Fisiología Vegetal

Bibliografía

Plant Physiology – L. Taiz and E. Zeiger.

Fundamentos de Fisiología Vegetal – J. Azcón-Bieto y M.Talón

Material de apoyo

Repartidos y protocolos para los prácticos en el Subespacio.
Reviews y papers.
Otros

Otras Referencias:

Plant Physiology // The Plant Cell
Plant Journal // Plant Molecular Biology
Annual Review of Plant Biology
Trends of Plant Science
Journal of Experimental Botany
Crop Science

Fisiología Vegetal

“la Fisiología Vegetal es el estudio de los componentes de los seres vivos (las plantas) y sus interacciones.” E. Zeiger.

Concepto de Fisiología Vegetal
Ascón-Bieto y Talón (2008)

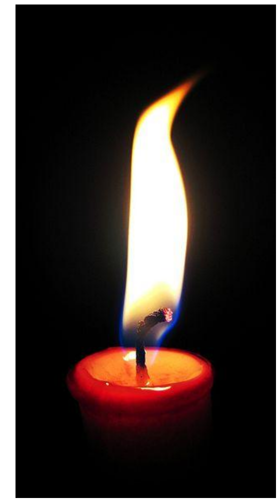
“Es la ciencia que estudia como funcionan las plantas, es decir, qué es lo que las mantiene vivas… el aspecto más importante no es el cúmulo de procesos físicos y químicos en cada punto de la planta y en cada momento de su programa de desarrollo, sino como se integran dichos procesos en el espacio y en el tiempo y como los modula el medio para llevar a buen término el desarrollo de la planta.”

Responsabilidad Social

Herramientas

Conocimiento

Generación y Asimilación de conocimiento



Seguridad

Tecnología

Monitoreo ambiental

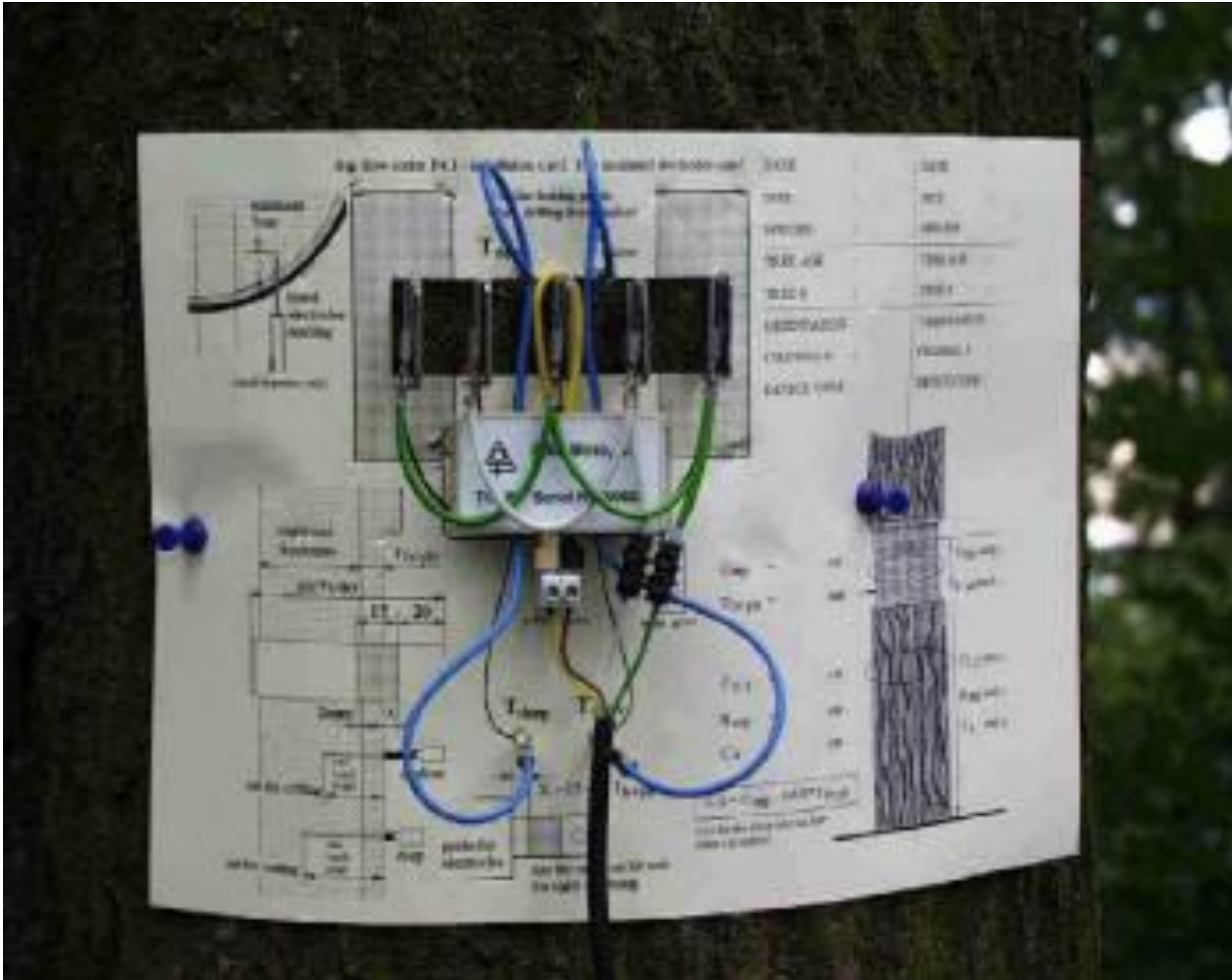
Herramientas

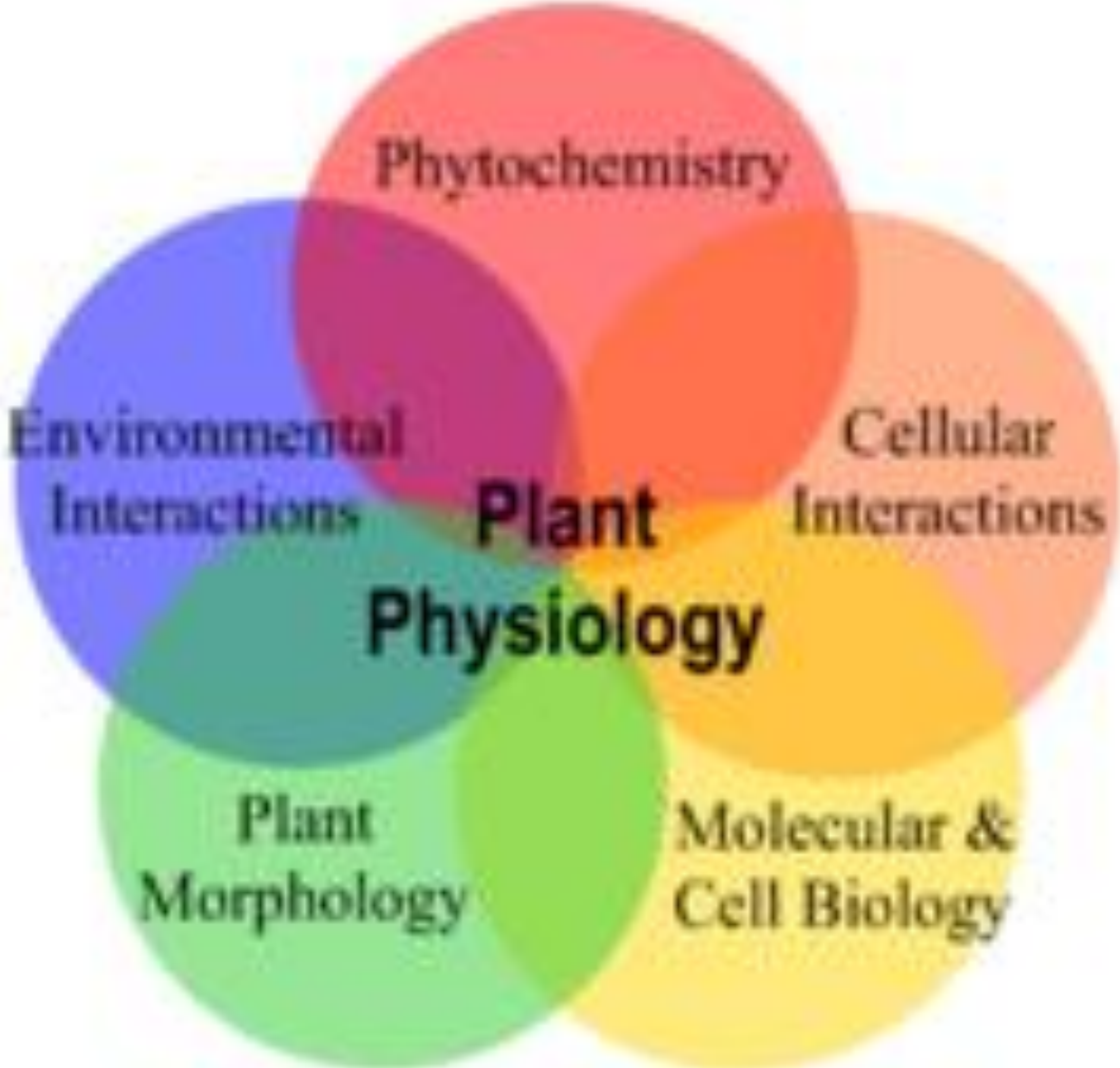
Biodiversidad

Fisiología Vegetal

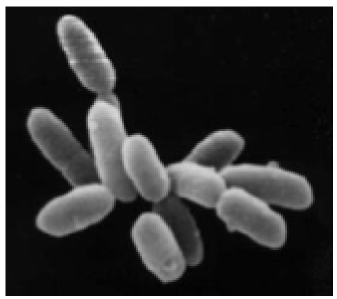
Bioseguridad

Biotecnología




Phytochemistry
Environmental Interactions
Cellular Interactions
Plant Physiology
Plant Morphology
Molecular & Cell Biology

Plants, like most animals, are multicellular eukaryotes



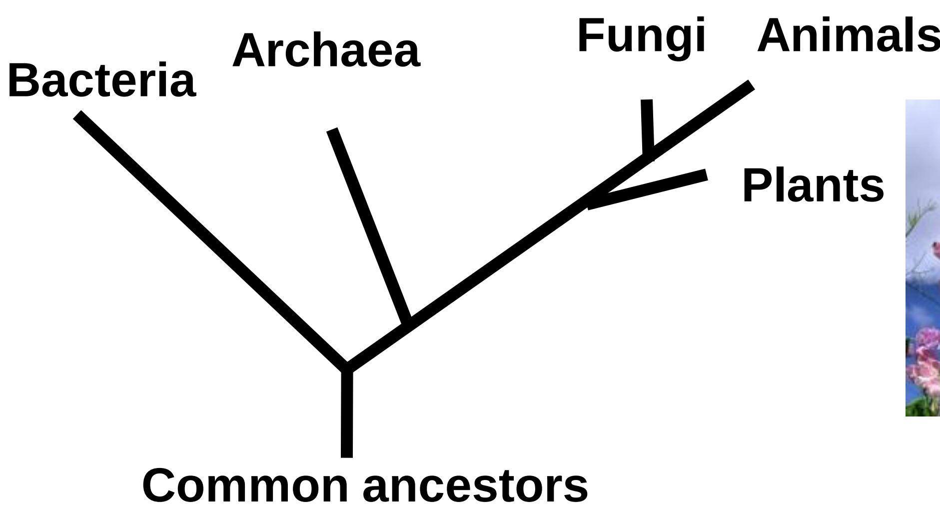
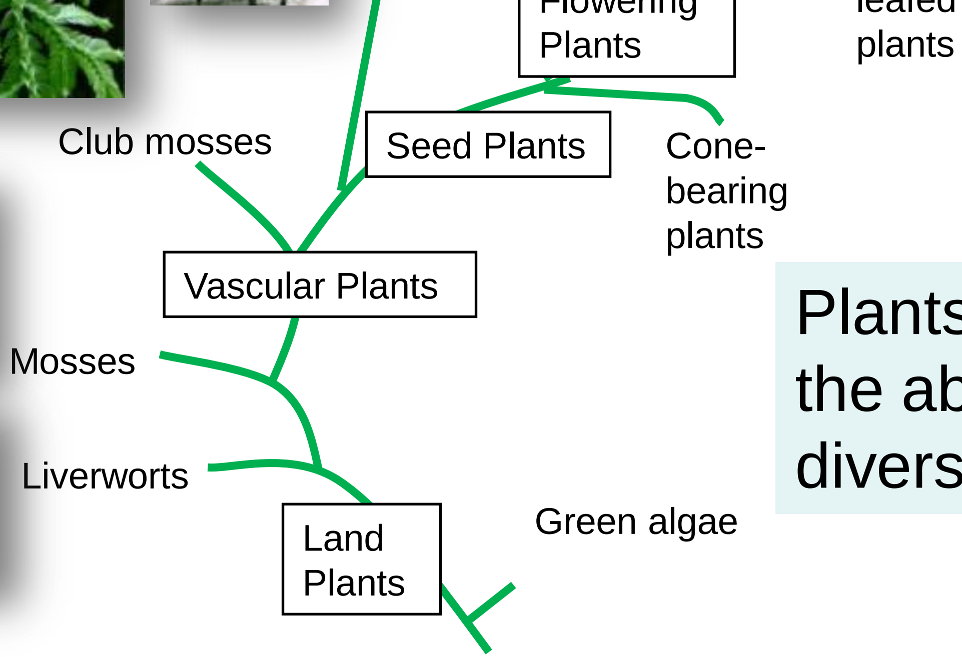


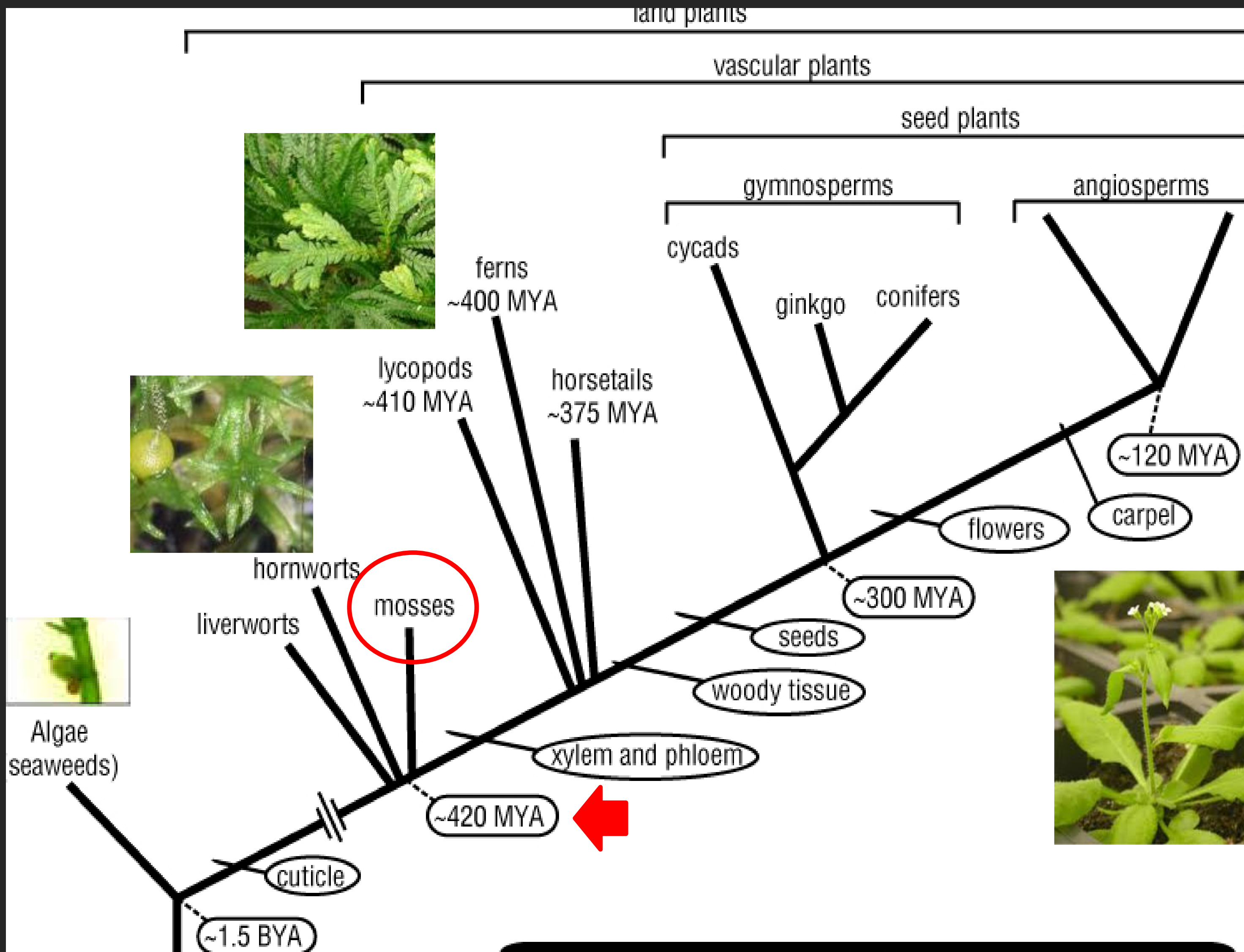
Photo credits: Public Health Image Library; NASA; © Dave Powell, USDA Forest Service; tom donald

Plants are diverse



Plants have evolved the ability to thrive in diverse land habitats

Images courtesy tom donald



land plants
vascular plants
seed plants
gymnosperms
angiosperms
cycads
ginkgo
conifers
ferns
~400 MYA
lycopods
~410 MYA
horsetails
~375 MYA
hornworts
mosses
liverworts
Algae
(seaweeds)
~120 MYA
carpel
flowers
~300 MYA
seeds
woody tissue
xylem and phloem
~420 MYA
cuticle
~1.5 BYA

Plants make us happy

People at work who can see plants report significantly greater job satisfaction than those who can't.

