A-Level Biology
Revision notes 2015

The **Golgi apparatus** is a series of flattened layers of plate-like membranes.

The proteins that are made by the RER for export from the cell are pinched off at the end of the cavity of the RER, so that a layer of membrane surrounds them. The whole structure is called a **vesicle**. This vesicle will move through the cytosol and fuse with the membrane of the Golgi apparatus.

In the cavity of the Golgi apparatus, the vessel proteins are modified for export - for example, by having a carbohydrate added to the protein. At the end of a Golgi cavity, the secretory product is pinched off so that the vesicle containing the substance can move through the cytosol to the cell surface membrane.

The vesicle will fuse with this membrane and so release the secretory product. If the vesicle contains digestive enzymes, it is called a **lysosome**. Lysosomes may be used inside the cell during endocytosis, or to break-down old, redundant organelles.

Mitochondria

A typical cell may contain 1,000 mitochondria, though some will contain many more. Generally, they are sausage-shaped organelles whose walls consist of 2 membranes.

The inner membrane is folded inwards to form projections called **cristae**. Inside this is the matrix.

Most of the reactions for aerobic respiration take place in the mitochondria and it is an incredibly important organelle.

Cell wall and chloroplasts

These are only found in plant cells. **Chloroplasts** like the mitochondria - have an envelope of two membranes making up the outer "wall".

They have pairs of membranes called **thylakoids** arranged in stacks, each stack being called a **granum**. Connecting different grana together are inter-granal thylakoids. Surrounding the internal membranes, inside the envelope is the**stroma**.

The reactions of photosynthesis take place in the membranes and stroma of the chloroplast.

Nucleus

The **nucleus** is separated from the surrounding cytoplasm by the double membrane around it, the nuclear envelope. This regulates the flow of substances into and out of the nucleus.

Other organelles

Vacuole: fluid-filled space in the cytoplasm surrounded by a membrane called the tonoplast; contain a solution of sugars and salts called the cell sap.

Microtubules: hollow rod-like structures with walls of tubulin protein. Provide the structural support of cells and can aid transport through the cell.

A **genus** is a group of similar or closely related species.

The Animalia Kingdom

Some examples of classifications within the Animalia Kingdom:

Kingdom e.g.Animalia

Phylum e.g Chordata

Class e.g Mammalia

Order e.g. Primates

Family e.g. Homindae

Genus e.g Homo

Species e.g. Sapiens

Useful tip: Use the following sentence to prompt you for the first letter for each classification below Kingdom:

Please **C**ool **O**ff, **F**or **G**oodness **S**ake!

Body Plans

A **body plan** can be thought of as a cross-section through an animal, showing only the most fundamental arrangement of the tissue layers. It does not show any detail, such as the position of the internal organs.

Three main body plans:

Diploblastic acoelomate

Triploblastic acoelomate

Triploblastic coelomate

Phyla of the Animal Kingdom

For each phylum it is important to know:

General features.

The classification of one member species.

Gas Exchange

General Principles for Efficient Gas Exchange

Different organisms have different mechanisms for obtaining the gases they require.

Diffusion is required to supply all organisms with oxygen.

The efficiency of diffusion is increased if there is:

1. A large surface area over which exchange can take place.
2. A concentration gradient without which nothing will diffuse.
3. A thin surface across which gases diffuse.

Fick's Law

Fick's law is used to measure the rate of diffusion.

The larger the area and difference in concentration and the thinner the surface, the quicker the rate.

Unicellular organisms

Unicellular Organisms do not have specialised gas exchange surfaces. Instead gases diffuse in through the cell membrane.

The smaller something is, the smaller the surface area is but, more importantly, the bigger the surface area is compared to its volume.

Multicellular organisms

Multicellular Organisms are bigger than Unicellular organisms. This makes efficient diffusion of gases more difficult.

However, if they are small, or large but very thin (like the flatworms, Platyhelminths), the outer surface of the body is sufficient as an exchange surface because the surface area to volume ratio is still high.

Gas Exchange in Plants

Plants obtain the gases they need through their leaves. They require **oxygen for respiration** and **carbon dioxide for photosynthesis**.

