

Revision Notes Topic 3

Prokaryotic organisms are **prokaryotic cells**(single-celled like bacteria)- **no nucleus**

Eukaryotic organisms are **eukaryotic cells**(complex, including animal and plant cells) - **nucleus**

- Both types contain **organelles** which are parts of cells with a **specific function**.
- **Cell ultrastructure** is the **internal** structure and organelles.

Animal cells- eukaryotic

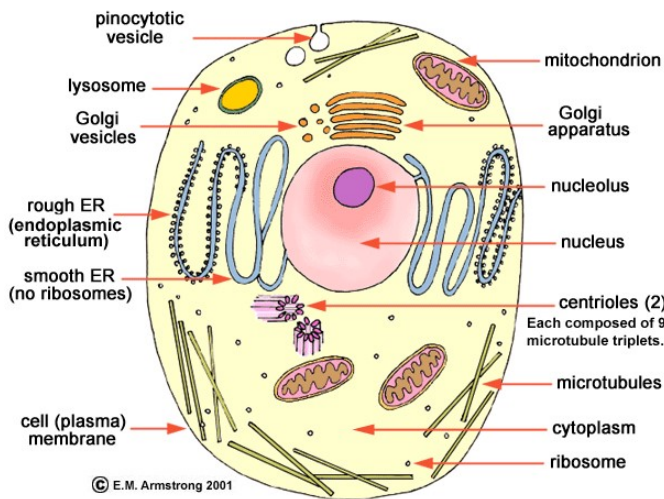


Diagram	Description	Function
Nucleus 	- Large organelle surrounded by a nuclear envelope (double membrane) - Pores - Chromatin is made from DNA and proteins - Nucleolus	- Controls the cells activities - DNA contains instructions for making proteins - Pores allow substances (e.g. RNA) to move between the nucleus and cytoplasm - Nucleolus makes ribosomes
Lysosome 	- Round organelle surrounded by a single membrane - No clear internal structure - Acrosome= specialised lysosome	- Contains digestive enzymes kept separate from the cytoplasm by the surrounding membrane - Used to digest invading cells - Break down worn out components of the cells
Rough Endoplasmic Reticulum (RER) 	- Membranes enclosing a fluid-filled space - Covered with ribosomes	- Folds and processes proteins made by the ribosomes
Ribosome 	- Small organelles that floats free in the cytoplasm or is attached to the RER - Made of proteins and RNA - No membrane	- Site for protein synthesis
Golgi Apparatus 	- Fluid-filled, membrane-bound, flattened sacs - Vesicles seen at the edge of the sacs - Formed by fusion of vesicles	- Modifies proteins - Processes and packages new lipids and proteins in vesicles for transport - It also makes lysosomes

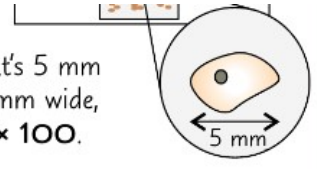
Magnification, microscopes, micrometers..

Magnification:

$\frac{\text{Size of image}}{\text{Size of real object}}$

For example:

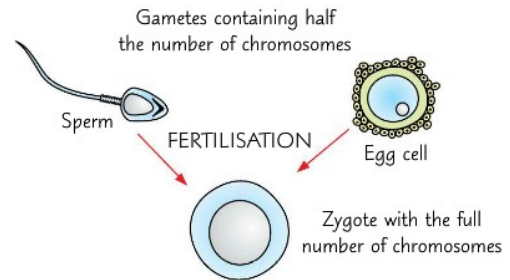
If you have a magnified image that's 5 mm wide and your specimen is 0.05 mm wide, the magnification is: $5 \div 0.05 = \times 100$.



Gametes and fertilisation

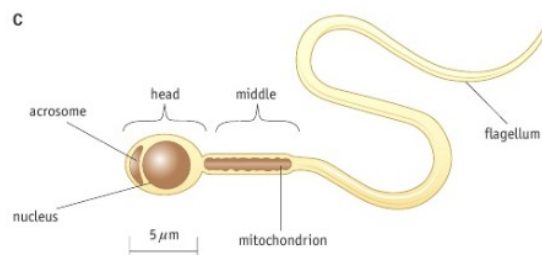
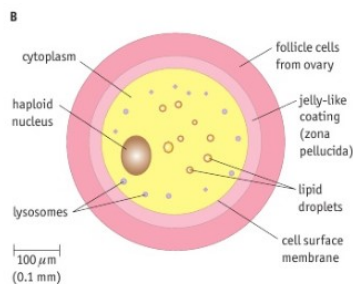
Gametes are male and female **sex cells** found in organisms that reproduce **sexually**. During fertilisation, they join to form a **zygote** which develops into a new organism.

