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Health and Social Care Level 3 | OCR | H025/H125

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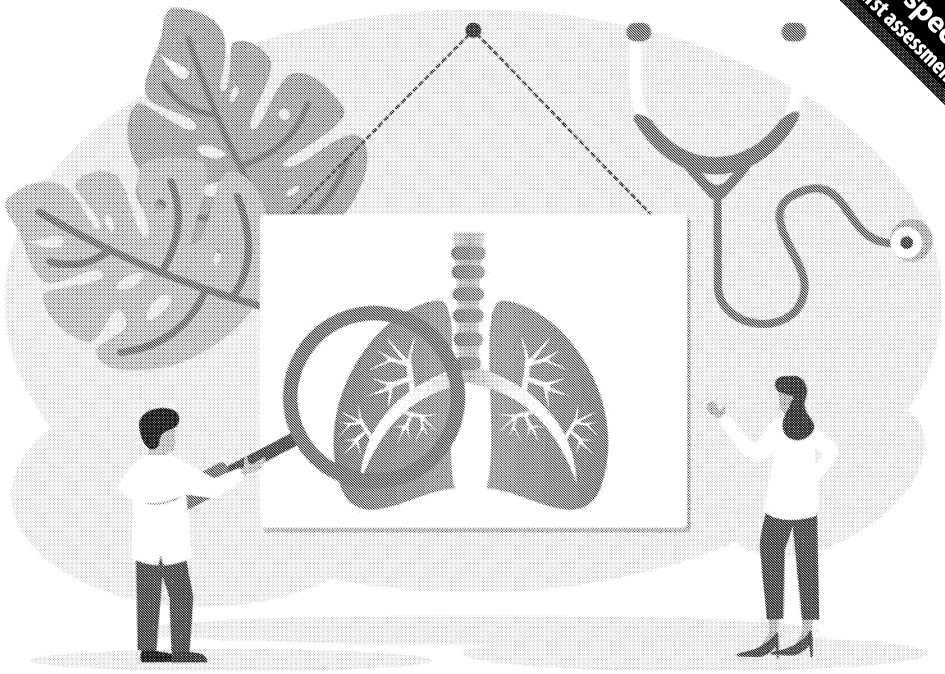

Course Companion

for OCR L3 (AAQ) Cambridge Advanced National: Health and Social Care

Unit F091: Anatomy and Physiology for Health and Social Care

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POD 12929

Contents

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- Bacterial pneumonia diagram, courtesy of BruceBlaus
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Teacher's Introduction

This is a Course Companion for **F091: Anatomy and Physiology for Health and Social Care**, part of the OCR Level 3 Alternative Academic Qualification (AAQ): Cambridge Advanced National in Health and Social Care. The aim of this resource is to guide students through the core content of this unit, providing them with in-depth information that covers each of the specification points. This resource aims to provide students with the knowledge and skills that will help them succeed in the assessment for this unit.

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

For clarity and ease of use, the content of this Course Companion matches the order of the specification points. The content is structured as follows against the unit's content:

Content Area	Content
Topic Area 1: Cardiovascular system	• 1.1 Composition and functions of blood • 1.2 The heart (*structure, blood pressure, electrical activity*) • 1.3 Blood vessels • 1.4 Conditions of the cardiovascular system (*angina, DVT*)
Topic Area 2: Respiratory system	• 2.1 Structure and function of the respiratory system • 2.2 Mechanics of breathing • 2.3 Gas exchange • 2.4 Cellular respiration • 2.5 Conditions of the respiratory system (*asthma, bacterial pneumonia*)
Topic Area 3: Digestive system	• 3.1 Structure and function of the digestive system • 3.2 Mechanical and chemical digestion • 3.3 Absorption and assimilation • 3.4 Conditions of the digestive system (*bowel polyps, gallstones*)
Topic Area 4: Musculoskeletal system	• 4.1 Skeletal system (*skeletal structure, structure and formation of bone, synovial joints*) • 4.2 Muscular system • 4.3 Conditions of the musculoskeletal system (*carpal tunnel syndrome, osteoarthritis*)
Topic Area 5: Control and regulatory systems	• 5.1 The nervous system (*components, the brain, neurons*) • 5.2 Homeostasis • 5.3 Conditions of the control and regulatory systems (*ischaemic strokes, type 2 diabetes*)
Topic Area 6: Reproductive system	• 6.1 Female and male reproductive systems • 6.2 Conditions of the reproductive system (*endometriosis, testicular cancer*)

Throughout the resource, there are key features to keep an eye out for:

Keywords: used to draw students' attention to various keywords throughout the unit.

Did you know? Provides further information and additional content to inspire and engage students.

Case studies
Help students to apply the issues identified in the resource to real-world scenarios.

Applied activities: encourage application of knowledge to the case studies or to real-world scenarios in the health and social care sector.

Research activities: inspire further research and stretch and challenge higher-ability students.

Some of the activities can be completed using either computers, mobile phones or tablets to aid students' research, and/or can be completed outside the classroom as homework.

There are also two sets of **questions** – *checking your understanding* and *taking it further* – provided at the end of each section (with answers included). These should help students recap their knowledge and then apply their knowledge and understanding, respectively, throughout the Course Companion.

June 2025

Chapter 1: Cardiovascular Sy

The cardiovascular system is like the body's delivery network, responsible for tra
nutrients and waste. This system includes the heart, blood and blood vessels. In
about the key processes within the cardiovascular system and the conditions that

1.1: Composition and functions of blood

COMPOSITION OF BLOOD

Whole blood

Blood flows through the blood vessels carrying oxyge
nutrients and other substances to tissue
up waste products and takes them where they can be
removed from the body. It needs to be able to flow
easily but also contains the components to allow it to
carry out the functions. It consists of liquid and cells.

White blood cells

White blood cells make up typically less than 1% of the blood and are responsible for defence against disease and immunity. There are several different types with different roles. Collectively they are known as leucocytes. Some white blood cells can engulf and kill invading microorganisms such as bacteria. This process is known as **phagocytosis**. Others (lymphocytes) can produce **antibodies** to help fight specific diseases. White blood cells can also destroy cancer cells. White blood cells often squeeze through the capillary walls to enter the tissues to fight infections.

Did you know? White blood cells can 'remember' previous infections and quickly fight them off if they show up again. This is why we have vaccines, which help to 'train' the immune system to recognise and respond to infections more quickly.

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You
whit
whit

Red blood cells

Red blood cells (erythrocytes) carry oxygen to cells and
make up around 40–45% of the blood. A protein called
haemoglobin carries the oxygen in the form of
oxyhaemoglobin. They have room for as much haemoglobin
as possible, and blood cells are adapted by not having
the organelles that most cells have, including a nucleus.
They are shaped as a **biconcave** disc. This increases
surface area to increase the amount of oxygen they can
absorb. They have flexible cell membranes allowing them
to be squeezed through narrow capillaries.

Haemoglobin – l
iron. It is used to c
the reason why it
iron in the diet.

Oxyhaemoglobin
bound with oxyge
through the blood

Biconcave – word
has an indentation

Plasma

Plasma is the liquid part of the blood, making up around 55% of its total volume. It consists mainly of water and contains dissolved substances such as salt, glucose and amino acids from digested food. It also contains special plasma proteins such as **blood clotting factors** and hormones. Elevations in plasma proteins can increase **blood viscosity**, impairing blood flow. It carries the blood cells through the circulatory system.

Blood clotting fac
travel in the blood
they help to form b

Blood viscosity – h
viscosity, the harde
blood around the b

Platelets

Platelets are responsible for blood [illegible] and make up less than 1% of the blood red or white blood cells. Th[illegible]ually carried around the blood in an inactive disc-shaped [illegible]vin[illegible] flow easily through the blood. However, when activ from dama[illegible]od vessel walls, they become spikey. This shape makes them st clump by the [illegible]nage, preventing blood loss through the tear in the blood vessel v contains tangles of fibrin protein strands, which are formed from blood clotting fa playing a key role in the clotting process.

Applied activity: Make a model of the blood to fill a beaker or jar. You can choo components but below are some suggestions:

- Plasma – water with yellow food colouring in, diluted syrup
- Red blood cells – pomegranate seeds for red blood cells
- White blood cells – mini marshmallows
- Platelets – small white beads

1.2: The heart

The heart is the pump of the cardiovascular system. It is composed mostly of car
keep contracting and relaxing throughout life to keep the heart beating. The hea
blood vessels of the circulatory system so that it can carry substances from one p
the end of this section you should understand how the heart is structured, what
electrical activity that regulates the heart's function.

Structure of the heart

For each circulation of the body, it passes through the heart twice. The first time blood is pushed from the right-hand side of the heart to the lungs where carbon dioxide diffuses out of the blood and oxygen diffuses in. The now **oxygenated** blood returns to the left-hand side of the heart where it is given another boost so that it has enough pressure to travel around the rest of the body. This **double circulatory system** is necessary because the blood loses pressure when it goes through the lungs, and it would not be able to get around the rest of the body.

Oxygen
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Deoxyg
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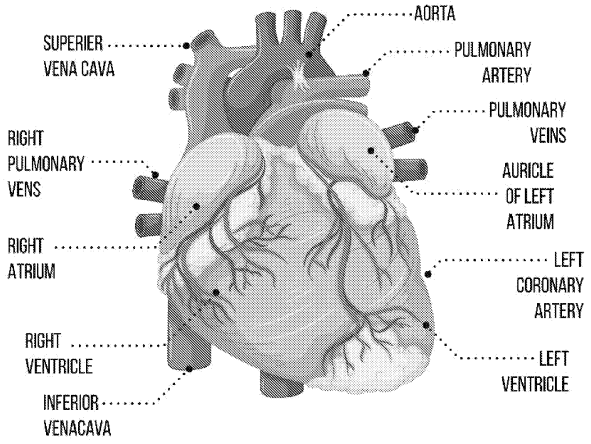


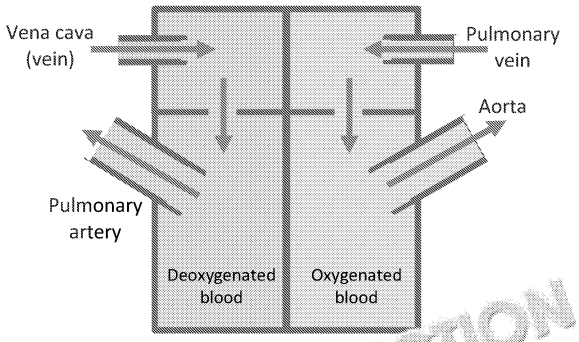
Chambers of the heart

The heart is made up of four chambers which can be seen labelled on the diagram known as atria. They receive blood at low pressure from veins. The lower two ch much thicker muscular walls because they pump blood further – out of the heart

Chamber	Function
Right atrium	Receives blood from the vena cava veins which bring **deoxygenated** blood from the body. Blood passes from here into the right ventricle below.
Left atrium	Receives blood from the pulmonary veins which bring **oxygenated** blood from the lungs. Blood passes from here into the left ventricle below.
Right ventricle	Receives blood from the right atrium. It contracts to pump **deoxygenated** blood out of the heart, through the pulmonary artery, to the lungs.
Left ventricle	Receives blood from the left atrium. It contracts to pump **oxygenated** blood out of the heart, through the aorta (largest artery in the body) to the rest of the body.

Blood vessels of the heart

The blood vessels are explained in more detail later in this chapter. In general te
from the heart and veins bring blood towards the heart. It is important to know t
related to the structure of the heart.

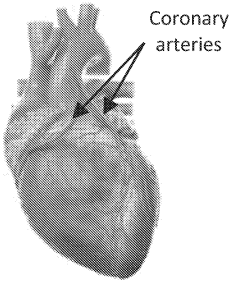


Blood vessel	Oxygenated or deoxygenated
Superior vena cava (vein)	Deoxygenated
Inferior vena cava (vein)	Deoxygenated
Pulmon… vein	Oxygenated
P…monary artery	Deoxygenated
Aorta (artery)	Oxygenated

The corona… …y and veins

The heart itself is a muscle and needs its own blood supply to carry oxygen and nutrients so that it has the energy to keep pumping. The heart muscle is supplied with blood through the coronary artery which runs from the base of the aorta around the outside of the heart, branching into smaller arteries as it goes. Blood is returned to the heart through the coronary veins which return the blood to the right atrium.

If the coronary artery becomes blocked, parts of the heart do not receive a blood supply, and the result is a heart attack (cardiac arrest). The severity will depend on which part of the artery is blocked.



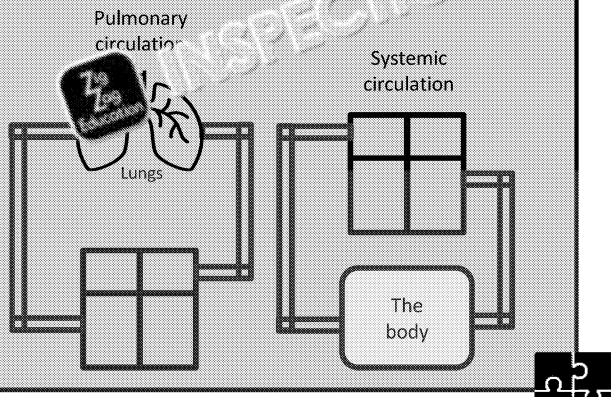
Exam tip

Arteries do not … blood, and vein… deoxygenated … between the tw… blood to the he… heart (arteries).

Applied activity: Pu… chambers in the corre… pass through them. S… atrium; left atrium; b… cava vein; aorta; lun… vein; right ventricle.

Applied activity: Draw a similar diagram to the one below showing the main chambers and blood vessels. Label the chambers and blood vessels and colour them as follows:

Red – oxygenated blood
Blue – deoxygenated bl…



Applied activity: Si… coronary arteries.

- Two paper cup… represent blood… coronary artery… prevent a mess… equivalent

…structions:

1. Make a hole in… enough to fit th… bottom.
2. Cut the straws i… in each hole so … outside the cups…
3. Seal the holes a… modelling clay.
4. Partially block … a blocked coro…
5. Pour water into … of 'blood' throu…
6. If the partially … coronary artery… nutrients to your… be the consequ…

Valves

It is important that blood does not flow the wrong way through the heart otherwis
deoxygenated blood making the heart less efficient. Different valves within the he

Valve	Type of valve	Location	
Tricuspid valve	**Atrioventricular valve**	Between the right atrium and right ventricle	Prevents backfl ventricle to the through the pu
Bicuspid valve (or mitral valve)	Atrioventricular valve	Between the left atrium and left ventricle	Prevents backfl ventricle to the through the ao
Aortic valve	**Semilunar valve**	At the bas of h aorta	Prevents backfl left ventricle.
Pulmonary valve	Semilunar va	t the base of the pulmonary artery	Prevents backfl back into the ri

Atrioventric valve – heart valve between an atrium and the ventricle below it. There
the right and the bicuspid (mitral valve) on the left.

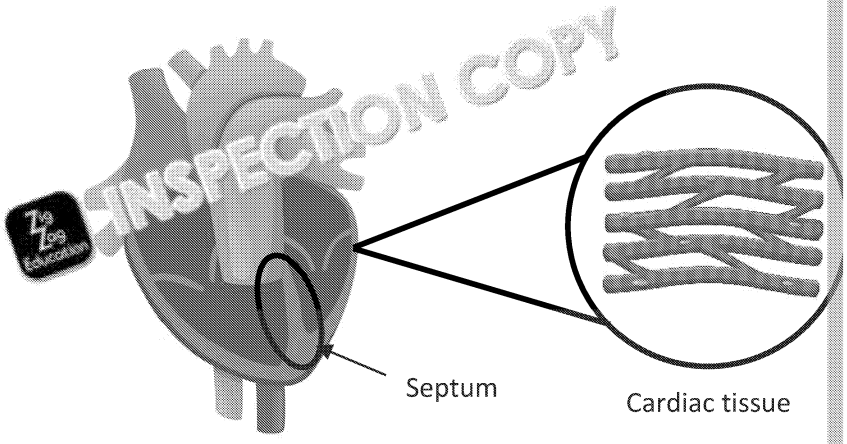
Semilunar valve – type of valve found in blood vessels. They consist of three pockets of
blood flows the wrong way. This closes the blood vessel and prevents backflow of blood.
are also at the base of the aorta and pulmonary arteries.

Did you know? The lub-dub sound of the heart is caused by the heart valves opening and closing.

Other structures

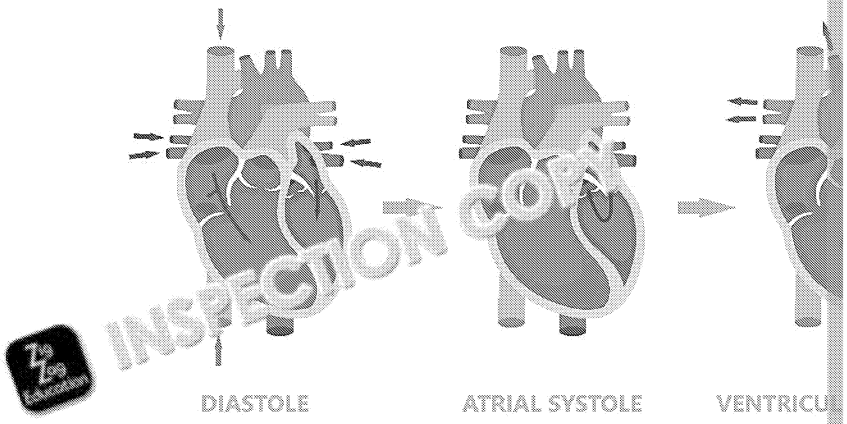
In addition, the heart has other crucial structures that you should be aware of:

- **Septum** – thick wall of tissue that divides the heart into the left and right side from the left side from mixing with deoxygenated blood from the right side.
- **Cardiac tissue** – involuntary (automatic) muscle throughout the walls of the h ability to contract rhythmically and pump blood throughout the body.



Cardiac cycle and blood pressure

The cardiac cycle is the name given to the processes which occur during one beat parts of the heart are contracting or relaxing, which direction the blood is flowing open or closed at each stage. When the heart is relaxed it is known as diastole a as systole. However, the atria and ventricles mostly relax and contract at differen



1. **Diastole:** Both atria and ventricles relax. Blood floods into both atria from th veins. Some blood flows from the atria to the ventricles. The atrioventricula to flow from atria to ventricles.
2. **Atrial systole:** Atria contract forcing more blood into the ventricles, which a at the base of the two arteries are closed.
3. **Ventricular systole:** Now that the ventricles are full, the ventricles contract. the atrioventricular valves preventing backflow of blood into the atria. Bloo semilunar valves and into the aorta and pulmonary arteries.

Applied activity: Use a blood pressure monitor to measure your blood pressure. N values – systole (when the heart is contracting) and diastole (when the heart is rela or doing exercise affect your blood pressure?

Applied activity: Draw a table like the one below. Try to fill it out without looking at the notes and then check your notes.

Stage of cycle	Which parts of the heart, if any, are contracting?	Which valves are open?	Which valves are closed?	Where is blood flowing from and to?
Diastole				
Atrial systole				
Ventricular systole				

Exam tip

Remember the difference between the terms systole and diastole with the following phras
Systole – **S**trong contraction
Diastole – **D**eep relaxation

What is blood pressure?

Blood pressure is related to the volume of blood in the cardiovascular system and width of blood vessels. More fluid in the blood will lead to higher blood pressure. It is important to have a reasonably high blood pressure, particularly in the arteries, otherwise blood would not get to cells and tissues fast enough to provide them with the essential substances such as nutrients and oxygen.

Systolic and diastolic pressure

As mentioned, when the heart beats, it goes through two main phases:

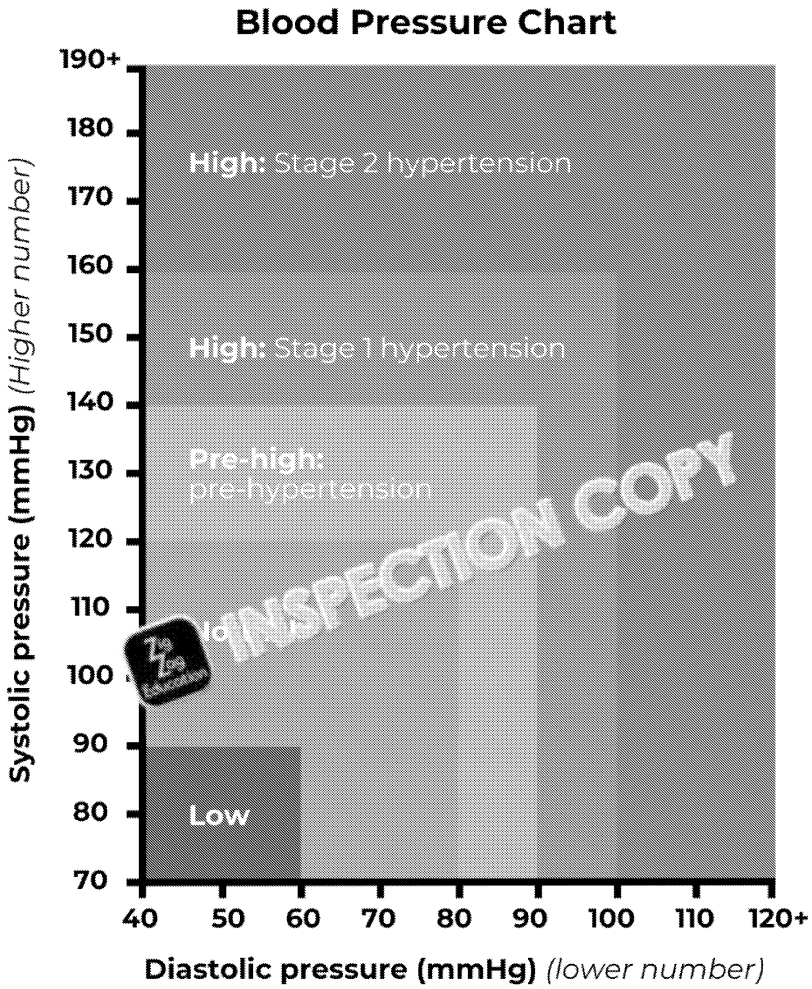
- **Systolic phase**: the heart contracting and pushing blood into arteries. This ca
- **Diastolic phase**: the heart relaxing and filling with blood. This causes diastol

Blood pressure values

Blood pressure is measured by recording two types of pressure:

- Systolic pressure – this is the higher number and measures the pressure in the arteries when the heart contracts and pumps blood out.
- Diastolic pressure – this is the lower number and measures the pressure in the arteries when the heart relaxes between heart beats.

These values show how healthy someone's blood pressure is and can be measured on a chart:



Applied
pressure

Compare
pressure
category
or high).

Readings
1) 124/7
2) 138/8
3) 155/9

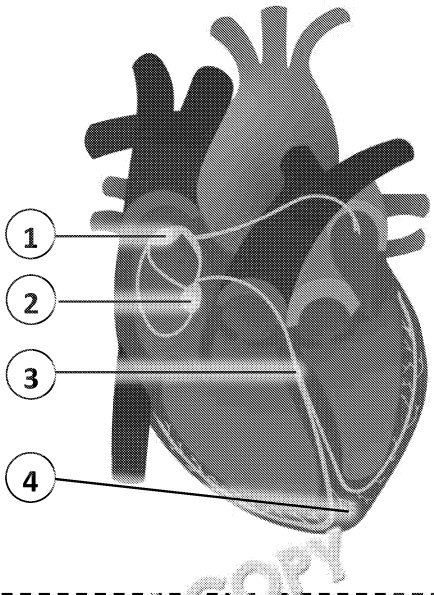
Electrical activity of the heart

Electrical activity is another crucial part of the cardiovascular system, controlling v
blood. This system is also known as the conduction system and is made up of ma
control how the heart beats at the right time; whether we're awake or asleep, it's
beating 24/7.

Location and function of the key components

The cardiac muscle of the heart is described as myogenic (or intrinsic), meaning a
the cardiac muscles. The electrical stimulus in the cardiac cycle takes the followin

1. **Sino-atrial (SA) node:**
   Often referred to as the pacemaker of the heart, it r... tes the heart rate i
   sending out an electrical stimulus which trav... s... the muscle cells in the
   contract (atrial depolarisation).
2. **Atrioventricular (AV) node:**
   The impulse travels ... e AV node, where it delays the next contraction to a
   with bl... On ... e AV valves have closed, the stimulus travels to the bund
3. **The bu... His:**
   The stimulus travels down the bundle of His, which is a group of conduction
   and left branches which consist of the Purkinje fibres.
4. **Purkinje fibres**:
   These are found in the ventricular walls and cause ventricular contraction as
   electrical impulse in the ventricles (ventricular depolarisation).



Atrial depolarisation – the effect that the ... le ... as on the atria, causing them to
electrical stimulus across them.

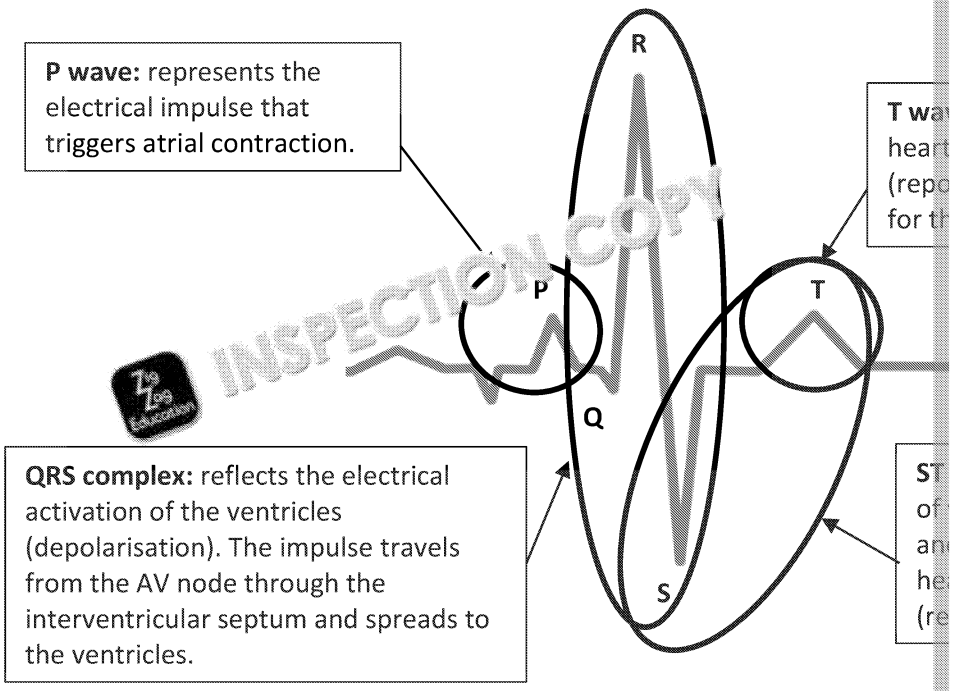
Ventricular depolarisati... – ... effect that the AV node has on the ventricles, causi
an electrical ... s.

Atrial and ve... ...lar repolarisation – occurs during a brief time period following
electrical impulse returning to a baseline value.

Research activity: Watch this useful YouTube video which explains the key compo
activity system in more detail: **zzed.uk/12929-Cardiac**
Make some notes to aid your understanding!

Electrocardiogram (ECG) trace

An electrocardiogram (ECG) is a test that records the electrical activity of the hea
onto specific parts of the body (chest, arms and legs). It measures heart rate, rh
impulses, producing ECG traces – graphical representations of electrical activity.
as waves, including P, Q, R, S and T waves.



