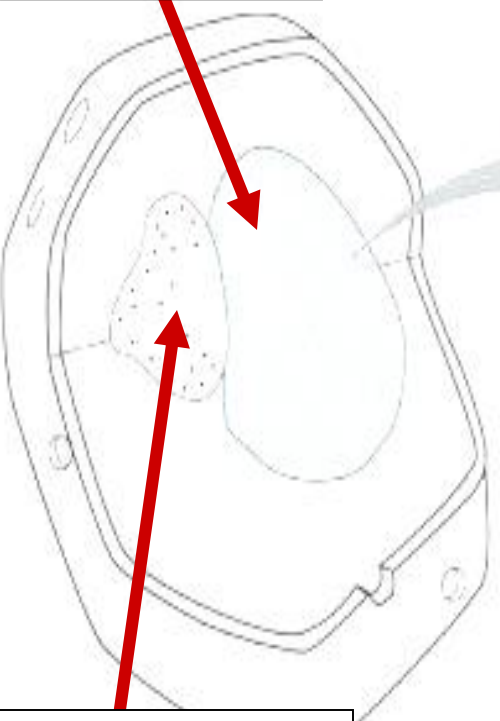
TONOPLAST

VACUOLE

CYTOSOL

MONOMERS

VACUOLE



NUCLEUS



**VACUOLE
RECYCLES
METABOLIC
WASTES**

TONOPLAST



CELL WALL



CELL MEMBRANE

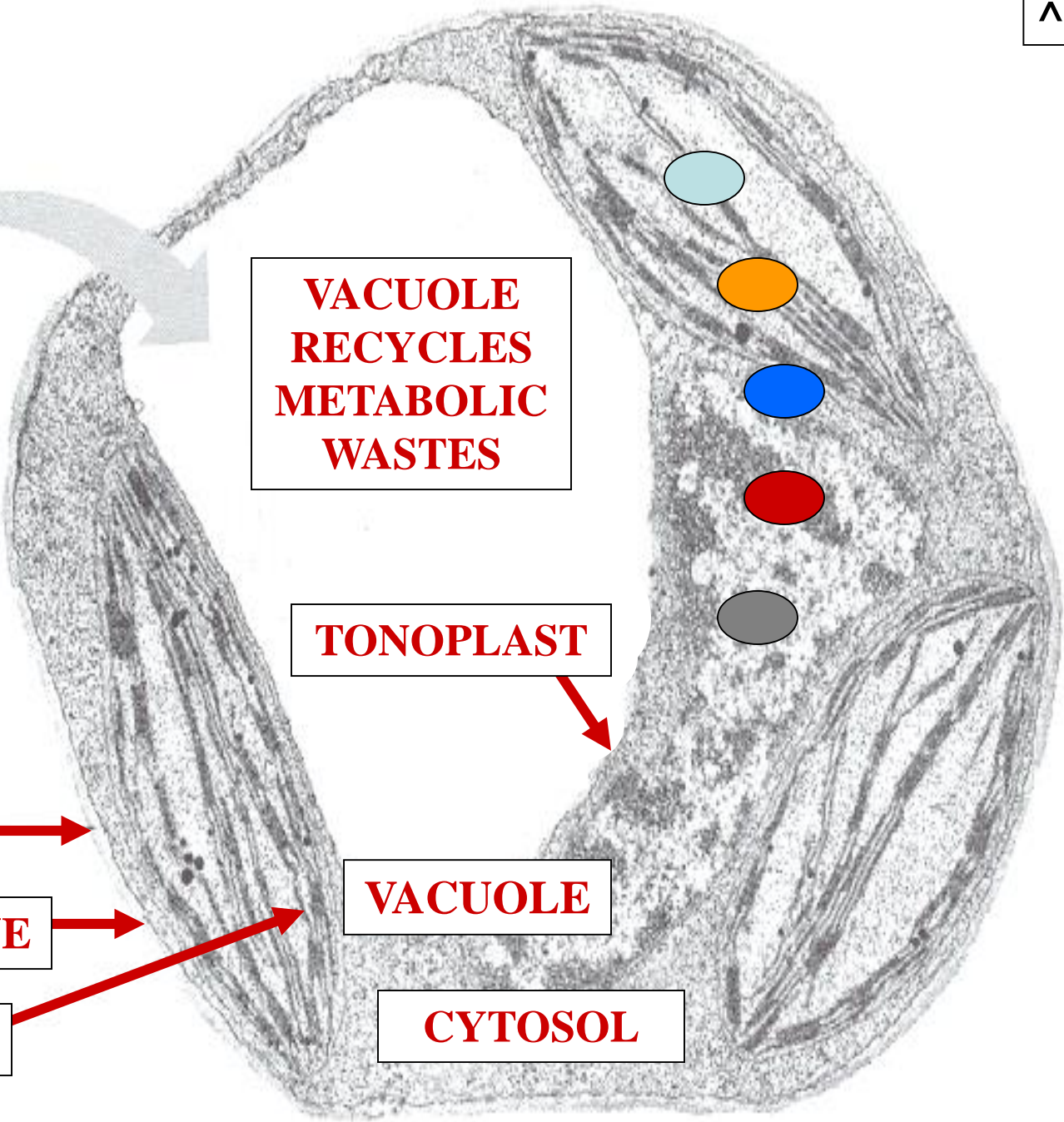


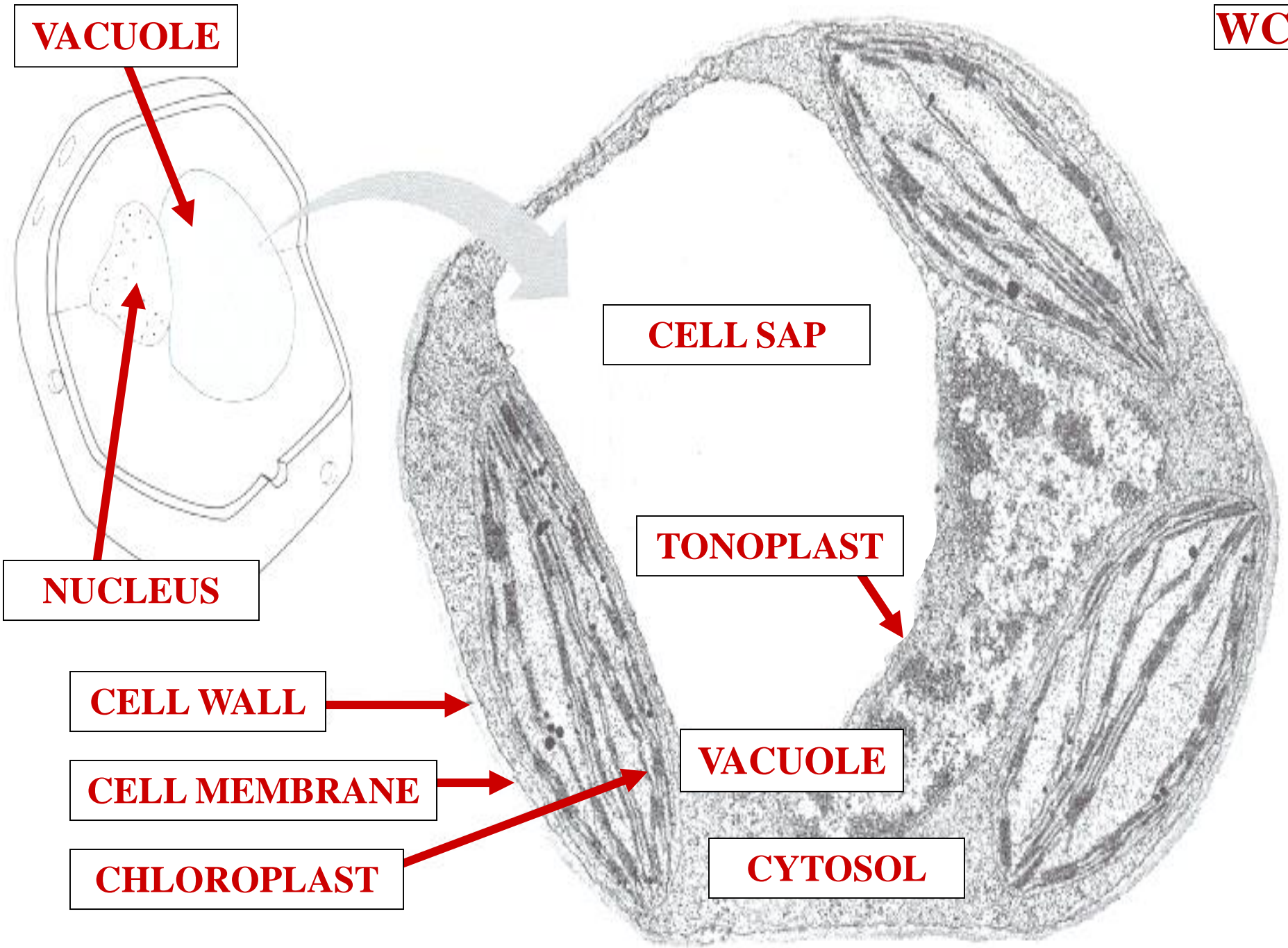
CHLOROPLAST



VACUOLE

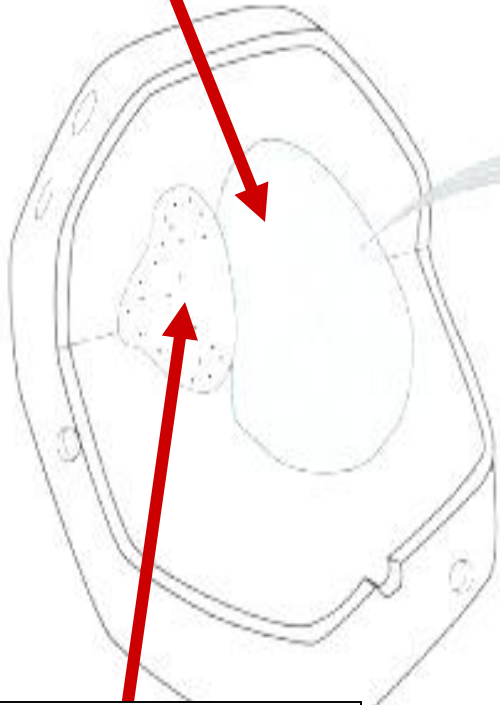
