



Exercise EKG
Tests your heart's response to exercise and stress

Lung volume
Measures your total lung capacity

Cholesterol
Keeps track of your good and bad cholesterol

THE MEDICAL CHECKUP BOOK

UNDERSTAND THE TESTS YOU NEED
TO KEEP YOUR BODY AND MIND HEALTHY





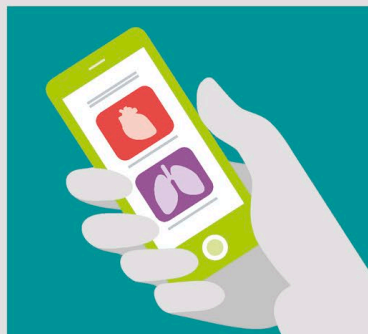
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UNDERSTAND THE TESTS YOU NEED TO
KEEP YOUR BODY AND MIND HEALTHY

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Penguin
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House

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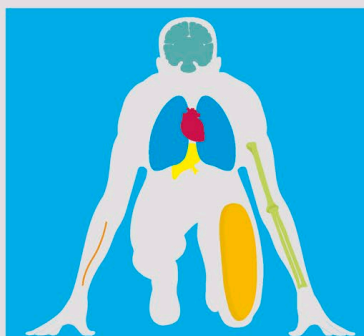
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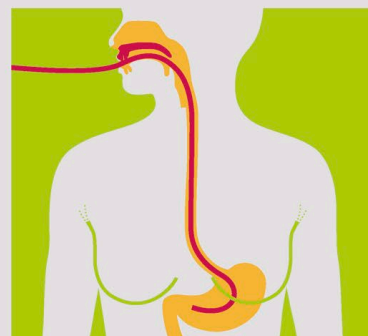
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Introduction

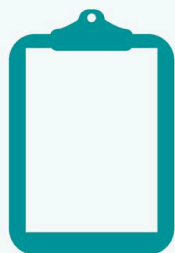
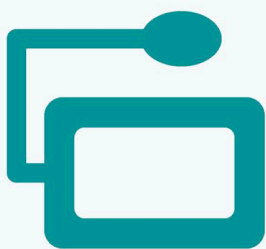
In recent years, there has been a quiet revolution in medicine and health care, with a move away from the traditional emphasis on treating disease and increasingly toward prevention. Moreover, the concept of prevention itself has expanded, from simply preventing disease toward actively taking measures to optimize health. Key aspects of this new trend in health maximization are screening tests for particular conditions and regular monitoring of significant indicators of health, such as blood pressure, in order to spot early signs of a potential problem so it can be dealt with before it develops into illness. Furthermore, with new technology, you can monitor many aspects of your health yourself, so you can get expert medical advice early. Health professionals also increasingly benefit from new technology to offer a range of sophisticated health checks and tests.

However, the many health check options available can be confusing. This book aims to demystify health screening and tests so you can make good choices about monitoring and maintaining your health. The book is divided into four main sections. The first, "Monitoring your health," provides an overview of health and health checks, from the factors that affect your health to the ways in which you can keep an eye on your health. The second section, "General adult tests," gives detailed, accessible information about the most common and useful tests, including not only tests that a health professional might carry out, but also those you can do yourself, such as checking your skin. The third section, "Optimizing your health," gives practical advice on measures you can take to ensure you keep as healthy as possible, from diet and exercise, to information about vaccinations and psychological health. The final section includes information about important but less commonly performed medical tests, such as biopsies to analyze tissue samples, as well as an overview of screening options to consider and pages for you to copy and use to record your own and your family's health check results.

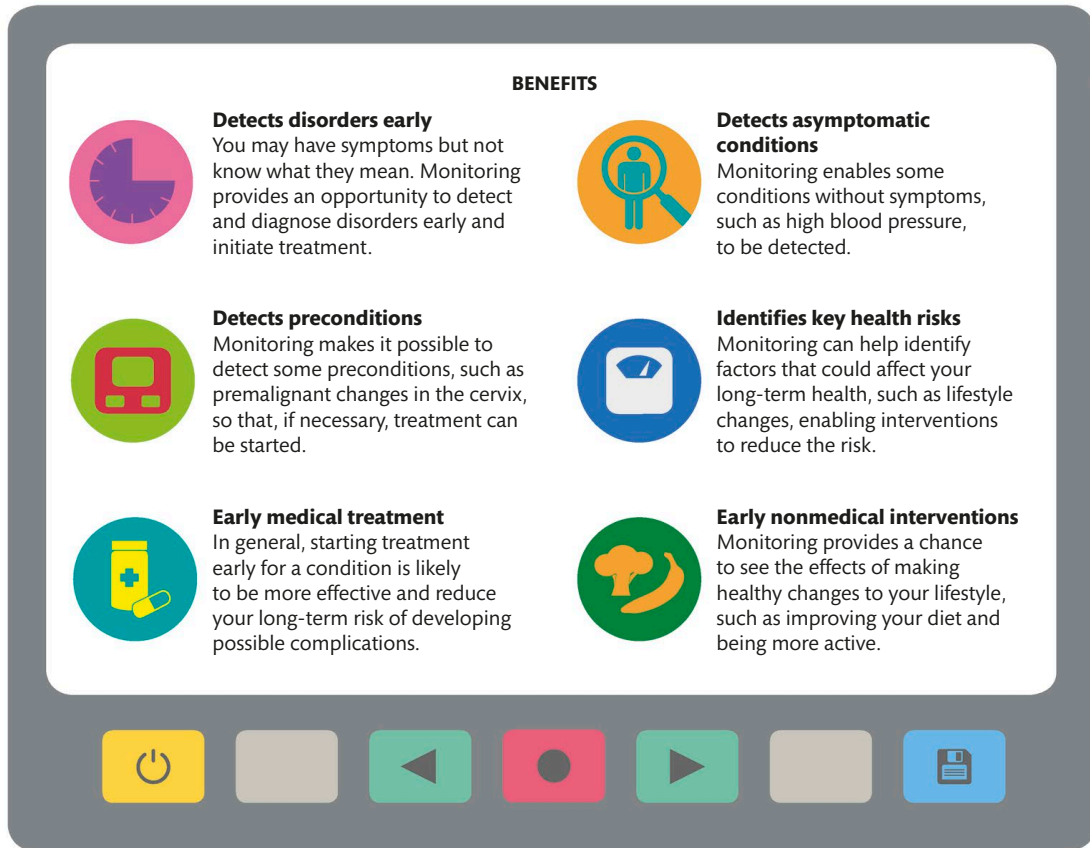








**Monitoring
your health**



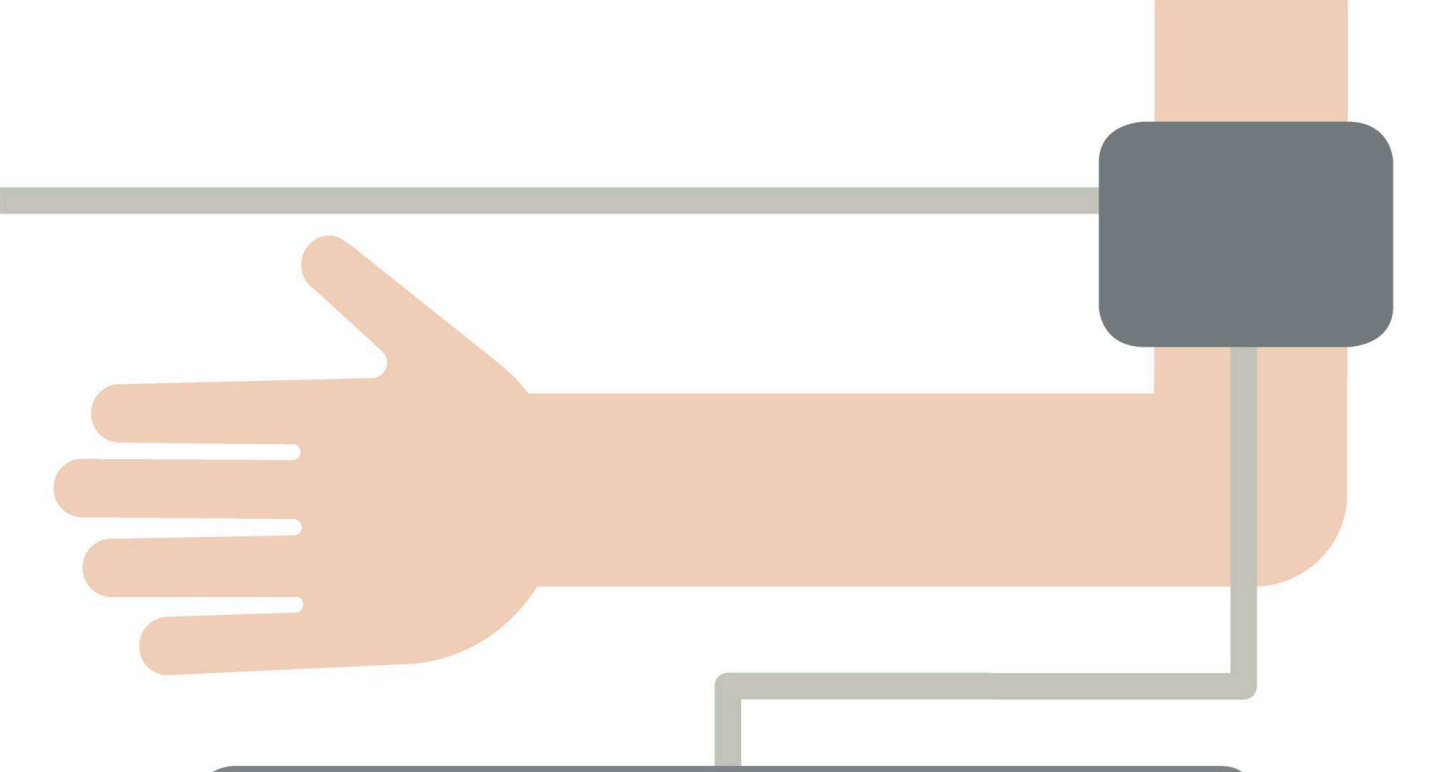
Why monitor your health?

Health is a state of physical and mental well-being, not merely the absence of disease. Generally, most people are well most of the time. However, health monitoring is useful because it can detect risk factors or the early signs of a condition that might become a health problem.

Advantages and disadvantages of monitoring

Monitoring provides a positive way for you to learn about your own body, and is an opportunity for you to engage with and affect your own health. Early detection of conditions by monitoring can even improve your life expectancy. For example, by detecting prediabetes, early medical intervention together with lifestyle changes could delay the onset of the disease itself by several years.

However, it is important that monitoring provides accurate results that do not lead to unnecessary further tests because of a wrong positive result or lead to you ignoring symptoms because of a wrong negative result. Although health monitoring tests are not perfect, in general, monitoring is beneficial because of the advantage of early identification of a problem, and because identifying risk factors early may help you take appropriate action.



DISADVANTAGES AND LIMITATIONS



Tests not 100% accurate

No medical test gives completely accurate results for everybody every time. A test may give a false-negative or false-positive result.



False-positive result

When a test gives a false-positive result, it indicates that you have a condition when, in fact, you do not.



False-negative result

When a test gives a false-negative result, it indicates that you do not have a condition when, in reality, you do.



Additional unnecessary tests

A test that gives a false-positive result may lead to further tests that are not needed because you do not actually have the disorder.



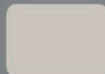
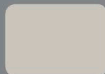
Stress

Having tests and waiting for the results can cause stress. A positive test result may lead to more stress, even if the result is a false-positive.



Tests provide only a snapshot

Tests only give information about your health at the time of the test. Even if you test negative, you could still develop a problem in the future.



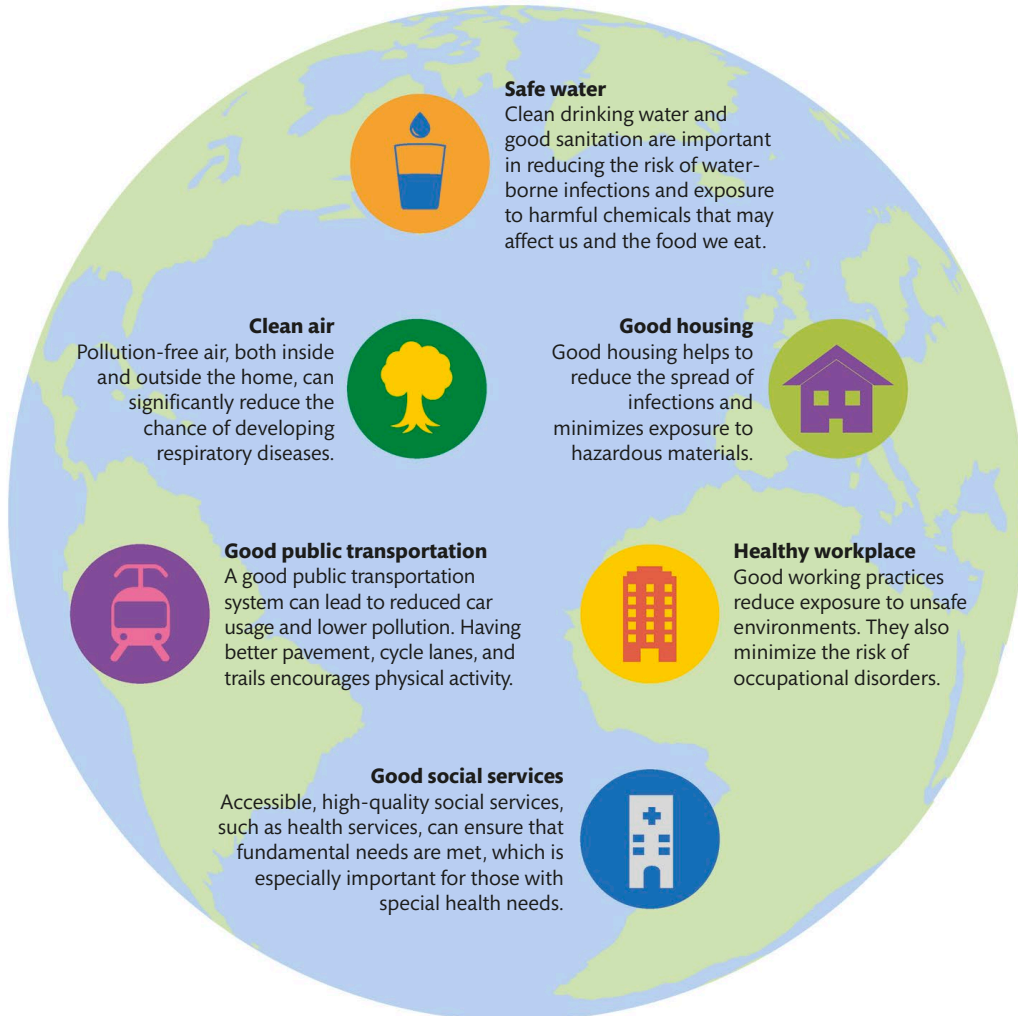
Environmental and personal factors

A wide range of factors affect your health. Some of these are outside your control, including environmental factors, such as a safe water supply and clean air, and personal factors such as your age, sex, and genetic inheritance.

Environmental factors

Your physical environment plays an important role in your quality of health. It determines your exposure to physical, biological, and chemical agents that might affect your

health, such as hazardous substances that could be ingested, inhaled, or absorbed through the skin. Not only can a healthy environment reduce the likelihood of health problems, it can also increase your lifespan.



Personal factors

As well as environmental factors, your health is also significantly influenced by a wide range of factors individual to you. Many of these factors depend on your

parents; for example, your genetic inheritance, ethnicity, and family medical history. Your family, together with your peers, also influence your health in more subtle ways, by influencing behavior, for example (see pp.14–15).



Age

In general, health declines with age. As you age, it is important to exercise and eat healthily. You should stay in touch with friends and family and look after your mental and physical health.



Genetics

The genes you inherit from your parents determine many characteristics, from hair color to susceptibility to various diseases. In some cases, a gene may mutate and cause disease.

Gender

On average, women live longer than men. Men and women also tend to suffer from different illnesses. For example, men can develop prostate cancer and women can develop gynecological cancers.



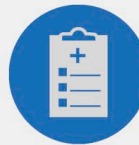
Ethnicity

Ethnicity plays a large role in your well-being. It influences your culture, lifestyle, and customs. These, in turn, influence your diet and habits, such as smoking, and can make you more prone to certain illnesses, such as diabetes.



Family medical history

Some conditions tend to run in families, such as asthma and heart disease. Knowing your family medical history can help identify possible health problems and enable you to take measures to reduce risk factors.



Personal medical history

Your medical history—for example, immunizations, illnesses, and medication—can not only affect your present health but may also influence future well-being by affecting your risk of developing various disorders.

Weight

It is important to maintain a healthy weight to maximize health. Body shape is also important: a large amount of fat around your abdomen is worse for your health than fat around your thighs and buttocks.



Height

It is not clear how height affects health but, on average, tall people have a lower chance of developing heart disease and dementia but a higher risk of certain cancers than shorter people.



Behavioral factors

In addition to personal and environmental factors (see pp.12–13), behavioral factors also influence your health. Furthermore, behavioral factors are largely within your control—you can choose what to eat and how much exercise to do, for example—and so you can actively choose to improve your health.



Diet

A healthy diet can reduce your risk of obesity and of certain diseases, such as diabetes. Eating plenty of vegetables, fruit, and fiber; using unsaturated fats; and eating low-fat protein can maximize your health.



Exercise

Regular exercise improves the quality of life, enhances mental well-being, and increases life expectancy. To benefit your health, every week aim to do at least 150 minutes of exercise that raises your heart rate.



Smoking

If you smoke, stopping is probably the most important thing you can do to improve your health. It is never too late to stop, but the sooner you stop, the greater the reduction in your risk of smoking-related diseases.



Drug use

It is important to take medication only as advised by a health care professional. Recreational drug use can severely damage physical and mental health, and can be fatal. It can also affect relationships and work life.



Alcohol use

Excessive alcohol use can seriously damage your health, and the more you drink, the greater the health risk. However, drinking a small amount may help to protect against heart disease and stroke.



Sleep

Most adults need seven to nine hours of sleep a night. Good sleep improves concentration, motivation, and mood. Exercise, reducing the time using a computer, and cutting down alcohol intake can help to improve sleep.

Behavior, lifestyle, and health

Your lifestyle can have a large impact on your health. To some extent, lifestyle behaviors are influenced by your family and peers; for example, if they generally follow a healthy lifestyle, such as exercising regularly and not smoking or using recreational drugs, you are likely to do the same. However, ultimately it is your personal choice about which lifestyle behaviors to adopt.



Relationships

Good-quality relationships with family, friends, and the community in which you live are important for both your physical and mental well-being, helping you to have a longer, happier life with fewer mental-health issues.



Social life and leisure

An active social life and engaging in leisure activities can help reduce stress and improve physical and mental well-being. Social isolation is linked with higher rates of illness and decreased life satisfaction.



Sexual health

Safer-sex methods reduce your risk of catching a sexually transmitted infection. For heterosexual sex, they also reduce the likelihood of an unwanted pregnancy. The fewer partners you have, the lower the risk of catching an STI.



Occupation

A good-quality job, with adequate pay, protection from physical hazards, job security, and job satisfaction, is associated with a higher level of both physical and psychological well-being.



Stress

In the short term, a certain amount of stress can be positive because it can help motivate you. However, long-term stress can damage your physical health and cause anxiety and depression.

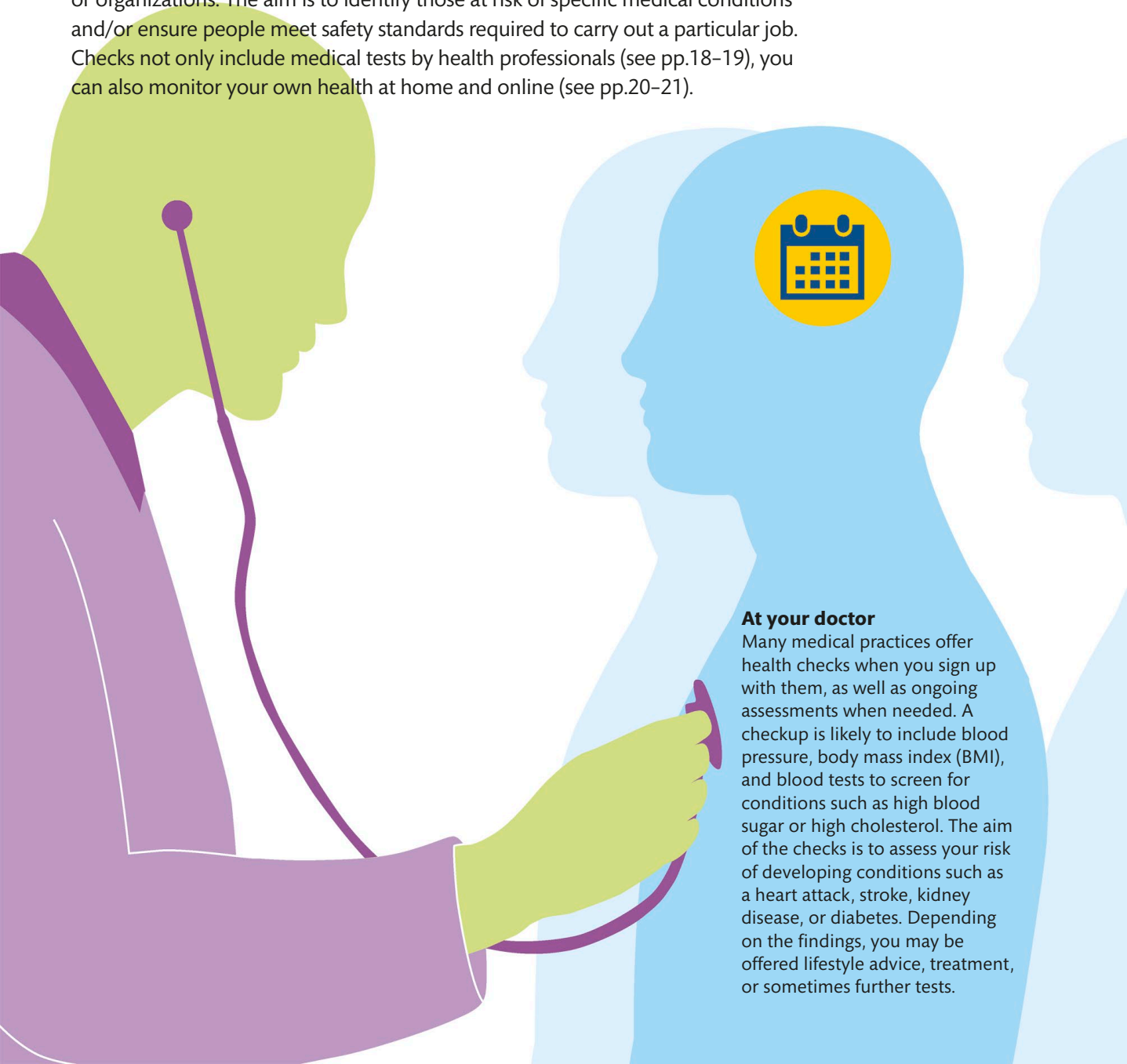


Income

For reasons that are not entirely clear, people with higher incomes are generally less at risk from mental illness; harm from drugs, alcohol, or smoking, and from emotional issues.

Types of health check

There are a range of health checks available, from those carried out by your own doctor, to workplace assessments, and specific tests required by certain occupations or organizations. The aim is to identify those at risk of specific medical conditions and/or ensure people meet safety standards required to carry out a particular job. Checks not only include medical tests by health professionals (see pp.18–19), you can also monitor your own health at home and online (see pp.20–21).



At your doctor

Many medical practices offer health checks when you sign up with them, as well as ongoing assessments when needed. A checkup is likely to include blood pressure, body mass index (BMI), and blood tests to screen for conditions such as high blood sugar or high cholesterol. The aim of the checks is to assess your risk of developing conditions such as a heart attack, stroke, kidney disease, or diabetes. Depending on the findings, you may be offered lifestyle advice, treatment, or sometimes further tests.

PREPARING FOR A PHYSICAL

You do not need to do much preparation, as health assessments aim to evaluate your baseline health status, but gathering some background information will help your doctor.

- Find out about the medical history of your immediate family, particularly for any conditions such as strokes, heart attacks, diabetes, or high cholesterol, as well as cancers, including their ages at diagnosis.
- Take a list of the medications you take regularly, including those bought over the counter, such as pain relief, vitamin and mineral supplements, as well as nonmedical preparations.
- Make a note of any known intolerances or allergies.
- Bring a list of vaccinations you have been given, and when you had them.
- Write down your own concerns or questions you want to ask the health professional—about links to family medical history, for example.



Workplace health checks

Many companies offer medical checkups when you join, as well as ongoing health monitoring. These usually comprise similar assessments to those carried out by your doctor, and if they identify abnormalities, they will usually refer you to your doctor. Some professions have further checks as a requirement for employment. For example, bus or train drivers need to undergo regular fit-to-work assessments. Commercial pilots must have a medical certificate that needs updating regularly.



Other health checks

Health checks may be requested by external organizations, too. Sports bodies require athletes to undergo cardiology screening and tests for performance-enhancing drugs before they can compete. Private medical and life insurance companies may ask you to have a physical before signing up for a policy. When you join a gym or enroll with a personal trainer, you may be offered a series of baseline health and fitness tests before you start. Some sports-footwear specialists provide gait assessments, too.

Medical checks

Medical testing takes many forms, from blood samples that check how your organs are working to scans that take two- or three-dimensional images of the body, and viewing tests that allow doctors to examine an organ internally. They may be used to assess symptoms or to monitor long-term problems.

Screening and diagnostic tests

What is the difference? Screening tests are checks carried out on a healthy person before symptoms of a disease have developed. The aim is to detect the condition or assess the risk of developing it. National programs offer screening to population groups at risk of certain medical conditions, usually targeted at groups of a particular age or sex (see pp.176–177). Diagnostic tests are procedures performed to determine the presence of disease in an individual suspected of having it, either because the screening shows a positive result or the person presents with symptoms.



Monitoring for preexisting conditions

People with long-term, or chronic, conditions are often required to undergo more frequent medical checks because they may be at risk of developing other complications, or to monitor any changes. For example, those with diabetes are offered annual assessments that review blood sugar control and kidney function and include specialist eye tests and foot checkups to identify peripheral nerve damage. Depending on your condition, these checkups might be carried out by your doctor, or at a specialist center. Some long-term conditions might also be partly monitored remotely, using wireless technology that sends health data to your doctor, leaving you to manage day-to-day aspects of your condition at home.



Additional tests for at-risk groups

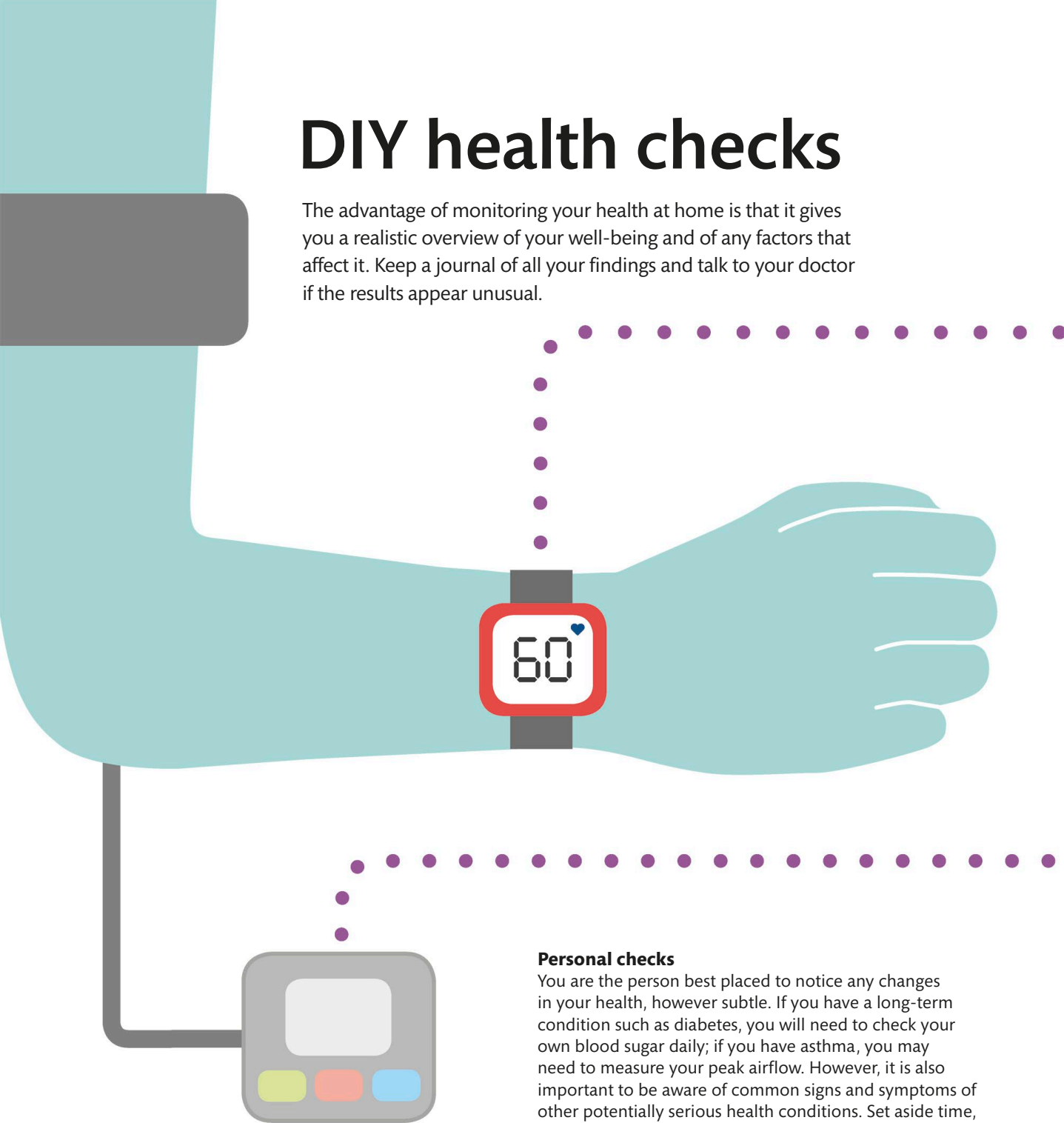
People with long-term medical conditions that put them at risk of other associated diseases may be offered further screening. For example, those with type 1 diabetes may be screened for other autoimmune conditions, such as celiac disease and thyroid problems. Those taking certain medications may also need additional checkups to ensure that the dose is correct or that it is not causing complications; for example, some blood pressure medications can potentially result in kidney damage.

If you have a family history of a medical condition that is genetic, a blood test may be offered to assess your risk of developing it. The decision to have genetic screening can be very difficult to make as some of the conditions are incurable, so you would usually be referred for counseling beforehand to help you understand the implications.



DIY health checks

The advantage of monitoring your health at home is that it gives you a realistic overview of your well-being and of any factors that affect it. Keep a journal of all your findings and talk to your doctor if the results appear unusual.



Personal checks

You are the person best placed to notice any changes in your health, however subtle. If you have a long-term condition such as diabetes, you will need to check your own blood sugar daily; if you have asthma, you may need to measure your peak airflow. However, it is also important to be aware of common signs and symptoms of other potentially serious health conditions. Set aside time, ideally once a month, to check your body: for example, for lumps or moles (see pp.98–99). Seek medical advice, too, if you notice changes such as blood in your stool or unexplained bloating, abdominal pain, or weight loss.



Commercial and online testing

A number of websites enable you to screen yourself for health issues, such as vision problems, and you can use online questionnaires to check for signs of dementia or depression. While these can all be useful indicators, they are not a substitute for medical advice, so you should speak to a health professional, too—taking your results with you.

You can also buy medical testing kits for use at home—online or at your pharmacy—that claim to analyze anything from cholesterol or fertility levels to bowel cancer. Remember, however, that not all companies are quality-assured, so results may not be accurate, and need to be interpreted correctly. Moreover, your doctor can request testing if you present with the relevant symptoms.

Wearable fitness devices

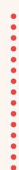
Technological advances have provided many platforms for monitoring your day-to-day health. Wearable gadgets, often linked to phone applications, enable you to track fitness and activity levels, food and calorie intake, even sleep quality. Some have a built-in electrocardiogram (ECG) that monitors heartbeat and rhythm, and there are applications that check oxygen saturation, women's health and fertility, cancerous changes in the skin, and much more. While these devices can be empowering, some applications are more accurate than others, so can give a false-positive or false-negative result. Do not rely solely on this technology; talk to your doctor if you are concerned.

HOME MONITORING EQUIPMENT

There are a number of devices that enable you to monitor your health. Make sure you know how to interpret the results.

- Weighing scales range from simple mechanical devices to sophisticated digital gadgets that can measure body fat, body-water percentage, or muscle mass—a few have built-in Wi-Fi so you can upload data to your phone or tablet.
- A tape measure is useful for measuring your waist (see p.24).
- Home blood pressure monitors allow you to take daily readings. Choose one that measures the pressure in the upper arm and make sure the cuff is the right size for your arm. Have it serviced regularly—at least every two years.
- A blood-oxygen saturation probe gives a digital readout when clipped onto your index finger.
- Blood glucose monitors are essential for anyone with diabetes. Choose one that keeps a record of your results. Some alert you to high or low glucose patterns and even check for ketones, a complication of type 1 diabetes.
- Peak-flow meters test the strength of your exhaled breaths.





**General
adult tests**

Body weight

It is important to keep to a healthy body weight, as being overweight or underweight can increase your risk of certain disorders. Your doctor may monitor your weight by weighing you and measuring your body mass index (BMI) and waist size.

Weight and health

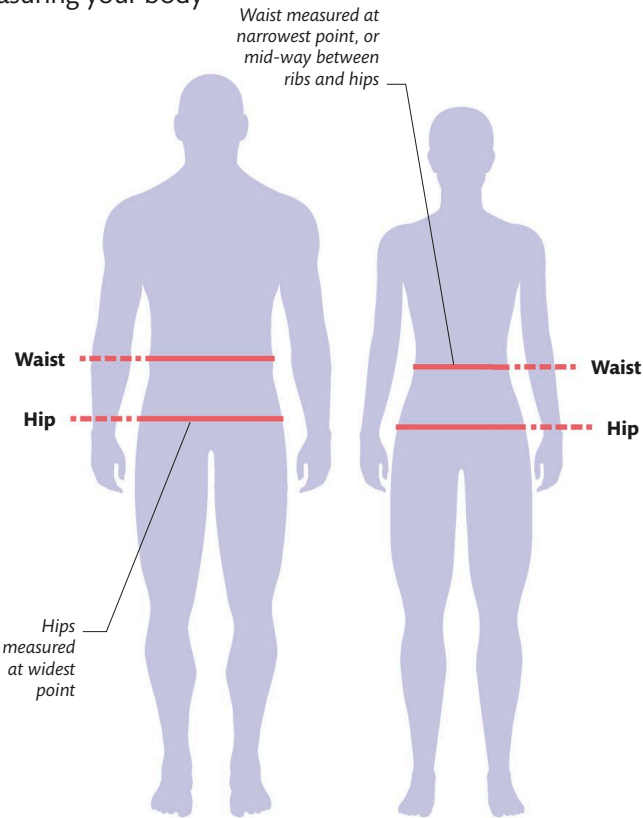
Your weight depends on your sex, age, height, shape, bone and muscle structure, and fat distribution. It is also influenced by your metabolism (how your body turns food into energy) and lifestyle. Being overweight might not immediately cause health issues, but excess fat can put a strain on your joints and can raise your risk of sleep disorders, heart disease, high blood pressure, and diabetes. It is also important not to be underweight, as this can increase your risk of disorders such as osteoporosis.

Waist and hip size

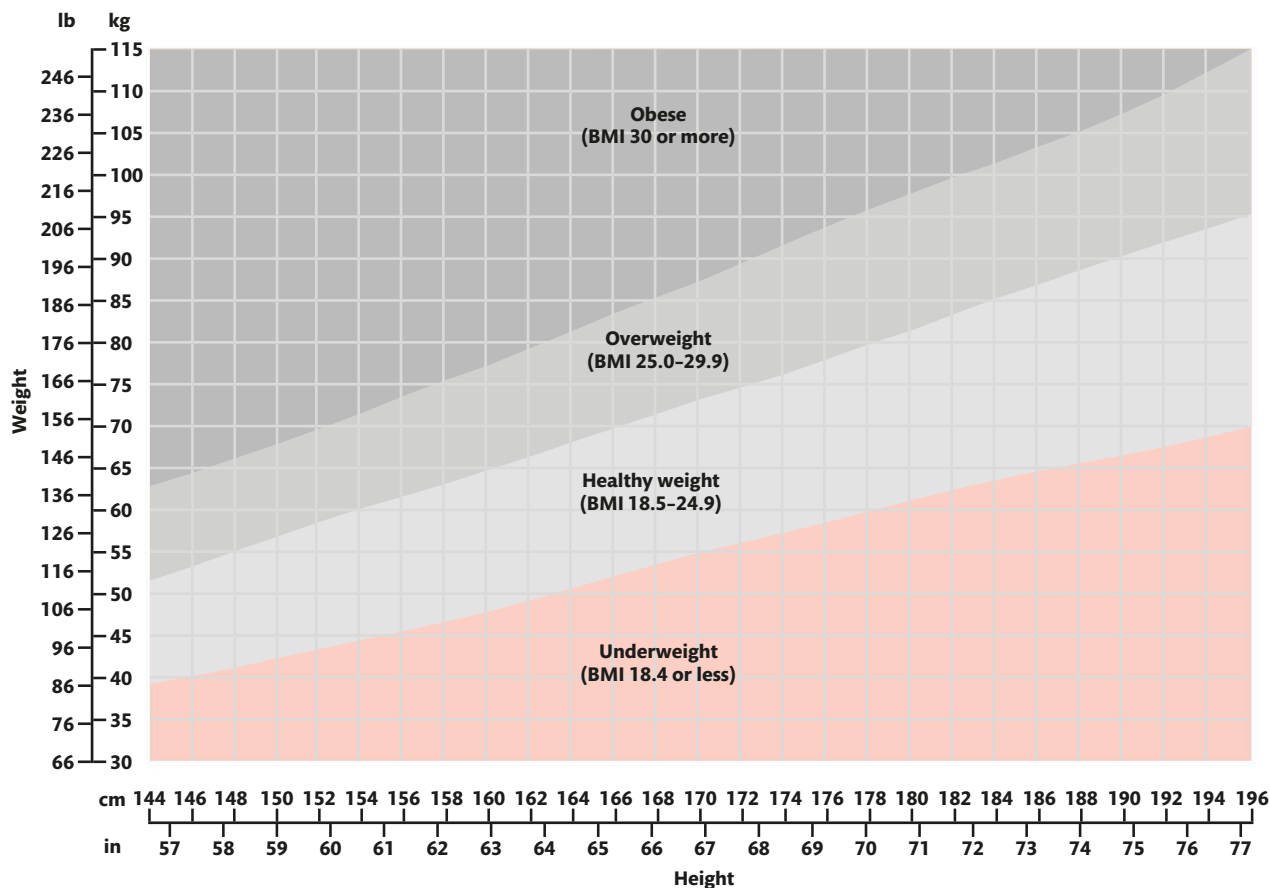
The doctor may measure your waist to see if you have excess fat around your middle, which can increase your risk of developing diabetes or heart and circulation diseases. The doctor may also measure around the hips and work out your waist-hip ratio, to assess body fat distribution.

Measuring your hips and waist

Use a cloth measuring tape or a piece of string. Wrap the tape around you so it is level and lies flat without digging in.



WAIST AND HIP MEASUREMENTS				
Weight around the middle usually means that there is more fat near the internal organs, which might influence the way they function.		Formula for waist-hip ratio:		
		Waist measurement (in or cm) Hip measurement (in or cm)		
Measurements	Gender	Healthy	Moderate risk	High risk
Waist size	Men	37 in (<94 cm)	37–40 in (94–102 cm)	40 in (>102 cm)
	Women	31½ in (<80 cm)	31½–34 in (80–88 cm)	34 in (>88 cm)
Waist-hip ratio	Men	<0.9	0.9–0.99	≥1.0
	Women	<0.8	0.8–0.89	≥0.9



Body mass index

Body mass index (BMI) is a calculation based on weight and height. It will show generally whether you are carrying too much or too little weight for someone of your height. It is not a totally accurate guide; for example, some muscular athletes may have a BMI suggesting that they are overweight, and BMI does not indicate fat distribution. In addition, BMI does not distinguish between men and women. However, it is still a quick and useful tool to help you assess weight-related health risks.

