

Cell and nuclear division

What happens in cell division?

Cell and nuclear division

How does cytokinesis happen in an animal cell?

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How does cytokinesis happen in a plant cell?

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Name two examples of unequal cytokinesis.

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Why must the nucleus divide before the cell divides?

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Mitosis vs meiosis: effect on chromosome number?

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What does a chromosome consist of after DNA replication?

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How are chromosomes condensed and moved?

A ring of contractile actin and myosin proteins pinches the cell membrane inwards until the cytoplasm is split.

A parent (mother) cell divides to produce two daughter cells.

Oogenesis in humans (polar bodies are tiny) and budding in yeast.

Vesicles gather at the equator and assemble sections of new cell membrane and cell wall across the cell.

Mitosis maintains the chromosome number and genome; meiosis halves the chromosome number and generates genetic diversity.

To avoid producing anucleate cells (cells with no nucleus).

DNA supercoils around histones to condense; spindle microtubules and microtubule motor proteins move the chromosomes.

Two elongated DNA molecules (sister chromatids) held together until anaphase.

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Phases of mitosis in order?

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Why are the nuclei produced by mitosis genetically identical?

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How do you recognise metaphase in a micrograph?

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Diploid vs haploid?

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The two rounds of segregation in meiosis?

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What is non-disjunction, and an example?

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Two ways meiosis generates genetic diversity?

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Three uses of cell proliferation, with examples?

Replication makes exact copies of each chromosome, and one chromatid of every chromosome goes to each pole in anaphase.

Prophase, metaphase, anaphase, telophase.

Diploid ($2n$): two of each type of chromosome. Haploid (n): one of each type of chromosome.

Chromosomes lined up across the equator (middle) of the cell, with no nuclear membrane.

Failure of homologous chromosomes or sister chromatids to separate in meiosis. Example: trisomy 21, Down syndrome.

Meiosis I: homologous chromosomes separate. Meiosis II: sister chromatids separate. Result: four haploid nuclei.

Growth (plant meristems, early embryos), cell replacement (skin) and tissue repair (wound healing in skin).

Crossing over between non-sister chromatids (prophase I) and random orientation of bivalents (metaphase I).

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Stages of the cell cycle in order?

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What happens to cell growth in interphase?

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How do cyclins control the cell cycle?

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Proto-oncogene vs tumour suppressor gene mutation?

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Benign vs malignant tumour?

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Primary vs secondary tumour?

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Mitotic index formula?

Gene expression **HL only**

What is gene expression?

Metabolically active: biosynthesis of proteins and DNA; mitochondria and chloroplasts grow and divide.

Interphase (G1, S, G2), then mitosis, then cytokinesis.

Proto-oncogene mutates to an oncogene that stimulates division constantly; tumour suppressor gene loses its function of slowing division.

Concentrations of different cyclins rise and fall; a threshold level of a specific cyclin is needed to pass each checkpoint.

Primary: where the tumour first forms.
Secondary: formed elsewhere by cells that spread (metastasis).

Benign: slow, stays in place, not cancer.
Malignant: fast, invades neighbouring tissue, metastasises, causes cancer.

The mechanism by which information in genes has effects on the phenotype: transcription, translation and function of the protein product.

Number of cells in mitosis $\div$ total number of cells observed.

Gene expression **HL only**

Promoter, enhancer, transcription factor?

Gene expression **HL only**

How does mRNA degradation regulate translation?

Gene expression **HL only**

What is epigenesis?

Gene expression **HL only**

Genome, transcriptome, proteome?

Gene expression **HL only**

Two examples of epigenetic tags?

Gene expression **HL only**

What is epigenetic inheritance?

Gene expression **HL only**

Example of the environment changing epigenetic tags?

Gene expression **HL only**

Why are ligers larger than tigons?

Nucleases break mRNA down; mRNA lasts minutes to days, so controlling breakdown controls how much protein is made.

Promoter: where RNA polymerase binds.
Enhancer: site where activators bind.
Transcription factor: protein binding specific DNA sequences to regulate transcription.

Genome: all DNA (same in all cells).
Transcriptome: all RNA transcribed.
Proteome: all proteins made. Last two differ between cells.

The development of patterns of differentiation in the cells of a multicellular organism. Phenotype changes but not genotype.

Passing phenotypic changes to daughter cells or offspring without changing the DNA sequence, when tags stay in place through mitosis or meiosis.

Methylation of cytosine in promoters (represses transcription) and methylation of histones (represses or activates transcription).

Not all tags are removed from gametes (imprinting): a liger gets strong growth promotion from its lion father but only weak growth restraint from its tigress mother.

Air pollution alters methyl tags on DNA, for example more methylation of the FOXP3 promoter in immune cells of children with asthma in a polluted city.

Gene expression **HL only**

What do monozygotic twin studies show?

Gene expression **HL only**

How does oestrogen change gene expression?

Gene expression **HL only**

How does lactose switch on the lac operon?

Water potential

How do ions dissolve in water?

Water potential

Hypertonic, hypotonic, isotonic?

Water potential

Direction of osmosis in terms of solute concentration?

Water potential

What happens to water in an isotonic environment?

Water potential

How do you deduce the isotonic concentration of plant tissue?

It enters target cells, binds a receptor, and the complex acts as a transcription factor on specific genes.

Identical genomes but methylation differences grow with age and time apart, so the environment affects gene expression.

Cations attract the δ^- oxygen ends and anions the δ^+ hydrogen ends of polar water molecules, which surround them.

Lactose binds the repressor, which leaves the operator, so RNA polymerase transcribes the genes for lactose uptake and breakdown.

From the less concentrated (hypotonic) solution to the more concentrated (hypertonic) solution.

Higher, lower or the same solute concentration compared with another solution.

Plot mean percentage change in mass or length against solute concentration; read where the line crosses zero.

Dynamic equilibrium: water moves in and out at equal rates, so there is no net movement.

Water potential

What does standard error show?

Water potential

Cell without a wall in hypotonic vs hypertonic medium?

Water potential

What is the role of a contractile vacuule?

Water potential

Turgor pressure vs plasmolysis?

Water potential

Two medical uses of isotonic solutions?

Water potential **HL only**

What is water potential and its reference point?

Water potential **HL only**

Which way does water move in terms of water potential?

Water potential **HL only**

Water potential equation, and signs of each term?

Hypotonic: swells and bursts. Hypertonic: shrinks and crenates.

How precisely the mean is known from the repeats; shown as error bars, used to compare reliability.

Turgor: pressure on the wall in a hypotonic medium. Plasmolysis: membrane pulls away from the wall in a hypertonic medium.

Collects and expels water that enters freshwater unicellular organisms by osmosis, so they do not burst.

Potential energy of water per unit volume; relative to pure water at atmospheric pressure and 20°C (0 kPa).

Intravenous fluids and bathing organs ready for transplantation.

$\psi_w = \psi_s + \psi_p$. ψ_s is zero or negative; ψ_p is usually positive in cells, negative in xylem under tension.

From higher to lower water potential, which lowers its potential energy.

Water potential **HL only**

**Plant tissue in a hypertonic solution:
 ψ_s and ψ_p ?**

Water leaves; ψ_s becomes more negative and ψ_p falls to zero until ψ_w of the cells equals that of the solution.