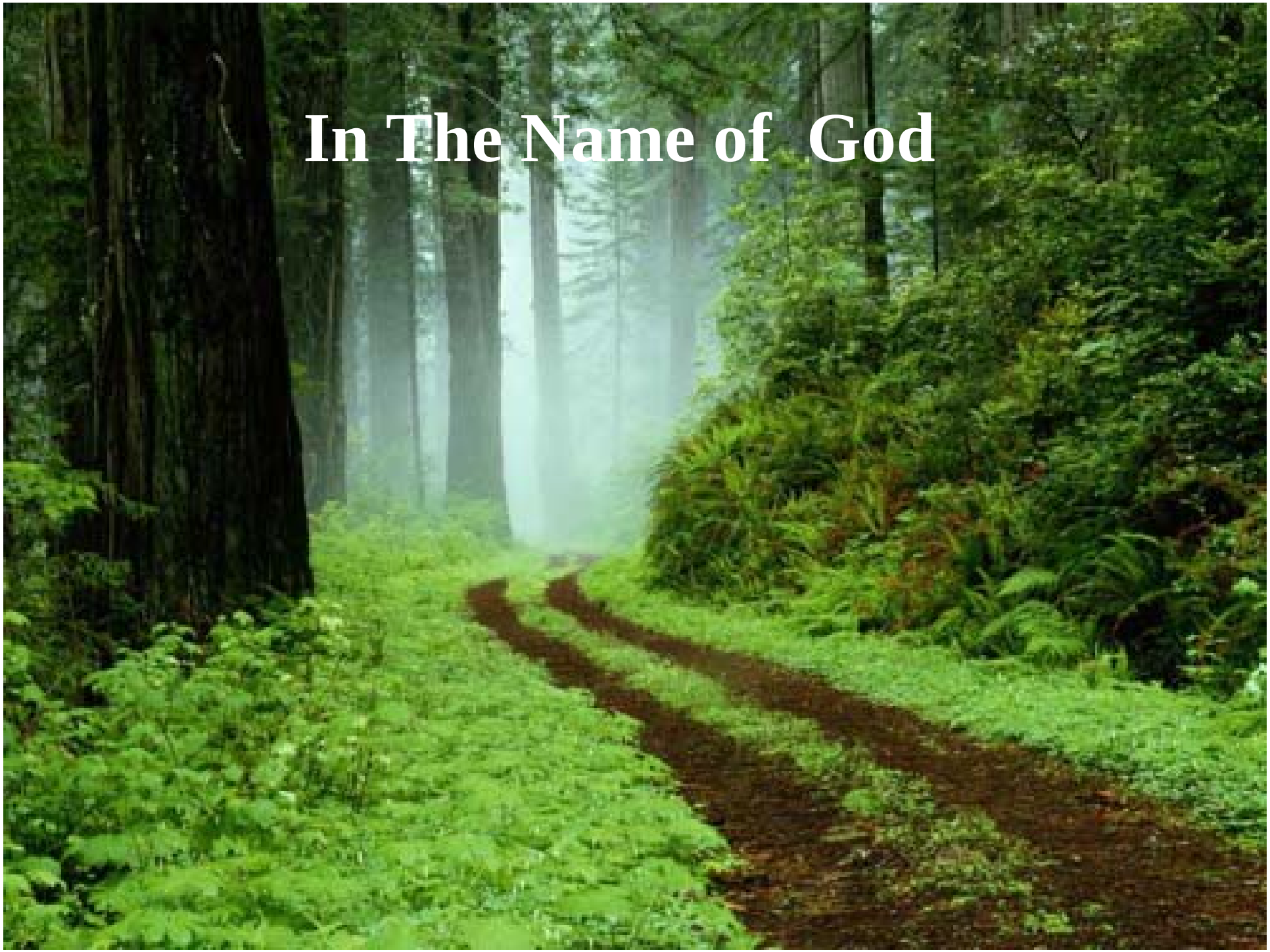

In The Name of God

Cytosole

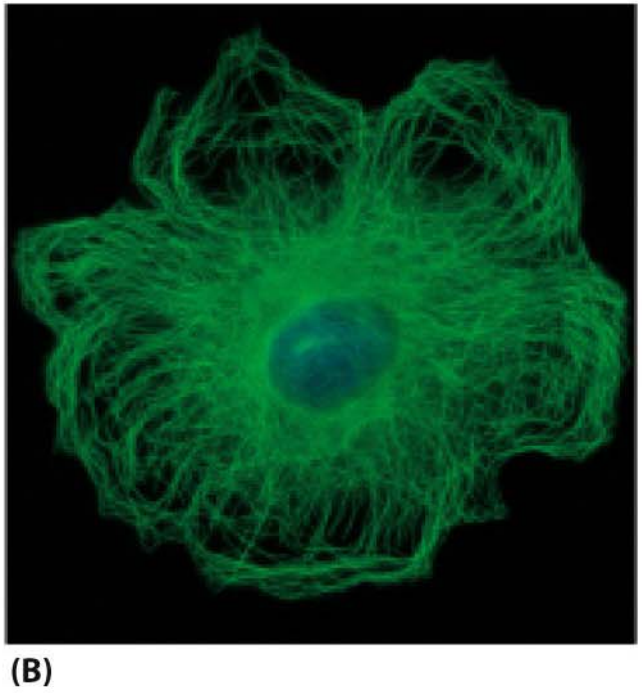
- Hydrated gel

Figure 1-26 Essential Cell Biology 3/e (© Garland Science 2010)