CYTOSOL







VACUOLE



NUCLEUS

CELL WALL



CELL MEMBRANE



CHLOROPLAST



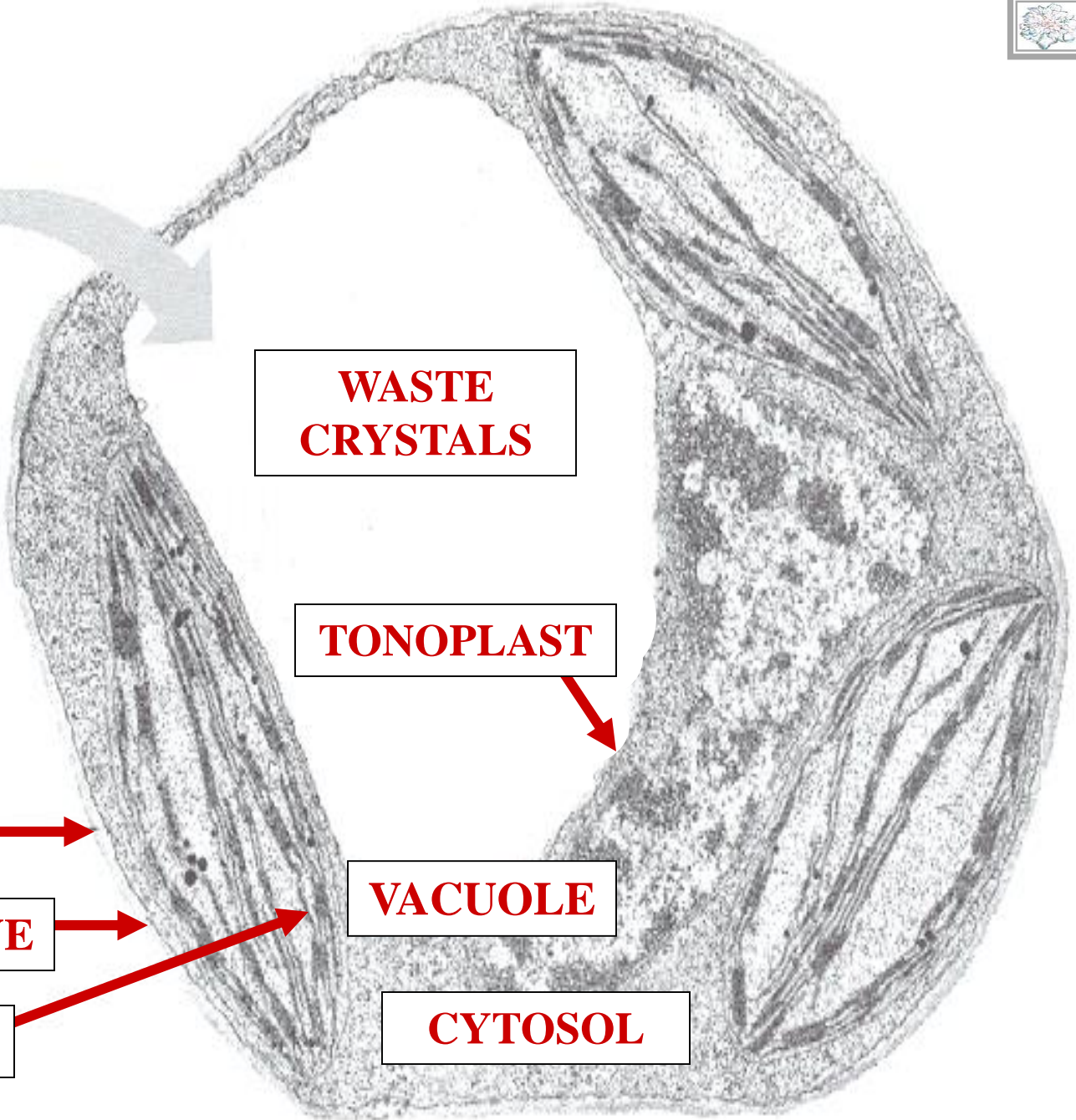
**WASTE
CRYSTALS**

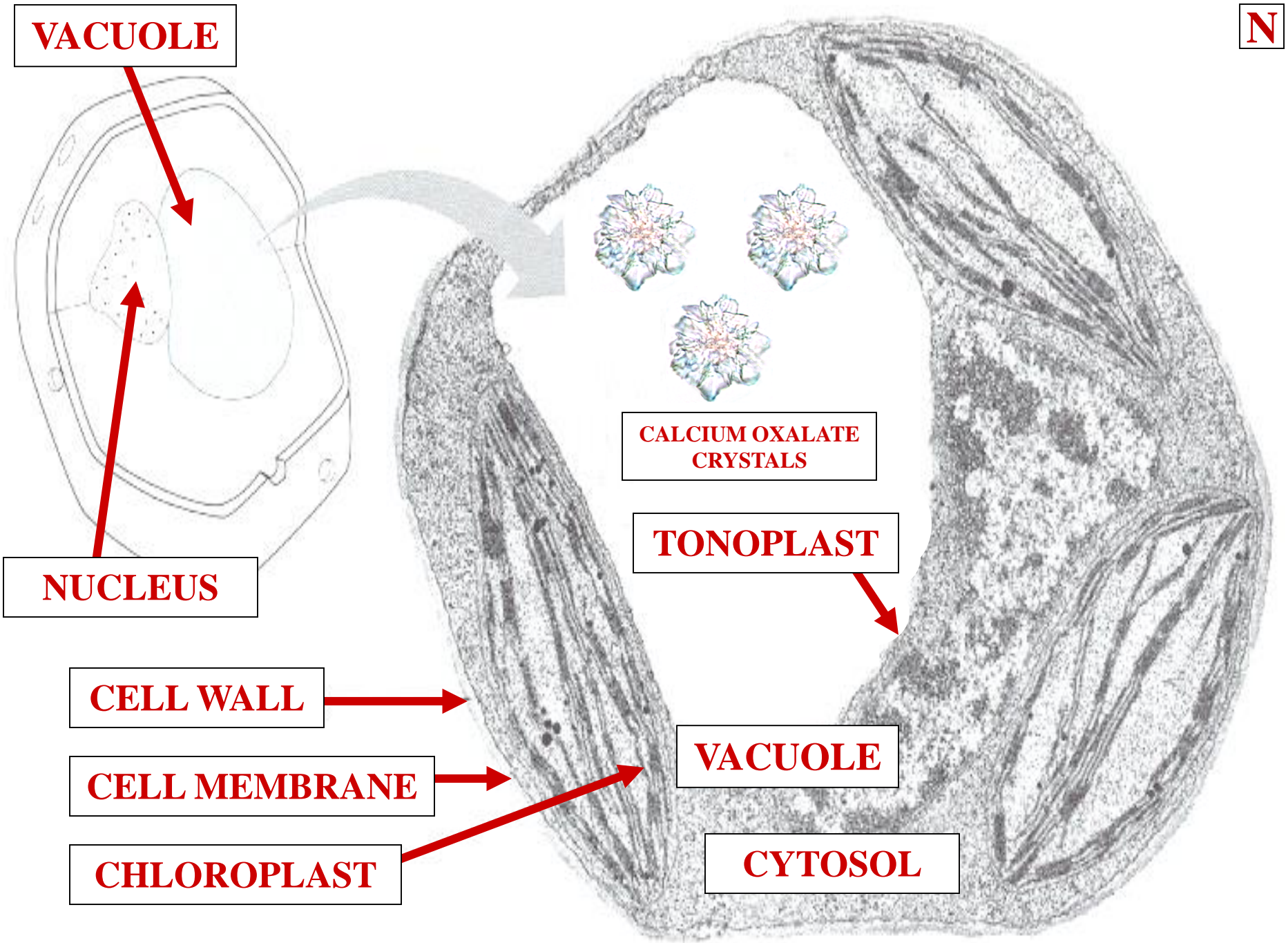
TONOPLAST



VACUOLE

CYTOSOL





VACUOLE

NUCLEUS

CELL WALL

CELL MEMBRANE

CHLOROPLAST

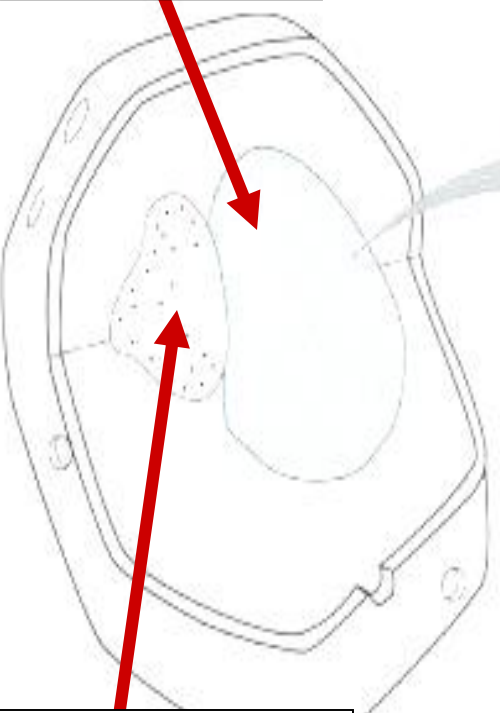
**CALCIUM OXALATE
CRYSTALS**