P wave: represents the electrical impulse that triggers atrial contraction.

T wa
hear
(repo
for t

QRS complex: reflects the electrical activation of the ventricles (depolarisation). The impulse travels from the AV node through the interventricular septum and spreads to the ventricles.

ST
of
an
he
(re

These ECG traces help healthcare professionals to identify any potential problems
traces may indicate arrhythmias (irregular heartbeats), heart attacks or electroly

- **P wave abnormalities:** if this is irregular, absent or an abnormal shape it may suggest issues with the atrial contraction.
- **QRS complex abnormalities:** long or distorted QRS waves can suggest issues with ventricular conduction or a blockage within the bundle of His.
- **ST segment abnormalities:** raised or reduced ST segment can indicate **ischemia** or **heart attack**.
- **T wave abnormalities:** inverted or unusually tall T waves can signal electroly

Heart atta
emergency
is blocked,

Ischemia
oxygen re
cause ches

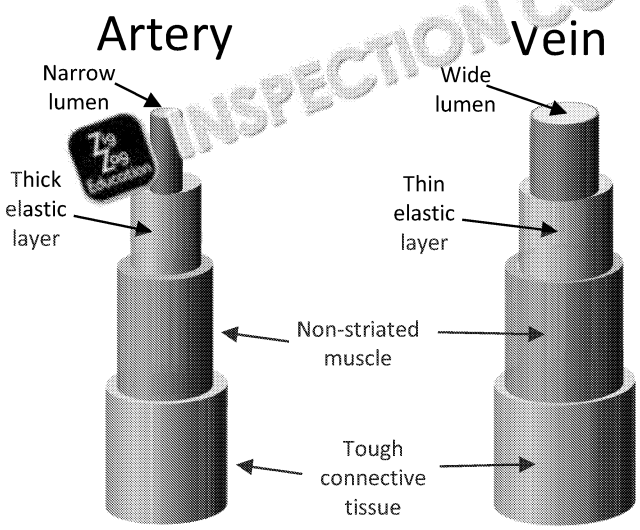
Exam tip

You may be asked to label the diagram in the exam, so remember the letters are in alph

1.3: Blood vessels

Blood vessels are an important part of the cardiovascular system as this is how blood travels around the body. There are three main types of blood vessel, each with different structures due to their different functions:

1. **Arteries** carry blood away from the heart
2. **Veins** carry blood towards the heart
3. **Capillaries** carry blood through the tissues where exchange of substances takes place



Arteries

The main function of arteries is to take blood away from the heart. In arteries the blood is at very high pressure, so the walls of the arteries need to be very strong. Structural adaptations such as thick muscular walls, elastic walls and a narrow **lumen** help aid this function. The thick muscular walls allow the arteries to control blood flow by tightening or relaxing. The elastic walls help the arteries str and the narrow lumen helps maintain the high pressure needed to move blood ef

Capillaries

The function of capillaries is to exchange substances to the cells which surround t products. To allow this, the walls are very thin (one cell thick) so that substances blood easily. Capillaries also have porous walls (small pores in walls) that aid subs narrow lumen and slow blood flow.

Veins

From the capillaries blood enters small veins to return to the heart. Blood pressure i as it goes through the capillaries. The low blood pressure makes it difficult for the bl back to the heart. To help with this, veins have a wide lumen which allows the blood low pressure. Additionally, to prevent backflow there are semilunar valves at regula

Summary

Below is a table comparing the structure and function of the three main types of b

	Arteries	Veins	
Function	Carry blood away from the heart	Carry blood towards the heart	Connect a Carry bloo exchange bringing n away wast
Wall thickness	Thick, muscular	Fairly thin	One cell th
Elasticity	Very elastic	A little elastic	Not elastic
Lumen size	Narrow	Wide	Very narro through in
Valves	No valves (apart from aorta and pulmonary artery which have one each)	Semilunar valves at regular intervals along the vein	No valves
Blood pressure	High or very high	Low	Low

Applied activity: Use different colours of modelling clo make models of each of the three types of blood vesse

1.4: Conditions of the cardiovascu

Cardiovascular conditions affect the heart and blood vessels, leading to problems delivery. Common symptoms include pain, swelling and breathlessness. People developing these conditions due to poor lifestyle choices, such as smoking and p history.

Angina

Overview and causes

Angina is caused by reduced blood flow to the heart mus , causing chest pain or discomfort, often described as pressure, t ght e or squeezing. It is often triggered by activity such as walkin ligh of steps. It typically lasts a few minutes and tends to get bet a t est. Angina is commonly caused by **atheroma** – fatty deposit t ild up in the walls of the coronary arteries. This atheroscler hi ows the coronary arteries and reduces oxygen delivery structural c in the cardiovascular system directly affect the function of the especially du ng increased demand (e.g. exercise).

Main signs and symptoms

- Chest pain that may radiate to the arms, neck and jaw
- Tight chest
- Breathlessness
- Dizziness
- Nausea

Diagnosis and monitoring

Multiple methods are available to diagnose and monitor angina, including:

Method	How it's used	
Electrocardiogram (ECG)	Records the electrical activity of the heart to detect abnormalities such as whether the heart is beating too fast or too slow. It can reveal signs of ischemia, often identified by a depression of the ST segment.	• When s angina • To diag • If a hea • To guid
Angiogram	An X-ray which uses a special dye to show blood through the coronary arteries, veins or the heart. It identifies blockages, **aneurysms** or signs of narrowing.	• After a • When s severe • Before or bypa
Blood test	Measures cholesterol levels and ac biomarkers like **troponi** w ich lps detect blockages or h t m e damage.	• To asse • If a hea • To eval

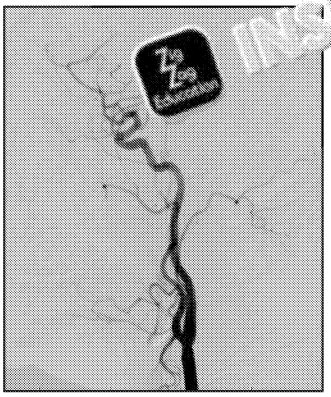


Image showing an angiogram

Aneurysm – swollen area in a blood vessel in the wall. If it bursts, it can cause serious bl

Troponin – protein in heart muscle that leaks

Exam tip

You may be asked to interpret angiograms of this condition in your exam.

Research activity: which shows what h

zzed.uk/12929-

Treatment

Treatments for angina can help prevent angina attacks, reduce symptoms and lo
complications such as heart attacks. There are a few options, some of which req

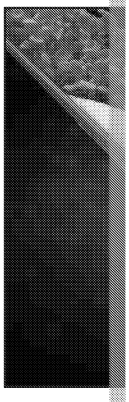
		How it works	Benefits
Surgical treatments	**Angioplasty**	A small balloon is inserted into a blocked artery to allow for a stent to be placed. This holds the blood vessel open to increase blood flow.	✓ Less invasive (still requires a catheter) ✓ Shorter recovery times ✓ Relatively quick procedure ✓ No general anaesthetic re[illegible]ed
	Coronary bypass	[illegible] blood vessel [illegible]s taken from another part of the body and connected above and below a blocked blood vessel. This allows for an alternative route for blood flow.	✓ More effective long term ✓ Treats severe blockages **Did you know?** During coronary bypass surgery, the heart is sometimes temporarily stopped! This is to allow the surgeon to be more precise.

		How it works	Benefits	
Non-surgical treatments	**Nitrolingual pump (angina pump)**	This is a spray that works by relaxing and widening blood vessels (known as vasodilation). This allows for improved blood flow.	✓ Fast-acting ✓ Convenient and portable ✓ Non-invasive	X Sho X Ma wit (e.g iron X Unp hea
	Anticoagulants	Medication that prevents the formation of and breaks down blood clots.	✓ Fast-acting ✓ Non-invasive ✓ Helps prevent clot-related complications	X Incr ble X Unp exp vom bru

Factors increasing likelihood of condition

There are many factors which can increase the ris[illegible] an[illegible]a, all of which are link
Examples include:

- **Obesity** – not only does bei[illegible] ou[illegible] place extra demand on the heart to sup
contributing factor t[illegible] a [illegible]isease, which can result in angina.
- **Diet hi[illegible]at [illegible] fat and salt** – a diet rich in fats that contai[illegible]" type of cholesterol known as low-density lipoprotein (LDL) can result in clogged arteries, increasing the risk of angina and potentially heart attacks. A diet high in salt is also a risk factor for angina, increasing the likelihood of atherosclerosis (fatty plaque that builds up in the arteries), which reduces blood flow.



Did you know? This image demonstrates atherosclerosis, with the yellow showing where plaque has accumulated in the artery.

- **Smoking** – smoking damages the walls of the arteries, which can lead to cho
  can lead to blockages in blood flow.
- **Diabetes** – this can cause damage to blood vessels due to high blood sugar le
  sugar stays high for a long time, it can result in inflammation and build-up of
- **Stress** – high levels of stress can increase blood pressure and release
  hormones that narrow arteries, making angina more severe.

Control and prevention

Making different lifestyle choices is key to managing and preventing angina, all of which help to improve blood flow. Examples include:

- ✓ **Reducing fat and salt in diet** – making healthy eating choices which are low in bad fats and salt helps to reduce the build-up of LDL cholesterol and atherosclerosis. As a result, this helps to promote increased blood flow.
- ✓ **Stopping smoking** – though smoking can cause long-term, damaging consequences to cardiovascular system, stopping can be the first step to
  it from ... after just one month of not smoking, the damage to arter
- ✓ **Reduci... ss** – prioritising lower stress levels can help reduce high blood
  This may help relax the arteries and reduce angina symptoms.
- ✓ **Exercising regularly** – physical activity not only keeps the cardiovascular syste
  reduce the risk of obesity, improve cholesterol levels and promote emotional
  work together to address many of the risk factors for angina, helping to manag
- ✓ **Losing weight** – this helps to reduce the risk factors associated with obesity,
  prioritising a healthy weight this helps to improve heart function and reduce

Applied activity: Imagine you are a healthcare professional explaining to a pers
changes they should implement. Design a leaflet outlining these changes and expl
important in controlling and preventing their angina!

Impact on the individual

Angina can significantly impact an individual's life – from uncomfortable physical s
the emotional challenges of experiencing this condition, it affects all aspects of a
exam, remember these impacts as PIES.

Physical	The physical symptoms associated with angina, including chest pa nausea and fatigue, may cause significant physical discomfort and engage in daily activities such as exercise and physical tasks.
Intellectual	Experiencing angina symptoms may make it difficult to concentra This could create challenges in education, work or family life.
Emotional	Living with angina can cause emotional distress due to worries ab physical, intellectual and social challe[illegible] things. The unpredict also increase fear, frustration, and the risk of developing anxiety a
Social	The symptoms ex[illegible]d with angina may cause an individual t preventing [illegible] engaging in social events that involve physi disc[illegible]participation in social life. The emotional changes ma e to emotional stress or cognitive difficulties.

Case study

John has angina and has begun experiencing more severe symptoms. As a result, he's unable to visit his grandson at weekends, as he fears an angina attack might occur if he engages in physically demanding activities with him. John has also experienced difficulties concentrating at work, resulting in warnings from his boss due to concerns about his performance.

Deep vein thrombosis (DVT)

Overview and causes

DVT is a blood clot that forms in a deep vein, typically in the leg or pelvis, which causes restricted blood flow. It can be very serious if this blood clot breaks loose and travels to the lungs – causing something known as a pulmonary embolism. A pulmonary embolism occurs when a blood clot breaks free and travels to the lungs, causing a blockage that restricts blood flow.

Main signs and symptoms

These signs and symptoms **all** occur at the site of the DVT, including:

- pain and tenderness
- swelling
- redness

Diagnosis and monitoring

Detecting and observing DVT can be done through the following:

Method	How it's used
Ultrasound	Uses high-frequency sound waves to produce images of blood vessels to identify if and where there are any blood clots.
Venography	Uses an X-ray to examine the blood flow in the blood vessels by injecting a dye (typically iodine-based) into the veins. This helps detect blood clots or other issues.

Treatments

There are a few treatment options for DVT, all of which help to prevent a blood clot from getting worse and reduce the risk of pulmonary embolism.

Did you know? Anti known as 'blood thi thin the blood! This i how they work.

	How it works	Benefits	
Anticoagulant medicine	Medication that prevents the formation of and breaks down blood clots.	✓ Fast-acting ✓ Non-invasive ✓ Easy to administer (available to take in oral and injectable forms) ✓ Long-term treatment, helping to prevent future clots	✗ ✗ ✗
Thrombolytic therapy	Thrombolytics ('clot-busting' drugs) work by dissolving the blood clot, which helps to restore normal blood flow.	✓ Breaks down blood clots ✓ More effective than anticoagulants at completely breaking down blood clots ✓ Helps prevent long-term complications such as post-thrombotic syndrome (PTS)	✗ ✗ ✗ ✗ ✗
Thrombectomy	Surgical procedure which removes a blood clot from a blood vessel.	✓ Removes large blood clots ✓ Immediate results ✓ Minimally invasive	✗ ✗

	How it works	Benefits	
Filter	A small metal device is placed in the inferior vena cava to catch blood clots before they reach the lungs.	✓ Prevents clots from travelling to other parts of the body ✓ Can be used as a treatment option for individuals who can't take anticoagulants or thrombolytics ✓ Long-term solution – can be kept in the body for a long time	✗ ✗ ✗ ✗

Factors increasing likelihood of condit on

Several factors can increase the risk of DVT, many of which are linked to the cardiova include:

- **Age** – an individual can have DVT at any age, but being over the age of 60 inc slows the blood flow, increasing the likelihood of blood clotting.
- **Being overweight** – this puts extra pressure on the veins, especially in the pe the risk of blood clots.
- **Smoking** – smoking influences how blood flows by damaging the walls of the arteries, resulting in an increased risk of blood clots.
- **Contraceptive medication** – certain birth control pills, especially those containing oestrogen, can cause high levels of clotting factors in the blood, making it easier for blood clots to form.
- **Hormone replacement therapy (HRT)** – similar to contraception, HRT can increase clotting risk due to oestrogen.
- **Previous DVT** – having a blood clot in the past increases the chances of developing another DVT. This is a result of weakened and damaged veins which may make it easier for new clots to form.
- **Flying / restricted movement** – sitting for long periods, e.g. during a flight, can cause blood to pool in the legs and damage the veins behind the knees. High altitudes can also affect blood circulation, all of which increase the risk of blood clots.

Control and prevention

There are many methods which can help manage and prevent DVT, all of which h
to reduce blood clots.

- ✓ **Compression stockings** – tight-fitting socks which help to improve blood flo
  and reduce pain and swelling. They can be used to help alleviate symptoms
  associated with DVT and help prevent blood clots.
- ✓ **Regular movement** – moving the body, especially after long periods of sitti
  can help to improve blood flow and reduce the risk of clots.
- ✓ **Hydration** – keeping hydrated can help maintain the proper viscosity of the
  making it less likely to clot. This is especially important during periods of im
  as dehydration can cause slow blood flow and increased risk of clots.
- ✓ **Lifestyle changes:**
  - ➢ **Stopping smoking** – quitting smoking n… proves blood flow and
    formation, it also helps other t… nts (such as those mentioned abo
  - ➢ **Exercising regularly** – … ening muscles in the legs, exercise ca
    heart, preven… om pooling in the legs where clots may form.
    th… after a pulmonary embolism.
  - ➢ **Lo… eight** – being a healthy weight can help to improve blood flow
    being overweight can place extra pressure on the veins, increasing the

Applied activity: Discuss with your partner how the methods listed link to the card
knowledge from this chapter to guide your discussion.

Impact on the individual

Living with DVT can impact many aspects of life – from uncomfortable physical sy
swelling to the intellectual challenges of dealing with this condition, it affects ma

Physical	The symptoms associated with DVT, such as pain, swelling and redness, may cause mobility difficulties and restrict an individual's ability to engage in everyday activities or exercise.
Intellectual	The physical discomfort caused by DVT may impair concentration, planning and decision-making, which can affect work, education a daily responsibilities.
Emotional	DVT can be significantly distressing, including the physical discomfort and the intellectual and social changes that may come with it. Fears of pulmonary embolism, recurring blood clots and t long-term nature of this condition may increase the risk of depression, anxiety and other mental health challenges.
Social	Living with DVT may lead to social isolation due to mobility restrictions or uncomfortable physical symptoms, preventing an individual from engaging in social activities. This could lead to relationship strain and loneliness.

Chapter 1: Questions (1.1–1.4)

Checking my understanding:

1. State **one** function for each composition of blood.
   i) White blood cells
   ii) Red blood cells
   iii) Plasma
   iv) Platelets

2. Which of the following heart chambers receives blood from the left atrium?
   a) Right atrium
   b) Left atrium
   c) Left ventricle
   d) Right ventricle

3. Complete the sentence below to describe the function of the conduction sy

   The co[illegible]on system controls **A)**_____ the heart beats and pumps blood. **B)**_____ components, including the SA node, **C)**_____, bundle of His an

4. Explain how **one** structural adaptation of capillaries aids their function.

5. a) How is angina caused?
   b) State **two** ways angina can be treated.

6. Which of the following is **not** a risk factor of DVT?
   a) Contraceptive medication
   b) Flying
   c) Smoking
   d) Low blood pressure

Developing my understanding/skills:

7. Jenny, 50, has recently been diagnosed with angina. Her doctor has told her her fat and salt intake, stop smoking and reduce her stress levels.

   a) State **one** symptom of angina.
   b) Explain why the **three** factors the doctor has identified may be contribu Jenny's angina.

8. Patrick, 67, has deep vein thrombosis (DVT). He has started to experience symptoms, such as swelling and redness on his leg. He decides to ask his doc treatment options are available to him, and he has been offered the following:
   - Thrombolytics
   - Thrombectomy

   a) Give an overview of what DVT is.
   b) Explain how these treatments work.
   c) Evaluate these two treatments.

Chapter 2: Respiratory Syst

The body needs energy to be able to function. Most of this energy comes from ae
place in the cells of the body and requires oxygen. For this to happen, oxygen need
around us into each cell in the body. The oxygen is carried to the cells by the cardio
be able to get into the blood easily. The role of the respiratory system is to get the
remove carbon dioxide from the blood. Too much carbon dioxide makes the blood
body. If the respiratory system does not function properly then the body will not have enough energy. Disorders which affect the respiratory system include asthma and bacterial pneumonia. Understanding the structure and function of the respiratory system helps with
prevention, diagnosis and treatment of these diso

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2.1: Structure and function of the resp

To get enou gen into the blood there needs to be a gas exchange surface wi
provided by the alveoli in the lungs. Airways such as the trachea, bronchi and bro
from the alveoli. Air passes through the nose and mouth before it enters the trac
The structure and function of these are described in more detail below.

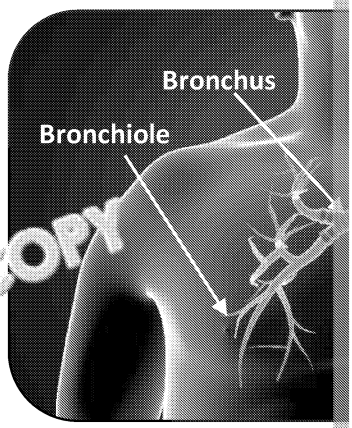
Epiglottis and larynx

After the nose or mouth, the epiglottis and larynx are where the respiratory syste

Structure	Location	
Epiglottis	A flap of tissue located below the tongue towards the back of the throat.	Acts as a 'flap' to p entering the trache
Larynx	A tubular structure in the middle of the neck, sitting at the top of the trachea and oesophagus	Passes air from the structure is also re sounds, which is w

Trachea

The trachea carries air from the nose and mouth to the lungs. It extends from the throat down the neck and into the chest where it divides into two bronchi just above the heart. It has C-shaped rings of cartilage embedded within the walls to keep the tube open so air can flow easily. These rings keep the trachea open so the air can flow easily.



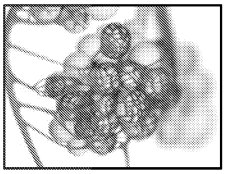
It helps to warm and moisten the air b f re
reaches the delicate lungs. It filt out dust, pollen, pollutants and i microorganisms such as bac na uses. To do this, the lumen is lin specialised epithelium tissue. This tissue produces mucus to t has cilia to move the mucus to the throat to be swallowed. Most infectious micro killed by the strong stomach acid.

Did you know? The rings of cartilage in the trachea are C-shaped with the open the trachea. The oesophagus (food pipe) runs down behind the trachea and can e passing through it. If the cartilage rings were whole, the oesophagus would not be trachea and the food would be more likely to get stuck.

Lungs – bronchi, bronchioles and alveoli

There are two lungs located in the thorax – one on each side of the heart. Each **bronchus** carries air from the trachea into one of the lungs. The bronchi branch int smaller and smaller tubes until they reach the alveoli, where gas exchange takes pla The bronchi, like the trachea, have cartilage rings and specialised epithelial tissue to unwanted particles and warm and moisten the incoming air.

As the bronchi get narrower, they eventually become too narrow for the rings of transition into **bronchioles**. Bronchioles have muscular walls so that the amount alveoli can be controlled. The function of the bronchioles is to carry the air to the Bronchioles are also lined with ciliated epithelial tissue, which traps particles and



Alveoli are the site of gas exchange in the lungs. They have v thick. The cells are squamous epithelial cells which are flatte carbon dioxide to diffuse through them easily. The alveoli ar capillaries so that oxygen can enter the blood and car

Did you k lveoli are only between 100 µm and 300 µm in diameter and t per lung. Th e number ensures a very large surface area of about half a tenn

Key structures involved in mechanics of breathing

As air moves through the respiratory system, several key structures work togethe process of breathing, ensuring the efficient movement of air into and out of the l

Structure	Location	
Diaphragm	A sheet of muscle at the base of the thorax (chest cavity).	Controls breathing. Wh lowers, allowing the lun (inhalation). When it re lungs (exhalation).
Ribcage	In the chest, attached to the spine and curving around to the sternum.	Protects vital organs su well as aiding breathing chest cavity. It does thi lie between the ribs, kn
Internal intercostal muscles	Between the ribs, beneath the external intercostal muscles.	Push air out of the lung down the ribcage. This chest cavity and forces
External intercostal muscles	The outer layer between the ribs. They run from the back (vertebral column) to the front (sternum).	Allow the lungs to fill w the ribcage. This increa ty, allowing air to fl

Did you know? You don't just use your diaphragm for breathing. You also use it for coughing, sneezing and singing.

More on this is covered in Section 2.2.

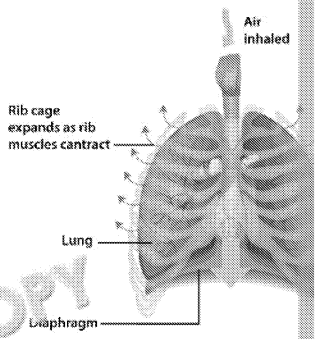
Protective structures of the lungs

The pleural membranes and pleural fluid play crucial roles in protecting and facilita friction and ensuring the lungs move efficiently within the chest cavity.

Structure	Location	
Pleural membrane	Lines the chest well, wrapping around the heart to form the sides of the middle part of the chest and covers the lungs.	Provides cush them from ru
Pleural fluid	A lubricating fluid inside the pleural cavity (the space between two layers of the pleural membrane).	Lubricates the prevent frictio helps make br

2.2: Mechanics of breathi

The air in the lungs needs to be constantly replaced as the oxygen gets absorbed into the blood and carbon dioxide enters from the blood. Breathing out (expiration or exhalation) gets rid of the used air, and breathing in (inspiration or inhalation) replaces it with fresh air.



INHALATION

To breathe in, air in the lungs needs to be at lower pressure than air outside the body. To breathe out, air in the lungs must be at a higher pressure than air outside the body. The respiratory system is designed to ensure that these different air pressures can be achieved by changing the volume of the lungs. If you have the same number of air molecules in two different-sized containers, the air pressure in the smaller container would be at higher pressure than the air in the larger container.

Ex
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To breathe in you need to decrease the pressure in the lungs, which means you need to increase their volume. To breathe out it is the opposite – you need to increase the pressure in the lungs by decreasing the volume. The lungs are not able to change their own volume. The outside of the lungs is effectively stuck to the inside of the chest cavity by the **pleural membranes**. So, when the chest cavity expands, the lungs expand. When the chest cavity gets smaller, the lungs are squeezed into a smaller volume. The two structures which can cause the change in chest cavity, and therefore lung volume, are the diaphragm and the ribcage.

Ple
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con

The role of the diaphragm and the internal and external interc

The diaphragm is a sheet of muscle at the base of the thorax (chest cavity). Whe
dome-shaped, giving the lungs less room. When it contracts it pulls down and fla
the chest cavity and the lungs.

The ribcage is flexible because the ends of the ribs near the sternum are made of
ribs changes the volume of the chest cavity and the lungs. The ribs are moved by
the ribs, known as intercostal muscles. There are two types of intercostal muscles – internal intercostal muscles and external intercostal muscles. It is the external intercostal muscles that are involved in normal breathing. When the external intercostal muscles contract, the ribcage is pulled up and out. This expands the chest cavity, giving the lungs more volume. When they relax, the ribcage springs back into its natural position and air is forced out of the lungs.

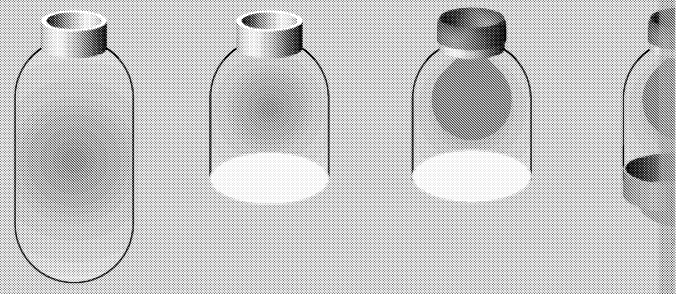
Did
your
also
and

Summary of the mechanics of breathing:

	Inspiration / inhalation / breathing in	Expirati
External intercostal muscles	Contract	Relax
Internal intercostal muscles	Relax	Contract
Ribcage	Moves up and out	Spring ba
Diaphragm	Contracts and moves down and flat	Relaxes a
Lung volume	Increases	Decrease
Lung pressure	Decreases	Increases
Result	Air rushes in from outside the bod through the nose or mouth due to ...er pressure outside the body ... re... to the lungs	The highe forces air the nose

Applied activity: ...odel of the lungs from a small plastic water bottle a...

1. Cut ...er bottle all the way around at about 10 cm from the top. You c... bottle.
2. Place one balloon in the bottle with the end of the balloon over the open bo...
3. Tie a knot in the end of the other balloon and cut off the round tip.
4. Place the second balloon around the cut end of the bottle. Air should now no... as there is a balloon at either end.
5. Pull down the second balloon, making sure that you don't pull it off the bottl...
6. Watch the first balloon inflate like the lungs inflate due to pressure changes...
7. Which respiratory system structure does the second balloon represent?
8. How does the movement of the second balloon cause pressure changes inside...
9. Why do these pressure changes cause the first balloon to inflate?



Case study

Asa is in the third trimester of her pregnancy. She often ...s breathless even when s... foetus grows it pushes upwards on the lungs ...ich can no longer expand as much d... lungs cannot increase their volume ...ch ...ss air can get into the lungs and the b... breathe more often. This gives the sensation of breathlessness.