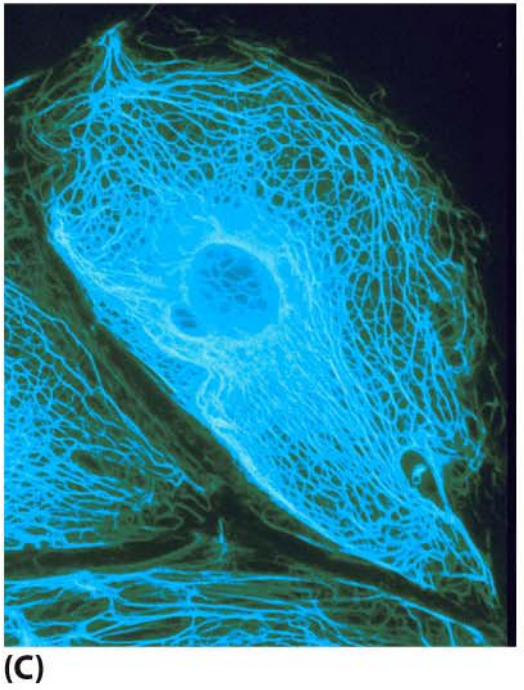
Cytoskeleton

- Actin filaments
- Intermediate filaments
- microtubules

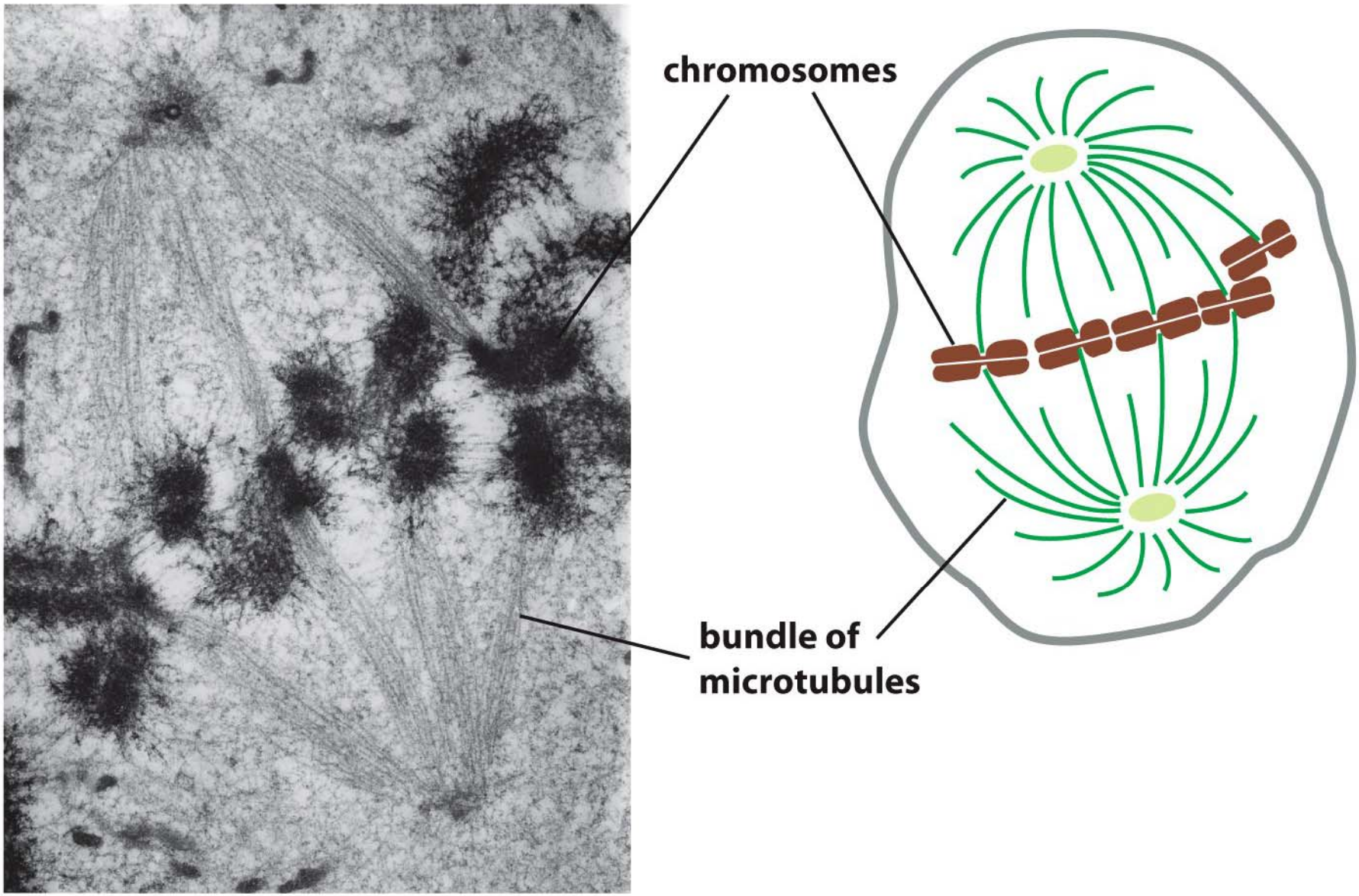
A) Actin filaments



B) Microtubules



C) Intermediate filaments

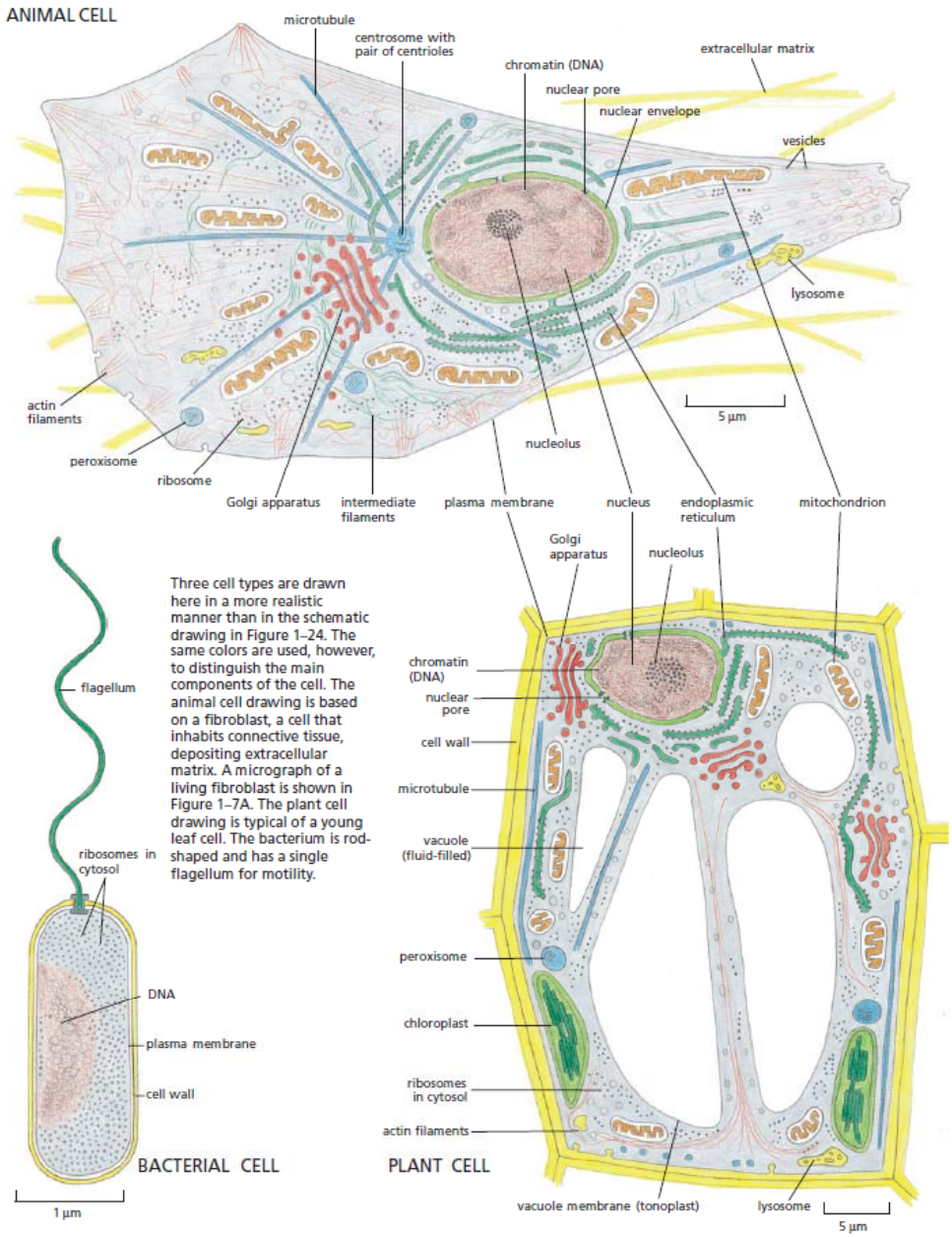

chromosomes
bundle of
microtubules

Dynamic cytoplasm

- Organelle movement
- Cytoskeleton

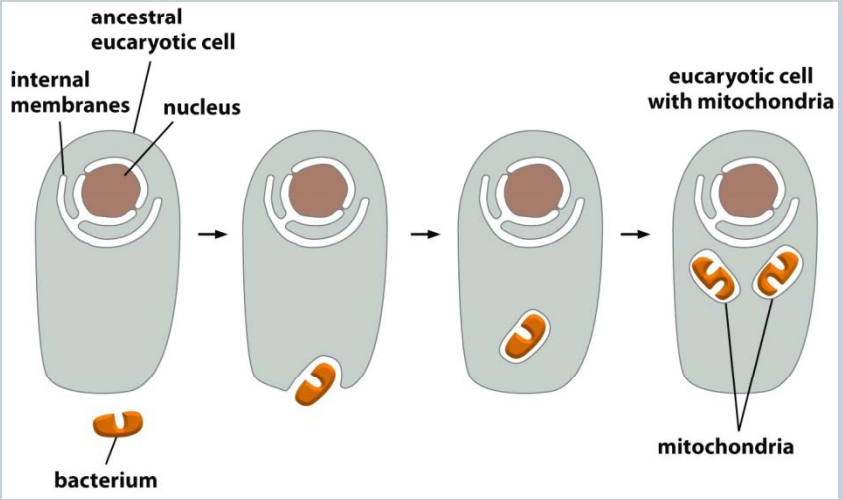
TABLE 1–1 HISTORICAL LANDMARKS IN DETERMINING CELL STRUCTURE

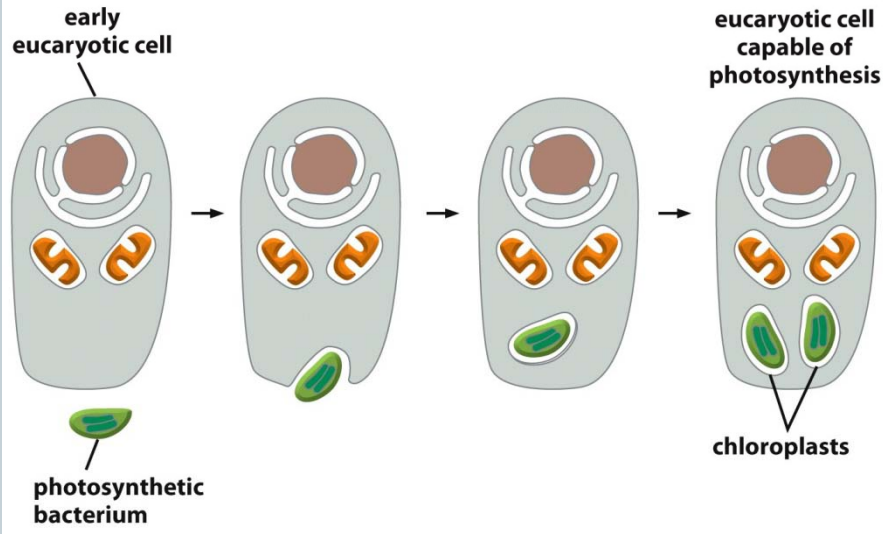
1665	Hooke uses a primitive microscope to describe small pores in sections of cork that he calls "**cells.**"
1674	Leeuwenhoek reports his discovery of **protozoa.** Nine years later, he sees **bacteria** for the first time.
1833	Brown publishes his microscopic observations of orchids, clearly describing the cell **nucleus.**
1838	Schleiden and Schwann propose the **cell theory,** stating that the nucleated cell is the universal building block of plant and animal tissues.
1857	Kölliker describes **mitochondria** in muscle cells.
1879	Flemming describes with great clarity **chromosome behavior during mitosis** in animal cells.
1881	Cajal and other histologists develop staining methods that reveal the structure of **nerve cells** and the organization of neural tissue.
1898	Golgi first sees and describes the **Golgi apparatus** by staining cells with silver nitrate.
1902	Boveri links **chromosomes and heredity** by observing chromosome behavior during sexual reproduction.
1952	Palade, Porter, and Sjöstrand develop methods of **electron microscopy** that enable many intracellular structures to be seen for the first time. In one of the first applications of these techniques, Huxley shows that muscle contains arrays of protein filaments—the first evidence of a **cytoskeleton.**
1957	Robertson describes the bilayer structure of the **cell membrane,** seen for the first time in the electron microscope.
1960	Kendrew describes the first detailed **protein structure** (sperm whale **myoglobin**) to a resolution of 0.2 nm using **X-ray crystallography.** Perutz proposes a lower-resolution structure for **hemoglobin.**
1965	Christian de Duve and his colleagues use a **cell fractionation** technique to separate **peroxisomes, mitochondria,** and **lysosomes** from a preparation of rat liver.
1968	Petran and collaborators make the first **confocal microscope.**
1974	Lazarides and Weber use **fluorescent antibodies** to stain the cytoskeleton.
1994	Chalfie and collaborators introduce **green fluorescent protein (GFP)** as a marker to follow the behavior of proteins in living cells.