TONOPLAST

VACUOLE

CYTOSOL

VACUOLE



NUCLEUS

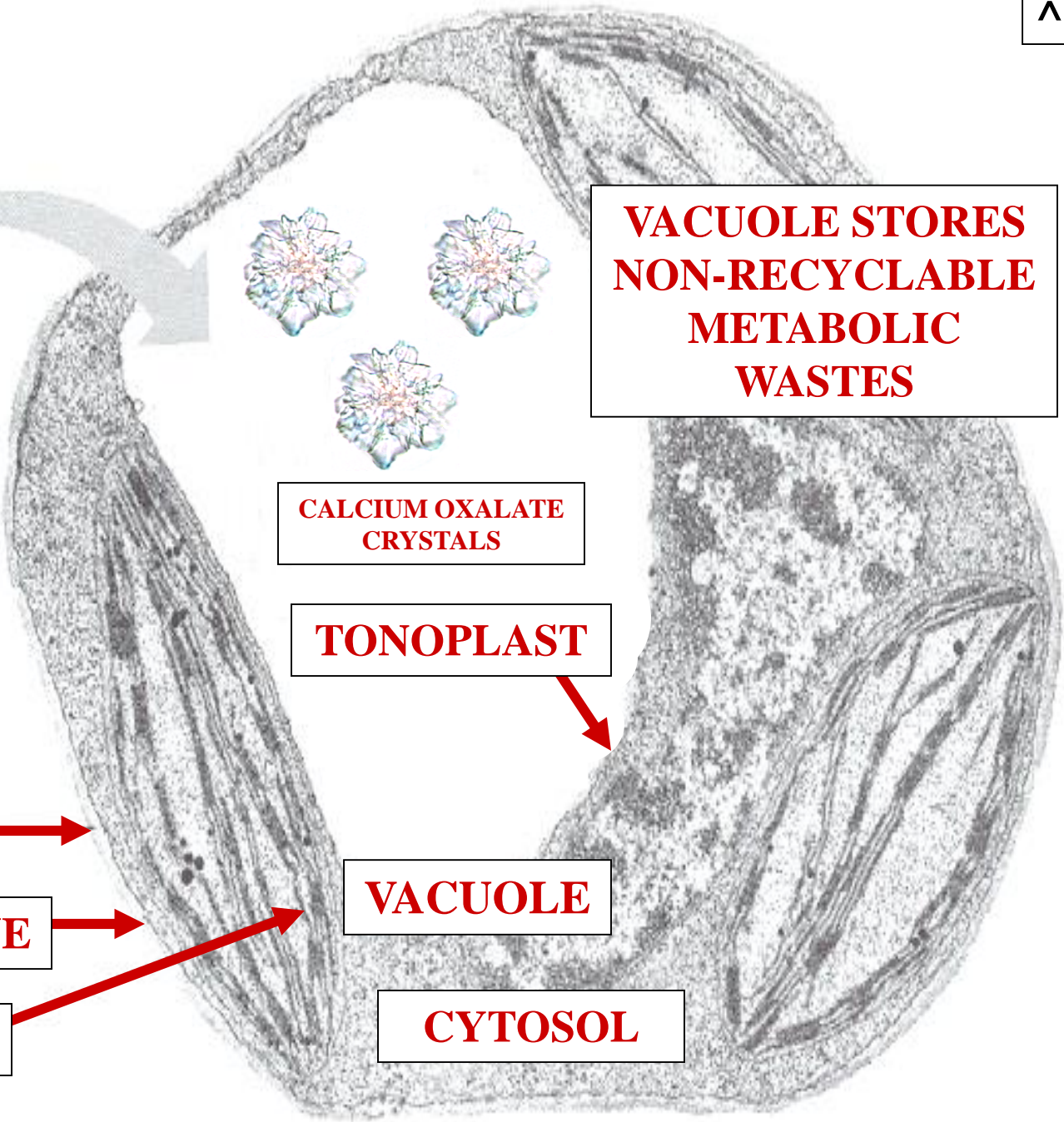
CELL WALL



CELL MEMBRANE

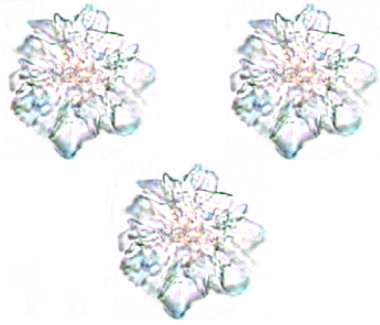


CHLOROPLAST



**VACUOLE STORES
NON-RECYCLABLE
METABOLIC
WASTES**

**CALCIUM OXALATE
CRYSTALS**

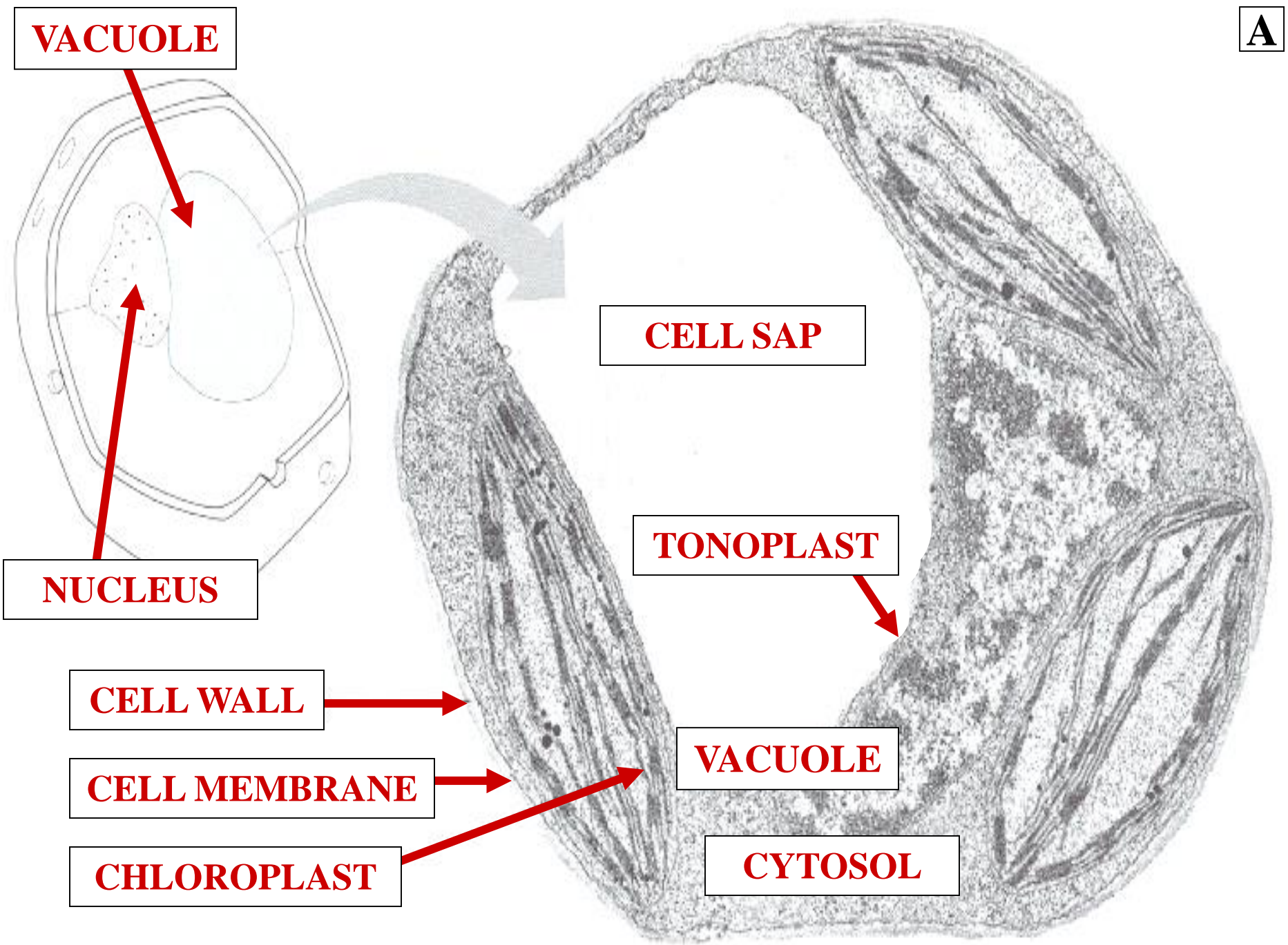


TONOPLAST