Dravigne, A., Waliczek, T.M., Lineberger, R.D., Zajicek, J.M. (2008) The effect of live plants and window views of green spaces on employee perceptions of job satisfaction. HortScience 43: 183–187. Photo credit: tom donald

Plants are amazing living organisms

Largest flower (~ 1m)

Longest living (~ 5000 years)

Largest organism (> 100m)

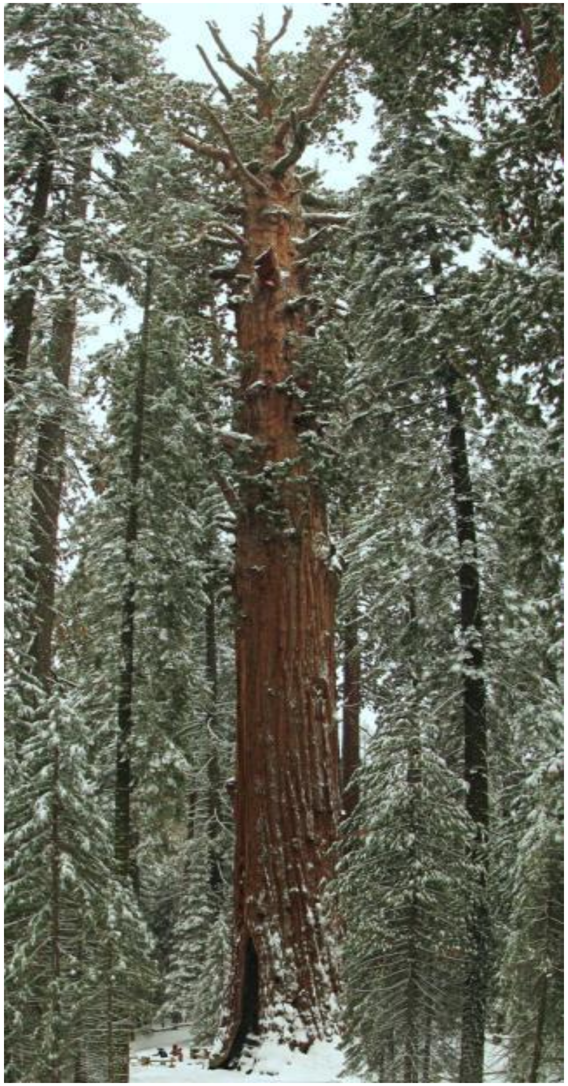
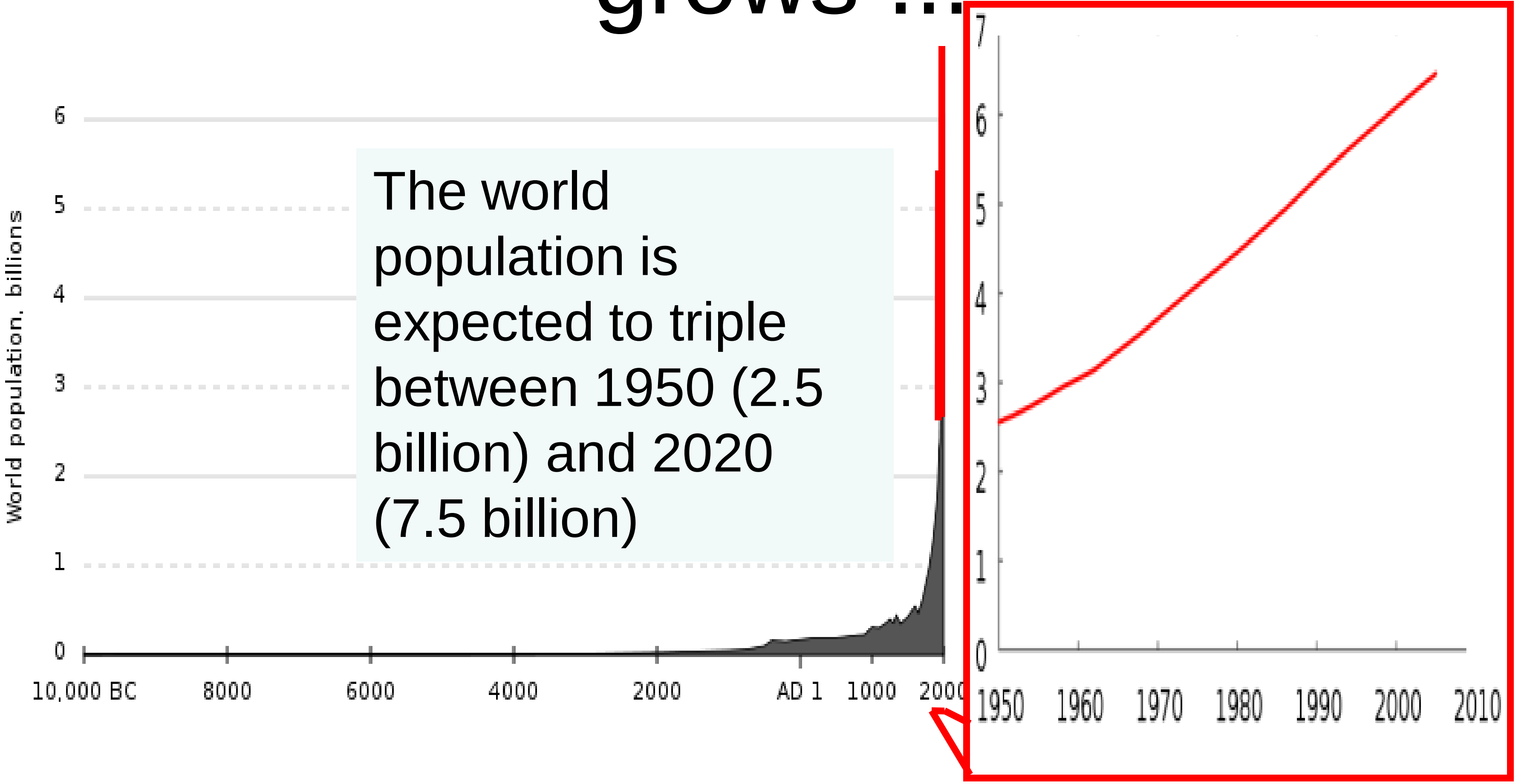


Photo credits: ma_suska; Bradluke22; Stan Shebs

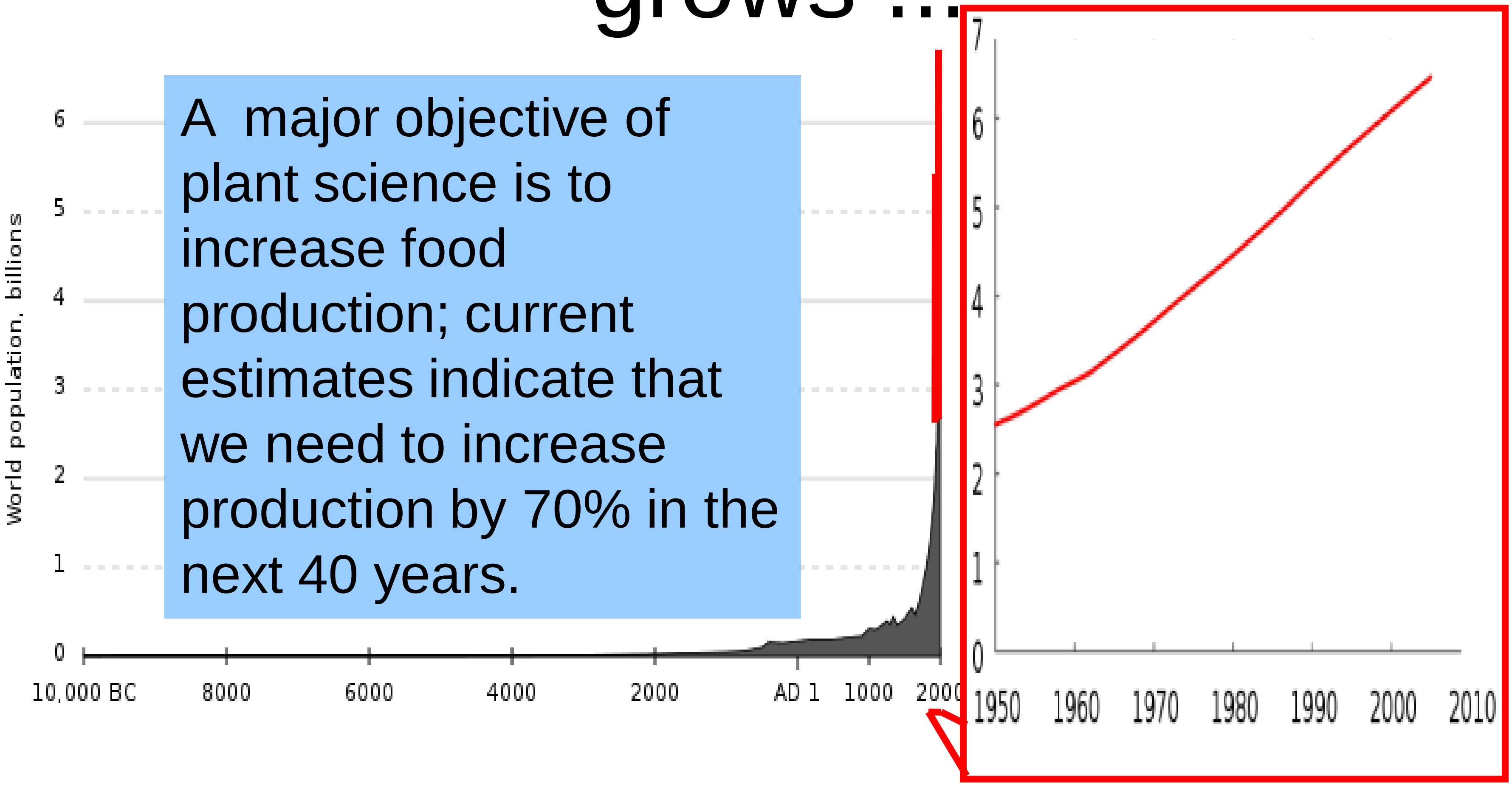
The world population grows and grows ...



The world population is expected to triple between 1950 (2.5 billion) and 2020 (7.5 billion)

The world population grows and grows ...

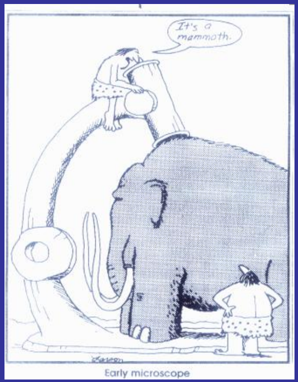
A major objective of plant science is to increase food production; current estimates indicate that we need to increase production by 70% in the next 40 years.

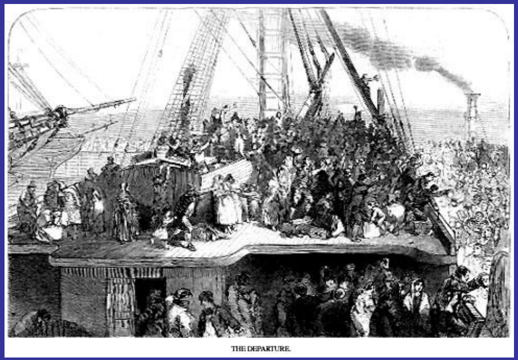


We could not live without plants

- Plants produce most of the oxygen we breathe.
- Plants produce most of the chemically stored energy we consume as food and burn for fuel.
- Plants produce an amazing assortment of useful chemicals.

Eventos históricos





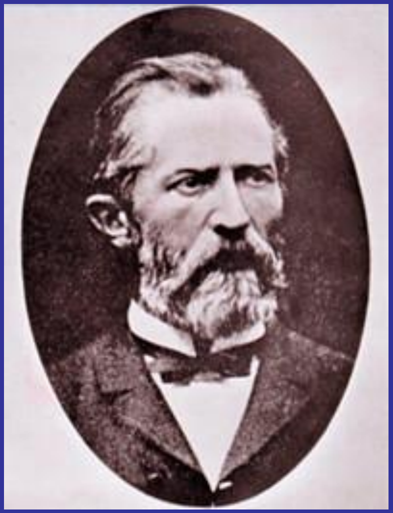
Interés humano

Theoprhastus (300 AC)

Microscopio (1600)

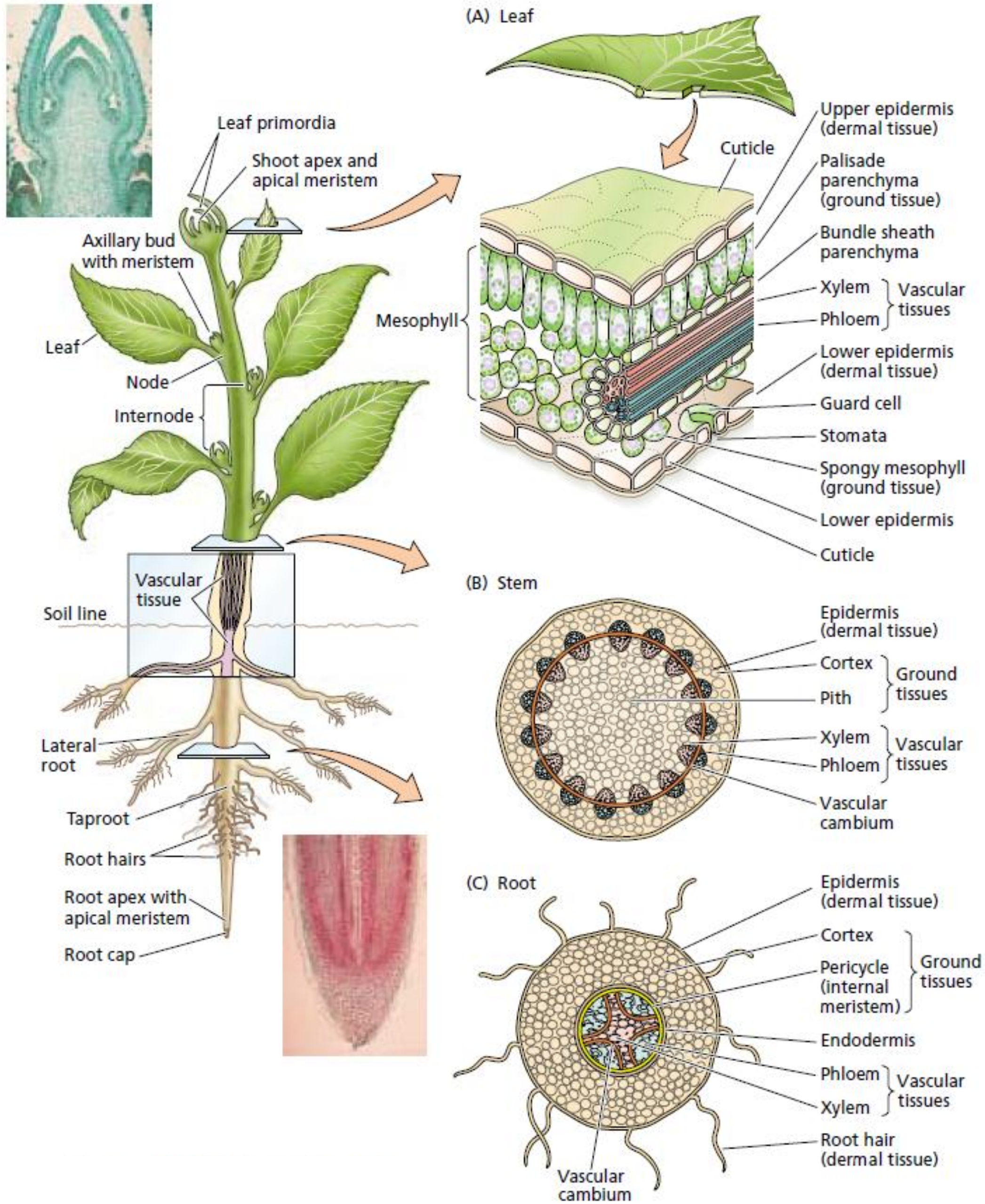
1600-1800s Los microrganismos son consecuencia de la enfermedad y no la causa

Julius von Sachs, “*Lehrbuch der Botanik*”