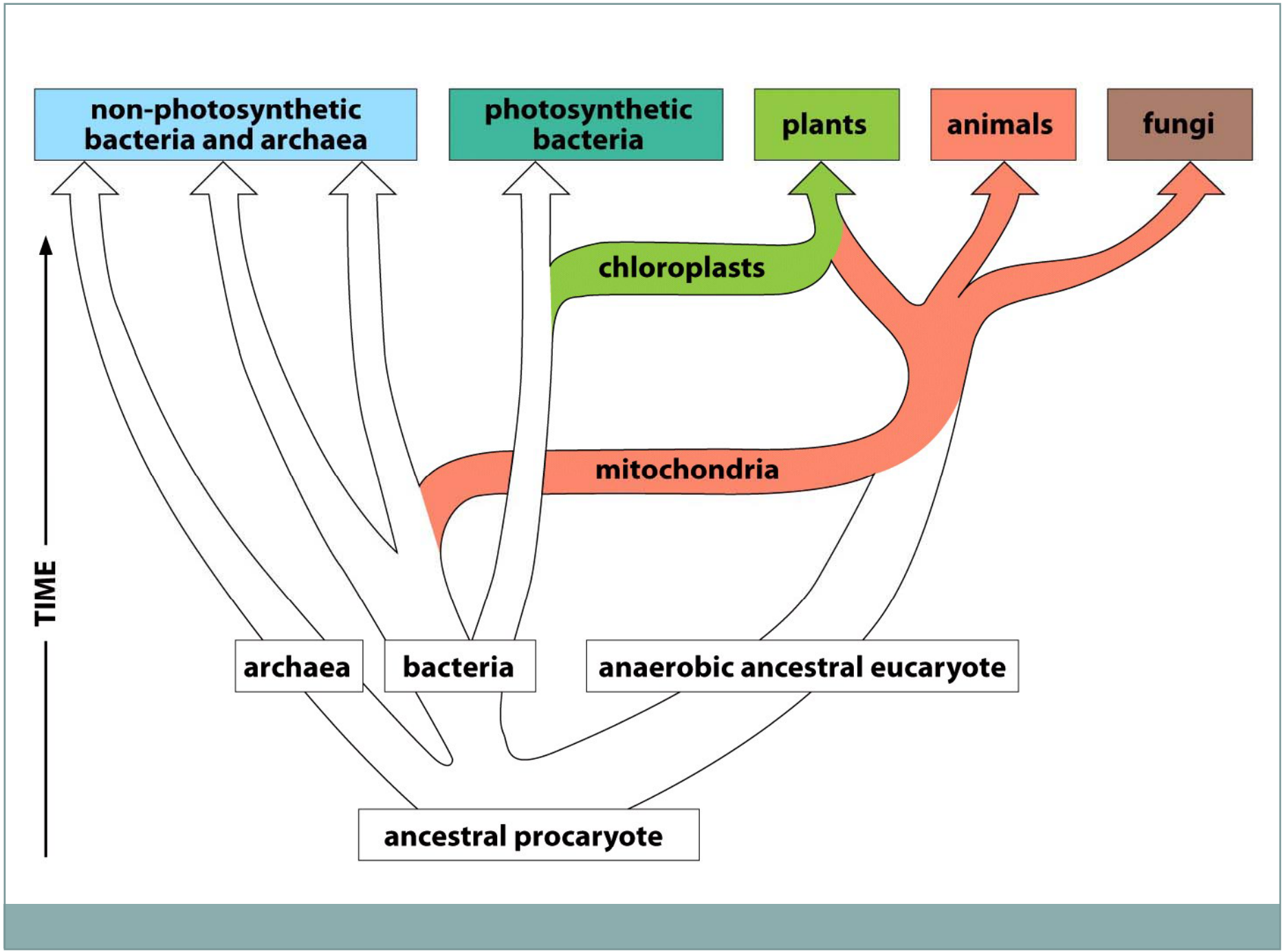

ANIMAL CELL
microtubule
centrosome with pair of centrioles
chromatin (DNA)
nuclear pore
nuclear envelope
extracellular matrix
vesicles
lysosome
5 µm
actin filaments
peroxisome
ribosome
Golgi apparatus
intermediate filaments
nucleolus
plasma membrane
nucleus
endoplasmic reticulum
mitochondrion
Three cell types are drawn here in a more realistic manner than in the schematic drawing in Figure 1–24. The same colors are used, however, to distinguish the main components of the cell. The animal cell drawing is based on a fibroblast, a cell that inhabits connective tissue, depositing extracellular matrix. A micrograph of a living fibroblast is shown in Figure 1–7A. The plant cell drawing is typical of a young leaf cell. The bacterium is rod-shaped and has a single flagellum for motility.
flagellum
ribosomes in cytosol
DNA
plasma membrane
cell wall
BACTERIAL CELL
1 µm
Golgi apparatus
nucleolus
chromatin (DNA)
nuclear pore
cell wall
microtubule
vacuole (fluid-filled)
peroxisome
chloroplast
ribosomes in cytosol
actin filaments
PLANT CELL
vacuole membrane (tonoplast)
lysosome
5 µm