The gases diffuse into the intercellular spaces of the leaf through pores, which are normally on the underside of the leaf - **stomata**. From these spaces they will diffuse into the cells that require them.

Gas Exchange in Insects

Platelets

These are formed in the **bone marrow** and are fragments of larger cells. They have no nucleus but reactions do take place in the **cytoplasm**.

They have a variety of role such as **blood clotting** and the production of **prostaglandins** that regulate the degree of constriction or dilation in blood vessels.

Blood groups

The most commonly required blood-grouping system is the **ABO system**. It concerns two antigens that can occur on the surface of red blood cells. The antigens are called **agglutinogens** in this case and are: agglutinogen A and agglutinogen B.

Plasma also contains antigens, called **agglutinins** in this case, and they are agglutinin A and agglutinin B.

Blood transfusions

It is important to match blood correctly so that agglutinins in the recipient don't clump the red blood cells of the donor.

In transfusions it is important to remember that the volume of blood donated is relatively small compared to the volume of the recipient's blood. The agglutinins in the plasma from the donor are so diluted that no harm is done. However the aggluinogens on the red blood cells are not so diluted and harm can be done.

Oxygen carriage

Oxygen does dissolve in plasma but the solubility is low and decreases further if the temperature increases. The amount that could be carried by the plasma therefore would be completely insufficient to supply all cells.

The Heart

The structure is closely related to its function.

Mammals have a **double circulation**, which means that the right hand side of the heart pumps deoxygenated blood to the lungs in the pulmonary artery to pick up oxygen and release carbon dioxide. The oxygenated blood then returns to the left hand side of the heart in the **pulmonary vein**.

From there the blood is pumped to the body in the aorta, eventually returning to the right hand side of the heart in the **vena cava** to start the cycle again.

Since the right side pumps to the lungs which are situated close to the heart, the walls are much thinner than the left side which has to pump blood out of the heart to the body.

The heart has 4 chambers:

2 on the left hand side

Sexual Reproduction in Flowering Plants

Most exam boards only require knowledge about reproduction in **Angiosperms** - the flowering plants.

Flower structure

Sexual reproduction in flowering plants centres on the flower. Within a flower, there are usually structures that produce both male gametes and female gametes.

Development of the ovule and female gamete

Inside the ovary there may develop one or more **ovules**. Each ovule begins life as a small projection into the cavity of the ovary. As it grows and develops it begins to bend but remains attached to the ovary wall by a **placenta**.

At the start, the ovule is a group of similar cells called **the nucellus** . As it develops, the mass of cells differentiates to form an inner and an outer integument, surrounding and protecting the nucellus within, but leaving a small opening called the **micropyle** .

At the centre of the ovule is an embryo sac containing the haploid egg cell (the **female gamete**)

Development of the male gamete

Each anther contains 4 **pollen sacs**. Many pollen grains develop inside each pollen sac. It begins with a mass of large pollen mother cells in each pollen sac. All are **diploid**.

In each pollen grain the wall thickens and forms an inner layer (**the intine**) and an often highly sculptured outer layer (**the exine**). The surface pattern is different on pollen grains from different species. When the pollen grains are mature, the anther dries out and splits open (a process called **dehiscence**) and the pollen is released.

Pollination

Many plants favour **cross-pollination**, so pollen must be transferred to the stigma of another plant if sexual reproduction is to take place. Some flowers rely of the wind to carry pollen grains others rely on insects.

Self-pollination is where the pollen is transferred to the stigmas of the same flower or the stigma of another flower on the same plant. Self-pollination is obviously more reliable, particularly if the nearest plant is not very close.

Fertilisation

If the pollen grain lands on a compatible stigma, a pollen tube will grow so that eventually the egg cell, hidden away in the embryo sac, can be **fertilised**. A tube emerges from the grain, its growth being controlled by the tube nucleus at the tip of the tube. It may grow downwards in response to chemicals made by the ovary (a response known as chemotropism).

When an action potential reaches the end of one neurone there must be a way to start an action potential in the next neurone.

The two neurones will not be in direct contact and action potentials cannot jump across the gap, called a **synapse** (or synaptic cleft), so another method is employed...

