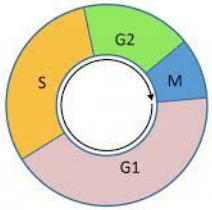
Highsted Knowledge Organiser Biology Year 9: Cell Division

What I need to know

Cell division-mitosis;
Growth and differentiation;
Stems cells and stem cell dilemmas.
Calculate the percentage of time a cell is in each stage of the cell cycle.
Evaluate the use of stem cells in research.

Key Vocabulary:

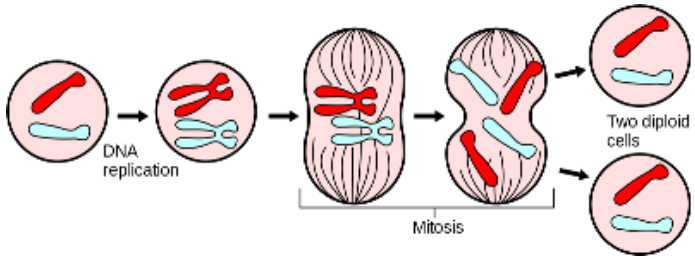
Chromosome: made of DNA and contains genes that code for certain characteristics.
Nucleus: membrane bound structure that contains DNA
Gamete: a sex cell e.g. sperm or egg.
Genes: short sections of DNA that code for a characteristic.
Allele: a different version of a gene. E.g. the allele for blue eye or green eyes
Zygote: a single new cell made after a sperm and egg fuse.
Allele: a different version of a gene. E.g. the allele for blue eye or green eyes.
Cell cycle: the series of stages the cells goes through in cell division.
Mitosis: cell division that produces two genetically identical cells.
Differentiate: where a cell become specialised to perform a particular function
Stem Cell: an unspecialised cell that can differentiate into any type of cell.
Cloning: producing genetically identical offspring.



G1 - Growth
S - DNA synthesis
G2 - Growth and preparation for mitosis
M - Mitosis (cell division)

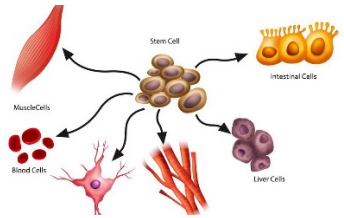
Mitosis and the cell cycle
Stage 1: DNA replicates and forms two copies of each chromosome and increase the number of cell organelles.

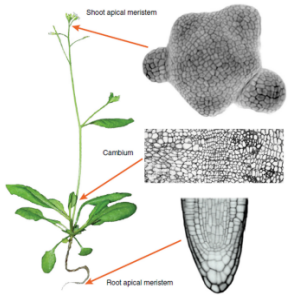
Stage 2: Mitosis: one set of chromosomes are pulled to each end of the cell and the nucleus divides.
Stage 3 :the cytoplasm and the cell membranes divide to form two genetically identical cells.



Stem Cells

Embryonic stem cells are undifferentiated cells, they have the potential to turn into any kind of cell.
Adult stem cells are found in the bone marrow, they can only turn into some types of cells e.g. blood cells.
Uses of stem cells:
• Replacing faulty blood cells;
• making insulin producing cells;
• making nerve cells.





Stem Cells in Plant

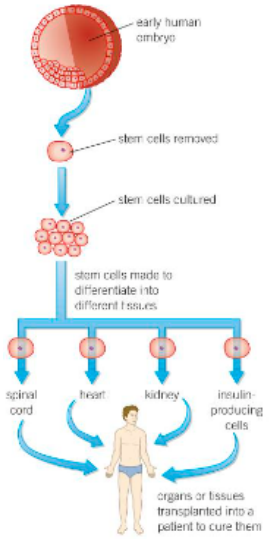
In plants, stem cells are found in the meristem. These stem cells are able to produce clones of the plant. They can be used to grow crops with specific features for a farmer, e.g. disease resistant.

Stem cell dilemmas

• Embryonic stem cells (ESCs) can be collected & cloned for potential medical uses.
• This raises ethical & religious issues however, as some believe it interferes with human reproduction & the embryo cannot give consent.
• Adult stem cells on the other hand might be infected with viruses, as well as triggering an immune response if the donor & patient are unrelated. DNA replication & production of new cell organelles e.g. ribosomes & mitochondria

Therapeutic cloning

• An embryo is produced with the same genes as the patient.
Stem cells from the cloned embryo are not rejected by the patient & so could be used for medical treatment.



Challenge question:
Why are plant stem cells useful to agriculture? Why might stem cells not be as successful as once hoped?