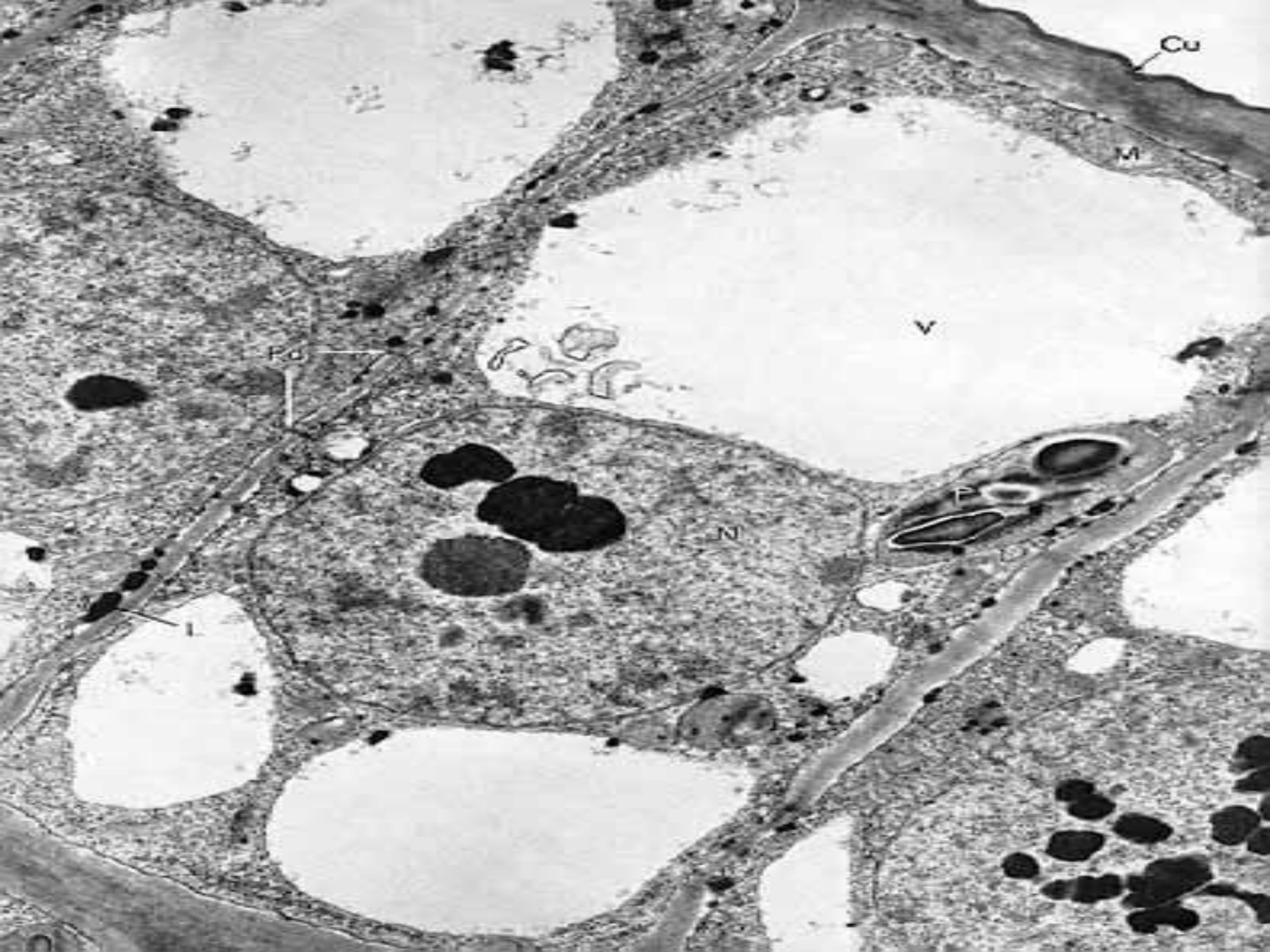


1840s Potato Late Blight. Epidemia en Europa.

A. de Bary (1861-1863)
Late blight (*Phytophtora infestans*)



Leaf primordia
Shoot apex and apical meristem
Axillary bud with meristem
Leaf
Node
Internode
Vascular tissue
Soil line
Lateral root
Taproot
Root hairs
Root apex with apical meristem
Root cap
(A) Leaf
Cuticle
Mesophyll
Upper epidermis (dermal tissue)
Palisade parenchyma (ground tissue)
Bundle sheath parenchyma
Xylem
Phloem
Vascular tissues
Lower epidermis (dermal tissue)
Guard cell
Stomata
Spongy mesophyll (ground tissue)
Lower epidermis
Cuticle
(B) Stem
Epidermis (dermal tissue)
Cortex
Pith
Ground tissues
Xylem
Phloem
Vascular tissues
Vascular cambium
(C) Root
Epidermis (dermal tissue)
Cortex
Pericycle (internal meristem)
Ground tissues
Endodermis
Phloem
Xylem
Vascular tissues
Root hair (dermal tissue)
Vascular cambium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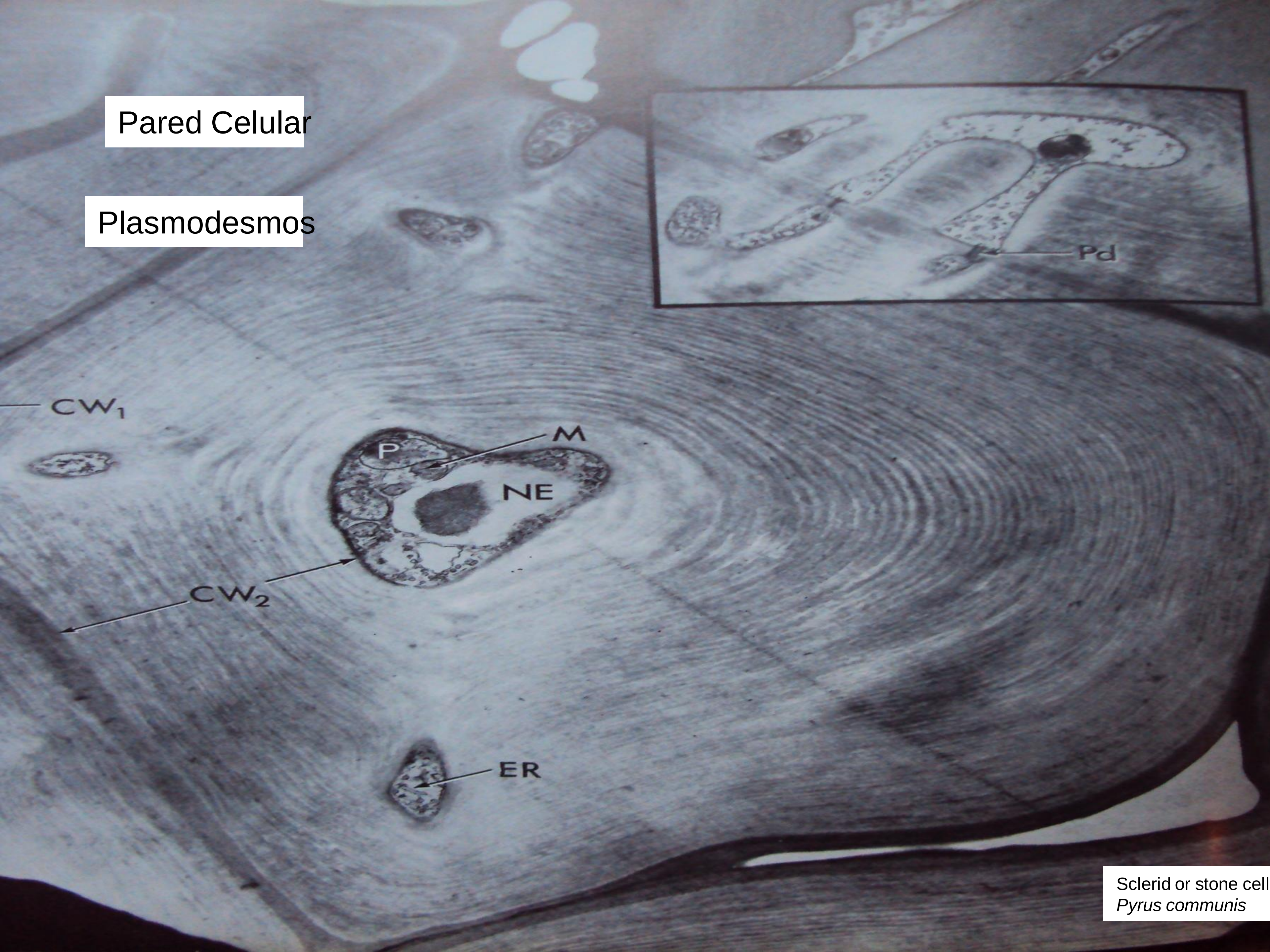
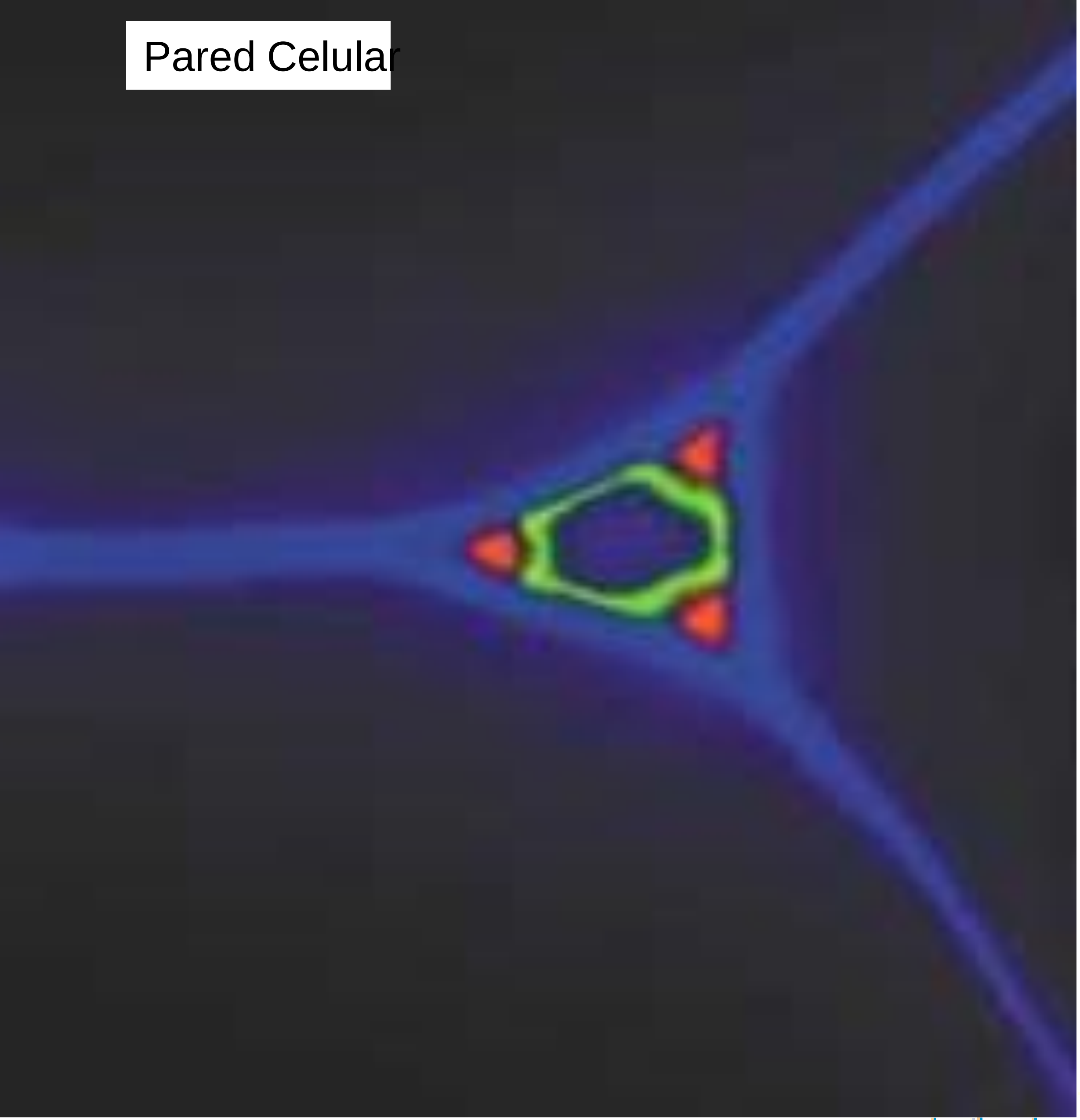
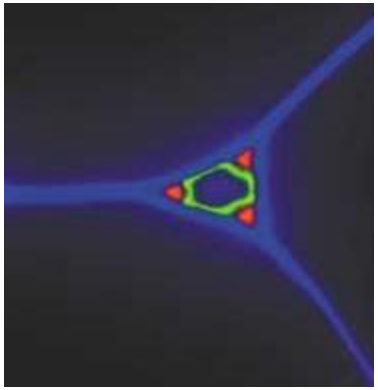


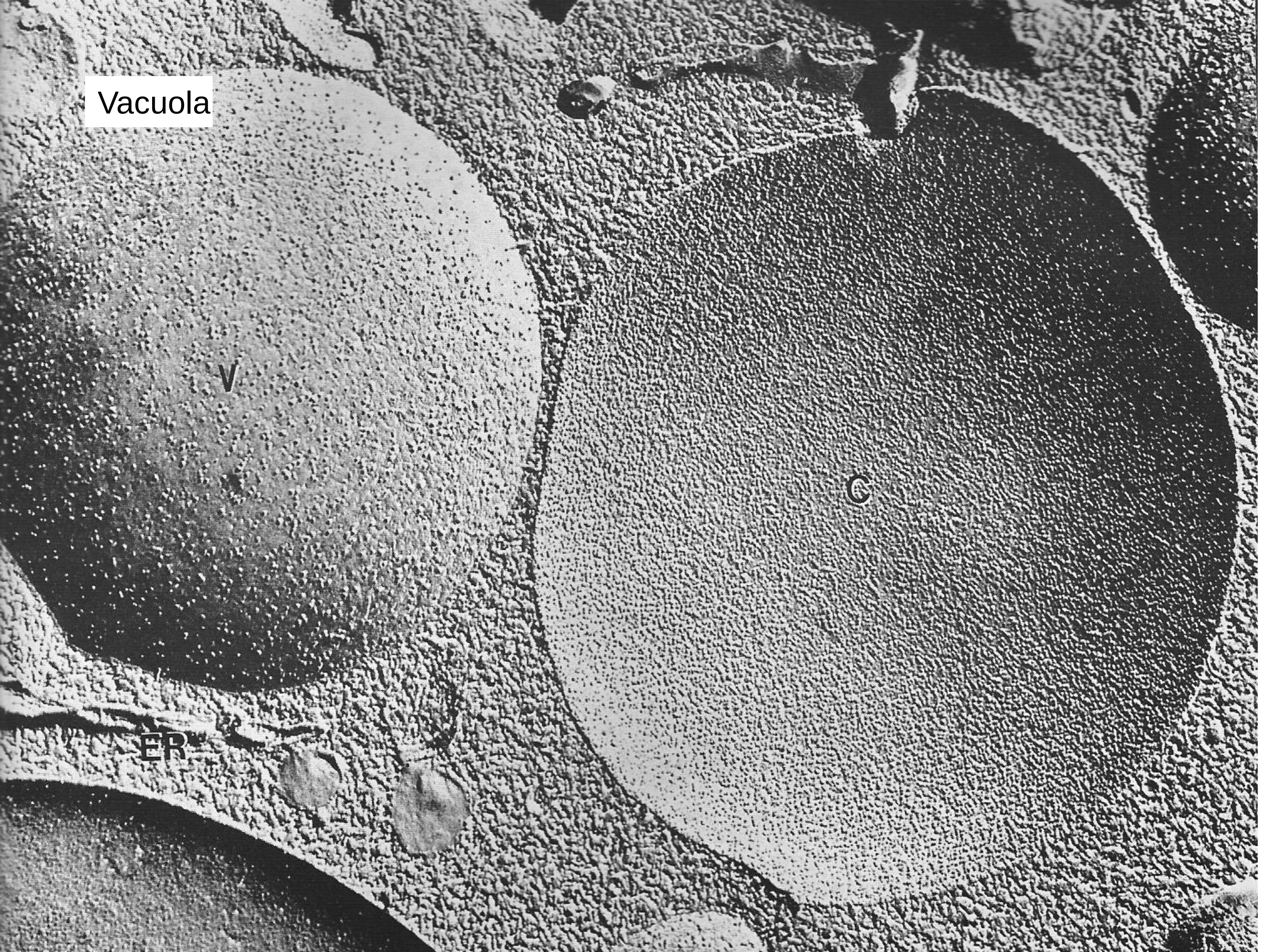
Sclerid or stone cell
Pyrus communis

Pared Celular





Triple-fluorescence-labeled section of tobacco stem showing the primary cell walls of three adjacent parenchyma cells bordering an intercellular space. The blue color is calcofluor (staining of cellulose), and the red and green colors indicate the binding of two monoclonal antibodies to different epitopes (immunologically distinct regions) of pectic homogalacturonan. (Courtesy of W. Willats.)



