

# Edexcel IAL Biology A-level

## Topic 3: Cell Structure, Reproduction and Development Definitions and Concepts

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### 3.1-3.8 - Cell Structure and Microscopy

**Bacterial capsule:** A layer around the cell walls of certain bacteria, made from starch, gelatin, protein or glycolipid, which protects the bacterium from phagocytosis by white blood cells.

**Cell wall:** A tough outer layer which surrounds some cell types and is made of peptidoglycan in bacteria and cellulose in plants.

**Cell:** The basic unit of a living organism composed of organelles suspended in a cytoplasm with a cell membrane surrounding it.

**Centrioles:** Small structures found in the cytoplasm made of microtubules that produce the spindle fibres that are involved with the separation of chromosomes in mitosis.

**Circular DNA:** DNA that forms a closed loop and has no ends.

**Differential staining:** Using multiple different stains to distinguish different parts of a specimen.

**Eukaryotic cell:** A type of cell that contains a nucleus along with membrane bound organelles.

**Eyepiece graticule:** A scale bar inside the eyepiece of a light microscope which can be calibrated against a ruler to measure structures.

**Flagella:** A whip-like structure that sticks out of the cell surface of bacterial cells and is used for cell movement.

**Golgi apparatus:** An organelle found in eukaryotic cells that is involved in the modification and packaging of lipids and proteins.

**Gram-negative bacteria:** A type of bacteria with an outer membrane and a thin inner peptidoglycan cell wall which does not retain the crystal violet stain during gram staining.

**Gram-positive bacteria:** A type of bacteria with thick outer peptidoglycan cell walls which retain the crystal violet stain during gram staining.

**Light microscope:** A type of microscope that uses a series of lenses to magnify the visible light reflecting off a specimen.

**Lysosomes:** Membrane-bound vesicles found in the cytoplasm that contain a hydrolytic enzyme called lysozyme that is used to digest an invading cell or break down worn out components of the cell.

**Magnification:** How much bigger an image appears compared to the original object calculated using the following formula:

$$\text{Image size} = \text{Actual size} \times \text{Magnification}$$



**Mitochondria:** The organelles found in eukaryotic cells which are the sites of aerobic respiration.

**Mitosis:** The division of a cell to produce two genetically identical daughter cells.

**Nucleoid:** The area in prokaryotic cells where the chromosomes are found.

**Nucleolus:** A dense region found inside the nucleus that contains proteins and RNA and is involved in synthesizing new ribosomes.

**Nucleus:** An organelle found in eukaryotic cells that stores the genetic information of the cell as chromosomes and is surrounded by a membrane called the nuclear envelope.

**Organ system:** A group of specialised organs working together to carry out a specific function.

**Organ:** A group of specialised tissues working together to carry out a specific function.

**Permanent vacuole:** A membrane bound structure found in plant and fungal cells that contains cell sap.

**Plasmids:** Circular loops of DNA found in the cytoplasm of prokaryotic cells separate from the nucleoid.

**Prokaryotic cell:** A type of cell that does not contain any membrane bound organelles or a nucleus.

**Prokaryotic DNA:** Circular pieces of DNA that do not have associated proteins.

**Resolution:** The ability to distinguish two different nearby points in a specimen.

**Ribosome:** An organelle found either free in the cytoplasm or as a part of the rough endoplasmic reticulum which catalyses protein synthesis.

**Rough endoplasmic reticulum (RER):** A membrane-bound organelle (with a surface covered in ribosomes) that is involved in the synthesis and packaging of proteins.

**Scanning electron microscope (SEM):** A type of electron microscope that passes a beam of electrons over the surface of a specimen to produce an image.

**Smooth endoplasmic reticulum (SER):** A membrane-bound organelle involved in lipid synthesis.

**Tissue:** A group of specialised cells working together to carry out a specific function.

**Tonoplast:** The membrane which surrounds the permanent vacuole.



**Transmission electron microscope (TEM):** A type of electron microscope that passes a beam of electrons through a sample to produce an image.

### **3.9-3.16 - Meiosis, Mitosis and Reproduction**

**Acrosome:** An organelle found in the head of sperm cells which is specialised to digest the outer coating of an egg cell during fertilisation.

**Alleles:** Different versions of the same gene.

**Anaphase:** The third stage in mitosis where the chromosomes are pulled apart to the poles of the cell by the spindle fibres.