BMI

=

Weight (kg)

Height (m) x Height (m)

BMI

=

Weight (lb)

Height (in) x Height (in)

X 703

Adult BMI chart

You can check whether you fall in a healthy weight range by using the weight/height chart above, or by calculating it yourself (see below, left). This chart shows the ranges for adults only.

SELF-HELP MEASURES			
	Diet	Follow a healthy diet and cut down on sugar and salt	pp.146-149
	Exercise	Keep physically active	pp.152-153
	Sleep	Stick to regular sleeping hours	p.164
	Stress	Try to reduce stress	p.164

Your heart and circulation

Your heart and blood vessels—arteries, veins, and capillaries—form the transport network that carries blood to every cell in your body, supplying the cells with oxygen, nutrients, and other vital chemicals, and removing wastes. The heart beats continually to pump blood through the blood vessels; muscles and valves in the blood vessels also keep the blood moving freely.

Pumping blood

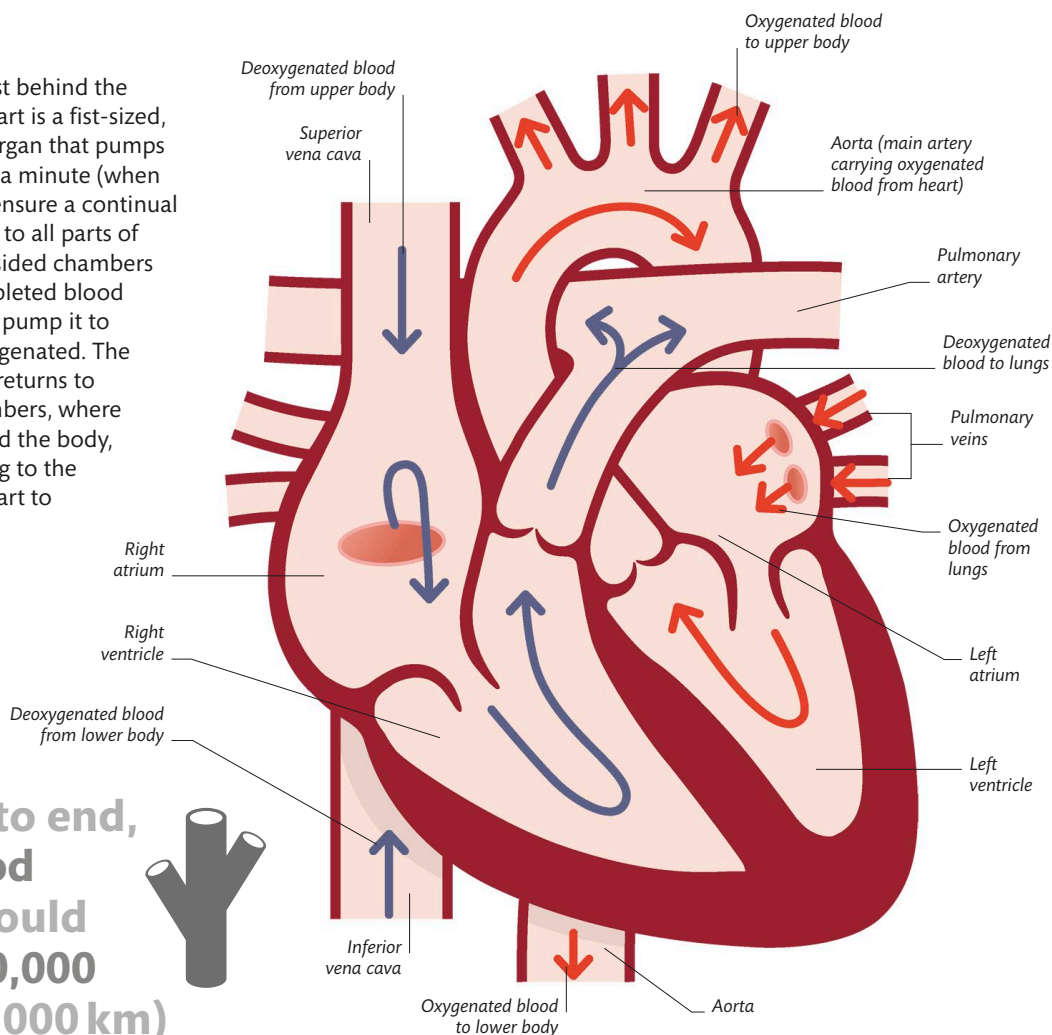
Located in the chest behind the breastbone, the heart is a fist-sized, hollow, muscular organ that pumps about 60–70 times a minute (when you are at rest) to ensure a continual flow of fresh blood to all parts of the body. Its right-sided chambers receive oxygen-depleted blood from the body and pump it to the lungs to be oxygenated. The oxygenated blood returns to the left-sided chambers, where it is pumped around the body, eventually returning to the right side of the heart to repeat the cycle.

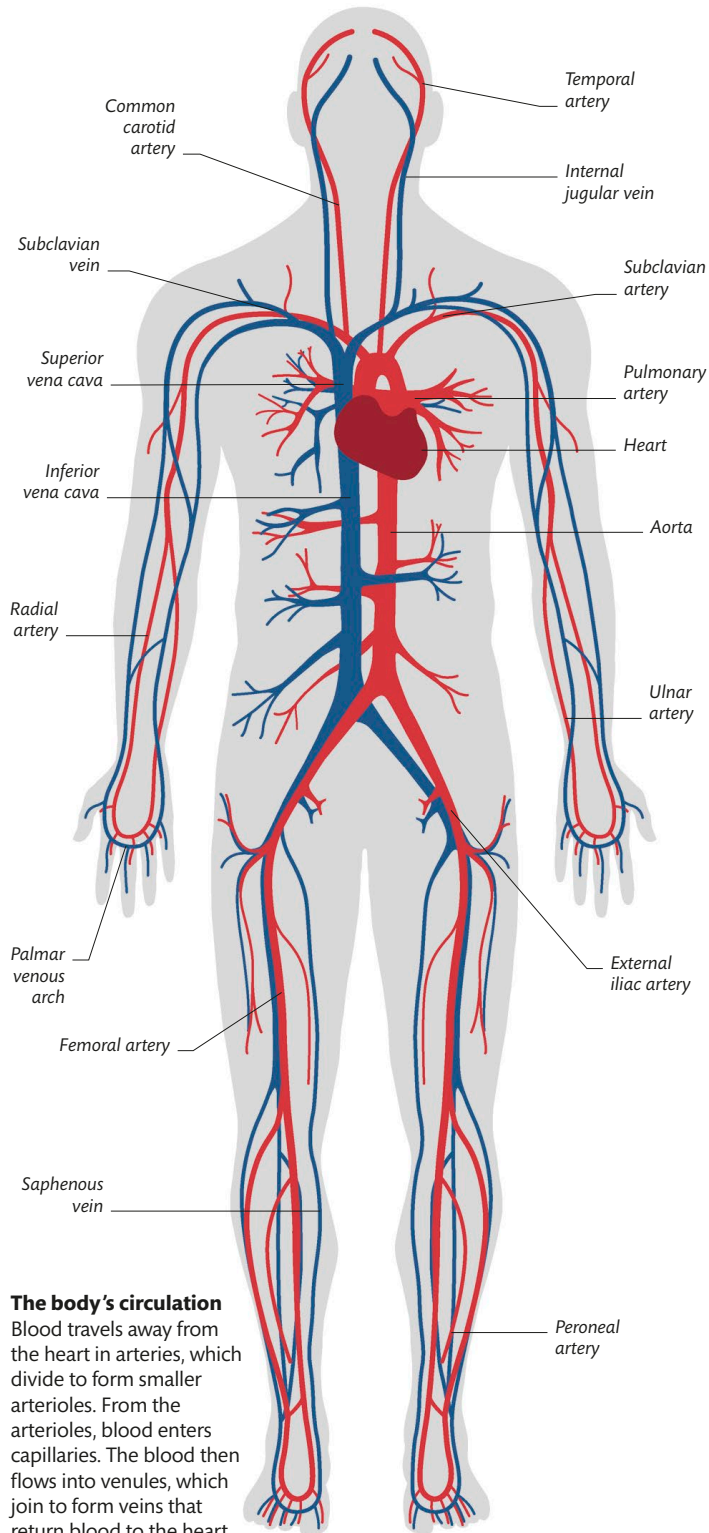
**Laid end to end,
your blood
vessels would
stretch 60,000
miles (97,000 km)**



Structure of the heart

The heart is divided vertically into two halves. Each half consists of an upper chamber (atrium) that receives blood from the veins, and a lower chamber (ventricle) that pumps blood into the arteries. One-way valves prevent backflow of blood.



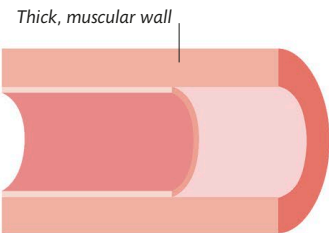


The body's circulation

Blood travels away from the heart in arteries, which divide to form smaller arterioles. From the arterioles, blood enters capillaries. The blood then flows into venules, which join to form veins that return blood to the heart.

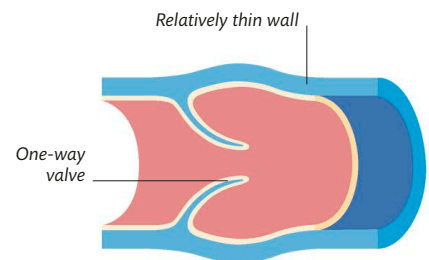
CHECKING THE HEART AND CIRCULATION

Problems with your heart and circulation are potentially serious, as they could lead to conditions such as a heart attack or a stroke. Basic checks of cardiovascular health include measuring your blood pressure and your heart rate and rhythm. More sophisticated checks include electrocardiography (ECG) and ultrasound imaging such as echocardiography and scanning for an aortic aneurysm.



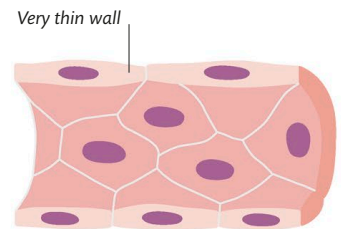
Structure of an artery

Arteries have thick, muscular walls to withstand the high pressure of blood pumped from the heart. Arteries can dilate or constrict to help regulate blood pressure.



Structure of a vein

Veins have relatively thin, stretchy walls so that they can cope with any increases in blood flow. Large veins contain one-way valves to prevent backflow of blood.



Structure of a capillary

Capillaries are the smallest blood vessels. They have walls only one cell thick to allow oxygen, nutrients, and wastes to pass into and out of the blood easily.

Measuring blood pressure

The pressure of blood in your arteries as your heart beats can reveal how well your heart and blood vessels are working and show any signs of high blood pressure, or hypertension. Hypertension over a sustained period can lead to potentially serious health problems.

Systole

The ventricles contract, forcing blood into the pulmonary arteries and aorta. The blood pulses at high pressure through these blood vessels to the lungs and body tissues, respectively.

The heart pumps about 10½ pints (6 liters) around the body once every minute

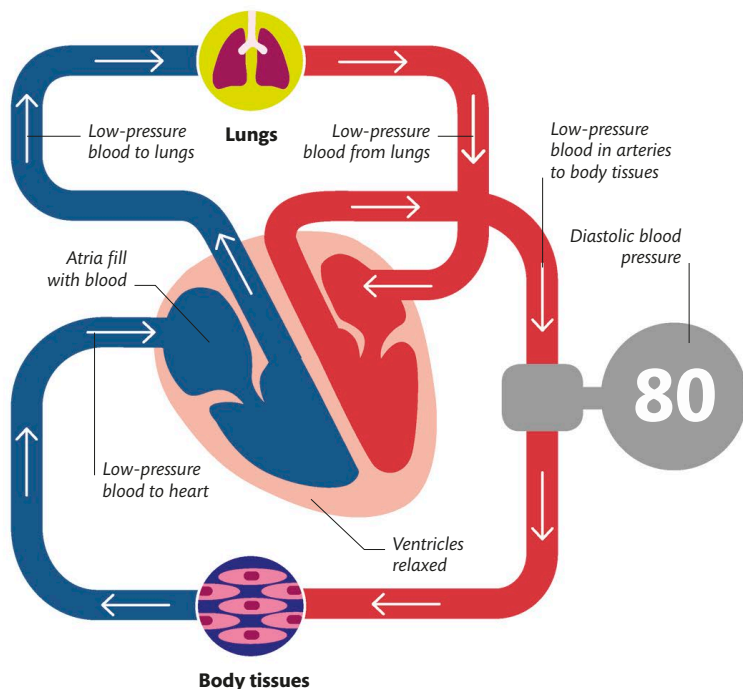
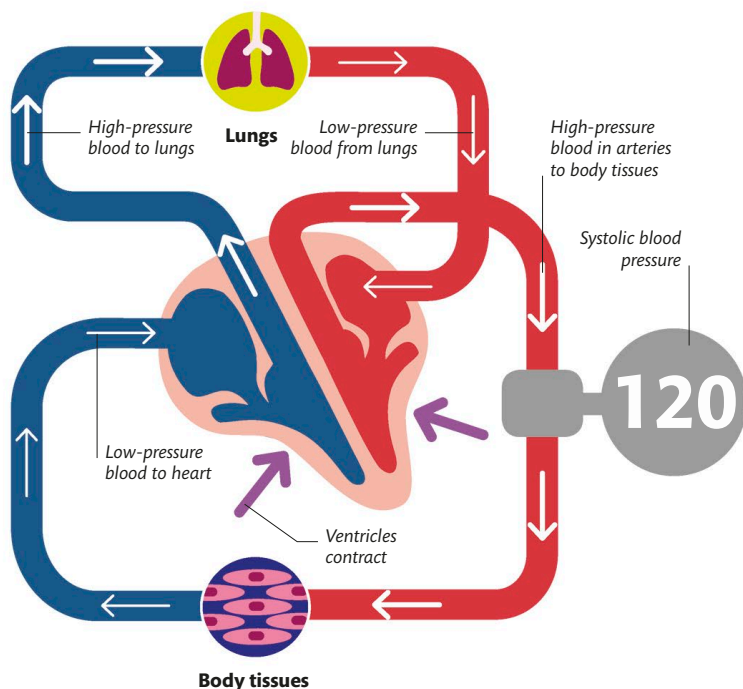


Diastole

The heart muscle relaxes and the atria fill with blood from the veins. The blood then passes from the atria into the ventricles. Blood is not being pumped out of the heart so blood pressure is lower.

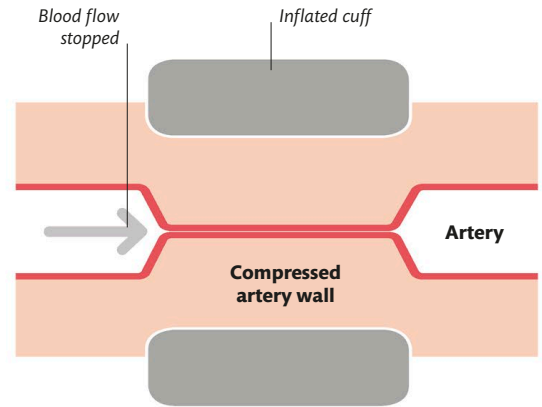
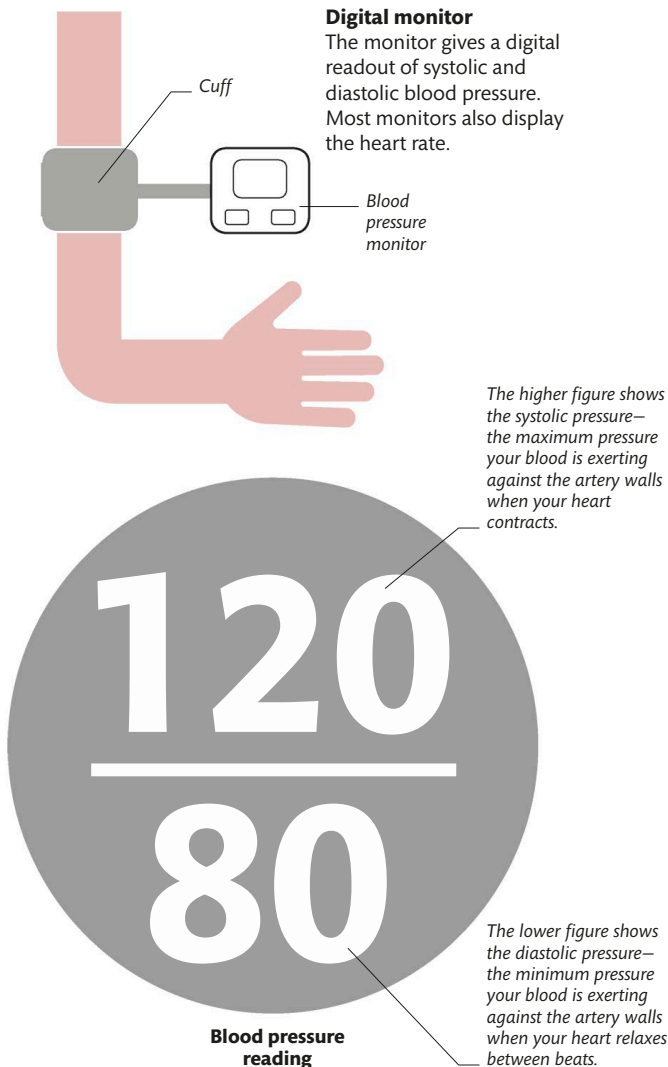
What happens when the heart beats

Each time the heart beats, the arteries pulse with blood so the pressure inside them rises and falls in waves. Each heartbeat is triggered by a signal from the heart's natural pacemaker. When the ventricles (lower chambers) contract—systole—blood is forced out of the heart. This is followed by diastole, when the heart muscle relaxes ready for the next beat.

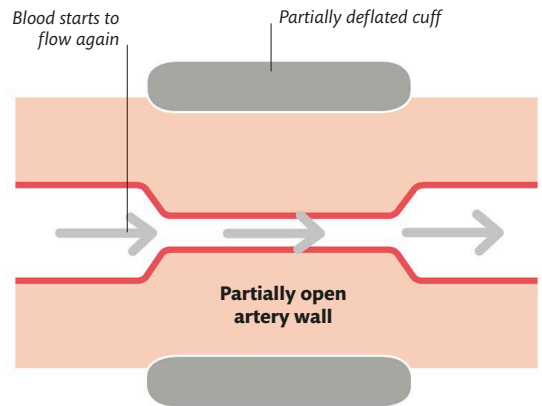


Blood pressure measurement

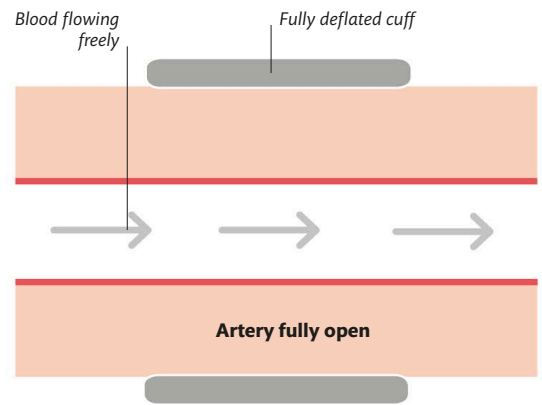
Blood pressure is measured with a device called a sphygmomanometer, consisting of an inflatable cuff and a monitor. The doctor fits the cuff around your upper arm. The cuff is connected with a tube to a pump to inflate it, and to a digital monitor to measure the blood pressure and display the reading. When you are sitting comfortably, with your forearm resting on a flat surface, air is pumped into the cuff. You may feel a slightly uncomfortable squeezing. The air is then slowly released, and the monitor automatically measures the maximum (systolic) and minimum (diastolic) pressure.



1 The cuff is inflated



2 Systolic pressure measured

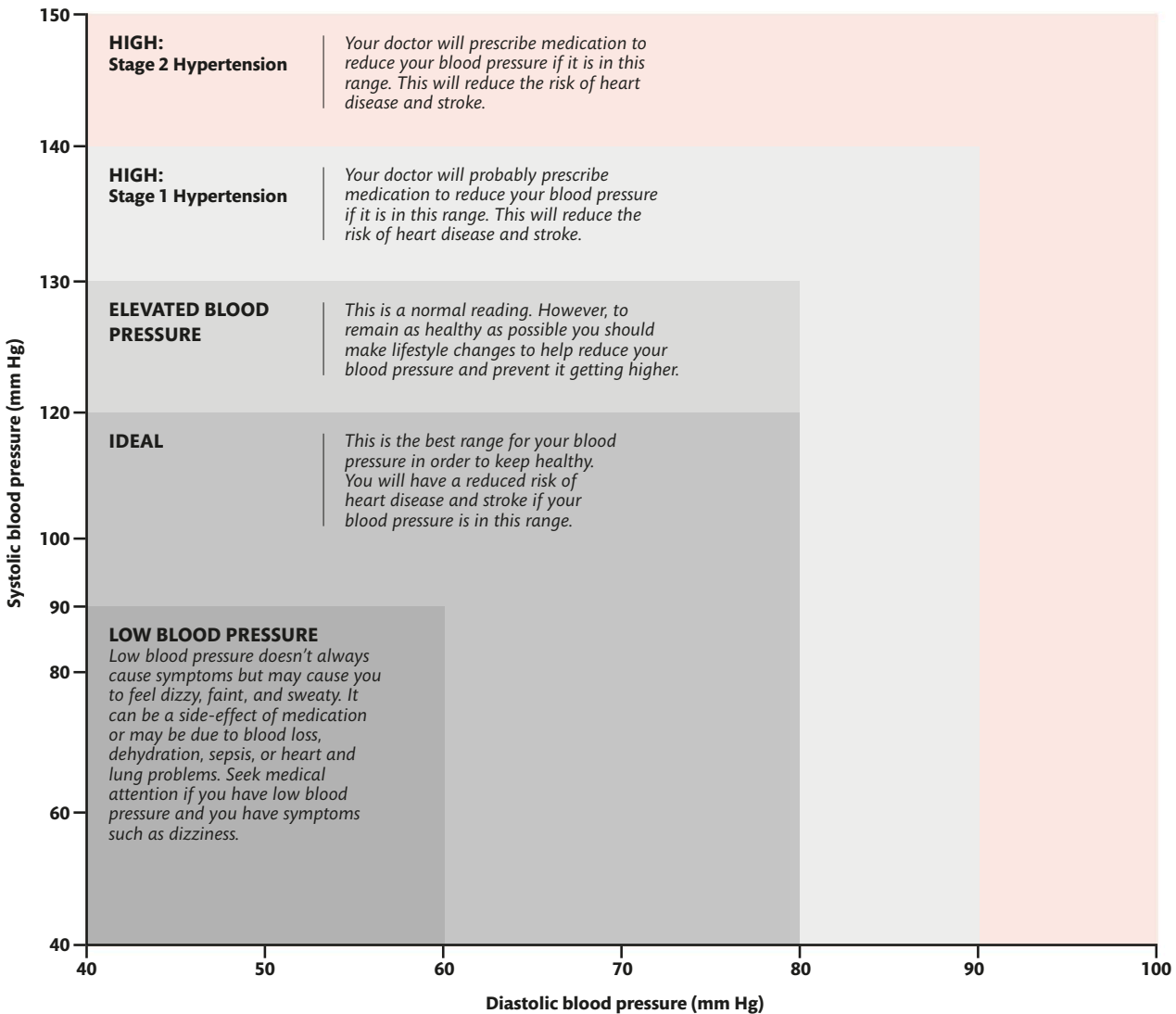


3 Diastolic pressure measured

What your blood pressure reading means

High blood pressure—also known as hypertension—is a long-term medical condition that can lead to cardiovascular disease. However, this “silent killer” is both preventable and treatable. Along with other lifestyle choices, what we eat and drink can have a direct effect on our blood pressure.

Blood pressure at rest
Your blood pressure may go up when you exercise or rush around. It then settles when you are at rest and this is when you should measure it.

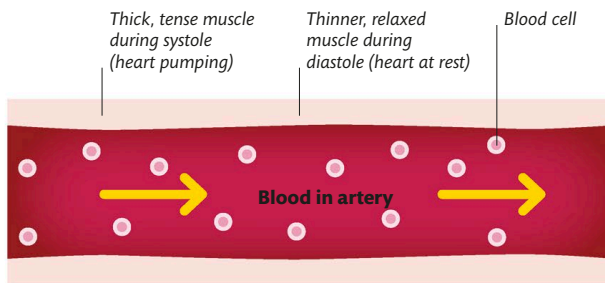


Interpreting your results

Your blood pressure is written as two numbers, such as 140/90 (see pp.28–29). When only one of these figures is high and the other one is normal, you should use the high one to determine which blood pressure category (see opposite) you are in. Don't rely on a single reading; you should monitor it twice a day for at least a week. See your doctor if your home readings are consistently elevated. Seek immediate medical care if your blood pressure is much higher than your normal readings or if you have chest pain, severe headache, dizziness, or blurry vision.

Why is high blood pressure dangerous?

Although there are rarely any symptoms of high blood pressure, if it is left untreated the heart gradually becomes enlarged and less efficient. Slowly, the blood vessels, kidneys, eyes, and other parts of the body can become damaged. As blood pressure goes up, artery walls become thicker and stronger and arteries become narrower, threatening to slow or even stop blood flow. This increases the risk of heart attack.



NORMAL BLOOD PRESSURE

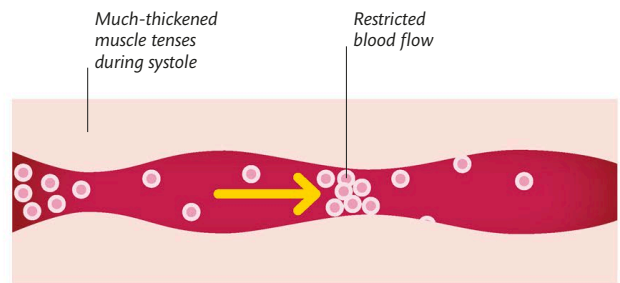
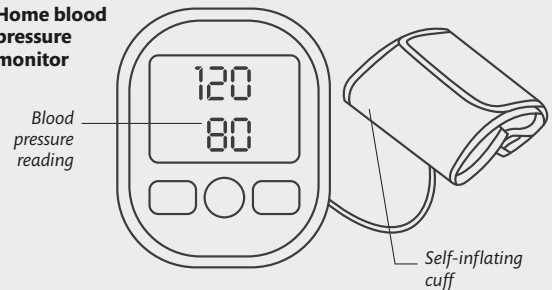
Healthy arteries

A normal blood pressure changes from a high, as the heart pumps, to a low, when it relaxes. The muscles in our artery walls respond to these fluctuations by tensing and relaxing in rhythm.

SELF-MONITORING

Taking your own blood pressure using a home monitor has become very popular. You can purchase reliable machines from stores or online. Home blood pressure machines usually have a standard upper arm cuff, but there are wrist cuff monitors available, though they may give a slightly higher and less accurate reading. Home monitors are not suitable if you have an irregular pulse.

Home blood pressure monitor



CHRONIC HIGH BLOOD PRESSURE

Narrowing arteries

If your blood pressure is high, your arteries have to work harder to resist the pressure, so their walls become stronger and thicker. As your arteries get narrower, blood pressure rises further.

Worldwide, the number of people with uncontrolled hypertension is estimated to exceed 1 billion



SELF-HELP MEASURES



Diet

▶ Eat a high-fiber diet low in fat, salt, and sugar

▶ pp.146–149



Alcohol

▶ Reduce alcohol intake

▶ p.150



Physical activity

▶ Engage in regular aerobic exercise

▶ pp.152–153

Checking your heart rate

Your heart rate—also known as your pulse rate—is the number of times your heart beats per minute. The rate varies from person to person, and also according to a wide range of other factors, such as level of activity, stress, emotion, age, and substances such as caffeine.

Although there are considerable variations in heart rate, in general, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness, with an associated reduced risk of a heart attack.

Measuring the heart rate

Your doctor may measure your heart rate at the same time as measuring your blood pressure with an automatic blood pressure monitor (see pp.28–29).

Your heart rate varies according to how much physical activity you have been doing. To get the most accurate reading, it should be measured after you have been at rest for at least five minutes. This is known as your resting heart rate. To improve the accuracy of the measurements, it is important that the readings are taken before you’ve taken any stimulants, such as caffeine, or medication. You should also try to ensure that the readings are taken at the same time of day.

SELF-MONITORING

Personal fitness monitors allow you to automatically keep track of your heart rate at any time. They record your heart rate at rest as well as during exercise and work. They can be used for fitness training but the records can also be sent to your doctor for monitoring of your heart rate.

You can also measure it yourself (see panel, above), using a personal heart rate monitor, many types of wrist fitness tracker monitors and smart watches, or simply by counting your pulse rate. Your pulse can be felt in your neck or wrist and should be taken using two fingers.

What the results might mean

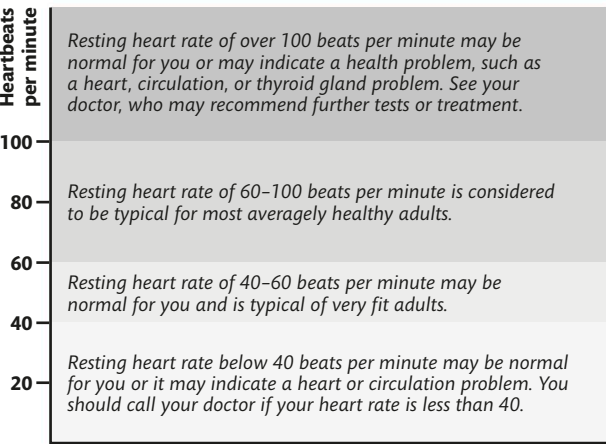
You can get a more accurate picture if you average several readings. Although it can be normal for you to have a pulse rate outside the typical range for healthy adults, it is important to call your doctor if you feel dizzy, weak, or lightheaded to decide if you should be seen more urgently. If you have chest pain, seek immediate medical help.

Assessing your heart rate

Your heart usually beats in a regular rhythm. An irregular pulse can be caused by a medical problem, anxiety, or be the result of having too much caffeine. If you have an irregular pulse and it persists, you should see a doctor.

SELF-HELP MEASURES

 Diet	▶ Eat a healthy low-salt, low-caffeine, low-sugar, and high-fiber diet	▶ pp.146–149
 Smoking	▶ Stop smoking	▶ p.151
 Physical activity	▶ Regular exercise to stay fit	▶ pp.152–153
 Stress	▶ Try to reduce stress levels	▶ pp.164–165



Checking your neck pulse

Your neck pulse can be checked by placing two fingers on your neck to the side of your windpipe below your jaw. Press gently and count for one minute.

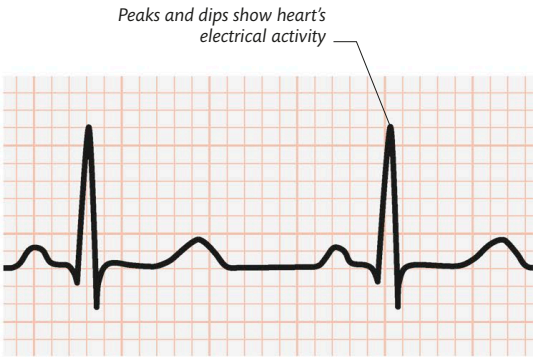


Measuring your heart's rhythm

Your heart has a natural electrical circuit that is continually active. This electrical activity starts in the upper right chamber and travels along a conducting pathway to the lower chambers, causing the heart to pump and creating your heartbeat. Although it is not possible to visualize the electrical circuit directly, the electrical pattern can be visualized on an electrocardiogram (ECG or EKG).

What the test involves

An ECG can be used to diagnose a possible cause for symptoms such as chest pain, dizziness, breathlessness, or palpitations. It can also be taken to check the heart's health prior to an operation or if you have a family history of heart problems at a young age. For the test you will lie down on an examination table. The technician will apply six small sticky pads—called electrodes—to the front of your chest and one to each arm and leg. If you are a woman, you may be asked to remove your bra and wear a gown instead. Occasionally men with very hairy chests will be asked to shave a small area so that the pads can stick to the skin. Wires from the ECG machine will then be clipped to each pad. You will be asked to keep still while the recording is made, which only takes about 30 seconds and is completely painless.



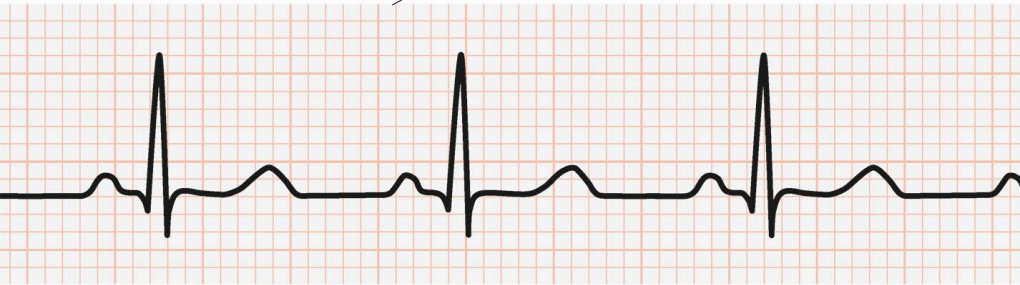
What the results mean

The ECG shows how fast your heart is beating (see pp.32–33) and whether your heartbeat is regular. It may indicate that your heart is healthy and beating normally. However, it may reveal features of a heart attack and can also indicate if you have had a heart attack in the past. Other changes on the ECG may indicate abnormalities in the normal electrical conduction pathway or in the heart muscle, as well as an abnormally fast or slow heart rate. Sometimes, you may be sent for further tests such as an ambulatory ECG or an exercise ECG (see pp.36–37).

SELF-HELP MEASURES			
	Weight	▶ Maintain a healthy body weight	▶ pp.24–25
	Blood pressure	▶ Keep your blood pressure normal	▶ pp.30–31
	Diet	▶ Eat a healthy, balanced diet	▶ pp.146–147
	Smoking/ alcohol	▶ Quit smoking and limit your alcohol intake	▶ pp.150–151
	Physical activity	▶ Exercise regularly	▶ pp.152–153

SELF-MONITORING
It is possible for you to do a mini-ECG recording yourself using some of the latest smart watches or specific handheld devices. These are linked to an app on your cell phone. They produce an ECG tracing from a section of your ECG. The tracings are particularly useful if you have palpitations or there are concerns that you have an irregular heartbeat, because an ECG record can then be done at the exact time the symptoms occur and may help diagnose conditions such as atrial fibrillation.

Graph paper allows exact measurements to be taken



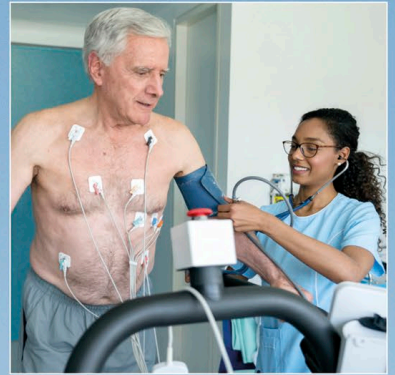
Normal ECG

The ECG is a series of tracings printed onto graph paper that give a graphical representation of the electrical activity of your heart at that particular time. This image shows a tracing from one section of an ECG of a person with a normal heartbeat.

Undergoing an ECG

A resting ECG is taken while you lie comfortably on your back, with the electrodes that take the measurements attached to your skin.





Blood pressure

An exercise ECG is usually done on a treadmill. Before and during the test your heart rate and blood pressure will also be measured.

Increased workload

When you exercise, your heart works harder to get oxygen to your muscles.

Exercise electrocardiogram

An exercise electrocardiogram (ECG) is a graphical recording of the electrical activity of your heart while you exercise. Exercise causes your heart to beat faster, and this test can see how your heart copes with the increased workload.

What to expect from the test

This test detects changes in the heart's electrical activity that may only become apparent when your heart speeds up, such as during exercise or when under stress. For this reason, it is also known as a stress test. It can be used to find a cause for symptoms such as breathlessness, chest pain, or palpitations that occur when you exert yourself. This test is usually only recommended if your doctor is concerned about your heart. It is also used to check your heart after a heart attack or heart procedure.

This test requires you to walk on a moving treadmill that gradually gets faster and steeper over about 10 minutes. Occasionally, you may be asked to pedal a stationary bike instead. You will be connected to an ECG machine via sticky pads on your chest and also have your blood pressure and heart rate monitored. It is not a competition and the test will be stopped if you complain of chest pain, shortness of breath, feel unwell, or if there are certain changes on

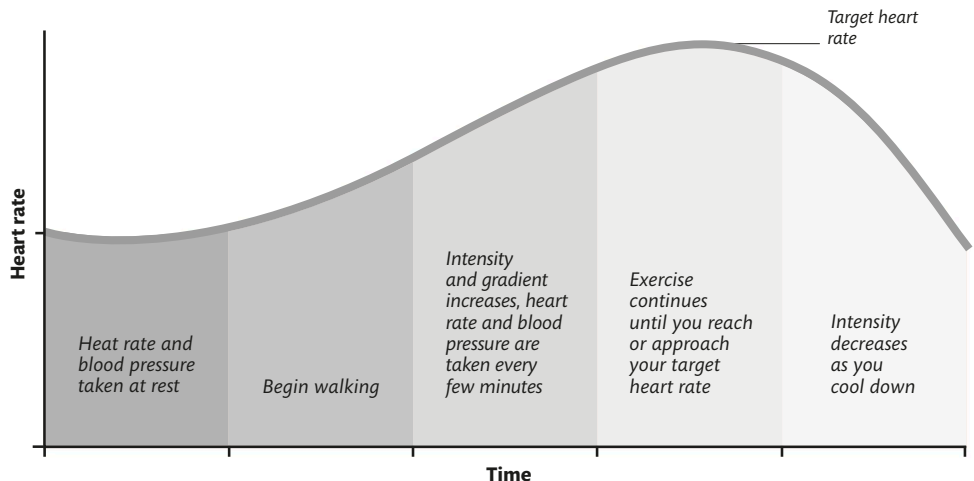
your ECG tracing. If you are not able to do the exercise required, there are other tests, such as a nuclear scan, which can provide similar information to the exercise ECG.

What the results mean

Your exercise ECG tracing may be normal, which can be very reassuring for you. However, it may also show changes that suggest you may have reduced blood flow to your heart muscle. This can be due to narrowing in the arteries supplying your heart. In this case, your doctor will recommend that you have further tests to look at these blood vessels in more detail.

Reaching your target heart rate

During an exercise ECG, the intensity of the activity will increase until you reach a target heart rate set by your doctor. This may be 85% of your maximum heart rate. Once you've reached your target heart rate, the intensity is gradually decreased so that you cool down, rather than stopping abruptly.