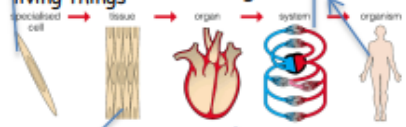
Suggested reading
https://www.bhf.org.uk/informationsupport/heart-matters-magazine/research/breakthroughs-in-stem-cell-research
https://www.bbc.co.uk/news/topics/cvenzmgygr8t
https://hsci.harvard.edu/diabetes-0

Highsted Knowledge Organiser, Biology, Term 3, Year 9: Organisation and the Digestive system

What I need to know
Tissues and organs; the human digestive system; chemistry of food; enzymes; factors effecting enzymes.
Required practical activity 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins.
Required practical activity 5: investigate the effect of pH on the rate of reaction of amylase enzyme.
Key Vocabulary:
Cell: The basic building block of all living organisms.
Tissue: A group of cells with a similar structure and function.
Organs: Aggregations of tissues performing specific functions.
Organ systems: Groups of organs that work together to form organisms.
Enzymes: Biological catalysts that increase the rate of reactions in living organisms
Amylase: An enzyme produced in the salivary glands and pancreas that breaks carbohydrates down into glucose.
Metabolism: that is the sum of all reactions in the cell or body.
Denatured: the substrate will no longer fit into the active site of the enzyme as it has lost its 3D shape.
Lipase: An enzyme that is produced in the pancreas that breaks lipids down into fatty acids and glycerol.
Protease: An enzyme produced in the stomach and pancreas that breaks proteins down into amino acids.
Bile: A substance made in the liver and stored in the gallbladder which is used to neutralise stomach acid in the intestine and emulsify fats.
Challenge question: Why is the gut important to you mental wellbeing.
Suggested reading:
https://www.bmj.com/content/361/bmj.k2179
https://www.youtube.com/watch?v=1UvuBYUbFk0

Tissues & Organs

Cells: Basic building blocks of living things



Organs are organised into **organ systems** (e.g. digestive system) which work together to form **organisms**

Tissues: Group of cells with similar structure & function

Organs: Groups of tissues performing specific functions

Chemistry of Food

Carbohydrates:
- provide us with **fuel** to carry out all the reactions in our bodies.
- Contain **C, H & O** & are made of units of **sugar**, sometimes just 1 or more than 1 unit joined together.

Lipids:
- Are fats (solid) & oils (liquid)
- Most efficient **energy store** in the body & source of energy, role in **cell membranes** & as **hormones**.
- Made up of **3 fatty acids** joined to **1 glycerol**.
- *Different* combination of **fatty acids** determine nature of lipid.

Proteins-
- Used for building up cells & tissues, as well as **enzymes**.
- Made up of **amino acids**. *Different* arrangements of **20** *different* **amino acids** creates different proteins.

How the digestive system works

Amylase (a carbohydrase) breaks down **carbohydrate** & is produced by the **salivary glands**, & used in the **mouth**.
Starch (a carbohydrate) → sugars

Protease & lipase produced by & used in the **small intestine**

Food is broken down by **digestive enzymes** into **small, soluble** molecules that can be absorbed into the blood.

Protease breaks down **proteins** & is produced by & used in the **stomach**. **Protein → amino acids**

Amylase, lipase & protease produced by the **pancreas**. **Lipase** breaks down **lipids**. **Lipid → fatty acids & glycerol**

Catalysts & Enzymes

Biological catalyst that *speeds up* chemical reactions.

1. **Substrate** has a ***complementary shape*** to the...
3. **Active site** which it fits into perfectly...
4. **Substrate** splits into **products** which leave **active site**.
2. **Enzyme's...**
5. **Enzyme** is *unchanged* & ready to use again.

Making digestion efficient

The **stomach** environment is **acidic**. This kills most bacteria & is the **optimum pH** for **protease** enzymes.

The **small intestine** requires an **alkaline** environment for the enzymes here to work. **Bile** made in the **liver**, & stored in the **gall bladder**, flows into the **small intestine** to ***neutralise*** the **hydrochloric acid** from the **stomach**.

The **bile** also breaks down large **drops** of **fat** into **smaller droplets**, *increasing* their **surface area** (SA). This is called **emulsification**. The **alkaline** conditions & **large SA** *increase* the rate of fat breakdown by **lipase**.

Factors affecting enzyme action

Enzyme-controlled reactions are affected by **temperature** & **pH**.

Increasing **temperature** increases the ***rate of an enzyme-controlled*** reaction, but only up to the **optimum temperature** after which the **enzyme's protein structure** is altered & the **enzyme** is **denatured**. The **substrate** no longer fits in the *altered* shape of the **active site**.

A change in **pH** away from the **optimum** also alters the shape of the **active site** & therefore **denatures** the **enzyme** too.

RP4 - Food Tests

The presence of **protein** is tested for using **Biuret reagent** which is blue. A colour change to lilac shows a positive result.

The presence of **sugar** is tested for using the **Benedict's test**. **Benedict's reagent** is blue & a colour change to light green shows a little sugar is present, whereas **brick red** shows a positive result for lots of sugar.