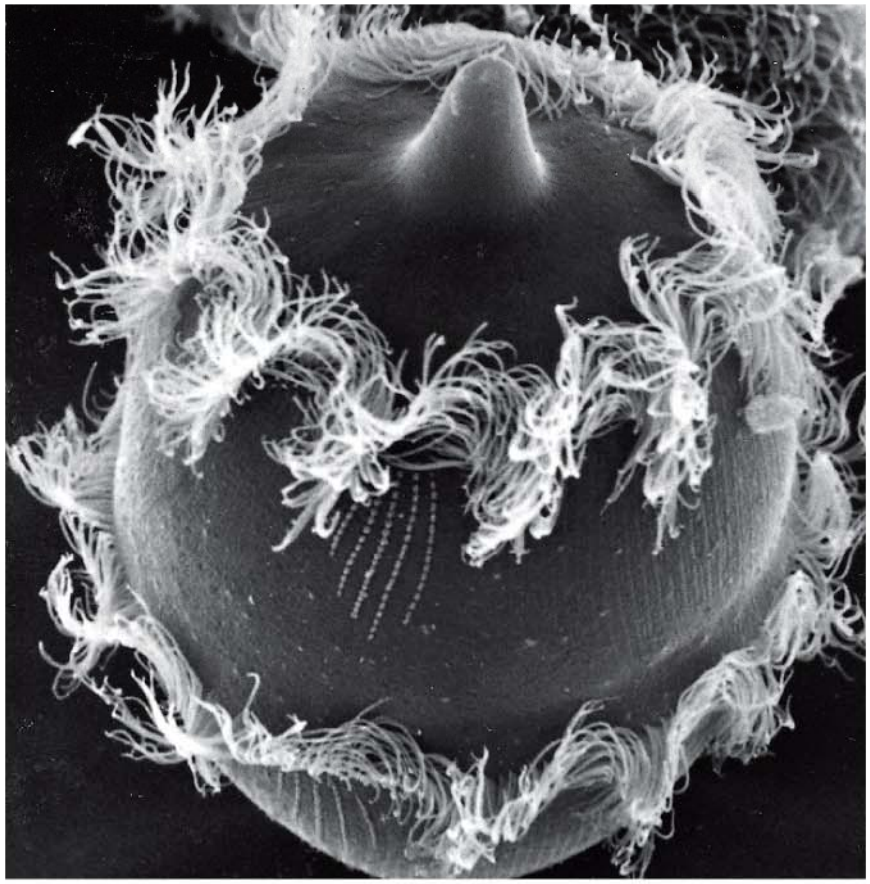
Ancestral eukaryote

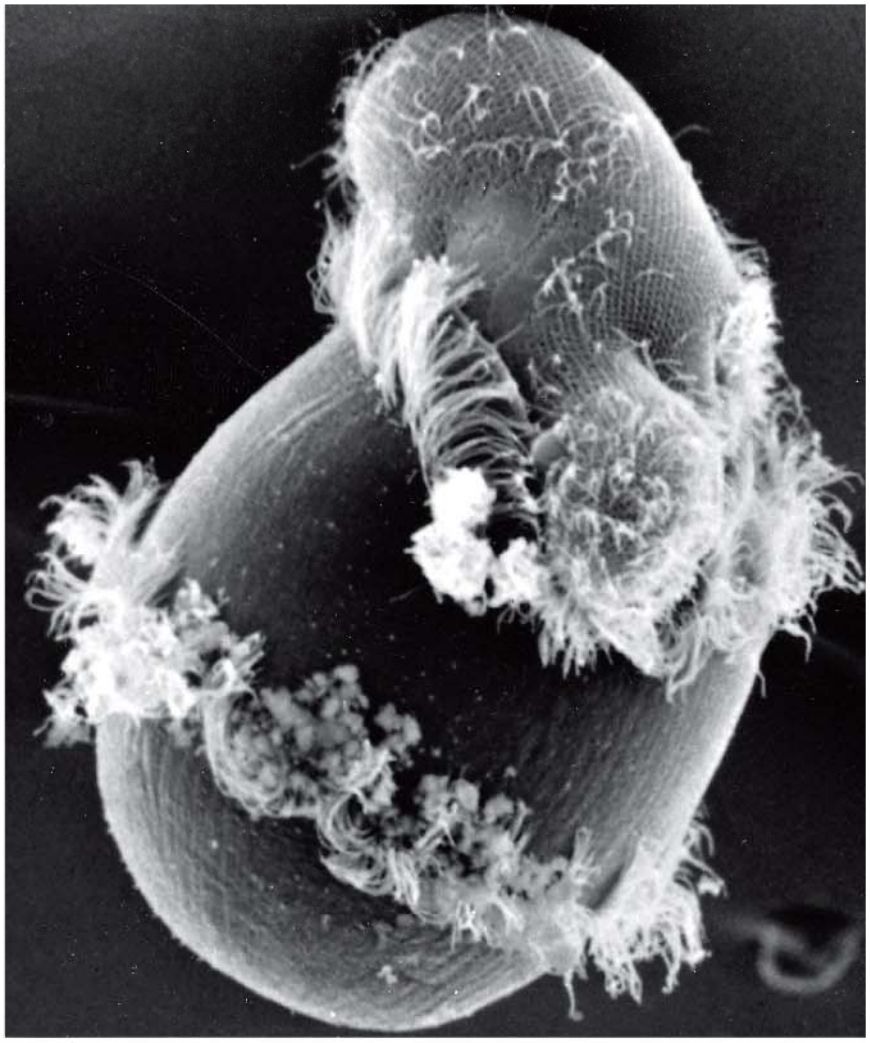
- As a predator



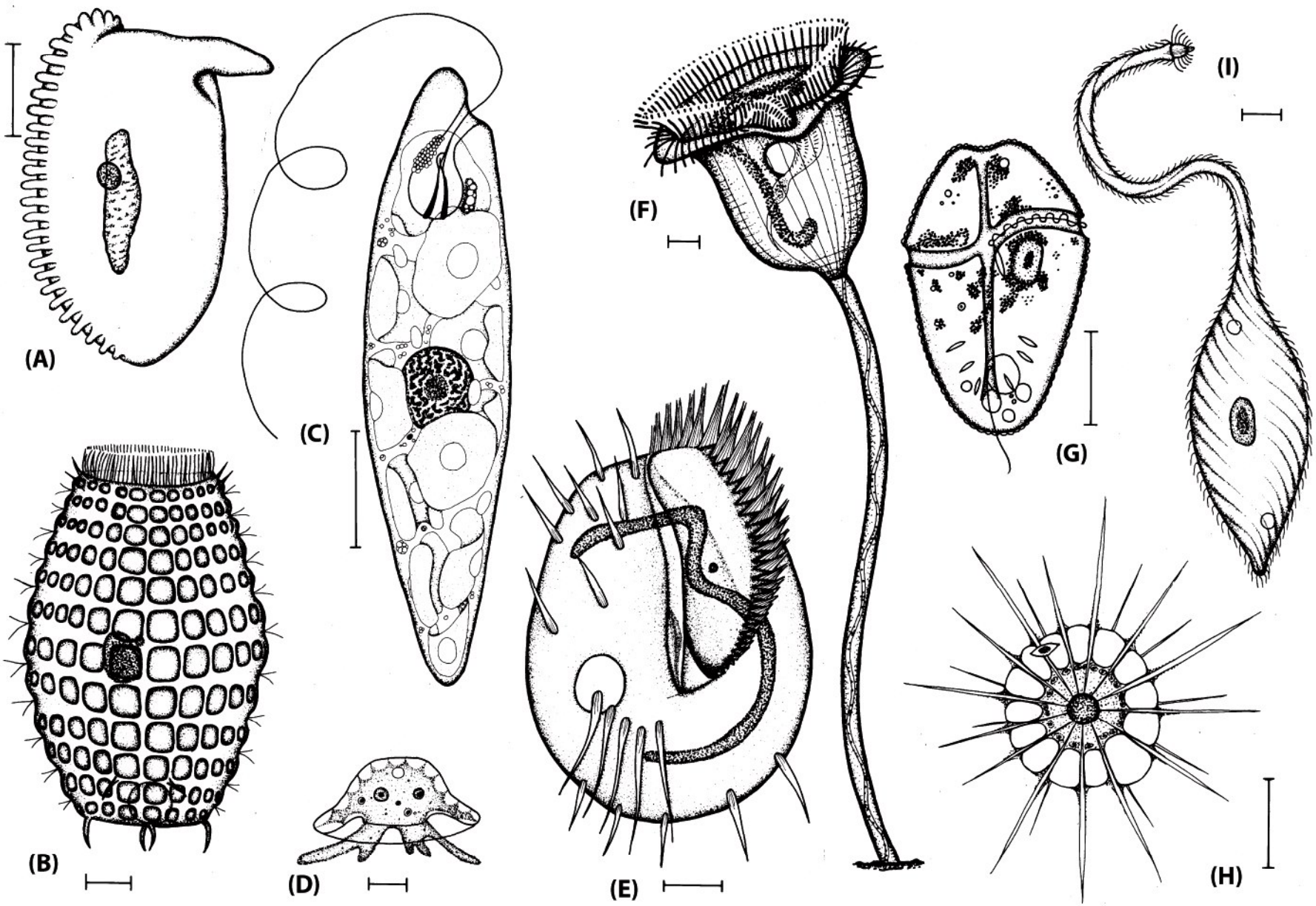



non-photosynthetic bacteria and archaea
photosynthetic bacteria
plants
animals
fungi
chloroplasts
mitochondria
TIME
archaea
bacteria
anaerobic ancestral eucaryote
ancestral procaryote