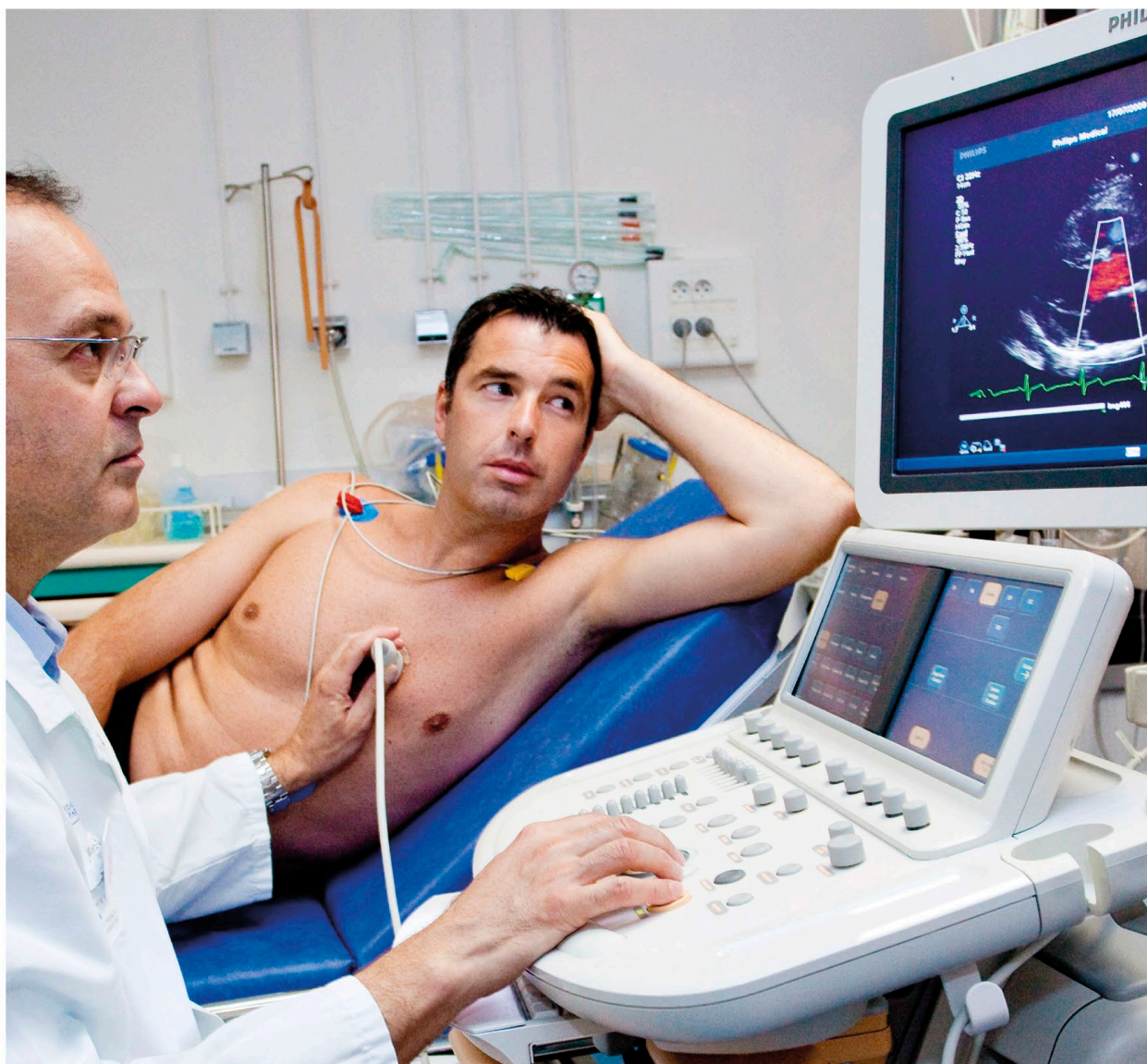


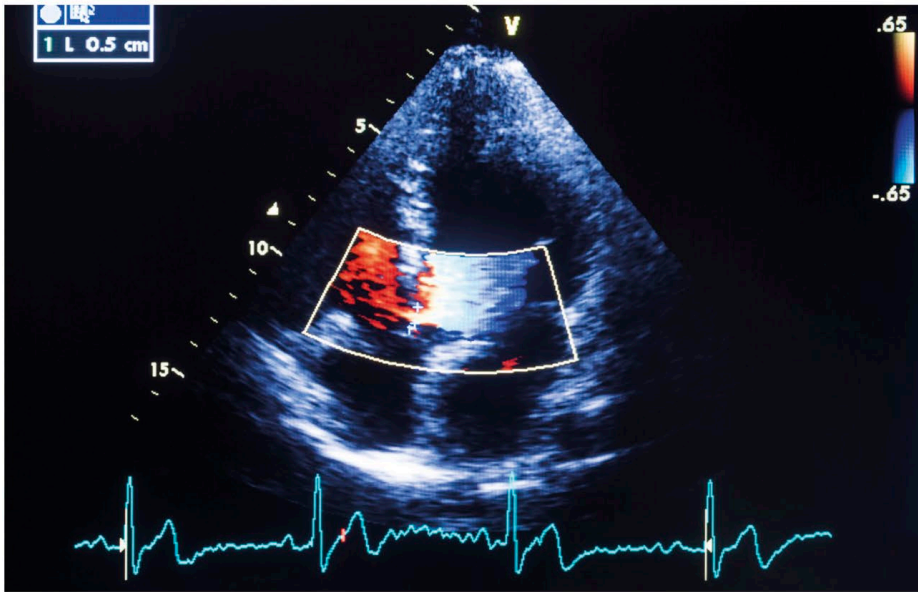
Echocardiography

An echocardiogram is a heart scan that uses sound waves to create images of your heart on a screen. This is an excellent way for your doctor to assess the size of your heart, how efficiently it is pumping, and whether the valves are leaking or have thickened.

Heart scan

A technician places a probe on the chest of a person having an echocardiogram and Doppler scan. The additional electrodes, attached to his chest, measure his heartbeat.





Doppler scan

An echocardiogram shows the four chambers of the heart, while the blue and red colors are the result of the Doppler ultrasound scan. This shows the flow of blood through the heart.

What the test involves

You may be sent for an echocardiogram if you complain of breathlessness or chest pain or have been found to have a heart murmur or high blood pressure. You may also have one after a heart attack to see if your heart muscle is damaged.

The most common type of echo is called a transthoracic scan. A small probe, which transmits sound waves, will be placed on various areas of your chest wall. It is painless, but you may feel some pressure. You will be asked to remove

your top clothes and will be given a gown to wear if necessary. The echo is performed while you are lying on a bed on your left side. The room lights will be dimmed so that the screen can be easily seen.

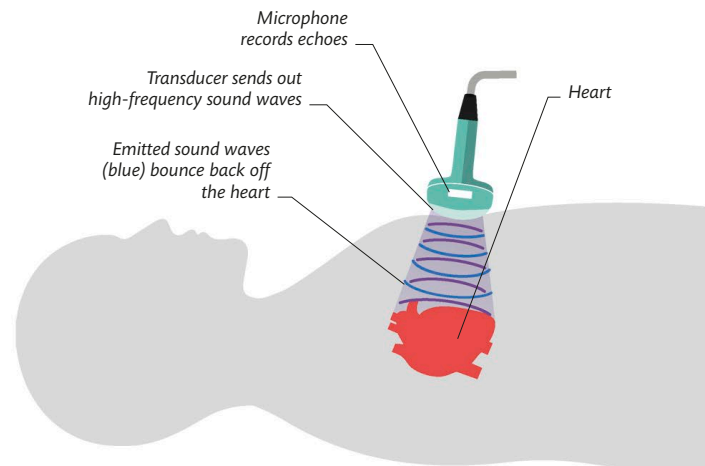
The virtual moving picture of the inside of your heart will show the heart's general structure, the valves opening and closing, and the heart muscle moving. At the same time, a Doppler scan is done, which shows the speed and direction of blood flowing through your heart.

What the results might mean

The echo may show your heart is normal, which is very reassuring. It may also help diagnose heart failure, valve problems, and heart muscle disorders. Following the echo you may be started on medication or be referred for further tests that may lead to heart surgery, depending on the abnormality found.

Sonic picture

An ultrasound scan is made with high-frequency sound waves. The sound waves bounce off solid substances, such as organs or bone, and the returning echoes are processed by a computer to generate an image.



Abdominal aortic aneurysm scan

The aorta is the main blood vessel that carries oxygen-rich blood from your heart to the rest of your body. As you get older, the wall of your aorta can weaken and swell. This bulge is called an aneurysm. It is more common in the part of the aorta situated in the abdomen.

What the test involves

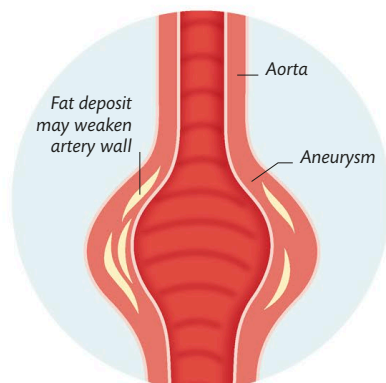
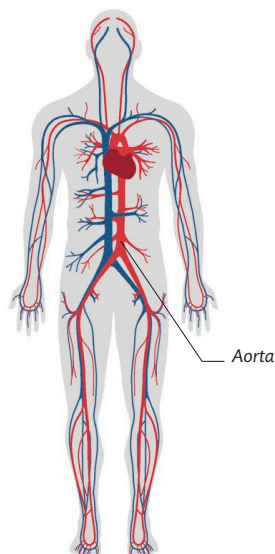
You are more likely to have an aneurysm if you are male and you smoke and have high blood pressure or high cholesterol. Sometimes there may be a history of an aneurysm in a close relative. You may be unaware that you have an aneurysm as it rarely causes symptoms until it ruptures. A ruptured aneurysm is a medical emergency as it causes severe internal bleeding and is often fatal, so early detection can be life-saving. You may be offered a scan if you are at increased risk—for example, if you are a man over age 65.

The ultrasound scan will involve you lying on a bed with your top clothes pulled up. Some gel will be put on your abdomen

and a probe that transmits the sound waves is placed on it. Images of your aorta will appear on a screen and the width of it will be measured to check for an aneurysm.

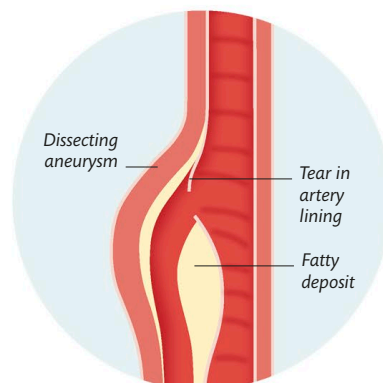
What the results might mean

You will usually be given your results right away. It is very reassuring if your scan shows that your aorta is normal and you will not need further scans. However, if a small aneurysm is found then you will be called back for regular repeat scans, as aneurysms usually get larger over time. If an aneurysm reaches 2¼ in (5.5 cm) then it is more likely that you will be considered for surgery as the risk of rupture is significant once it is larger than this.



Common aneurysm

Blood pressure in the aorta can cause a weakened area of the artery wall to bulge. The bulge will continue to grow and has the potential to burst, which is often fatal.



Dissecting aneurysm

A dissecting aneurysm occurs when there is a tear in the inner wall of the artery. Blood seeps into the artery wall, causing it to swell and the wall to thin. This is a medical emergency.



Detecting an aneurysm
A technician will use a probe, called a transducer, to bounce sound waves off your aorta. This echo information is then used to create an image of the aorta on a computer screen.

TABLE OF RESULTS	
Diameter of aorta	What this means
Less than 1¼ in (3 cm) across	This is normal and no aneurysm is detected
1¼–1¾ in across (3–4.4 cm)	Small aneurysm; manage size through lifestyle changes
1¾–2¼ in across (4.5–5.4 cm)	Medium aneurysm; manage size through lifestyle changes; could require surgery
Over 2¼ in (5.5 cm) across	Large aneurysm; likely to require surgery to prevent rupture

SELF-HELP MEASURES			
	Blood pressure	➤ Maintain a normal blood pressure	➤ pp.30–31
	Diet	➤ Cut out saturated fat from your diet	➤ pp.146–149
	Smoking	➤ Stop smoking	➤ p.151
	Exercise	➤ Keep physically active	➤ pp.152–153

How breathing works

Breathing is the process by which the body takes in oxygen, which cells use to generate energy from food. There are two main elements: ventilation—the movements of the chest (inhalation and exhalation)—and gas exchange—the transfer of oxygen and carbon dioxide inside your lungs.

The breathing process

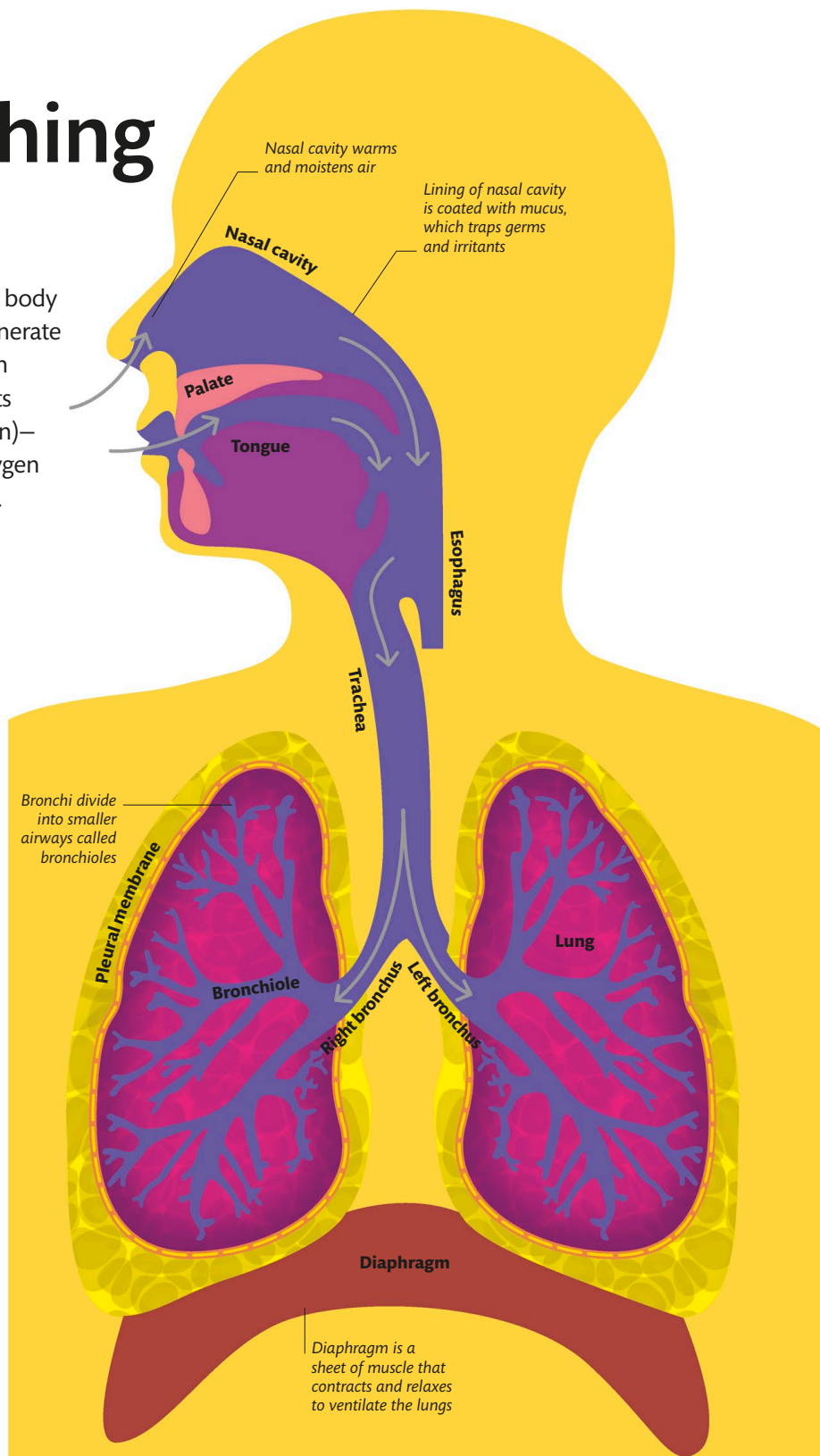
The action of breathing muscles draws air in through the nose, mouth, or both. The air passes down the trachea (windpipe) into the two bronchi (the main airways into the lungs). From here, it passes through smaller airways until it reaches tiny pouches called alveoli. Here, oxygen passes into the bloodstream, which carries it to the heart and then to the body tissues. Blood that has released its oxygen is returned via the heart to the lungs. This low-oxygen blood also releases waste carbon dioxide into the alveoli, from where it is exhaled.

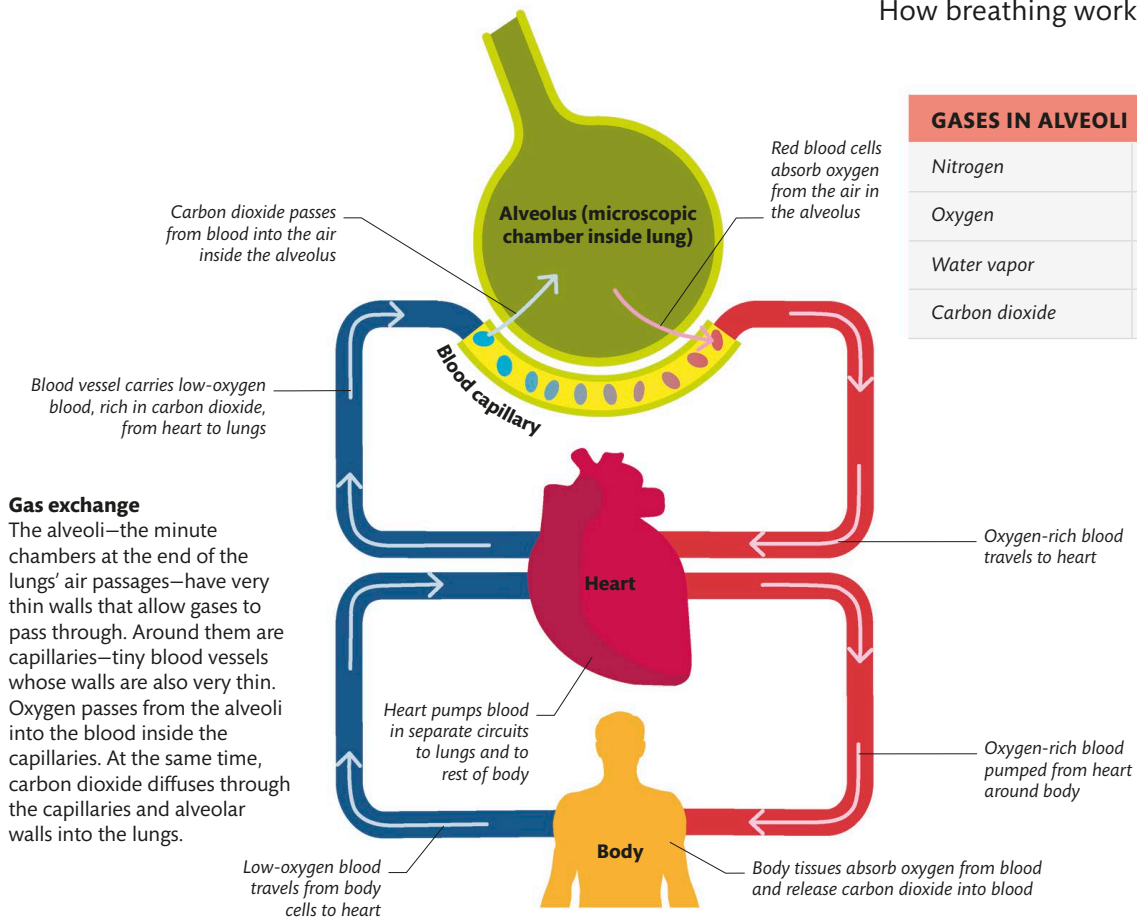
An adult breathes at least 13 pints (7.5 liters) of air per minute



The lungs

The lungs are contained in a slippery, double-layered membrane called the pleural membrane, which allows the lungs to expand freely inside the chest as they are moved by the breathing muscles, principally the diaphragm.



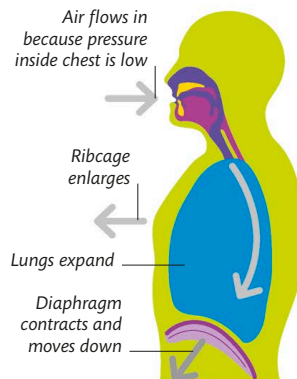


GASES IN ALVEOLI

Nitrogen	74.9%
Oxygen	13.7%
Water vapor	6.2%
Carbon dioxide	5.2%

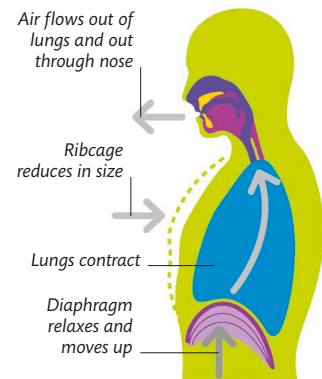
LUNG FUNCTION TESTS

Tests are used to assess how well your lungs and airways are getting oxygen into your body. Chest X-rays (see p.44) show the structures inside your lungs, to reveal any problems such as fluid or air around your lungs. Peak flow tests (see p.45) and spirometry (see pp.46–47) measure how effectively you can breathe in and out, and lung volume tests (see pp.48–49) show how much air your lungs can hold. Pulse oximetry (see p.51) and exercise capacity testing (see p.50) show how much oxygen is reaching your body tissues.



Inhalation

When the diaphragm contracts, it flattens and moves down while muscles between the ribs contract to pull the ribs outward. As the chest and lungs expand, they draw air in through the airways.



Exhalation

The rib muscles relax and the diaphragm becomes more domed as it, too, relaxes, causing the chest and lungs to contract in size. Air in the lungs is pushed out of the body via the airways.

Chest X-ray

A chest X-ray is an image of your chest taken using a small amount of X-ray radiation. It might be ordered by your doctor to check your lungs but can also give information about your heart size, ribs, and other bones. It is a very quick test and easy to do.

What the test involves

Once you have arrived at the clinic or hospital, if you are female, you will be asked if you could be pregnant, since the X-rays could harm a developing baby. If you are not a pregnant woman, you will be taken to a changing cubicle to remove your upper clothing (including an underwire bra or neck jewelry) and to put on a gown. In the X-ray room the radiographer will ask you to stand against the machine and take a breath in. The X-ray picture is taken, but you won't feel anything. The X-ray will be sent to your doctor to explain to you.

A healthy chest X-ray

X-rays pass through less dense tissues, such as lungs, and darken the X-ray-detecting plate. Harder tissues, such as bone and cartilage, absorb X-rays. The darkness in this image indicates the lungs are full of air and healthy. Only the largest air passages, near the heart in the center, are pale, since they are hardened with cartilage.

Having a chest X-ray

Health care professionals position the patient against a screen containing an X-ray-detecting plate. The X-ray generator (out of shot) then shines a beam of X-rays through the patient's tissues, creating an image on the plate.

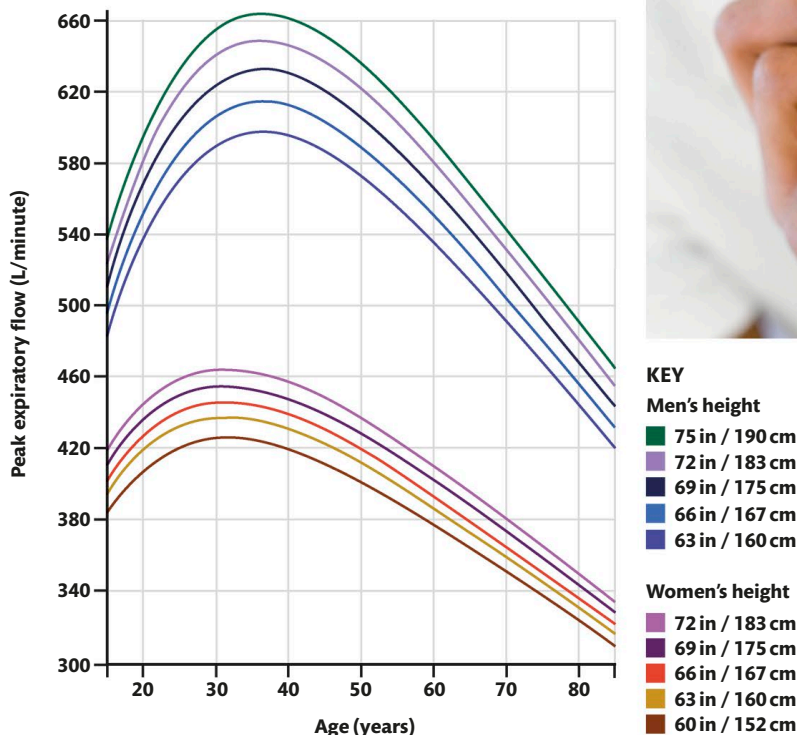


Measuring peak flow

Peak flow, or peak expiratory flow (PEF), is a measurement of the maximum rate at which you can blow air out from your lungs. It is done with a handheld device called a peak flow meter. Your doctor or nurse may ask you to do a peak flow test in order to diagnose or monitor asthma.

What the test involves

The peak flow meter is a hollow device with a scale on the side and a disposable mouthpiece for hygiene. The doctor will ask you to blow as hard as you can into the mouthpiece. This is done three times, and the highest reading is compared to a chart of expected measurements (below) for someone your age, sex, and height. If it is much lower than expected, you might have narrowed airways, and you may be referred for spirometry (see pp.46–47). If asthma is confirmed, sometimes you are given a peak flow meter to monitor your readings at home, to help you recognize when your asthma is not well controlled.



KEY

Men's height

- 75 in / 190 cm
- 72 in / 183 cm
- 69 in / 175 cm
- 66 in / 167 cm
- 63 in / 160 cm

Women's height

- 72 in / 183 cm
- 69 in / 175 cm
- 66 in / 167 cm
- 63 in / 160 cm
- 60 in / 152 cm

Using a peak flow meter

You take a deep breath in. Making sure your lips form a secure seal around the mouthpiece, you then blow into the device as hard as possible.

Predicted values

This graph of "normal" peak flow values was drawn from data from white populations. In estimating your predicted value, your doctor might use values specific to your ethnicity or country. If using a peak flow meter longterm, you might have your own expected values based on your personal best.



Spirometry

Spirometry looks at how fast and how much you can exhale in one breath. It takes two key measurements—the volume of air you can exhale, or “expire,” in the first second of breathing out, and the total volume you can expire. This test can reveal lung problems before symptoms develop.

What the test involves

Spirometry can be used to monitor illnesses and assess your health before an operation. It is also used to diagnose the cause of respiratory problems, such as cough or breathing difficulty, including chronic obstructive pulmonary disease (COPD). If you smoke, you may be advised to stop 24 hours before the test. You may also need to avoid alcohol, exercise, or having a heavy meal a few hours beforehand. If you are on inhaled medication, you may be asked to stop using it before the test. In addition, wear loose clothing that will allow you to breathe freely.

SELF-HELP MEASURES



Weight



Maintain a healthy body weight



pp.146–148



Smoking



Quit smoking



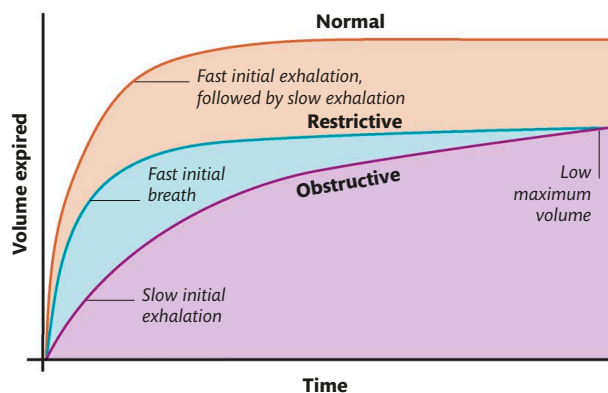
pp.150–151



Globally, COPD is under-diagnosed by up to 93%

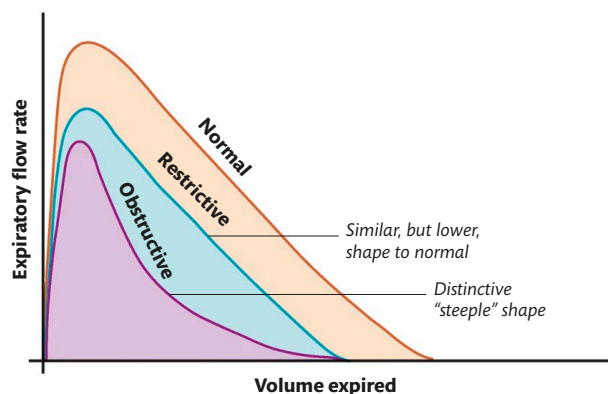
Taking the test

A clip is placed over your nose. The clinician then asks you to exhale as hard and fast as you can three times into a mouthpiece connected to the spirometer. Repetition is needed to get a reliable reading, because the results are dependent on exactly how you exhale. The test may be done again in 15 minutes after a dose of inhaled medication.



Volume curve

Someone with normal lungs breathes out quickly in the first second, then exhalation slows. Someone with a restrictive problem follows the same pattern, but reaches a lower maximum volume. Someone with an obstructive disorder also has a low maximum volume, but breathes out slowly and takes longer to reach that maximum.



Flow-rate curve

Sometimes the clinician will look at the pattern of flow rate during breathing out. The shapes produced help distinguish between restrictive and obstructive disorders.

What the results mean

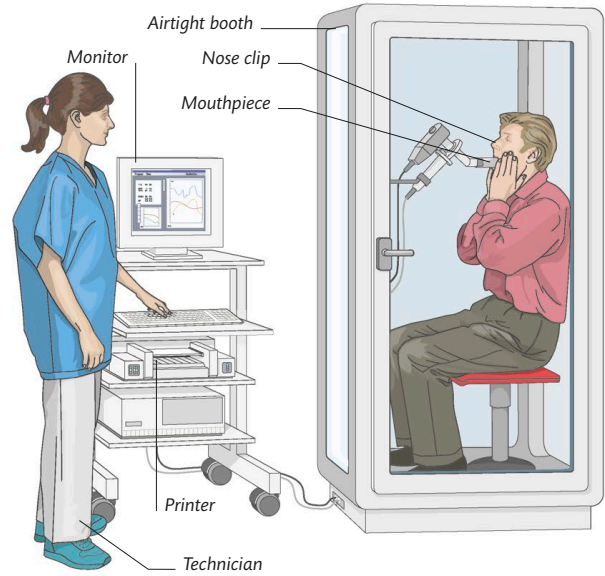
The test measures your breathing rate over the course of one exhalation. Your results are presented as graphs and compared to those predicted for someone of your age, sex, and height. This reveals whether your airways are normal, obstructed, restricted, or a combination. Obstruction could be due to asthma or COPD, which narrow the airways. Inhaled medication often improves the result. Restriction could be due to obesity or kyphoscoliosis—a spine abnormality that prevents the lungs from moving normally.

Lung volume

The most accurate method of measuring lung volume is whole-body plethysmography. Like spirometry (see pp.46–47), it measures the volume of air inhaled and exhaled. However, since the test takes place in a closed box, technicians can determine the volume remaining in the lungs after exhalation, which allows them to calculate total lung capacity (TLC)—the total space inside your lungs that air can occupy.

What the test involves

Whole-body plethysmography takes 3–5 minutes. You sit in a clear booth and a technician supervises you. Pipes are attached to the booth to measure the pressure inside and are connected to a monitor. You are given a mouthpiece and nose clip and are asked to breathe normally, then to pant rapidly while the mouthpiece shutter is closed, and then to breathe as deeply as possible, both in and out. Wear loose, comfortable clothing and avoid smoking for 6 hours beforehand. If you use an inhaler, you may have to stop 6 hours before the test.



Undergoing the test

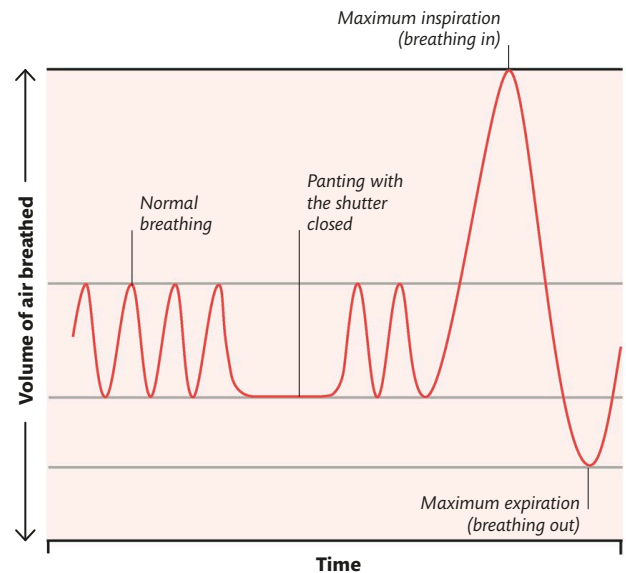
You may be asked to hold your cheeks as you breathe to avoid changes in pressure in the mouth due to blowing the cheeks out. You can open the booth from inside if necessary.

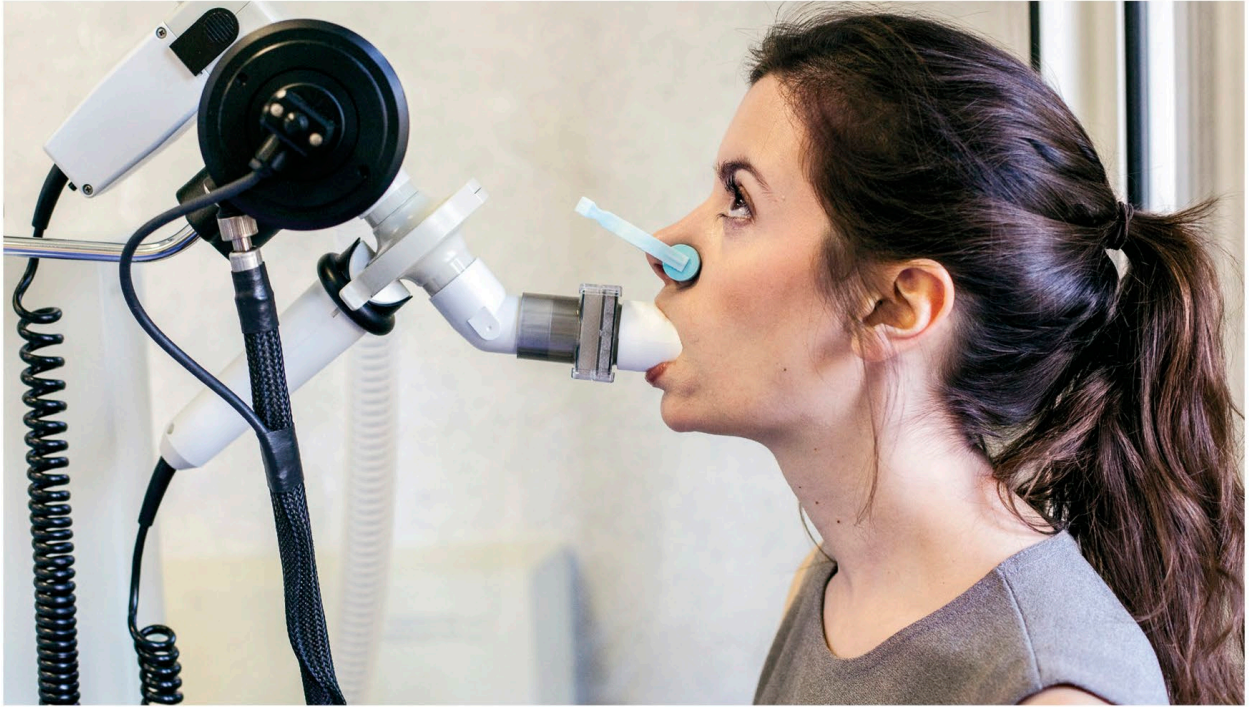
Your residual volume is around 2 pints (1 liter) of “dead air” in your lungs that you cannot exhale



Breathing pattern

This graph shows the pattern of airflow during the test. When you are asked to pant, the mouthpiece shutter is closed. No air flows, but the volume and pressure in your lungs still change. The technicians measure pressure changes in the booth, which allows them to calculate your TLC.





Breathing into a mouthpiece

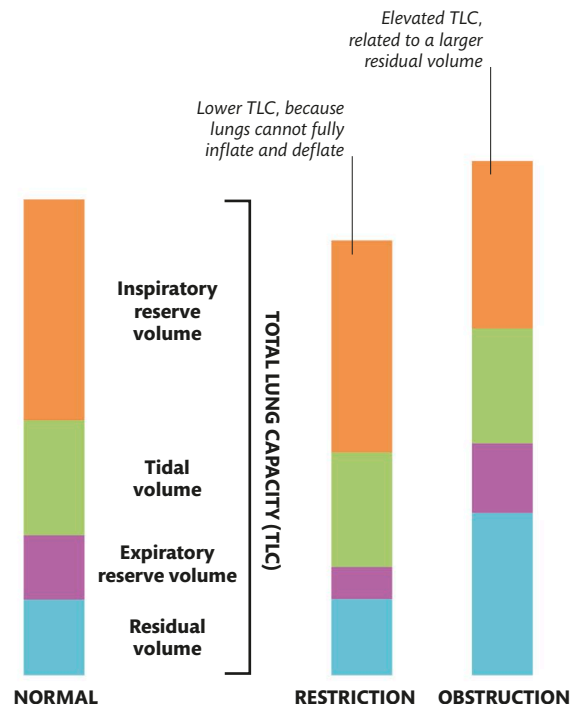
Whole-body plethysmography uses a mouthpiece similar to spirometry (see pp.46–47). The key difference is that you sit inside an airtight booth, which means that volume changes in your lungs can be measured as changes in air pressure within the booth.

What do the results mean?

The test yields several volume figures in addition to TLC. Tidal volume is the amount of air moved during normal breathing. Inspiratory and expiratory reserve volumes are the additional amounts of air moved during forced breathing. The residual volume is the air remaining in the lungs even after maximum expiration. All these measures can be compared to healthy individuals of the same age, ethnicity, sex, and height. This helps diagnose obstructive or restrictive lung disease, or both. Causes of restrictive disease include pulmonary fibrosis and obesity. In obstructive disease, the lungs cannot allow as much air to leave as normal. COPD (chronic obstructive pulmonary disease) and asthma are examples.

Results

Results show four different volume measurements. Each may be of interest, but together they add up to your total lung capacity (TLC).



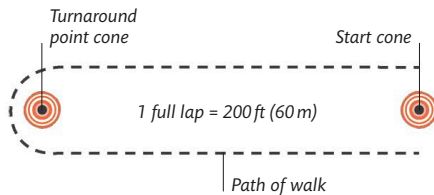
Exercise capacity

Tests are sometimes needed to measure your heart function, lung function, and blood circulation in response to exercise. They are often used before a major operation, especially to your chest and abdomen, or if you have unexplained breathlessness or chest pain and other tests have been normal.



What the test involves

During cardiopulmonary exercise (CPEX) testing, you are instructed to sit on a stationary bicycle. As you pedal, resistance is increased gradually from zero, so that the exercise intensifies. The test can also be done with a treadmill. The results are compared to those expected for someone of your age, sex, and weight. A result lower than expected suggests your fitness is low. This helps your clinician decide whether the proposed surgery is safe. Alternatively, the spirometry, ECG, and oximetry data may identify the cause of your symptoms.



Walking tests

Other forms of exercise capacity tests include the six-minute walk, in which you walk between two cones and your heart rate and oxygen saturation are monitored. In a variation called the shuttle test, you are asked to walk faster each time until you reach your limit.



**If used to
diagnose
disease, CPEX**

**gives an accurate
assessment in
73–90% of cases**

Cardiopulmonary exercise (CPEX) testing

In CPEX testing, you are given a mouthpiece, which measures how much air you breathe (see spirometry, p.47). Chest electrodes record your ECG (see p.37), and an oximeter on your finger (see right) records oxygen saturation.

Blood oxygenation

Pulse oximetry is a painless method of checking how much oxygen is in your blood. The oxygen is attached to the chemical hemoglobin inside red blood cells, which circulate in the bloodstream. The test is performed during a routine examination, or sometimes on arrival at an emergency department.

What the test involves

A plastic device is clipped onto the end of your finger. It shines red and infrared light into your small blood vessels and measures how the light is absorbed, which relates to the oxygen saturation level of the hemoglobin. The result is given as a percentage. The normal range for an adult or child is 95–100 percent. At 94 percent or below, you could have an underlying breathing problem such as asthma, or you could simply be very cold and the tracing is not picking up accurately.



Vital signs

The red light used by oximetry measurement is visible in this portable pulse oximeter, which can be used at your doctor's office or in the home. In the hospital, pulse oximeters are attached to larger "vital signs" machines that also measure heart rate and blood pressure.

TESTING AT HOME

Most people do not need to monitor their blood oxygenation with a pulse oximeter at home. However, some fitness tracker devices and smart watches shine light through the skin to measure oxygen saturation. Some smartphone apps even use light from your phone's camera flash. However, at present, these are not accurate enough to be trusted as medical devices.

"Normal"
reading of
97%
Pulse rate
of 66 beats
per minute

**Portable
pulse
oximeter**



The roles of blood

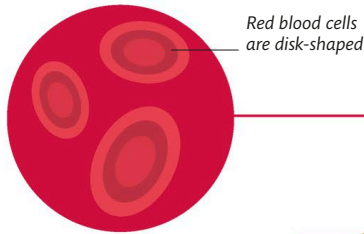
Blood is the fluid that circulates in the blood vessels to carry oxygen, nutrients, and body chemicals to the cells, and to take waste products away for excretion. The blood is also a vital part of our immune system, which defends the body against disease.