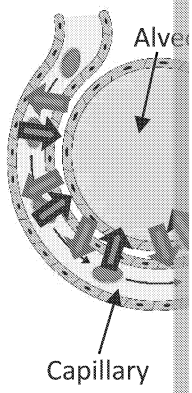
2.3: Gas exchange

Gas exchange is the process by which oxygen from the lungs passes into the bloo
from the blood into the lungs. This occurs in the alveoli. Each **alveolus** is surrou
and carbon dioxide move from one place to the other by **diffusion**.

Alveolus – the singular of alveoli. The alveoli are the structures within the lungs where oxygen gets absorbed into the blood and carbon dioxide is removed from the blood – gas exchange.

Diffusion – the process whereby molecules move from a area of high concentration to an area of low concentration. It is a passive process wh[illegible] require the body to use energy.

Diffusion gradient – the difference in concentration between [illegible] causes diffusion to happen. The stronger the diffusion gradient, the faster molecules move from an area of higher concentration to an area of lower concentration.



The air in the alveoli has a relatively high concentration of oxygen compared to the blood in the capillaries which surround the alveoli. This is because the oxygen concentration in the alveoli is the same as the oxygen concentration of the air we breathe in. The blood in the capillaries that surround the alveoli is deoxygenated as it has already been round the body. Oxygen diffuses from a high concentration of oxygen in the alveoli to a low concentration in the surrounding blood. To get into the blo through the alveoli and capillary walls as well as the red blood cell membranes.

Exam tip

Remember diffusion g
The steeper the slide,
molecules will move fr
concentration (top of t
lower concentration (b

Once in the bloodstream, oxygen binds to haemoglobin molecules in red blood ce
This binding is crucial for transporting oxygen efficiently throughout the body. A
diffuses into the alveoli from the capillaries. This occurs because the concentrati
alveoli is lower than in the blood, creating a **diffusion gradient**. This means that o
high concentration (alveoli) into an area of low concentration (blood). Carbon dioxide moves from an area of high concentration (in the capillaries) into an area of low concentration (alveoli).

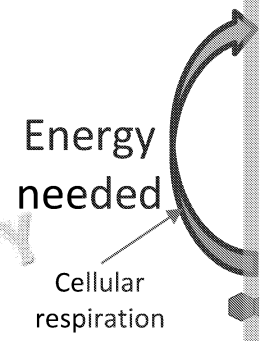
Did you know? N
used in gas exchan
This is known as an
approximately 15

The structural adaptations of the alveoli play an important role in facilitating this process:

- **Thin walls** – the walls of the alveoli are one cell thick, allowing for gases to di shorter distance to travel.
- **Large surface area** – the alveoli cover a large surface area in the lungs, increa exchange can take place.
- **Fluid-lined** – the alveoli are lined with a thin layer of fluid that keeps the wall gases and make it easier to diffuse across.

2.4: Cellular respiration

Your body requires a lot of energy to stay alive and even more to carry out activities. This energy comes from the food we eat. Even when it has been digested, our food is not in a form that cells can use for energy. This is where cellular respiration comes in, as it converts the nutrients from food into usable energy for our cells.



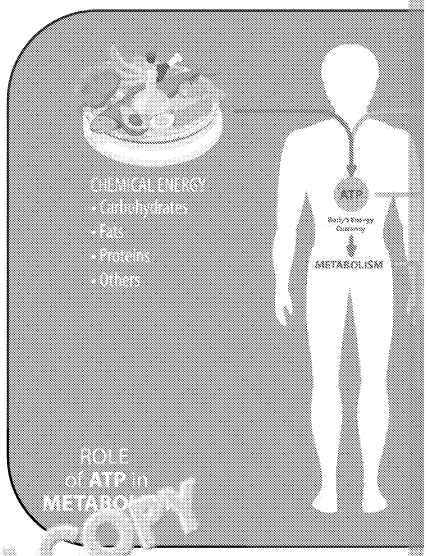
Cells store energy in a molecule known as adenosine triphosphate (**ATP**). ATP can release energy quickly when it is broken down into adenosine diphosphate (**ADP**). It does this by breaking a bond between the p[illegible] of the molecule and a **phosphate gr[illegible]** chemical reactions which take pla[illegible]s to generate ATP molecules ar[illegible]ow[illegible]ular respiration. Cellular respiration [illegible] down nutrients such as glucose into smaller mole[illegible]es. This is an example of catabolism, which releases energy. The energy released from the catabolic reactions of cellular respiration is used make ATP from ADP.

ATP – chemical called [illegible] which acts as a store o[illegible]

ADP – chemical called [illegible] is formed when ATP ha[illegible] be easily converted ba[illegible] respiration.

Phosphate group – pa[illegible] a phosphate atom.

Cellular respiration can occur without oxygen and is known as anaerobic respiration. Cellular respiration which uses oxygen is known as aerobic respiration and is much more efficient than anaerobic respiration as it produces significantly more ATP molecules. Anaerobic respiration does take place in your body, usually during strenuous activity when oxygen begins to run out. However, anaerobic respiration cannot make enough by itself to keep you alive. Oxygen is needed.



Did you know? An average cell in your body can use around 10 million molecules of ATP per second. Very active cells, such as muscle and liver cells, use a lot more.

Exam tip

Think of ATP and ADP as differen[illegible] of a rechargeable batte[illegible] the battery is char[illegible] like a us[illegible] that needs to be recharge[illegible]

Applied activity: Research the ki[illegible] your favourite foods. Compare th[illegible] of kilocalorie need as follows:
Males: 2,500 [illegible]
Females: 2,000

Research activity: Find out the chemical equations for bo[illegible] aerobic and anaerobic respiration (in humans) and write [illegible] the word formulae.

Aerobic respiration	Anaer
• Requires oxygen and glucose. • Involves a complex series of reactions which mostly take place within the mitochondria of cells. • Produces carbon dioxide and water as by-products. • Produces up to 38 molecules of ATP for each glucose molecule used.	• Breaks down gluc • Involves reactions cytoplasm of the • Produces **lactic ac** and alcohol (ethan products in plants • Produces only two glucose molecule

Applied activity: Discuss with your partner the sim ari s and differences between
anaerobic respiration.

Lactic aci acid formed by cells during anaerobic respiration ot responsible for muscle soreness after exercise as many think.

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2.5: Conditions of the respirato

Respiratory conditions, such as asthma and bacterial pneumonia, affect the airwa
symptoms include shortness of breath, wheezing and coughing. People can be a
conditions due to factors such as environmental triggers (e.g. pollution), family hi

Asthma

Overview and causes

Asthma is a narrowing of the airways (bronchi, bronchioles) due to inflammation of the airway walls and bronchoconstriction (tightening of the muscles surrounding the airways). The airways are sensitive to certain triggers, e.g. pollen and dust, which causes the smooth muscle of the airways to constrict. This is due to an overactive immune response. The overreaction of the immune system causes over production of mucus, inflammation of the airway walls and for the muscles surrounding the bronchi and bronchioles to contract, narrowing the airways. The narrowed airways make it harder to get air into and out of the lungs, reducing gas exchange. This means that less oxygen can enter the bloodstream.

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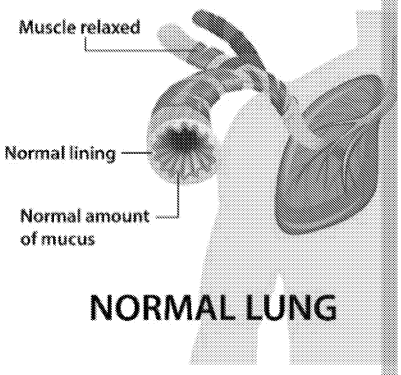
It is a **chronic** condition which has no cure but can be managed. Some children may find their asthma disappears, often in their teens, but it may return later in life. Some people do not develop asthma until they are adults. It is a common condition which can have a big impa with asthma can suffer periods when their symptoms are worse – these are know important to treat asthma attacks immediately as they can cause death.

Main signs and symptoms

- Wheezing
- Tight chest
- Coughing
- Breathlessness



NORMAL LUNG

Diagnosis and monitoring

A couple of methods are available to diagnose and monitor asthma, both of which assess lung function.

Method	How it's used	
Peak flow meter	A small, portable device used to measure how quickly someone can exhale air from their lungs. It helps determine how well air is moving out of the lungs.	•
Spirometer	A device that assesses lung function in more detail, measuring volume of air someone can breathe in and out, as well as how quickly they can do it. It helps detect any problems with breathing, like **obstructive** or **restrictive** issues. It also helps identify if any other respiratory conditions are present, like **bronchitis** or **emphysema**.	• • • •

Obstructive – relating to blockages in airflow.
Restrictive – where the ability of the lungs to expand is restricted.
Bronchitis – inflammation in the bronchial tubes, causing difficulties breathing,
Emphysema – a lung disease where alveoli become damaged, causing difficu

Treatments

Since asthma is a chronic condition with no cure, treatment aims to control symp
condition over time.

	How it works	Benefits
Reliever inhaler	A medicine which helps to quickly open up the airways by relaxing the lung muscles. This provides relief during an asthma attack or when symptoms such as wheezing and breathlessness occur.	✓ Portable ✓ Fast-acting, provid immediate relief ✓ Easy to use
Preventer inhaler	A medicine which contains ds which help reduce inflam ne airways over time a asthma symptoms ing.	✓ Portable ✓ Easy to use ✓ Helps manage long term asthma symptoms ✓ Reduces frequency and severity of symptoms/attacks
Steroid tablets	Medication used for more severe asthma, used to help reduce inflammation and control symptoms or when inhalers do not provide sufficient relief	✓ Easy to use ✓ Alternative treatme when inhalers don work ✓ Effective for managing more severe asthma
Nebuliser	Changes liquid asthma medication into a fine mist to allow for easy inhalation. It can deliver a high amount of medicine directly to the respiratory system to reduce inflammation and alleviate symptoms.	✓ Delivers medicatio more effectively, especially during a severe asthma atta ✓ Suitable for individuals who struggle using inhalers, such as children

Did you know? Steroid tablets can be used for many health conditions, from asthma to inflammatory bowel disease.

Case study

Yusuf is 10 years old and ... football at school. He has asthma but has forg... It is spring and a lot ... are flowering. The pollen count is high. Yusuf starts to ... his teache... Peel can hear that he is wheezing. Yusuf complains of a tightness ... sit down a... his breath back. He asks him to take slow deep breaths, but his sy... calls for an ambulance. Because Yusuf has breathing difficulties, he is treated as a p... arrives quickly. The paramedics treat him with a nebuliser which is a machine that tu... into a fine mist which Yusuf breathes in through a mouthpiece. His parents arrive soo...

Adrenal suppression – linked to prolonged use of oral steroids, affect the body's ability to produce natural cortisol. This can caus... weakness and low blood pressure.

Factors increasing likelihood of condition

The causes of asthma are what lead a person to suffer from the condition in the f

- **Family history** – people with a close family member who suffers from asthm condition – this is a genetic cause.
- **Triggers** – often the genetic cause combines with other factors, such as:
  - **Chest infections** – having a chest infection can trigger asthma by making the airways more inflamed and sensitive. Other respiratory illnesses, including cold and flu, can also trigger asthma, causing inflammation and mucous which can worsen symptoms such as breathlessness, coughing and wheezing.
  - **Allergies** – allergies to substances such as anim[illegible] feathers, dust and pollen can trigger asth[illegible] symptoms because they cause the immu[illegible]m to overreact. This reaction releases chemicals that make the airways swell and tighten, leadi[illegible] breathlessness and wheezing.
  - **M[illegible]e** – certain medicines, such as non-steroidal anti-in[illegible]tory drugs (NSAIDs), e.g. aspirin and ibuprofen, can exacerbate asthma symptoms in sensitive individuals. This is because these medicines can cause the body to produce substances known as leukotrienes (which are present during an asthma attack), which can trigger symptoms like wheezing and difficulty breathing.
  - **Mould or damp** – living in mouldy or damp conditions can trigger asthma by releasing tiny spores (reproductive cells produced by mould) into the air. When these spores are inhaled, they can irritate the airways and trigger asthma symptoms. Additionally, damp environments can increase the growth of dust mites and harmful bacter immune system and make asthma symptoms worse.
  - **Environmental factors** – the environment we are exposed to, such as po also trigger asthma. Pollution can irritate and inflame the airways, caus making it harder to breathe. Asthma can also be triggered by temperat hot humid weather. Cold weather can irritate the airways, dry them ou production. Hot humid climates can promote the growth of mould and inflammation and triggering an immune system reaction.
  - **Exercise-induced** – for some individuals, their asthma can be triggered b physical activity increases breathing rate, causing airways to narrow due can lead to a loss of heat and moisture in the airways.

Applied activity: Discuss with your partner how these factors which increase th link to the respiratory system.

Control and prevention

Methods to control and prevent asthma are all aimed at helping individuals to live with the condition. This involves implementing treatments and lifestyle changes which can help people to manage their asthma by reducing the frequency and severity of symptoms as well as preventing serious asthma attacks from happening.

Examples include:

- **Preventer inhaler** – using this treatment can help to reduce the frequency a by reducing the inflammation in the airways. However, for this treatment to consistently over a long period of time.
- **Steroid tablets** – individuals may be prescribed this medication to help contr they have experienced an asthma attack. Steroid tablets do this by helping t lungs, preventing it from getting w is medication is usually used for a individuals recover, contr nd reduce their symptoms and prevent an asthm some cases, they c h u d over a long period.
- **Avoidi ge** – certain triggers can bring on or worsen asthma oms. For some people, avoiding these triggers is the solution to managing their asthma. For example, someone with an animal fur allergy may avoid being in environments where there are animals, e.g. pets. Doing so can help to prevent an immune system reaction that causes their airways to
- **Lifestyle changes** – making healthy lifestyle changes, such as exercising regul help control and prevent asthma. Exercise helps improve and strengthen ou efficient. Over time, it can help to reduce inflammatory proteins responsible helping to reduce symptoms such as breathlessness and wheezing. Addition reduce flare-ups, improve lung function and reduce airway inflammation.

Applied acti
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Impact on the individual

Living with asthma doesn't just affect breathing; it can impact a person's physical, social dimensions. From the chronic nature of this condition, to the unpleasant s breathlessness, asthma can have far-reaching consequences on daily life.

Physical	The physical symptoms of asthma, such as wheezing and breathlessness, can cause significant discomfort and interfere with daily activities. This may make it harder to exercise and to engage in activities that require physical exertion.
Intellectual	Experiencing asthma symptoms may affect concentration and decision-making. This interfere with daily responsibilities such as work, school, or family life.
Emotiona	The chronic nature of sthma may cause emotional distress f e individual, including anxiety about vi s asthma attack or feeling frustrated that the dition limits their daily activities. Additionally, fears of certain triggers could contribute to high levels of stress and avoidance of situations.
Social	Asthma symptoms may make it difficult to engage in social activities, especially those that involve physical exertion or exposure to certain triggers. Fears of an asthma attack could lead to avoiding social events, which could place strain on personal relationships.

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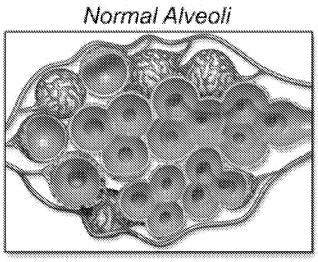
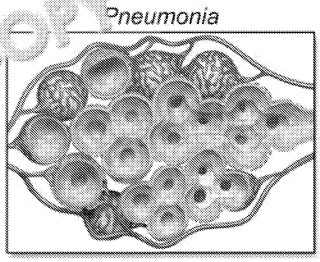
Bacterial pneumonia

Overview and causes

Bacterial pneumonia is a serious infection in the lungs caused by bacteria. It leads to inflammation of the lung tissue, causing the alveoli to fill with pus and other fluids. As these fluids accumulate in the alveoli, oxygen transfer into the blood is impaired, resulting in reduced oxygen levels in the body.





Main signs and symptoms

- Cough, which may include mucus that is yellow, green or bloody
- Breathing difficulties (rapid shallow breathing, shortness of breath)
- Chest pain which gets worse when you breathe deeply or cough
- Fever
- Other symptoms include extreme fatigue, sweating/chills and increased heart rate (tachycardia)

Diagnosis and monitoring

There are a few ways bacterial pneumonia can be both diagnosed and monitored.

Method	How it's used	
Physical examination	A healthcare provider listens to the lungs with a stethoscope to check for abnormal breath sounds (e.g. crackles or bubbling) to detect signs of inflammation in the lungs.	• If so symp • Initia • To d • To h
Chest X-ray	A chest X-ray is often used to detect the location of the infection by revealing areas of **lung consolidation**, where the alveoli are filled with pus, fluid, or inflammatory cells **Lung consolidation** – when the alveoli are filled with pus or fluids instead of air.	• Whe susp exam • To c the e • To m impr • If sev susp
Sputum test	Analyses the mucus or phlegm coughed up from someone's lungs to identify the type of bacteria causing the infection. A sample of sputum (lung fluid) is collected after a strong cough.	• To id • Whe antib
Blood test	A blood test can help detect signs of infection, such as elevated white blood cell counts or other markers of inflammation, which may suggest bacterial pneumonia.	• Whe detai • To c asses • To m to tr

Applied activity: Imagine you are a healthcare professional. Design an informative different methods used to diagnose and monitor bacterial pneumonia.

Treatments

Treatment for bacterial pneumonia typically involves targeting the bacteria causing the infection, as well as managing the symptoms to aid recovery.

	How treatment works	Benefits
Antibiotics	**Tablets** – oral antibiotics are absorbed into the bloodstream to target the infection and help control bacterial growth.	✓ Non-invasive ✓ Convenient and easy to take ✓ Fast-acting
	Intravenous – antibiotics delivered directly into the bloodstream, providing a more rapid and efficient treatment, especially in severe cases of bacterial pneumonia.	✓ More direct and faster delivery of antibiotics ✓ Useful for severe cases of bacterial pneumonia ✓ Doesn't rely on digestion for absorption, allowing the full dosage to reach the bloodstream
Fluids	Intravenous (delivering directly into a vein through injection or drip) or oral fluids are given to rehydrate the body to prevent dehydration. This helps to support recovery and makes mucus easier to clear by thinning it.	✓ Prevents and treats dehydration, especially for severe cases when a patient can't drink fluids ✓ Ensures controlled and precise fluid intake ✓ Supports overall recovery
Oxygen	Oxygen supplementation can be used to support patients unable to breathe independently. This can be delivered through nasal tubes or face masks.	✓ Increases oxygen levels in the bloodstream, reducing the strain on the heart and lungs ✓ Non-invasive

Antibiotic resistance – w
and become resistant to t
making medications ineff
infections.

Did you know? Fluids aren't just for rehydration! Some treatments involve removing fluid from the lungs if there is too much between the lungs and the chest wall.

Factors increasing likelihood of condition

Certain factors can increase the risk of developing bacterial pneumonia, all of which

- **Lifestyle choices** – engaging in certain lifestyle behaviours, e.g. smoking, can pneumonia by damaging the respiratory system, impairing the body's ability and weakening the immune system, making someone more vulnerable to re

- **Age** – certain age groups can be more vulnerable to bacterial pneumonia, es
  This is because babies' immune systems are still developing and the elderly h
  making it harder for them to fight off infections.
- **Underlying health conditions** – chronic illnesses such as **chronic obstructive**
  diabetes and asthma can increase the risk of bacterial pneumonia. For exam
  harmful bacteria to grow in the airways, diabetes can weaken the immune sy
  function, and the damage caused by asthma can weaken the lungs.
- **Weakened immune system** – when the immune system isn't functioning properly, the body becomes less capable of defending itself against bacterial infections in the lungs. Conditions that weaken the immune system, such as HIV/AIDS, cancer treatments, or immunosuppressive drugs, also increase the risk of bacterial pneumonia.

Control and prevention

Bacterial pneumonia can be a very serious, life-threatening illness. Therefore, me
aimed at controlling and preventing it are crucial, especially for those most at risk
are two ma[illegible]tegies.

- **Flu vac[illegible]ns** – flu vaccinations help protect against influenza, a viral infec
  can lead to secondary bacterial pneumonia. They are especially important fo
  vulnerable groups, such as infants, the elderly and those with underlying health conditions, as they help to reduce the risk of serious complications, such as hospitalisations and death. Additionally, the more people get vaccinated, the less likely this illness can spread, due to **herd immunity**.
- **Lifestyle changes** – lifestyle changes, such as giving up smoking, maintaining good hygiene, and managing chronic conditions like COPD, can h
  pneumonia. Exercising regularly has been found to reduce the risk of seriou
  from bacterial pneumonia through its impact on strengthening the immune s
  not only benefits overall health, but also supports lung function and helps to
  mucus.

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Case study
Patrick, 68, maintains a healthy lifestyle and stays active with regular dog walks and swimming. However, he was recently diagnosed with COPD due to smoking in his younger years.

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Impact on the individual

Experiencing bacterial pneumonia can significantly impact an individual. Not only
can have wide-reaching effects on a person's well-being, from physical to social in

Physical	The physical symptoms which accompany this illness, such as brea fever, can cause significant discomfort and fatigue. These sympto perform daily activities, such as eating or sleeping, and lead to we
Intellectua	The physical toll of this illness, such as a fever, can cause confusio These cognitive challenges can make it harder for the individual to them, including difficulties with focus and decision-making.
Emotional	Dealing with this serious illness could cause feelings of anxiety, fe are particularly vulnerable, like the elderly, could suffer significant about the life-threatening nature of this illness.
Social	The physical symptoms and infectious nature of this illness can ca individuals from engaging in daily activities or interacting with fa

Chapter 2: Questions (2.1–2.5)

Checking my understanding:

1. State **one** function for the following:
   i) Epiglottis
   ii) Bronchioles
   iii) Alveoli
   iv) Pleural membrane

2. During inspiration, the internal intercostal muscles relax. What do the inter during expiration?

3. What structural adaptations do the alveoli have that aid gas exchange? Select a
   A) Walls that are two cells thick
   B) Large surface area
   C) Lined with fluid
   D) Near pleural

4. Which molecule do cells store energy in?

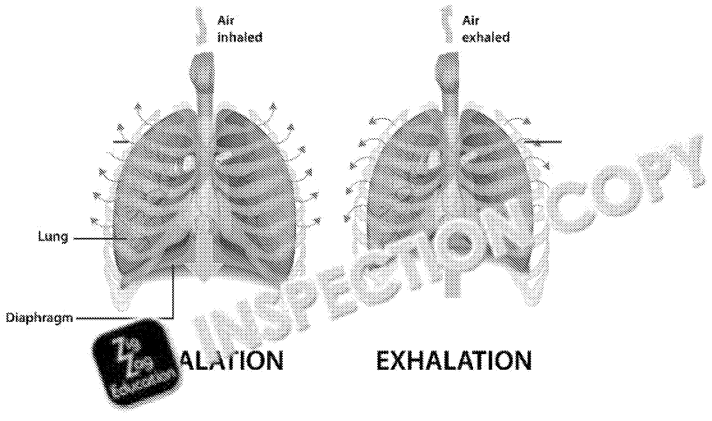
5. State **one** method of diagnosing and monitoring asthma. *(1 mark)*

6. Which of the following are treatments for bacterial pneumonia? Select all th
   A) Intravenous antibiotics
   B) Oxygen therapy
   C) Steroid inhalers
   D) Nebuliser

7. Complete the sentences below to describe the location and function of the The diaphragm is a sheet of muscle located at the **A)**___ of the **B)** _____. is to **C)**_____.

Developing my understanding/skills:

8. The diagram shows the mechanics of breathing.



Explain what happens during inspiration to the external intercostal muscles.

9. Charlie has asthma and has been struggling to manage his condition. He has experienced more severe and frequent symptoms and asthma attacks, so he visit his GP to talk about treatment options. Charlie already has a reliever in

Discuss which treatment would be best for Charlie. Consider the benefits, and why you would recommend this treatment.

Chapter 3: Digestive Syste

We need nutrients to act as the basic buildin
provide energy. We get our nutrients from f
in an appropriate state for our bodies to use
is it able to get to the cells of the body where
digestive system is to break down food both
constituent molecules. These can then be us
Importantly, they are now small enough to e
can be carried to all the cells in the body.

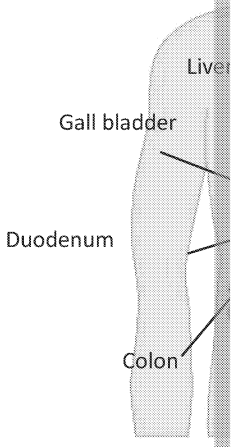
3.1: Structure and function of the dig

The digestive system has two main functions:

1. **Digestion** – the physical and chemical breakdown of food into small and simple molecules
2. **Absorption** – the transfer of these small nutrient molecules into the blood

The different structures of the body ensure that these two functions can occur. Generally, the structures higher up in the digestive system break down the food (digestion) while the structures further down absorb the nutrients into the bloodstream (absorption).

The digestive system consists of the alimentary canal and some accessory organs. The alimentary canal is the tube which extends from the mouth at one end of the digestive system to the anus at the other. There are different sections of the alimentary canal which have specific functions. Food passes through the alimentary canal and changes as it goes along due to the different structures it passes through. The accessory organs help the alimentary canal carry out its functions.



Did you know? The stomach lining needs to be protected against stomach acid and the enzymes of the stomach. To do this, special cells in the lining of the stomach produce thick mucus.

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Functions of structures of the alimentary canal

Component	Location	Funct
Buccal cavity	The beginning of the digestive tract, extending from the lips to the pharynx (throat)	This is where the alimentary canal breaking down food (by chewing), (e.g. tasting) and producing sound
Oesophagus	A food pipe located behind the trachea, connecting the pharynx and the stomach	The oesophagus (food pipe) carrie stomach. It has muscular walls to as peristalsis. Food has already be chewing in the mouth and has had added with th saliva. Food will co digest du ile in the oesophagus l pr d ced here.
Stomach	side of the body, near the top of the abdomen	The stomach churns food and mixe enzymes released into the stomach molecules called peptides. The sto hydrochloric acid (HCl), which help swallowed with food and provides enzyme activity. Note: the acid is food.
Small intestine	Lower abdomen, between the stomach and the large intestine	Responsible for nutrient absorptio into a liquid form. It produces dige along with bile, help break down fo then absorbed through tiny structu small intestine called villi. Any rem to the large intestines, and will eve
➥ **Duodenum**	The first section of the small intestine, connecting the stomach to the middle of the small intestine	The duodenum is a small section o connects the stomach to the ileum digestive system where most chem Enzymes are released by both the the pancreas. There are different carbohydrates, proteins and lipids time the food, now known as chyn consists of simple sugars, amino ac
➥ **Ileum**	The final and longest part of the small intestine, leading to the large intestine	The ileum is where the nutrients th absorbed from the lumen of the di It has a lot of adaptations to absor possible. It has a rich blood supply large surface area is created by th in the wall ger-like projections fro lls which line the villi k
Large intestine ➥ **Colon**	Surrounds the small intestine, fo final the digestive tract	The colon, part of the large intesti the bloodstream and forms what faeces to be removed from the bo are also absorbed into the blood h
➥ **Rectum**	End of large intestine	The rectum holds stool, and abso electrolytes, making the waste mo signals are sent to release the stoo
➥ **Anus**	End of rectum	The final stage of the alimentary c expelled from the body. The proc sphincters, special muscles which

The **bowel** collectively refers to both the small and large intestines. The small int nutrient absorption, while the large intestine focuses on the reabsorption of wate expulsion of waste.

