

Cell structure

Cell theory: three statements

Cell structure

How is cell theory used to make predictions?

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Three structures common to all cells

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Magnification formula

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How is an eyepiece graticule calibrated?

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Coarse or fine adjustment at high power?

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Stains for temporary mounts

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Main advantage of electron microscopes

By deduction: a newly discovered organism is predicted to consist of one or more cells.

All organisms consist of one or more cells; cells are the basic structural unit of life; cells only arise from pre-existing cells.

magnification = image size $\div$ actual size, so
actual size = image size $\div$ magnification
(both in the same units).

DNA as genetic material, a cytoplasm composed mainly of water, and a plasma membrane composed of lipids.

Fine adjustment only. The coarse adjustment is used first, at low power.

Line it up against a stage micrometer for each objective lens, then calculate the length of one eyepiece unit.

Much higher resolution, because electrons have a shorter wavelength than light, so ultrastructure is visible.

Iodine for plant cells (starch, nuclei); methylene blue for animal cells (nuclei).

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Freeze fracture

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Cryogenic electron microscopy

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Immunofluorescence

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Five components of a Gram-positive bacterium

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Two examples of Gram-positive eubacteria

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Structure of the eukaryotic nucleus

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What makes up the eukaryotic cytoskeleton?

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The eight functions of life

Rapid freezing in glass-like ice; many images combined by computer give 3D protein structures at near-atomic resolution.

A rapidly frozen sample is split along membranes; a replica viewed by electron microscopy shows proteins spanning the bilayer.

Cell wall, plasma membrane, cytoplasm, naked DNA in a loop and 70S ribosomes.

Antibodies tagged with fluorescent markers bind specific proteins, showing where they are in the cell under a light microscope.

Chromosomes of DNA bound to histones, enclosed in a double membrane with pores.

Bacillus and *Staphylococcus*.

Homeostasis, metabolism, nutrition, movement, excretion, growth, response to stimuli and reproduction.

Microtubules and microfilaments.

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How does Paramecium carry out homeostasis?

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How does Chlamydomonas respond to light?

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Cell wall composition in plants and fungi

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Vacuoles in plant and animal cells

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Which eukaryotic cells have centrioles?

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Atypical cells with many nuclei

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Atypical cells with no nucleus

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How do you identify a mitochondrion in an electron micrograph?

An eyespot detects light, and two flagella move the cell towards it.

Contractile vacuoles collect and expel excess water that enters by osmosis.

Plants: a large permanent central vacuole of cell sap. Animals: small, temporary vacuoles.

Plants: cellulose. Fungi: chitin. Animal cells have no cell wall.

Aseptate fungal hyphae (no cross walls) and skeletal muscle fibres (formed by fusion of cells).

Animal cells. Centrioles are absent from flowering plants and most fungi.

Oval, with a double membrane; the inner membrane is folded into cristae.

Mature mammalian red blood cells and phloem sieve tube elements.

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Rough versus smooth ER in an electron micrograph

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Annotation for the Golgi apparatus

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Label versus annotation

Cell structure **HL only**

Endosymbiosis: which organelle came first?

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Three pieces of evidence for endosymbiosis

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Which prokaryotes became mitochondria and chloroplasts?

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Basis of cell differentiation

Cell structure **HL only**

Two advantages of multicellularity

Processes proteins and packages them into vesicles, for example for secretion.

Rough ER: flattened sacs studded with ribosomes. Smooth ER: tubular membranes without ribosomes.

Mitochondria, in the ancestor of all eukaryotes; chloroplasts later, in some lineages only.

A label names a structure; an annotation adds a brief note, such as its function.

An aerobic bacterium became the mitochondrion; a cyanobacterium became the chloroplast.

Mitochondria and chloroplasts have 70S ribosomes, naked circular DNA and the ability to replicate.

Larger body size and cell specialisation.

Different patterns of gene expression, often triggered by changes in the environment.

Which groups are multicellular?

All plants and animals, and many fungi and eukaryotic algae. Multicellularity evolved repeatedly.