What is in blood?

Blood consists of a liquid called plasma, together with blood cells. Red blood cells carry oxygen from the lungs to body cells. White blood cells fight infection. Platelets are cell fragments that form clots to seal wounds. Plasma carries water, hormones, nutrients, and other chemicals to body tissues and removes waste. It also carries vital proteins, such as immunoglobulins (antibodies) that protect the body from infections.

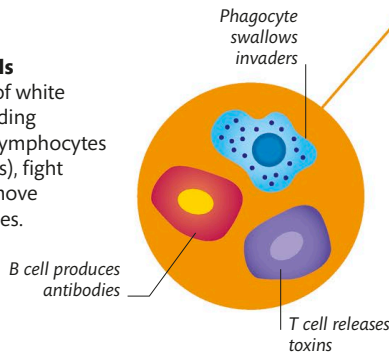
Red blood cells

Red blood cells contain a red pigment called hemoglobin, which picks up oxygen in the lungs and releases it in the body's cells.



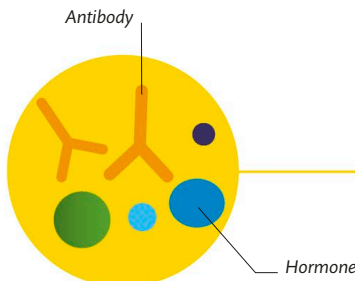
White blood cells

The many types of white blood cells, including phagocytes and lymphocytes (B cells and T cells), fight infection and remove harmful substances.



Plasma

Plasma carries antibodies, hormones and other body chemicals, salts and minerals, and water to body tissues. It also removes waste and excess water.



45% red blood cells

1% white blood cells and platelets

54% plasma

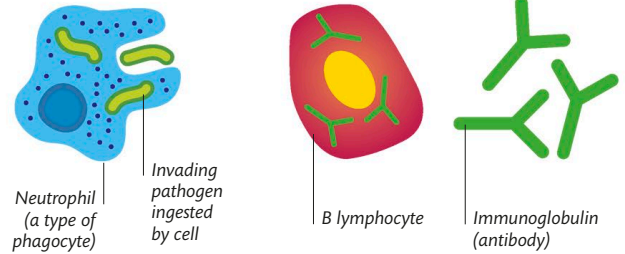


Blood makes up
7–8 percent of
our total body weight

The immune system

White blood cells defend the body against pathogens (bacteria, viruses, or other microorganisms), toxins, and cancer cells. There are several types. Phagocytes kill and ingest infectious organisms and dead cells. B cells produce antibodies to stick to targets and mark them for destruction by other white blood cells. T cells destroy infected and cancerous cells. After an infection, some B and T cells “remember” the invading organism in case of another attack.

In some disorders, however, the immune system overreacts, as in allergies, where it attacks harmless foreign substances, or autoimmune disorders, in which it attacks normal body tissues. Conversely, in immunodeficiency disorders such as AIDS, the system fails to protect the body.

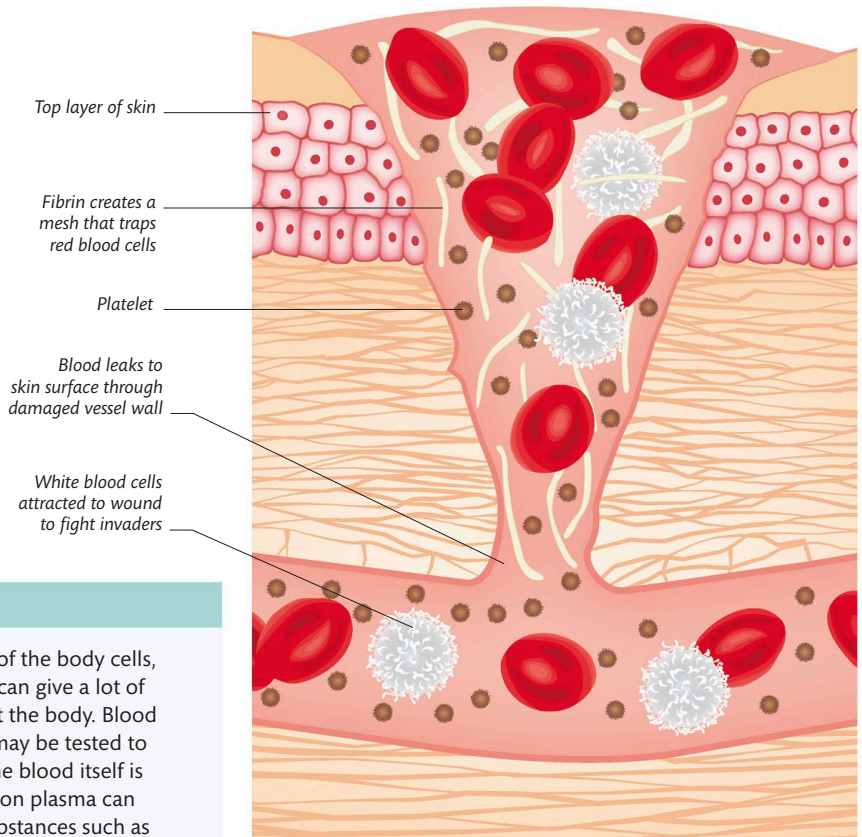


Destroying pathogens

Neutrophils (above), the most common type of white blood cell, ingest pathogens and damaged tissue.

Producing antibodies

B lymphocytes, or B cells, release antibodies into the plasma. Some B cells recognize pathogens if they reenter the body.



BLOOD TESTS

Blood reaches all of the body cells, so tests on blood can give a lot of information about the body. Blood cells and plasma may be tested to assess how well the blood itself is functioning. Tests on plasma can reveal levels of substances such as glucose and cholesterol, and chemicals produced by the kidneys and the liver. Tests on white blood cells and immunoglobulins can reveal problems with the immune system.

Clotting

When a blood vessel is torn, platelets clump around the injury. The platelets and damaged tissues release chemicals that react with proteins in the plasma called clotting factors, causing a mesh of sticky material (fibrin) to form and trap blood cells, creating a clot. Some blood tests measure platelets and clotting factors to detect whether the blood is clotting properly.

Giving a blood sample

Blood tests are useful for investigating a wide range of conditions and are very commonly performed. For example, you may have a blood test to see if you have a problem such as diabetes, thyroid disease, or an infection; to assess your general health; or to check the health of specific organs, such as the kidneys. Blood tests may also be used to monitor conditions and find out if treatment has been successful.

Having a sample taken

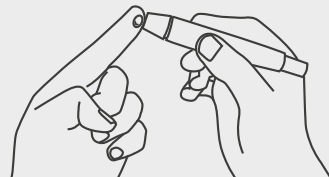
Having a blood test is a simple procedure that takes less than five minutes. A tourniquet or tight band is put around your upper arm, which makes the vein swell so that it is easier for the sample to be taken. You may be asked to clench and unclench your fist. A sterile needle, attached to a syringe or a special vacuum container, is inserted into your vein, and a sample of blood is withdrawn. After the sample has been taken, the tourniquet is released and the

Obtaining a blood sample

A blood sample is usually taken from a vein in your upper arm. If you tend to feel faint at the sight of blood or needles, you should tell the health care professional beforehand so that he or she can try to make you feel more comfortable.

FINGER-PRICK TESTING

A blood sample can be obtained at home using a finger-pricking technique. The blood can then be sent to a laboratory for testing. If you have diabetes, finger-pricking is a common way of obtaining blood for monitoring your blood glucose levels.



needle removed. You will be asked to press on the site with a cotton pad, and a small adhesive dressing may be applied. You may get a small bruise but this will fade within a few days. The sample will be sent to the laboratory for analysis. For some blood tests, you may need to fast beforehand. This means you should not eat or drink anything, apart from water, for 8–12 hours before the test. You may also need to stop taking certain medications; if so, your medical professional will let you know.



Blood count

A complete blood count (CBC) is one of the most common blood tests. It gives information about red blood cells, white blood cells, and platelets.

What does the test involve?

A blood sample is taken, as described opposite, and the sample is analyzed in a laboratory to measure the number of red blood cells, white blood cells, and platelets. Also measured are the size of the red blood cells, the amount of hemoglobin (see pp.52–53) in the red blood cells, and the proportion of blood that comprises red blood cells (known as the hematocrit). If any abnormalities are found, your doctor may recommend further tests to determine the cause or treatment.

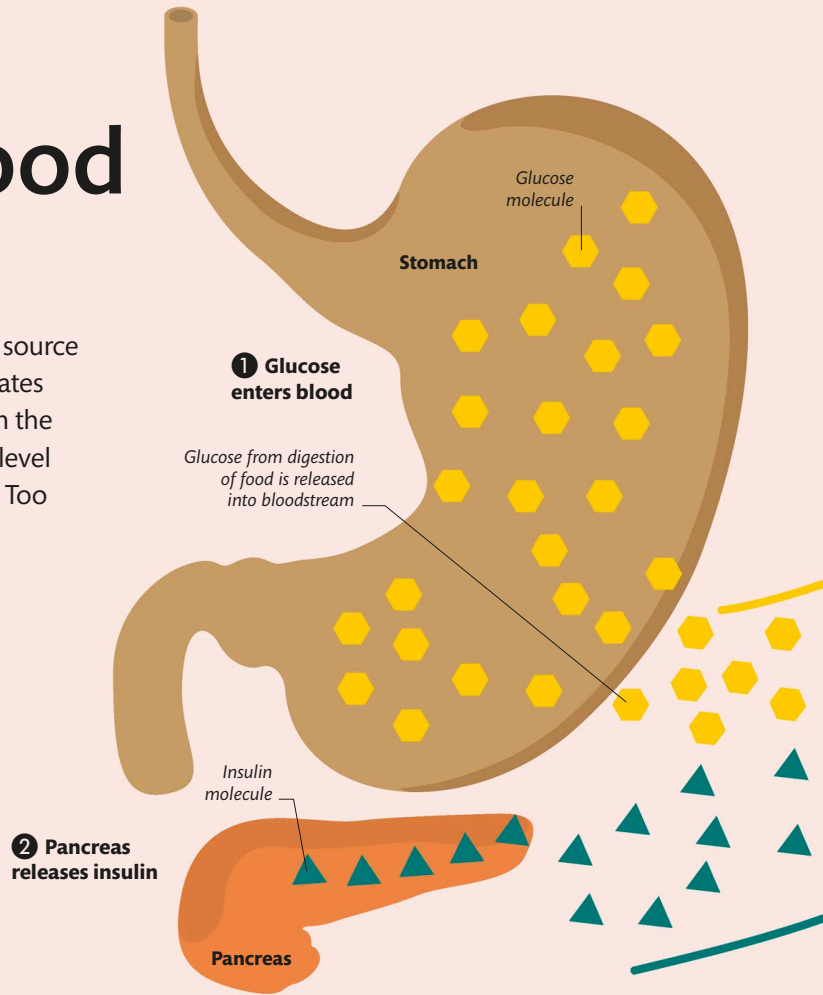
WHAT THE RESULTS MIGHT MEAN		
Test	Result	Possible cause
Red blood cell levels	Low	Too few red blood cells is most commonly due to iron deficiency anemia, which may have various underlying causes, including too little iron in the diet, poor absorption of iron, bleeding, or low levels of folic acid, vitamin B6, or vitamin B12.
	High	A high level of red blood cells is normal in people who live at high altitude. In other cases, it may be due to smoking or various disorders, such as the lung disease chronic obstructive pulmonary disease (COPD), kidney disease, or certain blood cancers; it may also be genetic.
Red blood cell size	Abnormally small	The presence of small red blood cells is known as microcytosis. Possible causes include bleeding, iron deficiency, or some genetic disorders, such as the blood disorder thalassemia.
	Abnormally large	The presence of large red blood cells is termed macrocytosis. Possible causes include thyroid disease, liver disease, or deficiency of vitamin B12.
Hemoglobin level	Low	A low hemoglobin level is a sign of anemia.
	High	A high hemoglobin level is normal for people who live at high altitude. It may also be due to dehydration, smoking, or an underlying disorder, such as cardiovascular or lung disease.
Hematocrit (proportion of red blood cells in blood)	Low	A low hematocrit reading is a sign of anemia.
	High	A high hematocrit reading may be the result of dehydration, or it may be due to an underlying disorder, such as lung disease, heart disease, or certain blood disorders.
White blood cell levels	Low	Low white blood cell levels are normal in some people; in others, possible causes include certain infections, such as HIV; blood disorders, such as leukemia; or certain medications, such as some chemotherapy drugs.
	High	A high white blood cell count is often due to infection. Other possible causes include certain medications, such as corticosteroids; inflammation; severe allergy; stress; and certain blood disorders, such as leukemia.
Platelet levels	Low	Too few platelets is known as thrombocytopenia. Possible causes include bleeding; certain medications, such as some diuretics; some autoimmune disorders; and bone or blood cancers.
	High	Too many platelets is known as thrombocytosis. Possible causes include acute bleeding; inflammation; infection; removal of the spleen; or disorders such as disease of the bone marrow or certain cancers.

Checking blood glucose

Glucose, a type of sugar, is the primary energy source of all body cells. It is obtained from carbohydrates in the diet and is circulated around the body in the blood. Maintaining the correct blood glucose level is essential for proper functioning of the body. Too high a level indicates diabetes.

Blood glucose control

The level of glucose in the blood is kept within normal limits by various hormones. If the level rises too high—after eating, for example—the pancreas releases insulin to lower the level. If the blood glucose level falls too low, other hormones (such as glucagon from the pancreas) can raise the level by mobilizing carbohydrate stores in the body. If your blood glucose is persistently raised, the cause is either insulin resistance (cells become less responsive to insulin) or decreased production of insulin by the pancreas, indicating diabetes.

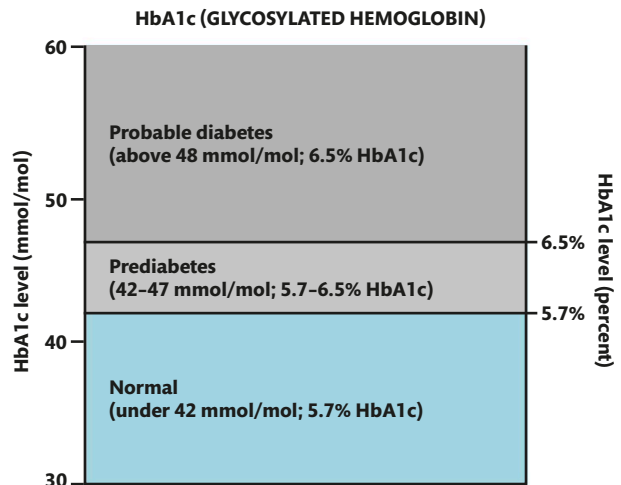


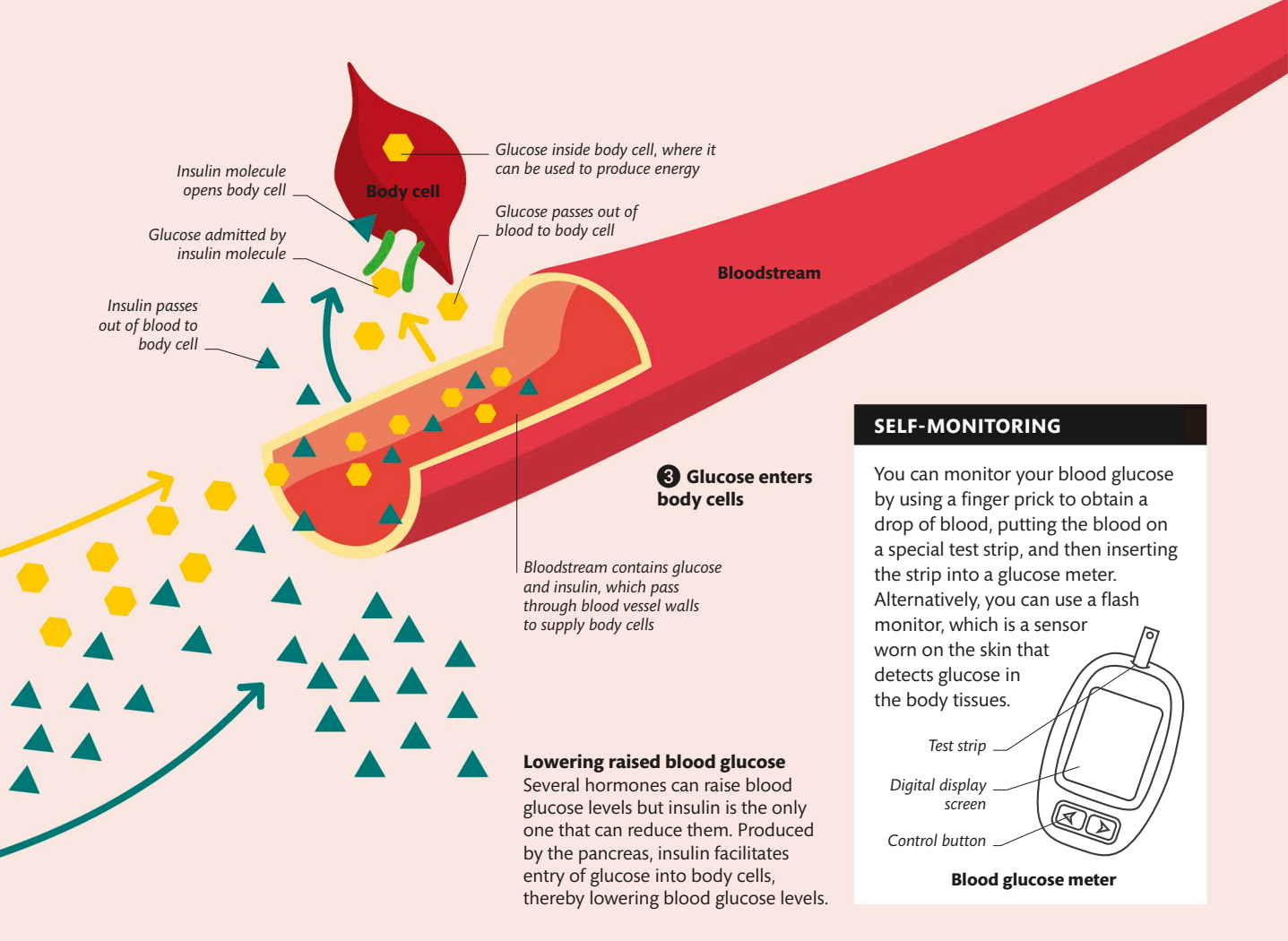
HbA1c test

Also known as the glycosylated hemoglobin test, the HbA1c test provides a measure of your average blood glucose level over the previous few months. In the blood, glucose joins to hemoglobin (the oxygen-carrying component of blood), forming glycosylated hemoglobin, or HbA1c. The level of HbA1c is not significantly affected by recent food intake, so it provides a good overall picture of your longer-term blood glucose levels. The HbA1c test itself simply involves giving a blood sample (see p.54) for analysis.

HbA1c levels

The blood levels of HbA1c may be given in terms of its concentration (mmol/mol) or what percentage of the blood's hemoglobin is in the form of HbA1c. A level under 5.7 percent (42 mmol/mol) is considered normal.



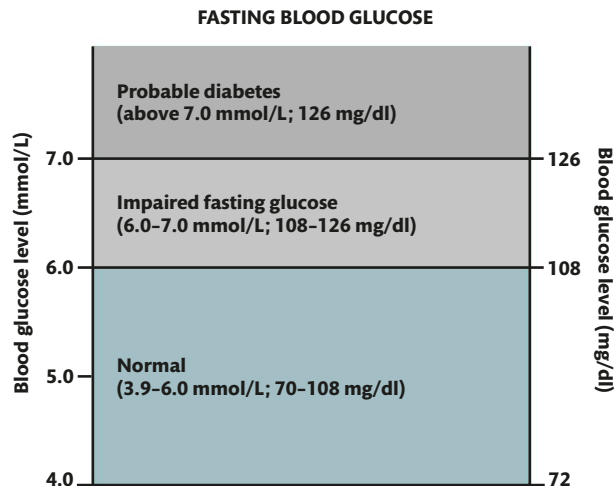


Fasting blood glucose

This test involves checking your blood glucose level after you have not eaten for several hours. It provides an accurate measure of your general blood glucose level because the result is not influenced by anything you may have eaten. You will be instructed not to eat for 8–10 hours before the test and also to avoid drinking anything apart from normal or small amounts of plain water. You can usually continue to take most medications but you should ask your health professional if you are not sure. After the fasting period, a blood sample is taken in the usual way (see p.54) and the amount of glucose in the sample is measured.

Fasting blood glucose levels

The blood glucose level after fasting can indicate whether you have diabetes or impaired fasting glucose (a type of prediabetes).



Checking blood cholesterol

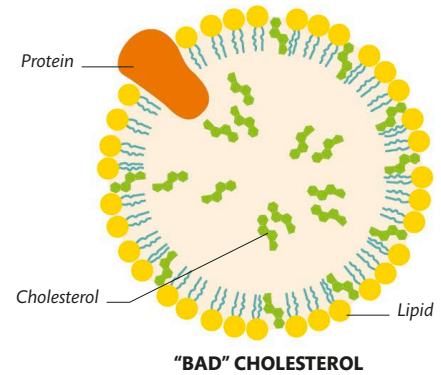
Cholesterol is a fat-like substance carried in the blood. Some cholesterol is vital for normal functioning of the body, but too much of a certain type may increase your risk of developing health problems such as heart disease and stroke.

What does cholesterol do?

Cholesterol plays a vital role in many body functions, such as making hormones, producing bile to help digestion, and keeping cell membranes flexible but firm. About 90 percent of cholesterol in the body is made in the liver; only a small proportion comes from the diet. Cholesterol is carried in your blood attached to proteins, in particles called lipoproteins. There are two main types of these: low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs). Triglycerides are a type of fat in the bloodstream. When you eat more calories (energy) than you need, the excess energy is converted into triglycerides by the liver then stored in body cells. High blood levels of triglycerides are associated with an increased risk of cardiovascular disease, which is why it is important to measure blood levels of triglycerides as well as cholesterol.

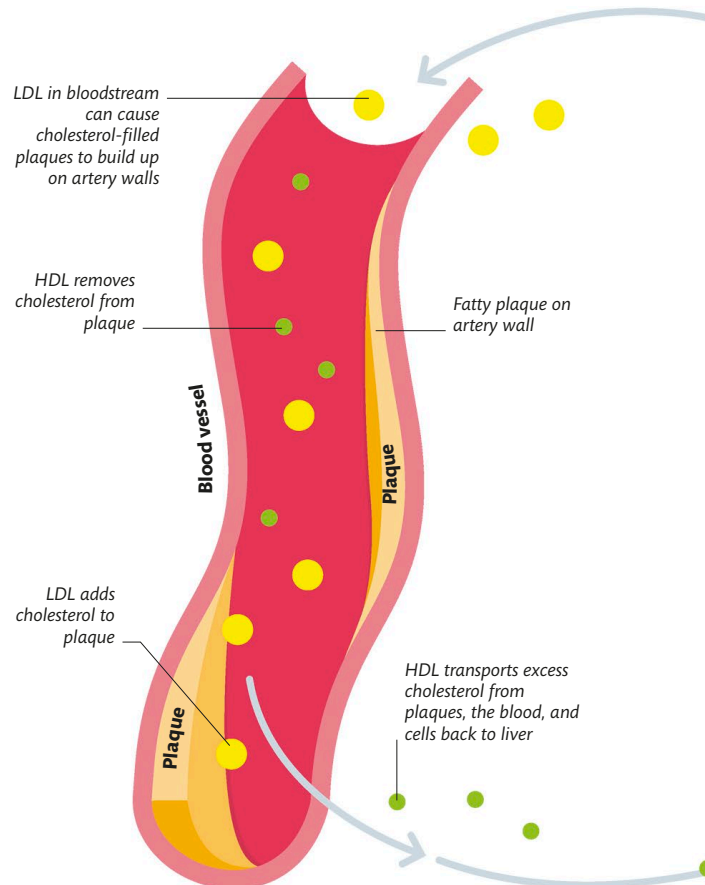
HOME CHOLESTEROL TESTS

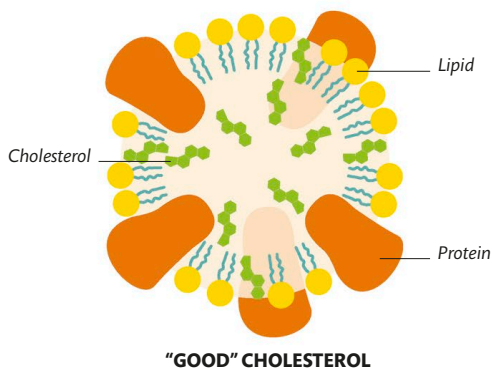
You can check your cholesterol yourself with a home testing kit. This uses a special reactive strip on which you place a drop of blood from a finger prick. The strip is then inserted into an analyzer, which gives the results within a few minutes. As well as the total cholesterol level, some devices also measure HDL, LDL, and triglyceride levels and calculate the HDL to LDL ratio. Alternatively, there are home tests in which you send off the strip or a blood sample to a laboratory for analysis. Some pharmacies also offer blood cholesterol tests. The results should be considered in combination with other risk factors for cardiovascular disease, and appropriate medical advice should be sought.



Low-density lipoprotein (LDL)

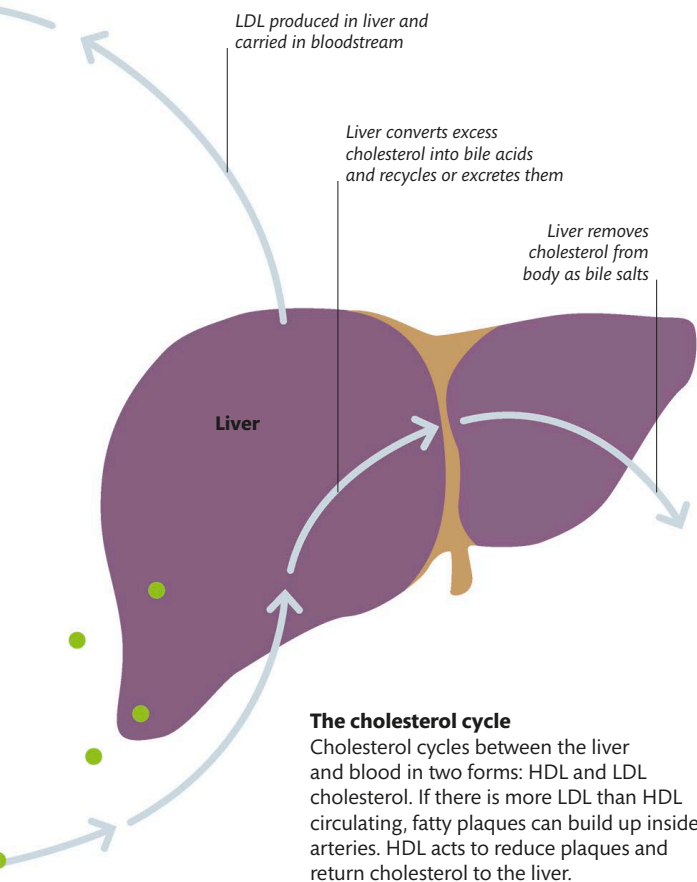
Containing a relatively small amount of protein and large amount of cholesterol, LDL particles carry cholesterol from the liver to the body cells. LDL can deposit cholesterol on artery walls, forming fatty plaques that reduce blood flow, which is why LDL is called "bad" cholesterol.





High-density lipoprotein (HDL)

HDL particles contain relatively more protein and less cholesterol than LDLs. HDL helps to remove cholesterol from fatty plaques on the artery walls and carries the cholesterol to the liver for removal from the body, which is why HDL is known as “good” cholesterol.



The cholesterol cycle

Cholesterol cycles between the liver and blood in two forms: HDL and LDL cholesterol. If there is more LDL than HDL circulating, fatty plaques can build up inside arteries. HDL acts to reduce plaques and return cholesterol to the liver.

Measuring cholesterol levels

Cholesterol levels are measured by analyzing blood obtained from a finger prick or by taking a small sample from a vein in the arm (see p.54). You may sometimes, but not always, be asked to fast for 8–12 hours before the blood sample is taken. If you are asked to fast, you should not eat or drink anything, apart from plain water. You may also be asked to stop taking certain medications; if in doubt, consult your health professional. The blood sample is analyzed for HDL and LDL cholesterol levels, and often also for triglycerides. The HDL and LDL levels enable the total cholesterol and the total to HDL ratio to be calculated. Together, the results give an indication of your cardiovascular health in relation to your blood lipid level.

BLOOD LIPID LEVELS		
Total cholesterol (mg/dl; mmol/L)	Total cholesterol: HDL ratio	Triglyceride (mg/dl; mmol/L)
Unhealthy Above 195 mg/dl (5 mmol/L)	Unhealthy Above 4	Unhealthy Above 205 mg/dl (2.3 mmol/L) (non-fasting blood test) Above 150 mg/dl (1.7 mmol/L) (fasting blood test)
Healthy Below 195 mg/dl (5 mmol/L)	Healthy Below 4, ideally as low as possible	Healthy Below 205 mg/dl (2.3 mmol/L) (non-fasting blood test) Below 150 mg/dl (1.7 mmol/L) (fasting blood test)

REDUCING YOUR CHOLESTEROL LEVEL		
 Weight	➤ Maintain a healthy body weight	➤ pp.146–149
 Alcohol	➤ Limit your alcohol intake	➤ pp.150–151
 Smoking	➤ Quit smoking	➤ pp.150–151
 Exercise	➤ Exercise regularly	➤ pp.152–153

Other blood tests

Blood may be tested for more than 100 different substances. Some tests are carried out only to diagnose specific health problems, while others, such as liver function tests, are widely used for both diagnosis and health checking.

Automated blood testing

Most blood samples are analyzed automatically by machine, which produces quick, accurate results. The results are then evaluated by a medical professional.

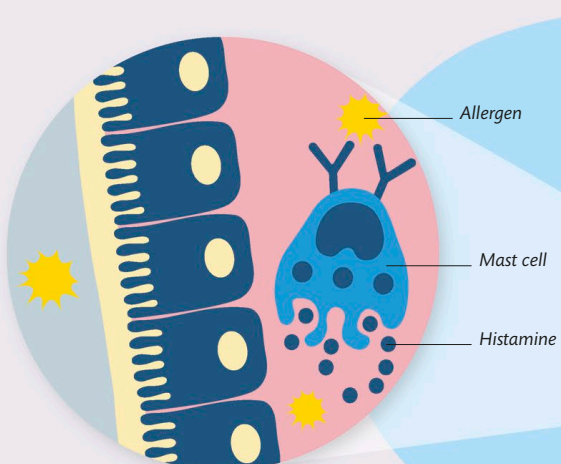


Types of blood tests

As well as checking the levels of blood cells (see p.55) and substances such as glucose (see pp.56–57) and cholesterol (see pp.58–59), blood can be tested for numerous other

substances, including vitamins, minerals, proteins, hormones, enzymes, antibodies, and even certain genes. The table below lists some of the more common tests and what the results may indicate.

Test	What is measured/detected	What the results might mean
Vitamins and minerals	Calcium (an essential mineral)	Abnormal levels of calcium may indicate a health problem, such as parathyroid disease, kidney disease, a bone disorder, or certain cancers.
	Phosphate (an essential mineral)	Abnormal phosphate levels may be due to various health problems, including kidney problems, parathyroid gland problems, excessive vitamin D, or cancer.
	Vitamin B12 and folic acid	Low levels of these substances may indicate anemia, too little dietary intake of the substances, or autoimmune disease; certain medications may also cause low levels.
	Vitamin D	Low levels of this vitamin may be due to various causes, including dietary deficiency, too little exposure to sunlight; impaired kidney function; or certain disorders that impair absorption in the intestine, such as celiac disease.
	Ferritin (a form of iron stored in the body)	Low levels of ferritin usually indicate anemia. High ferritin levels may indicate any of various underlying disorders, such as liver disease, diabetes, or some types of cancer; obesity may also cause high ferritin levels.
Blood clotting	Clotting factors (proteins essential for normal clotting)	Abnormal levels of clotting factors may indicate a disorder, such as liver disease or a bleeding disorder. Clotting factor levels are also used to monitor treatment with some anticoagulant drugs.
Infection and inflammation	The presence of specific antibodies	The presence of an antibody against a specific infection indicates that you have or have had that infection.
	CRP (C-reactive protein, a substance produced in the liver in response to inflammation)	High levels of CRP indicate the presence of inflammation somewhere in the body; however, this does not indicate what part of the body is inflamed.
Thyroid function tests	Levels of thyroid hormones (thyroid-stimulating hormone, thyroxine, triiodothyronine)	Abnormal thyroid hormone levels may indicate that your thyroid gland is overactive (hyperthyroidism) or underactive (hypothyroidism).
Liver function tests	Levels of certain proteins and liver enzymes	Abnormal levels of liver proteins or enzymes may indicate liver injury. See also p.71.
Kidney function tests	Levels of urea (a waste product of protein metabolism), creatinine (a waste product formed in muscles), and electrolytes	Levels of these substances indicate how well your kidneys are working. High levels of any of these substances may indicate kidney injury. See also p.77.
Cancer tests	Prostate-specific antigen (PSA)—a protein associated with prostate problems	High levels of PSA may indicate a prostate problem, such as an enlarged or inflamed prostate or prostate cancer. However, PSA levels may be abnormal without there being an underlying problem.
	CA-125 protein	High CA-125 levels may indicate various reproductive system problems in women, including ovarian cancer and ovarian cysts. However, high levels may also occur normally, during menstruation, for example.
	BRCA1 and BRCA2 genes	The presence of certain versions of these genes is associated with an increased risk of breast and ovarian cancer.

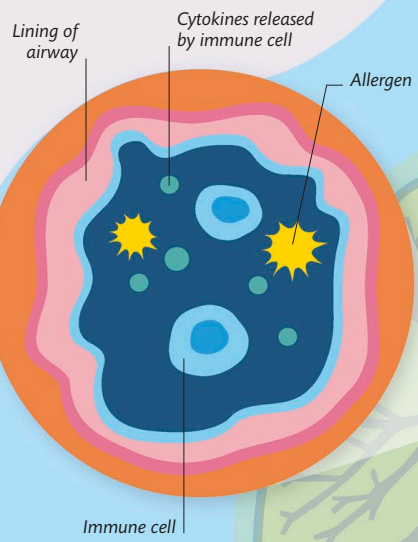


COMMON ALLERGIES

Hay fever (also called allergic rhinitis), eczema, and asthma are among the most common allergies. As with other allergies, they are due to an overreaction of the body's immune system, which produces excessive amounts of substances such as histamine and cytokines. It is these substances that cause the symptoms of allergy.

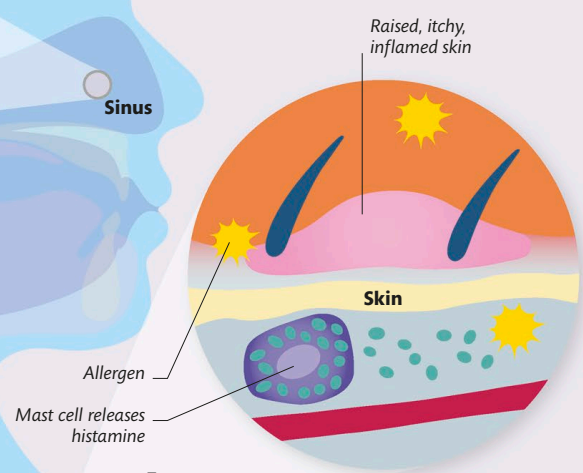
Hay fever

Many people suffer from hay fever, or allergic rhinitis, an allergy to pollen or dust. When allergens bind to mast cells (a type of immune cell) just below the lining of the nose, sinuses, and eyes, these cells release histamine. The histamine triggers an inflammatory response, including sneezing; a runny nose; and itchy, watery eyes.



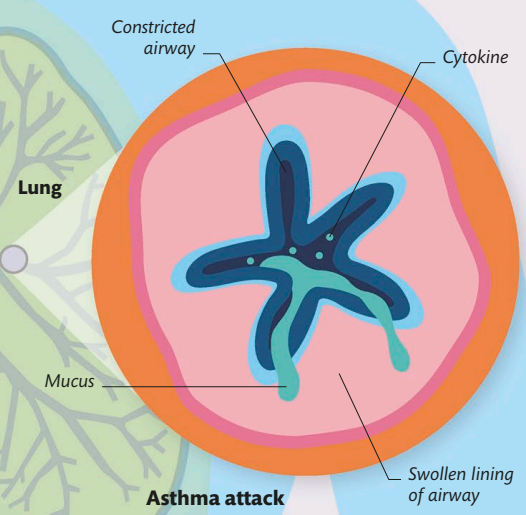
Normal immune response in lungs

When an allergen is inhaled, immune cells in the airways of the lungs produce chemicals called cytokines. Normally, these substances cause only minor swelling of the airways.



Eczema

Eczema is probably triggered by an irritant (allergen) on the skin that stimulates mast cells in the deeper layers of the skin to release histamine, which causes inflammation and irritation.



Asthma attack

In an asthma attack, there is an exaggerated response to an inhaled allergen. The cytokines cause the airways to swell and produce large amounts of mucus, leading to symptoms including wheezing, coughing, and breathlessness.

Checking for allergies

An allergy is an exaggerated response by the immune system to a substance that is normally harmless, such as a pollen or a specific food. Allergies are not usually serious, although rarely they can be life-threatening. Tests for allergies include skin prick testing and patch testing.

The body's allergic response

The body continually encounters foreign substances that stimulate the immune system. Normally, this does not cause any problems, but in susceptible people the immune system overreacts to a particular substance (the allergen), causing an allergic reaction. Most allergic responses occur shortly after exposure to the allergen, but sometimes a reaction may not occur for up to about three days after

exposure. Most people with an allergy have only relatively mild symptoms, such as a runny nose, rash, watering eyes, sneezing, and wheezing. Rarely, a severe allergic response may occur, causing symptoms of anaphylactic shock: swelling of the face, mouth, throat, and tongue; difficulty breathing; and possibly loss of consciousness. Anaphylactic shock is a medical emergency that needs immediate treatment with an injection of adrenaline (epinephrine).

Skin prick testing

Skin prick testing is one of the most common allergy tests and is carried out to identify possible allergens immediately. Dilute solutions are produced from extracts of allergens that commonly cause allergic reactions, such as pollen, foods, and dander (flakes of skin shed from animals). A drop of each solution is placed on your skin, which is then pricked with a needle. The doctor examines the skin for a reaction, which typically occurs within about 10–15 minutes. If you are allergic to one of the test substances, an inflamed, red, itchy lump appears. The size of the lump is not an indication of how severe your allergy is. If you usually take antihistamines or other anti-allergy medications, you may need to stop taking them for a few days before testing, depending on the specific medication.



Applying drops of possible allergens

Patch testing

Patch testing is used to investigate contact dermatitis, a type of allergic eczema. It is carried out to determine which substances provoke your eczema. Tiny amounts of possible allergens are placed on small patches or metal disks, which are then taped to your skin. They are commonly taped to your back, but sometimes your arms or legs may be used instead. After about two days, the patches or disks are removed and the skin underneath is examined by a dermatologist. A red, itchy, inflamed area indicates a positive reaction to the particular allergen on the patch or disk. The dermatologist will reexamine the test area about two days later to check for any delayed reactions. If you usually take anti-allergy medication, you will be asked to stop taking it before the test.



Applying patches of possible allergens

Your digestive system

The digestive system breaks down food and drink to release nutrients and energy for body cells. It is centered on a long tube called the alimentary canal. It also includes the liver, gallbladder, and pancreas, which supply digestive chemicals.

The alimentary canal

The distinct parts of the alimentary canal carry out the digestion and absorption of food and drink in several stages. The material remaining at the end of these processes is expelled as feces.

Mouth and esophagus

Food is broken down physically by the teeth and chemically by an enzyme called amylase in the saliva. The tongue mixes the food and saliva to form a ball (bolus) for swallowing. This passes down the gullet (esophagus) to the stomach.