**Anaphase 1:** The third stage of meiosis where the homologous chromosomes that make up the bivalent are pulled apart to the poles of the cell by the spindle fibres.

**Anaphase 2:** The seventh stage of meiosis where the chromatids are pulled apart to opposite poles of the cell.

**Anther:** The pollen-bearing structure of the stamen.

**Asexual reproduction:** The production of genetically identical offspring from one parent through the process of mitosis.

**Carpel:** The female part of the plant consisting of a stigma, a style and an ovary.

**Cell cycle:** The series of stages preparing the cell for division consisting of 3 main phases (interphase, mitosis and cytokinesis).

**Chromatid:** One strand of a replicated chromosome.

**Chromosome:** A structure composed of tightly condensed DNA which contains many genes.

**Cortical reaction:** The reaction that occurs in a fertilised oocyte to harden the zona pellucida and prevent multiple sperm from fertilising the oocyte.

**Cross-pollination:** A type of pollination in which pollen is transferred from an anther of one plant to a stigma of a different plant. This results in plants with greater genetic diversity.

**Crossing over:** The exchange of genetic material between two chromosomes in a bivalent during meiosis 1.

**Daughter cells:** Genetically identical cells formed as a result of cell division.

**Diploid:** Cells with two copies of each chromosome.



**Double fertilisation:** The fertilisation event occurring in seed plants where one sperm cell fertilises the egg cell to produce a diploid zygote and the other fuses with the two polar nuclei to form a triploid endosperm.

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**Egg cell (ovum):** The female gamete, which fuses with a sperm cell to form a zygote. Mammalian ova have a tough zona pellucida to prevent their fertilisation by multiple sperm.

**Embryo sac:** A sac which contains the female ovule of a flowering plant.

**Endosperm:** A mass of tissue formed from the fusion of a sperm cell with the two polar nuclei (and subsequent division) which provides energy and nutrition for the growing seed.

**Fertilisation:** The fusion of a sperm cell nucleus and an egg cell nucleus to produce a diploid zygote.

**Gametes:** Reproductive cells or sex cells that contains the haploid set of chromosomes and which fuse together during fertilisation.

**Generative nucleus:** The haploid nucleus found in the pollen grains of flowering plants which divides by mitosis to form the two sperm nuclei.

**Genetic variation:** The difference in the genetic code (DNA) of organisms within a population.

**Germination:** The process by which a plant grows from a seed.

**Haploid:** Cells with only one copy of each chromosome.

**Independent/ random assortment:** A source of variation in meiosis where the bivalent chromosomes can line up either way around on the metaphase plate.

**Insect-pollinated flower:** A type of flower that relies on insects to transfer pollen grains between flowers.

**Locus:** The location of genes on a chromosome. ↯

**Meiosis:** A type of cell division used to produce gametes that produces four genetically different haploid daughter cells from one parent cell.

**Metaphase:** The second stage in mitosis where the chromosomes attach to the spindle fibres and align in the centre of the cell along the metaphase plate.

**Metaphase 1:** The second stage of meiosis where the bivalent chromosomes align along the



metaphase plate and independent assortment occurs.

**Metaphase 2:** The sixth stage of meiosis where the recombinant chromosomes align on the metaphase plate.

**Micropyle:** A pore in the integument of an ovule through which the pollen tube enters the embryo sac. It remains as a pore in the testa.

**Micropyle:** A small opening in the ovule which the pollen tube grows towards and allows for the entry of sperm nuclei into the ovule.

**Mitotic index:** In a population of cells, the ratio of the number of cells undergoing mitosis to the number of cells not undergoing mitosis.

**Oogenesis:** The formation of a mature haploid ovum from the differentiation of immature diploid Oogonium.

**Ovary:** Part of the carpel that holds the ovules and following fertilisation, develops into the fruit.

**Ovule:** The structure in seed plants which contains the embryo sac and becomes the seed after it has been fertilised.

**Pollen:** Grains produced by flowers which contain the male gametes from the plant.

**Pollen tube:** The tube used to transport the sperm nuclei from the pollen grain to the micropyle on the embryo sac for fertilisation of the ovule.

**Pollen tube digestive enzymes:** Enzymes found in the tip of the pollen tube which break down the style to create a path for tube growth from the pollen grain to the embryo sac.