VACUOLE

CYTOSOL



ANTHOCYANINS



ANTHOCYANINS

CELL SAP

BLUE & RED PIGMENTS

ANTHOCYANINS



ANTHOCYANINS

CELL SAP

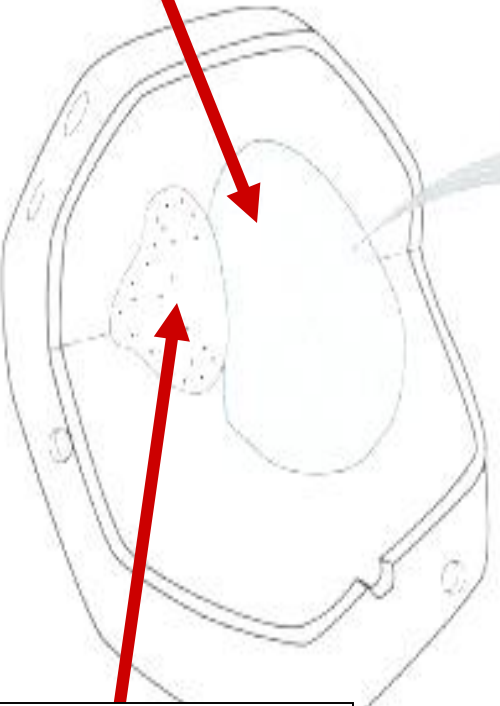
BLUE & RED PIGMENTS

ATTRACT ANIMALS

ANTHOCYANINS



VACUOLE



NUCLEUS



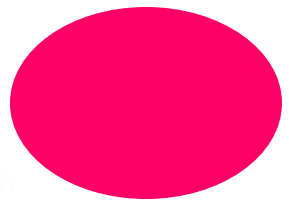
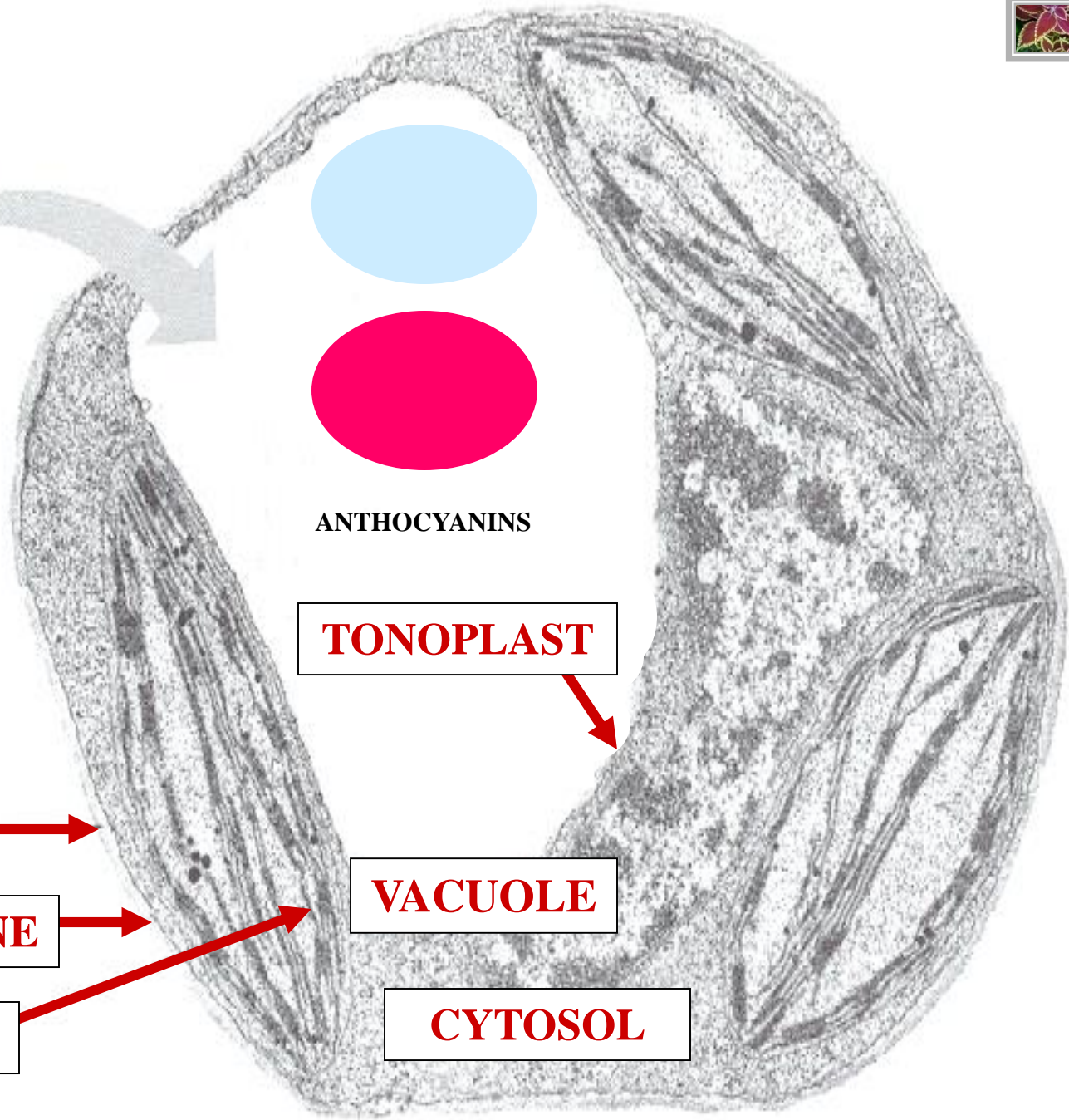
CELL WALL