Release of neurotransmitters

As you can see above, the electrical impulse cannot cross the **synaptic cleft**, so a chemical called a **neurotransmitter** is released at the end of the first neurone out of the presynaptic membrane. It diffuses across the synapse, binds with the second neurone on the postsynaptic membrane and generates an action potential.

Two examples of neurotransmitters are **acetylcholine (ACL)** and **noradrenaline**. They are synthesised in vesicles, which requires energy, so the synaptic knobs have many ATP-producing **mitochondria** in them.

Immunity

Self and non-self

On the surface of all cells are chemical markers (for example, proteins) called **antigens**.

Your body recognises the antigens on your cells as your own (self); anything with different antigens to you (non-self) stimulates an **immune response**.

In an immune response, your body will recognise the antigen as **foreign** (and therefore bad) and will attack it.

Infection and disease

Your immune system is made up of cells that work with the body's physical and chemical barriers. It helps prevent any **pathogen** (disease-causing organism) entering your body, and your body therefore becoming infected.

Note: Harmful bacteria are an example of a pathogen.

If the worst comes to the worst and any pathogens do get into your body, the immune system tries to stop them from causing harm.

Physical and chemical barriers

The first line of defence is made up of **physical** and **chemical barriers.**

These types of barrier are **non-specific** (i.e. if any organism is not recognised, it is assumed to be a pathogen, and will be treated the same way).

These barriers occur at the skin or any other openings to the outside world.

Here is a list of some physical and chemical barriers you should know to quote in your exams:

Physical Barriers

Skin: it is a hard outer layer that generally prevents the entry of any undesirables.

Nose, throat and digestive tract: the membrane lining these secretes sticky mucus to trap microbes. Fine hairs called cilia waft the mucus away.

Chemical Barriers

Eyes: tears have lysozyme enzyme in them. This kills some bacteria.

Ear: your wax has antimicrobial properties.

Stomach: hydrochloric acid in your stomach kills bacteria.

Other functions include:

Fat metabolism

Making cholesterol

Bile production

Detoxification

Storage of Vitamins

Breakdown of haemoglobin (Hb)

Synthesis of plasma proteins

Genetics

Monohybrid crosses - single gene inheritance

When studying genetics, the following conventions are used:

P is used as shorthand for the parent generation.

$\mathbf{F_1}$ is used for their offspring.

$\mathbf{F_2}$ is used if the offspring ($\mathbf{F_1}$) are crossed.

Capital letters are used to denote a dominant allele.

Lower case letters are used to denote a recessive allele.

Incomplete dominance

This is when neither allele is dominant.

Both alleles are expressed and contribute equally to the phenotype.

A heterozygote has an intermediate phenotype as there is partial influence from both alleles.

Codominance

In this case, both alleles are dominant.

They are independent, so there is no 'blending' as in the snapdragons; instead the phenotype is a result of the full expression of both alleles.

Pleiotropy

This is where one gene affects several characteristics. For example, a disease caused by one pair of alleles may have several or many symptoms.

Polygeny

This is where one characteristic is affected by two or more genes (e.g, skin colour).

Epistasis

This is where one gene interferes with the expression of another gene.

Public debate of aspects of GE has resulted in arousing great concern for health and the environment. GE is a new technology, and as such is met with scepticism on one hand and enthusiasm on the other. To fully appreciate the advantages and disadvantages, a good understanding of the facts is essential.

Genetic engineering and traditional breeding

Traditional breeding

Traditional crop and animal breeding has been practiced for thousands of years.

Traditional breeding involves selecting animals or plants with particular characteristics and producing individuals that clearly demonstrate the desired trait or characteristic. Crossing takes place, usually between individuals of the same or closely related species.

The gene pool for such improvements, therefore, is limited to those genes found naturally in the breeding individuals.

Genetic engineering methods

These include terms such as **genetic manipulation, recombinant DNA technology and gene therapy (in humans).**

Transplant surgery

Transplanting foreign tissue carries a great risk of rejection by the body's immune system. The patient faces the rest of their life with a cocktail of anti-suppressant drugs.

There is a great shortage in organs suitable for transplantation, resulting in patients suffering or even dying before they get a chance to have the transplant operation.

Xenotransplantation

Organs from other animals can be used in human transplantation, but they pose a potentially greater risk of rejection.