Functions of structures of accessory organs

Accessory organs of the digestive system, such as the liver, pancreas, and gall bla
process by producing enzymes, bile, and other substances that aid in the breakdo
being part of the alimentary canal.

Component	Location	Function
Liver	Upper part of the abdomen on the right, below the diaphragm	The liver has many functions not related digestion, the liver produces a substance down fat droplets into smaller droplets, area of the droplets. This is known as em droplets are smaller, they have a much la easier for enzymes to digest. So, bile doe it easier for enzymes to digest. Bile is ma gall bladder, and is released into the duo when needed.
Bile duct	Tubes that runs from the liver and gall bladder to the small intestine	**Did you know?** The liver is able to rege and is the only organ that can grow bac of it has been removed by surgery. This may be possible to donate part of your someone else while you are alive.
Pancreas	Back of stomach, extending across the abdomen	The pancreas has an endocrine function However, its role in the digestive system enzymes. These are made in the pancrea duodenum through the pancreatic duct, enzymes to help break down fats, carboh
Gall bladder	Under the liver, on the right side of the abdomen	The gall bladder is where bile, made in th needed in the duodenum. The gall bladd when the stomach empties its contents i
Salivary glands	Under the lining of the mouth and pharynx	Salivary glands release saliva into the mo digestive enzymes and helps to moisten t it is easier to swallow. The enzymes in th carbohydrates like starch into smaller ca **Applied activity:** Test the action o Slowly chew a piece of bread or c without swallowing for a few minut starts to taste sweet? Explain this in know abo e function of saliva.

3.2: Mechanical and chemical d

In order to digest food, we need two key processes to work together – mechanica
Mechanical digestion is where food is physically broken down to reduce it into sm
food into more manageable particles, this supports chemical digestion, which furt
enzymes. Let's look at these processes in more detail.

Mechanical digestion

As mentioned, mechanical digestion is the process of physically breaking down fo
reduce its size. This physical breakdown involves three main processes:

- **Chewing** – also known as mastication, this is the beginning of mechanical dig
starting at the mouth. This is where the food we eat is broken down by the t
which grind the food into small particles. Once chewed, the tongue directs
towards the pharynx which continues its journey down the oesophagus.
- **Churning** – this happens in the stomach, where the smooth muscles in the st
contract and relax to mix food with digestive juices (stomach acid and
digestive enzymes). This process happens over several hours, where
food is turned into a substance known as chyme. Chyme then enters
the duodenum, where most chemical digestion takes place.
- **Peristalsis** – this is a wave-like rhythmic contraction and relaxation of
muscles in the gut wall. It helps to move food and chyme through the
gastrointestinal tract. It does this by contracting circular muscles
behind the food to push it forwards, while longitudinal muscles
ahead of it contract and widen to shorten the path, making
movement easier. This process works a bit like a snake swallowing its
prey and slowly pushing it down its body. See the image, right, which
shows this process in action.

Mechanical digestion is incredibly important for chemical
digestion, as it increases the surface area of food. By breaking
down food into smaller pieces, it allows digestive enzymes to act
more efficiently, speeding up chemical breakdown and improving
nutrient absorption.

Chemical digestion

Although mechanical digestion is a crucial part of digestion, breaking down food p
enough on its own. Without chemical digestion to change the food's chemical pr
digestive system wouldn't be able to extract the important nutrients we need fro
as carbohydrates, proteins and lipids (fats). Through **digestive enzymes**, food is b
into smaller nutrients that can be absorbed by the body. Enzymes work like keys,
different types unlocking certain nutrients. To unlock these nutrients, three key s
are needed:

- **Mouth** – the process of chemical digestion begins in the mouth with the enzyme salivary amylase. This breaks down carbohydrates into simple sugars such as glucose.
- **Stomach** – in the stomach, chemical digestio[illegible]es with the help of gastric juices secreted by the gastr[illegible]. These juices contain hydrochloric acid and protea[illegible]reak down proteins into amino acids. Hydrochloric a[illegible]o make sure the acidic conditions in the sto[illegible]ar[illegible]ight level for proteases to function.
- **Small i[illegible]e** – as mentioned, most chemical digestion takes place here. Enzymes are released by both the walls of the duodenum and by the pancreas. There are different types of enzymes so that carbohydrates, proteins and lipids are all digested here. Fats are broken down by lipase into fatty acids and glycerol. Bile, produced in the liv
is released into the duodenum to help break down large fat globules into sm
for lipase to act. By the time the food, now known as chyme, leaves the duo
sugars, amino acids, fatty acids and glycerol.

Applied activity: Simulate the function of the stomach to physically break down food. Use a strong sealable plastic bag (like a freezer bag). Add some torn pieces of soft food (so as not to tear the bag) such as bread. Add about 100 ml of water to simulate the stomach fluids. Now gently squeeze the bag and churn the food about, mixing it well with the water. You should find that the food will gradually break down leaving a thick creamy liquid. Why is it not enough for the digestive system to just physically break down the food in this way?

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3.3: Absorption and assimil

Digestion is the physical and chemical breakdown of food into small, simple mole bodies to benefit from the food we consume – including nutrients such as vitamin and proteins – it first needs to absorb the digested food molecules into the blood **absorption**. Once absorbed, the nutrients travel through the circulatory system t The cells then convert these absorbed nutrients into useful substances in a proce a look at these two terms.

Absorption

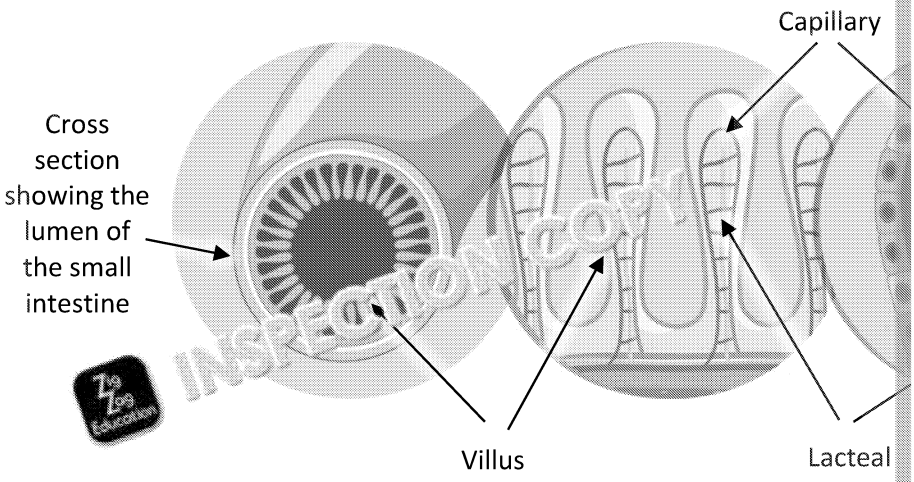
Absorption is the process of transferring digested f ecules into the bloods intestine, which plays a key role in ensuring t ntial nutrients are absorbed.

The main digested food m sorbed in the small intestine include:

- glucose (rates)
- fatty a d glycerol (from fats)
- amino a s (from proteins)

The small intestine has specialised structures to aid its function:

Structure	Function	How its st
Villi	The inner lining of the small intestine is covered with finger-like projections that absorb the food molecules.	Increases surface a more nutrients to bloodstream.
Blood capillaries	Within each villus (*plural villi*) is a network of capillaries that is responsible for absorbing food molecules into the bloodstream.	Thin, permeable w short diffusion dis bloodstream.
Lacteals	Each villus also contains a structure called a lacteal, which is part of the lymphatic system. Lacteals absorb fatty acids and glycerol into the lymphatic system.	Lacteals provide a lymphatic system, entering the blood



Did you know? Once digested, fats are packaged into large particles called chylomicrons, which are too large to enter through the capillary walls.

Did you know? The villi contain severa absorption, including enterocytes (which goblet cells (which secrete mucus to pro (which produce antimicrobial enzymes f cells (which release hormones to regula (which replace old or damaged intestin

Assimilation

Once nutrients are absorbed into the blood, they are transported to cells where t
process called assimilation takes place, in which nutrients are converted into esse
functions such as energy production, growth, and repair.

The capillaries with their thin, permeable walls, play a key role in transferring nutrients to body cells. As blood flows through capillaries, nutrients move from the plasma (the liquid portion of blood) into the tissue fluid surrounding cells. This movement is driven by **hydrostatic pressure**, which forces fluid and dissolved nutrients out of the capillaries and into the surrounding tissues, ensuring that cells receive the nutrients they need.

There are several nutrients that are assimila[illegible] in the body. Let's explore some o

- **Glucose storage** – the liver c[illegible]ocess glucose into glycogen, which is st
when needed.
- **Amino [illegible] fo[illegible] synthesis** – amino acids from digested proteins are
build r[illegible]teins, essential for growth, repair, and enzyme production.
- **Fat use [illegible] storage** – fatty acids and glycerol are absorbed and either used f
tissue as an energy reserve.
- **Vitamin absorption** – the small intestine absorbs vitamins, such as vitamin B
blood cell formation and other bodily functions.
- **Minerals for bodily functions** – essential minerals like calcium are assimilate
and teeth, while iron is needed for haemoglobin production in red blood cel

Assimilation is important; without it the body would not be able to use the nutrie

Applied activity: Create a flow chart that traces the journey of a nutrient from foo
all stages of digestion. Here is an example of one for protein:

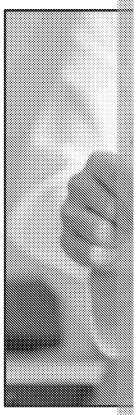
1. **Ingestion** – protein is consumed from eating an egg
↓
2. **Mechanical digestion (mouth)** – the teeth break down the egg into smaller pi
↓
3. **Chemical digestion (mouth)** – amylase (digestive enzyme) within the saliva b
no protein breakdown happens in the mouth)
↓
4. **Digestion (stomach)** – pepsin (digestive enzyme) and stomach acids break do
↓
5. **Digestion (small intestine)** – trypsin and peptidase (en[illegible]nes) break down po
↓
6. **Absorption (small intestine)** – amino ac[illegible] a[illegible]sorbed into the bloodstrea
↓
7. **Transport (cardiovascula[illegible]ster.)** – blood transports amino acids to muscle c
↓
8. **Assimi[illegible]** – [illegible] cells use amino acids to synthesise new proteins for gro

3.4: Conditions of the digestive

When parts of the digestive system aren't functioning properly, certain conditions gallstones can arise. Common symptoms that arise in these conditions include ab movements, and nausea. While family history and underlying health conditions c these conditions, lifestyle factors also play a significant role.

Bowel polyps

Overview and causes



This condition is an abnormal production of cells in the li[illegible]f the bowel, occurring in the colon and rectum. Bowel pol[illegible]ps a[illegible]e mostly harmless, but they can develop into bow[illegible]er, which is why diagnosing, monitoring and treat[illegible]ng t[illegible]ondition is so important. Bowel polyps can vary in [illegible]z[illegible]n small to large; large bowel polyps can cause a[illegible]na[illegible], diarrhoea, and blood in the stool due to blocking a p[illegible]he bowel.

Main signs and symptoms

- Blood or mucus in stool
- Changes in bowel movements such as diarrhoea and constipation
- Abdominal pain

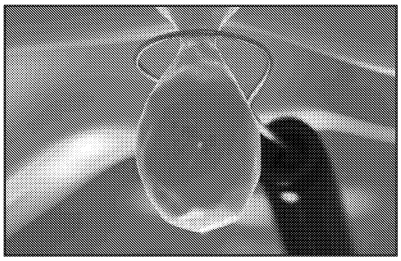
Diagnosis and monitoring

There are two main ways to diagnose and monitor bowel polyps:

Method	How it's used
Screening	Although this is usually done for bowel cancer, screening can also help detect polyps. This involves collecting a sample of stool, which is sent to a lab for testing. This test screens for tiny amounts of blood in the stool which can be caused by polyps.
Colonoscopy	A small camera with a light is inserted into someone's rectum to detect any polyps in the colon.

Treatments

Treatments for bowel polyps aim to remove the abnormal production of cells in t Depending on the severity and size of the polyp, certain treatments are given.

	How it works	Benefits
Polypectomy	This is where a 'wire loop' is inse[illegible]te into the rectum whi[illegible]en [illegible]s the polyps by sc[illegible]ng t[illegible]n off without dam[illegible]e surrounding tissue. This s u[illegible]ally used alongside a olonoscopy. See image below which shows a polypectomy. 	✓ Painless ✓ Simple procedure ✓ Quick recovery tim ✓ Allows for a sample be collected to tes cancer ✓ Helps prevent colo cancer (by removin polyps before they become cancerous)

	How it works	Benefits
Open surgery	A surgical procedure involving an incision into the abdominal wall, where a section of the colon is removed where the polyp is. This treatment is used for more severe, large polyps which pose a greater risk of developing into cancer.	✓ Helps prevent colo cancer (by removi polyps before they become cancerous) ✓ Can address more severe cases of bo polyps ✓ Alleviates symptom associated with lar polyps such as abdominal pain an blood in stool

Case study

Samir, 6[illegible] tly had a colonoscopy that revealed a large polyp in his colon. He options be[illegible] he doesn't fully understand what they involve, their benefits, or thei

Factors increasing likelihood of condition

Certain factors can increase someone's risk of bowel polyps, from diet to certain health conditions. This is because all of these factors influence the digestive system, which can increase the risk of abnormal cell growth in the lining of the bowel.

- **Gender** – men are more at risk of developing bowel polyps than women.[1] Although the reasons for this aren't fully understood, it's believe hormonal differences, genetics and lifestyle factors can contribute to the growth in men's bowels.
- **Age** – those who are over the age of 50 are more likely to develop bowel polyps. This is because as we age, the risk of abnormal cell growth in the bowel increases.
- **Diet** – a diet high in fat and processed foods can be difficult for the digestive system to process, as bile and digestive juices can struggle to break down these fatty foods. As a result, this means the by-products from these foods can become stuck in the colon and lead to abnormal growth of cells in the bowel.
- **Family history** – those with a family member who has had bowel polyps are more at risk of developing the condition. This is due to genetic factors that may increase the likelihood of abnormal cell growth in the bowel. This is why individu[illegible] with a family history of bowel polyps are recomm[illegible] to undergo regular screening to detect and mo[illegible] polyps and prevent cancer.
- **Crohn's disease** – th[illegible] chronic condition that causes inflamm[illegible] swelling in the gastrointestinal tract. This infl[illegible] can make it more likely for abnormal cells to grow in the bo polyps as well as bowel cancer.
- **Smoking** – smoking is incredibly damaging to each system within the bod People who smoke are more at risk of bowel polyps because of the harmf (particles that cause cancer) present in tobacco smoke. These substances in the tissues of the body, leading to abnormal cell growth in the bowel.

[1] MD Anderson **https://www.mdanderson.org/cancerwise/colon-polyps--10-things-to-know.h00-159538167.html#:~:text=Men%20are%20more%20likely%20to,of%20screening%20for%20colorec** 06/02/2025)

Control and prevention

Controlling and preventing bowel polyps involves making healthy lifestyle changes. These changes can help to improve the functioning of the digestive system and prevent the likelihood of abnormal cell growth.

- **High fibre diet** – eating a diet rich in fibre, such as fruits, vegetables and wholegrain foods, can help to reduce abnormal cell growth in the bowel by keeping the walls of the colon healthy and strong. Eating this diet can also help to reduce the risk of reoccurring polyps.
- **Losing weight** – losing weight helps to lower the levels of fat and cholesterol in the body, which can reduce the likelihood of developing bowel weight can also improve overall digestive health and reduce inflammation, lo cell growth.
- **Exercising regularly** – engaging in physical activity on a regular basis can help by improving circulation and digestive function. Exercise also helps in maint further lowers the risk of polyps.
- **Stopping smoking** – quitting smoking can help prevent any further damage t cause abnormal cell growth. As a result, this can help to reduce the risk of fu improve the overall health of the digestive system.

Impact on the individual

Experiencing bowel polyps can significantly impact someone's life, especially in re

Physical	The physical symptoms of bowel polyps, such as abdominal pain, bowel movements, could cause significant physical discomfort, es experiencing more severe, large polyps. This could make it challe activities like daily chores and responsibilities, as well as exercise.
Intellectual	These physical symptoms could make it difficult for individuals to concentrating, decision-making and problem-solving. As a result, education, or family life.
Emotional	The sensitive nature of this condition could make individuals feel experiencing this condition. Additionally, fears of polyps leading t significant emotional distress such as anxiety and stress.
Social	The embarrassment or emotional distress caused by bowel polyps Individuals may feel uncomfortable discussing their condition with could prevent them from seeking the medical support they need.

Applied activity: Come up with a real-life case study that s bowel polyps can impact a person's life in relation to PIES.

Gallstones

Overview and causes

This is where stones form in the gall bladder from crystals of cholesterol and bilirubin (a yellow substance in bile). These stones gradually become larger and can become trapped in the bile duct, blocking the secretion of bile into the small intestine. This blockage can affect the digestion of fat.

Main signs and symptoms

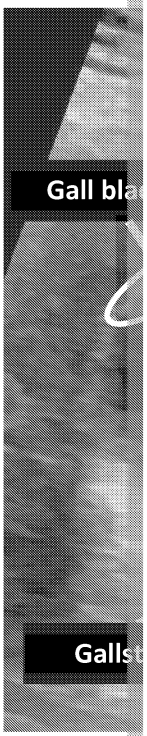
- Abdominal pain
- **Jaundice**
- Fever
- Nausea

Jaundice – a condition caused by abnormally high levels of bilirubin, causing the skin and eyes to turn yellow

Diagnosis and monitoring

There are a[illegible]ys to diagnose and monitor gallstones:

Method	How it's used	When it's used
Physical examination	A healthcare professional examines someone's upper right stomach area by placing their hands on this area while asking the individual to breathe. Any pain during this process helps identify the presence of gallstones.	• If someone shows signs and symptoms of gallstones • To diagnose gallstones • To direct future treatment
Ultrasound	Involves moving an ultrasound across an individual's abdomen. This creates an image of the structures of the abdomen to detect any gallstones present.	
Blood test	A blood sample is taken to help identify gallstones by detecting any infections, such as jaundice, which can be caused by gallstones.	



Treatments

There are surgical and [illegible]rgical options for treating gallstones. Surgical treatments [illegible]moving the gall bladder to alleviate symptoms and prevent [illegible] happening. [illegible]urgical treatments help manage symptoms such as abdominal [illegible]

Did you k[illegible]
non-surgica[illegible]
get rid of g[illegible]
prevent ful[illegible]
surgery is [illegible]

		How it works	Benefits
Surgical treatments	**Laparoscopic cholecystectomy**	This is a **keyhole surgery** where numerous small incisions are made in the abdomen. Thin surgical instruments are then placed inside the abdomen to remove the gall bladder.	✓ Less invasive ✓ Quicker recovery ✓ Shorter hospital stay ✓ Less pain after surger ✓ Alleviates symptoms a avoids future complications
	Open cholecystectomy	A larger incision is made in the right side of the abdomen (under the ribs) to remove the gall bladder.	✓ Alleviates symptoms a avoids future complications ✓ Overcomes limitation laparoscopic cholecystectomy such more control over excessive bleeding, cl visibility, and suitable patients who have ha previous abdominal surgery

Keyhole surgery – a type of operation which allows a procedure to be performed inside a part of the body without requiring a large incision.

Research activity: Find out when open cholecystectomy is used instead of laparoscopic cholecystectomy.

		How it works	Benefits
Non-surgical treatments	**Pain relief**	Painkillers can be prescribed to individuals to help alleviate symptoms such as abdominal pain by interrupting pain signals before they reach the brain.	✓ Easy to use ✓ Can be used alongsid surgical treatment ✓ Non-invasive

Did you know? Antibiotics are another non-surgical treatment which are used to treat infections which can be caused by gallstones.

Factors increasing likelihood of condition

There are certain factors which can increase the risk of developing gallstones, all

- **Gender** – females are more at risk of developing gallstones due to higher le oestrogen, particularly from pregnancy or contraceptives. High levels of oes can slow down the movement of the gall bladder and increase cholesterol i bile. Together, these factors can lead to the formation of gallstones.
- **Age** – being older than 40 can increase the risk of developing gallstones bec we age the gall bladder can become less effective at emptying, and bile can more concentrated, increasing the likelihood of stone formation.
- **Obesity** – being obese can increase the likelihood of developing gallstones b cholesterol in the bile. This makes it easier for cholesterol to form stones.
- **Family history** – family history of gallstones can i the likelihood of d of genetic factors that may affect bile co gall bladder function.
- **Alcohol abuse** – the link betwee buse and gallstones is still up for that alcohol can indirectl rea the risk of gallstones forming. This is bec liver problems, w bile production and contribute to gallstone deve

Case study

Yasmin is 43 years old and worried she might develop gallstones because her mother has had them. She doesn't drink or smoke, and eats a healthy diet.

Applied activi

Identify the fa higher risk of consider what helping to pre

Control and prevention

Controlling and preventing gallstones involves making lifestyle changes that can h function and reduce the risk of developing stones.

- **Dietary changes** – eating a balanced diet, low in unhealthy fats and high in fibre, can help prevent gallstones. Making these dietary changes can promote healthy digestion and gall bladder function. Additionally, reducing fatty and processed foods can lower cholesterol, which helps to reduce the risk of gallstones forming.
- **Losing weight** – losing weight can help reduce the risks associated with being obese, including lowering cholesterol levels in the bile. In turn, this helps reduce the likelihood of gallstone formation.

Impact on the individual

Gallstones can be incredibly painful and uncomfortable for someone to experienc on physical, intellectual, emotional and social dimensions.

Physical	The symptoms that accompany gallstones, such as abdominal pa may make it hard for individuals to function in daily life. Individ from these symptoms, which may m ha der to engage in p Additionally, these sympto could disrupt basic needs such as
Intellectual	These physical s p could make it difficult for individuals t as conc ecision-making and problem-solving. A feve fu interfere with cognitive abilities. As a result, this could i mily life.
Emotional	Dealing with gallstones can be emotionally distressing, especiall Abdominal pain in particular could increase suffering and cause Additionally, the lack of non-surgical treatments for gallstones c worry and stress for individuals, particularly for those who fear
Social	Individuals with gallstones may struggle to engage in social activi symptoms that accompany it. Abdominal pain, nausea and a fe bed-bound, and increase the risk of loneliness. Additionally, jau from engaging in social activities due to concerns about how the embarrassment of having visible symptoms like yellowing of the

Checking my understanding:

1. Which of the following structures of the alimentary canal is responsible for n turning semi-solid food into a liquid form?
   A) Buccal cavity
   B) Small intestine
   C) Ileum
   D) Stomach

2. Where in the digestive system is bile stored?
   Mechanical digestion is the process of physically b[illegible]ng down food to redu

3. State **one** process that happens in [illegible]cal digestion.

4. What structure is [illegible]ns[illegible]e for absorbing fatty acids and glycerol?
   A) C[illegible]es
   B) La[illegible]
   C) Villi
   D) Plasma

5. John has just started experiencing blood in his stool, constipation and painful
   He has gone to his GP. State what condition John is most likely suffering fro

6. Which of the following are treatment options for gallstones? Select **all** that
   A) Laparoscopic cholecystectomy
   B) Painkillers
   C) Open surgery
   D) Polypectomy

7. Complete the sentences below to describe the function of the salivary glands

   The salivary glands release A)_____ in the mouth. Saliva contains B)_____ a
   moisten the food and C)_____ it so it's easier to swallow. The enzymes in t
   begin D)_____ digestion.

Developing my understanding/skills:

8. Identify the enzymes which break down the following food groups:
   A) Protein
   B) Fat
   C) Carbohydrate

9. Patrick, 57, has recently develo[illegible]o[illegible]l polyps. Despite maintaining a heal
   exercising, he is a smo[illegible]is doctor has explained that his age, gender and
   may be increasi[illegible]k for this condition.

   a) Ex[illegible]what bowel polyps are.
   b) Justify why Patrick's doctor has identified his age, gender and smoking as
      for this condition.

Chapter 4: Musculoskeletal s

The musculoskeletal system consists of the muscular system and the skeletal syst
Both are needed for movement. The skeleton provides structure, support and protection, acts as a mineral store and produces both red and white blood cells. muscular system enables you to move. It is needed to pull different bones in rela to each other so that movement can be achieved. Problems with the skeleton, su strength of the bones or movement at the joints, can affect support and moveme Problems with muscles or the structures which attach muscles to bones will also movement. By the end of this section, you should understand the components o the skeletal and muscular systems, as well as the conditi at can affect the musculoskeletal system.

4.1: Skeletal system

The skeleta n is made up of various components. First, let's focus on its str

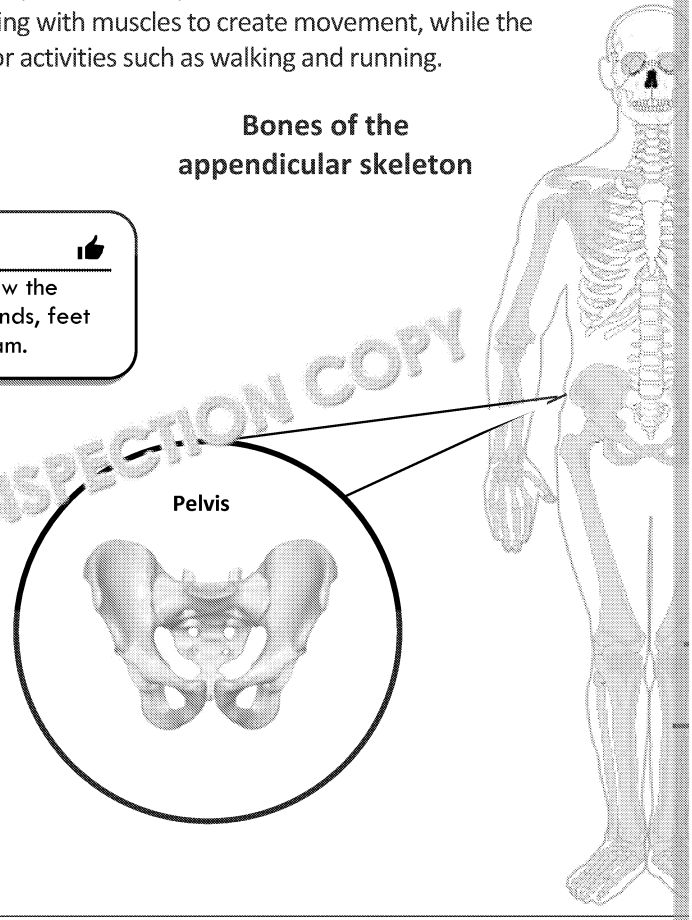
Skeletal structure

Bones are the framework of our body and allow movement by working with muscle g Bones also provide protection of vital organs, and joints allow different types of mov They are split into the appendicular skeleton (made up of the upper limbs, lower limb shoulder girdle and pelvic girdle) and the axial skeleton (made up of the core bones o body, including the thoracic cage, the vertebrae and the cranium).

The appendicular skeleton

The appendicular skeleton is responsible for movement, flexibility and **locomotion**. It includes the upper limbs (scapula, clavicle, humerus, radius and ulna) and lower limbs (pelvis, femur, patella, tibia and fibula). These bones act as levers, working with muscles to create movement, while the pelvis provides stability for activities such as walking and running.