Vacuola
V
C
ER

Vacuola

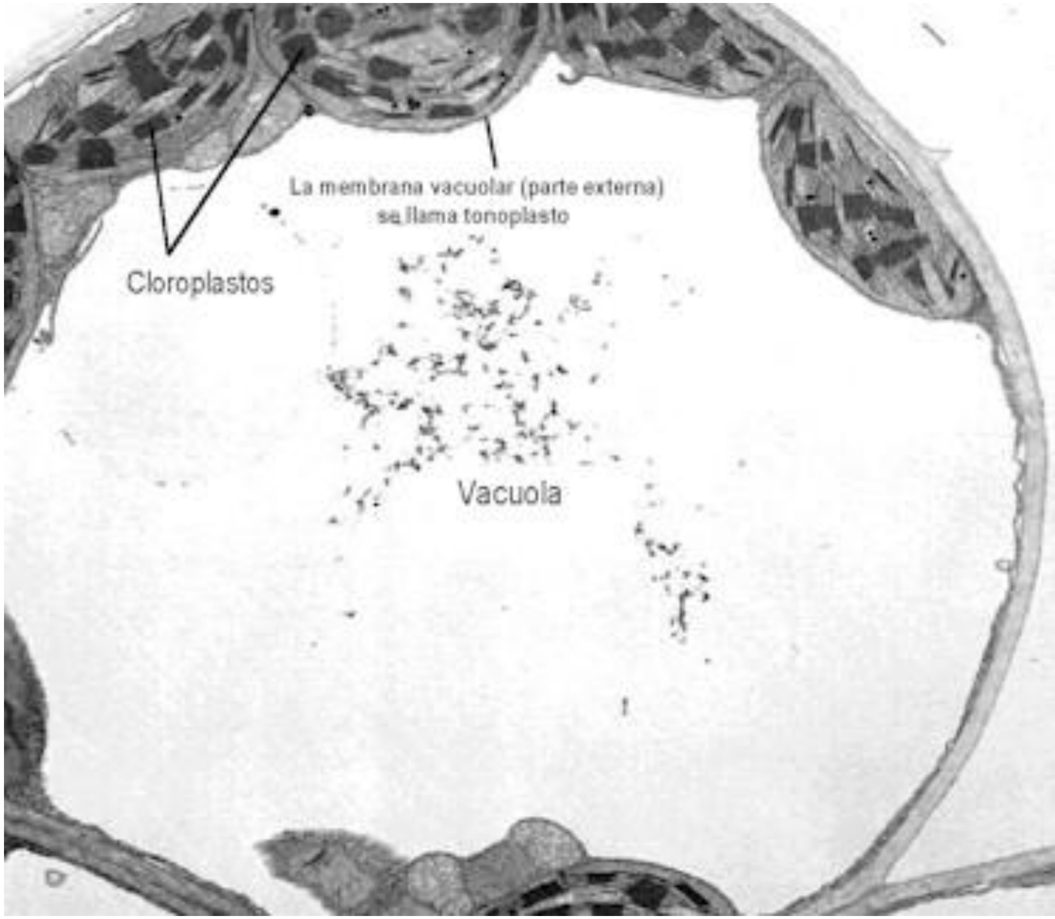
Puede llegar a ocupar el 80 o 90% del volumen celular

Se desarrolla a partir pequeñas provacuolas que luego se fusionan

Funciones:
Reserva de iones inorgánicos (NO_3^-, Cl^-) y de iones orgánicos (malato, oxalato)
Reserva de agua
Ricas en enzimas hidrolíticas

Contiene sustancias toxicas
Contiene metabolitos secundarios útiles para defensa.

Regulación osmótica,
Liberación de compuestos tóxicos vegetales
Detoxificación de xenobióticos
Otras



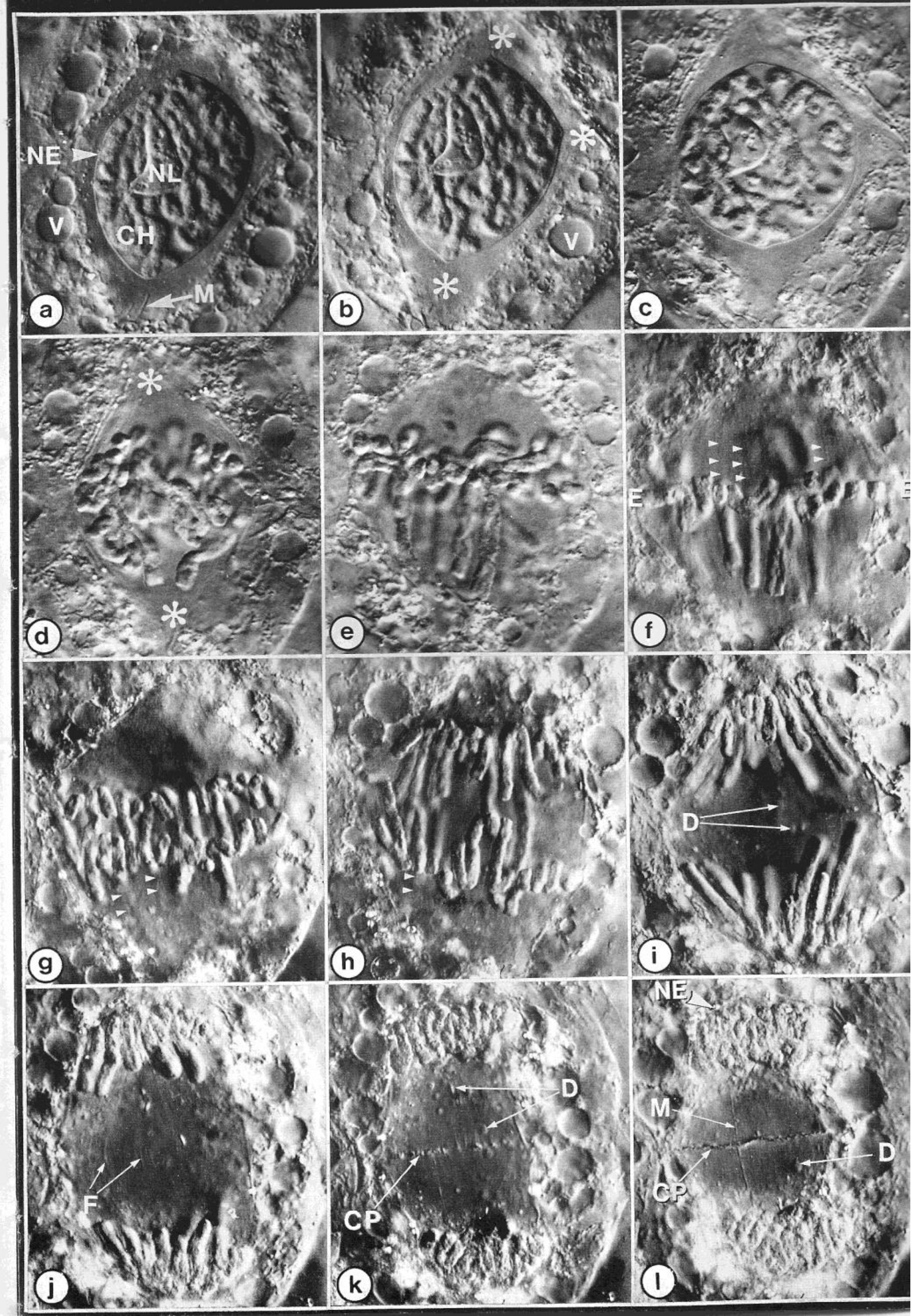
Mitosis-Citokinesis

profase

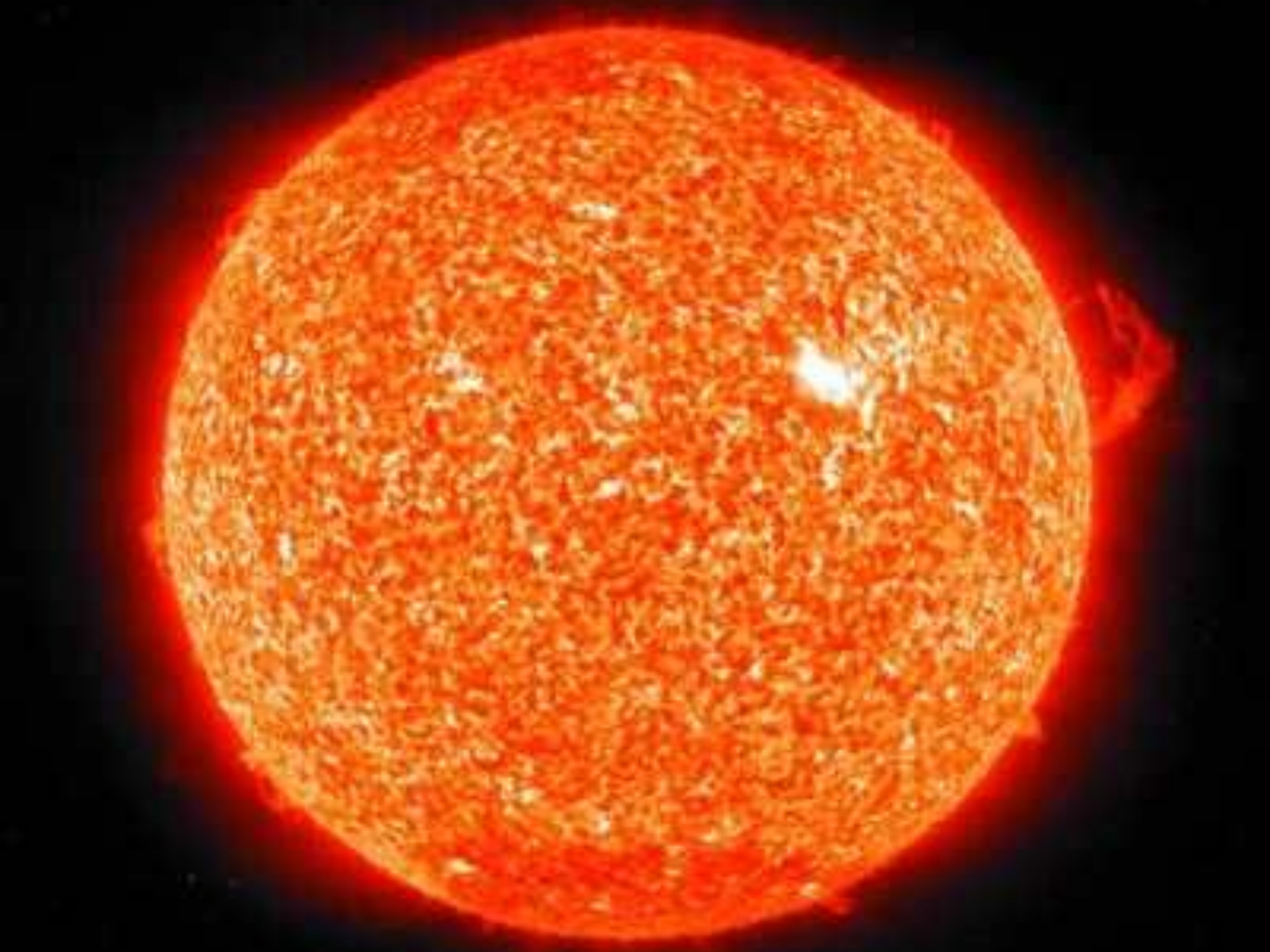
Prometafase-metafase

Anafase

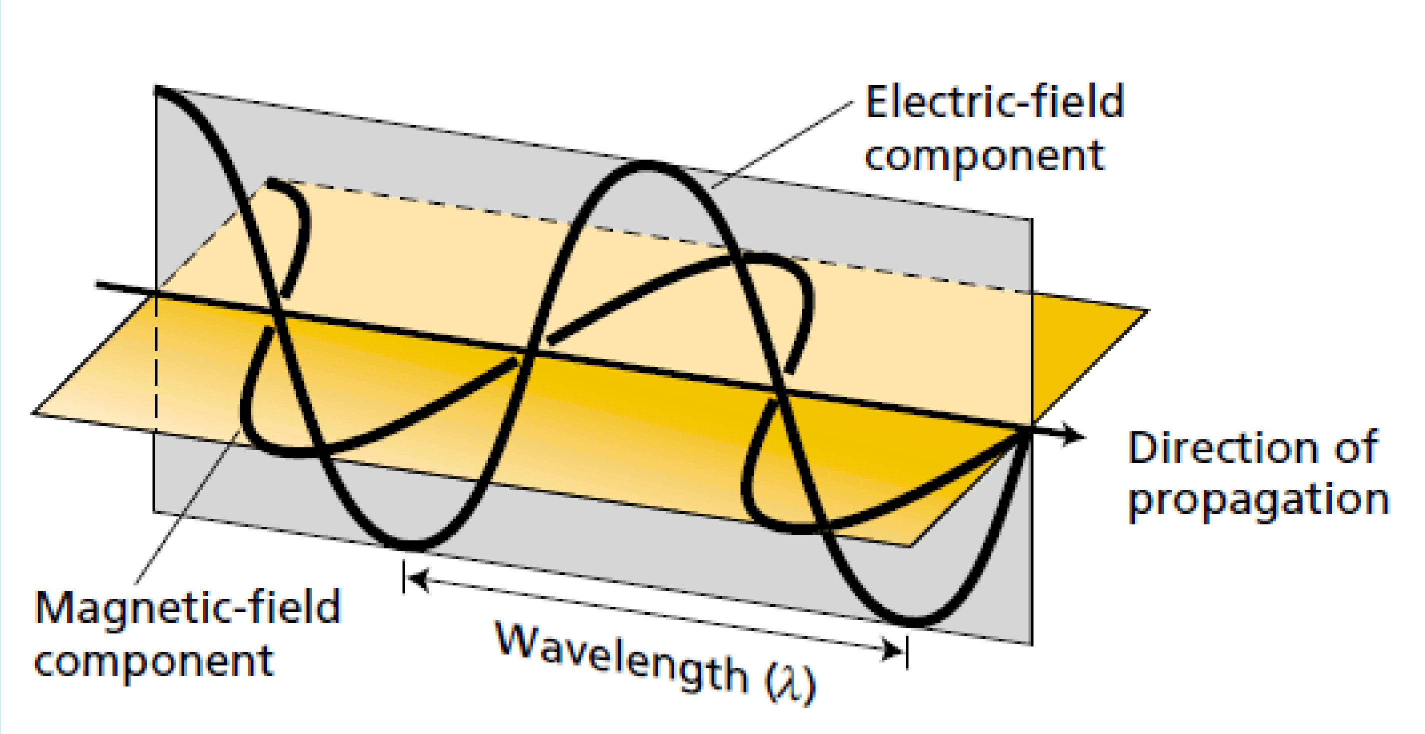
Telofase-citoquinésis temprana



(Haemanthus katherinae)