Stomach

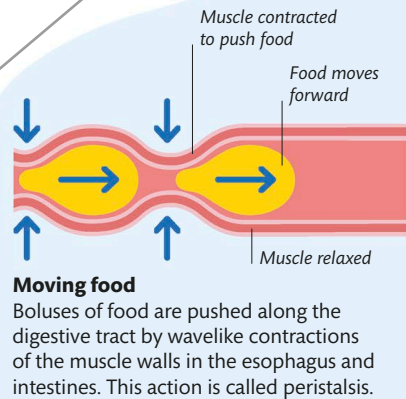
Food is mixed with strong stomach acids and enzymes and churned by the muscular stomach walls, so that it breaks down into a semiliquid substance called chyme. Food may stay in the stomach for hours before entering the intestine.

Small intestine

This long, muscular tube has three sections. In the first and second sections (duodenum and jejunum), food is mixed with further digestive juices to release nutrients. In the third (ileum), the nutrients are absorbed into the blood and lymph.

Large intestine (colon)

This tube contains bacteria that act on the remains of the food to release further nutrients. The large intestine also absorbs water into the body. The remaining waste is concentrated to form feces, which pass out via the rectum and anus.



The intestinal lining is about 345 sq ft (32 sq m) in area—or around eight king size beds

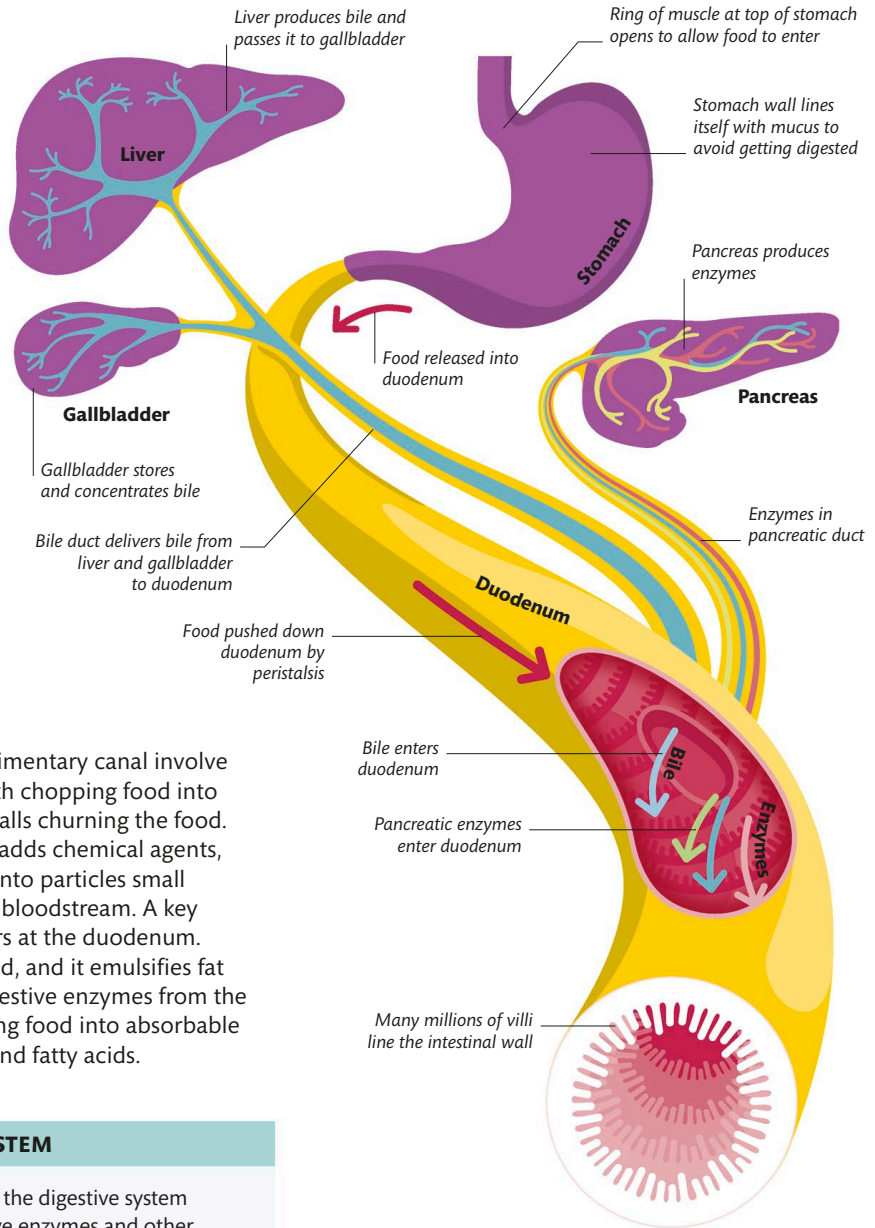


Digesting food

The digestive processes in the alimentary canal involve physical actions, such as the teeth chopping food into small pieces, and the stomach walls churning the food. However, throughout, the body adds chemical agents, mainly enzymes, to digest food into particles small enough to be absorbed into the bloodstream. A key cocktail of these chemicals enters at the duodenum. Bile from the gallbladder is added, and it emulsifies fat into tiny droplets. A range of digestive enzymes from the pancreas also enter here, breaking food into absorbable nutrients—sugars, amino acids, and fatty acids.

TESTS ON THE DIGESTIVE SYSTEM

Tests may be carried out to assess the digestive system structures, or the levels of digestive enzymes and other chemicals. Imaging such as X-rays, or viewing with endoscopy, can reveal blocked or narrowed areas, tumors, or bleeding in the digestive tract. Certain tests are done to detect ulcers (sore areas in the stomach or duodenum lining). Blood tests may be carried out to assess the levels of chemicals produced by the liver, or of insulin or digestive enzymes from the pancreas.



Intestinal lining

The lining of the small intestine is covered with millions of tiny, fingerlike structures called villi. These, in turn, are covered with smaller microvilli. The villi provide a huge surface area to enable nutrients to be absorbed into the blood.



Screening for colorectal cancer

Automated test

Specimen tubes sit in a machine that automatically carries out fecal immunochemical tests (FIT) to look for the presence of blood in the samples.

Colorectal or colon cancer is common worldwide, mostly affecting those over the age of 50. Screening tests are designed to identify early-stage cancers, which have a better chance of being effectively treated.

FECAL BLOOD TESTS

There are two tests that look for non-visible blood in stool, which could be a sign of colorectal cancer.

How the tests are done

The fecal occult blood test (FOB) and the fecal immunochemical test (FIT) both require a fecal sample. The FOB test requires the user to collect a stool sample on three separate occasions and wipe a small amount onto a card enclosed in a test kit. The FIT only requires one

sample, which is collected on a stick and put into a plastic tube. Follow the instructions carefully to ensure accuracy.

What the results mean

The results may be: normal (no blood noted in the stool), which will require no immediate action; unclear, which would require a repeat test; or abnormal (blood found in sample). An abnormal result may or may not be caused by colorectal cancer; in this case you would be asked to have a colonoscopy (so that the lining of the colon can be viewed).

COLORECTAL SCREENING

Colorectal screening uses a technique called colonoscopy. A thin, flexible tube with a camera is inserted into the colon through the rectum to identify and remove polyps that could turn into cancer over time.

What the test involves

The test takes place in a hospital or clinic. Information about the test and an enema or strong laxative to clear the bowels are given to you several days beforehand. You may be advised on dietary changes to make prior to the test and you will need to use the laxative the day before the test to enable the bowel to be as clear as possible. During the test the camera is inserted into the rectum and moved

into the colon, after which some air is used to inflate the bowel. If any polyps are found, they would usually be removed during the same procedure. The colonoscopy screening is done under general anesthesia and it is not usually painful.

What the results may mean

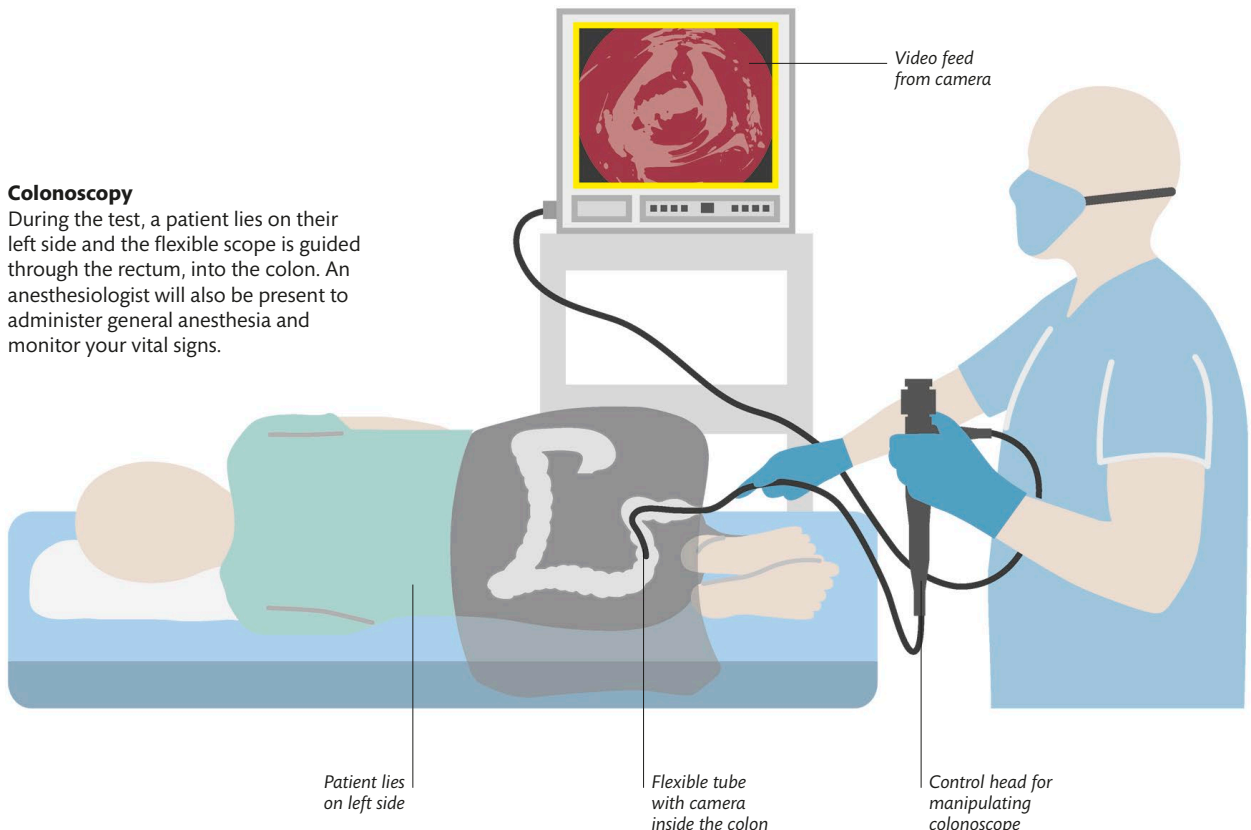
Any polyps removed are sent to a laboratory for testing. You will be told that polyps have been sent for analysis on the day of the procedure. If a polyp is found to contain cancerous cells, you would be sent to a cancer specialist for treatment. If the polyp is found to be noncancerous, you will be advised to repeat the colonoscopy in 3 to 5 years.

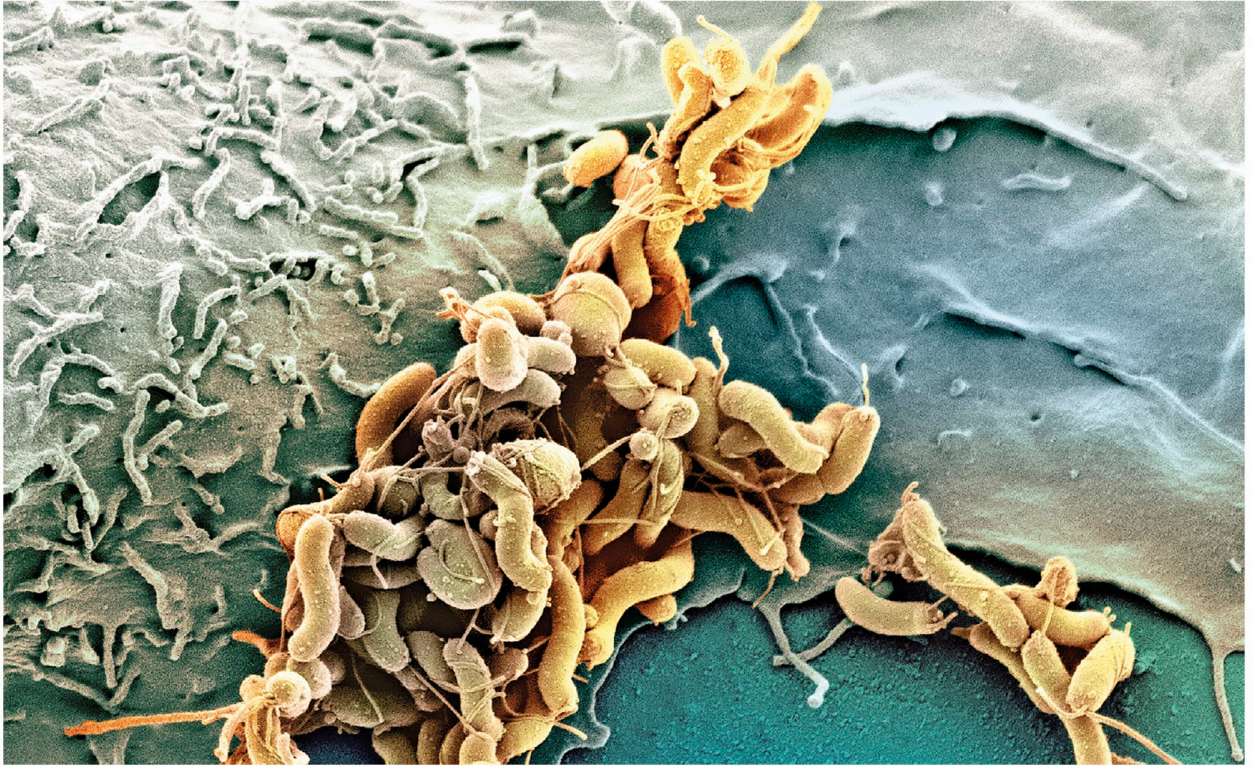


During a colonoscopy, the entire colon, also known as the large intestine, is examined.

Colonoscopy

During the test, a patient lies on their left side and the flexible scope is guided through the rectum, into the colon. An anesthesiologist will also be present to administer general anesthesia and monitor your vital signs.





Testing for *H. pylori*

Helicobacter pylori is a type of bacteria that thrives in the stomach lining, where it can cause recurrent indigestion and stomach (gastric) ulcers to develop. It may also be present but cause no symptoms, which is why many people who have the infection are not aware of it.

Bacterial infection

A magnified view shows a number of *H. pylori* bacteria (colored yellow) on cells from a person's stomach.

FECAL ANTIGEN TEST

A stool sample can be used to identify an active *H. pylori* infection by checking for antigens (substances that cause an immune response) associated with the bacteria.

What the test involves

A stool sample is sent to the lab for analysis. You do not need to fast before the stool sample is given, but you will need to avoid taking any antibiotics for a month beforehand as they may affect *H. pylori* bacteria. Acid-suppressing medication can't be taken for the two weeks before the sample is given.

What the result means

If an active infection is detected, your doctor will prescribe antibiotics. You will also need to be tested again after the treatment to ensure that the infection has been cured.

***H. pylori* is found in up to 50 percent of the population**



BREATH TEST

The presence of *H. pylori* in the stomach can be detected by analyzing a breath sample taken after drinking a special liquid.

What the test involves

You will be given a drink that contains urea (which is tasteless), and after waiting 15–30 minutes, a breath sample will be taken. You will need to stop taking antibiotics for four weeks or acid-reducing medication for two weeks leading up to the test, as these could affect the validity of the test result; your doctor or the test center should give you details. You will also need to fast for six hours before the test.

PREVENTING *H. PYLORI* INFECTIONS

Helicobacter pylori infection is thought to be widespread, though most affected people do not experience any symptoms. It is not completely clear how a person becomes infected with the bacterium. It could be through coming into contact with stools from an infected person, or via food or drink that they have prepared. Good hygiene practices, such as hand washing and eating properly cooked food can help prevent infection. Recurrence in a partially treated person can also occur, for example if the treatment is not taken properly.

How the test works

Before you swallow the liquid containing the urea you will be asked give a breath sample for a baseline to compare against. If *H. pylori* bacteria are present, they will break down the urea solution and this can be detected on your breath.

1 Fluid

Patient drinks a urea solution containing an uncommon form (isotope) of carbon.

2 Urea split

H. pylori bacteria in the stomach break down the urea into ammonia and carbon dioxide.

5 Analysis

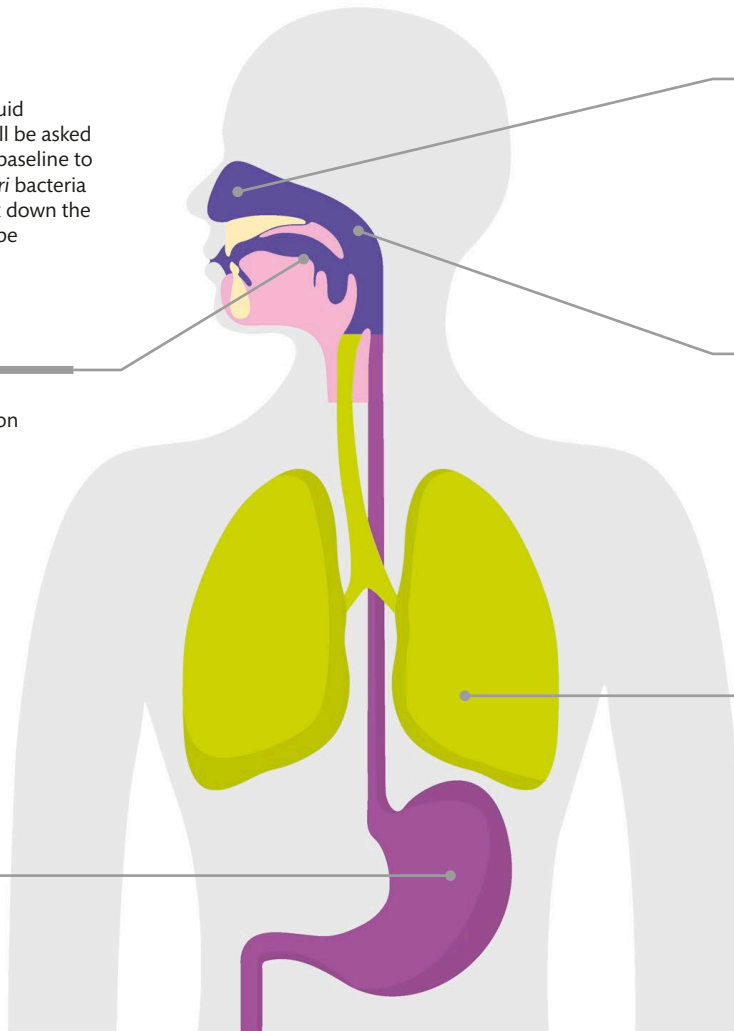
Breath sample is analyzed and the presence of the uncommon carbon isotopes indicates that an active infection of *H. pylori* is highly likely.

4 Breathing out

Carbon dioxide, including the carbon isotopes from the urea sample, is breathed out and the breath sample is captured for analysis.

3 Lungs

Carbon dioxide moves from the stomach, via the bloodstream, to the lungs.



Abdominal ultrasound

An ultrasound of the abdomen is an outpatient test performed at many clinics or hospitals. It is quick, noninvasive, and painless. This scan is performed to enable doctors to view the organs in the abdomen and identify possible causes of abdominal complaints such as pain, bloating, nausea, or vomiting.

What the test involves

The test is performed by a technician who will press a probe, which emits sound waves, onto your abdomen. The echoes of the sound waves allow images to be created of your vital organs, such as the liver, gallbladder, spleen, and kidneys. If you are a man, you may be asked to wear a gown or remove your top clothing. If you are a woman, you will need to wear a front-opening gown. You should not eat or drink anything for a few hours beforehand. The scan usually lasts 10 to 15 minutes.

What the results mean

The images created by the scan may take a few minutes to be interpreted, but if the test is not urgent, you may only get the results a few days later, or at your next doctor's appointment. The scan can detect many health problems, such as gallstones, kidney stones, an enlarged spleen, or a hernia of the abdominal wall.

Sometimes it is not possible to get a clear view of all your abdominal organs. If this happens, your clinician may refer you for another type of scan.

Abdominal scan

The scan is done while you lie on your back, but you may be asked to change position so that your organs can be viewed clearly.



Liver blood tests

Liver blood tests, also sometimes called liver function tests, are done to find out how well your liver is working. They involve measuring the levels of various substances, such as proteins and enzymes, in the blood.

What the test involves

For the tests, you will need to have blood taken (see p.54). Some food and medication may influence the results and you will need to check with your doctor beforehand to see what needs to be avoided prior to the test. The test looks at a number of indicators to diagnose liver issues such as infection, inflammation, or a blockage in the bile ducts. It also measures the liver’s ability to produce a protein called albumin and blood-clotting factors. The tests are also done to detect signs of liver disease. Other blood tests that seem unrelated to your liver may be requested at the same time—for example, a complete blood count (see p.55).

What the results mean

The blood samples are sent to the lab for analysis and it can take a few hours for the results to be processed. An abnormal result does not necessarily indicate liver disease, and sometimes additional tests will be required. The tests may also be used to monitor the progression of a disease or to monitor the possible side-effects of medication.



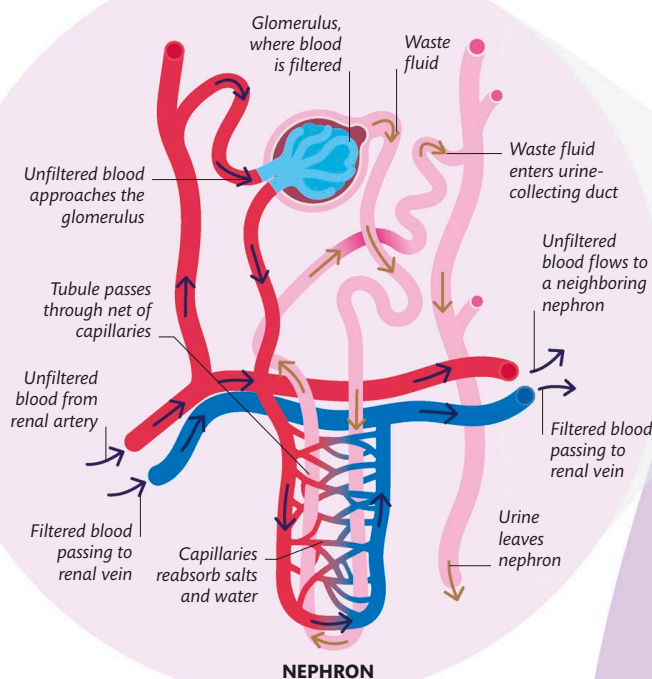
Blood test

The blood sample is analyzed to look for any abnormal levels in the enzymes, proteins, and other substances produced by the liver.

What is tested	What this means
Alanine transaminase (ALT)	This is raised when the liver cells are damaged or inflamed.
Aspartate transaminase (AST)	This is raised when cells are damaged or inflamed, but AST is not specific to cells in the liver.
Alkaline phosphatase (ALP)	This is raised when there is a blockage, such as gallstones, within the bile ducts.
Albumin and total protein	Low levels of albumin or total protein mean that your liver is not working properly, and could indicate liver failure. Malnutrition can also cause a lower level of albumin.
Bilirubin	High levels of bilirubin can indicate that there is an obstruction of the bile ducts in your liver or in your gallbladder. It may also indicate liver damage due to inflammation.
γ-Glutamyltransferase (GGT)	Raised when there is damage to your liver. It can also be raised by chronic excess alcohol consumption.
L-lactate dehydrogenase (LD)	This enzyme is released when cells anywhere in the body are damaged or break down. It can be raised in many conditions, such as liver disease, as well limb injury, or hemolytic anemia.
Prothrombin time (PT)	Measures how quickly your blood clots. A high prothrombin time means that your liver is not adequately producing clotting chemicals and is a sign of liver disease. Medications such as warfarin can also affect this.

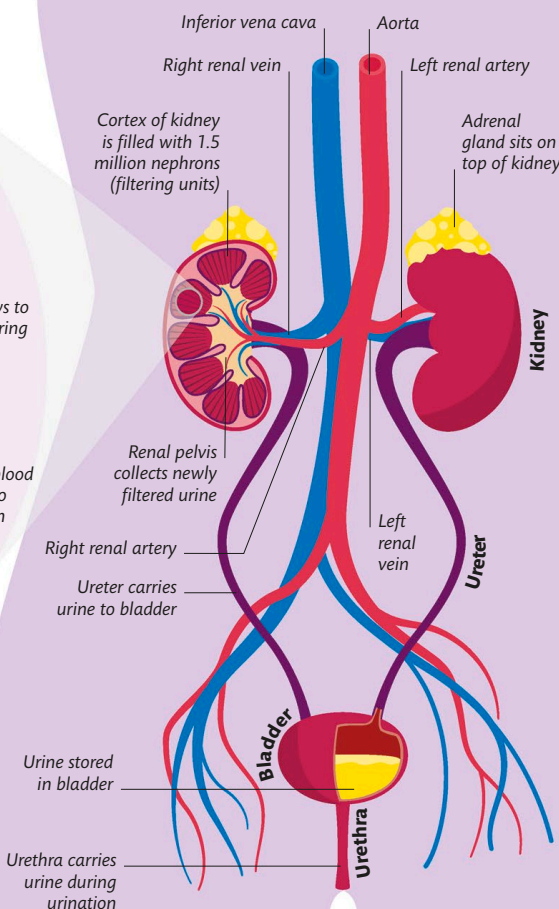
Urinary system

The urinary system consists of the kidneys and bladder, plus the urinary vessels—the ureters and urethra—that connect them to the outside world. Blood enters the kidney via the renal artery. It passes through smaller vessels to the nephrons (see below, left) for filtering. Cleaned, filtered blood leaves the kidney via the renal vein. Urine is collected in the renal pelvis and passes into the ureters, where it flows to the bladder for storage, where it flows to the bladder for storage prior to urination through the urethra.



Filtering the blood

Blood entering the kidney passes through microscopically small filtering units called nephrons. The blood first enters a knot of capillaries (tiny blood vessels) called a glomerulus. Here, waste materials and excess fluid are filtered out of the blood. The filtered fluid passes through looped tubules where essential fluids and substances are reabsorbed into the blood, while the waste leaves the kidneys as urine.



How your kidneys work

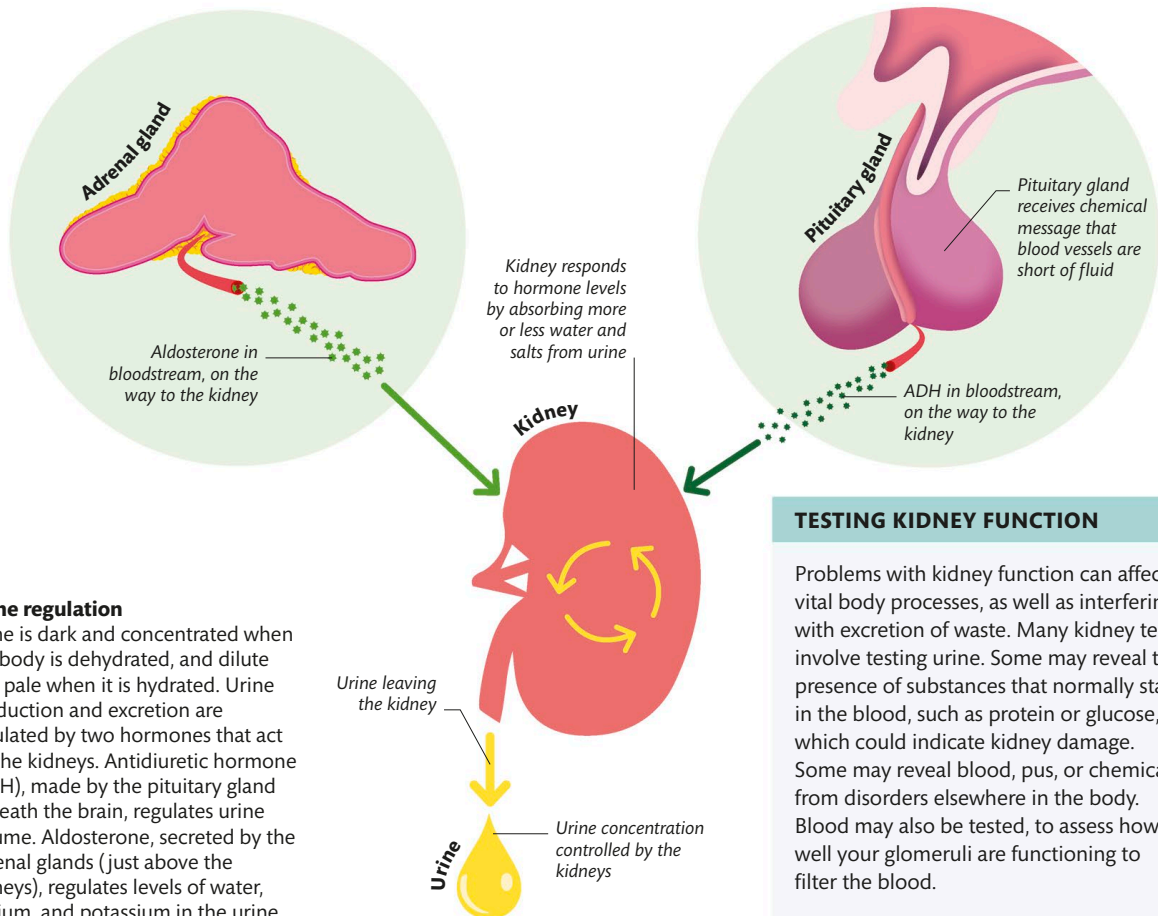
The kidneys are a pair of bean-shaped organs midway down your back. As the key components of the urinary system, they have two main jobs: filtering waste products out of the blood and regulating the body's fluid balance.

The kidneys' nephrons and tubules, laid end to end, would stretch 50 miles (80 km)

Fluid balance

The kidneys constantly exchange signals with the endocrine (hormonal) system and the circulatory system (see p.27) to balance the amounts of water, salts, minerals, and waste that are expelled in urine or retained in the

bloodstream and body tissues. This is essential as dehydration (having too little fluid in your tissues) can upset vital functions such as regulating blood pressure and body temperature. Having too much fluid is rare but can also pose risks to health.



Urine regulation

Urine is dark and concentrated when the body is dehydrated, and dilute and pale when it is hydrated. Urine production and excretion are regulated by two hormones that act on the kidneys. Antidiuretic hormone (ADH), made by the pituitary gland beneath the brain, regulates urine volume. Aldosterone, secreted by the adrenal glands (just above the kidneys), regulates levels of water, sodium, and potassium in the urine.

TESTING KIDNEY FUNCTION

Problems with kidney function can affect vital body processes, as well as interfering with excretion of waste. Many kidney tests involve testing urine. Some may reveal the presence of substances that normally stay in the blood, such as protein or glucose, which could indicate kidney damage. Some may reveal blood, pus, or chemicals from disorders elsewhere in the body. Blood may also be tested, to assess how well your glomeruli are functioning to filter the blood.

Urine analysis

Urine analysis, or urinalysis, encompasses a range of tests performed on a sample of urine. These can be done either during your appointment with a health care professional (urine dipstick test) or in the laboratory (urine microscopy and culture) in order to diagnose and monitor a variety of conditions including diabetes, infection, and chronic kidney disease.

Giving a sample

You may be asked to provide a mid-stream, clean catch sample of urine. This means that the first and last parts of your urine stream, which are more likely to be contaminated with bacteria from the skin, are not included in the sample. Women should clean the labia, and hold it open as you collect the sample. Men should clean the tip of the penis.

Your doctor or nurse will provide you with a sterile container and this should have your details and the date written clearly on it. A sample can be kept in a fridge for up to 24 hours if you are unable to give it to your doctor within the hour. Urine samples provided first thing in the morning will be more concentrated and therefore more likely to pick up an abnormal result. Urine samples can also be affected by your diet, physical activity, and dehydration, so it is important to mention this to your doctor if you think it may be relevant.

Home testing kits are available, but it is advisable to see your primary care provider to get your urine tested. They will be able to provide the right equipment and have the expertise to interpret the results correctly, and send the sample off for further tests, if needed. You should get your urine tested if you notice blood in the urine; if you are passing urine more often than usual and/or with any pain, burning, or stinging; or if the urine is cloudy, smelly, or a different color than usual.

Bacteria test

Urine may be sent to a laboratory for analysis.

A culture test looks to identify any bacteria present in the sample, which may indicate the cause of a urinary tract infection (UTI).





Dipstick test

A dipstick test uses a strip with colored pads, which change color when they react to the presence of a substance in the urine.

Urine dipstick test

Urine can be tested rapidly using a multicolored plastic strip that is dipped into your urine sample. Your health care professional will compare the strip to a color scale, which correlates color changes in the pads to possible abnormal findings in the urine, such as blood or glucose (see table, above right). Sometimes a machine may be used to analyze the pads. The level of changes in color depend on how much of that substance is present, and this is graded using a plus sign.

Sending a sample to the lab

Urine can be examined under a microscope and cultured, where the bacteria are allowed to grow to identify which antibiotics may be used to treat infections. It usually takes

What is tested	Results
Leukocytes (white blood cells)	Usually suggestive of a urinary tract infection or contamination from vaginal discharge.
Nitrites	Nitrites are released by certain bacteria and their presence is suggestive of an infection.
Protein (proteinuria)	May represent damage to the kidney's filtration system due to diabetes, high blood pressure, kidney disease, or conditions such as myeloma.
pH (acidity/alkalinity)	The pH of the urine can change as a result of your diet, kidney stones, or certain infections.
Ketones (ketonuria)	Ketones may be found in diabetic people with very high blood sugar (diabetic ketoacidosis), in those on low carbohydrate or starvation diets, and in urine that has been left stagnant.
Blood (hematuria)	Red blood cells in the urine may be the result of infection, stones, kidney disease, cancers, or contamination from menstrual blood.
Bilirubin and urobilinogen	May be seen in those with liver disease.
Specific gravity	This is a measure of how dilute or concentrated the urine is and depends on your hydration level.
Glucose/sugar (glucosuria)	Glucose is found in diabetic people's urine and this is a useful screening test for the condition.

around 72 hours for the results to be made available. The presence of abnormalities, such as red blood cells, white blood cells, casts, crystals, yeasts, and parasites, can be seen and counted using a microscope. Another test performed in the laboratory is to measure the amount of a protein called microalbumin. This measurement is used to calculate a score called ACR (albumin creatinine ratio), which is used to monitor people with diabetes, hypertension, and kidney disease.

There are an estimated 150 million cases of urinary tract infections globally each year



Testing kidney function

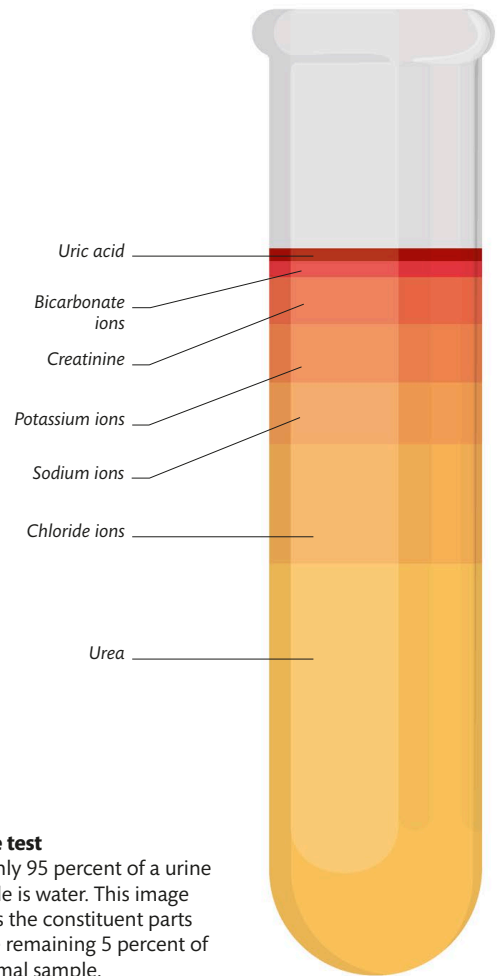
The kidneys act as filters, cleaning the blood and expelling waste via urine. Information on how well the kidneys are working can be obtained by tests done on a urine sample and on a blood sample.

URINE TEST FOR KIDNEY FUNCTION

The urine can be tested quickly and effectively by urinary dipstick analysis (see p.75) or by sending a urine sample to the laboratory (see p.75) for analysis.

What is tested

A dipstick test can identify infections, complications of diabetes, and damage to the kidneys, which may result in leakage of protein, ketones (a byproduct when fatty acids are broken down), or blood. A lab test of the level of a protein called microalbumin together with the amount of creatinine (a waste product of muscle) in the urine is used to calculate the albumin creatinine ratio, or ACR. The urine for the ACR test is best collected as an early-morning sample. People with diabetes and those with raised blood pressure and protein in the urine should have an ACR done each year. A raised ACR (more than 30 mg/g or 3mg/mmol) is associated with an increased risk of chronic kidney disease and heart disease.

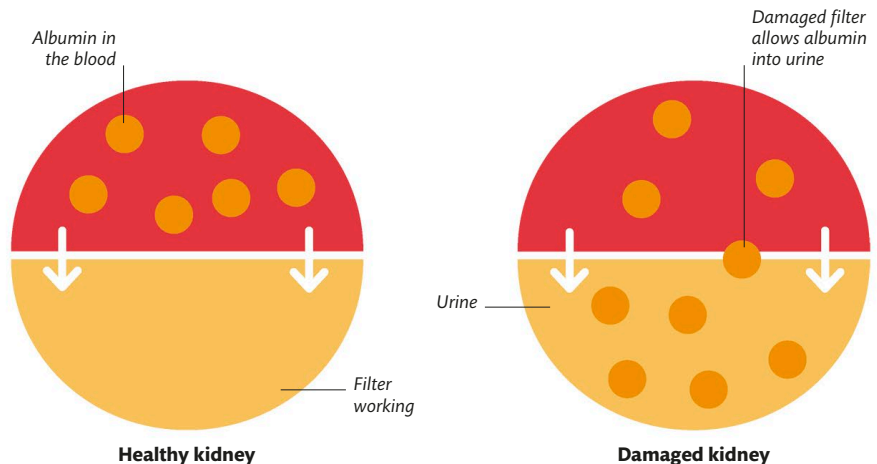


Urine test

Roughly 95 percent of a urine sample is water. This image shows the constituent parts of the remaining 5 percent of a normal sample.

Microalbumin test

Healthy kidneys will retain necessary components of blood, such as the protein albumin. If there is kidney damage, albumin is one of the first proteins to leak out and be expelled in urine.



BLOOD TEST FOR KIDNEY FUNCTION

A blood sample is taken in the usual way (see p.54) and sent to the lab for kidney function tests, also sometimes known as U&E (urea and electrolytes).

What the results mean

The blood is measured for the quantity of urea, creatinine, and electrolytes or salts, and the estimated glomerular filtration rate (eGFR) is calculated.

Urea and creatinine are both waste products passed into the urine via the kidneys, and if the organs are not working properly the levels in the blood of both are increased. They can rapidly increase and then lower again in normally healthy individuals following an episode of dehydration, stones, or severe infection, or due to certain medications. This is known as an acute kidney injury (AKI). The levels of salts or electrolytes can fluctuate due to kidney damage or conditions related to other organs.

The general function of the kidneys and how they do their job of filtering the blood can be determined by calculating the eGFR. This is calculated based on your age, sex, and ethnicity. The estimation can be affected by your build, dehydration, and muscle wasting or amputation. A normal eGFR has a value over 90ml/min/1.73m². If two tests are found to show eGFR below this level, over 90 days apart, this may indicate chronic kidney disease (CKD). Unlike AKI, CKD is a chronic or long-term condition that may progressively worsen.

Blood sample

High levels of waste products in a blood sample may indicate that the kidneys are not functioning properly.