Bones of the appendicular skeleton

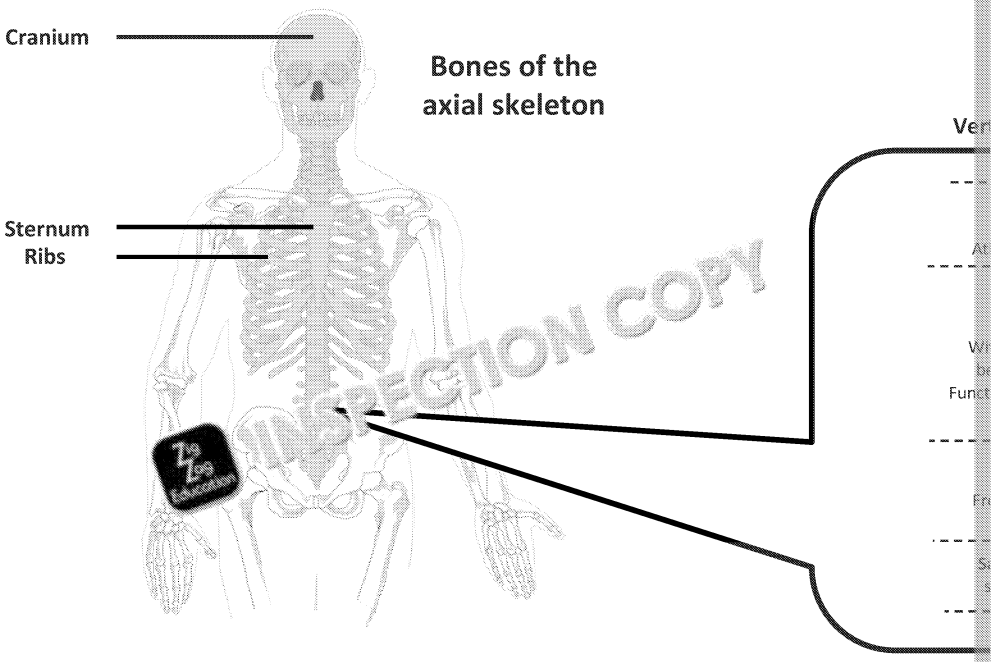


Exam tip

You do not need to know the specific bones in the hands, feet and pelvis for your exam.

The axial skeleton

The axial skeleton provides support, protection and posture. It includes the cran
column, which protect vital organs such as the brain, heart and lungs.



Structure of bone

Bones provide the framework for the body and other functions, such as protection, movement, blood cell production and mineral storage. Bones are composed of living tissue that adapts, grows and changes throughout the life of a person. The limbs are made of long bones.

Below is a diagram showing the main structural components of a bone, which you will need to know for your exam.

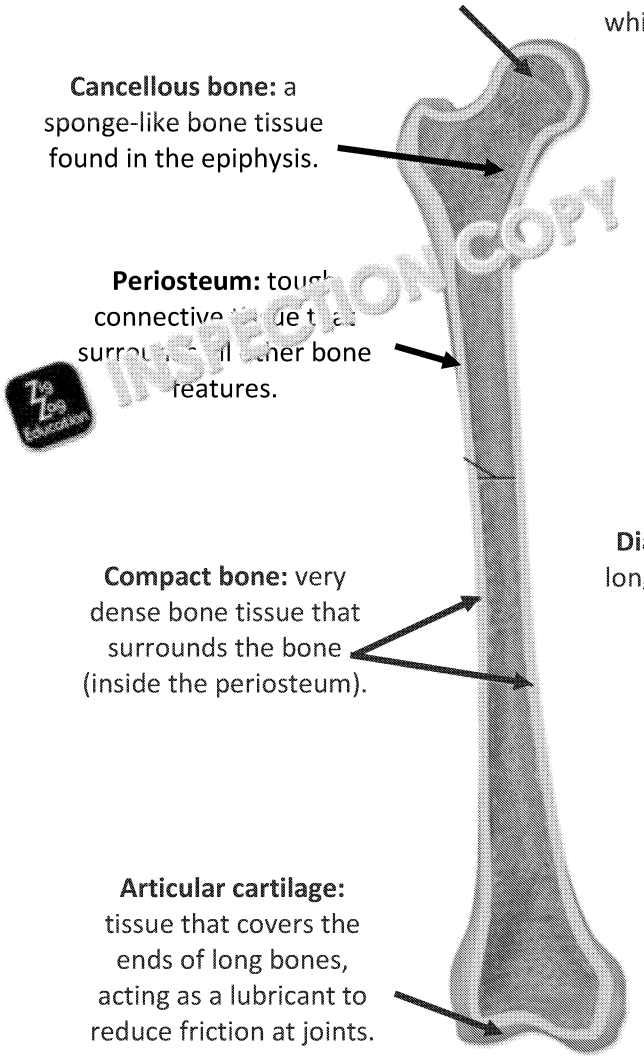
Did you know? Bone has several functi

- ✓ **Protection:** It is hard, so it is used t organs. For example, the skull pro ribcage protects the heart and lun
- ✓ **Structure:** It gives the body structu
- ✓ **Movement:** There are special are attach, as one of the main function movement of the body.
- ✓ **Storage of minerals:** The bones al example, calcium is stored in bone different functions in the body, incl communication between nerve cells
- ✓ **Blood cell production:** The bone m bones, is where the blood cells are

Growth plate: a section of cartilage found on the end of long bones in children and young adolescents. Once the bones have stopped growing, it transforms into an epiphyseal line.

Epiphysis: the en
which forms a joint

Cancellous bone: a sponge-like bone tissue found in the epiphysis.



Periosteum: tough connective tissue that surrounds all other bone features.

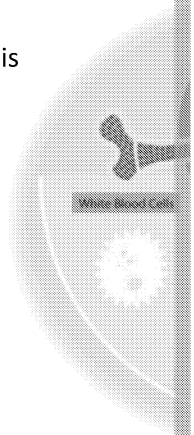
Diaphysis: the cent
long bone between

Compact bone: very dense bone tissue that surrounds the bone (inside the periosteum).

Articular cartilage: tissue that covers the ends of long bones, acting as a lubricant to reduce friction at joints.

Epiphysis

Other bone anatomy you should be aware of is **bone marrow**. This is sponge-like bone tissue that is the location of blood cell production, including red blood cells, white blood cells and platelets. Bone marrow also plays a key role in supporting the immune system by producing B cells, a type of white blood cell that is responsible for producing antibodies.



Did you know? There are key minerals that are stored within bones known as **bone minerals**. They aid bone growth and heath!

Formation of bone

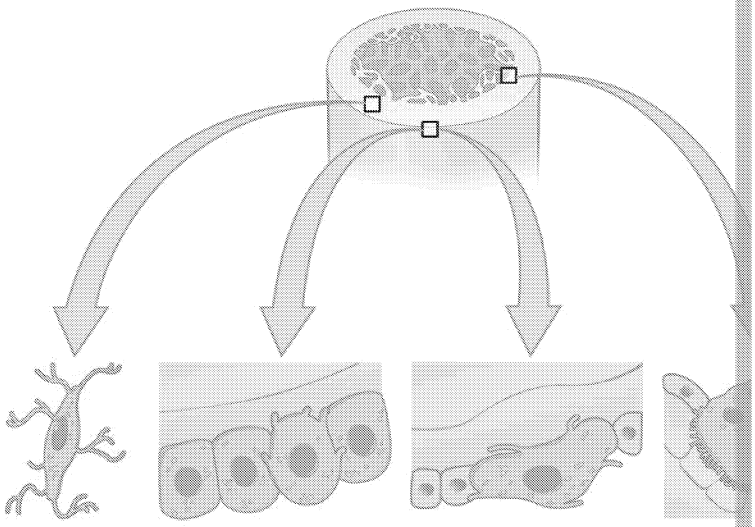
It is known that bone is a living tissue and it changes and grows throughout life. I
the human body can break down and build new bone tissue when required, simila
destroyed and replaced. **Ossification** is the term given to the process of bone re
ossification uses **osteoclasts** (bone breakdown, where old bone tissue is dissolved
remodelling / growth, where new bone tissue is created).

Calcium is the mineral that acts as the building block of bones, alongside vitamin D, v
of calcium in the body. When a bone is being remodelled and a breakdown of bone
less calcium (because calcium is for bone growth). **Osteoclasts** are cells that remove
removal of calcium makes bones more brittle, allowing them to be broken down to a

Osteoblasts carry calcium to the bone to build new bone tissue. The new bone is
Osteocytes build layer upon layer to create the new bone tissue.

A good example of bone remodelling at work is the growth plates in children and adolescents. During childhood, the growth plates are constantly remodelled until the long bones have reached full maturity. The growth plates are then replaced by the epiphysis.

Did you
conditio
reductio
overact
much ca
bones,
prone t

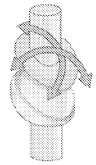
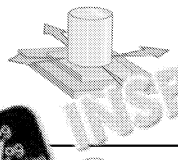
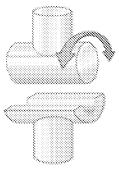
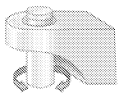


Osteocyte (maintains bone tissue) | **Osteoblast** (forms bone matrix) | **Osteogenic cell** (stem cell) | **Osteo** (reso

Structure of synovial joints

Synovial joints allow movement. The shoulder, elbow, knee, finger joints and hips are all examples of synovial joints. They are a little more complicated in structure than the other two types of joint (fibrous and cartilaginous) as they have to allow two bones to move smoothly against each other. The ends of the bones are covered with hyaline cartilage because cartilage is smoother than bone so the bones can move against each other with less friction. The friction is further reduced as the joint is encased in a tough capsule which contains a fluid known as synovial fluid. Synovial fluid is made by the synovial membrane which lines the joint. The bones themselves are connected to each other with ligaments.

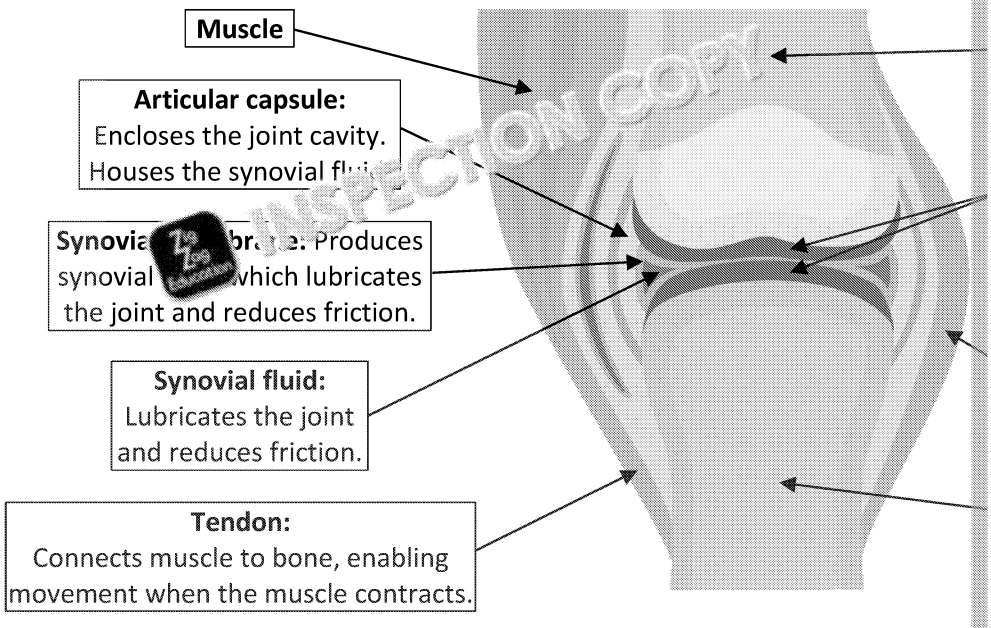
There are six types of synovial joint found in the body that allow the body to mov

Type	Diagram	Movement(s)	
Ball-and-socket		Flexion, extension, abduction, adduction, rotation, circumduction	Hi
Condyloid		Flexion, extension, abduction, adduction, circumduction (no rotation)	W an
Gliding		...ling or gliding movements	Ha an
Saddle		Flexion, extension, abduction, adduction, circumduction (more freedom than condyloid)	Th
Hinge		Flexion and extension only	El
Pivot		Rotation around a single axis	Ne (ra

Applied activity: In pairs, practise using different types of synovial joint. One movement, and the other identifies which type of synovial joint is being used.

** You do not need to know the names of each joint in brackets, just the locations.*

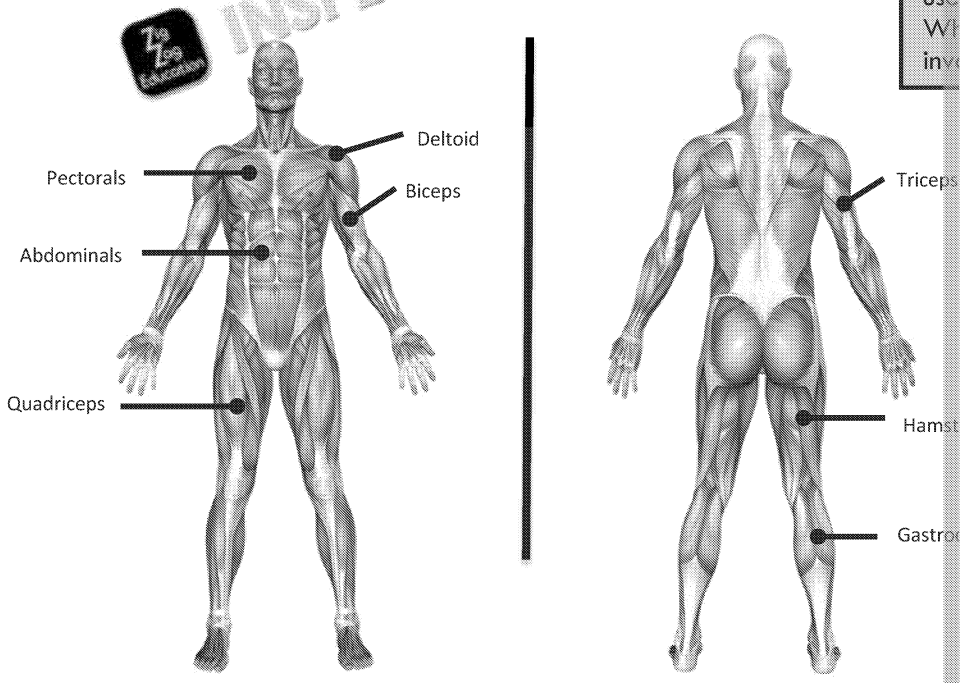
You should now know the location of, and types of, movement found at different range of different movements and are designed to help prevent injury. Their func movements and preventing injury is based on their structure. This is outlined bel



4.2: Muscular system

The muscular system is made up of the skeletal muscles (mostly striated muscle tissue) that attach to the skeleton. Movement of the skeleton occurs at the joints, which is where one bone connects to another. Bones need to be connected securely to each other at joints, otherwise the skeleton is at risk of falling apart. Ligaments are made of tough fibrous tissue that holds one bone to another at a joint. For a bone to move at a joint, it must be pulled by a muscle. So, the muscles must be securely attached to a bone. Tendons are tough fibrous tissue that attaches muscles to joints.

Skeletal muscles are under voluntary control, meaning that movement is consciously caused when the person chooses. When muscles contract, working in **antagonistic pairs**, they pull the bones to cause movement at joints. Below is a diagram that you should identify the key skeletal muscles.



Muscle	Function
Biceps	Flexes the elbow and assists in supination (rotating the forearm
Triceps	Extends the elbow, straightening the arm.
Pectorals	Moves the shoulder; specifically allows flexion, **adduction**, and
Deltoid	**Abducts** the arm (especially the middle deltoids), and the anter deltoids assist in shoulder flexion, extension, and rotation.
Hamstrings	Flexes the knee and extends the hip, important for walking, run
Quadriceps	Extends the knee and helps with hip flexion.
Gastrocnemius	Flexes the knee and **plantar flexes** the ankle (points the toes do running, and jumping.
Abdominals	Flexes and rotates the torso, helps stabilise the pelvis, and assis during exercise and forced exhalation.

Adduction – movement of a body part towards the

Abduction – movement of a body part away from t

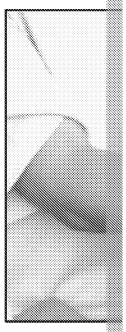
Plantar flexion – movement where the top of the fo

4.3: Conditions of the musculoske

Conditions which affect the musculoskeletal system, such as carpal tunnel syndro muscles, bones and joints. Common symptoms include pain, weakness and limite conditions can significantly impact daily life, and factors such as lifestyle, age and increase the likelihood of developing them.

Carpal tunnel syndrome

Overview and causes



This is a condition that occurs when the median nerve, w[illegible] runs from the forearm into the palm of the hand, bec[illegible] compressed as it passes through the carpal tunnel in th[illegible] This pressure on the nerve interferes with its norma[illegible] leading to reduced sensory and motor control. Th[illegible] prevents the nerve from transmitting [illegible], which can cause numbness in the hand, as well as ti[illegible] weakness.

Main signs and symptoms

- Numbness in hand
- Pain in arm or hand
- Tingling
- Weakness in hand or wrist

Diagnosis and monitoring

There are a few ways carpal tunnel syndrome can be diagnosed and monitored, a nerve function and detect signs of compression.

Method	How it's used
Physical examination	A healthcare professional examines the wrist for signs o muscle loss (atrophy) and asymmetry. They may also apply pressure to the carpal tunnel to trigger symptoms and perform movement tests such as the **Phalen test**, where specific wrist positions help confirm the diagnosis **Did you know?** This image shows the Phalen manoeuvre. This movement provokes pain in patients with carpal tunnel syndrome.
Ultrasound	Involves usi[illegible] quency waves to create images of the [illegible]. T[illegible] test detects if there is median nerve [illegible], compression or flattening.
Electromyography (nerve test)	A fine needle electrode is inserted into specific muscles controlled by the median nerve to assess electrical activity during contraction and relaxation, helping detec any muscle or nerve damage.

Treatments

There are surgical and non-surgical treatment options for carpal tunnel syndrome reduce pressure on the median nerve, alleviate symptoms and improve wrist and

		How it works	Benefits
Surgical treatments	**Carpal tunnel surgery**	Also known as carpal tunnel release surgery, this is a procedure which involves cutting the transverse carpal ligament to relieve pressure on the median nerve.	✓ Long-term solution compared to non-surgical options ✓ Addresses the root cause of nerve compression ✓ Alleviates symptoms ✓ Restores motor and sensory functions
Non-surgical treatments	**Wrist splint**	A wrist splint is worn around the wrist to limit movement. This keeps the wrist in a neutral position to reduce pressure on the median nerve. 	✓ Non-invasive ✓ Easy to use ✓ Relief of symptoms after a few weeks of use ✓ Non-surgical option
	Pain medication	Painkillers can be prescribed to individuals to reduce inflammation or alter the way the brain perceives pain signals, offering symptomatic relief.	✓ Easy to use ✓ Non-invasive ✓ Can be used alongside other treatments
	Hand exercises	Helps strengthen supporting muscles and improve flexibility, which may reduce pressure on the nerve and alleviate symptoms.	✓ Non-invasive ✓ Convenient, can be done anywhere ✓ Helps alleviate symptoms and treat the root cause

Factors increasing likelihood of condition

The following factors can increase the risk of developing carpal tunnel syndrome:

- **Wrist fracture** – a broken wrist can cause the space in the carpal tunnel to narrow, increasing pressure and irritation on the median nerve, which can result in carpal tunnel syndrome.
- **Obesity/becoming overweight** – excess weight can cause fluid build-up which can compress the median nerve and contribute to increased risk of carpal tunnel syndrome.
- **Family history** – having a close family member with carpal tunnel syndrome can increase the likelihood of developing this condition. Genetics are believed to play a role in structural abnormalities of the carpal tunnel, making it more prone to compression.
- **Working with vibrating tools** – repetitive motions and vibrations from power tools, for example, can cause musculoskeletal strain on the wrist and hands, such as damage to blood vessels, nerves and joints. This can compress the median nerve in the carpal tunnel.

- **Prolonged/regular computer-based activities** – continuous typing or using a and repetitive stress on the median nerve, increasing the risk of carpal tunne
- **Rheumatoid arthritis** – inflammatory conditions such as rheumatoid arthritis thickening of the tissues around the carpal tunnel, putting pressure on the m
- **Hormonal or metabolic changes (thyroid imbalance)** – hormonal fluctuation menopause, can cause swelling in the wrists due to fluid retention in the car build-up can place increased pressure on the median nerve.
  Additionally, metabolic changes, such as a thyroid imbalance, can cause **peripheral neuropathy**. This can also lead to fluid retention which puts extra pressure on the median nerve.

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Research activity: Research the different types of hand exercises for carpal tunnel syndrome. Consider how these exercises help to reduce pressure on the median nerve.

Control a re tion

Controlling eventing carpal tunnel syndrome involves adopting specific mo reduce pressure on the median nerve:

- ✓ **Grip with less force** – using a lighter grip can help reduce strain on the wrist and prevent excessive pressure on the median nerve.
- ✓ **Take breaks when working with hands** – taking regular breaks, especially when performing repetitive movements or using vibrating equipment, helps to avoid prolonged stress on the wrist and reduces the risk of compression in the carpal tunnel.
- ✓ **Keep hands warm** – keeping the hands warm helps maintain better circulation and prevents stiffness, helping to reduce pressure on the median nerve.
- ✓ **Hand stretches** – performing hand stretches improves flexibility and can relieve tension in the wrist and arm, all of which helps reduce pressure on the median nerve.

Impact on the individual

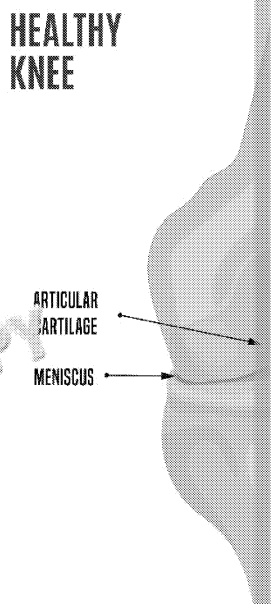
Carpal tunnel syndrome can have a significant impact on a person's life. Since we rely on our hands for nearly everything, sensory and motor issues can affect many aspects of daily living, particularly in terms of PIES.

Physical	The sensory and motor symptoms, such as pain, numbness and w wrists, can cause physical restrictions. Individuals may struggle to using their hands or wrists, which could inte re with most daily
Intellectual	Carpal tunnel syndrome may affe in ividual's ability to focus discomfort or pain. This mp t tasks that require mental e problem-solving.
Emotiona	Dealing h pain and physical restrictions that accompany thi no l distress. Individuals may experience feelings of frustra ecially if the condition interferes with their ability to engage in perform daily tasks.
Social	Individuals may find it difficult to participate in social activities tha such as eating or holding objects, which can lead to social isolatio

Osteoarthritis

Overview and causes

This is a degenerative joint disease where there is a gradual breakdown of joint cartilage. This results in reduced joint space and friction between the bones, which increases inflammation and the formation of **bone spurs**. While osteoarthritis is non-inflammatory in nature (in contrast to rheumatoid arthritis), inflammation can still occur secondarily. This leads to symptoms such as pain and stiffness.



Bone spurs – bony growths that develop along the edges of bones, often in joints affected by osteoarthritis.

Main signs and symptoms

- Pain
- Inflammation
- Stiffness
- Limited range of movement
- Grating and cracking sounds in joints

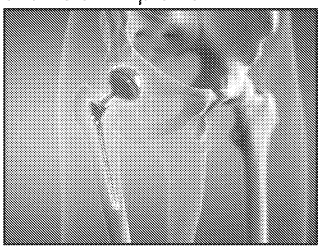
Diagnosis and monitoring

Diagnosing and monitoring osteoarthritis involves detecting the extent of cartilage loss and presence of bone spurs.

Method	How it's used	
Physical examination	A healthcare professional examines the affected joint for signs of osteoarthritis by visually assessing the area (checking for swelling, redness, etc.), checking for tenderness and evaluating range of motion.	• If sy • To • To
X-ray	This provides a detailed image of a joint, allowing for the detection of joint space loss, bone spurs and other structural changes in the bone. **Research activity:** Research X-rays for osteoarthritis. See whether you can detect bone spurs, a loss of joint space and other structural characteristics.	•
Exploratory surgery	Also known as arthroscopy, this is a keyhole surgery whereby a healthcare professional makes a small incision into a joint. A fine device is inserted with a small camera at the end which can provide an image inside the joint to detect cartilage damage, bone spurs and inflammation.	•

Treatments

There are surgical and non-surgical options for osteoarthritis. Surgical options he damage by repairing or replacing damaged joints, whereas non-surgical options f such as pain and inflammation.

		How it works	Benefits
Surgical treatments	**Joint fusing**	Also known as arthrodesis, this is a procedure in which damaged cartilage between two bones is removed. The bone ends are trimmed and secured with metal hardware (e.g. screws and plates). Over time, the bones heal and fuse into a single solid structure.	✓ High success rates in eliminating pain and symptoms ✓ Long-term solution in addressing symptoms ✓ Safe and effective procedure
Surgical treatments	**Joint replacement**	A procedure which involves removing a joint damaged by osteoarthritis and replacing it with an artificial implant. 	✓ Significantly reduces symptoms ✓ Improves mobility in affected joint ✓ Long-lasting results (implants can last 10–15 years, depending on the individual and activity level)

		How it works	Benefits
Non-surgical treatments	**Pain medication**	Painkillers can be prescribed to individuals to help reduce the perception of pain by altering how the nervous system processes pain signals.	✓ Non-invasive ✓ Easy to use ✓ Can be used alongside surgical treatments ✓ Helps people manage their condition
Non-surgical treatments	**Non-steroidal anti-inflammatory drugs (NSAIDs)**	NSAIDs are medication which help reduce pain and swelling by interfering with specific enzymes.	✓ Helps reduce inflammation ✓ Non-invasive ✓ Easy to use ✓ By managing pain and inflammation, NSAIDs can improve joint mobility and function

		How it works	Benefits
	Steroid injection	A steroid injection is administered into the affected joint to help decrease inflammation, stiffness and pain. It works by mimicking the effects of natural hormones made by the adrenal glands.	✓ Provides localised relief to affected joint ✓ Improves mobility ✓ Quick effect

Factors i si g likelihood of condition

Certain facto increase the risk of developing osteoarthritis, all of which cont inflammation or increased strain on the cartilage.

- **Age** – as we age, the likelihood of developing osteoarthritis increases. This is joints undergo repeated stress, which can gradually wear down cartilage, co tear'. Additionally, as we age, our cells and tissues lose their ability to handl them more prone to damage and cartilage breakdown.
- **Obesity** – extra body weight increases the strain on joints, contributing to fa cartilage breakdown and a higher likelihood of developing osteoarthritis. Additionally, higher levels of fat increase the amount of inflammation-causin proteins, which can trigger inflammation in the joints.
- **Other joint conditions** – osteoarthritis can develop in joints that have already damaged by another condition, such as **rheumatoid arthritis** or **gout**. These conditions can cause inflammation that leads to cartilage breakdown, making t joints more susceptible to osteoarthritis (which is referred to as 'secondary art
- **Joint injury** – experiencing an injury to the joint increases the risk of osteoar inflammation in the joint. This inflammation can lead to damage to the joint breakdown. Factors such as the severity of the injury, the degree of swelling joint can influence whether someone will develop osteoarthritis after an inju

Control and prevention

While osteoarthritis cannot be fully prevented, it can be minimised by engaging in healthy lifestyle habits and using supportive devices.