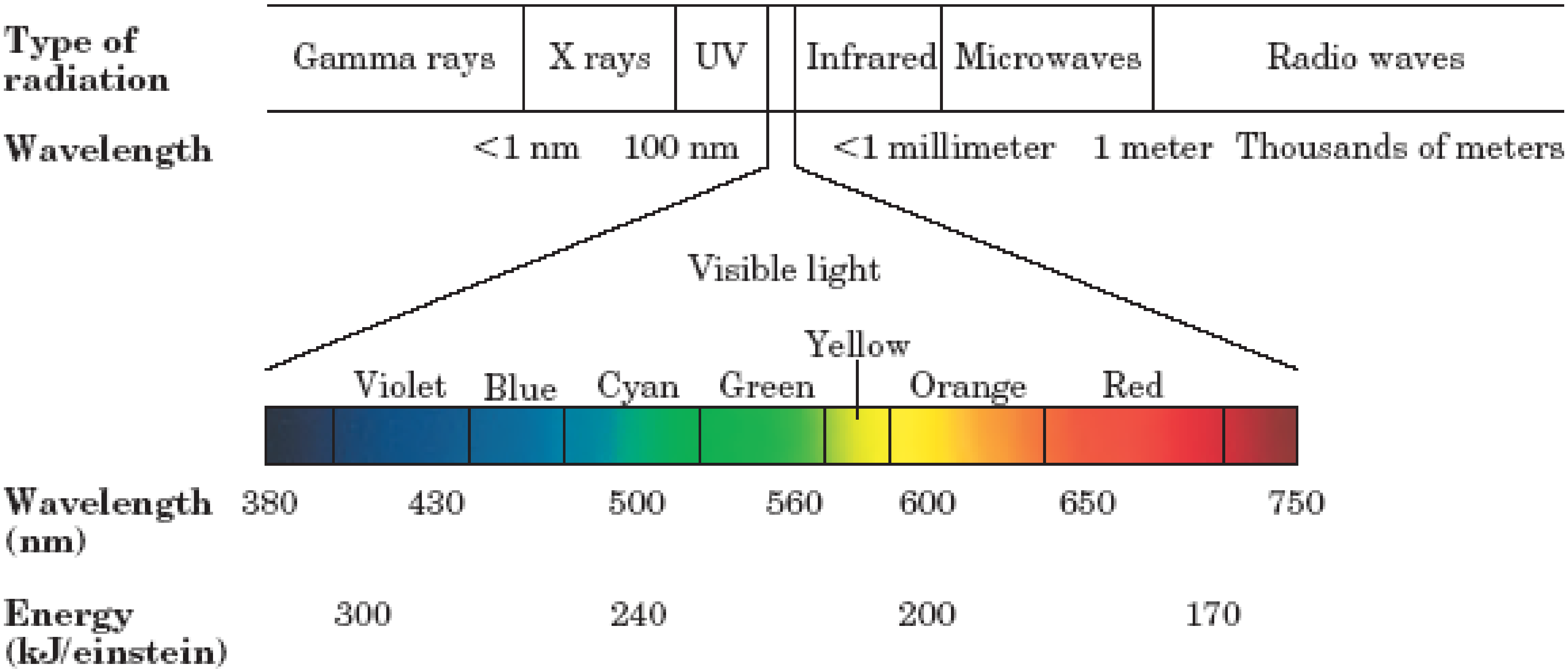


Luz

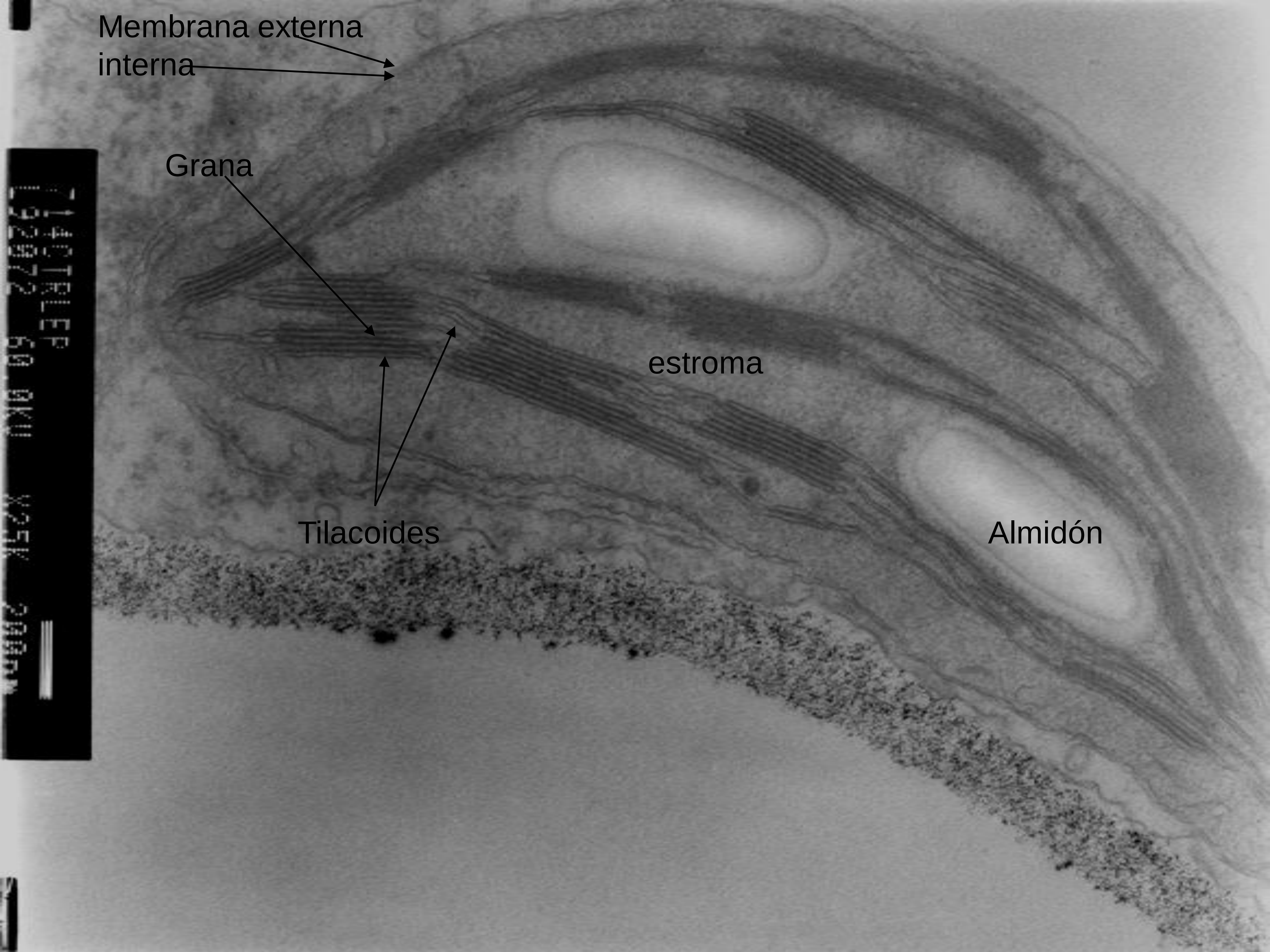


Onda electromagnética que consiste de campos eléctricos y magnéticos que oscilan perpendicularmente cada uno con respecto al otro y en dirección de la propagación de la luz. ($v=3x10^8$ m s^{-1}).

Radiación electromagnética

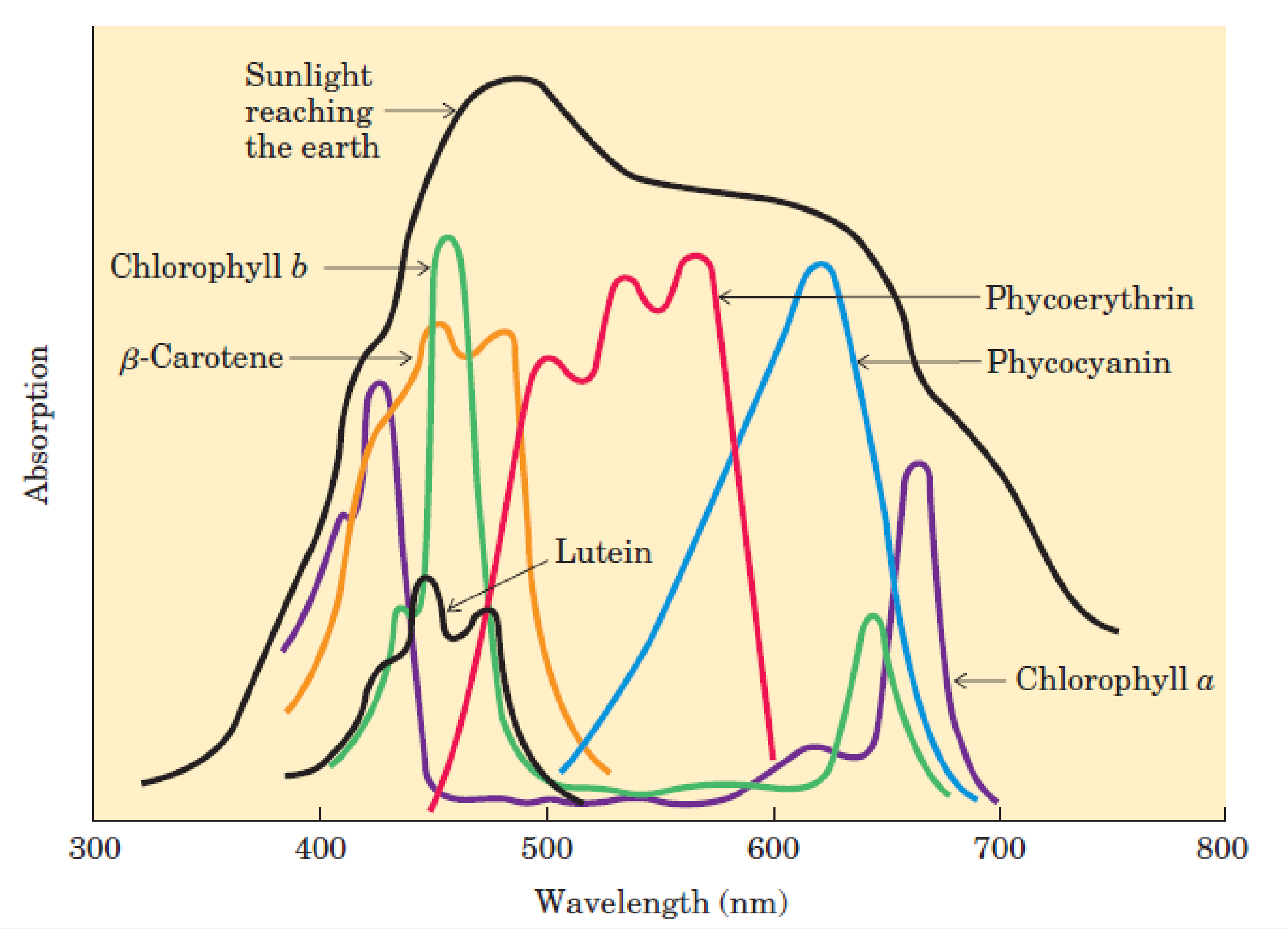


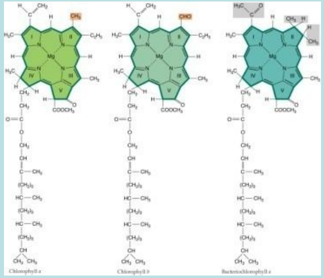
El espectro de la radiación electromagnética y
la energía de fotones en el rango visible del espectro. Un einstein =6 x 10^{23} fotones