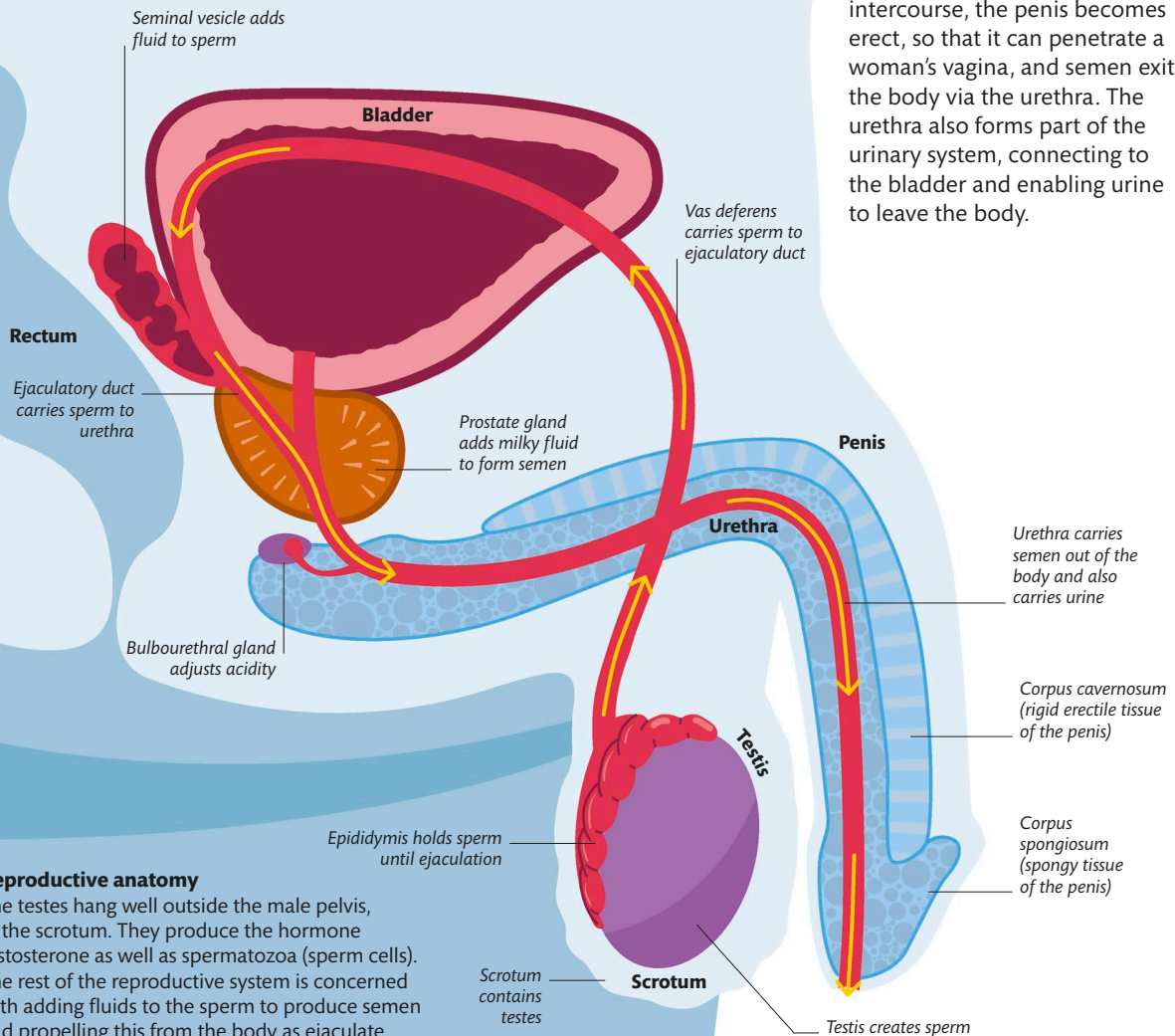
SELF-HELP MEASURES			
	Blood pressure	▶ High blood pressure strains the kidney's filtration tubes	▶ pp.30-31
	Hydration	▶ Avoid dehydration	▶ p.146
	Weight	▶ Being under- or overweight can cause kidney problems	▶ p.148
	Smoking	▶ Smoking can cause decline in kidney function	▶ p.151
	Alcohol/salt	▶ Excessive salt and alcohol may impair kidney function	▶ p.149, p.150

The male reproductive system

The male reproductive system comprises the penis and testes, the prostate gland, the passages and ducts connecting these parts, and the urethra. These organs and structures make and carry sperm, which fertilize a woman's eggs during sex.

Structures and functions

Sperm are made and stored in the testes. They travel through a system of passages and ducts to the penis, passing via the prostate gland, which adds liquid nutrients, creating semen. During sexual intercourse, the penis becomes erect, so that it can penetrate a woman's vagina, and semen exits the body via the urethra. The urethra also forms part of the urinary system, connecting to the bladder and enabling urine to leave the body.

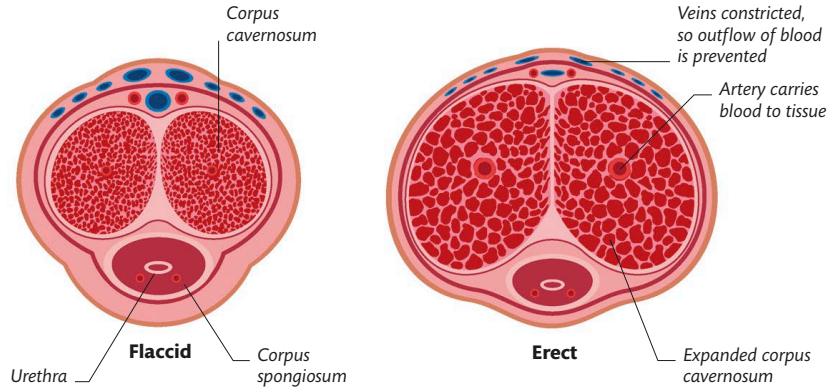


Reproductive anatomy

The testes hang well outside the male pelvis, in the scrotum. They produce the hormone testosterone as well as spermatozoa (sperm cells). The rest of the reproductive system is concerned with adding fluids to the sperm to produce semen and propelling this from the body as ejaculate.

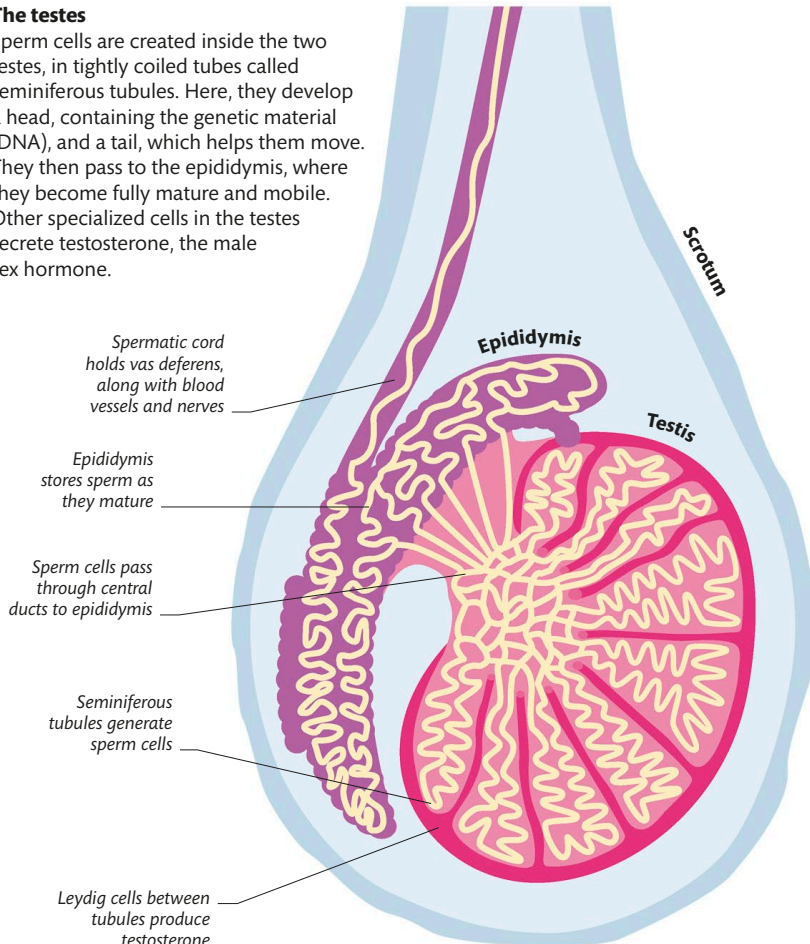
Structure of the penis

The penis contains three columns of spongy tissue: the corpus spongiosum, holding the urethra, and two corpora cavernosa. During sexual arousal, extra blood is carried to the penis, making the corpora cavernosa (singular: corpus cavernosum) expand; this constricts the veins, so blood builds up in the penis, making it erect. After ejaculation, the pressure decreases and the blood drains away, so the penis becomes flaccid.



The testes

Sperm cells are created inside the two testes, in tightly coiled tubes called seminiferous tubules. Here, they develop a head, containing the genetic material (DNA), and a tail, which helps them move. They then pass to the epididymis, where they become fully mature and mobile. Other specialized cells in the testes secrete testosterone, the male sex hormone.



MALE REPRODUCTIVE HEALTH CHECKS

The most common tests are carried out on samples of urine or blood, to detect sexually transmitted infections (STIs) or to screen for cancer. It is important to identify STIs promptly because they can be passed on to sexual partners, and they can affect fertility in a man or his partner. Men can be screened for signs of prostate cancer. To detect any early signs of testicular cancer, men should examine their own testes for lumps regularly.

A man can produce more than 500 billion sperm cells in his lifetime



Checking for infections

Men and women (see pp.88–89) can contract and spread sexually transmitted infections (STIs). They do this through unprotected vaginal, anal, or oral sex, or just close genital contact—with male or female partners. Some STIs can be transmitted via infected blood, saliva, or from mother to baby. STIs may produce no symptoms, so it is sensible to have an STI check before starting a sexual relationship, to reduce the risk of infecting others.

Blood tests

Some viral infections can be detected by blood tests. At the time of infection, HIV may cause a flulike illness, but 1 in 5 people develop no symptoms. HIV is detected with a blood test for antibodies raised by the body against the virus. Antibodies can take 3 months to multiply sufficiently to give a positive result, so the best HIV tests look for antigens (traces of the virus itself) as well, which can be detected 4 weeks after infection.

If using “point of care” testing, at a sexual health clinic for instance, results can be produced from a pinprick blood sample on-site within a few minutes. In some clinics, you might be asked to provide saliva. A second test to confirm the results is strongly recommended.

Hepatitis C is also often asymptomatic. Blood tests look for antibodies, but in this case, antibodies can only show that the body has been exposed to the virus—it may since have fought the virus off. To confirm you are infected (and infectious), more precise tests are needed that detect the viral RNA (genetic material).

More than 1 million sexually transmitted infections are acquired every day worldwide



Consultation

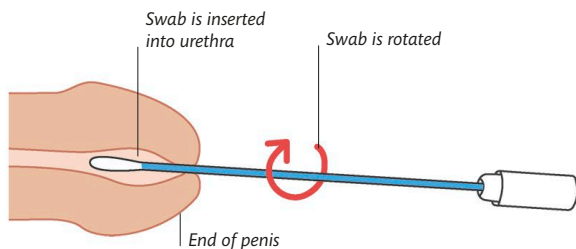
If you suspect you have an STI, a clinician will ask you about your sexual history as part of the testing procedure. You might be asked when you last had sex, and if you used a condom.

Infection	Agent	Symptoms
HIV	Viral	All of these infections can produce symptoms in some cases, but any of them can also be completely asymptomatic, particularly in the early stages
Hepatitis B	Viral	
Hepatitis C	Viral	
Genital warts	Viral	
Genital herpes	Viral	
Syphilis	Bacterial	
Gonorrhea	Bacterial	
Chlamydia	Bacterial	
Nongonococcal urethritis	Bacterial	
Trichomoniasis	Protozoan parasite	Visible lice (crabs)
Pubic lice	Animal parasite	



Urine tests and swabs

Bacterial infections, such as chlamydia and gonorrhea, can be detected in urine or in swabs from the urethra. In the case of urine, you will be asked to wait for at least 2 hours since you last urinated before passing a urine sample. The first part of the urine stream should be caught in a sterile container. This is because, by the end of urination, vital telltale bacteria might have been washed away.

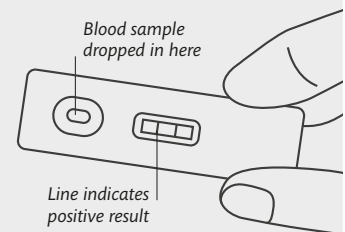


Urethral swab test

The health care professional may want to take a swab. A small cotton-tipped swab is inserted directly into the urethra to collect any bacteria there. A swab can also be used to collect a specimen from your anus, throat, or eyes.

TESTING AT HOME

Home testing and home sampling HIV kits are available and legal in some countries. Most of them use a pinprick blood sample and/or a urine sample. You can sometimes do postal testing, too.



Home sampling HIV kit

SELF-HELP MEASURES

	Vaccination	➤ Discuss with your doctor having the hepatitis B vaccine	➤ pp.144-145
	Sex	➤ Practice safer sex	➤ pp.162-163

Checking the testicles

Caught early, testicular cancer is treatable and curable. If you start checking your testes in your teens, you will know what normal feels like, so you can spot early signs if they develop. You might feel a painless lump or heaviness in your testes or one of them might feel different from the other. Testicular cancer most commonly affects men aged 15 to 49.

Self checking

The best time to check your testes is after a warm bath. The heat allows the scrotum to relax and the testes to drop so it is easier to feel them. Try to do this once a month so you get familiar with how your testes feel.

 **Less than 4 percent of testicular lumps are cancerous**



The testis

Examine one testis at a time. Roll it gently between your thumb and first two fingers. Feel for lumps or changes in the size, consistency, and shape. Check the other testis and make sure it feels similar.



The epididymis

The epididymis sits at the back of the testis and feels a little squishy and ropelike. This is normal.

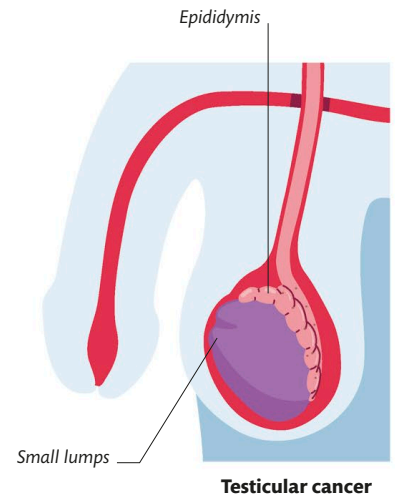
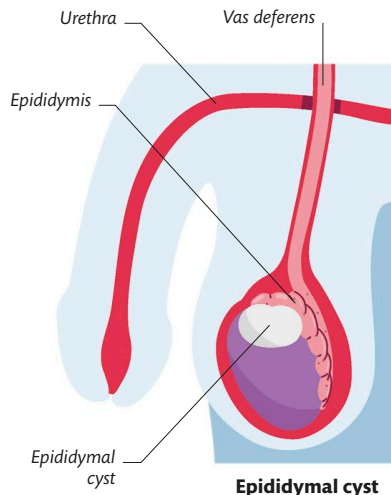


The vas deferens

The vas deferens feels like a firm, smooth, movable tube running behind each testicle. Run your thumb and forefinger along its length in both testicles, feeling for lumps or tenderness.

What you might find

If you feel a lump it is unlikely to be cancerous, but you cannot decide this yourself, so seek medical advice. Most are caused by harmless conditions, such as an epididymal cyst or swollen veins around the testes called a varicocele. Your doctor will examine you and may shine a light through your scrotum to check if there is a buildup of fluid. You may then need an ultrasound scan of your testes and possibly also blood tests, to determine if a lump is cancerous.

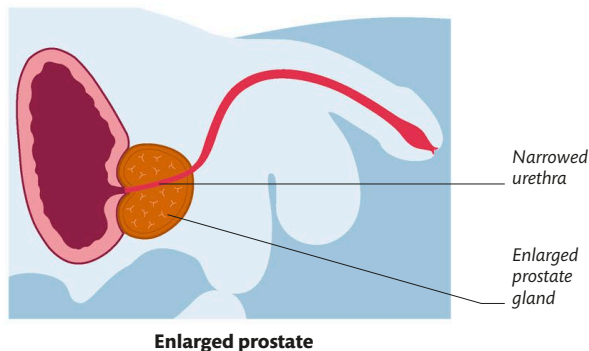
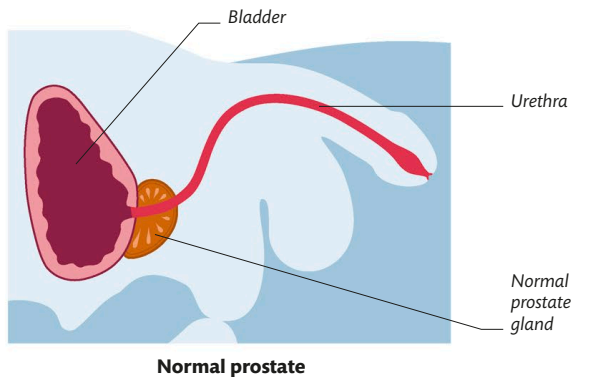


Checking the prostate

As you get older, your prostate tends to enlarge and can put pressure on your urethra. This may cause no symptoms or you might have difficulties passing urine. In many men, the enlargement is benign, although sometimes it may be due to prostate cancer.

The prostate gland

The prostate, a plum-sized gland that adds fluid to semen (see p.78), is present only in men. An enlarged prostate may make it hard to start or stop passing urine, it might make you go more often, or you might feel unable to empty your bladder completely. The enlargement may be harmless, but the chances of it being cancerous are greater if you are of Afro-Caribbean ethnicity or have a family history of prostate cancer or breast cancer.

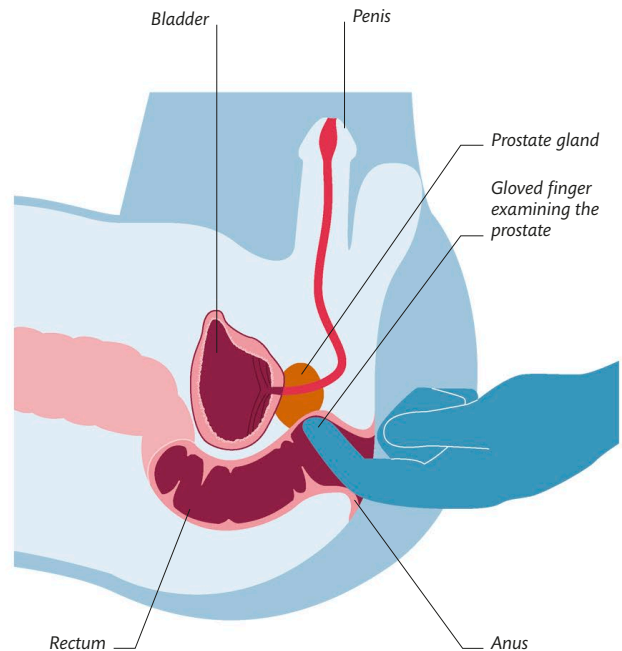


Prostate enlargement

The urethra passes through the prostate gland, so if the prostate swells, it can compress the urethra, narrowing it and, in some cases, affecting urination.

Digital rectal examination

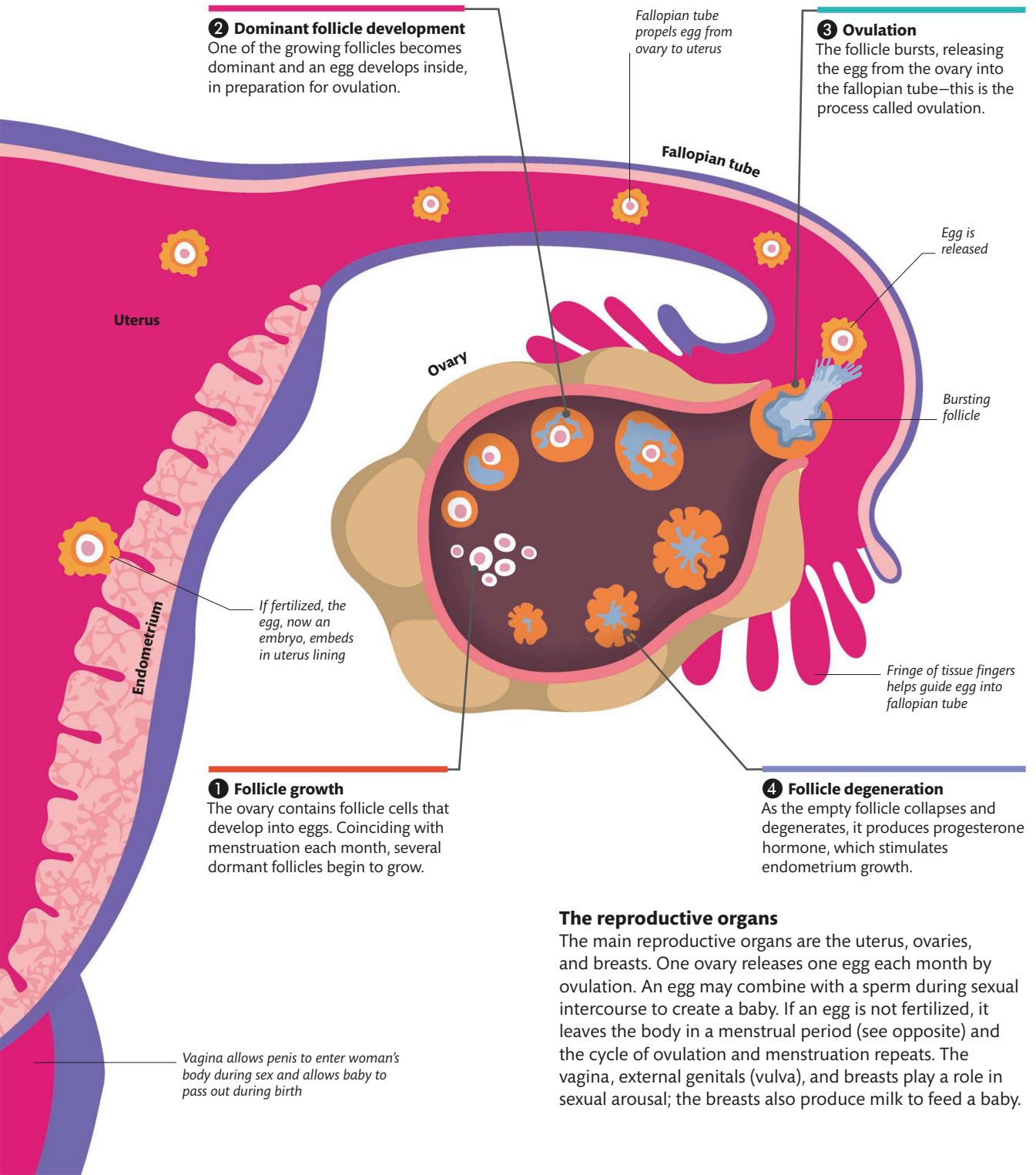
To undergo this examination, you will need to remove your underwear, stand, and bend forward, placing elbows on the table.



Prostate tests

A diagnosis of prostate cancer is based on a series of tests, but the first step might be a digital rectal examination (DRE) or a blood test for prostate-specific antigen (PSA). During DRE, your doctor examines your prostate through the rectum. Using lubricating gel, they will insert a gloved finger. Your doctor will be able to feel if the prostate is enlarged or unusual in consistency.

The PSA test is not very specific. The PSA level can be raised if you have prostate cancer, but also by non-cancerous causes such as age, benign enlargement of the prostate, or urinary tract infections. You may also have prostate cancer even if you have a normal PSA level. If your PSA is raised, you may be referred for an MRI (magnetic resonance imaging) scan of your prostate or a prostate biopsy (removal of a sample of prostate tissue for analysis).



The reproductive organs

The main reproductive organs are the uterus, ovaries, and breasts. One ovary releases one egg each month by ovulation. An egg may combine with a sperm during sexual intercourse to create a baby. If an egg is not fertilized, it leaves the body in a menstrual period (see opposite) and the cycle of ovulation and menstruation repeats. The vagina, external genitals (vulva), and breasts play a role in sexual arousal; the breasts also produce milk to feed a baby.

The female reproductive system

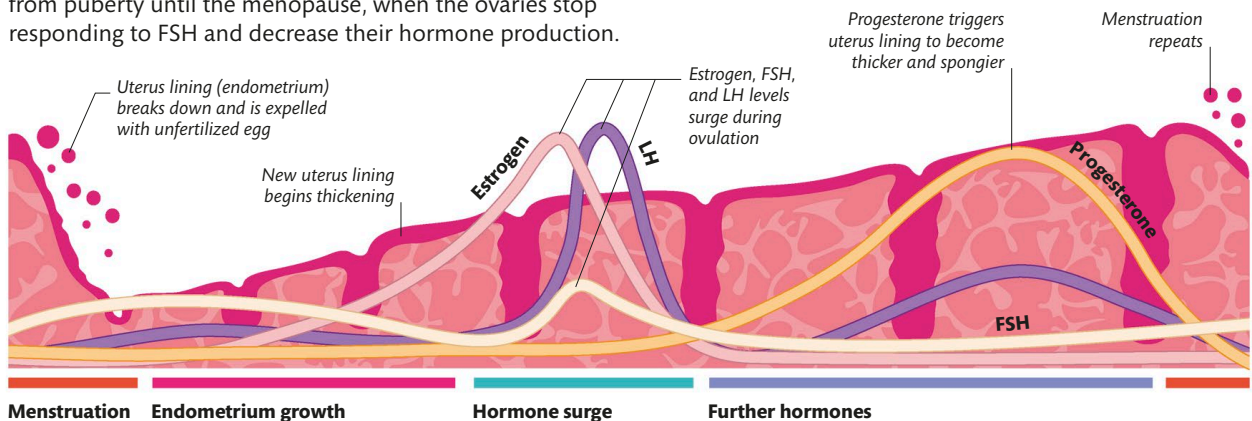
The reproductive system in women includes the sex organs and the uterus (left), which holds a fetus (developing baby) during pregnancy. The system is controlled by hormones. Tests may be carried out to detect problems with either the body structures or the hormone levels.

The menstrual cycle

A woman's body goes through the menstrual cycle every month, when an egg is released (left) and the uterus lining thickens to receive it (below). The process is controlled by the hormones estrogen and progesterone, produced in the ovaries, and follicle-stimulating hormone (FSH) and luteinizing hormone (LH), secreted by the pituitary gland. Menstruation continues from puberty until the menopause, when the ovaries stop responding to FSH and decrease their hormone production.



Normal menstrual cycles range from 21 to 35 days.

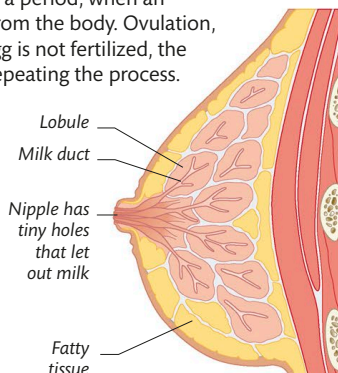


Stages of the menstrual cycle

A menstrual cycle starts with a period, when an unfertilized egg is expelled from the body. Ovulation, occurs at mid-cycle. If the egg is not fertilized, the uterus lining breaks down, repeating the process.

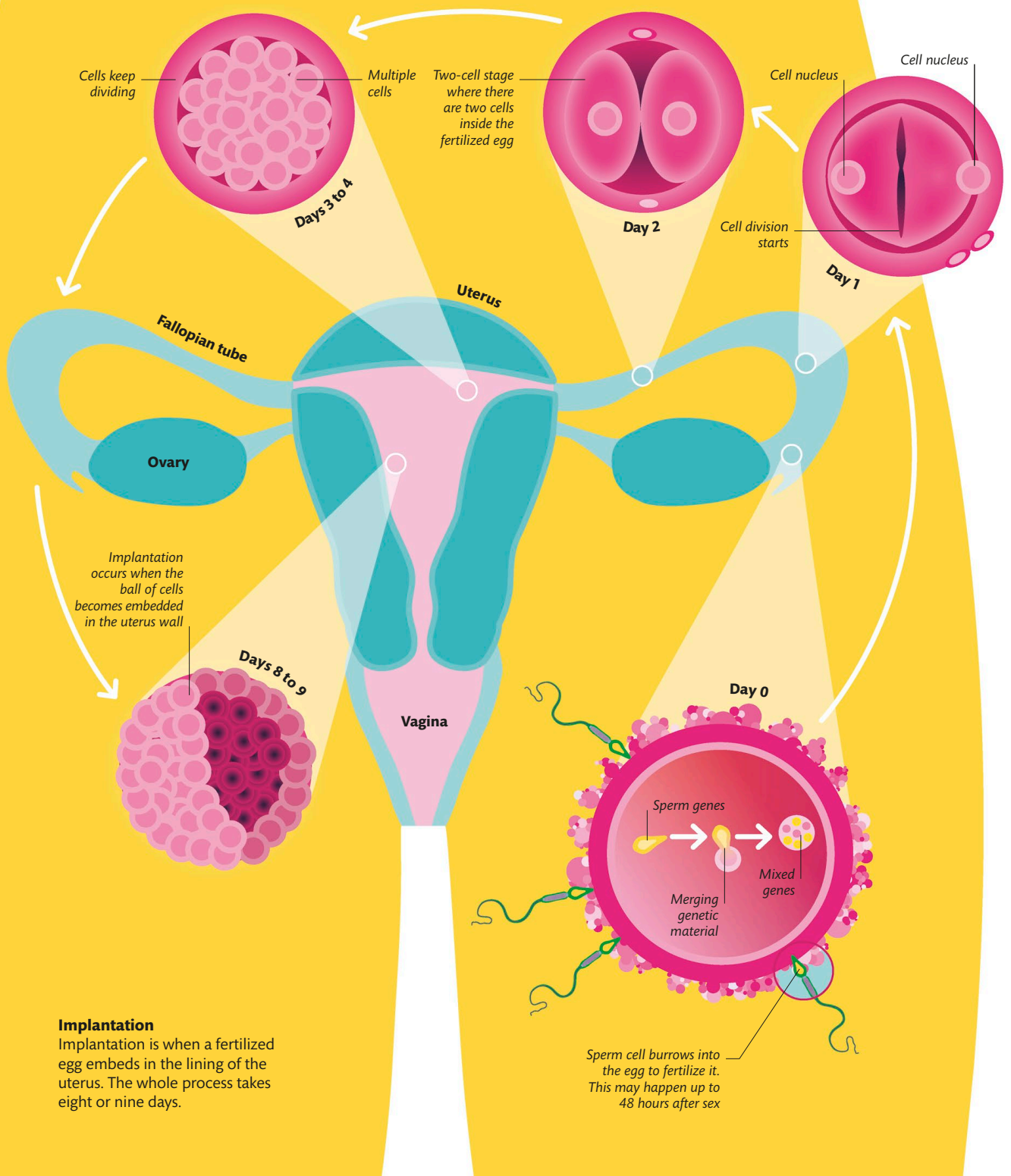
Breasts

Most of a woman's breast tissue consists of lobules—glands that produce milk during late pregnancy and after a birth. The milk passes along ducts to the nipple. The lobules are supported by fat and connective tissue.



FEMALE REPRODUCTIVE HEALTH TESTS

One of the most common tests for women is a urine test to detect pregnancy hormones. Other urine or blood tests may be carried out to identify hormonal disorders or sexually transmitted infections. Women may have regular screening with smear tests to detect cervical cancer, or mammograms to detect breast cancer. Other tests for diagnosing problems include blood tests to investigate causes of heavy or absent periods, imaging such as pelvic ultrasound, or viewing of the vagina, cervix, and body of the uterus.



Implantation

Implantation is when a fertilized egg embeds in the lining of the uterus. The whole process takes eight or nine days.

Testing for pregnancy

A pregnancy test is a quick and reasonably accurate test to show if you are pregnant or not. The test is usually done using a urine sample and can be performed either at home or in a health clinic.

What the test involves

As soon as a woman becomes pregnant, her body starts producing an increased amount of a hormone called human chorionic gonadotropin (hCG). Pregnancy tests detect the presence of hCG in either the urine or the blood.

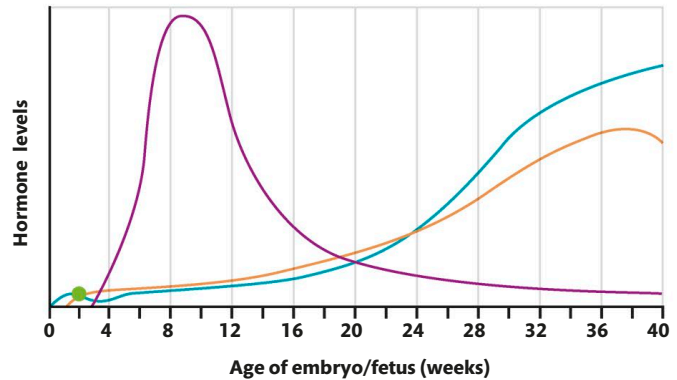
The urine test involves either peeing onto a test strip, dipping the test strip into a small sample of urine, or using a small pipette to drop urine onto the strip. In each case there is a small chemical reaction if hCG is present and the strip will show this either by a color change, a line appearing on the strip, or by indicating it digitally. Some newer tests can even tell you how many weeks pregnant you are.

The urine pregnancy test can show whether you are pregnant as soon as you have missed your period. This will be about two weeks after you actually conceived. However, there are some very sensitive tests that can be used as early as six days before a period is due.

What the results mean

If the pregnancy test is positive, it usually means that you are pregnant. Rarely, however, the test can be positive although you are not pregnant. This might occur if the test is done soon after you have given birth or had a miscarriage or if you are taking certain medications. Likewise, the test can occasionally be negative although you are actually pregnant. This might occur if the test is done too early or the particular test kit is not very sensitive. If you think you are pregnant and the test is negative, it is a good idea to repeat the test about a week later or ask your doctor for a hCG test, which is even more accurate.

When your pregnancy test is positive, you should arrange to see your doctor for prenatal care. You should also discuss whether you should be taking any vitamins, such as folic acid. However, if you have abdominal pain or bleeding then you should see your doctor immediately as these may indicate a medical emergency.



Pregnancy hormones

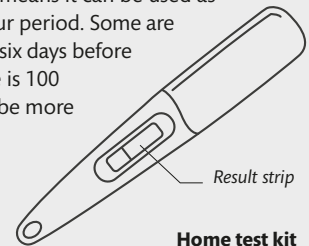
In the early stages of pregnancy, the production of human chorionic gonadotropin (hCG) increases sharply. Testing for this hormone is used to determine pregnancy.

KEY

- Human chorionic gonadotropin (hCG)
- Estrogen
- Progesterone
- Ovulation

HOME TEST

Home pregnancy tests are readily available from pharmacies and supermarkets in many countries. They use a sample of your urine to detect hCG, but they may vary, so always follow the instructions. Results are available in a few minutes. The convenience of the test means it can be used as soon as you have missed your period. Some are sensitive enough to be done six days before your period is due, but none is 100 percent accurate. Tests may be more accurate if an early morning sample is used, especially in very early pregnancy.



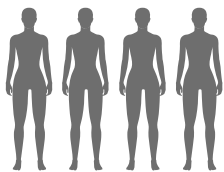
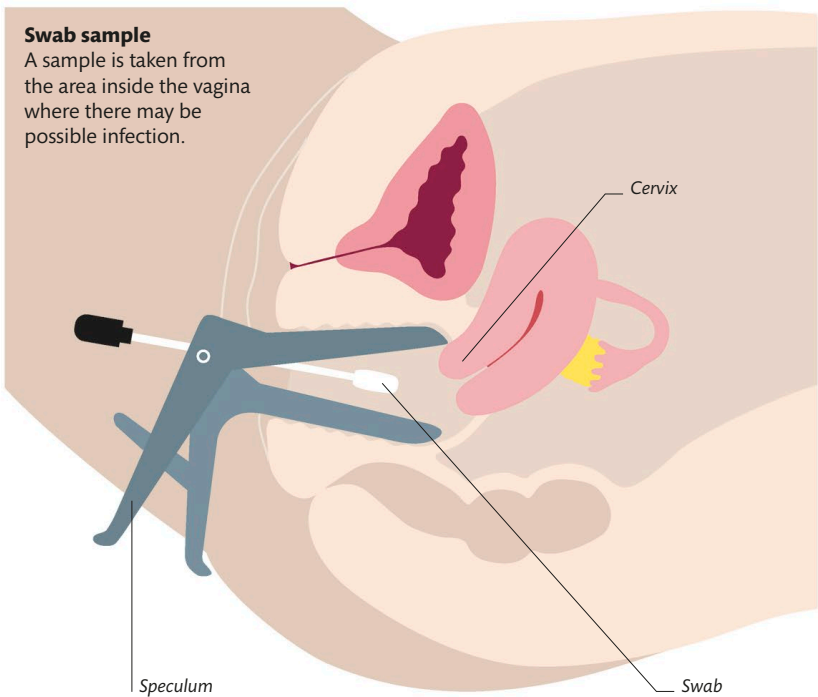
Home test kit

Checking for infections

Gynecological and sexually transmitted infections can be diagnosed by various tests. Before any tests are done, you will be asked about your gynecological and sexual history and symptoms, such as abnormal vaginal discharge, itching, soreness, abdominal pain, or whether you are feeling unwell.

What to expect

There are three main types of test to check for infection; a blood test (see p.54), a urine test (see pp.74–75), and a vaginal swab. A swab is one of the most common tests you may have. The swab is a thin plastic stick with a cotton tip. It is gently wiped across the area where there may be infection or discharge. In order to see the area inside the vagina, your doctor will use a small plastic or metal viewing instrument called a speculum. The end is coated with lubricating gel, then gently inserted into the vagina and the swab will be taken. However, you may be given a swab at the clinic so that you can take the sample yourself. Sometimes swabs are taken from sore places on the outside genital area and occasionally from the anus.



**Many people
with infections
experience
no symptoms**

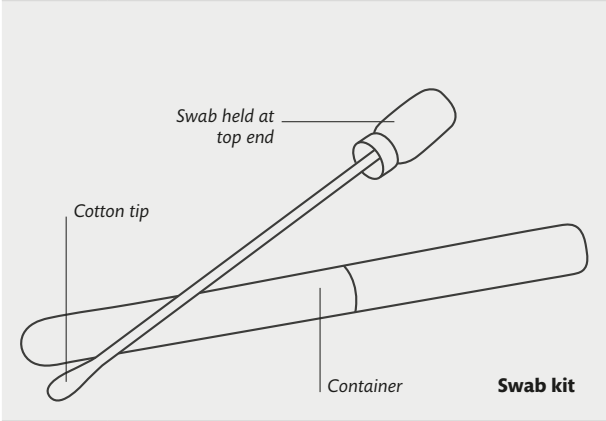
SELF-HELP MEASURES			
	Screening tests	▶ Get smear annually, or less frequently if suggested by health care provider	▶ pp.92–93
	Vaccination	▶ Consider having the HPV vaccine if you are offered it by your doctor; discuss having the hepatitis B vaccine with your doctor if you change your sexual partner frequently	▶ pp.144–145
	Safer sex	▶ Use condoms and dental dams and visit a sexual health clinic immediately if you think you may have contracted HIV or hepatitis B	▶ pp.162–163

What the results mean

Any blood, urine, or swab samples are usually sent for testing in a laboratory. If the tests indicate that you have an infection, your doctor will recommend specific treatment appropriate for the infection, such as antibiotic tablets or cream.

TAKING A SWAB AT HOME

You may be given a swab kit by the clinic to take a sample yourself, or you can also buy home self-testing kits.	
Step 1	Before taking the sample, wash your hands thoroughly with soap and water.
Step 2	Remove the swab from the packaging, ensuring that you do not touch the cotton tip. Hold the other end with your thumb and forefinger.
Step 3	You can sit or stand to take the swab. Put the tip of the swab stick about ¾ in (2 cm) inside the vagina—approximately where you insert a tampon.
Step 4	Rotate the swab for 15–30 seconds.
Step 5	Place the swab into its container. You will need to label and date the sample before sending it off.
Step 6	Wash your hands with soap and water.



A closer look
Some infections are best diagnosed by using a urine or blood sample. Samples sent to the lab may be viewed under a microscope to look for abnormalities.

Pelvic examination

A pelvic or internal examination is an examination of your genital area and internal reproductive organs. It may be done if you have symptoms such as abnormal vaginal discharge, period problems, or lower abdominal pain.