- ✓ **Joint support devices** – using supportive devices, e.g. a knee brace, can help individuals engage in activities which would usu ly cause pain or instability. These devices can help manage s pt ms such as joint pain, reduce pressure on affected jo ts an improve stability.
- ✓ **Lifestyle changes** – implementi es e changes, such as exercising regularly and g ight, can help prevent and control osteoarthritis. P activity, especially low-impact exercises such as swi ar walking, not only helps strengthen the muscles around fected joints but also keeps the cartilage lubricated, which can reduce pain and stiffness. Additionally, losing weight helps reduce the amount of strain put on the joints which contributes to cartilage breakdown, as well as reducing the amount of inflammation-causing proteins.

Rhe auto bod atta caus swel **Gou** caus cry swel

Research activity: Research examples of different types of joint support device. Find out how they work, their benefits, and how they can help manage osteoarthritis symptoms.

Impact on the individual

Living with osteoarthritis can be significantly debilitating, making everyday tasks c
of this, it can impact physical, intellectual, emotional and social dimensions.

Physical	The physical symptoms that accompany this condition, such as pa of movement, can make physical tasks (walking, lifting objects, cl to perform.
Intellectual	Chronic joint pain and the physical discomfort of this condition ma such as concentration, decision-making and problem-solving. As a performance in all aspects of someone's life, from work to family l
Emotional	Living with this condition may cause fe... o hopelessness, frust physical limitations it can place on daily activities. Additionally, chr risk of anxiety and de... sio... especially when it interferes with in
Social	The physi... ...ns caused by osteoarthritis may prevent indi te... ..., especially if they involve physical movement. This co ...eliness, and place strain on relationships.

Case study

Anne, 75, has osteoarthritis and has been experiencing increased joint pain and inflammation. These symptoms have limited her ability to engage in her favourite activities, such as cooking and visiting her neighbour for afternoon lunch. She has tried reading and doing crosswords to pass the time, but struggles to concentrate due to the pain. As a result, she feels frustrated, lonely and depressed.

Applie
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Checking my understanding:

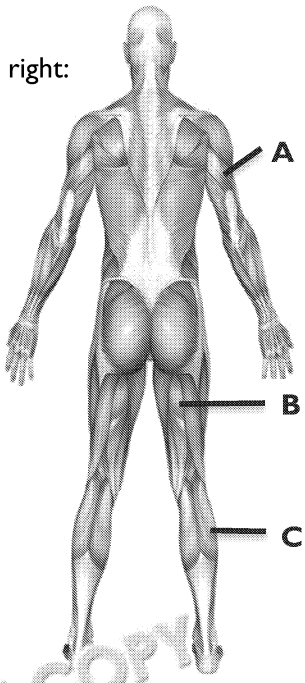
1. What is the appendicular skeleton responsible for? Select **all** that apply.
   A) Locomotion
   B) Protection
   C) Movement
   D) Posture

2. State the function of osteoblasts.

3. Which synovial joint allows movement in all directions?
   A) Condyloid
   B) Pivot
   C) Ball-and-socket
   D) Gliding

4. State **one** way carpal tunnel syndrome can be diagnosed and monitored.
   Which of the following is a risk factor for osteoarthritis? Select **all** that apply.
   A) Gout
   B) Obesity
   C) Family history
   D) Hormonal imbalance

5. Identify the muscles in the diagram on the right:



6. Give **three** types of bone structure.

Developing understanding/skills:

7. Complete the sentences below which describe what carpal tunnel syndrome

   Carpal tunnel syndrome is a condition that occurs when the **A)**_____ becom
   as it passes through the carpal tunnel in the wrist. This compression prevent
   from **C)**_____ proper signals, which can cause **D)**_____, tingling and weakn

8. Jamie has osteoarthritis in his knee. His doctor has suggested he should enga
   activity and use joint support devices to help manage his condition.

   Explain why the doctor has recommended physical activity and joint support de

Chapter 5: Control and regulator

The body is a very complicated structure with different body systems that need to interact with each other and adapt to changing internal and external conditions. Coordination is carried out by the nervous system. The nervous system carries out lot of unconscious processes such as maintaining body temperature, adapting breathing rate as needed, and deciphering messages from sensory cells to give you the perception of sight. It also is responsible for all conscious thoughts and decisio

It consists of nervous tissue including different types of n...ns and their connec It is important to understand how it works in ord...to be able to diagnose and tre nervous system, such as ischaemic strok... ...pe 2 diabetes.

5.1: The nervous systen

The nervous system is the body's command centre. It processes information, send responses that allow us to interact with the world around us. Understanding the c system, as well as the role of the brain and neurons, is essential for understanding

Components of the nervous system

The central nervous system

The central nervous system (CNS) consists of the brain and spinal cord. It is wher all the coordination takes place. Both receive information from sensory neurons. This information is processed by the central nervous system. If action is needed, instructions are sent to effectors (muscles or glands) by motor neurons. Most processing occurs in the brain, but the spinal cord can make smaller decisions without referring to the brain.

One example is a reflex reaction. For example, if your hand touches something very hot, sensory neurons send this information to the spinal cord which triggers your arm muscles to move your hand out of the way. This reaction occurs before brain to save time and protect the arm from harm.

Research activity: Research the structure of the brain and make a list of the different sections. What processes is each section responsible for?

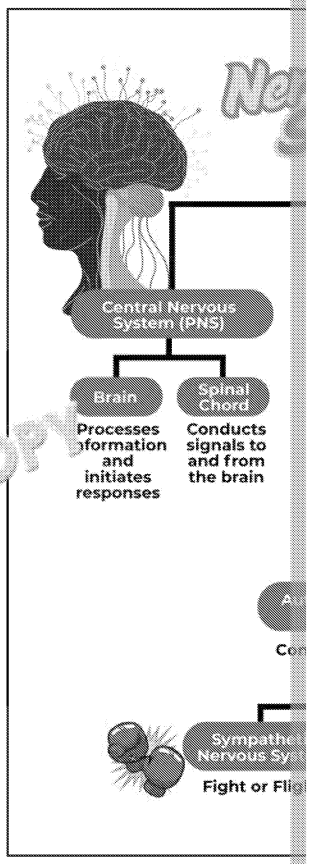
The peripheral nervous system

The peripheral nervous system consists of all part...of th...ervous system that are system. It is mostly made up of neurons ...ing both sensory and motor neuro signals from receptors such as to...ch ...ors in the skin are sensory neurons. Ne from the brain to organs ...uscles are motor neurons. The peripheral nervous and motor ...ns ...are bundled together to form nerves.

Ganglia are also part of the peripheral nervous system. Ganglia are swellings in the nerve fibres that are found close to the spinal cord but are still part of the peripheral nervous system. They are where all the cell bodies of the neurons that make up the nerve collect. As there are two main types of neurons, there are also two main types of ganglia. One type of ganglion contains the cell bodies (soma) of sensory neurons, and the other contains the soma of motor neurons. The sensory ganglia are part of the peripheral nervous system whereas the motor ganglia are part of the central nervous system.

The autonomic nervous system

The autonomic nervous system controls involuntary functions of the body. These are the functions that keep us alive and keep our internal environment balanced – a process known as homeostasis. Examples of functions controlled by the autonomic nervous system include heart rate and breathing rate, digestion, secretion of hormones from glands, and automatic response to external stimuli. The part of the nervous system which controls voluntary actions, such as deciding to walk across the room, is known as the somatic nervous system.



The autonomic nervous system consists of sensory and motor neurons. Information about the internal environment is sent to the CNS along sensory neurons. Instructions to muscles and glands in response to changes in the internal environment are sent along motor neurons from the CNS to muscles or glands. The autonomic nervous system can be divided into two branches:

1. **The sympathetic nervous system** prepares the body for action.
2. **The parasympathetic nervous system** restores the body to its normal state after action has taken place.

As you can see from the table below, preparing the body for action means **inhibiting** the digestive system. This is because digestion requires energy that could be used for the action. The parasympathetic nervous system brings things back to normal after action.

Exam tip

Remember the **para**sympathetic nervous system sounds a bit like a **para**chute which slows you down while you fall out of the sky, and the parasympathetic nervous system slows your body down after action.

Exam tip

Remember the act
nervous system as
reduces the rate o
increases digestio

Sympathetic nervous system	Parasympat
Increases heart rate	Reduces heart rate
Increases breathing rate	Reduces breathing rate
Dilates pupils of the eye	Contracts pupils of the
Dilates airways of the lungs	Constricts airways of th
Slows down digesti	Stimulated digestive sy

The brain

The brain is the control centre of the nervous system, connecting with the spinal c
form the central nervous system. The brain controls everything we do, from our
cognitive functions, such as memory and emotion, to maintaining homeostasis, su
regulating body temperature. Understanding the structure and function of the br
crucial for comprehending how the nervous system works as a whole.

Applied activity: Test your autonomic immune system. Rest for a few minutes and
and breathing rate. Now do some physical activity such as running on the spot fo
and breathing rate every minute until both return to the level they were before y
which points of the process was the sympathetic nervous system sending message
parasympathetic nervous system in control. Explain your answer. Did some peopl
normal? Can you explain why?

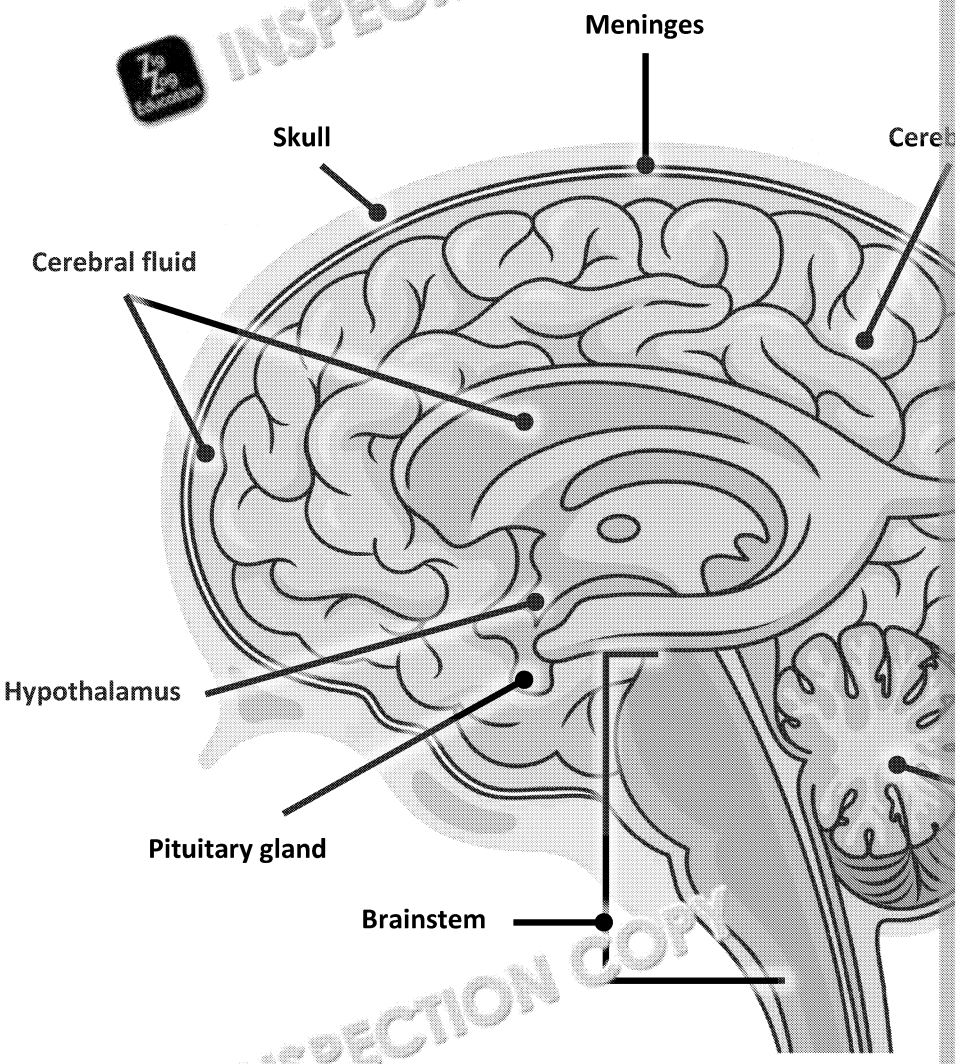
Different parts of the brain have specialised roles, and they all work together to e
properly. Examples include:

	Location	
Cerebral cortex	Outermost layer of the brain **Sensory processing** – the way the brain receives, interprets and responds to information from the senses (sight, sound, touch, taste and smell). **Emotion regulation** – ability to manage and control emotions.	Also known as responsible for such as **sensory** memory, **emoti** making.
Cerebellum	Back of the brain, near the brainstem	Responsible for balance, as wel
Brainstem	Bottom of the brain, connecting the brain to the spinal cord	Regulates esse heart rate, con plays a role in coordination a
Meninges	Protective layers around the brain and spinal cord	Act as a shock a nervous system
Cerebral fluid	Fills the ventricles of the brain and the space between the meninges, surrounding and protecting the brain and spinal cord.	Fluid that cushi removes waste
Pituitary g	Pea-sized gland located at the base of the brain below the hypothalamus (just behind your nose).	Known as the controls hormo body functions the stress respo

Did you know? Damage to the brain stem can be life-
If it stops functioning permanently, a person is legally c
dead in the UK

The role of the hypothalamus

Both the nervous system and the endocrine system are responsible for controllin unconscious or automatic processes in the body. The hypothalamus is a structure the brain and is the link between the central nervous system and the endocrine sy The hypothalamus is part of the central nervous system and so receives informati sensory neurons and can control body functions by sending signals to muscles and via motor neurons. The hypothalamus also releases hormones in response to stim the sensory neurons. These hormones usually stimulate other glands, usually the gland, to release their own hormones. It can also stimulate the pituitary gland di nerve impulses. The hypothalamus is the main area where homeostasis is contro

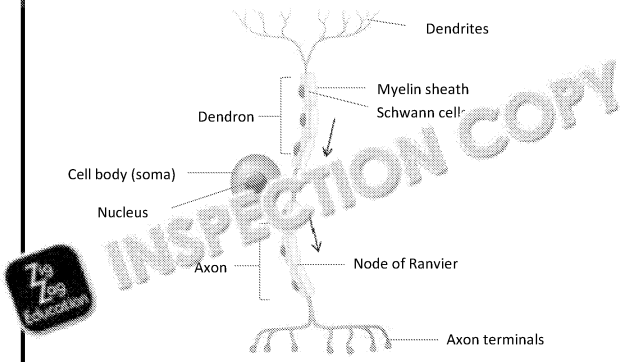
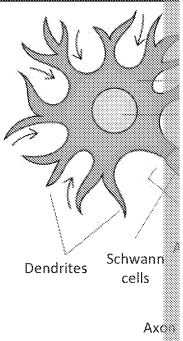


Neuron

Nervous tissue consists of specialised cells and falls into two groups – **neurons**, w
neuroglia, which support the neurons.

Structure of neurons

The two main types of neuron are sensory neurons and motor neurons, as detail

	Sensory neuron	
		
Features	A sensory neuron has a long process known as a **dendron** which extends from the sensory cell to the cell body (soma) which is located just outside the **spinal cord**. The **soma** contains the **nucleus**, which controls cell functions and maintains the neuron's activity. The sensory neuron has a short axon which carries impulses into the spinal cord; here, these impulses can either be transmitted to an interneuron, which relays the information to a motor neuron, or they can directly synapse with a motor neuron. Both the dendron and the axon are protected with a **myelin sheath** which consists of special cells known as **Schwann cells**. The myelin sheath increases the speed of impulse transmission by allowing the signal to jump between small gaps called **nodes of Ranvier**.	The long process which extends fr to the muscle or the motor neuro central nervous s the axon is prote which speeds up them to jump be At the end of the releases neurotra to the next neuro muscle/gland.
Function	To carry nerve impulses from a sensory cell or organ to the central nervous system (brain or spinal cord). For example, they carry information from a touch sensor in your fin to your brain, allowing you to feel w touching.	To carry nerve im a muscle or a gla muscles to tell th tell them to secre when you decide goes from the br muscles in your a your arm.

Neuroglia a sometimes called glia or glial cells. There are several types, all supporting the neurons. There are about 10 times more neuroglia than there are Neuroglia support neurons in several ways:

- Provide nutrients and oxygen to the neurons
- Help maintain the internal environment of the neurons to ensure they contin
- Protect the neurons by destroying **pathogens**
- Provide structure
- Include the cells that make up the myelin sheath that surrounds the axons o speed up the nerve impulse

Axon – long process of a neuron which carries nerve impulses away from the cell

Central nervous system (CNS) – the part of the nervous system consisting of the

Dendrites – tiny branches of a neuron which carry nerve impulses towards the cell

Dendron – long process of a neuron which carries nerve impulses towards the cell

Myelin sheath – protective coating which surrounds some axons and dendrons on

Nerve impulse – electrical signal which travels along a neuron.

Neuroglia – specialised nervous tissue cells which support neurons.

Neuron – specialised cell that can carry messages in the form of electrical impulse

Pathogens – microscopic organisms which can cause dise[illegible]e, including viruses, ba

Spinal cord – bundle of nerve cells which runs th[illegible]he vertebral column (back central nervous system.

Nerve actio

Nerve actio[illegible]s to the transmission of electrical impulses along neurons and t occurs across synapses, allowing signals to travel between different parts of the b messaging system, delivering signals for sensation, movement and reflexes. This components, each with a specific function:

1. **Stimulation and action potential**
   When a neuron is stimulated (e.g. by a sensory receptor or another neuron), an action potential is generated. This is an electrical impulse caused by a rap change in electrical charge across the axon membrane—a process known as depolarisation.
2. **Impulse travels along the axon**
   The action potential travels along the neuron's axon, jumping between the nodes of Ranvier (gaps in the myelin sheath) in a process called saltatory conduction, which increases the speed of transmission.
3. **Arrival at the synaptic knob**
   When the impulse reaches the synaptic knob (the swollen end of the axon terminal), it triggers the opening of calcium channels, allowing calcium ions to enter the neuron.
4. **Release of neurotransmitters**
   The influx of calcium causes neurotransmitters—chemical messengers stored in vesicles—to be released into the synaptic cleft (the gap within the synapse).
5. **Crossing the synapse**
   The neurotransmitters diffuse across the synaptic cleft[illegible]d bind to specific receptors on the membrane of the next neuro[illegible]or [illegible]ge muscle/gland).
6. **Response in the next cell**
   Once the receptors are activ[illegible]
   - If the signal is e[illegible]may trigger a new action potential in the nex
   - If it'[illegible]may prevent the next neuron from firing.

Applied activity: Identify the similarities and differences in structu a sensory neuron and a motor neuron.

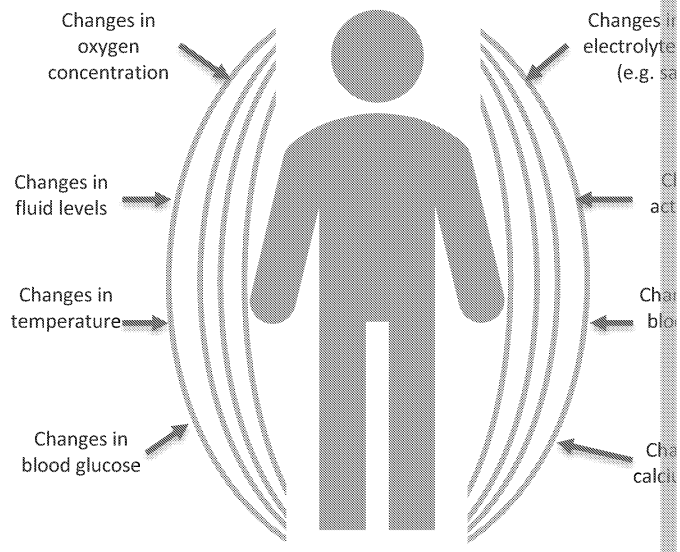
5.2: Homeostasis

Throughout the day our bodies are exposed to different environmental conditions such as changes in temperature. Despite these external changes, we can keep our body temperature in the range of 36.4 °C to 37.6 °C. As we eat and drink and undertake activities, our internal environment also changes.

We lose water through sweat, and drink fluids to replace it, leading to potentially large **fluctuations** in blood fluid levels. We go through periods of activity where we use energy from the glucose circulating in the blood; at other times we eat, leading to spikes in blood sugar levels.

Our bodies can manage these changes to reduce the impact of such large fluctuations in the chemistry of our bodies. The mechanisms used to maintain our internal environment and counteract these changes are known as homeostasis.

Homeostasis



What is homeostasis?

Homeostasis is the process by which the body maintains its internal environment despite external changes. This is important to ensure that the cells of the body are in the best environment for them. If the body's environment is not controlled, it can affect enzymes which are very sensitive to changes in either temperature or pH. There are many different processes which make up homeostasis, including maintenance of body temperature, body fluid, blood glucose levels and body fluid.

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Homeostasis mechanisms

Homeostasis involves complex control mechanisms which we do not have any co
Homeostasis often requires both the nervous and **endocrine** systems. If these m
it leads to various disorders, e.g. diabetes.

Negative feedback mechanism

A negative feedback mechanism is the process by which the body works to counteract a change that has occurred in the internal environment, or internal **variables**, of the body. In other words, it brings the body back to a normal state, or a state of **equilibrium** after some kind of internal change. For example, if you go outside on a cold winter's day, your body will start to cool down, causing an internal variable like body temperature to drop. This would be extremely dangerous as a body temperature of 35 °C and below is classed as **hypothermia** and can lead to organ malfunction and death. Your body automatically stimulates a negative feedback mechanism to counteract this loss of heat to maintain your internal **core body temperature** at around 37 °C.

Another example is during and after exercise where you will have sweated to cool down, leading to reduction in fluid levels, which is another variable the body must regulate. Negative feedback mechanisms work to hold on to as much fluid as possible by reducing urine production.

Negative feedback mechanisms require three main components:

1. **Receptors** – these sense changes in the body's variables, e.g. thermoreceptors detect changes in internal body temperature.
2. **Coordinator** – also known as the control centre, usually located in a specific part of the brain. The coordinator receives information from different receptors and controls and coordinates the regulatory mechanism to counteract the changes in variables.
3. **Effectors** – these are parts of the body which act to bring about a change. They can be muscles or glands which release substances including sweat or hormones.

Optimum point – the value where the body works best. In homeostasis it is the equilibrium that homeostasis is working to return to.

When receptors detect a specific change in the inte... reduction in body temperature, they send nerve im... the associated control centre in the brain. The con... response and sends impulses down motor neurons ... glands) to counteract the change. Once the body h... known as an **optimum point**, the receptors will sto... centre which will stop sending signals to the effecto... mechanism prevents the system from overcompen...

Applied activity: Simulate your own negative feedback mechanism. The challeng... around 37 °C.

To prepare – you will need ice and access to hot (but no... ing) water and a th... water in a 500 ml measuring beaker. Heat it unti... a ...ina 37 °C.

You will be divided into groups of thre... the following roles:

1. **Receptor** – this person mea... ...mperature of the water and tells the co... 5 °C above or 3 °C b... ...rrain point. They can also tell the control centre...
2. **Contr... ...ntr... ...ator)** – this person decides how to return the water t... give... ...tio...s to the effector. They can tell them whether to add ice or ho... also i... the effector to pour off some water in the beaker if it is getting ...
3. **Effector** – this person carries out the instructions of the control centre and can... water bath to maintain its temperature. They are not allowed to measure th...

The receptor and the effector should not communicate directly with each other in ... temperature of the water?

Research activity: Find out what the normal ranges are of the f... breathing rate while resting; resting heart rate; blood glucose l... pH of blood.

Exam...

You can... mechani... central ... too cold... sends si... control ... brain) a... on to he...

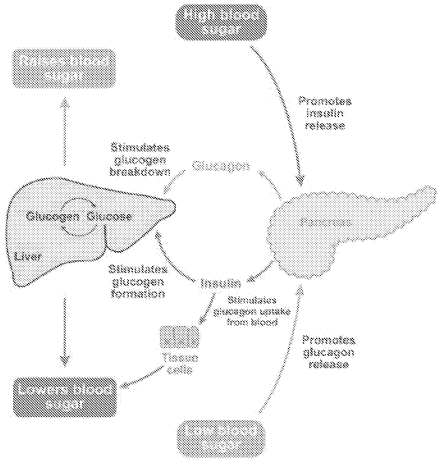
Control and regulation of blood glucose

Glucose enters the body as carbohydrates that we eat such as starch and sugary f
blood from the intestines to all the cells. Low blood glucose (blood sugar) levels c
able to make energy when needed. High blood glucose levels can damage blood v
very important that blood glucose levels are maintained within an optimal range.

The negative feedback control mechanism for blood glucose levels is as follows:

- Optimal range – according to Diabetes UK: 4–5.4 **mmol/L** when fasting, up to 7.8 mmol/L two hours after eating.
- Receptors – alpha and beta cells found in structu[illegible] islets of Langerhans in the **pancreas**.
- Coordinator – alpha and beta cells in the pancreas also act as coordinators.
- Effectors – alpha cells which release the hormone glucagon and beta cells w[illegible] release the hormone insulin.

Blood glucose control is a balance between the actions of two hormones: glucagon and insulin. Glucagon acts to increase blood glucose when it drops below the optimal range. Insulin acts to lower blood glucose when it rises above the optimal range. These changes in blood glucose levels are detected by the alpha and beta cells in the pancreas which also release the hormones that act as effectors.



After a meal the blood glucose levels will begin to rise as glucose has entered the
Insulin will be released from the beta cells to counteract this change and bring bl
After periods of activity or after periods of fasting, blood glucose levels will drop
the alpha cells to counteract this change and raise blood glucose levels back up t

Exam tip

Remember the definitions of glucagon and glycogen very carefully as they are often co

Action of glucagon

Glucagon is a hormone which is released fr[illegible]he alpha cells in the pancreas. It
- Causing the liver and muscle[illegible]t a carbohydrate, called glycogen, int
the blood.
- Stimula[illegible]eli[illegible]ke glucose from other molecules such as amino acids.

Action of ins[illegible]

Insulin is a hormone which is released by the beta cells in the pancreas. It lowers
- Causing the liver and muscles to convert excess glucose into glycogen and st
- Causing excess glucose to be converted into fat for storage.
- Enabling cells to absorb glucose from the blood. Glucose cannot diffuse thro
must enter via gates. The insulin causes the gates to open

Applied activity: For each of the following situations, state which of the two hormo most likely to be circulating in your blood and what is happening to the chemistry your answers.

Situation	Insulin or glucagon released?	Can glucose get into the cells?	Is glycogen made or b down
Waking up after a long sleep			
30 minutes after eating a slice of cheese			
20 minutes after eating a bar of chocolate			
90 minutes after eating a balanced meal			
Mid-day in Ramadan			

Control and regulation of water levels – osmor

Osmoregulation is the control of body fluid levels. Water enters the body from food and drink. Some water is also produced as a waste product of cellular respiration and other reactions. Water leaves the body in the urine, through sweating, exhaling and evaporation from the skin. It forms an important part of blood and other body fluids and most of the cytoplasm of the cells. So, it is important that fluid levels are balanced.