CELL MEMBRANE



CHLOROPLAST



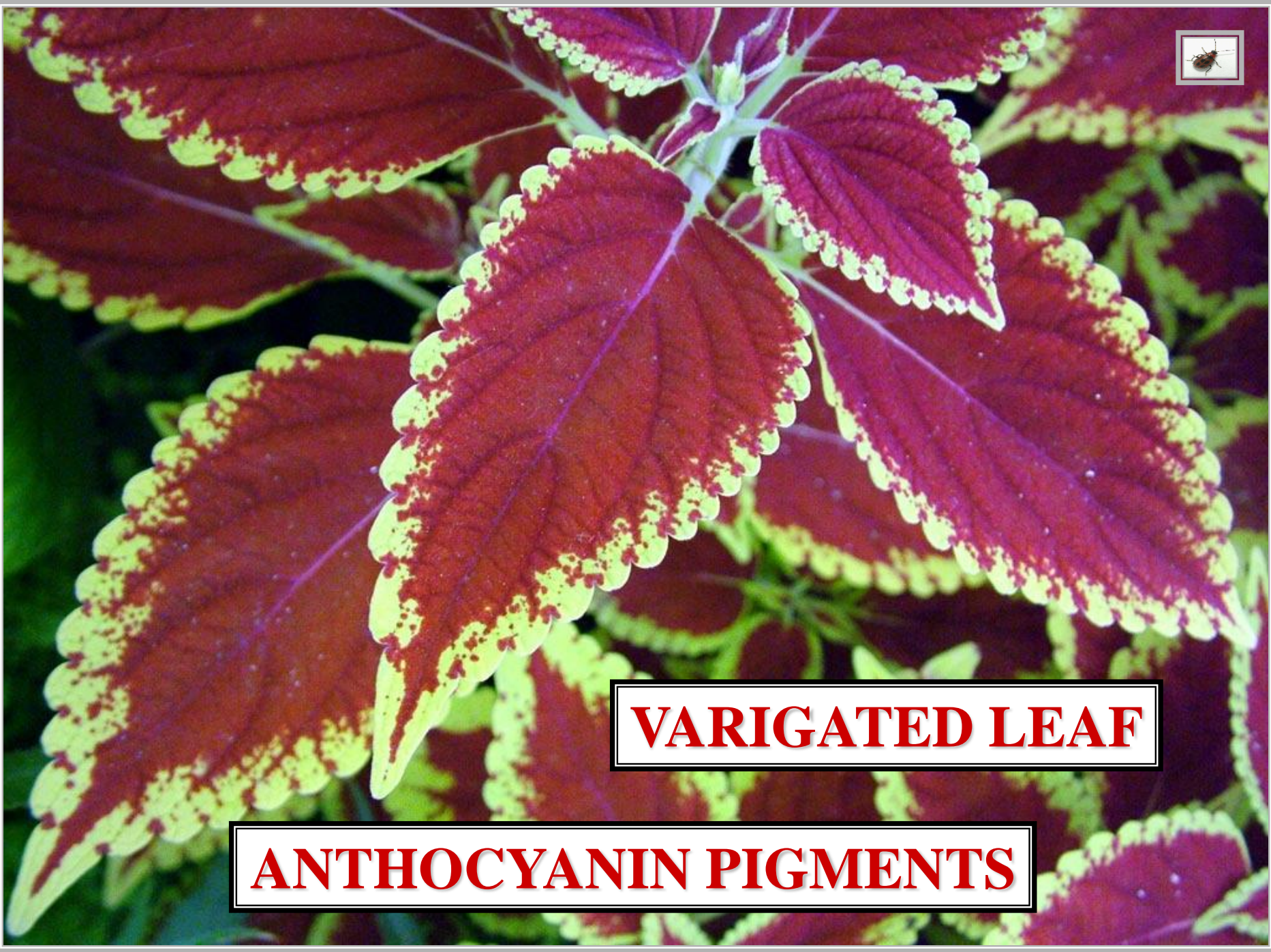
ANTHOCYANINS

TONOPLAST



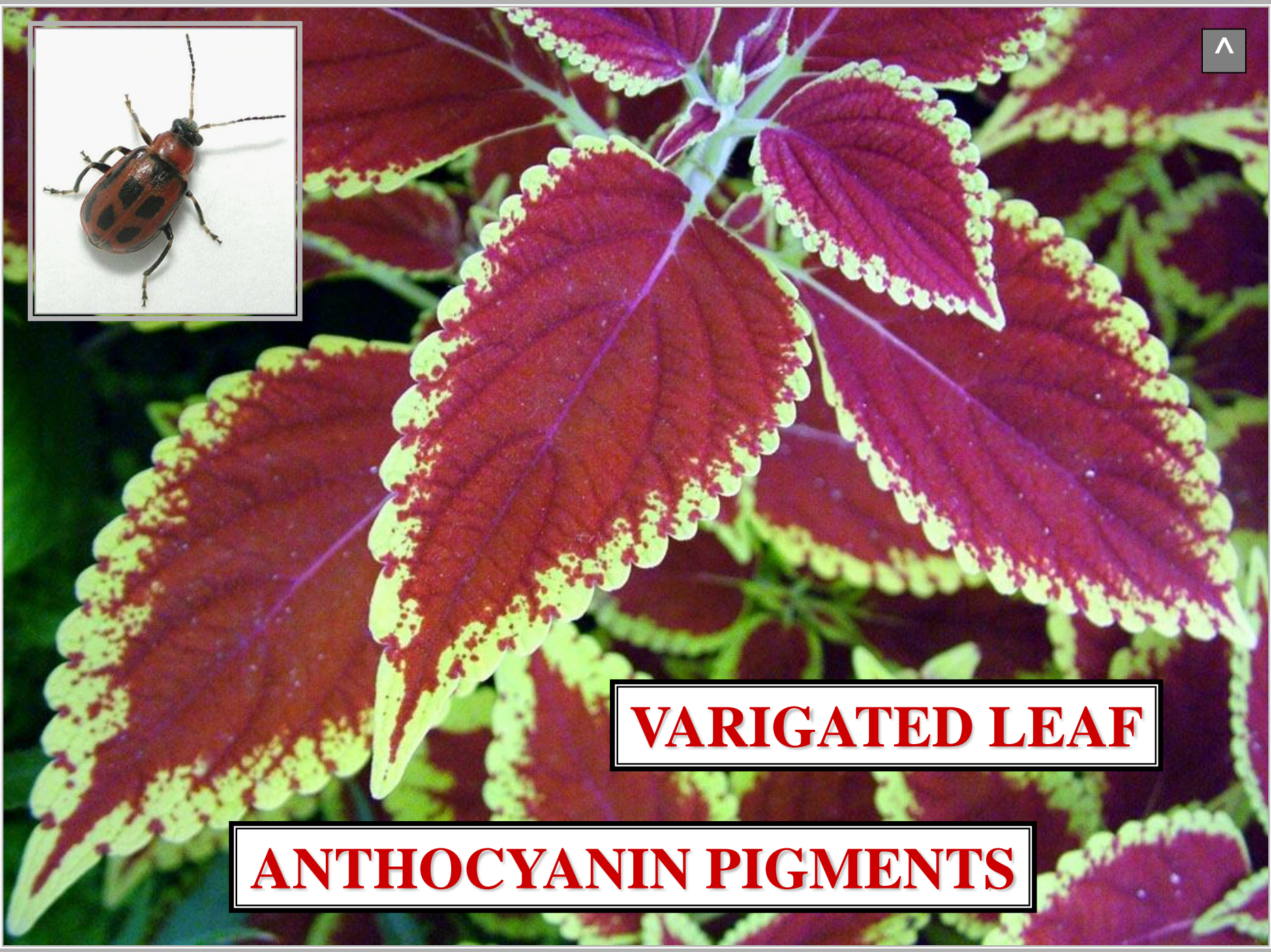
VACUOLE

CYTOSOL



VARIGATED LEAF

ANTHOCYANIN PIGMENTS



VARIGATED LEAF

ANTHOCYANIN PIGMENTS

PEROXISOME

PEROXISOME



PEROXISOME

PLANT CELLS ONLY

PEROXISOME



PEROXISOME

