Key Concepts in Biology

EdExcel 9-1 Biology topic 1
Plant and Animal cells (eukaryotic cells)

Eukaryotic cells have these features:

1) **Cytoplasm**
2) **Genetic material within a nucleus**
3) **Cell Membrane**

Typical size of animal cell = 10-30μm

Typical size of plant cell = 10-100μm
1) **Cytoplasm** - this is where the reactions happen and these are controlled by enzymes.

2) **Nucleus** - controls the cell's activities.

3) **Cell Membrane** - controls what comes in and out.

4) **Ribosomes** - protein synthesis happens here.

5) **Mitochondria** - energy is released here during aerobic respiration.
A Typical Plant Cell:

**Cell wall** - made of cellulose which strengthens the cell

**Cell membrane** - controls what comes in and out

**Large vacuole** - contains sap and helps support the cell

**Chloroplasts** (containing chlorophyll) - this is needed for photosynthesis

**Nucleus** - controls what the cell does and stores information

**Cytoplasm** - Chemical reactions happen here

**Ribosomes**
Consider a bacteria cell in more detail:

Bacteria contain cytoplasm and a _______ surrounded by a cell wall. The _______ are NOT in a distinct _______ and bacterial cells do not have mitochondria or chloroplasts. They may have one or more small rings of DNA called _______.

Words - nucleus, membrane, plasmids, genes

Typical size of bacterial cell = 2μm
<table>
<thead>
<tr>
<th></th>
<th>Plant cells</th>
<th>Animal cells</th>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nucleus?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cell membrane?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mitochondria?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chloroplasts?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ribosomes?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vacuole?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Specialised animal cells

<table>
<thead>
<tr>
<th>I.D.</th>
<th>Red Blood Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Carries oxygen around the body</td>
</tr>
<tr>
<td>Features</td>
<td>No nucleus and large surface area</td>
</tr>
</tbody>
</table>

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**Can you complete a similar description for these cells?**

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>White blood cell</td>
<td></td>
</tr>
<tr>
<td>Egg cell (ovum)</td>
<td></td>
</tr>
<tr>
<td>Ciliated epithelial cell</td>
<td></td>
</tr>
<tr>
<td>Nerve cell (neurone)</td>
<td></td>
</tr>
</tbody>
</table>
Eggs and sperm

The female egg cell and the male sperm cell are examples of ____________ cells:

The egg cell is packed with _______ in the cytoplasm and the membrane _______ after fertilisation to stop other sperm entering.

The sperm cell is specialised in a number of ways:

Each cell has a _______ nucleus

Acrosome packed with enzymes to _______ its way through the egg

Mitochondria for energy

Strong tail for _______

The egg cell is packed with _______ in the cytoplasm and the membrane _______ after fertilisation to stop other sperm entering.

Words - changes, swimming, specialised, digest, haploid, nutrients
Microscopy

These microscopes have different powers of magnification. Consider this image of velcro:

A “stereo” microscope

An old microscope!

If the “loop” on this image is measured to be 20cm tall at a magnification of 100x how big is it really?

2mm
Scanning Electron Microscopes have much higher magnification powers than light microscopes. This has led to a much greater understanding of cell structure.

An electron microscope image of a maggot...

Notice the resolution of this image of me. The high levels of resolution also make electron microscopes very useful. Now I'm going to eat you.
### Standard Form and prefixes

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milli</td>
<td>m</td>
<td>$10^{-3}$</td>
</tr>
<tr>
<td>Micro</td>
<td>μ</td>
<td>$10^{-6}$</td>
</tr>
<tr>
<td>Nano</td>
<td>n</td>
<td>$10^{-9}$</td>
</tr>
<tr>
<td>Pico</td>
<td>p</td>
<td>$10^{-12}$</td>
</tr>
</tbody>
</table>

Now try these conversions (higher tier only)...

1. What is 1 metre in mm?
2. What is 1 metre in nanometres?
3. What is 10 mm in metres?
4. What is 100 micrometres in metres?
5. What is 100 micrometres in mm?
6. What is 1 mm in picometres?
Using a microscope

1. Eyepiece
2. Arm
3. Focus adjustor
4. Base
5. Mirror
6. Stage
7. Lenses
Enzymes are biological catalysts. They help the reactions that occur in our bodies by controlling the rate of reaction.