Did y
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Water levels are balanced by controlling the amount of water that is lost as urine from the kidneys or drinking to replace fluids. Drinking a lot of water results in large quantities of dilute urine which will be pale yellow in colour. This is because excess water is allowed to pass into the urine from the blood. Sweating a lot or not drinking enough results in small quantities of concentrated urine which can be dark yellow, orange or even brown in colour. It is important to be able to regulate your body fluid levels f e organs and tissues to function properly.

Pituitary
the brain
different

Nephron
filters was
from the b

Reabsorb
process w
been remo
absorbed

Urea – wa
proteins a
removed

After the kidneys filter the blood, the u is stored temporarily in the bladder until it is excr e body. When you are well-hydrated, th de larger volumes of dilute urine, and when you are deh , the bladder stores more concentrated urine.

The negative feedback mechanism for osmoregulation is as follows:

- **Receptors** – osmoreceptors in the hypothalamus in the brain.
- **Coordinator** – hypothalamus of the brain.
- **Effectors** – antidiuretic hormone (ADH), also known as vasopressin, is release acts on the kidneys.

The function of the kidneys is to filter out waste chemicals from the blood and to
substances found in the blood plasma are filtered out into the kidney tubules (**ne**
nutrients, are **reabsorbed** back into the blood. Waste products like **urea**, excess
nephron and will become urine. When ADH is not circulating in the blood, the kid
so water leaves the body in the urine. However, when ADH has been released, th
reabsorb water from the kidney tubules and back into the blood.

In summary, when body fluid levels are high, fluid is automatically lost in the urine. On the other hand, when an individual is dehydrated, ADH is released from the pituitary gland and the kidneys are stimulated to reabsorb the water from the kidney tubules. The result is lower volumes of, and more concentrated urine, keeping water in the body and avoiding unnecessary loss of fluids.

Exam tip
Diuretics are
pass urine mo
Remember th
hormone) as
ADH reduces

Case study
*Oliver has been diagnosed with diabetes insipidus (a condition which leads to a l
include incr thirst and production of a lot of urine. People with diabetes mellitus
lack of inulin or inability to respond to insulin) also produce a lot of urine. This is why
diabetes. Diabetes insipidus has nothing to do with blood glucose or insulin but it is s
endocrine system.*

Research activity: Find out how the following affect the amount of urine you proc
- Drinking a caffeinated drink, e.g. coffee
- Eating salty food
- Hot weather
- Blood loss after an accident
- Taking a diuretic medication, e.g. furosemide

Control and regulation of body temperature –

Thermoregulation is the control and regulation of body temperature despite changes in external temperature.

The negative feedback loop consists of the following:

Optimal level – normal body temperature range is from 36.4 °C to 37.6 °C.

Receptors – thermoreceptors in the skin (detect external temperature) and organs of the bod (detect internal temperature).

Control centre – thermoregulato re in the **hypothalamus** of th

Effecto as, **arterioles** of the skin, striated tal) muscles, **erector pili muscles** in the skin.

Hypothalam
which is resp
homeostatic
with the end

Arteriole –
less elastic ti
arteries. Co
arteriole mu
blood flow t

Erector pili
base of hair
the hair is pu

The actual response depends on whether the internal temperature has started to ris

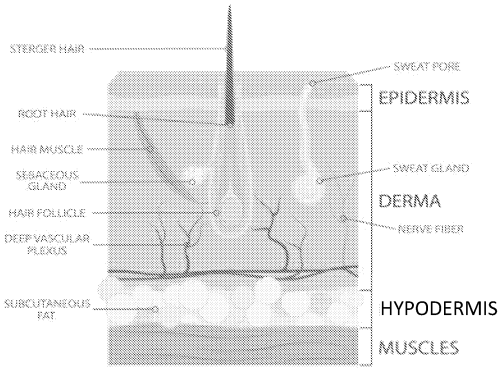
Applied activity: Draw a diagra
the changes that occur in your bo
too cold to bring you back to the

Body temperature falling below optimal level	Body temperatur
• **Shivering** – small movements of the muscles generate heat by friction and due to metabolism as the increased need for energy to shiver generates heat as a side effect. • **Vasoconstriction** – the arterioles in the surface of the skin constrict causing the lumen of these blood vessels to narrow. This leads to less blood getting to the surface of the body so the heat the blood contains stays at the core of the body, keeping vital organs at the correct temperature. Capillaries also play a role in this process by limiting heat exchange when vasoc tic occurs. Because capillaries surface of the skin, restrictin through them reduc heat that can escape the body, g to conserve heat. • **Contraction of erector pili muscles** – causes the hairs in your skin to stand up and trap air, which acts as an insulator.	• **Sweating** – sweat which moves to th water evaporates from the skin to gi evaporate. The sk • **Vasodilation** – the skin dilate (get wid larger. More bloo body where the h difference in temp the surrounding ai vasodilation. By in skin's surface, they from the blood to cooling process. • **Relaxation of the** e hairs to lie flat on t

Exam tip

To remember the difference between the terms constrict and dilate, think of the boa cons around its prey. You can also think of a midwife reporting how far dilated a woman is w much the cervix has widened.

THE STRUCTURE OF THE SKIN



Research activity: Research th body temperature falls too fa rises too far above it. Which g likely to be at risk of either of

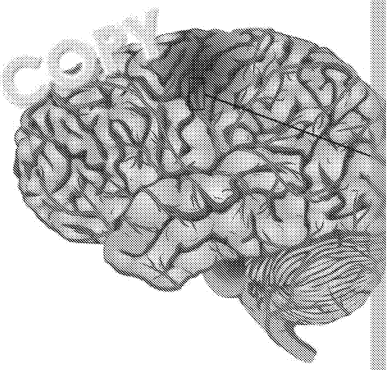
5.3: Conditions of the control and reg

Conditions that affect the control and regulatory systems, such as ischaemic strok the body's ability to function normally and maintain homeostasis. Common symp motor function and vision problems, to fatigue and loss of consciousness. This se conditions in more detail, including what can make them more likely and how to

Ischaemic stroke

Overview and causes

An ischaemic stroke is caused by a blood clot blocking a blood vessel in the brain. The blood clot might have formed elsewhere in the b but has been carried to the brain in the blood. Ischaemic strokes are the most common type of stroke. The blood clot can be permanent or it can be temporary, lasting from five minutes to 24 hours before it breaks down or moves away. Temporary blood clots in the brain are known as transient ischaemic attacks (TIAs) and are the main cause of vascular dementia.



When a blood clot restricts blood flow to the brain, it decreases the delivery of oxygen to brain cells. Brain tissue deprived of oxygen becomes damaged, leading to death of brain cells. This disrupts the brain's ability to control various essential body functions, from movement to speech and cognition.

Did
NH
isch

Main signs and symptoms:

- Face dropping
- Weakness in the arms
- Slurred speech
- Headache
- Blurred vision
- Loss of consciousness

Exam tip

One way to rem symptoms is the F
Face – is the fac
Arms – is one ar
Speech – is spee
Time – Time to c

Diagnosis and monitoring

An ischaemic stroke can be incredibly dangerous and life-threatening. Therefore and monitoring it regularly are key to better treatment outcomes and the possibl methods are used for diagnosis and monitoring, inclu

Method	How is used	
Physical examination	A healthcare professional carries out a physical examination using several tests, such as listening to the heart, checking blood pressure and performing a **neurological assessment** to evaluate how a stroke may be impacting the nervous system. This can help determine the possible cause of the stroke.	• If • T • T

Neurological assessment – a comprehensive evaluation of a person's nervous system function. It assesses factors such as mental status (someone's cognitive, emotional and behavioural state), motor and sensory function, and reflexes.

Method	How it's used	
Blood test	A blood test can be used to check red blood cell and platelet levels, along with blood sugar, to check whether they are within a healthy range. These tests can help confirm if someone has had an ischaemic stroke and assess which medications may be used for treatment.	• • •
MRI scan	An MRI scan uses a strong magnetic field and radio waves to create detailed images of the brain. In some cases, a dye is injected into a blood vessel to help visualise blood flow, arteries and veins in the brain. This can help identify damaged brain tissue caused by an ischaemic stroke as well as **brain haemorrhage**. **Brain haemorrhage** – type of stroke caused by bleeding in or around the brain. It happens when a blood vessel in the brain bursts, leading to bleeding that damages brain cells.	• •

Exam tip

You may be scans showin

Treatments

Treatment for ischaemic stroke is all about time. The sooner treatment is given a symptoms appear, the better the chances of recovery. Treatment not only saves but it also helps to prevent further damage to the brain, improve recovery and lo the risk of long-term disability.

		How it works	Benefits	
Surgical treatments	**Thrombectomy**	Surgical procedure which involves inserting a catheter (a thin, flexible tube) into an artery in the groin or the wrist to remove a blood clot, helping to restore blood flow to the brain.	✓ Removes large blood clots that can't be treated by thrombolysis alone ✓ Minimally invasive ✓ Helps minimise damage to the brain and reduce the risk of permanent disability	X X X

		How it works	Benefits	
Non-surgical treatments	**Thrombolysis**	Medication that works by dissolving blood clots which helps to restore normal blood flow to the brain.	✓ Significantly improves chances of recovery if administered early (3–4 hours after stroke symptoms) by minimising brain tissue damage ✓ Quick to administer ✓ Non-invasive	X X X

Factors increasing likelihood of condition

Certain factors can increase the risk of an ischaemic stroke, many of which are lin to the formation of blood clots that can block blood flow to the brain.

- **Obesity** – being obese can increase the risk of ischaemic stroke because it increases the amount of excess fatty tissue, which can cause inflammation. inflammation can restrict blood flow and increase the risk of a blockage in a blood vessel in or leading to the brain.
- **High fat and/or salt diet** – a diet high in saturated fats can increase the amou of 'bad' cholesterol in your blood (LDL), which can result in clogged arteries, clot. Additionally, a diet high in salt can increase the risk of an ischaemic stro blood pressure. High blood pressure can increase the risk of blood clot form leading to the brain.

Did you know? Having a diet high in LDL cholesterol can increase the risk of st
zzed.uk/12929-Cholesterol

[2] NHS **https://www.wsh.nhs.uk/CMS-Documents/Patient-leaflets/StrokeUnit/6484-1-Thrombolys**

- **Smoking** – tobacco contains many harmful, carcinogenic (cancer-causing) ch
enter the bloodstream, they can alter and damage cells in the body. Not on
pressure and raise LDL levels in the blood, but it also contributes to the narr
promotes the formation of blood clots. These factors together increase the
- **Diabetes** – individuals with diabetes are more at risk of ischaemic stroke bec
handles glucose. In diabetes, either the body doesn't produce enough insul
properly, which can cause too much glucose to build up in the blood. Over t
fat build-up or blood clots in the blood vessels, which can block blood flow t
ischaemic stroke.
- **Stress** – high levels of stress can make the heart work harder, increase the a
in the blood and contribute to high blood pressure. These factors combined
which block blood flow to the brain.
- **Hypertension (high blood pressure)** – having high blood pressure can damag
them to stiffen and narrow. This can lead to atherosclerosis (build-up of fat
the risk of clot formation.

Control and prevention

Control and prevention of ischaemic stroke involves adopting a combination of m
that work together to help reduce risk factors and prevent further complications.

Medication:

- **Statins** – these are medicines which help decrease LDL cholesterol in the blood. Doing so helps control and prevent the risks associated with high levels of this bad cholesterol, such as clogged arteries, which can lead to blood clots.
- **Anticoagulants** – medication that breaks down and prevents the formation of blood clots, helping to prevent a stroke from happening again.
- **Beta blockers** – this medication is most commonly used for heart conditions and helps to reduce blood pressure. Doing so helps to prevent damage to blood vessels caused by high blood pressure, which can reduce the risk of atherosclerosis and blood clots.

Lifestyle changes:

- **Lose weight** – losing weight helps to reduce fatty tissue, which can cause inf
helps widen the blood vessels and improve blood flow.
- **Reduce fat and/or salt in diet** – adopting a healthy diet that is low in fat and
cholesterol in the blood and reduce blood pressure. In turn, this helps to pre
reduce the risk of a blood clot, lowering the likelihood of ischaemic stroke.
- **Stop smoking** – quitting smoking can help to prevent any further damage to
cause the blood vessels to narrow and form blood clots. Additionally, giving
pressure and reduce LDL cholesterol levels, further decreasing the associated
- **Reduce stress** – reducing stress levels can reduce the strain on the heart, lo
fat levels in the blood, and lower blood pressure. Together, these factors he
clots by reducing inflammation and damage to blood vessels.
- **Regular exercise** – physical activity not only helps to maintain a healthy weight, reducing excess fatty tissues, but also helps to reduce high blood pressure and high LDL cholesterol levels. By exercising regularly, this helps reduce the risk of blood clot formation by reducing inflammation and preventing the build-up of plaque in the arteries.

Did you kno
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risk of a strok
zzed.uk

Impact on the individual

Experiencing an ischaemic stroke can significantly shape someone's life. From its potential to cause long-term disability, this condition can impact someone's physi social dimensions.

Physical	Depending on the severity, ischaemic stroke can result in a range such as weakness, difficulty speaking, and challenges with movem someone's daily activities and basic needs, such as eating, drinkin
Intellectual	Ischaemic stroke can significantly impact cognitive function, such and concentration, and cause confusion. Some individuals may ex understanding or expressing language, a condition known as apha could make it incredibly hard for someone to engage in work, edu
Emotional	Experiencing an ischaemic stroke can be incredibly distressing. In depression, anxiety and frustration, especially if the stroke leads t cognitive disabilities. Individuals may also experience grief over th and fear of recurring strokes.
Social	An individual who has experienced an ischaemic stroke may strug participate in social activities due to challenges with communicati impairments. Additionally, individuals with more severe disabiliti become dependent on others for daily functioning, which can lea and put strain on their caregivers.

Research activity: Research how ischaemic stroke can impact the body and discus factors could impact someone in relation to PIES.

Type 2 diabetes

Overview and causes

Type 2 diabetes is caused by either the body not making enough insulin or the insulin not working properly, or a combination of the two. This occurs when the insulin receptors in the body's cells stop responding effectively to insulin, which is known as **insulin resistance**. Remember that insulin lowers blood sugar. One of the ways it does this is by acting like a key to unlock the cells, allowing glucose to enter them. Having insulin resistance is a bit like changing the locks on the cells so the key (insulin) no longer works to allow glucose to enter the cells, which prevents glucose from being taken up properly, even when there is enough insulin in the blood. Over time, the pancreas becomes damaged as a result of this and stops producing insulin.

Insulin resistance – when the body does not respond to insulin as it should, even if there is enough insulin produced.

Main signs and symptoms

- Fatigue
- Unexplained weight loss
- Thirst
- Increased urination

ALWAYS TIRED | INCREASED THIRST | BLURRY VISION

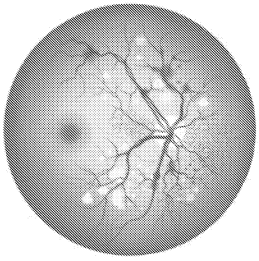
Diagnosis and monitoring

There are many ways to diagnose and monitor type 2 diabetes, including:

Method	How it's used
Blood glucose test	This is the most common test for diagnosing type 2 diabetes. It involves measuring the amount of glucose in the blood. If blood glucose levels are higher than normal, this can be an indicator of type 2 diabetes.
Urine test	It's important to note that a urine test cannot diagnose diabetes. However, it can be used as a way to monitor the condition by detecting a type of protein known as microalbumin. A positive result of this protein means the kidneys are leaking protein into the urine, which is a sign of early kidney damage.

Did you know? There are a few types of blood glucose tests, including:

- **Fasting blood glucose test** – a blood sample is taken after someone has fasted for around 8 hours.
- **Glucose intolerance test** – a blood sample is taken before and after drinking a liquid (that contains glucose) to measure blood glucose levels and assess how the body processes glucose over time.
- **Random blood sugar test** – a blood sample is taken at any time, without the need to fast or to drink anything.

Method	How it's used
Eye test	This involves an eye examination to check for any damage caused by high blood sugar levels. This test is crucial because people with diabetes are at risk of developing **diabetic retinopathy**. During the test an eye specialist dilates the pupils (using special eye drops) to examine the retina for any signs of blood vessel damage such as bleeding and abnormal blood vessels. **Diabetic retinopathy** – condition where high blood sugar damages the blood vessels in the retina, causing blindness. **Did you know?** This image shows the retina of an individual with diabetes. Can you spot any signs of damage or abnormalities? 
Neuropathy test	This is used to assess nerve damage, which is commonly caused by type 2 diabetes. The test typically involves checking for symptoms such as loss of sensation, tingling or pain in the feet and legs. **Research activity:** Research the different neuropathy tests used to diagnose type 2 diabetes. Make notes on what each test measures to help with your revision!

Treatments

There are several options for treating type 2 diabetes, including surgical, non-surg

		How it works	Benefits
Surgical treatments	**Gastric banding**	This is a surgical procedure where a band is placed around the upper part of the stomach to create a small pouch. It helps individuals to lose weight and improves **insulin sensitivity**.	✓ Helps regulate blood sugar levels and reduce the need for diabetes medication ✓ Some individuals can experience **remission** ✓ Reduces risk of diabetes complications such as nerve damage, kidney issues and heart disease

Insulin sensitivity – when the body's cells are more efficient at processing glucose from the bloodstream, lowering blood sugar levels.

Remission – when the signs and symptoms of a disease are no longer seen. Remission can be temporary or permanent. Being in remission does not mean the condition is cured.

		How it works	Benefits
Non-surgical treatments	**Metformin**	This is a medication that helps lower blood sugar by improving insulin sensitivity, reducing glucose production in the liver and helping the body use food for energy.	✓ Non-invasive ✓ Helps body respond better to insulin and lowers blood sugar levels ✓ Does not cause weight gain (unlike other medications for diabetes)
Lifestyle changes	**Losing weight**	Losing weight helps the beta cells in the pancreas to start to work again to produce more insulin. It also helps the cells of the body become less resistant to insulin.	✓ Non-invasive ✓ Can lead to **remission** ✓ Supports better blood sugar control, reducing the need for medication ✓ Improves overall health and quality of life

Factors increasing likelihood of condition

There are risk factors that make type 2 diabetes more likely, including age, ethnicity and inactivity. However, the factor that makes it most likely that a person will develop type 2 diabetes is being overweight.

- **Obesity** – being overweight leads to an excess of fat stored around the liver and pancreas, which can damage the pancreas and prevent it from producing enough insulin. Being overweight can also make the body not respond to insulin like it should. This is known as **insulin resistance**. Additionally, fat cells are more resistant to insulin than muscle cells, which makes it harder for the body to regulate blood sugar.
- **Age** – type 2 diabetes can occur at any age, but being over the age of 45 increases the risk of developing this condition. This is because as we get older, sensitivity to insulin and pancreas function is reduced. Additionally, as people age, an increase in fat mass due to a decline in muscle mass can contribute to insulin resistance. Together, these factors make it more difficult for the body to regulate blood likelihood of developing type 2 diabetes.

Did you know?
diabetes cases a
about 4 out of 5
zzed.uk/12

- **Inactivity** – not only does a lack of physical exer increase the risk of obesi pancreas and lead to insulin resistance, but it also impairs glucose uptake by higher blood sugar levels. When muscles aren't active, they are less able causing glucose to build up in the bloodstream. In turn, these factors make i blood sugar leve
- **Ethnic** People from certain ethnic backgrounds are more at risk of devel exampl viduals from a South Asian background are more likely to devel younger age, which is underpinned by a build-up of visceral fat (fat in the ab white populations are more likely to develop type 2 diabetes after 40 years o ethnicity can contribute to age-related differences in the development of ty

Case study
Nina, 35, has started showing symptoms of type 2 diabetes. She is from a South Asian background and leads an inactive lifestyle. She has gone to her GP to discuss her concerns about her health.

Applied a
Identify the
Nina's risk
and explai
and regula

The key to controlling and preventing type 2 diabetes lies in adopting lifestyle changes. By doing so, this can help individuals manage their blood sugar levels, reduce the risk of complications and increase their chances of **remission**. Examples include:

- ✓ **Losing weight** – losing weight helps reduce the amount of excess fat stored in the liver and pancreas. By doing so, it not only improves the body's response to insulin by helping the beta cells in the pancreas to function more effectively, but it also helps to lower glucose levels in the bloodstream.
- ✓ **Dietary changes** – adopting healthy eating choices, rich in fruit and vegetable is another way to control and prevent type 2 diabetes. These dietary change levels, improve insulin sensitivity and contribute to weight loss.
- ✓ **Regular exercise** – engaging in regular physical activity helps reduce blood su we use our muscles, they primarily use glucose (sugar in the blood) as a fuel sugar levels. Additionally, regular exercise helps improve insulin sensitivity a

Impact of [redacted] individual

Living with [redacted] diabetes can impact someone's life in many ways, including:

Physical	The physical symptoms of type 2 diabetes, such as fatigue, weight urination, could lead to difficulties performing daily tasks. If this c may face further health complications like blindness and nerve da could further limit mobility and functioning in everyday life.
Intellectual	Type 2 diabetes can damage nerves in the brain which can lead to such as memory, mood and learning. Additionally, individuals wit experience confusion and sluggishness. These factors could make perform well in education, work and family life.
Emotional	Living with type 2 diabetes can be emotionally challenging. For ex this chronic condition, dealing with potential complication and fea may lead to anxiety, depression and feelings of helplessness. Add lifestyle changes such as eating well, engaging in exercise and mai could cause frustration.
Social	Individuals with this condition may struggle to engage in social act involve food, due to dietary restrictions. Additionally, physical sy make it difficult for individuals to attend social events.

Chapter 5: Questions (5.1–5.3)

Checking my understanding:

1. The central nervous system consists of the brain and what other structure?
   A) Hypothalamus
   B) Spinal cord
   C) Synaptic knob
   D) Ganglia

2. State the function of the autonomic nervous system.

3. Which of the following brain structures is responsible for coordinating move
   A) Cerebral cortex
   B) Pituitary gland
   C) Cerebellum
   D) Hypothalamus

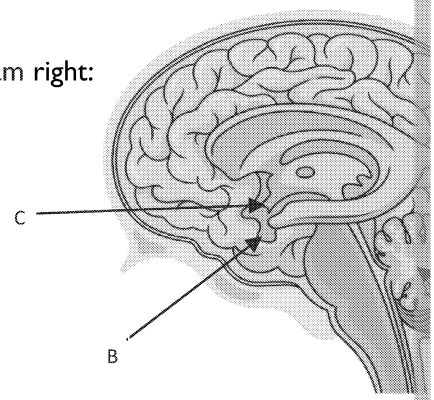
4. State three components required for negative feedback mechanisms.

5. Where does a blood clot form in an ischaemic stroke?

6. State **one** way that type 2 diabetes can be diagnosed and monitored.

7. Complete the sentence below to describe what homeostasis is.
   Homeostasis is the process where the body A)_____ its B)____ environment
   C)_____ changes.

8. Identify the brain structures in the diagram right:



9. Name **four** structures found in a motor neuron.

Developing my understanding/skills:

8. Thermoregulation is the control and regulation of body temperature despite temperature.
   Explain the role of the capillaries when body temperature rises above optima

9. Tom is 59 years old and has type 2 diabetes. He has been struggling to manag as a result is started experiencing blurred vision, pain in his legs and feet, and
   His doctor already suggested losing weight as a way to control and manage h condition, but Tom has struggled to stick to his meal plan.

   The doctor suggests two treatment options:
   - Gastric band
   - Metformin

   In your answer:
   - Explain what each treatment is and what it involves.

   Discuss the benefits and limitations of each treatment.

Chapter 6: Reproductive sys

The reproductive system is essential for human life, allowing the creation of offsp
function and producing hormones essential for sexual development, the menstru
system is made up of specialised organs that work together to fulfil these functio
you should understand the structure and function of the female and male reprod
conditions that can affect them.

6.1: Female and male reproducti

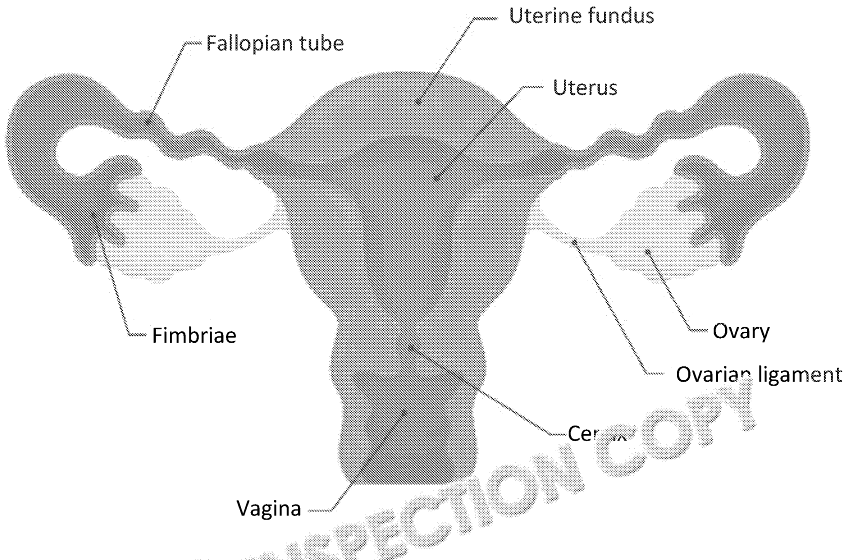
There are two reproductive systems – the male reproductive system and the fem
both have very different functions. The function of the female reproductive syste
to then nurture and protect it while it develops in the uterus until it is born. The
baby out of the body and nurturing the baby with milk after birth are also functio
system. The function of the male reproductive system is to produce sperm to fer
The two systems have different structures to support their different functions.

Location, structure and function of the female reproductive system

The female reproductive system

The female reproductive system is designed to create an environment where a fe
baby. It is made up of several structures, all of which have a specific function. To
processes such as the menstrual cycle, fertilisation, pregnancy and childbirth.

Let's look at these structures in more detail, including their location and function.



Structure	Function
Uterus	The uterus (womb) protects and nurtures the developing **foetus** un provides physical protection by having muscular walls. The placenta to pass from the mother to the baby and waste products to pass fro muscular walls of the uterus are needed to push the baby out throu
Ovaries	The ovaries contain structures called follicles which are where imma month before they are released during ovulation. As well as produc important part of the endocrine system. Hormones such as oestrog produced in the ovaries. These help regulate the menstrual cycle, s secondary sexual characteristics and are important in maintaining p

Structure	Function
Vagina	The vagina is where the female reproductive system connects to the sexual intercourse it allows an entrance point for the penis so that t close to the uterus as possible. During birth, it expands and lengthe **birth canal**. It also contains strong, powerful muscles to help the ba
Fallopian tubes	These are two bilateral tubes which connect the ovaries to the uteru transporting the egg (ovum) from the ovary to the uterus. This is als occurs if a sperm meets the egg. The fallopian tube has tiny hair-like special muscles which help move the egg along the tube towards the
Cervix	This is the lower, narrow part of the uterus which connects to the va uterus from bacteria and infections by acting like a barrier. It is also mucus that changes during the menstrual cycle to either help or prev uterus, allows the passage of menstrual blood out of the body and d enable the baby to pass through.