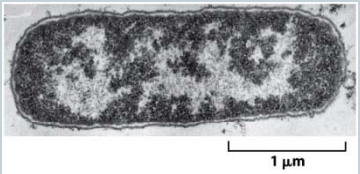
Didinium (protozoa) eats paramecium


(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
(I)

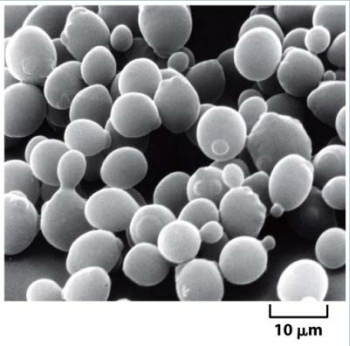
Model animals

- Rapid division
- Genetic Manipulation
- Lucid

- E. coli



- Saccharomyces cerevisiae

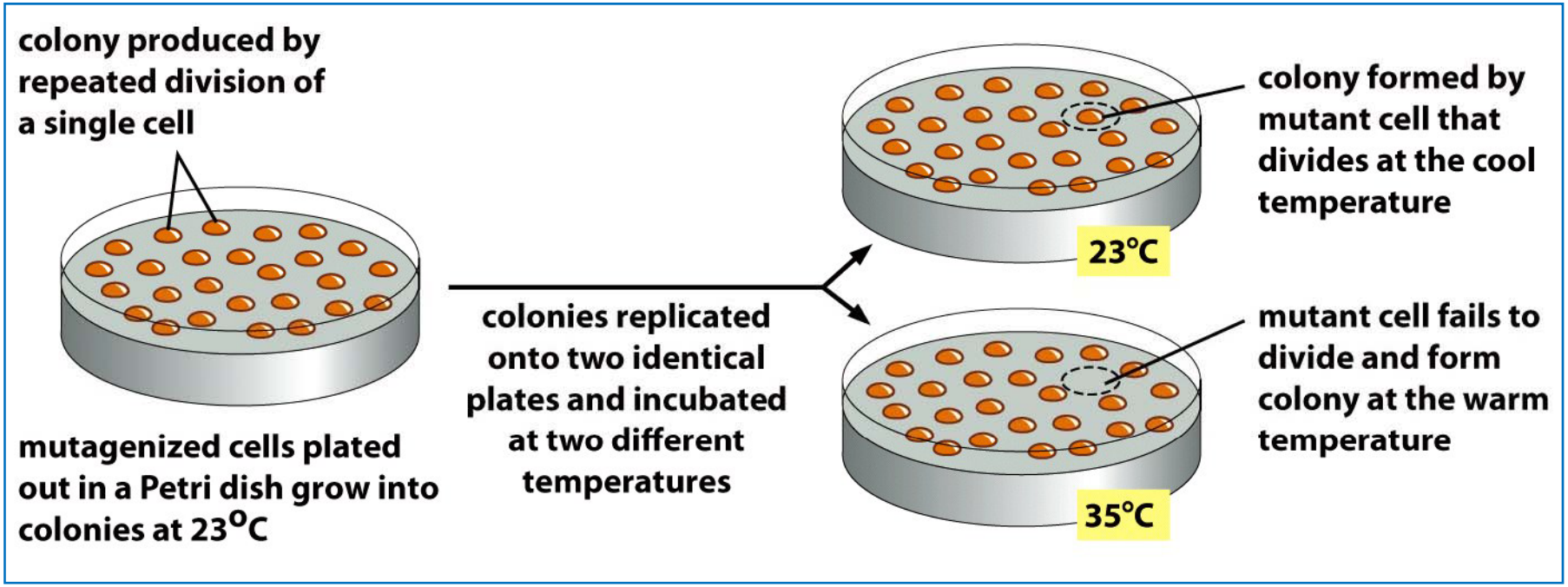


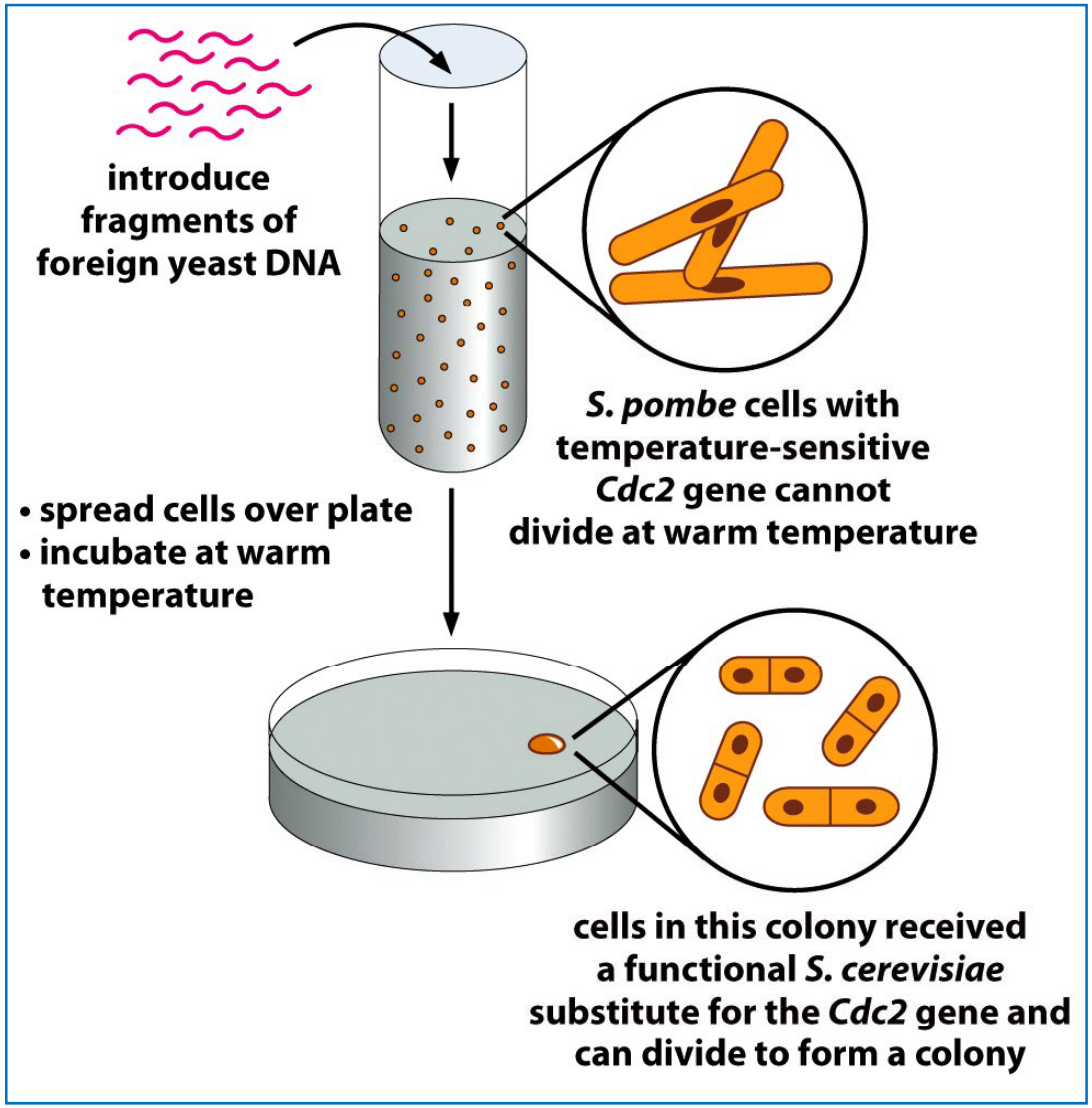
- Arabidopsis thaliana

- Drosophila melanogaster

General Life Mechanism