An enzyme is basically a large protein molecule made up of long chains of amino acids. These molecules are then “folded” to create a certain shape.

The enzyme’s shape helps another molecule “fit” into it (“lock and key”):

This shape can be destroyed (“denatured”) by high temperatures or the wrong pH:
If the shape of the active site is changed then the substrate won’t “fit” any more.
Enzymes are denatured beyond 40°C. Enzymes work best in certain conditions:

- **Temp**: Enzymes are denatured beyond 40°C
- **pH**: Could be protease (found in the stomach)
- **pH**: Could be amylase (found in the intestine)

Notice that most enzymes are denatured at high temperatures. Different enzymes work best in different pH conditions.
Enzyme activity and substrate concentration

Rate of enzyme activity could be calculated by using an equation like this:

\[
\text{Rate} = \frac{\text{Amount of product formed}}{\text{Time}}
\]

Q. What do you think this graph would look like?
Quiz on the last few slides on Enzymes

1) What are enzymes?
2) What do they do in your body? What is their basic function?
3) What are enzymes made up of?
4) What term describes the way an enzyme “fits” a specific substrate?
5) What temperature do bodily enzymes often work quickest at?
6) What happens to an enzyme if it gets too hot?
7) What approximate pH range would you want an enzyme in your stomach to work best at?
8) Name 3 places in your digestive system that enzymes are produced in.
What's the point of the digestive system?

The whole point of digestion is to break down our food into small molecules which the body can then use to make carbohydrates, lipids and proteins. Here's how enzymes are involved:
Enzymes can be produced by the body to help ________. When they come into contact and react with food they break it down into _______ pieces which can then pass into the ________:

Amylase (produced in the mouth, pancreas and small intestine) breaks _______ (a carbohydrate) down into glucose:

Protease (produced in the stomach, pancreas and small intestine) breaks _______ down into amino acids:

Lipase (produced in the pancreas and small intestine) breaks fats (______) down into fatty acids and glycerol:

Words - blood, lipids, proteins, digestion, starch, smaller
We can use apparatus like this to investigate the amount of energy contained in different foods:
Diffusion is when something travels from an area of high concentration to an area of low concentration. For example, consider the scent from a hamburger...

The “scent particles” from this hamburger are in high concentration here:

Eventually they will “diffuse” out into this area of low concentration:

Substances can move across a cell membrane by diffusion.
Diffusion is when particles spread from an area of high concentration to an area of ____ concentration. The particles move along a “concentration ______”. Diffusion can be accelerated by increasing the ________ of the particles, which makes them move ________, or by making the surface area of the membrane ________.
An example of Diffusion: the lungs

Oxygen diffuses in and carbon dioxide diffuses out of blood in the lungs:

\[ \text{O}_2 \text{ diffuses in and CO}_2 \text{ diffuses out of blood.} \]

Diffusion also occurs in cells - urea diffuses out of cells into blood plasma for excretion in the kidney.
Osmosis is a “special kind of ________________”. It’s when water diffuses from a ___________ area to a less concentrated area through a partially permeable ____________ (i.e. one that allows water to move through but not anything else): 

In this example the water molecules will move from left to right (along the concentration _______ ) and gradually _______ the sugar solution.

**Words** - membrane, concentrated, dilute, diffusion, gradient
We can easily calculate the % gain or loss in mass using the equation:

\[
\% \text{ gain/loss} = \frac{\text{change in mass}}{\text{original mass}}
\]
Active Transport

In diffusion substances moved along a concentration gradient. In active transport, substances move against this gradient:

Outside cell

Inside cell

This process takes _______ and this comes from _______________. It enables cells to take in substances even though there are in very small _____________. Root hair cells take in _______ using active transport.

Words - concentration, energy, respiration, nutrients
Active Transport in plants and humans

Mineral

Less concentrated

More concentrated

Plant nutrients are taken in by root hair cells using active transport.

Sugar molecules are absorbed from the gut into blood by active transport.
Comparing Diffusion, Osmosis and Active Transport