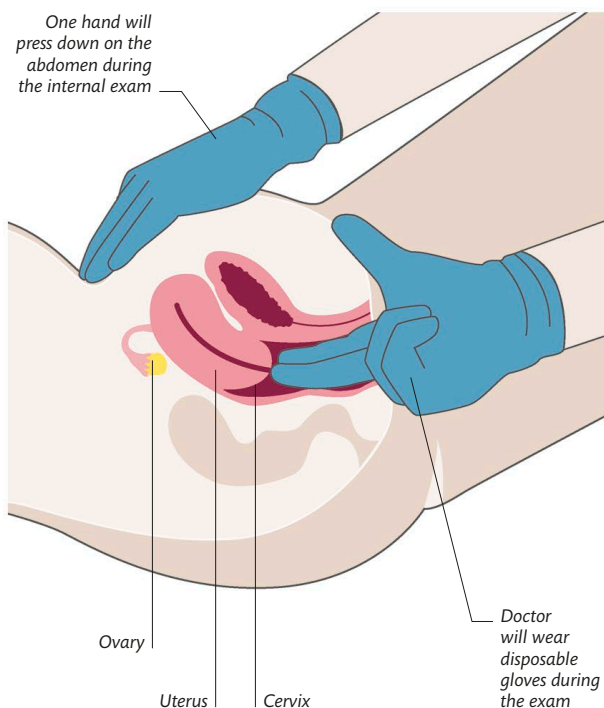
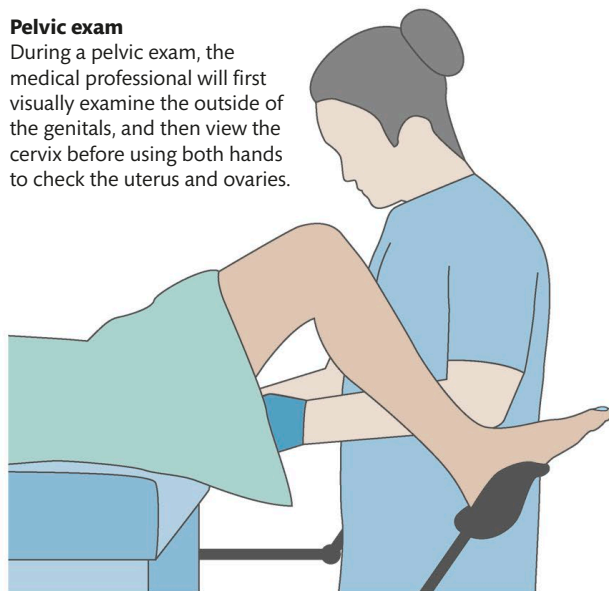
What the test involves

You should always be asked if you would like a chaperone present for this type of examination. You will be required to remove your underwear and then lie on your back on the examination couch with your knees bent up and legs slightly apart or with your feet in stirrups. The doctor will wear disposable gloves for this examination and will first inspect the area around the outside of the vagina and then

insert a speculum with gel on it gently into the vagina. The speculum is then opened slightly so that the inside of the vagina and the neck of the uterus can be seen. A Pap smear and swabs can be taken if necessary. Finally, the doctor will use two fingers to feel gently inside the vagina, with the other hand on your lower abdomen. Sometimes you may also be sent for an ultrasound scan. These tests may be slightly uncomfortable but should not be painful.

Pelvic exam

During a pelvic exam, the medical professional will first visually examine the outside of the genitals, and then view the cervix before using both hands to check the uterus and ovaries.



What the results mean

These tests can show whether you have any abnormality in the genital region or cervix or whether you may have a vaginal or pelvic infection. The ultrasound can show if your uterus is enlarged or has a thickened lining or if you are pregnant. It can also check for cysts in the ovaries. Following these, your doctor may recommend further tests or treatment.

Colposcopy

This is an outpatient test to look at your cervix in detail to check for abnormal cells. It is done using a special microscope, called a colposcope, that resembles a pair of binoculars.

What the test involves

You may be sent for a colposcopy if your cervical screening test (see pp.92–93) has shown abnormal cells; if your cervix looks abnormal; or if you have symptoms, such as bleeding after intercourse. It should not be done during your period and you should avoid intercourse and using tampons or vaginal cream, gel, or tablets for two days before the test.

The test is similar to having a pelvic examination. The doctor will insert the speculum to get a clear view of the cervix. The colposcope is then used to look at your cervix although it does not touch or go inside you. A vinegarlike

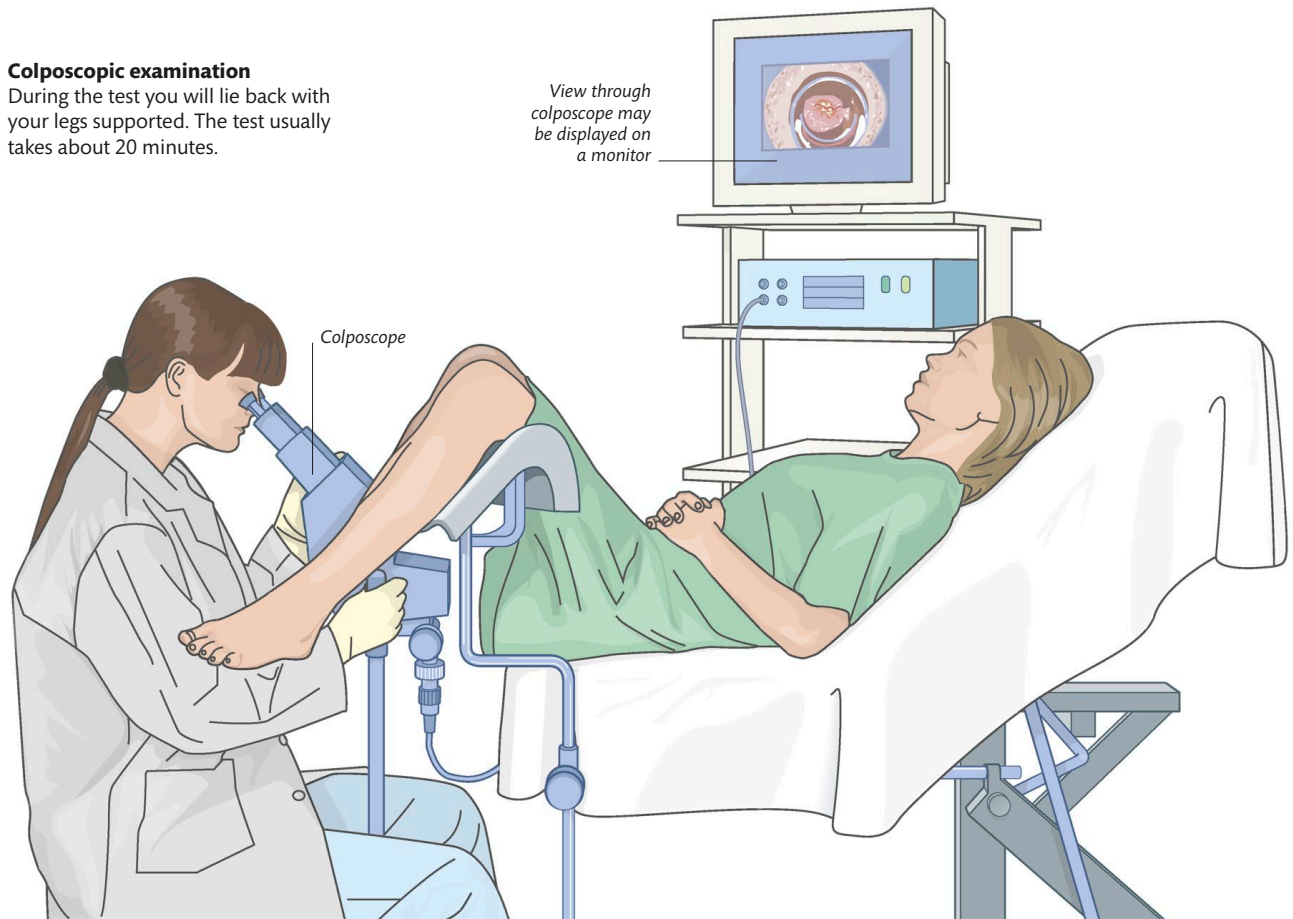
solution will be brushed onto the cervix, which reveals any areas where there are abnormal cells. This may sting a little but should not be painful. If there are any abnormal cells, the doctor can then take a small biopsy of this area and send it to the laboratory for analysis.

What the results mean

The test might show that your cervix is healthy and you will be advised to have regular smears. Sometimes the biopsy will show abnormal cells and this may need further tests or treatment.

Colposcopic examination

During the test you will lie back with your legs supported. The test usually takes about 20 minutes.



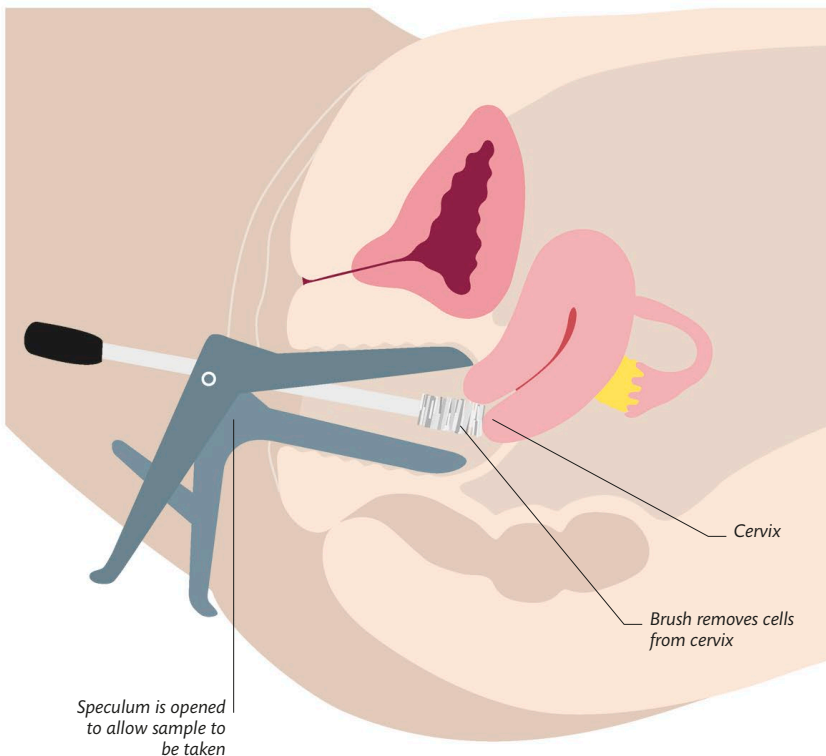
Checking for cervical cancer

A cervical, or Pap, smear is a test to check whether or not the cells of the cervix are healthy. Cells are removed and analyzed for either the presence of a virus, which can cause cancer, or for precancerous cells, which can be treated before they can develop into cancer.

Why this test is important

A smear is a screening test to help prevent cancer. Cervical cancer is thought to be caused mainly by certain types of a sexually transmitted virus called human papillomavirus (HPV). Therefore women who have ever had any kind of

sexual contact, regardless of when it was, should have regular smears. This includes lesbians and trans men who still have a cervix. You should also have smears even if you have had the HPV vaccine. However, if you have never had any sexual contact you may decide not to have this test.

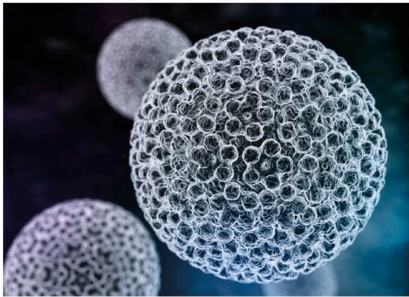


Globally, cervical cancer is the fourth most common cancer in women



Cervical screening test

A smear, also sometimes called a cervical screening test, requires cells to be taken from the cervix. The vagina is held open with a speculum while the sample is taken. Cells are then examined for abnormalities.



Cancer-causing virus
Certain strains of HPV are thought to be the cause of nearly all cases of cervical cancer. Screening for the virus is becoming an important way to determine the initial risk of someone developing cervical cancer.

Cytology
If a cancer-causing strain of HPV is found in the smear test, the individual cells are examined under a microscope for abnormalities. This is called cytology.

What the test involves
Initially you will be asked some questions regarding your periods and sexual history and you should be offered a chaperone. The test is very similar to having an internal pelvic examination (see p.90). The cervix is seen using a speculum, which may be lubricated with a small amount of gel. Cells from the cervix are removed, usually with a small brush. The cells are sent to the lab in a small pot containing a special liquid. Having the test may be slightly uncomfortable, although it should not be painful. It will also help if you can relax.
You should avoid having a smear during a period and should not have intercourse or use spermicidal cream or jelly for 24 hours beforehand.

What the results mean
You should receive your results in 2–4 weeks. Most people will have a negative (normal) result. A positive result may indicate either the presence of the HPV or abnormal cells seen on cytology. The nature of the cell changes found will determine whether you are followed up with another smear or referred for colposcopy (see p.91) to examine the cervix in more detail.

TABLE OF RESULTS	
Result	What it means
Negative or normal	No action needed—you should have another routine smear in 3–5 years.
Inadequate	There were not enough cells in the sample and the test needs to be repeated. It does not mean anything is wrong.
Positive or abnormal	Cancer-causing strains of HPV were found to be present in the sample. The sample will then be checked for any abnormal cells and further tests or treatment will depend on whether or not any abnormalities are found.

Checking for breast cancer

Breast cancer is one of the most common forms of cancer worldwide, and many countries have a screening program that offers regular mammograms, usually after the age of 50 (or earlier if certain risk factors are present). Early detection increases survival rates, as the earlier the cancer is treated, the more effective the treatment will be.

BREAST AWARENESS

To pick up breast abnormalities as early as possible, a breast self-check should be done regularly. This could be once a month or after your period.

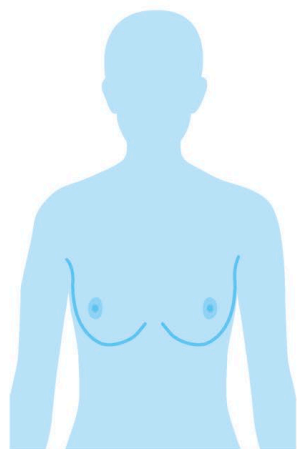
What the test involves

First, look at your breasts in a mirror. Start with your arms by your sides, then lift them up, and put your hands on your hips. Next, feel each breast, one at a time, using the hand opposite to the breast you are checking. This should be done when you are standing up and then when you are lying down, with the arm on the side you are examining lifted above your head. Use the flat part of your fingers and run your hand in a circular motion over

all the breast tissue. Remember to check the breast going right up into your armpit and also going up to your collarbone. Gently squeeze around the nipple to check for any discharge or bleeding.

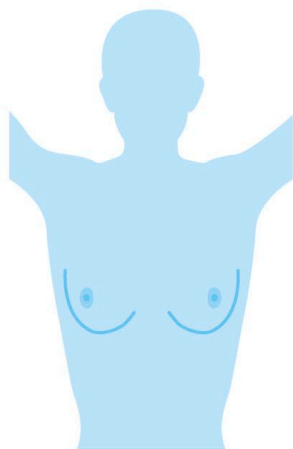
What to look for

Check for changes in the shape and contour of the skin and breasts, and any in the nipples. Examine the skin for changes such as puckering, dimpling, or any redness. And look for any breast lumps or swellings in the armpit. See your doctor immediately if you find any new changes or abnormalities. Remember that most lumps are not cancer, but it is always vital to get them checked by your doctor.



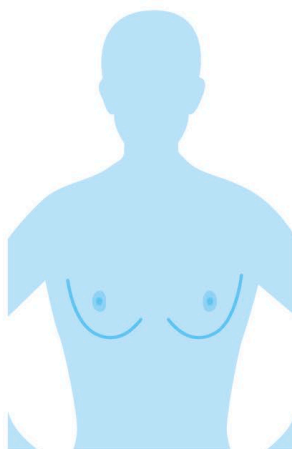
Arms down

Stand in front of a mirror with your arms at your sides and examine each breast. Look for any changes in shape, size, or symmetry.



Arms raised

Raise your hands above your head and check for changes. Always look for swelling, lumps, or changes in the skin or nipple.



Hands on hips

Now, place your hands firmly on your hips. Again see if you notice any visible changes. Remember to check up to the armpit and the collarbone.



Lying down

Move your hand in small circles, pressing all around each breast, including the nipple and armpit. Feel for any changes, swelling, or lumps in the breast tissue.



MAMMOGRAPHY

A mammogram is a low dose X-ray of your breasts that can show changes in your breast tissue, which may be breast cancer. This early detection of cancer can allow you to have treatment much sooner and will increase the chance of successful treatment.

What to expect

The mammogram takes about 10 minutes and it can pick up abnormalities even though your breasts can look and feel normal. You will first be required to remove your top clothes, including your bra. The X-ray is taken while you are standing up and each breast is X-rayed separately. The radiographer will stand you next to the machine and position your arm so that the whole breast can be seen. Your breast will then be placed on the machine's X-ray plate and a second plate will slowly be lowered onto the breast to gently squeeze it while the X-ray is being taken. This is often uncomfortable and occasionally painful, although this pressure only lasts for a few seconds. Each breast will usually be X-rayed from above and from the side.

Screening for cancer

A technician positions a patient's hand on the X-ray machine in order to ensure that she is aligned correctly for the mammogram to be taken.

What the results mean

In most cases the mammogram is normal, and you will then just be called back for a further routine screen in the future. If the mammogram result is unclear, you may be called back for a repeat test. If your mammogram shows any abnormalities, you will be called back for more tests. The radiologist will compare your latest mammogram to any others you have had in the past to see if the appearances are new or not.

If there are changes, you may have a breast examination, another mammogram, and an ultrasound scan. To rule out breast cancer, you may have a biopsy. A small sample is taken out with a needle and examined under the microscope to look for cancerous cells (see p.172).

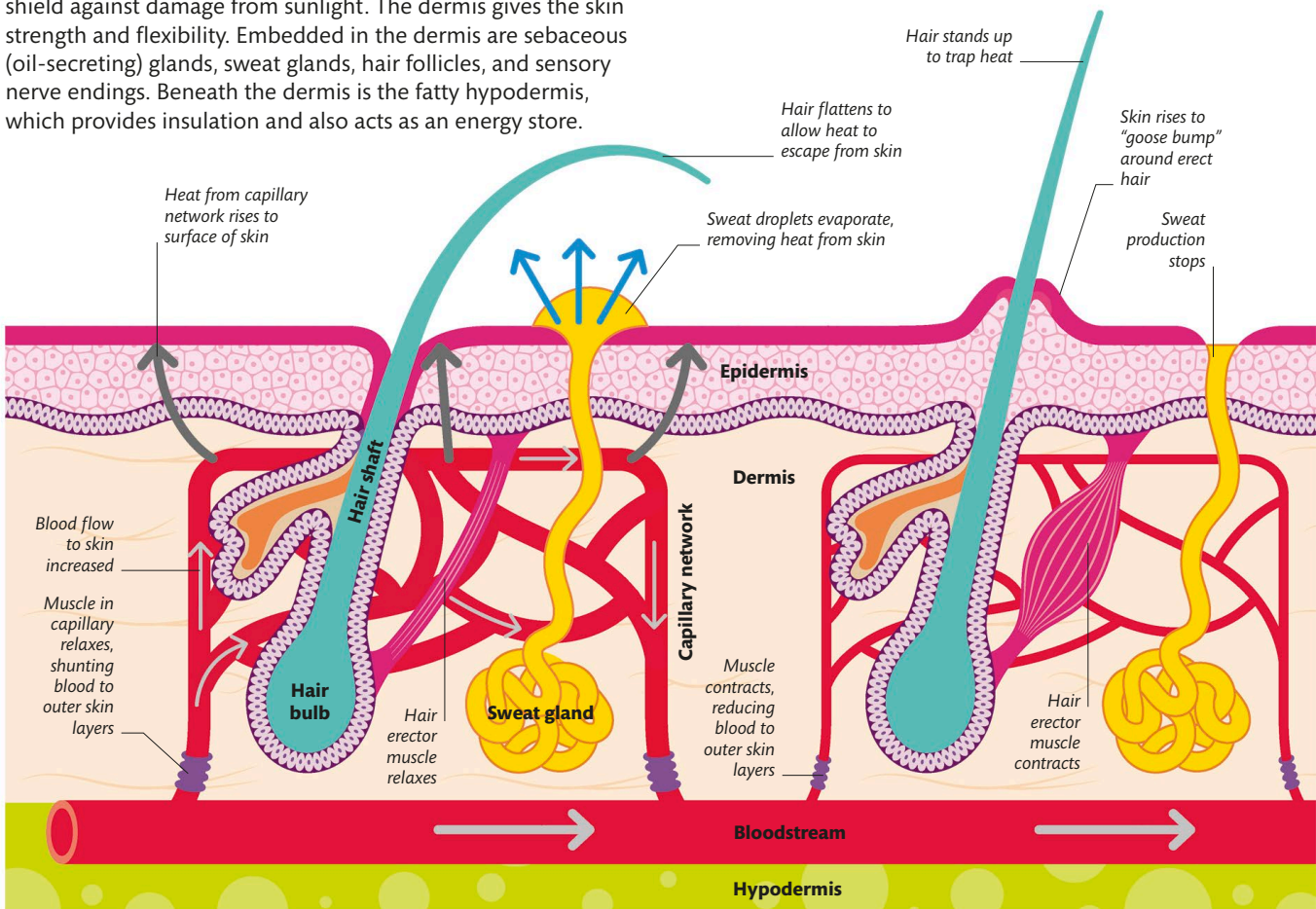
Your skin

Your skin forms a vital barrier between the body and its surroundings. It helps protect deeper tissues, and also plays a key role in regulating body temperature.

Structure and function of skin

The skin consists of a thin outer layer called the epidermis and a thicker inner layer called the dermis. The epidermis contains the pigment melanin, which determines skin color and helps shield against damage from sunlight. The dermis gives the skin strength and flexibility. Embedded in the dermis are sebaceous (oil-secreting) glands, sweat glands, hair follicles, and sensory nerve endings. Beneath the dermis is the fatty hypodermis, which provides insulation and also acts as an energy store.

The skin of an adult covers an area of about 16–21 sq ft (1.5–2 sq m)



Hot-weather skin

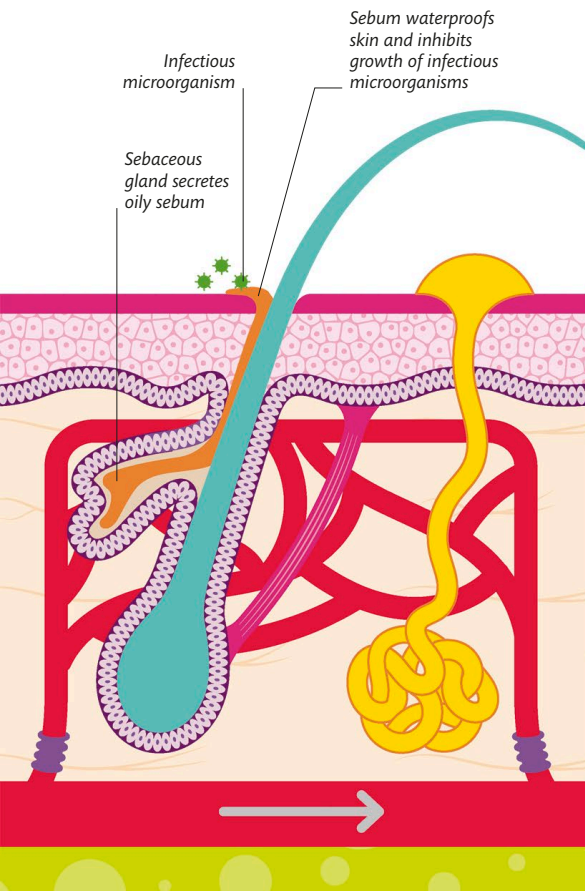
When the body is hot, capillaries in the skin widen to increase heat loss from the skin's surface. The skin also produces sweat, which evaporates and takes heat away.

Cold-weather skin

When the body is cold, skin capillaries narrow to conserve body heat. Tiny muscles at the base of hair follicles contract, pulling body hairs upright to trap warm air near the skin.

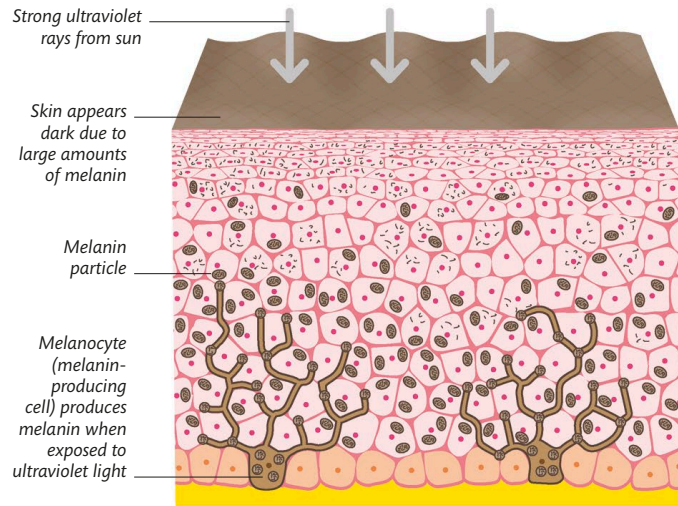
CHECKING THE SKIN

Your skin reflects your general health and can reveal signs of a range of conditions. Checking the skin can therefore be a valuable health indicator. Changes in the skin may be caused by a disorder of the skin itself, such as skin cancer or a fungal infection, or may indicate a more general disease involving other body systems. Conditions affecting the skin often look different in dark skin and light skin.



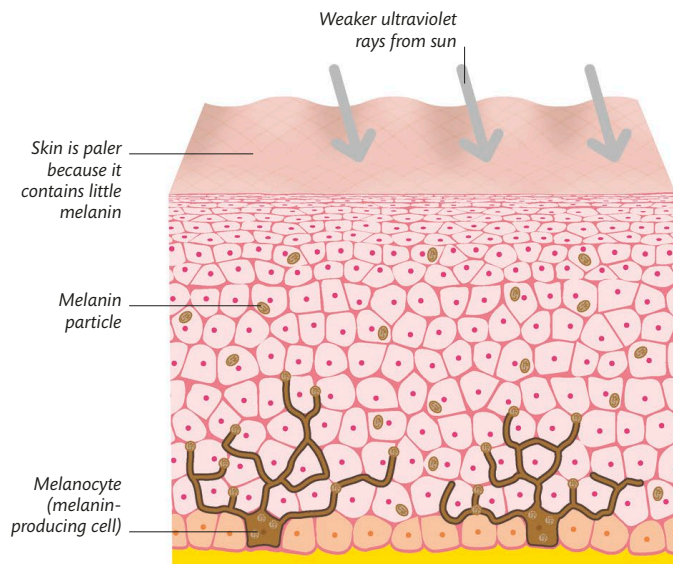
Defensive barrier

The epidermis is a tough, waterproof layer whose dead surface cells are constantly replaced by new cells from beneath. Sebum reduces water loss from the skin surface and protects against infection.



Dark skin

Dark skin contains large amounts of melanin, a pigment that helps protect against ultraviolet rays in sunlight, which can trigger skin cancer. Vitamin D is made in skin exposed to ultraviolet light, and people with dark skin are at risk of deficiency if they receive too little sunlight.



Pale skin

Pale skin contains small amounts of melanin but this is usually sufficient to protect against the weaker ultraviolet rays from the sun outside equatorial regions. However, people with pale skin are more at risk of skin cancer if they are exposed to a lot of sunlight.

Checking your skin

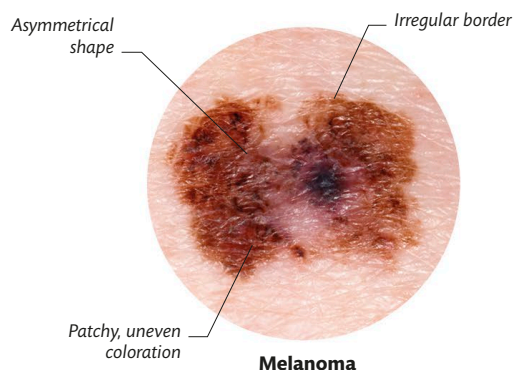
Regularly checking your skin can help detect any problems early, when they are more easily treatable. Most skin complaints are minor but some, notably melanoma, are potentially serious and require prompt medical evaluation. Some skin problems may also indicate an underlying disorder that may require medical intervention.

Skin examination

It is important to check your skin regularly for any abnormalities, especially any new moles or changes to existing ones, which may indicate melanoma skin cancer (see below). Check your entire skin in a well-lit area. Use a mirror or ask somebody else to check areas you cannot see yourself. It is useful to photograph the size, position, and appearance of moles. If you spot anything unusual, you should consult a doctor, who will perform a detailed examination, including inspecting the skin with a dermoscope and possibly taking whole-body images to map all your moles.

Signs of possible skin cancer

Features of moles that may indicate melanoma include asymmetrical shape, irregular border, uneven color, size over $\frac{1}{4}$ in (6 mm) and any change in appearance. You should also look out for any other unusual lump, sore, or blemish that grows, darkens, hurts, itches, bleeds, or does not heal within about four weeks.



Dermoscopy

Dermoscopy involves a detailed inspection of the skin with a magnifying instrument (a dermoscope). The dermoscope may be connected to a digital imager, which enables the images to be enhanced to aid accurate identification of abnormalities.



Common skin problems

Although skin problems are common, they are not usually serious and often clear up without treatment or with simple self-help measures, such as using an over-the-counter preparation for a mild fungal infection (athlete's foot, for example). The table (right) outlines typical features of some common problems. To confirm what the problem is, you should consult a doctor, especially if it persists, worsens, or recurs. The doctor will also be able to advise you about suitable treatment.



Glass test for meningitis

A type of bacteria that can cause potentially life-threatening meningitis can also cause a rash. The rash usually starts as tiny purplish spots. It does not fade if you press a clear glass against the skin. In dark skin, the rash may be easier to see on the palate or in the eyes. Meningitis is a medical emergency.

PROBLEM	TYPICAL FEATURES
Psoriasis	Thickened patches with silvery scales; an autoimmune disorder
Seborrheic dermatitis	Scaly, itchy patches on scalp (dandruff) and face
Athlete's foot	Itchy, sore, cracked skin between toes due to fungal infection
Ringworm	Itchy, ring-shaped patches due to fungal infection
Urticaria	Rash of itchy, raised lumps or patches due to allergic reaction
Skin tag	Soft lump that hangs from the skin
Blister	Fluid-filled swelling just under skin surface
Cold sores	Painful cluster of tiny blisters near edge of lips due to a virus
Sunburn	Painful, red, hot areas on skin exposed to sun
Warts and plantar warts	Firm, rough growths; plantar warts are warts that flatten into the soles of the feet
Corns and calluses	Thickened areas on hands or feet in areas of pressure or friction
Bruise	Dark, discolored area from bleeding under the skin due to injury, a blood disorder, or some medications
Insect bites	Small, itchy lumps that may have a tiny central bite-hole
Boil or abscess	Painful, pus-filled spot or lump due to bacteria
Acne	Pimples, spots, and greasy skin on face due to bacteria
Folliculitis	Pus-filled pimples around hair follicles due to bacteria
Cyst	Rounded, fluid-filled lump
Eczema	Dry, itchy patches on skin

SELF-HELP MEASURES



Diet



Eat a well-balanced diet



pp.146-147



Smoking



Quit smoking



pp.150-151



Ultraviolet light



Avoid excessive exposure to sunlight and other sources of ultraviolet light; use sunblock with an SPF of 30 when outdoors



pp.158-159

How the eyes work

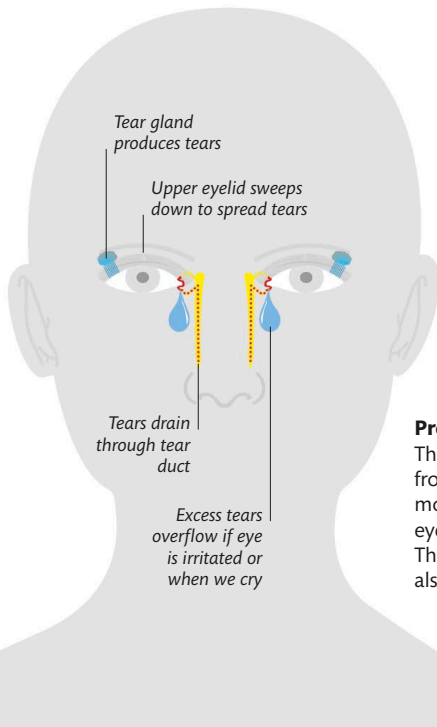
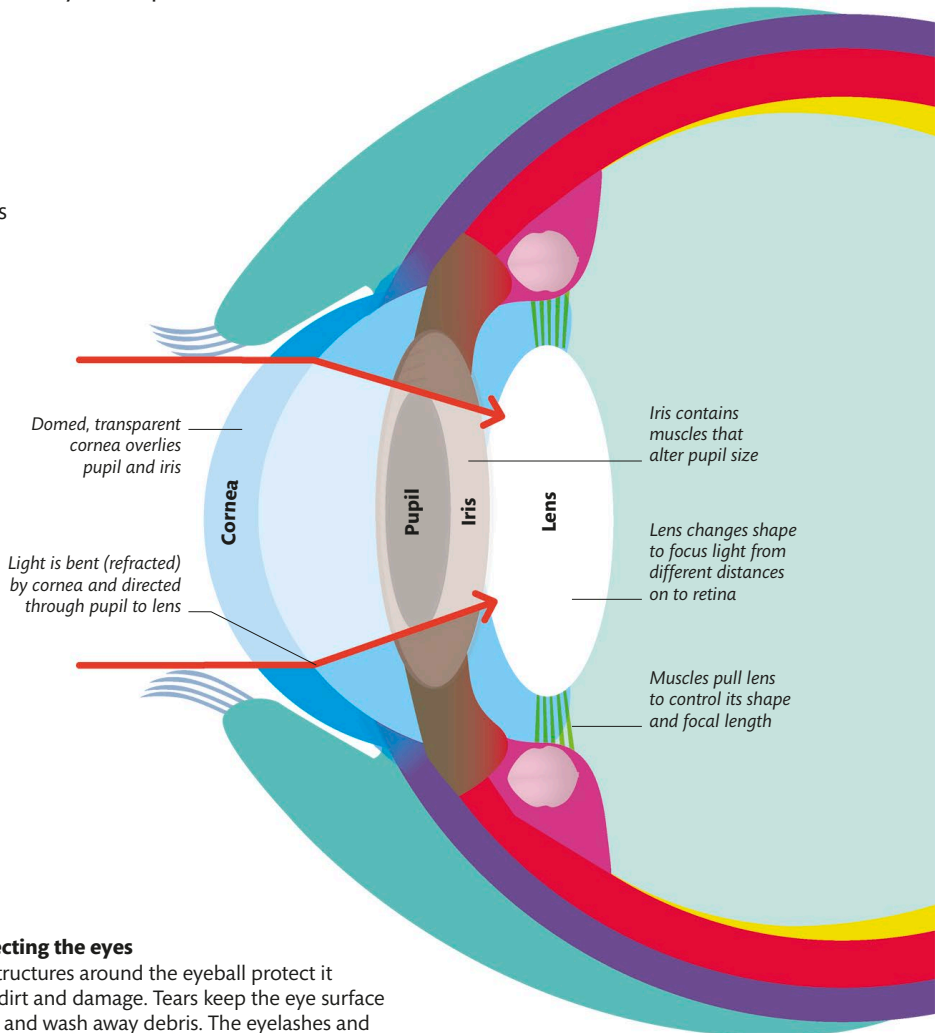


The retina contains
120–150 million rod cells
and **6–7 million cone cells**

The eyes take in light and focus it, producing sharp images. Their internal structures adjust automatically to control the focal length and the level of light entering the eye for optimum vision.

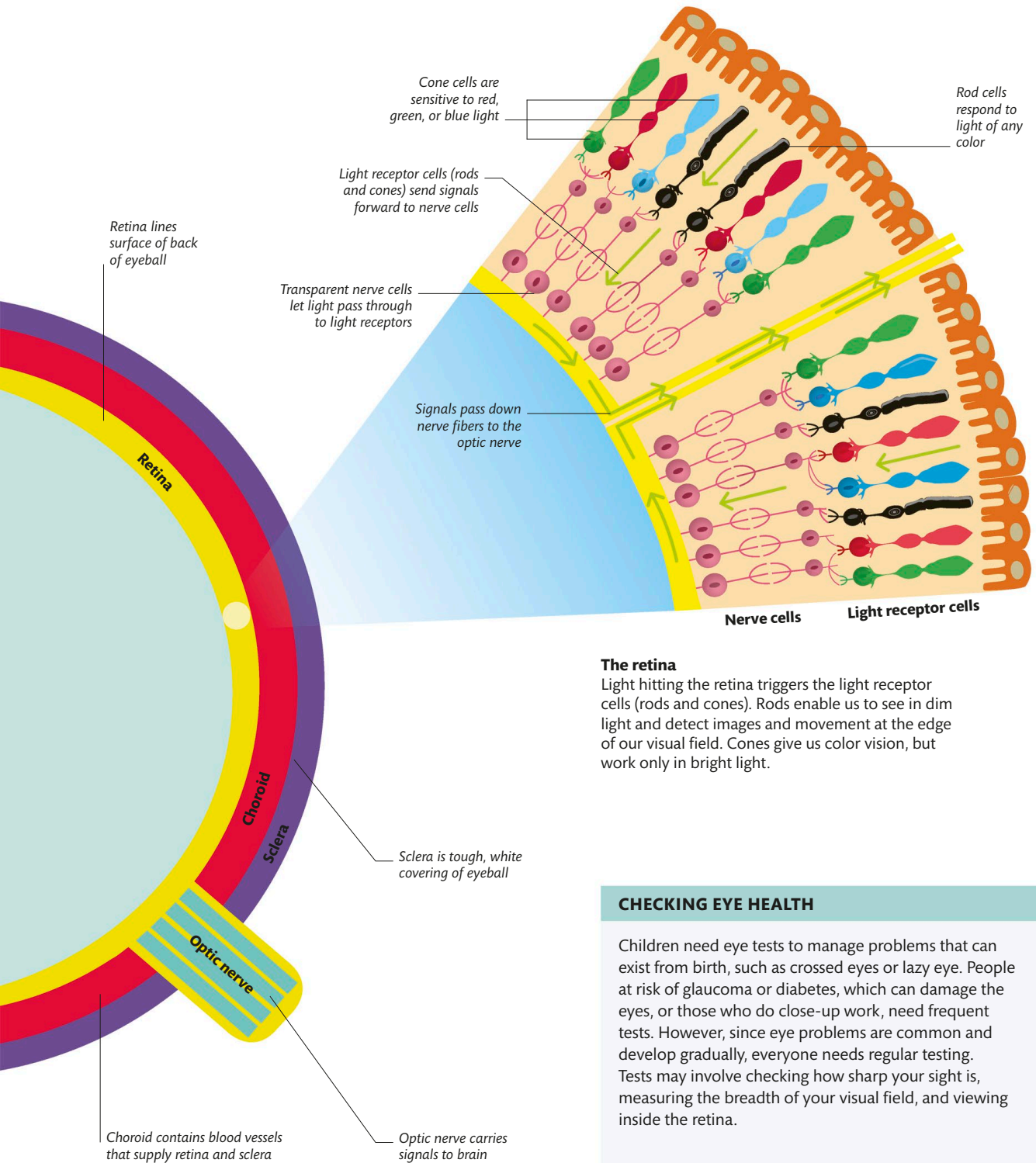
Structure of the eye

Structures at the front of the eye focus light on to light-receptive cells in the retina, deep inside the eyeball. Electrical signals from these cells pass along the optic nerve to the brain, which interprets the signals as images. Signals from both eyes are combined to give us depth perception. Muscles around the eyeball point the eye in different directions. The colored part of the eye, the iris, controls the amount of light entering the pupil, so we can see in bright or dim light.



Protecting the eyes

The structures around the eyeball protect it from dirt and damage. Tears keep the eye surface moist and wash away debris. The eyelashes and eyebrows trap debris before it enters the eye. The eyelids cover the eyes to protect them; they also spread tears across the eye by blinking.



The retina

Light hitting the retina triggers the light receptor cells (rods and cones). Rods enable us to see in dim light and detect images and movement at the edge of our visual field. Cones give us color vision, but work only in bright light.