PLANT CELLS ONLY

PHOTOSYNTHESIS CELLS ONLY

PEROXISOME



PEROXISOME

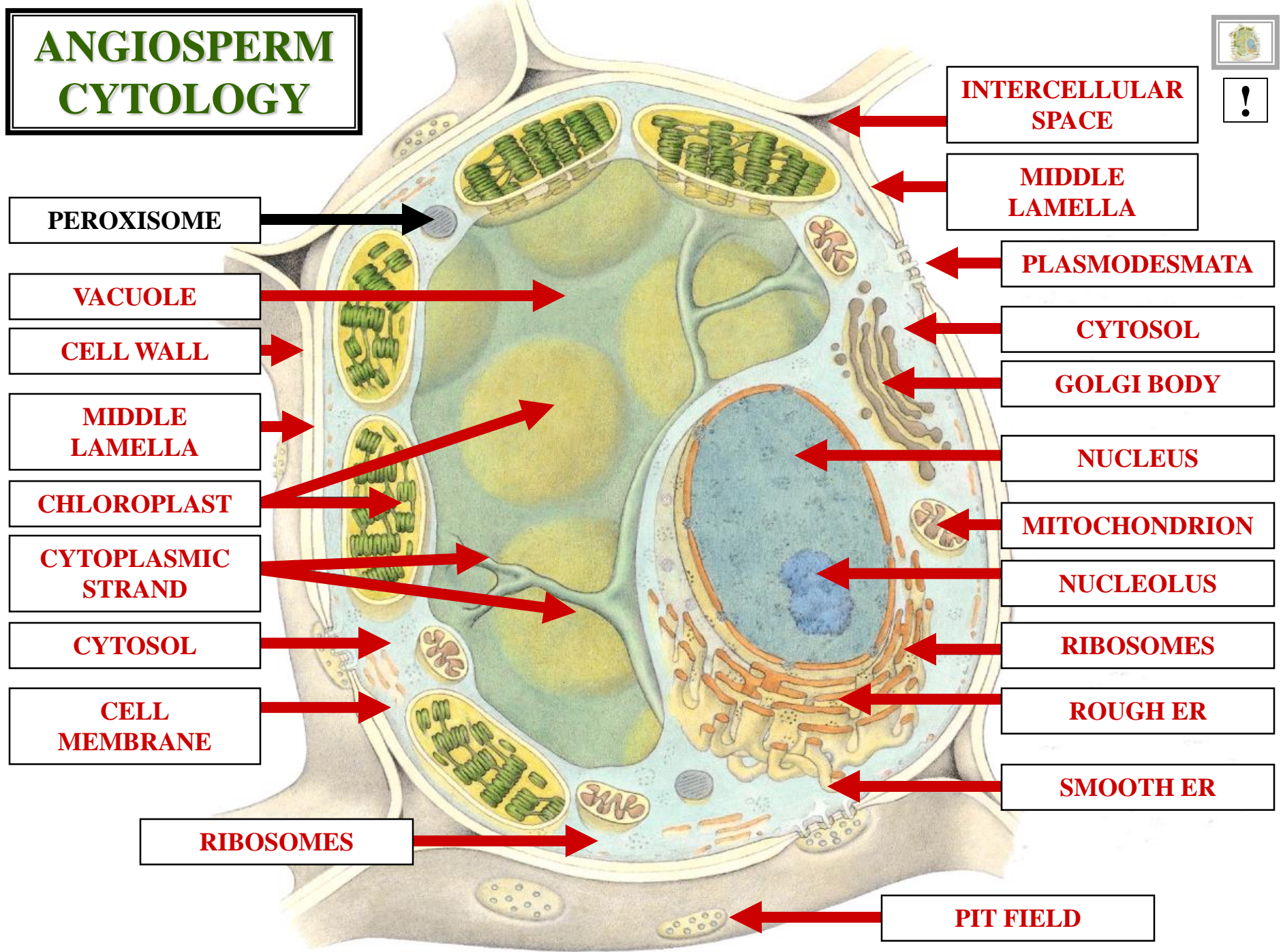
PLANT CELLS ONLY

PHOTOSYNTHESIS CELLS ONLY

SITE: PHOTO-RESPIRATION

PEROXISOME

ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

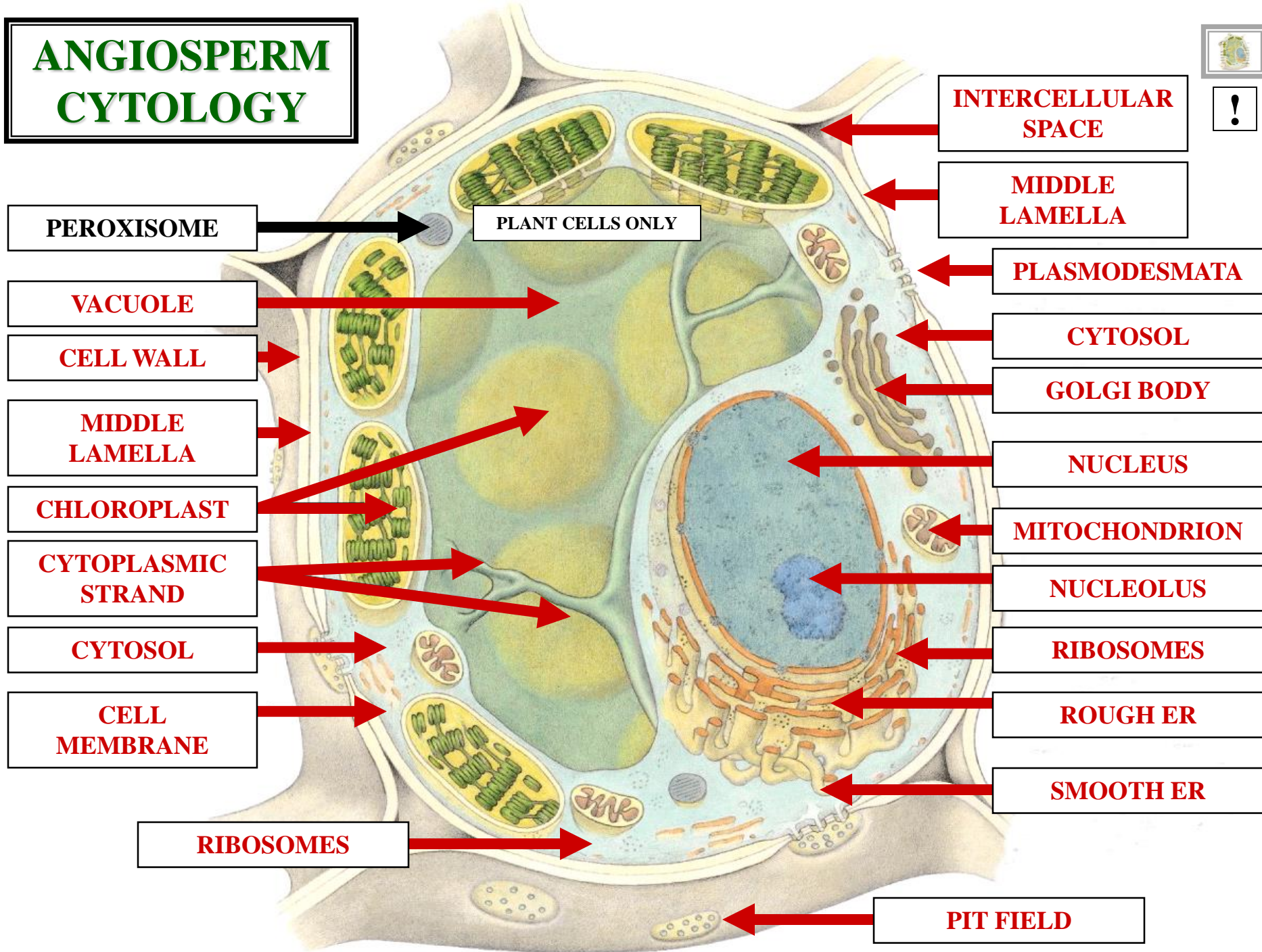
ROUGH ER

SMOOTH ER