- Cell division & death

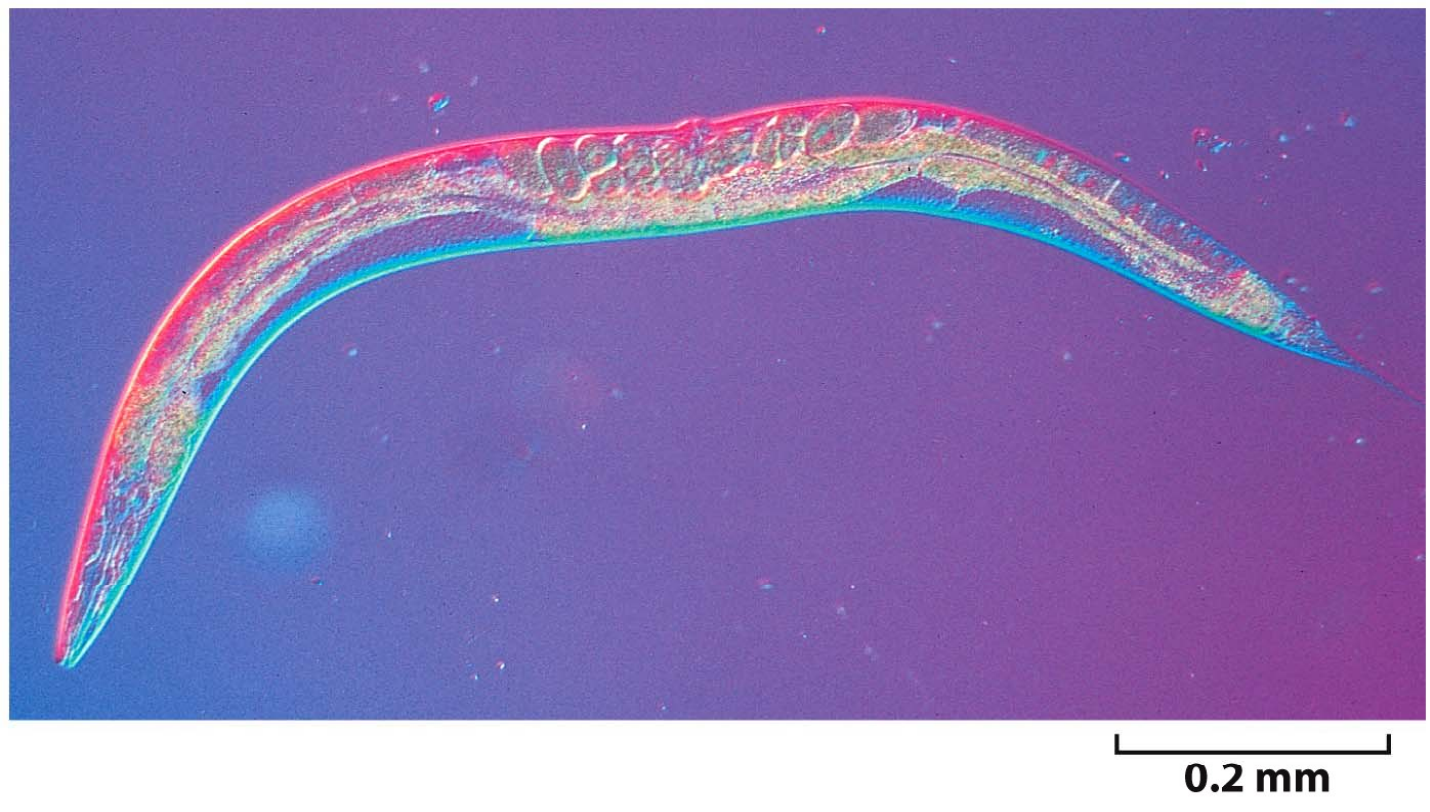





```
human       ···FGLARAFGIPIRVYTHEVVTLWYRSPEVLLGSARYSTPVDIWSIGTIFAELATKLPLFHGDSEIDQLFRIPRALGTPNNEVWPEVESLQDYKNTFP···
S. pombe    ···FGLARSFGVPLRNYTHEIVTLWYRAPEVLLGSRHYSTGVDIWSVGCIFAENIRRSPLFPGDSEIDEIFKIPQVLGTPNEEVWPGVTLLQDYKSTFP···
S. cerevisiae···FGLARAFGVPLRAYTHEIVTLWYRAPEVLLGGKQYSTGVDTWSIGCIFAEHCNRLPIFSGDSEIDQIFKIPRVLGTPNEAIWPDIVYLPDFKPSFP ··
```