- Gametes are **haploid** cells (23 chromosomes)



Fertilisation: fusion of the **nuclei** of the male and female gametes

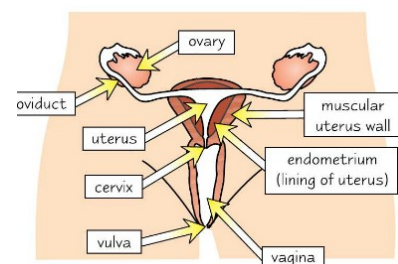
<u>Egg cell</u>	<u>Sperm cell</u>
- Larger than sperm - Food reserves to nourish the embryo - Cell plasma membrane - Nucleus - Incapable of independent movement - Wafted along by ciliated cells <u>Zona pellucida</u> - Protective glycoprotein layer that sperm have to penetrate - Jelly-like coating <u>Follicle cells</u> - Protective coating	- Respiration releases energy as ATP, which sperm uses to swim - Nucleus - Cell plasma membrane - Motile (can move) <u>Mitochondria</u> - Provide energy for tail movement <u>Flagellum</u> - Allows sperm to swim to egg cell <u>Acrosome</u> - Contains digestive enzymes to break down zona pellucida - Enable sperm to penetrate the egg



Fertilisation

Sperm is deposited close to the entrance of the **cervix**, moving through the **uterus** into one of the **oviducts** where fertilisation can occur.

1. Sperm reaches the **ovum**
2. Chemicals released by the cells **zona pellucida** trigger the **acrosome** reaction once the sperm makes **contact**



5 days after conception, a **ball of cells** called the **blastocyst** is formed, where the **outer cell layer** goes to form the **placenta** and the **inner mass** forms the **embryo tissue**. These are **pluripotent** embryonic stem cells as they can form **most cell types** but NOT **placenta** or **umbilical cord**.

Adult stem cells

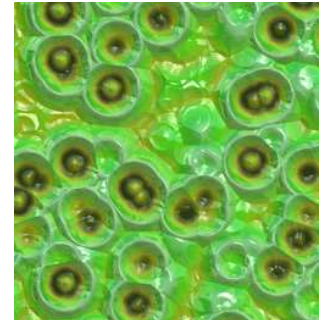
As the embryo develops they get **increasingly differentiated** and **adults** have **multipotent** stem cells which can develop into **some** types, for example:

- **Neural** stem cells can develop into various types of cell found in the **nervous system**
- **White blood cells** in the **bone marrow** can form into **red blood cells**, **platelets**, and other types of white blood cells (**macrophages**, **lymphocytes**)

Plant cells

Many plant cells **remain totipotent** throughout their life. Many differentiated cells can **de-differentiate** and develop into a **new plant**. Gardeners plant **clones** from **root**, **stem** or **leaf cuttings**.

Explants (small pieces of plant) are **surface-sterilised** and placed in a **solid agar medium** with **nutrients** and **growth regulators**. The cells divide to form a **callus** (a mass of **undifferentiated cells**).



- Altering the **growth medium** will encourage **differentiation** and forms a small group of calls similar to an embryo
- The embryos develop into complete plants that are **genetically identical clones**
- Plant **tissue culture** allows **commercial growers** to produce large numbers of identical plants **rapidly**

Tissue culture can be used in **plant research**, **plant breeding**, **genetic modification** and in **conservation** of **endangered plants**.

Use of stem cells in medicine

Used in **regenerative medicine** which involve **replacing**, **engineering** or **regenerating** human **cells**, **tissues** or **organs** to achieve normal function.

Fertility clinics get **pluripotent** stem cells from **spare embryos** and use **in vitro fertilisation** where the **ovum** is fertilised **outside** the body.

- Women are given **drugs** so they **superovulate**, producing more eggs than needed.
- Embryos are placed into the woman's womb and **additional embryos** are used for stem cells.

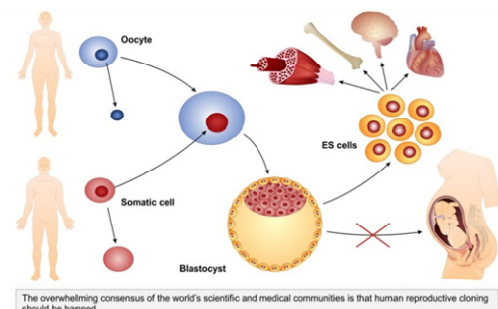
Embryos are cultured until stem cells are formed, then the cells are **isolated** from each embryo and the rest is **discarded**. Stem cells are then **cultured for research**.

Therapeutic cloning/somatic cell nuclear transfer

A **diploid** cell is **removed** and the **nucleus** is **fused** with an **ovum** from which the **haploid nucleus** has been **removed**.

- Produces a **diploid cell** rather like a **zygote**

The cell divides by **mitosis** to form a **blastocyst** and then stem cells are encouraged to develop into **tissues** (can lead to **organs**)



Problem:

The tissue formed from the stem cells may be **rejected** by the **immune system** of the person receiving the **transplant**.

Solution:

Using **drugs** that **prevent** the recipient from rejecting any transplanted tissue.

Using **tissue-typing**.