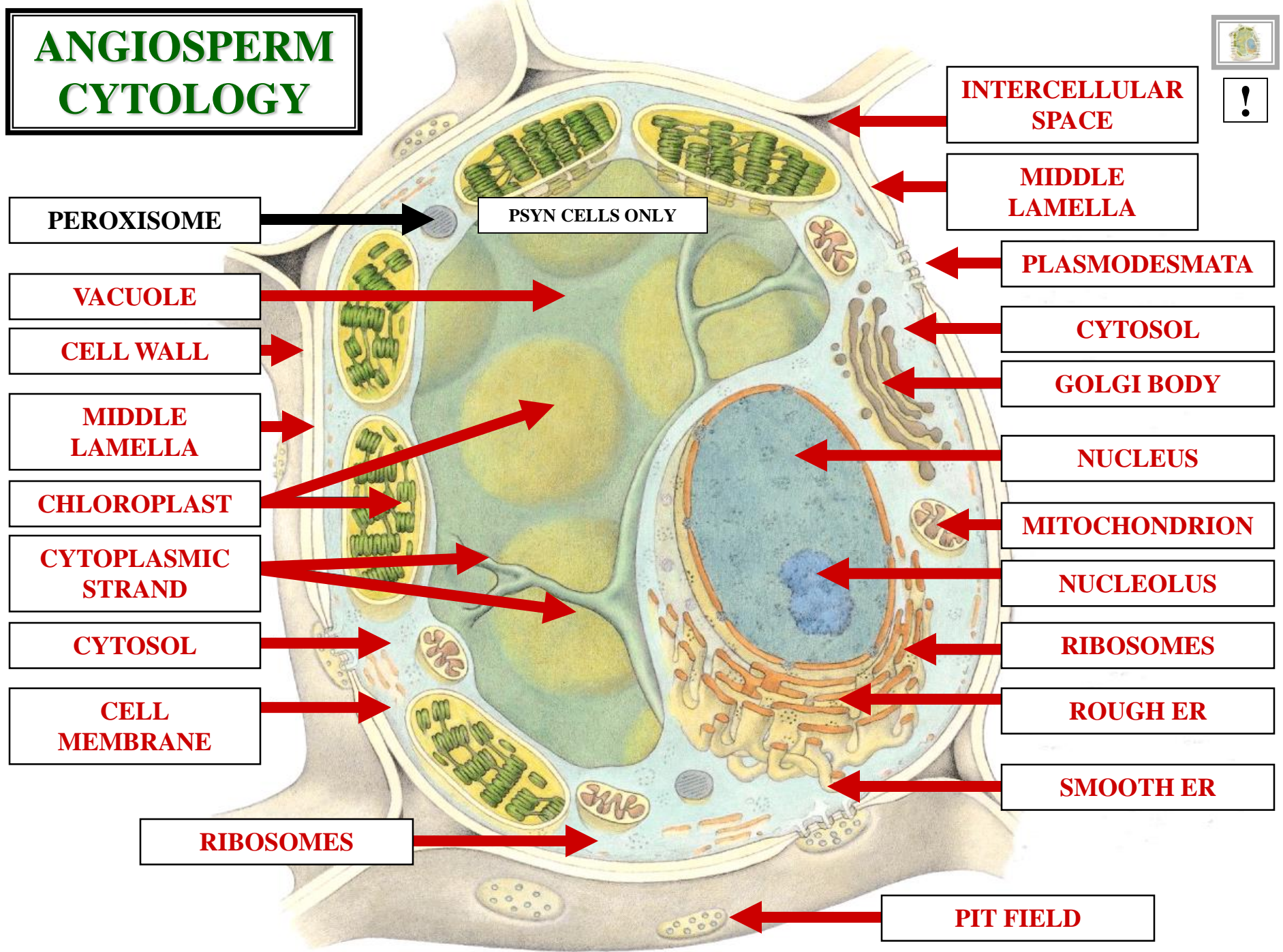
PIT FIELD



ANGIOSPERM CYTOLOGY



ANGIOSPERM CYTOLOGY



PEROXISOME

VACUOLE

CELL WALL

MIDDLE LAMELLA

CHLOROPLAST

CYTOPLASMIC STRAND

CYTOSOL

CELL MEMBRANE

RIBOSOMES

PSYN CELLS ONLY

INTERCELLULAR SPACE

MIDDLE LAMELLA

PLASMODESMATA

CYTOSOL

GOLGI BODY

NUCLEUS

MITOCHONDRION