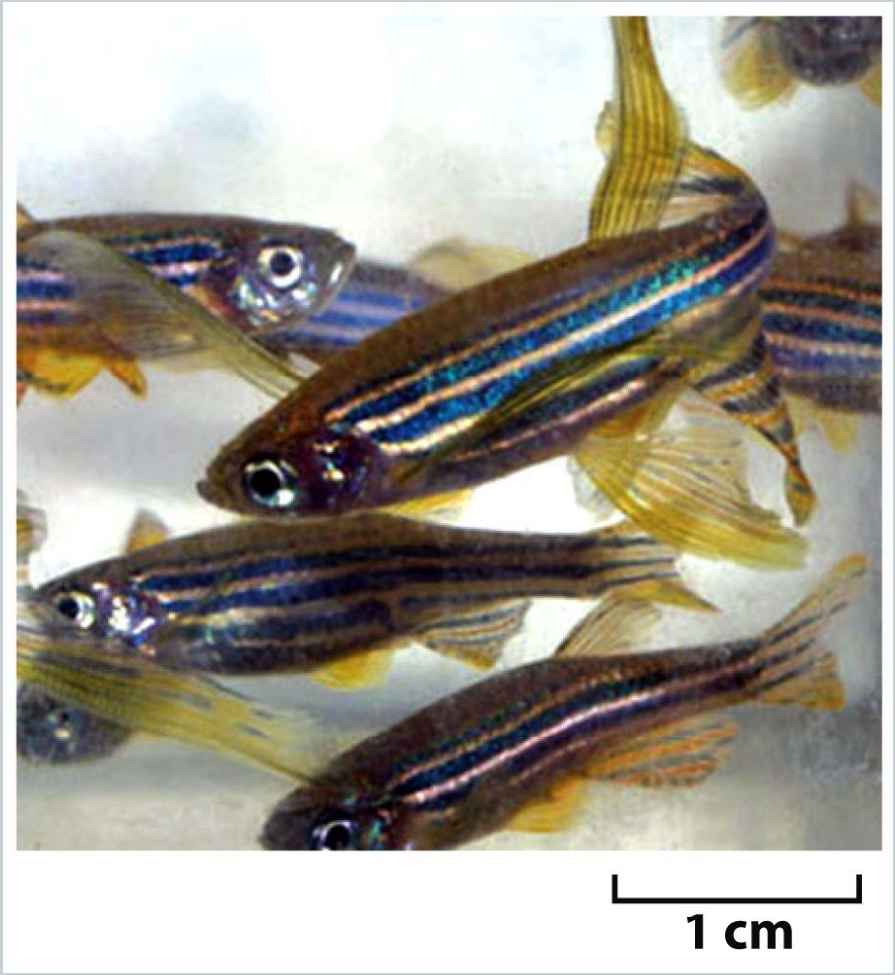
C. elegans

- 959 cells
- 19,000 genes
- 70% pr.
- Apoptosis
- Cancer

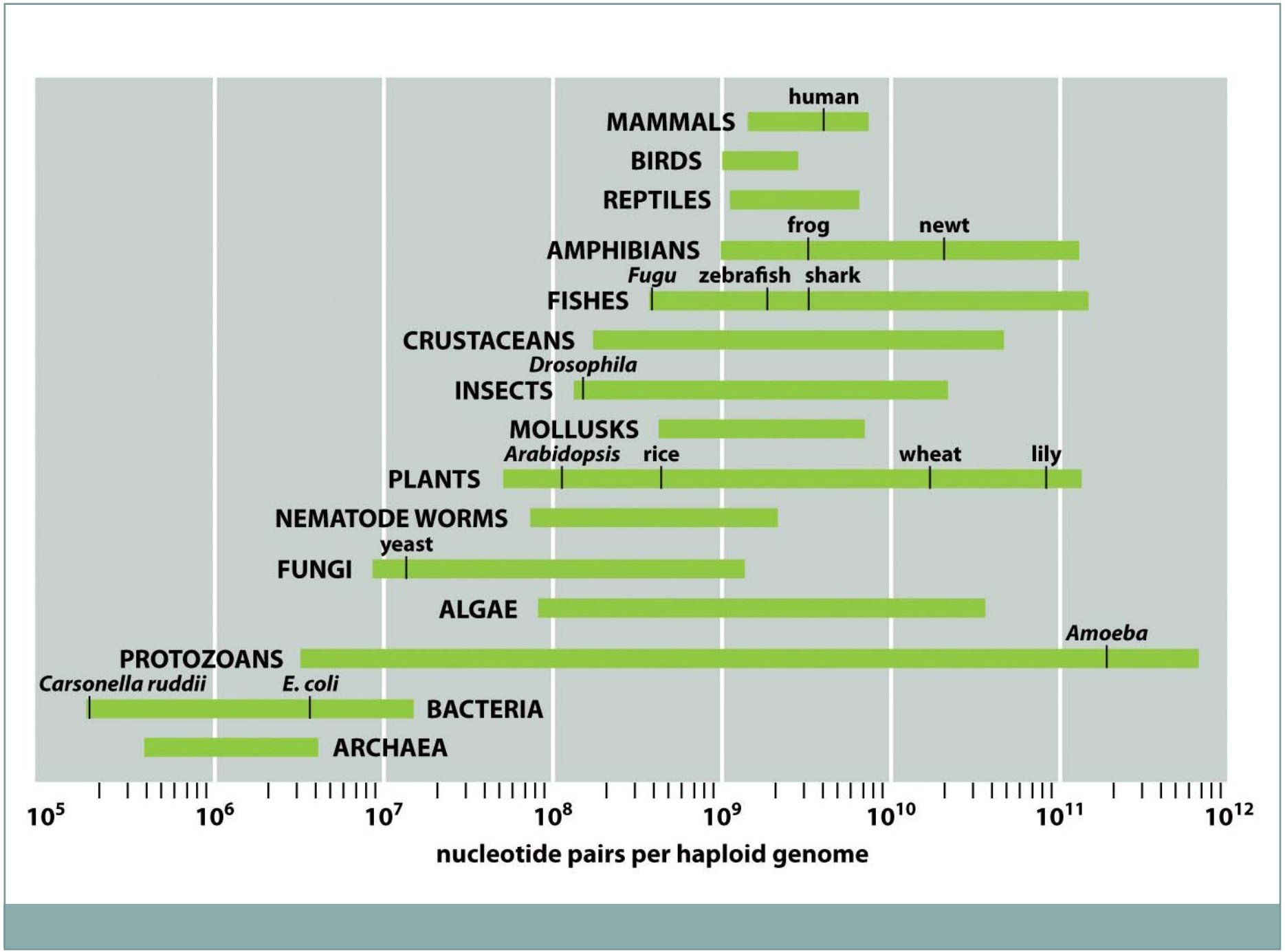


Zebrafish

- Lucid embryo (2 weeks)



Mice


human
MAMMALS
BIRDS
REPTILES
frog
newt
AMPHIBIANS
Fugu
zebrafish
shark
FISHES
CRUSTACEANS
Drosophila
INSECTS
MOLLUSKS
Arabidopsis
rice
wheat
lily
PLANTS
NEMATODE WORMS
yeast
FUNGI
ALGAE
Amoeba
PROTOZOANS
Carsonella ruddii
E. coli
BACTERIA
ARCHAEA
10^5
10^6
10^7
10^8
10^9
10^10
10^11
10^12
nucleotide pairs per haploid genome