Membrana externa
interna
Grana
estroma
Tilacoides
Almidón

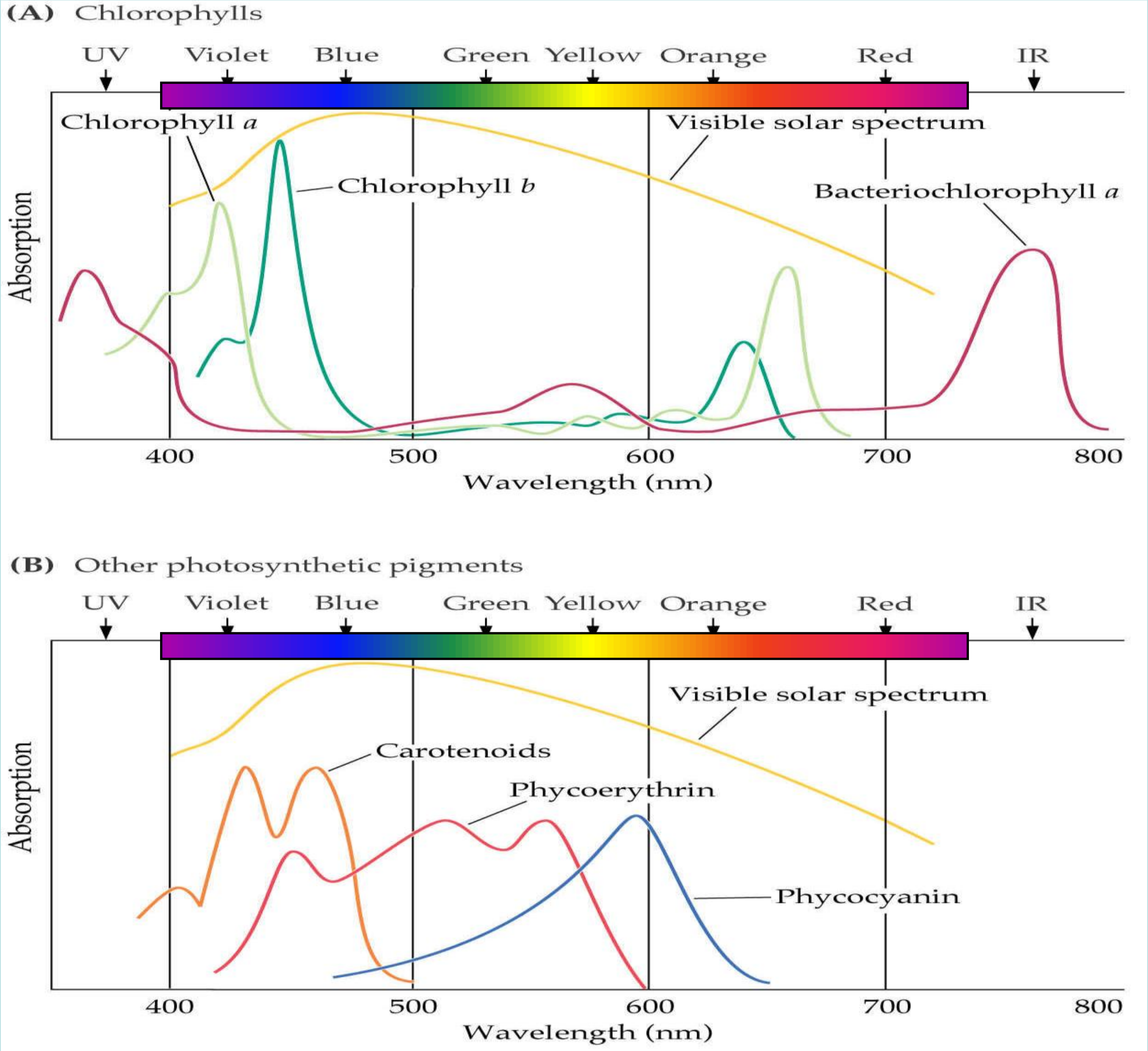

Grana
Tilacoides

Espectro de absorción de pigmentos fotosintéticos

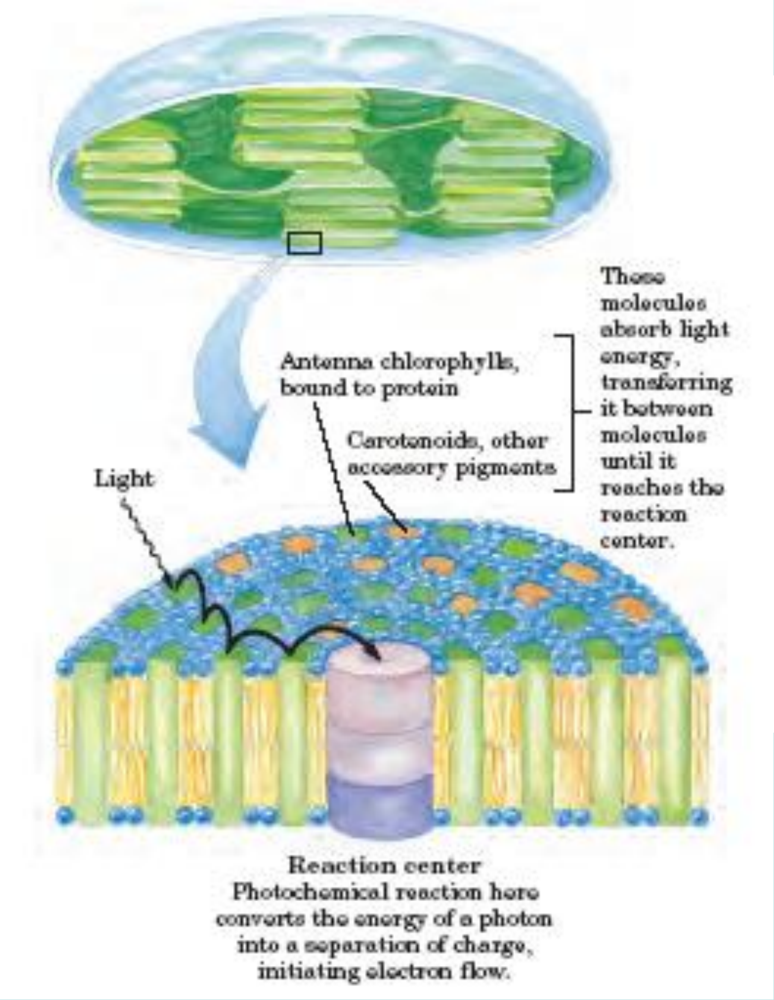


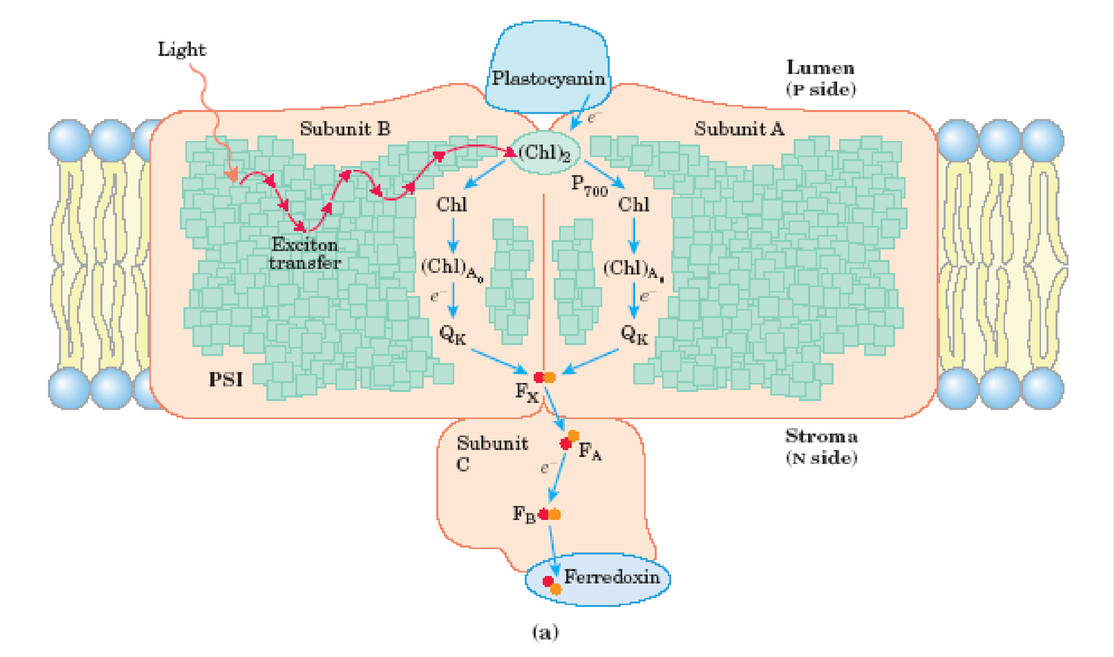


Espectro de absorción de pigmentos fotosintéticos

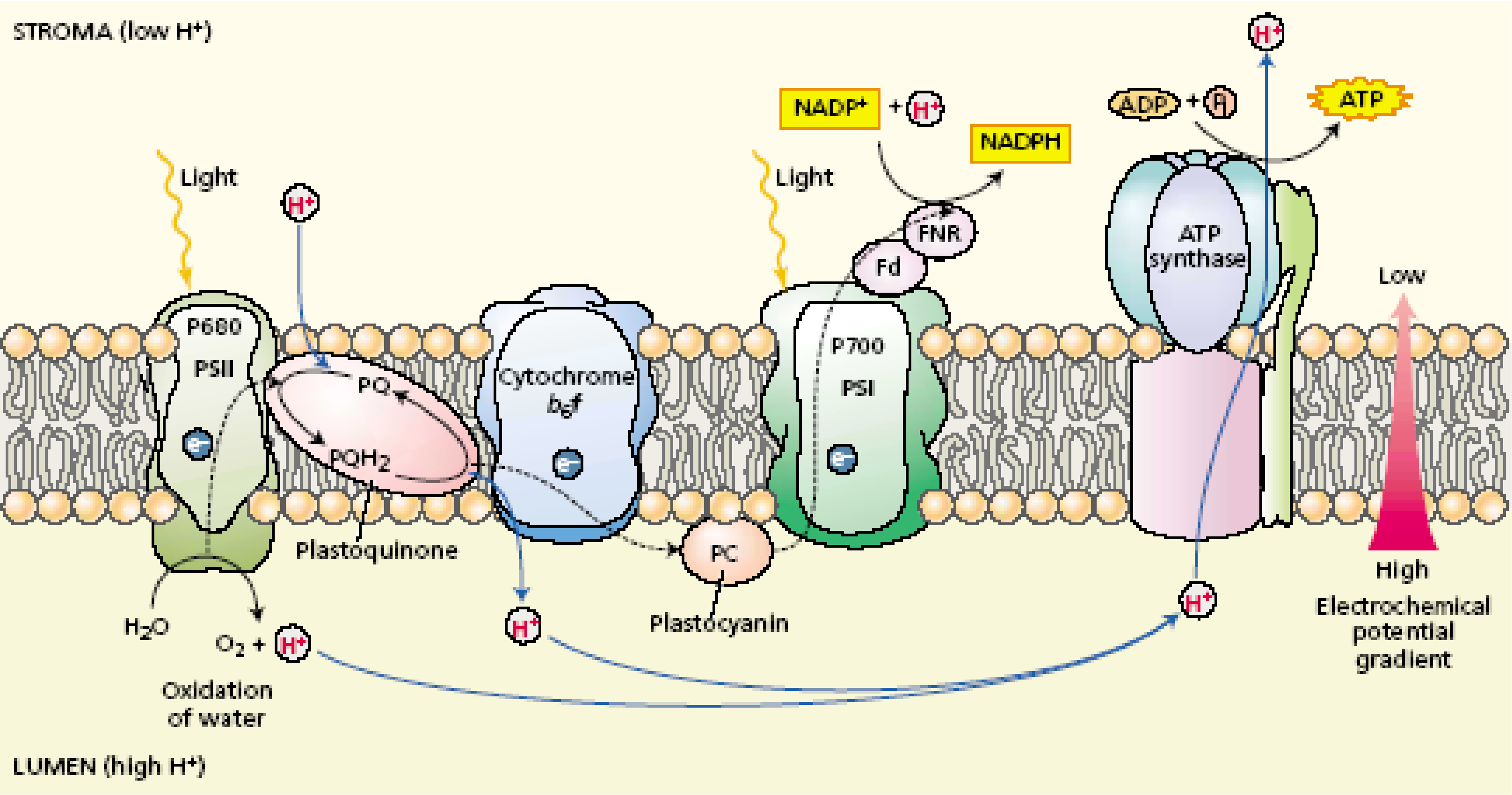


Absorción de la Luz en cloroplastos

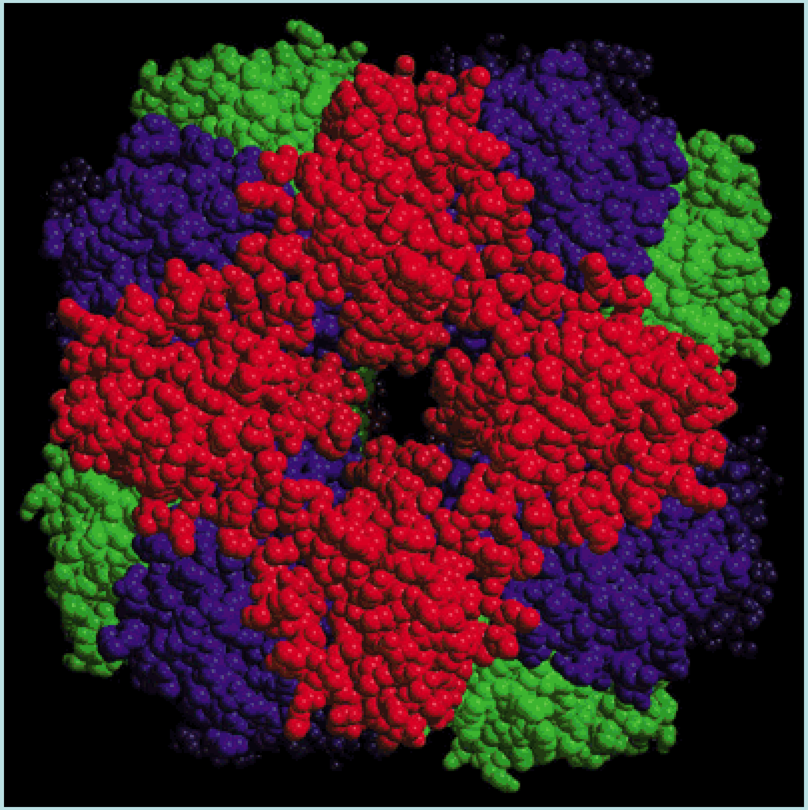




Transporte electrónico en tilacoides



Ribulosa bifosfato carboxilasa/oxigenasa   RUBISCO



A model for the structure of rubisco in chloroplasts from higher plants.
Rubisco consists of 8 large (L) and 8 small (S) subunits arranged as 4 dimers.
Small subunits are shown in red (only four of the small subunits are seen),
large subunits are shown in blue and green,
in order to show the boundaries of the dimers. (From Malkin and Niyogi 2000.)

Asimilación de Carbono en plantas C3

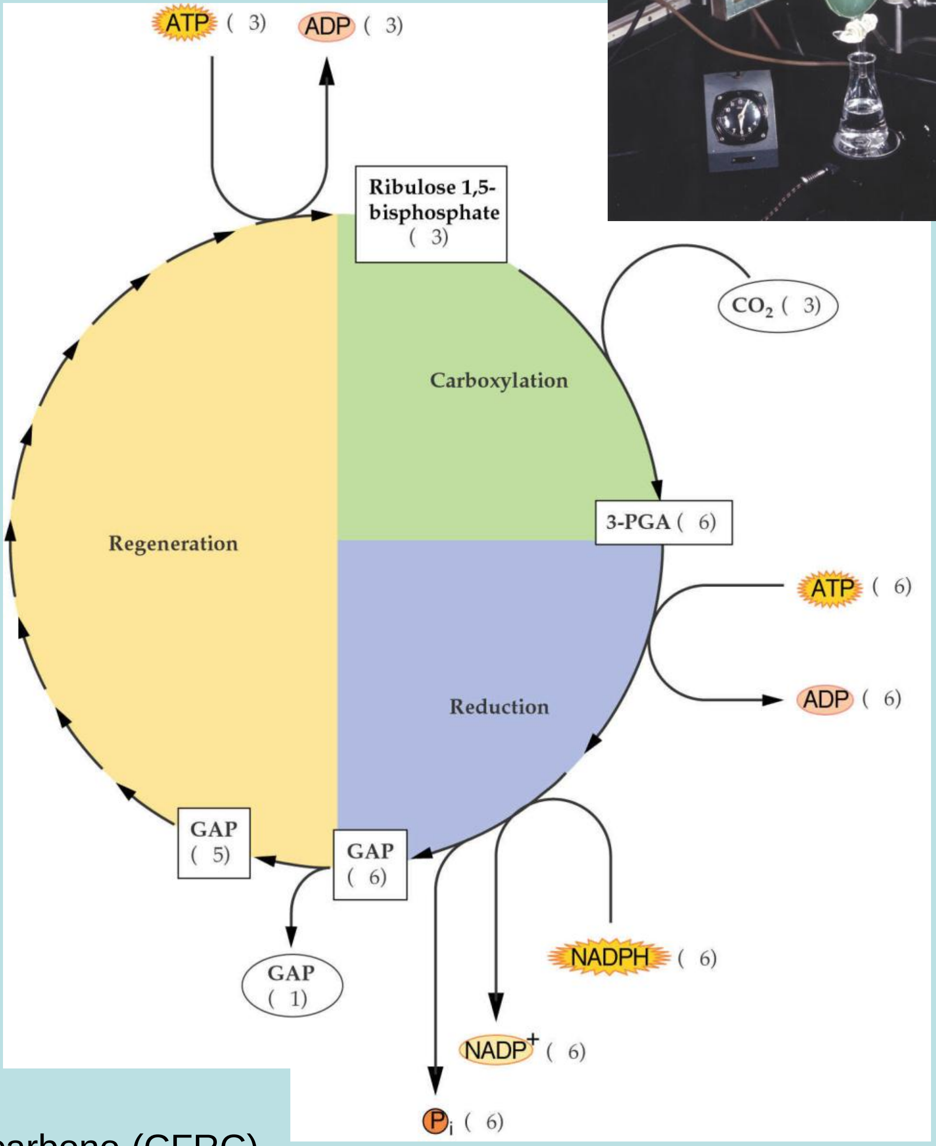
Ciclo de Calvin

1950s Calvin, Benson y Bassham

Fase I carboxilacion

Fase II reducción

Fase III regeneración



Chlorella sp

reductive pentose phosphate cycle

Ciclo fotosintético de reducción de carbono (CFRC)

Movimientos de la hoja hacia la intensidad lumínica


The Japan Times

Conference adopts Kyoto Protocol

Greenhouse gas emissions to be cut by average of 5.2%

KYOTO COP3

Kyoto convention's success open to debate

Gist of Kyoto Protocol

United Nations
Framework Convention on
Climate Change

The Kyoto mechanisms
Under the Treaty, countries must meet their targets primarily through national measures.
However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms.

The Kyoto mechanisms are:
Emissions trading – known as “the carbon market"
Clean development mechanism (CDM)
Joint implementation (JI).

The mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.

http://unfccc.int/kyoto_protocol/items/2830.php

Flooding and aerenchyma

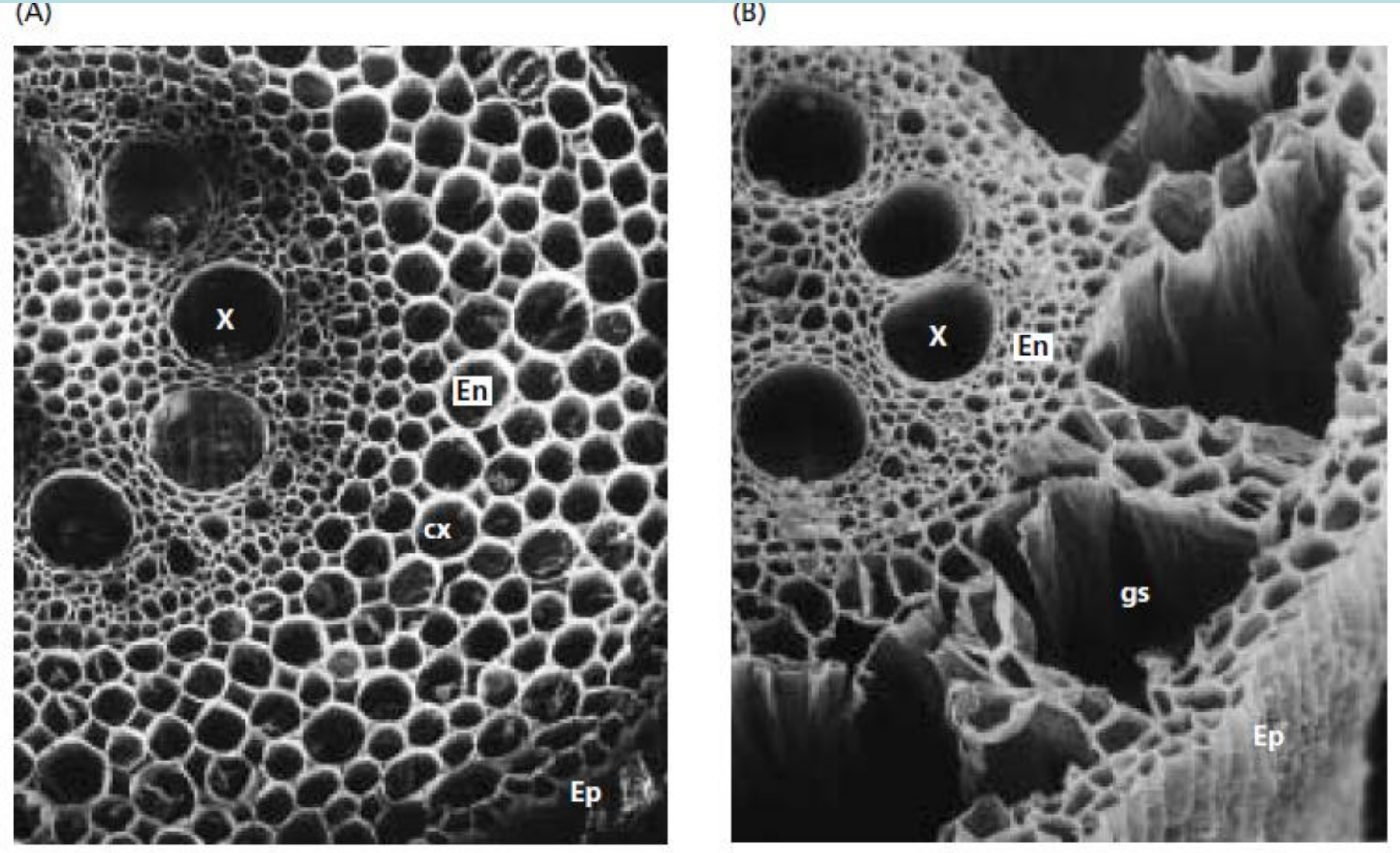
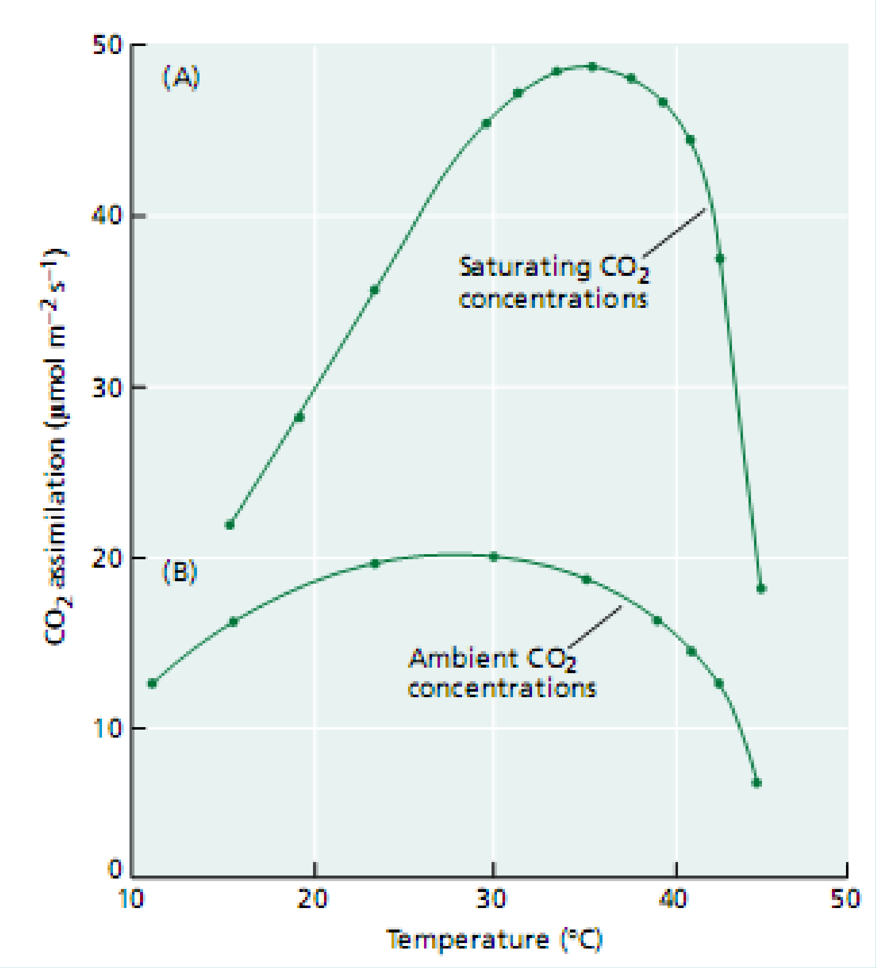


FIGURE 25.18 Scanning electron micrographs of transverse sections through roots of maize, showing changes in structure with oxygen supply. (150×) (A) Control root, supplied with air, with intact cortical cells. (B) Oxygen-deficient root growing in a nonaerated nutrient solution. Note the prominent gas-filled spaces (gs) in the cortex (cx), formed by degeneration of cells. The stele (all cells interior to the endodermis, En) and the epidermis (Ep) remain intact. X, xylem. (Courtesy of J. L. Basq and M. C. Drew.)