**Pollination:** The deposition of pollen onto a stigma from an anther.

**Polyspermy:** The fertilisation of an oocyte by multiple sperm.

**Prophase 1:** The first stage of meiosis where the nuclear envelope breaks down, the spindle fibres form and the chromosomes condense and form bivalents. This is the stage of meiosis where crossing over occurs.

**Prophase 2:** The fifth stage of meiosis where the nuclear envelope breaks down, the spindle fibres form and the chromosomes condense.

**Prophase:** The first stage in mitosis where the nuclear envelope breaks down, the centrosomes move to opposite poles of the cell, the mitotic spindle begins to form and the chromosomes condense.

**Secondary oocytes:** Haploid cells that have completed meiosis 1.



**Secondary spermatocytes:** Haploid cells that have completed meiosis 1 and give rise to spermatids.

**Sex linkage:** An allele which is found on a sex chromosome. Its expression is determined by the gender of the organism.

**Sperm cell:** The male gamete which contains a long tail, an acrosome and lots of mitochondria and is specialised to fertilise an egg cell.

**Spermatogenesis:** The formation of mature haploid sperm cells from diploid germ cells.

**Stigma:** The sticky structure of the carpel that receives pollen grains.

**Tapetum:** A specialised layer of cells within the anther that provide nutrients to developing pollen grains.

**Telophase:** The final stage of mitosis where new nuclear envelopes begin to form around the separated sets of chromosomes.

**Telophase 1:** The fourth stage of meiosis where the nuclear envelopes reform around the separated chromosomes and they uncoil.

**Telophase 2:** The final stage in meiosis where the nuclear envelopes reform around the separated chromatids (now called chromosomes) and they uncoil.

**Testa:** The outer covering of a seed, commonly referred to as the seed coat.

**Triploid:** Cells with three copies of each chromosome.

**Tube nucleus:** The nucleus found in the pollen grains of flowering plants which controls the growth of the pollen tube.

**Wind-pollinated flower:** A type of flower that relies on wind to transfer pollen grains between flowers.

**Zona pellucida:** The tough outer layer of the egg cell which is composed of glycoproteins and is used to prevent multiple sperm cells from fertilising the egg.

**Zygote:** A diploid fertilised egg cell formed from the fusion of a sperm and ovum.

### **3.17-3.21 - Development of Organisms**

**Blastocyst:** A fluid filled mass of cells which contains the inner cell mass (ICM) which later becomes the embryo.

**Differential gene expression:** The process of switching on or off genes to control functions



within a cell by varying the production of proteins.

**DNA methylation:** The epigenetic modification of DNA by the addition of a methyl group which reduces transcription.

**Epigenetics:** The study of how gene expression influences traits in an organism.

**Genotype:** The genetic makeup of an organism.

**Histone acetylation:** The epigenetic modification of histone proteins by the addition of an acetyl group which relaxes the DNA and increases transcription.

**Lac operon:** A group of genes that control lactose uptake and metabolism in certain types of bacteria and are all regulated by the binding of the lac repressor to the lac operator.

**Mature mRNA:** The final mRNA product that has had introns removed, as well as having undergone other post-transcriptional changes.

**Morula:** An early-stage embryo consisting of 16 cells (called blastomeres) in a solid ball contained within the zona pellucida.

**Multipotent stem cell:** A stem cell that can divide into a limited range of differentiated cells. Most somatic stem cells are multipotent.

**Operon:** A group of genes which are all under the control of the same operator.

**Phenotype:** The observable physical characteristics of an organism which is based on the interaction with genotype and the environment.

**Pluripotent stem cell:** A type of stem cell which has the ability to differentiate into any cell type in the body.

**Polygenic inheritance:** The inheritance of multiple different alleles at multiple loci that control a single phenotype.

**Post-transcriptional control:** The level of gene regulation in which primary mRNA can be modified, controlling translation.

**Post-translational control:** The level of gene regulation in which proteins can be modified post-synthesis.

**Pre-mRNA:** The product of transcription before any post-transcriptional regulation.

**Somatic stem cell:** Another name for an adult stem cell.

**Stem cell:** A type of undifferentiated cell which has the ability to divide many times and differentiate into many different cell types.





**Totipotent stem cell:** A type of stem cell which has the ability to differentiate into any type of cell in the body or in the placenta.

Definitions denoted with a '+' taken from: [Pearson Edexcel International Advanced Subsidiary/Advanced Level in Biology – Specification – Issue 1 \(September 2017\)](#).