Birth canal – passage through the pelvic bones that the baby passes through the uterus, cervix and vagina which form a continuous tube through the pelvis.

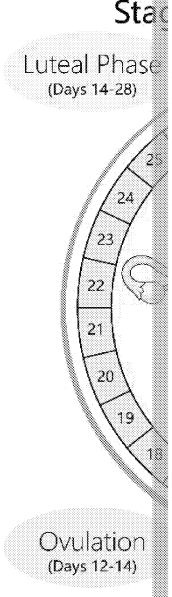
Foetus – the baby developing in the uterus. It is known as the foetus from nine we

Fertilisation – the process by which a sperm cell joins with an egg cell to form a z

Implantation – stage where a fertilised egg attaches itself to the lining of the ute a crucial step for pregnancy, as it allows the embryo to receive nutrients and dev

Menstrual cycle

The menstrual cycle is a monthly process that prepares a woman's body for pregn environment that can support a fertilised egg. A typical menstrual cycle is 28 day days. This process is regulated by hormones such as oestrogen, follicle-stimulatin hormone (LH) and progesterone, which work together to control each phase of th key phases, all of which occur at different times in the cycle to fulfil a certain func



Menstruation

Also known as a period, this occurs in the first 1–5 days of a menstrual cycle if no fertilisation took place in the previous cycle. In this phase, low levels of oestrogen and progesterone trigger the uterus to shed its lining (endometrium), causing menstrual bleeding.

Follicular phase

This phase begins on day 1 of menstruation and continues until ovulation and typically lasts around 14 days. In this phase, the pituitary gland releases follicle-stimulating hormone (FSH), which stimulates the ovaries to develop **follicles**, each containing an immature egg. As the follicles grow, they produce oestrogen, which helps rebuild and thicken the uterine lining in preparation for possible fertilisation. By the end of this phase, one dominant follicle matures and prepares for ovulation.

Follicles – small sacs in the ovaries filled with fluid that contain an immature egg, known as an oocyte.

Ovulation

This occurs around day 14 of the menstrual cycle. This is where a mature egg is r
fallopian tube, triggered by the release of luteinising hormone (LH). This is where
cycle, as the egg can be fertilised if the sperm is present. Oestrogen levels peak ju
decrease after the surge in LH.

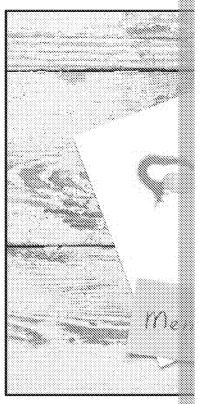
Luteal phase

This falls around 14–28 days into the menstrual cycle, just after ovulation. During
drop, while progesterone rises (and oestrogen increases slightly). Once the egg h
follicle closes and forms a structure called the corpus luteum, which produces pro
oestrogen help to thicken the uterus lining to prepare for a possible pregnancy.

If fertilisation doesn't take place, the corpus luteum breaks down, stopping the pr
oestrogen. This causes the wall of the uterus lining to shed, causing menstrual ble
cycle starts again!

Research activity: Carry out research into the menstrual cycle and draw a post
different stages. Include the function of the different hormones.

Menopause



Menopause marks the end of monthly menstruation, officially confirmed after 12 months without a period. It occurs due to a reduction in oestrogen and progesterone, causing ovulation to stop. As a result, fertility ceases. Menopause typically occurs between the ages of 45 and 55, signalling that a woman can no longer get pregnant.

Research activity: Research the physiological and psychological changes that occur during the menopause. Discuss with your partner how these symptoms might impact a woman's quality of life.

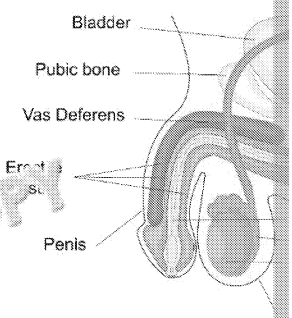
Location, structure and function of the male reproductive system

The male reproductive system

The male reproductive system is structured to produce sperm and deliver it to the female reproductive system for fertilisation. It has several key structures, which all work together to ensure this system works efficiently.

It's important for you to be aware of the location of these structures (see diagram) and the function of each (see table).

Male repro
Si



Exam tip

It's likely you will only need to lab[illegible] res covered in the table belo[illegible] am.

Struct	Function
Penis	The function of the penis in the male reproductive system is reproductive system. To do this it must enter the vagina to cervix, as close to the uterus as possible. To do this it conta firm enough to enter the vagina.
Urethra	The penis contains the urethra which is the tube which carri and out of the penis. The urethra also carries urine from th
Scrotum	This is a pouch of skin that contains and protects the testes thermoregulation of the testes, moving them closer or furth maintain an optimal temperature for sperm production.
Testes	The testes have two functions. One is to produce sperm wh to make a baby (**fertilisation**). The other function is as part producing the hormone testosterone. Testosterone stimula and stimulates the development of secondary sexual charac
Epididymis	This is a coiled tube located at the back of the testes where After sperm are produced in the testes, they travels to this swim and fertilise an egg.
Vas deferens	This is a tube that carries mature sperm from the epididym ejaculation. It acts as a pathway for sperm to travel from th
Prostate	This is a small gland located just below the bladder which pr semen. This fluid helps to nourish sperm and lubricate the muscles which help to push semen through the urethra duri

Research activity: Research conditions that affect the male reproductive system and make a poster of what you have learned.

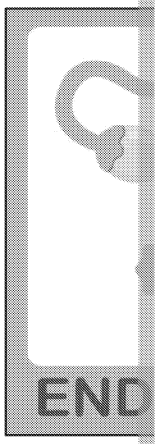
6.2: Conditions of the reproducti

The reproductive system can be affected by various conditions that impact its org include endometriosis and testicular cancer, which can cause fertility issues, disco implications. Certain factors can increase the risk of developing these conditions, family history. This section will delve into these conditions in more detail, includi treated and controlled.

Endometriosis

Overview and causes

This is where endometrial tissue (lining of the uter[illegible] outside the uterus. It commonly affects t[illegible]ries, fallopian tubes and pelvic regions. This tissue be[illegible]ave[illegible]normal endometrial tissue, but because it is l[illegible]outside of the uterus, it can cause severe pelvi[illegible]in[illegible]mation and fertility problems.



Main signs and symptoms

- Pelvic pain
- Pain during or after sexual intercourse
- Heavy periods
- Severe period pains
- Difficulties conceiving

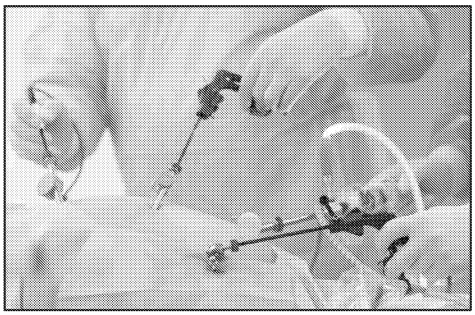
Did you know?: Endometriosis affects around 1 in 10 women, meaning most of us has this condition.

zzed.uk/12929-Endometriosis

Diagnosis and monitoring

There are several methods used to diagnose and monitor endometriosis. Howev laparoscopy is the **only** method that can directly diagnose the condition, while ot endometriosis.

Method	How it's used	
Pelvic examination	This is a physical exam which involves checking the lower abdomen and pelvic area. During the exam, a healthcare professional may perform an internal vaginal examination, using their fingers to feel for any abnormalities, such as irregular growth[illegible]pressing on the abdomen to assess the int[illegible]gans.	• If[illegible] sy[illegible] • T[illegible] • T[illegible]
MRI	An MRI scan uses a st[illegible]netic field and radio waves to create det[illegible]images of the pelvic organs. This can help t[illegible]y endometrial tissue that has grown outside the uterus. This method is particularly helpful in identifying **deep infiltrating endometriosis**. **Deep infiltrating endometriosis** – a severe form of endometriosis where endometrial tissue grows deep into surrounding pelvic organs such as the bladder and bowel.	• [illegible] • [illegible] • [illegible]

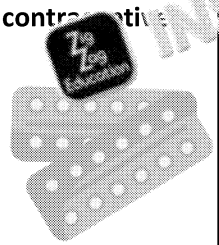
Method	How it's used	
Ultrasound	This involves using high-frequency waves to create images of the pelvic organs. There are two main types: • A transabdominal ultrasound, which examines the pelvis through the abdomen • A transvaginal ultrasound, which provides a clearer, more detailed view of the pelvic organs through the vagina This method helps identify signs of endometriosis such as ovarian endometrioma, which are cysts commonly associated with this condition. **Did you know?** Ovarian endometrioma are also known as 'chocolate cysts' due to their dark brown colour.	•
Laparoscopy	This is a procedure during which a camera is inserted into a small incision made just below the belly button. This allows a healthcare professional to directly view the pelvic organs and identify any signs of endometriosis, such as abnormal tissue growth and cysts. This procedure also allows a biopsy (small sample) to be taken to confirm the presence of this condition and assess the extent of the disease. 	•

Treatments

There is currently no cure for endometriosis, but treatments help to manage this and non-surgical treatment options, all of which help to alleviate pain and other s endometriosis.

		How it works	Benefits
Surgical treatments	**Laparoscopic removal of endometrial tissue**	This surgical procedure is carried out during a laparoscopy and involves a healthcare professional surgically removing endometrial tissue. There are two main ways this can be done: ➢ **Electrosurgical heat treatment** – a high-frequency electrical current or laser is used to burn away endometrial tissue ➢ **Excision** – surgically cutting out endometrial tissue, particularly for deeper or more invasive deposits of tissue In rare cases, this procedure may require open surgery for more severe cases.	✓ Can significantly improve symptom and relieve pain ✓ Minimally invasive surgery – reduces risks such as bleeding and infection ✓ Quicker recovery time
	Hysterectomy	This is a major surgical procedure involving the removal of the uterus. This can help remove endometrial tissue. This procedure is usually used as a last resort if other treatments haven't been successful.	✓ Can significantly reduce pain caused by endometriosis ✓ Alleviates other symptoms such as heavy periods and severe period pain

Research activity: Research the **three** different types of hysterectomy.

		How it works	Benefits
Non-surgical treatments	**Pain relief**	Painkillers can be prescribed to individuals to help alleviate symptoms such as pelvic pain and period pain by interrupting pain signals before they reach the brain. Additionally, individuals may be given non-steroidal anti-inflammatory drugs (NSAIDs) which help to reduce pain and swelling by interfering with specific enzymes.	✓ Easy to use ✓ Can be used alongside surgical treatment ✓ Non-invasive ✓ Helps to alleviate pain
	Hormonal medicines and contraceptives 	Hormonal medicines and contraceptives can help manage endometriosis by regulating hormone levels, particularly oestrogen, which slows the growth of endometrial tissue. These treatments achieve this by suppressing the normal menstrual cycle.	✓ Helps relieve endometriosis pain and heavy periods ✓ Helps prevent condition from worsening by slowing down or stopping the growth of endometrial tissue ✓ Multiple types to choose from such as tablets, injections and implants

Factors increasing likelihood of condition

The exact cause of endometriosis is still under debate; however, certain factors can developing this condition, including:

- **Family history** – women who have a close relative, such as a mother or sister more likely to develop this condition. While there is no single 'endometriosis specific genes affecting inflammation and hormone regulation may increase endometriosis. However, family history is just one factor contributing to the the environment still plays a big influence.
- **Age of period onset** – starting a period at a young age (under 11 years old) can increase the likelihood of developing endometriosis due to longer exposure to oestrogen. Oestrogen stimulates the growth of endometrial tissue, so prolonged exposure can increase the risk of this tissue growing outside the uterus.
- **Short menstrual cycle** – a short menstrual cycle is classed anywhere below 27 days means that a person has more frequent periods. This increases the risk of **retrograde bleeding** which is a known risk factor for developing endometriosis. This is because blood contains endometrial cells that can stick to the pelvic walls or other pelvic
  - ✓ **Heavy menstrual periods** – heavy periods that last longer than seven days increase the risk of endometriosis because they increase the amount of menstrual blood and tissue. This can also increase the risk of **retrograde**

Applied activity: Design an informative and engaging leaflet which outlines the the likelihood of developing endometriosis. Remember to link these to the repro

Control and prevention

As mentioned, there is currently no cure for endometriosis. Unfortunately, there
However, there are several strategies that may help reduce the likelihood of deve
strategies can also support individuals who already have endometriosis by helpin
improve their quality of life.

- ✓ **Pain relief** – pain relief treatments such as painkillers and NSAIDs can help individuals control their symptoms such as pelvic pain and severe period cramps. These treatments do this by blocking pain signals before they can reach the brain and by helping to reduce pain and swelling by interfering with specific enzymes used to make prostaglandins.
- ✓ **Hormonal medicines and contraceptives** – h[illegible] treatments such as the individuals to manage their endom[illegible] symptoms over the long term. Th helping to regulate oestrogen, w[illegible] slows the growth of endometrial tissue alleviate pain and l[illegible] periods, as well as reduce an individual's likelihood
- ✓ **Lifesty[illegible]ng** – adopting healthy lifestyle choices can help individuals to prever[illegible] endometriosis from worsening, such as:
  - **Reduce stress** – stress plays a big role in inflammation and hormonal imbalance, and increases our sensitivity to pain. Together, these factors can contribute to more severe and painful endometriosis symptoms. By managing and reducing stress, this can help to reduce pelvic pain and severe menstrual cramps, improve hormone regulation, lower inflammation and make pain more manageable.
  - **Dietary changes** – eating foods that are high in anti-inflammatory properties, such as omega-3-rich fish, fruits and vegetables can help low symptoms such as pain. Additionally, introducing a high fibre and low f oestrogen levels, helping to reduce the growth of endometrial tissue.
  - **Exercise regularly** – regular physical activity not only helps reduce inflan oestrogen levels. Additionally, exercise can help improve mood and red these factors help to ease and manage the symptoms of endometriosis developing the condition.

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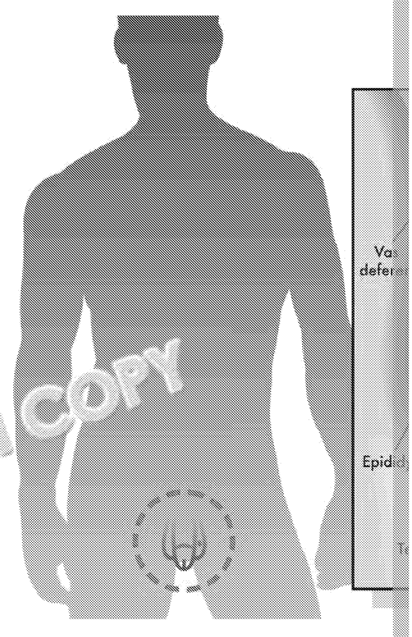
Impact on the individual

Living with endometriosis can significantly impact a woman's life. From its chron
symptoms, it can cause physical, intellectual, emotional and social disruptions.

Physical	The physical symptoms of endometriosis, such as pelvic pain, seve and pain during or after intercourse, can cause significant discom engage in everyday tasks, including daily chores and physical exer symptoms can interfere with essential activities such as sleeping a impact intimacy.
Intellectual	Experiencing these physical symptoms can disrupt cognitive funct concentrate, make decisions and remember things. Additionally, experiencing this condition can cause sensations known as **brain f** cause disruptions in educational and professional performance, a **Brain fog** refers to mental confusion and lack of clarity, fog, aspects such as memory, focus and thinking become impai
Emotional	Endometriosis can have a significant toll on emotional well-being. symptoms increase the risk of depression and anxiety, but the ch can lead to feelings of helplessness and frustration. Additionally, possibility of not being able to have a baby can cause significant e
Social	The physical symptoms of endometriosis could prevent individuals fr and family. Additionally, pain during or after sex, and difficulties co intimate relationships. Combined, these factors could cause social is

Testicular cancer

Overview and causes



Testicular cancer is a type of cancer that typically affects the germ cells, which produce sperm in the testicles. It is caused by DNA mutations which affect cell growth and division. These mutations can either turn on genes that promote cell growth (oncogenes) or turn off genes that normally prevent uncontrolled cell growth (tumour suppressor genes). As a result, these DNA changes result in the development of a tumour. For a tumour to be confirmed as testicular cancer, it must be confined to the testicle and not spread to the lymph nodes or tis

Main signs and symptoms

- Lump in the testicle
- Feeling of heaviness in the scrotum
- Pain in the testicles
- Increased firmness of the testicles

Diagnosis and monitoring

There are a few ways testicular cancer can be diagnosed and monitored, all of wh tumour is present.

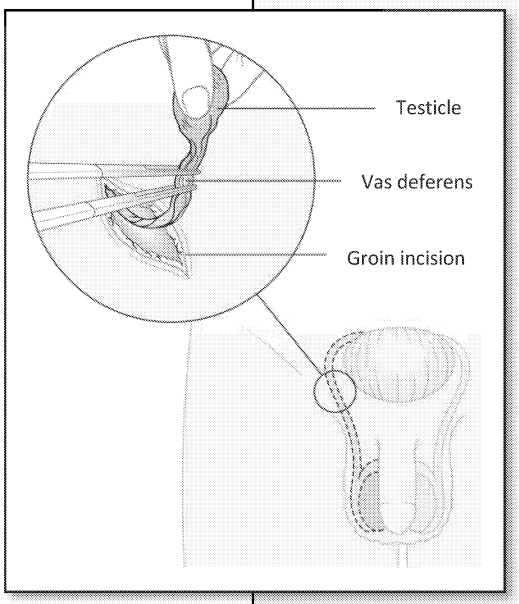
Method	How it's used	W
Physical examination	A healthcare professional feels for any abnormalities in the testicle, such as swelling, lumps or tenderness. This method also involves checking the lymph nodes and the abdomen to confirm whether there are signs the cancer has spread elsewhere.	• If someone shows testicular cancer • To diagnose testi • To monitor testic the progression o • To direct future t
Ultrasound	This involves using high-frequency waves to create images of the testicles. This helps identify whether a tumour is present by detecting any shadows in the ultrasound.	• When symptoms has been observe • To differentiate b epididymal cyst) a • When there is sus spread beyond th
Blood test	A blood sample is taken to check for specific proteins commonly produced by cancer cells. This is known as a tumour marker test.	• When symptoms s confirmed by phys • To monitor how t to treatment

Did you know? : Testicular cancer has one of the highest survival rates (zzed. Research suggests that this is down to increased awareness, screening programme in treatments.

Treatments

Early detection is key in treating testicular cancer. The sooner it is diagnosed, the which helps prevent the cancer from spreading outside of the testicle and improv

		How it works	Benefits
Surgical treatments	**Orchidectomy**	Also known as orchiectomy, this is a surgical procedure which removes one or both of the testicles. This is performed to remove tissues within the testicle that contain cancer, and also allows a healthcare professional who specialises in diagnosing diseases known as a pathologist, to confirm the presence of cancer and assess its severity.	✓ Allows for analysis of the cancer tissue ✓ Effective treatment i removing tumour ✓ Controls cancer growth by lowering testosterone levels ✓ Helps prevent testicular cancer fro returning ✓ Can provide a cure if localised and caught early[3]



		How it works	Benefits
Non-surgical treatments	**Chemotherapy**	This is a form of treatment which uses cytotoxic (cancer-killing) drugs to destroy cancer cells. These drugs travel through the bloodstream via an intravenous line to target cancer in different parts of the body. Chemotherapy is typically used when the cancer has spread to other areas or if there is a risk of the cancer returning.	✓ Treats cancer th has spread outsi of the testicle ✓ Can be used afte an orchidectomy to help prevent cancer from returning ✓ Helps slow dow the growth and prevents the spread of cancer other body parts ✓ Can cure testicul cancer

[3] Penn Medicine **Testicular Cancer Surgery: Orchiectomy & RPLND | Penn Medicine** (accessed on 1

Factors increasing likelihood of condition

There are certain factors which can increase the likelihood of developing testicular cancer, including.

- **Undescended testicles** – this typically occurs during foetal development when a testicle does not drop down from the abdomen into the usual position in the scrotum. Though the exact reason isn't fully understood, this is found to increase the likelihood of testicular cancer. Research suggests this is down to the abnormal position of the testicle, which can make it more prone to complications such as cancer.
- **Family history** – men with a close family member, such as a father or brother, who has / has previously had testicular cancer are more likely to develop the condition themselves. Although a specific gene for testicular cancer hasn't been identified, research suggests a **hereditary** link. Multiple genes may influence the development of the testes, fertility, and sperm production. Changes in these genes are believed to increase the risk of testicular cancer.
- **Age** – testicular cancer is also known as the 'young man's disease',[4] because men aged between 15 and 49 are most at risk of developing the condition. The testes produce more sperm and testosterone at this age, and higher levels of testosterone promoting the growth of prostate cancer cells.
- **Previous testicular cancer** – men who have had testicular cancer in one testicle have a higher risk of developing it again in the other testicle. This is because the factors that led to the initial cancer may still be present. Additionally, previous testicular cancer treatments can increase the risk of developing other types of cancer, known as secondary cancers. This is because treatments such as radiation and chemotherapy can damage healthy cells in the body, which increases the risk of DNA mutations which lead to cancer.
- **Radiotherapy** – radiotherapy is used to kill cancer cells and reduce tumour size. However, as mentioned previously, exposure to radiation can increase the risk of cancer as it can damage the DNA in healthy cells, leading to DNA mutations. If radiotherapy is used, it can raise the risk of developing this cancer.

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Exam tip

You may have noticed there is no 'Control and prevention' section for this condition. Cur
cancer cannot be prevented or controlled. This is because the factors that increase the ri
such as family history, age, and undescended testicles, cannot be changed.

[4] Mayo Clinic **https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/yo**
(accessed on 18/02/2025)

Impact on the individual

Being diagnosed with testicular cancer can be an incredibly overwhelming and sc
impacts, especially in relation to PIES.

Physical	Treatment for testicular cancer can be aggressive and cause a r example, symptoms such as extreme fatigue, nausea and stoma chemotherapy can make it incredibly difficult for individuals to day activities. Additionally, essential needs such as eating and s
Intellectual	Chemotherapy can disrupt cognitive functions such as thinking, Individuals may find it difficult to engage in everyday tasks such their care and staying focused at work. Additionally, the emotio further impair these cognitive functio
Emotional	Being diagnosed with testicular can can bring intense emotio may experience a wi of feelings, including anxiety, fear uncertainty reatment outcomes and the potential impact on and f ng) could cause feelings of helplessness and signi
Social	A gnosis of testicular cancer can have widespread impacts on amily. Individuals may withdraw from social activities due to p Friends and family may struggle to cope with the diagnosis, caus

Research activity: Research the different ways that individuals with testicular can be supported in managing the physical, intellectual, emotional and social impact of the condition. Consider how these support strategies can help them to cope.

Did you know? This image displ
the ribbon for Testicular Cancer
Awareness Month, which takes pl
April. This month aims to raise
awareness about the impact of
testicular cancer on those affecte
well as their friends and family.

Checking my understanding:

1. State **one** function of the cervix.

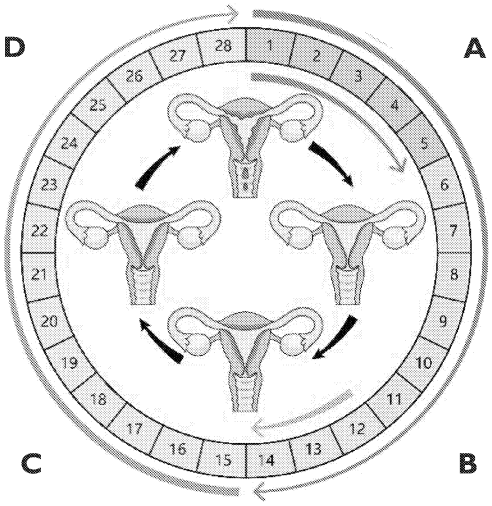
2. Which of the following is not a phase in the menstrual cycle?
   A) Follicular
   B) Ovulation
   C) Menopause
   D) Luteal

3. Where in the reproductive system do sperm mature?
   A) Testes
   B) Scrotum
   C) Epididymis
   D) Prostate

4. State **one** way of diagnosing and monitoring endometriosis.

5. What treatment involves using cytotoxic drugs to kill testicular cancer cells?

6. Identify the stages of the menstrual cycle in the diagram below:



7. Complete the sentence below to describe the function of the scrotum.

   The scrotum is a pouch of skin that contains and **A)**_____ the testes. It is re
   B)_____ of the testes, moving them closer or further away from the body t
   C)_____ temperature for **D)**_____ production.

Developing understanding/skills:

8. Sara has had a laparoscopy. The doctor explained that they found endo
   of her uterus, and have diagnosed her with endometriosis. Sara's sister has
   started her periods in primary school and has very heavy periods.

   a) Explain what factors could be increasing Sara's risk of endometriosis by
      reproductive system.
   b) Explain what testicular cancer is.

Chapter 1

Checking my understanding:

No.	Answer
1.	**1 mark for each:** i) White blood cells – fighting infections and destroying cancer cells (1) ii) Red blood cells – transporting oxygen around the body (1) iii) Plasma – transporting substances around the body (1) iv) Platelets – blood clotting (1) *Accept other suitable answers.*
2.	**1 mark for correct answer**: C) Left ventricle (1)
3.	**1 mark for each**: A) (1) B)) C) ode / atrioventricular node (1) D) Purkinje/Purkyne fibres (1)
4.	**1 mark for each**: • Porous walls / narrow lumen / slow blood flow (1) • Allows for substances to diffuse into and out of the blood easily (1) *Accept other suitable answers.*
5.	a) **1 mark for explaining**: Lack of blood flow to the heart muscles (1)
	b) **1 mark for each, any two from**: • Angioplasty (1) • Coronary bypass (1) • Nitrolingual pump / angina pump (1) • Anticoagulants (1) *Accept other suitable answers.*
6.	**1 mark for correct answer:** D) Low blood pressure (1)

Developing my understanding/skills:

No.	Answer
7.	**Up to 1 mark for**: • Chest pain / chest pain that radiates to arm, neck and jaw (1) • Tight chest (1) • Breathlessness (1) • Dizziness (1) • Nausea (1)
	1 mark for each: • **Reduce fat and salt intake** – reduces LDL build-up and risk of atherosclerosi • **Stop smoking** – heals damage to arterial walls (1) • **Reduce stress** – reduces high blood pressure and ... s hormones, relaxing reducing symptoms (1) *Accept other suitable answers.*
8.	a) **1 mark for overview**: • Blood cl... ...eep vein which restricts blood flow (1)
	b) ...k i... ...: • ...hrombolytics – drugs that dissolve blood clots to restore blood flow (1 • Thrombectomy – surgical procedure which removes blood clot from ve
	c) **Up to 2 marks for each treatment, 1 mark for benefits, 1 mark for limitatio** Thrombolytics ***Benefits*** • Fast breakdown of blood clots (1) • More effective than anticoagulants at completely breaking down blood • Helps prevent long-term complications such as post-thrombotic syndro ***Limitations*** • Invasive (1) • Only for severe cases (1) • Unpleasant side effects such as bleeding, bruising and swelling (1) • Long treatment time (1) • Requires careful monitoring in a hospital (1) Thrombectomy ***Benefits*** • Removes large blood clots (1) • Immediate results (1) • Minimally invasive (1) ***Limitations*** • Increases risk of damage to blood vessels (1) • Requires the use of other medications alongside, such as anticoagulant *Accept other suitable answers.*

Preview of Answers Ends Here