Respuestas fotosintéticas a la temperatura



La fotosíntesis exhibe fuerte dependencia de la temperatura en concentraciones saturantes de CO2

Fertilizer is an energy-demanding limiting resource

- Crops need fertilizer – potassium, phosphate, nitrogen, and other nutrients

- Potassium and phosphate are non-renewable, mined resources

- Synthesis of nitrogen fertilizers requires huge amounts of energy

Photo credits: Mining Top News; Library of Congress, Prints & Photographs Division, FSA-OWI Collection, LC-USW361-374

Agricultural fertilizer use is a considerable source of environmental pollution

Fertilizer run-off causes dead zones, algal blooms that then decay, reducing oxygen levels in the water and making animal life impossible

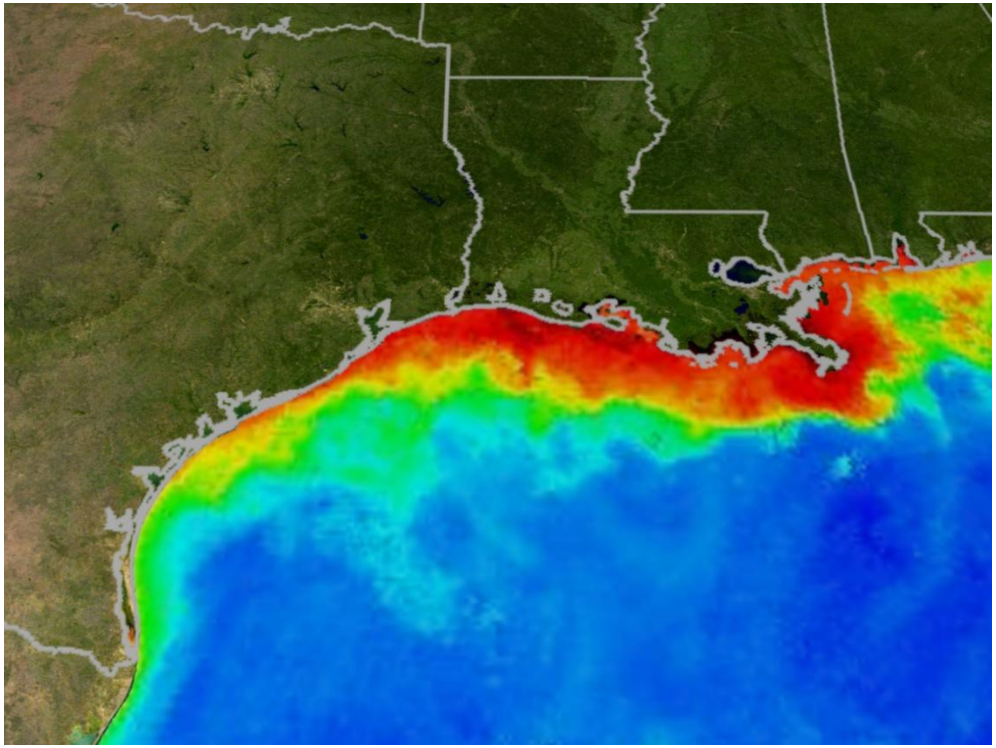


Photo courtesy of NASA/Goddard Space Flight Center Scientific Visualization Studio

Right now, two serious diseases threaten the world's food supply

•*Phytophthora infestans*, cause of potato late blight, has re-emerged as a threat.

•*Puccinia graminis tritici,* the wheat stem rust fungus, has developed into a highly aggressive form.

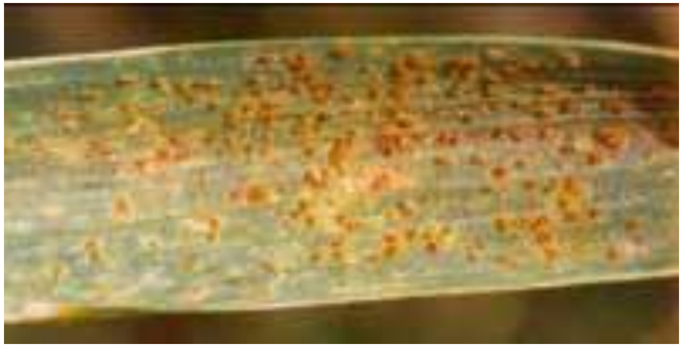


Photo credits: www.news.cornell.edu; www.fao.org

Genetically biofortified foods

Iron-enriched rice

Vitamin A–enriched rice

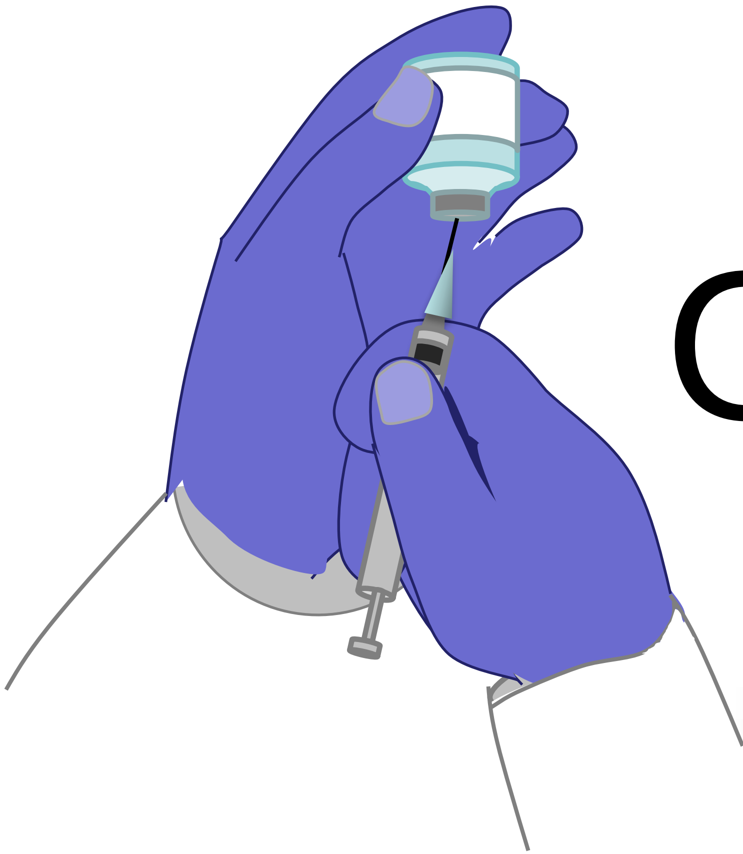
Wild-type (top) and antioxidant-enriched tomatoes

Photo credits: *Golden Rice* Humanitarian Board © 2007; *Credit: ETH Zurich / Christof Sautter*; Reprinted by permission from Macmillan Publishers, Ltd: Butelli, E., et al., Nature Biotechnology 26, 1301 - 1308 copyright (2008).

Plants produce hundreds of compounds we use as medicines or drugs

- **Willow** (*Salix*) bark as a source of aspirin (acetylsalicylic acid)
- **Foxglove** (*Digitalis purpurea*) as a source of digitalis (treatment for cardiac problems)
- **Pacific yew** (*Taxus brevifolia*) as a source of taxol (treatment for cancer)
- **Coffee** (*Coffea arabica*) and **tea** (*Camellia sinensis*) as sources of caffeine (stimulant)

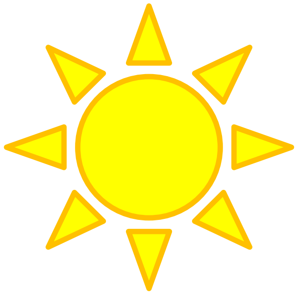
Plants can make safe and inexpensive edible vaccines and antibodies



OR

?

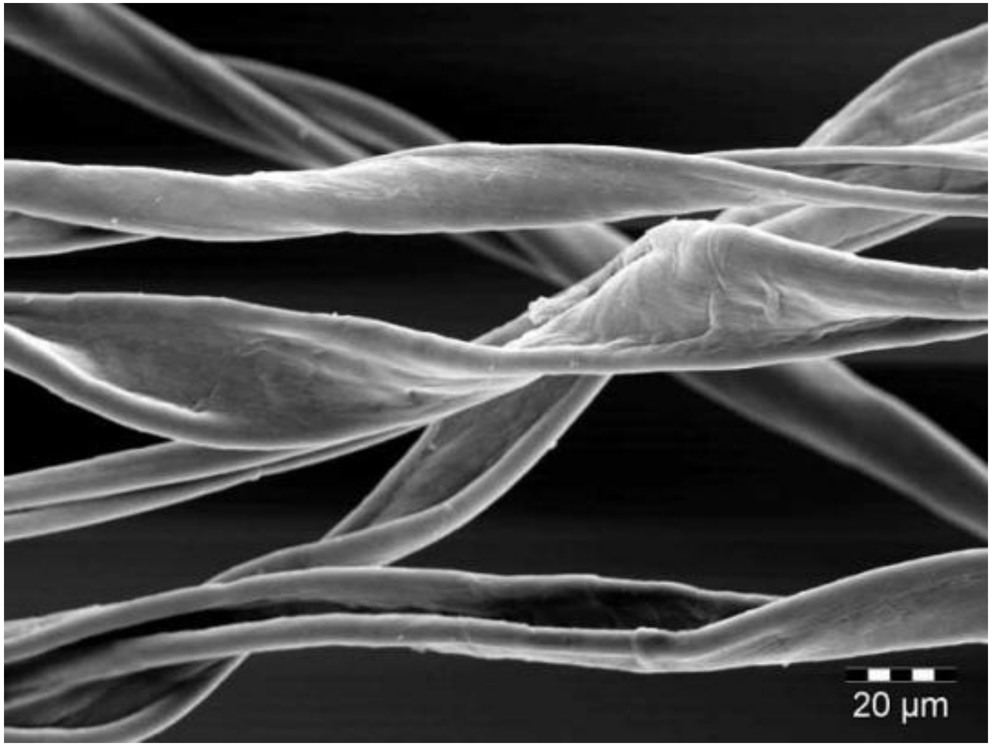
Plants can be a source of biodiesel



Biodiesel produced from rape, algae and soybeans are replacing petroleum-derived diesel.

Image sources: Tilo Hauke, University of Minnesota, Iowa State University Extension.

Plants provide fibers for paper and fabric



Cotton is being bred for increased pest resistance and better fiber production.

Photo credits: Chen Lab; IFPC

Plants can be sources of biorenewable and biodegradable resources

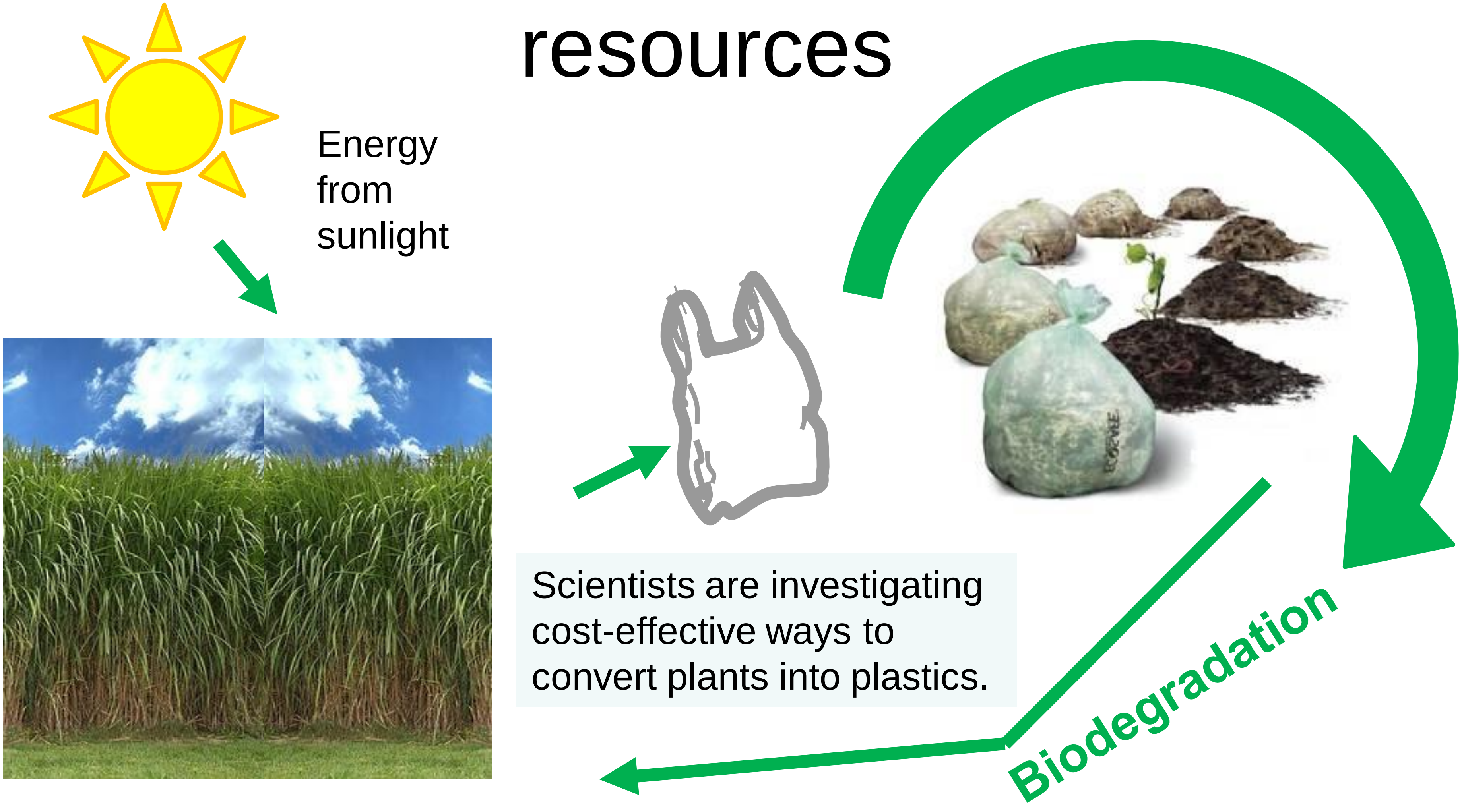


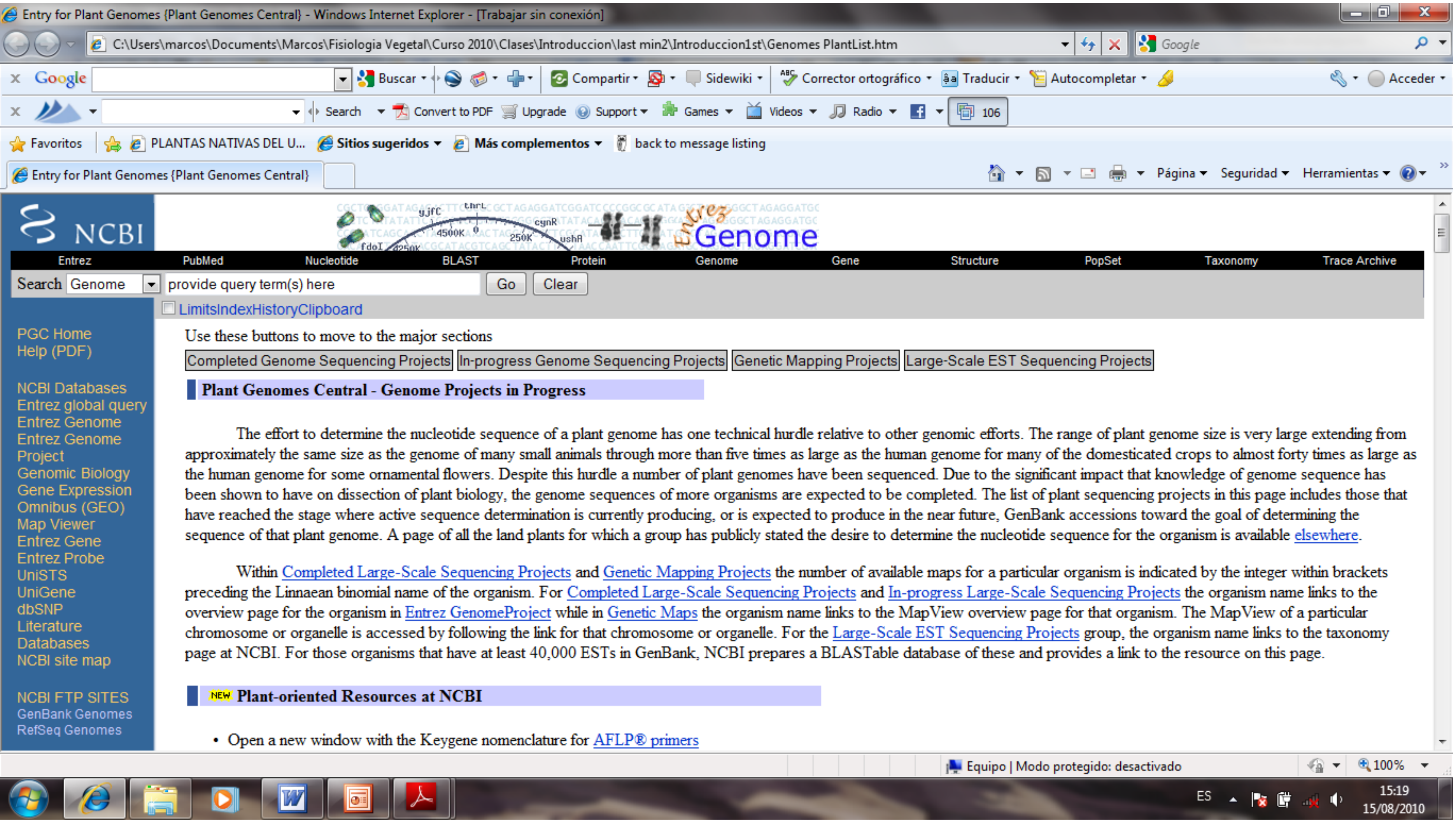
Photo Illustration courtesy S. Long Lab, University of Illinois, 2006

Why study plants?