The presence of **starch** is tested for using **iodine**, which is red/orange. A colour change to **blue/black** shows a positive result.

RP5 - The effect of pH on an enzyme

A **buffer** is a solution at a certain pH.
Amylase is an enzyme that breaks down **starch** into **glucose**

Buffer, amylase and starch are placed in a test tube. **Every 30 seconds** this solution is tested with **iodine** in a dimple tray

When the amylase has completed the breakdown of starch, the iodine will stop turning **black** and will remain orange

The solution that contains the **buffer closest to the optimum pH** for amylase, will **stop turning black the quickest**

Highsted Knowledge Organiser, Biology, Term 4, Year 9: Heart and lungs

What I need to know
Blood
Blood vessels
The heart
Helping the heart
Breathing and gas exchange

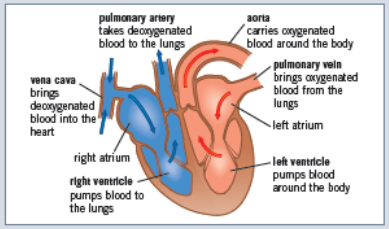
Key Vocabulary:
Alveoli
Aorta
Artery
Atrium
Bronchi
Bronchiole
Capillary
Cardiac
Coronary
Double circulatory system
Plasma
Platelet
Pulmonary
Valve
Vein
Vena cava
Ventricle

Challenge question:
How does gas exchange and the circulatory system work together?

Suggested reading:
www.kerboodle.com
https://www.bbc.co.uk/bitesize/guides/zsncsrd/revision/2

The heart

The heart is the organ that pumps blood around your body. It is made from **cardiac** muscle tissue, which is supplied with oxygen by the **coronary artery**.



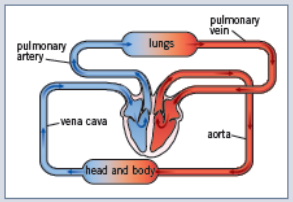
Heart rate is controlled by a group of cells in the right atrium that generate electrical impulses, acting as a pacemaker.

Artificial pacemakers can be used to control irregular heartbeats.

Double circulatory system

The human circulatory system is described as a **double circulatory system** because blood passes through the heart twice for every circuit around the body:

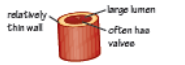
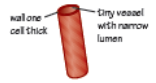
- the right ventricle pumps blood to the lungs where gas exchange takes place
- the left ventricle pumps blood around the rest of the body.



blood is a tissue made up of four main components

- red blood cells – bind to oxygen and transport it around the body
- plasma – transports substances and blood cells around the body
- platelets – form blood clots to create barriers to infections
- white blood cells – part of the immune system to defend the body against pathogens

Blood vessels

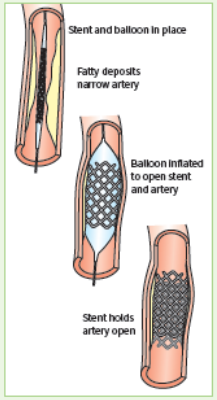
Vessel	Function	Structure	Diagram
artery	carries blood *away from* the heart (high pressure)	• thick, muscular, and elastic walls • the walls can stretch and withstand high pressure • small lumen	
vein	carries blood *to* the heart (low pressure)	• have valves to stop blood flowing the wrong way • thin walls • large lumen	
capillary	• carries blood to tissues and cells • connects arteries and veins	• one cell thick – short diffusion distance for substances to move between the blood and tissues (e.g., oxygen into cells and carbon dioxide out) • very narrow lumen	

Heart issues

Coronary heart disease is caused by a build up of fatty material in the coronary arteries, making them narrow, and reducing blood flow. Stents can be used to help keep the coronary arteries open.

Patients with heart failure often have to use artificial hearts before a donor heart becomes available for a heart transplant.

People with faulty heart **valves** may feel symptoms of breathlessness as valves do not fully open, making the heart less efficient. These can be replaced with biological valves (from animals), or mechanical valves (made from titanium and polymers).

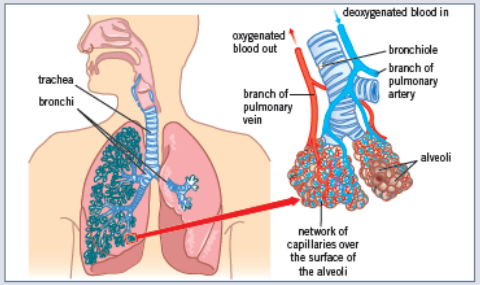


Lungs

When breathing in, air moves

1. into the body through the mouth and nose
2. down the trachea
3. into the **bronchi**
4. through the **bronchioles**
5. into the **alveoli** (air sacs).

Oxygen then diffuses into the blood in the network of **capillaries** over the surface of the alveoli.



Key terms