NUCLEOLUS

RIBOSOMES

ROUGH ER

SMOOTH ER

PIT FIELD



ANGIOSPERM CYTOLOGY

P-R

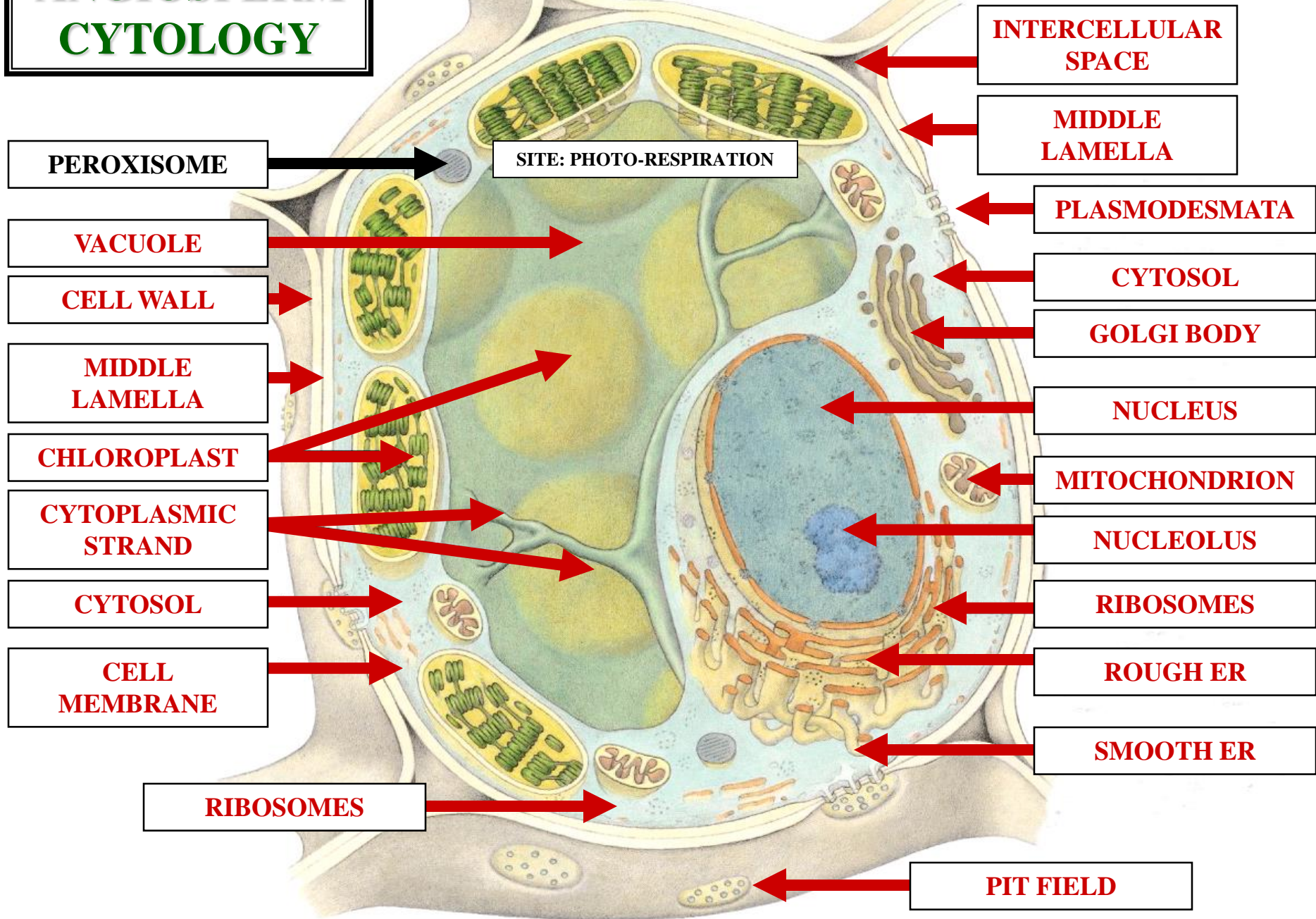
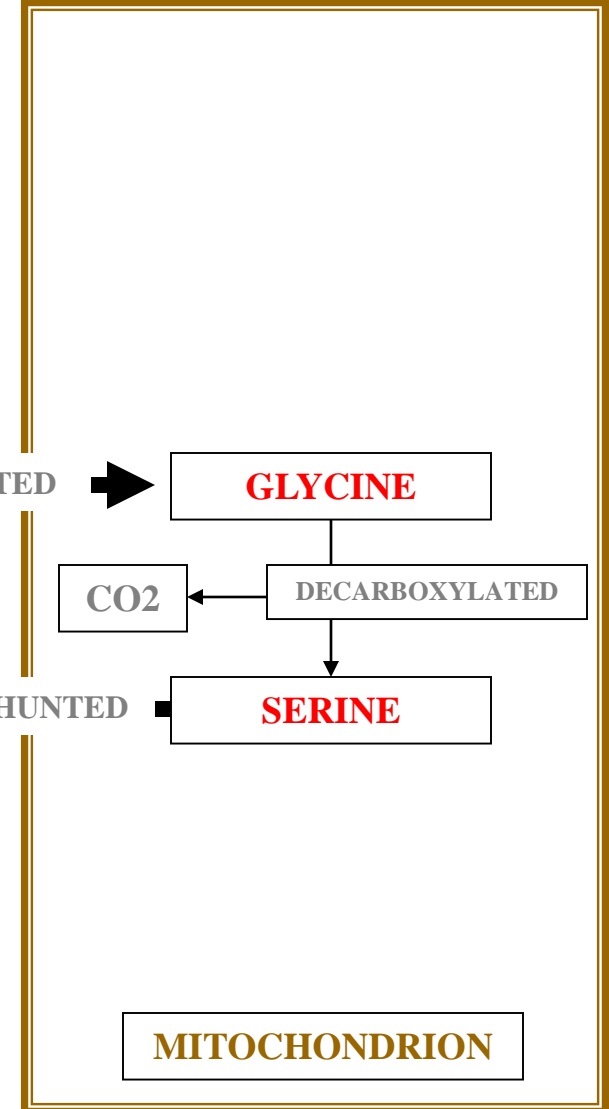
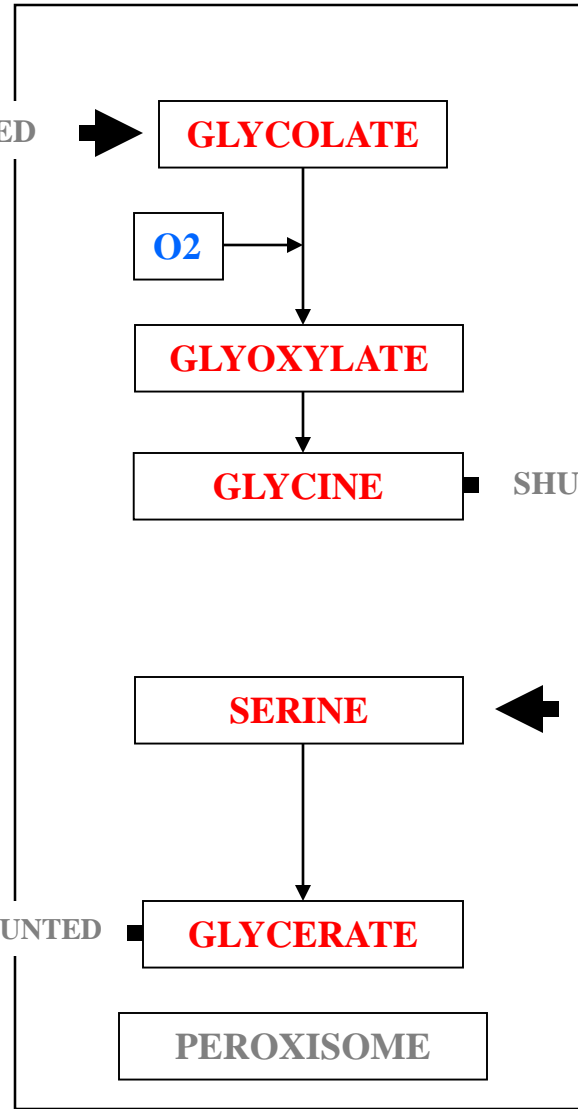
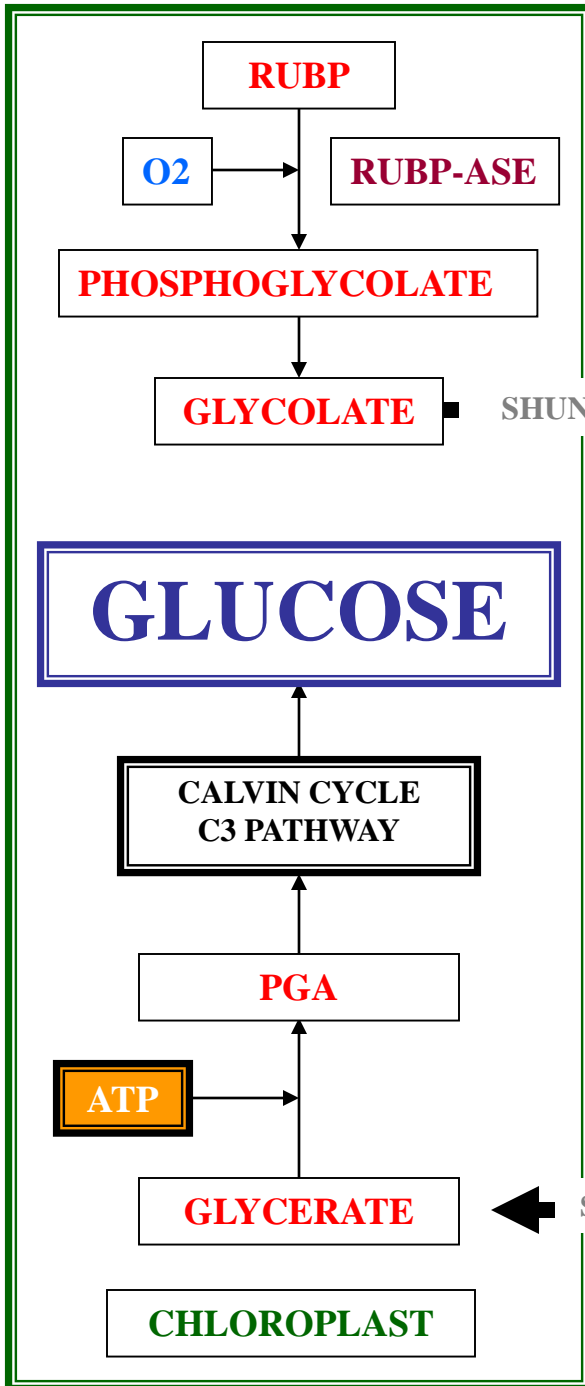




PHOTO-RESPIRATION



SHUNTED →

SHUNTED →

SHUNTED ←

← SHUNTED