Studying plants increases our knowledge about life in general and helps us to work with them to keep us fed, healthy, sheltered, clothed, and happy.







Entry for Plant Genomes {Plant Genomes Central} - Windows Internet Explorer - [Trabajar sin conexión]

C:\Users\marcos\Documents\Marcos\Fisiologia Vegetal\Curso 2010\Clases\Introduccion\last min2\Introduccion1st\Genomes PlantList.htm

NCBI | Entrez Genome

Entrez | PubMed | Nucleotide | BLAST | Protein | Genome | Gene | Structure | PopSet | Taxonomy | Trace Archive

Search Genome | provide query term(s) here | Go | Clear

Limits Index History Clipboard

PGC Home
Help (PDF)

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Entrez global query
Entrez Genome
Entrez Genome Project
Genomic Biology
Gene Expression Omnibus (GEO)
Map Viewer
Entrez Gene
Entrez Probe
UniSTS
UniGene
dbSNP
Literature Databases
NCBI site map

NCBI FTP SITES
GenBank Genomes
RefSeq Genomes

Use these buttons to move to the major sections

Completed Genome Sequencing Projects | In-progress Genome Sequencing Projects | Genetic Mapping Projects | Large-Scale EST Sequencing Projects

Plant Genomes Central - Genome Projects in Progress

The effort to determine the nucleotide sequence of a plant genome has one technical hurdle relative to other genomic efforts. The range of plant genome size is very large extending from approximately the same size as the genome of many small animals through more than five times as large as the human genome for many of the domesticated crops to almost forty times as large as the human genome for some ornamental flowers. Despite this hurdle a number of plant genomes have been sequenced. Due to the significant impact that knowledge of genome sequence has been shown to have on dissection of plant biology, the genome sequences of more organisms are expected to be completed. The list of plant sequencing projects in this page includes those that have reached the stage where active sequence determination is currently producing, or is expected to produce in the near future, GenBank accessions toward the goal of determining the sequence of that plant genome. A page of all the land plants for which a group has publicly stated the desire to determine the nucleotide sequence for the organism is available elsewhere.

Within Completed Large-Scale Sequencing Projects and Genetic Mapping Projects the number of available maps for a particular organism is indicated by the integer within brackets preceding the Linnaean binomial name of the organism. For Completed Large-Scale Sequencing Projects and In-progress Large-Scale Sequencing Projects the organism name links to the overview page for the organism in Entrez GenomeProject while in Genetic Maps the organism name links to the MapView overview page for that organism. The MapView of a particular chromosome or organelle is accessed by following the link for that chromosome or organelle. For the Large-Scale EST Sequencing Projects group, the organism name links to the taxonomy page at NCBI. For those organisms that have at least 40,000 ESTs in GenBank, NCBI prepares a BLASTable database of these and provides a link to the resource on this page.

NEW Plant-oriented Resources at NCBI

- Open a new window with the Keygene nomenclature for AFLP® primers

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Completed Large-Scale Sequencing Projects

[15] *Arabidopsis thaliana* (thale cress)
5 chromosomes: 1, 2, 3, 4, 5, plastid, mitochondrion

Glycine max (soybean)
20 chromosomes: A1, A2, B1, B2, C1, C2, D1a, D1b, D2, E, F, G, H, I, J, K, L, M, N, O, plastid, mitochondrion

Medicago truncatula (barrel medic)
8 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8 plastid, mitochondrion

[11] *Oryza sativa* (rice)
12 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, plastid , mitochondrion, mitochondrial plasmid B1, mitochondrial plasmid B2

[5] *Populus trichocarpa* (black cottonwood)
19 chromosomes: I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, plastid, mitochondrion

Sorghum bicolor
10 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, plastid, mitochondrion

[17] *Vitis vinifera* (wine grape)
19 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, plastid, mitochondrion

Zea mays (corn)
10 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, plastid, mitochondrion, mitochondrial 1.9 kb plasmid

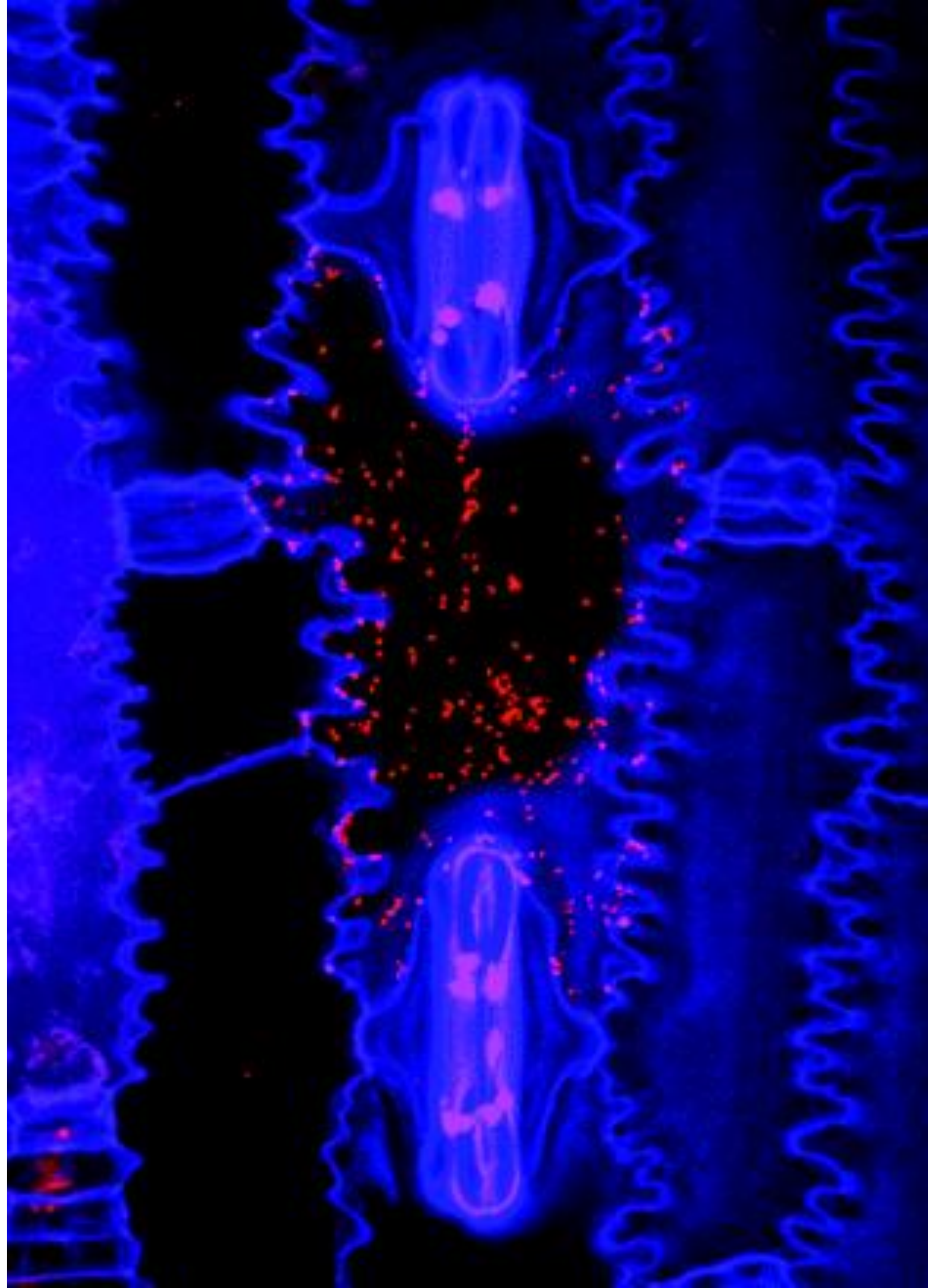
In-progress Large-Scale Sequencing Projects - funded, genome sequence expected in GenBank

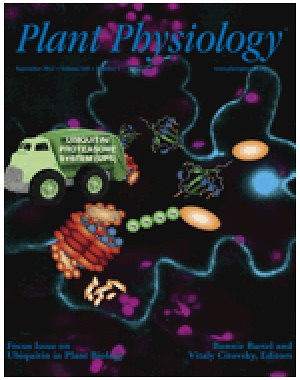
Brachypodium distachyon
5 chromosomes: 1, 2, 3, 4, 5, plastid, mitochondrion
Carica papaya (papaya)
9 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, plastid, mitochondrion
Lotus japonicus (lotus)
6 chromosomes: 1, 2, 3, 4, 5, 6, plastid, mitochondrion
Manihot esculenta (cassava)
20 chromosomes: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, plastid, mitochondrion
Solanum lycopersicum (tomato)
12 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, plastid, mitochondrion
Solanum tuberosum (potato)
12 chromosomes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, plastid, mitochondrion

Genetic Maps

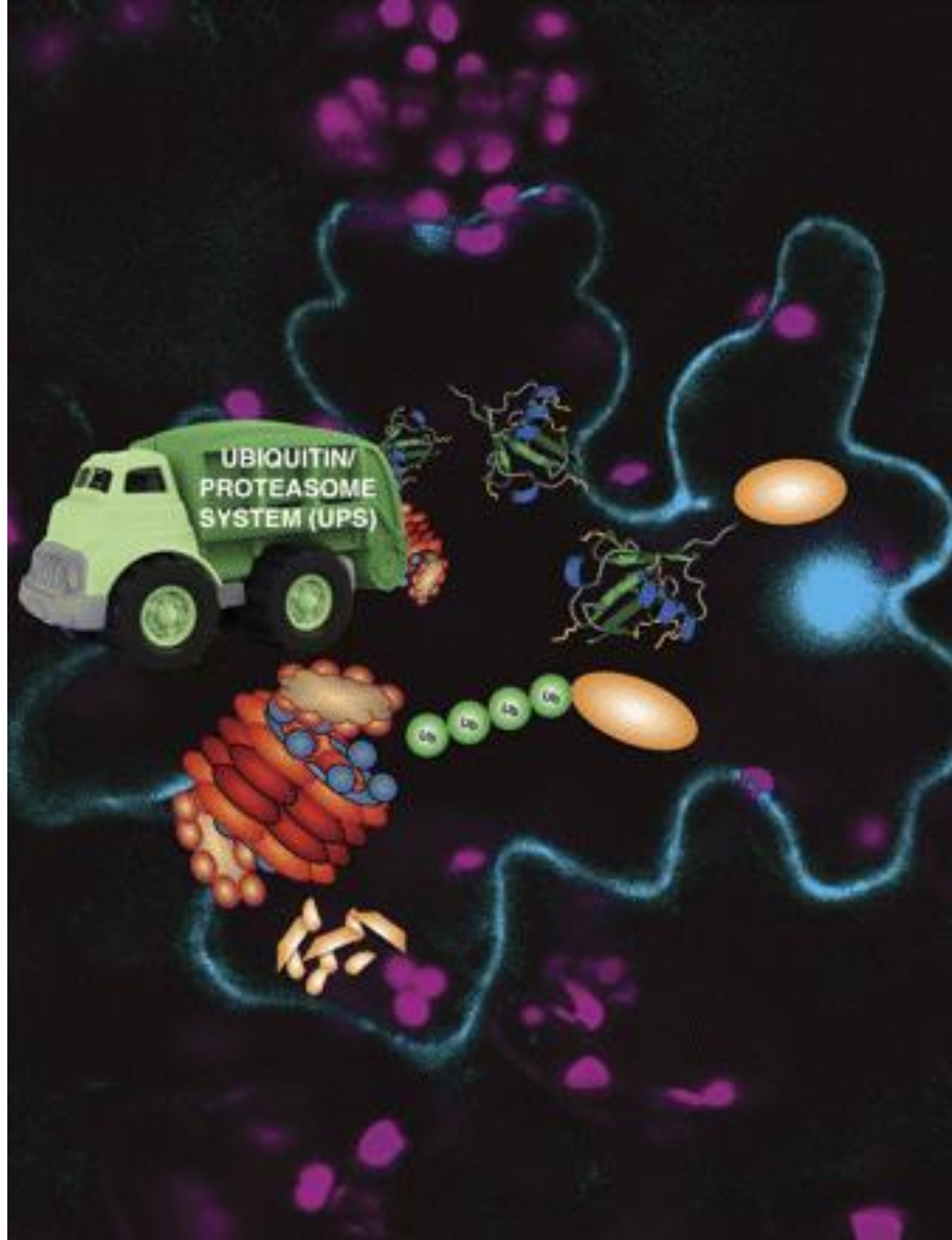
PPhys August 2012

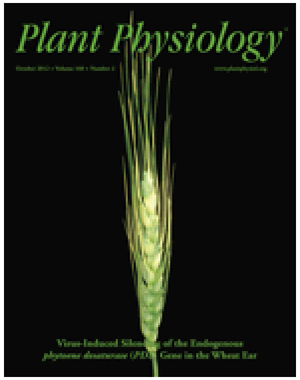
On the Cover: Functional genomics tools for maize (*Zea mays*)





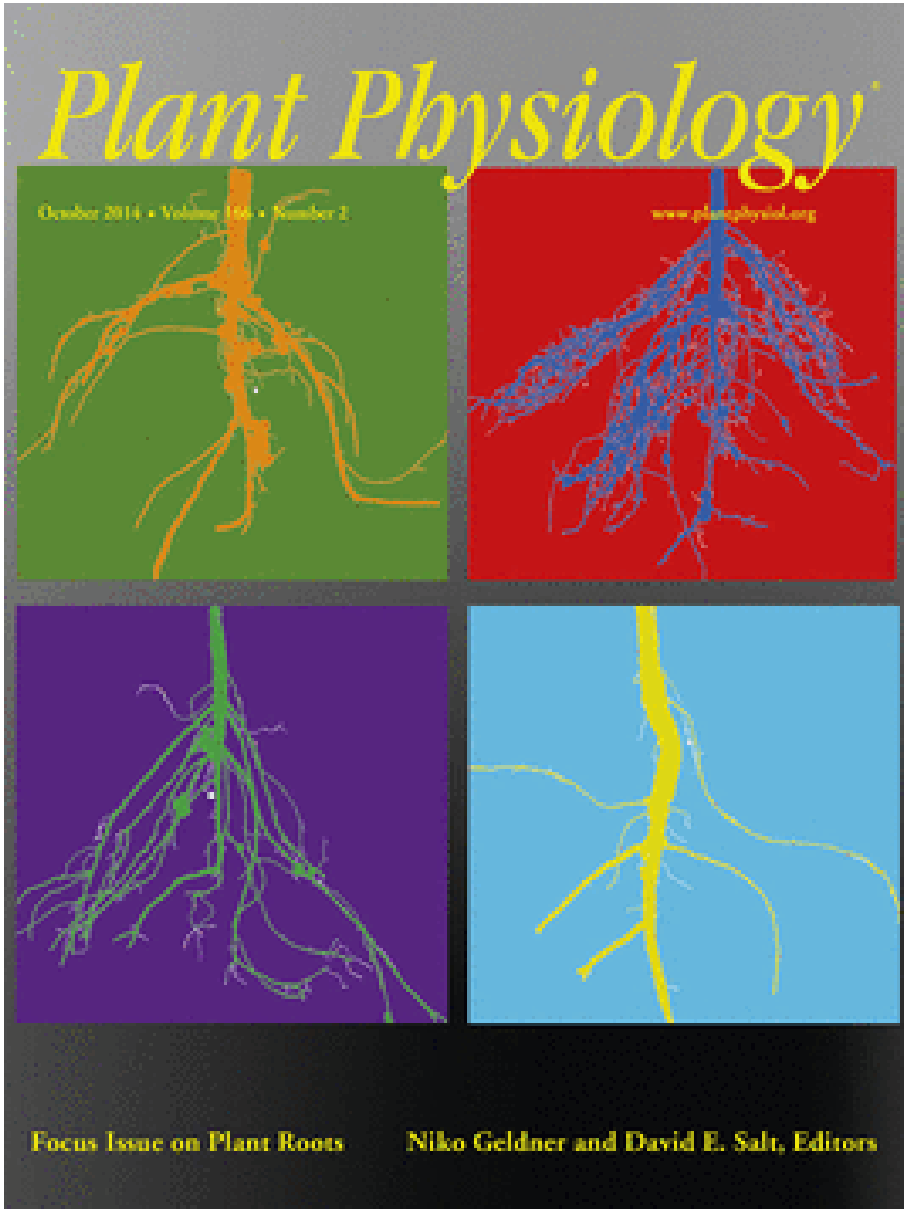
PPhys September 2012





PPhys October 2012

On the Cover: Wheat (*Triticum aestivum*)
***Barley stripe mosaic virus* (BSMV)-derived**
functional genomic tools,
Virusinduced gene silencing (VIGS)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Focus Issue on Plant Roots
Niko Geldner and David E. Salt, Editors

On the Cover: The cover image, entitled “The shape of roots to come,
“ was composed by Alexander Bucksch from the computed binary image masks of cowpea roots. The image conveys the diversity of root shapes of an emerging crop and the increasingly important algorithmic advances enabled by computational plant sciences. As described in Bucksch et al. (pp. 470–486), computational analysis of root systems excavated and imaged in field conditions enabled the phenotypic differentiation of 188 cowpea genotypes.