CHECKING EYE HEALTH

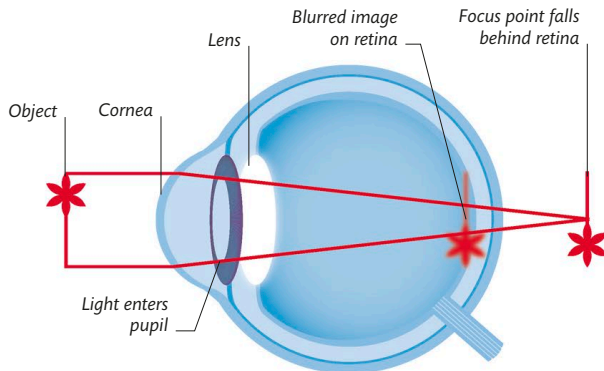
Children need eye tests to manage problems that can exist from birth, such as crossed eyes or lazy eye. People at risk of glaucoma or diabetes, which can damage the eyes, or those who do close-up work, need frequent tests. However, since eye problems are common and develop gradually, everyone needs regular testing. Tests may involve checking how sharp your sight is, measuring the breadth of your visual field, and viewing inside the retina.

Testing vision

One of the main aims of an examination by an optometrist (health care specialist trained to examine the eyes) is to check for vision disorders—most commonly refractive, or focusing, errors that can be adjusted by prescribing corrective lenses. Because eyesight changes with age, vision should be tested regularly.

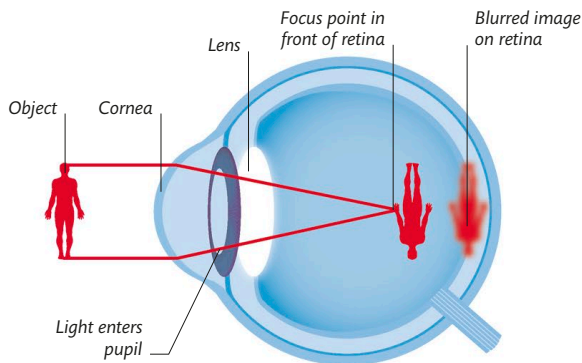
Potential refraction problems

Light is bent, or refracted, by the cornea and the lens to focus an image on the retina. Focus can be affected by the length of the eyeball and shape of the cornea (astigmatism, see p.104). Age-related lens hardening also causes gradual loss of the ability to focus on close-up images (presbyopia).



Farsightedness

Difficulty seeing nearby (and to a lesser extent, distant) objects—hypermetropia—occurs if the eyeball is too short, but can be corrected with plus-powered (convex) lenses.

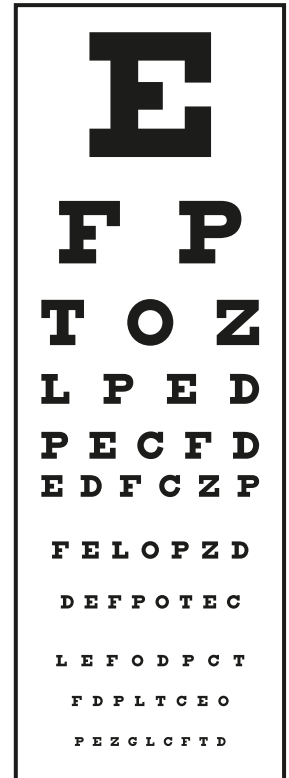


Nearsightedness

Difficulty in seeing distant objects clearly—myopia—can occur if the eyeball is slightly too long, but can be corrected with minus-powered (concave) lenses.

Refraction testing

An optometrist will test your vision by asking you to look through a series of lenses using a phoropter (opposite) or a trial frame to find out whether you have a refractive error. If one is found, the lenses will be adjusted until the right prescription is identified. Distance refraction is always assessed first, then if extra lens power is needed for close work, this can be added to your prescription.



Snellen chart

To test visual acuity, you may be asked to read lines of letters of gradually decreasing size on a screen or chart, named after the Dutch ophthalmologist who designed it. Each eye will be assessed separately.

ONLINE VISION TESTS

A number of websites now offer rudimentary online eye tests. Depending on the site, there is a range of options, from visual acuity and contrast and color vision tests, to assessment of the curvature of the cornea (astigmatism) and even field of vision (see p.108). They are useful as they can indicate whether your sight has changed, but should not be considered as a substitute for a check-up with an optometrist, as this will include a comprehensive eye-health examination.



Assessment with a phoropter

This is a device, used instead of a trial frame, which holds different lenses that can be dropped in front of each eye. Some units are controlled manually, others via a computer.

It is a myth that wearing reading glasses for presbyopia weakens eye muscles



SELF-HELP MEASURES			
	Diet	▶ Eat a healthy diet	▶ pp.146–149
	Smoking	▶ Quit smoking	▶ p.151
	Protection	▶ Wear sunglasses and use goggles	▶ p.161

Testing for astigmatism

33% of the population has astigmatism in one or both eyes



Astigmatism is an irregular curvature of the cornea or the lens of the eye. It can cause light to be focused in more than one place within the eye, which can result in a blurred image.

When is it tested?

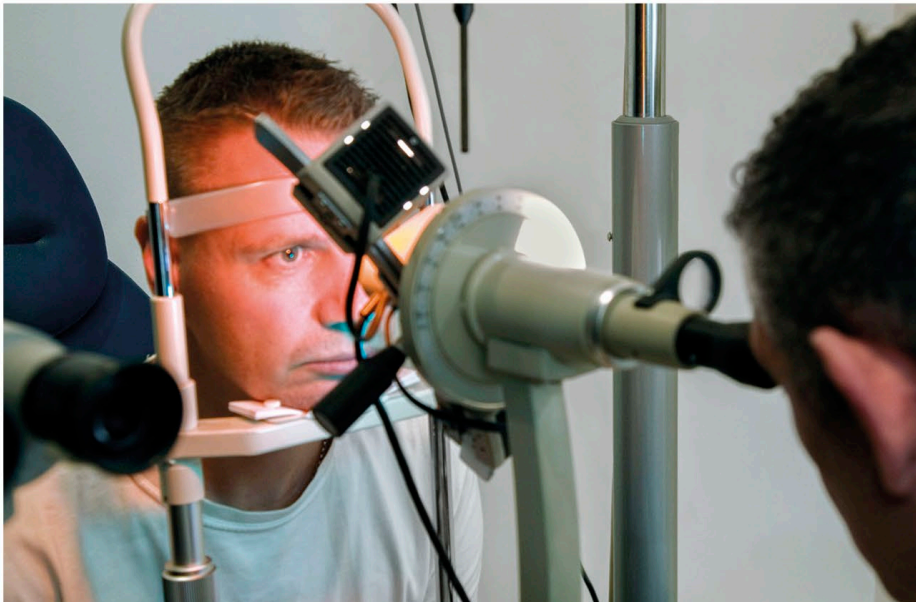
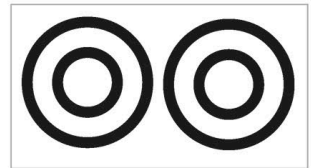
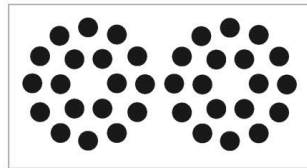
Astigmatism can cause blurring of distance and near vision, in addition to focusing errors that accompany nearsightedness, farsightedness, or presbyopia. The greater the difference in the curvature from the norm, the more difficult it is to focus. Your optometrist will check for astigmatism as part of the vision test (see p.102–103). Using a phoropter or a trial frame, they will present a series of lenses and ask you to look at circular targets (see right), then state when they appear clear and round.

What do the results mean?

Astigmatism does not go away. If it is mild, you may have no symptoms and require no treatment. If it is significant enough to cause blurred vision or eyestrain, then it will require correction with glasses, contact lenses, or even

laser surgery. The level of correction needed can be added to your prescription (see p.102).

If you wear contact lenses, the degree of astigmatism can also have a bearing on the type of contact lenses you can wear. Your optometrist may also need to take an exact measurement of the shape of the front of the cornea as well as the amount and alignment of the astigmatism, using a keratometer, or ophthalmometer (see below).



Focusing the circles

Your optometrist will either show you a pair of concentric circles (right) or circular patterns of dots (left).

A keratometer in use

With your chin and forehead supported, the optometrist will shine a target onto the cornea. By observing its reflection in the keratometer eyepiece they can measure the surface curvature.

Color vision test

People with color vision deficiencies have difficulty identifying some colors or distinguishing between certain colors—typically red and green, and more rarely, blue and yellow—and will generally see fewer colors than people without them.

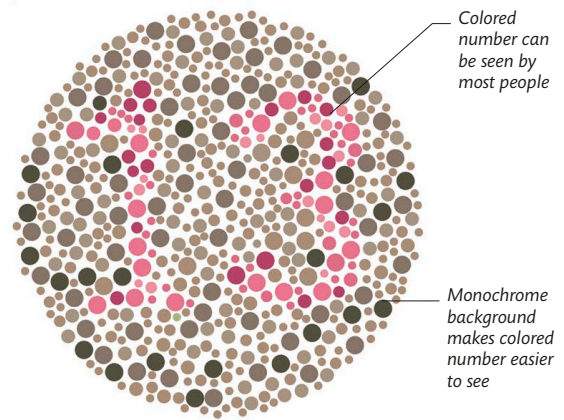
How color vision is assessed

Most color vision defects are inherited, and the need for testing will be identified when an optometrist takes a family history. It is recommended that all boys are screened, but a girl need only be tested if her mother or her male relatives are color deficient, or if she appears to have difficulty recognizing certain colors.

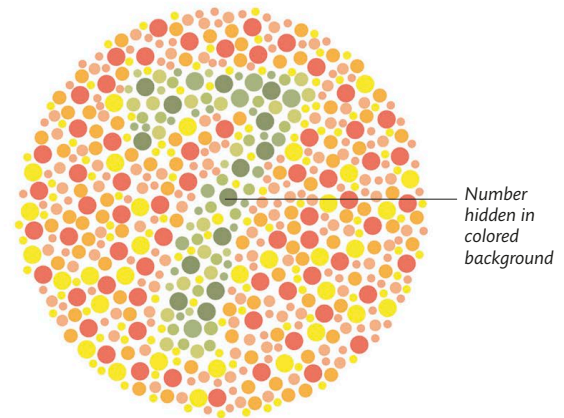
The most commonly used color vision test is the Ishihara test, named after the Japanese ophthalmologist who invented it, which is especially good for identifying red/green color deficiencies. The test comprises 38 color plates, including one control card, most of which have colored numbers hidden within a pattern of different colored dots. You will be shown the cards and asked to identify the numbers you can see. Another widely used test is the Farnsworth D-15 test, in which you will be asked to arrange 15 colored disks in sequence.

What the results indicate

People with a hereditary deficiency do not have a disease and the condition does not change. Contrary to popular belief, those affected are not “color blind”—it is very rare for a person to be unable to see any colors at all. The deficiency may be slight, moderate, or severe and may have an impact on potential career choices—tinted lenses can help in some cases. Some color vision defects can develop later in life, but they are likely to be associated with drugs, disease, or toxins (from excessive drinking and smoking, for example). Acquired defects are usually worse in one eye than the other and more often associated with a blue/yellow defect; they may improve, but can worsen, too.

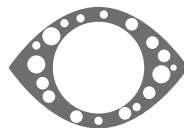


Introductory, control plate



Screening and classification plate

**1 in 12 men and only
1 in 200 women have
color vision problems**



Examples of Ishihara plates

The control plate is shown so you understand what is required in the test. Plates with colored dots are used to indicate the type and level of color deficiency.

Checking your eye health

As well as assessing your eyes for refractive errors, your optometrist will routinely check both the front and inside of your eyes. The checkup can reveal signs of eye-related health issues, from cataracts (lens clouding) to age-related macular degeneration; it can also indicate general physical conditions such as diabetes.

Examining the front of the eye

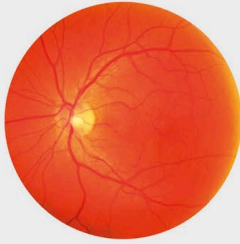
Your optometrist will begin by checking all the structures at the front of your eyes, from the eyelids and lashes to the body of the eye (see p.100), using a slit lamp. The lamp

focuses a narrow beam of light onto the eye, enabling them to examine the eye through a microscope. The light is normally white, but green or blue light may be used; if it is the latter, then yellow dye will be instilled in your eye first.



RETINAL PHOTOGRAPHY

A photographic image of the back of the eye (the fundus) provides a visual record of the health of your eyes and is a useful way to monitor any change in their appearance. Eye drops may be needed to dilate the pupil sufficiently, and you will sit in front of the camera with your chin and forehead supported in a frame.



Fundus image of a healthy eye

Examining the inside of the eye

Using a handheld ophthalmoscope or a slit lamp, your optometrist will shine a light directly into each eye to examine the internal structures: lens, light-sensitive retina (including the macula), retinal blood vessels, the head of the optic nerve, and the vitreous humor that fills the eye. It may be necessary to instill drops to dilate the pupils. This is painless, but you may need to wear sunglasses for an hour or two afterward and your vision may be blurred, so you might be advised not to drive.



An estimated 80% of all vision impairment worldwide is considered avoidable



Ophthalmoscope examination

As the light is directed into your eye, you will be asked to look straight ahead, then right and left, and up and down, while the optometrist scans inside the eye.

Slit-lamp examination

You will need to place your chin on a rest and your forehead against a strap. The optometrist will direct a beam of light onto the front of each eye while looking through the eyepiece of the microscope.

Testing visual field

Also known as perimetry, this test assesses the extent, or perimeter, of your visual field. This is done routinely to determine whether you have a blind spot, or more frequently if you are at a high risk of glaucoma.

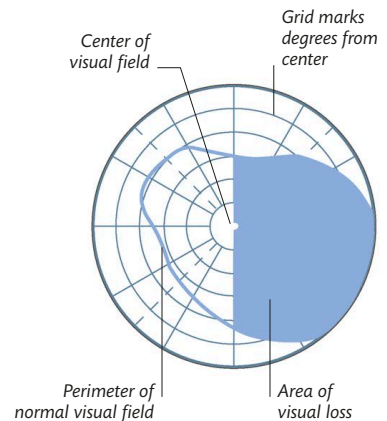
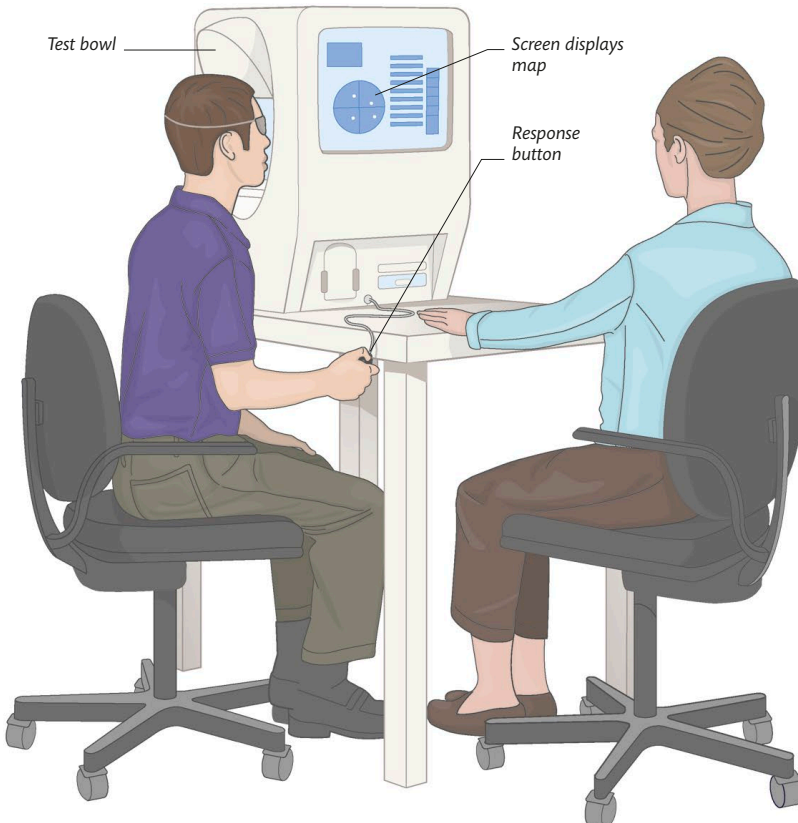
What to expect in the test

A confrontation test may be performed initially. Your optometrist will sit 3 ft (1 m) in front of you and ask you to look directly into their eye or at the tip of their nose. They will then wave their finger or an object at the edge of your visual field and ask you to indicate when you can see it. While this is not sensitive enough for fine assessment, it shows any major defects. An accurate assessment can be performed with automated perimetry testing, which “maps” your field of vision. You will sit at the machine while a set of lights flashes at the edge of your line of sight.

Understanding your results

If a defect is identified it is important that its size and position are analyzed. You will need to be monitored more closely to check for any change. Your optometrist may refer you to an ophthalmologist to identify the possible cause.

Loss of peripheral vision severely affects ability to drive safely



Visual field map

The perimetry machine tracks the position of the lights you do not see, and in doing so creates a “map” that shows the area of visual loss.

Automated perimetry test

If you wear glasses, the eye being tested will have your lens prescription placed in front of it; the other one will be covered. You will be asked to focus on the center of the test bowl and press a response button each time you see a light flashing.

Measuring eye pressure

Your optometrist will routinely measure your internal eye (intraocular) pressure to determine whether you are at risk of developing glaucoma, a condition in which the optic nerve can be damaged by an abnormal buildup of pressure (ocular hypertension).

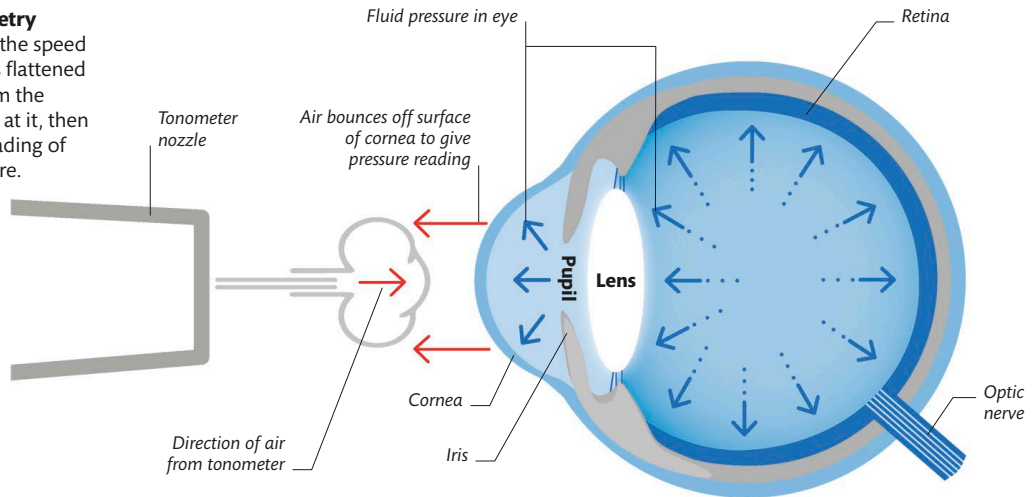
How is pressure measured?

Your eye is filled with a clear fluid that washes around inside it, passes through the pupil, and drains out through the "angle" between the cornea and the iris. The drainage channels can become blocked, leading to a buildup of

pressure within the eyeball. Your eye pressure can be measured with a table-mounted or handheld non-contact tonometer, placed $\frac{1}{2}$ – $\frac{3}{4}$ in (1–2 cm) in front of your eye. This emits a painless puff of air at the cornea. It will make you blink, but by then the reading has already been taken.

Non-contact tonometry

This device measures the speed at which the cornea is flattened when a puff of air from the tonometer is directed at it, then gives an estimated reading of the intraocular pressure.



What do the results indicate?

If your intraocular pressure is repeatedly raised, or is much higher in one eye than the other, a more precise measurement using applanation tonometry will be recommended. You may also be referred to an ophthalmologist for further tests and a more detailed examination before a full diagnosis can be made.

Glaucoma can lead to permanent loss of peripheral vision and even total blindness



APPLANATION TONOMETRY

Also known as contact tonometry, this is a very precise measurement in which a small tonometer probe is gently placed on the front of the cornea. Before the procedure, anesthetic drops and dye will be put in your eyes. During the test, which takes a few seconds, the optometrist will observe the flattening of the cornea and take an exact reading of the intraocular pressure in each eye.



Tonometer in use

How the ears work

Our ears have two very important functions. The most obvious one is hearing, a process that involves the whole ear. A less familiar function is enabling balance, which is done by certain structures in the innermost part of the ear.

Structures of the ear

The ear has three main parts called the outer, middle, and inner ear. In the outer ear, the pinna (visible part) directs sound waves down the ear canal to the eardrum. The eardrum vibrates; this causes ossicles (tiny bones) in the middle ear to move, transmitting the vibrations to the inner ear. Here, the vibrations are converted to electrical signals that are sent to the brain, which interprets them as sounds. Also in the inner ear are structures that register our movements and orientation relative to gravity, to maintain our balance.

Your ears never stop hearing sounds, even when you are asleep

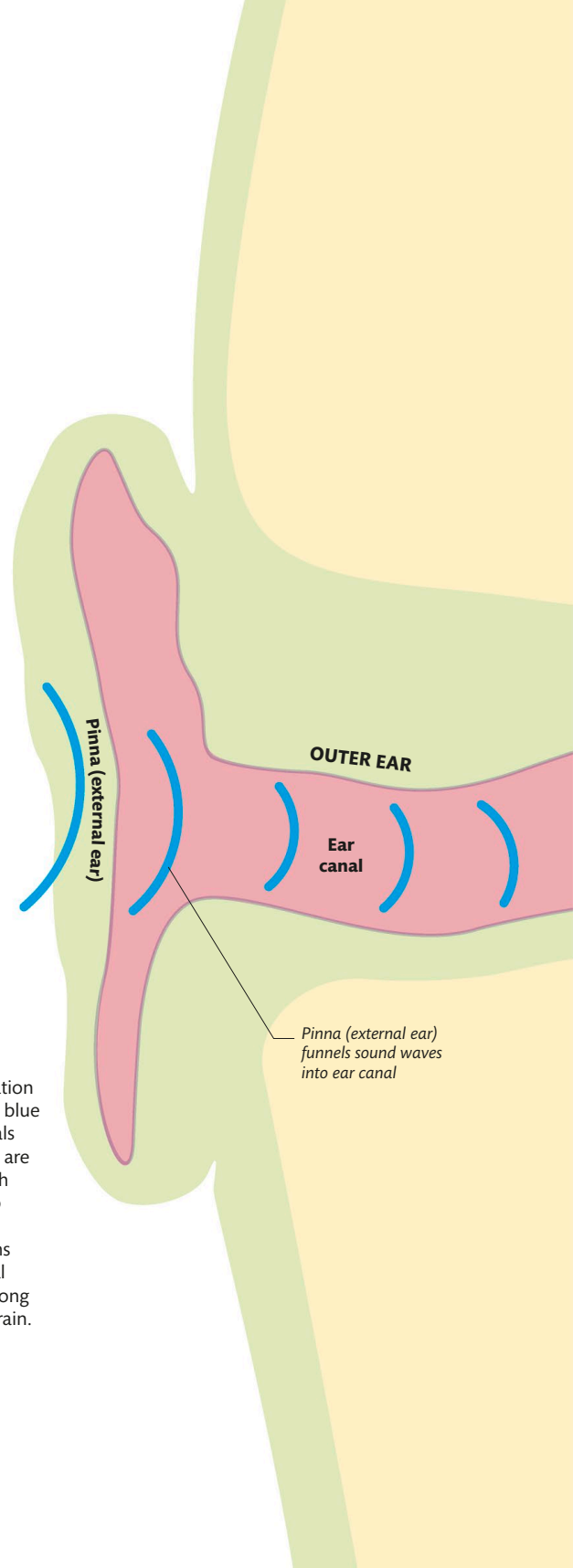


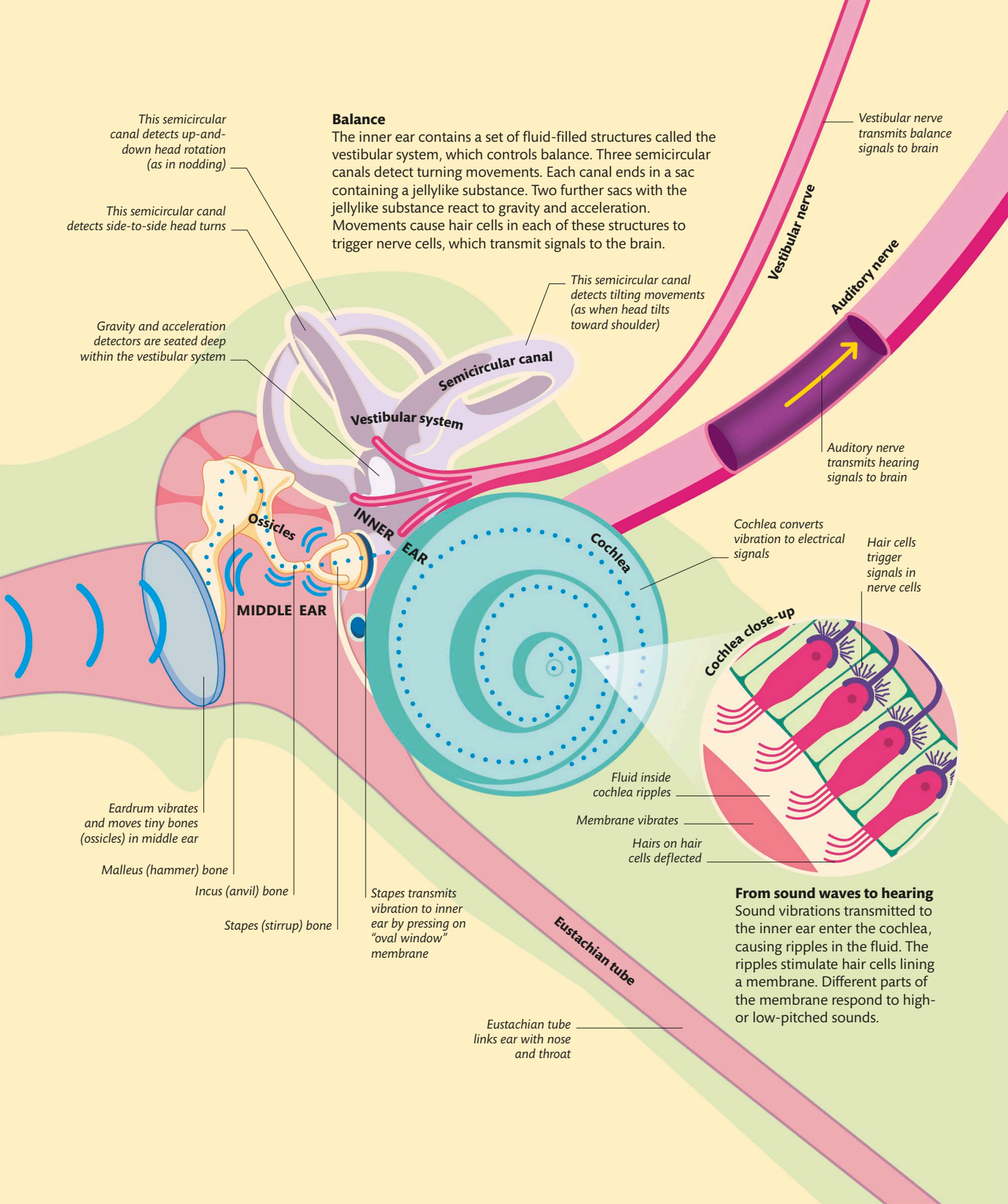
EAR TESTS

Most ear tests involve hearing. Babies and children are tested so that deafness can be picked up as early as possible. Adults may be tested for age-related hearing loss or to identify temporary problems such as earwax buildup or infection. Tests may involve examining your ear canal and eardrum and assessing your ability to hear sounds. Balance tests may involve the doctor moving your head and body to investigate problems that may be making you feel sick or unsteady on your feet.

Hearing pathway

The route of sound information through the ear is shown in blue in this illustration. The signals begin as sound waves, then are passed as vibrations through the eardrum and ossicles to a fluid-filled organ called the cochlea. Here, the vibrations are converted into electrical signals, which are passed along the auditory nerve to the brain.





Balance

The inner ear contains a set of fluid-filled structures called the vestibular system, which controls balance. Three semicircular canals detect turning movements. Each canal ends in a sac containing a jellylike substance. Two further sacs with the jellylike substance react to gravity and acceleration. Movements cause hair cells in each of these structures to trigger nerve cells, which transmit signals to the brain.

From sound waves to hearing

Sound vibrations transmitted to the inner ear enter the cochlea, causing ripples in the fluid. The ripples stimulate hair cells lining a membrane. Different parts of the membrane respond to high- or low-pitched sounds.

Testing your hearing

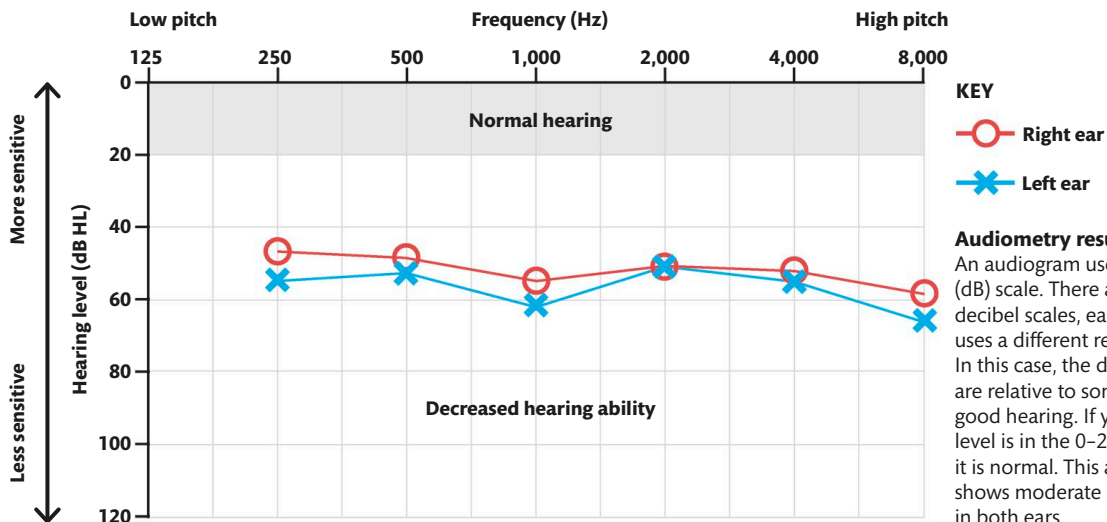
Untreated hearing loss has been linked with increasing the chances of developing dementia, a decrease in cognitive function, and also has possible links with depression. For these reasons, it is important to have your hearing checked throughout your lifespan.

Audiometry

Pure-tone audiometry is a test designed to measure the quietest sounds that you can hear. During the test you will listen to pure tones (sounds at a single, precise frequency, or pitch) at different volumes and frequencies. You listen through headphones and press a button each time you hear a sound. The results show the quietest sounds you can hear at each frequency and are plotted on a graph called an audiogram, with red circles for the right ear and blue crosses for the left. The graph shows a measure of hearing level against frequency. Any points that are heard at 20 decibels (dB) or quieter are considered to be within the normal range. The lower down the graph the points are plotted, the worse the hearing is.

What the test involves

Audiometry is ideally carried out in a soundproof booth to isolate you from ambient noise. You press a button whenever you hear a sound in the headphones.



Audiometry results

An audiogram uses a decibel (dB) scale. There are lots of decibel scales, each of which uses a different reference value. In this case, the decibel values are relative to someone with good hearing. If your hearing level is in the 0–20 dB HL range, it is normal. This audiogram shows moderate hearing loss in both ears.

Speech perception test

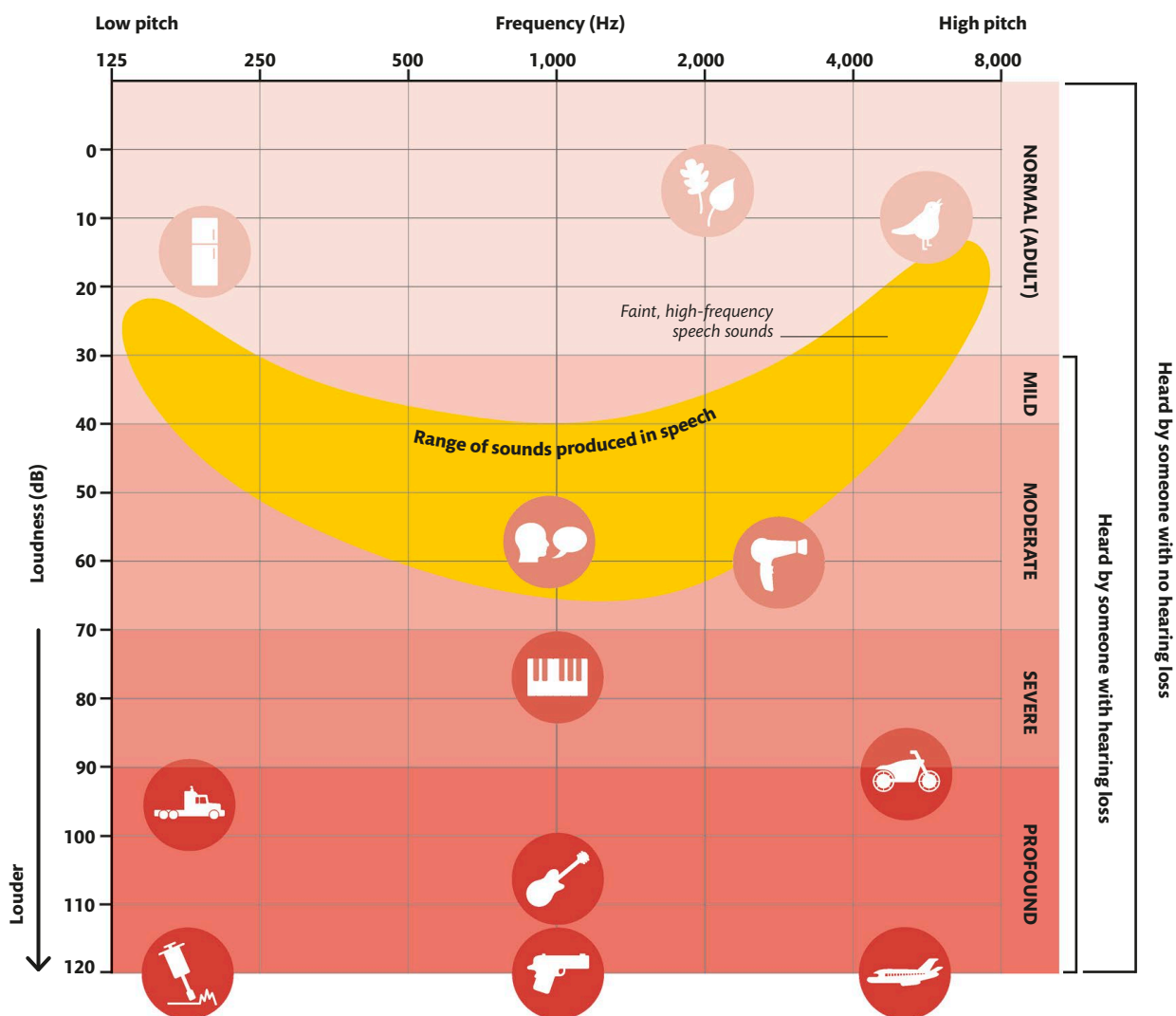
Pure tones, as used in audiometry (left), are rarely encountered in our day-to-day lives. The chart below shows the loudness and frequency of sounds as we commonly experience them, with speech sounds in yellow. Speech testing gives information that is more relevant to daily listening experiences. It is similar to pure-tone audiometry, but you will listen to words rather than sounds. It is a useful test to perform when considering hearing-aid provision, as it measures your ability to hear and interpret speech, and hearing aids are designed to improve the way you do this.

Noise at 100 dB can damage hearing in 15 minutes



The speech banana

The range of speech sounds we experience resembles a banana shape when plotted on a frequency-loudness chart. Extreme low- and high-frequency speech sounds tend to be fainter, but within normal hearing range. Listeners with even mild hearing loss, however, fail to hear these components of speech.



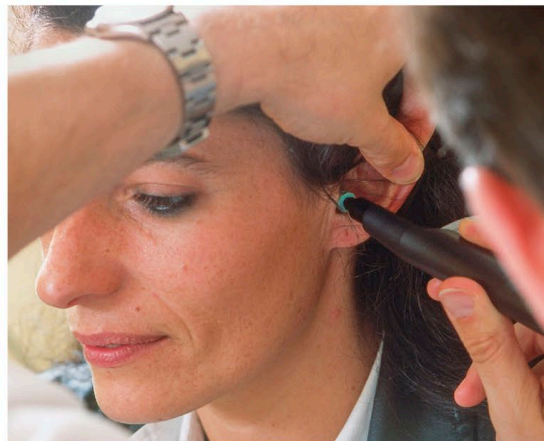
Tympanometry

Tympanometry is an examination used to test the condition of the middle ear and the mobility of the eardrum (tympanic membrane). It can help diagnose disorders that can lead to hearing loss, especially in children. The test measures the movement of your eardrum in response to changes in pressure.

What to expect

Tympanometry is a test to find out how effectively the middle ear transmits sound to the inner ear. When sound hits the eardrum, some is sent through the middle ear to the inner ear, while the rest is reflected from the eardrum. If the eardrum is functioning properly, it will be flexible and there will be little reflected sound; the admittance (also called compliance) of the ear is said to be high.

To begin the test, the audiology professional looks into your ear with an otoscope to check that there is nothing obstructing the ear canal. A tympanometer probe is then placed into the ear canal. The device emits a tone; it may feel slightly uncomfortable and you will hear some loud sounds as the device takes measurements. The probe changes the air pressure in your ear to move the eardrum back and forth, causing sensations similar to those you might feel during takeoff and landing on a plane. The test takes a few minutes.



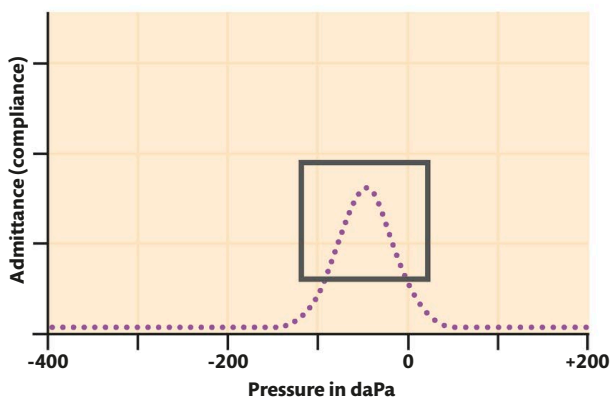
Tympanometer probe

The probe of a tympanometer has a soft rubber tip. The pressure of the rubber tip against the ear canal wall forms an airtight seal.

Interpreting the results

The graph produced, called a tympanogram, helps the audiology professional decide whether you have normal middle-ear function. If the test is normal, it means that there is no fluid in the middle ear, the eardrum moves normally, there is normal pressure in the middle ear, and there is normal movement of the ossicles (small bones) of the middle ear that conduct sound to the inner ear.

The most common reason for an abnormal tympanogram is fluid in the middle ear, but other common causes are perforation of the eardrum; earwax blocking the eardrum; lack of mobility or other problems with the ossicles of the middle ear; or a problem with the Eustachian tube, which links the nose and throat with the middle ear. If abnormal results are obtained, you may be referred to an ear, nose, and throat doctor for a medical opinion.

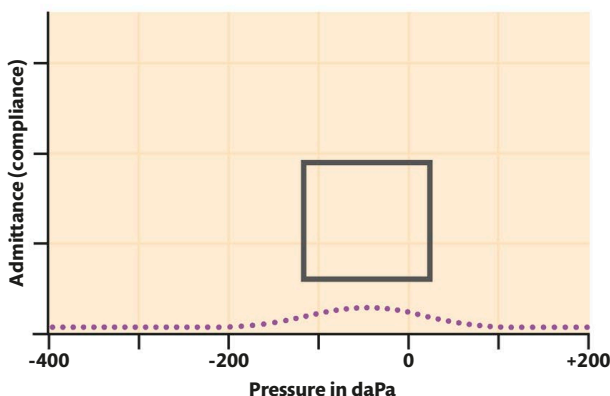
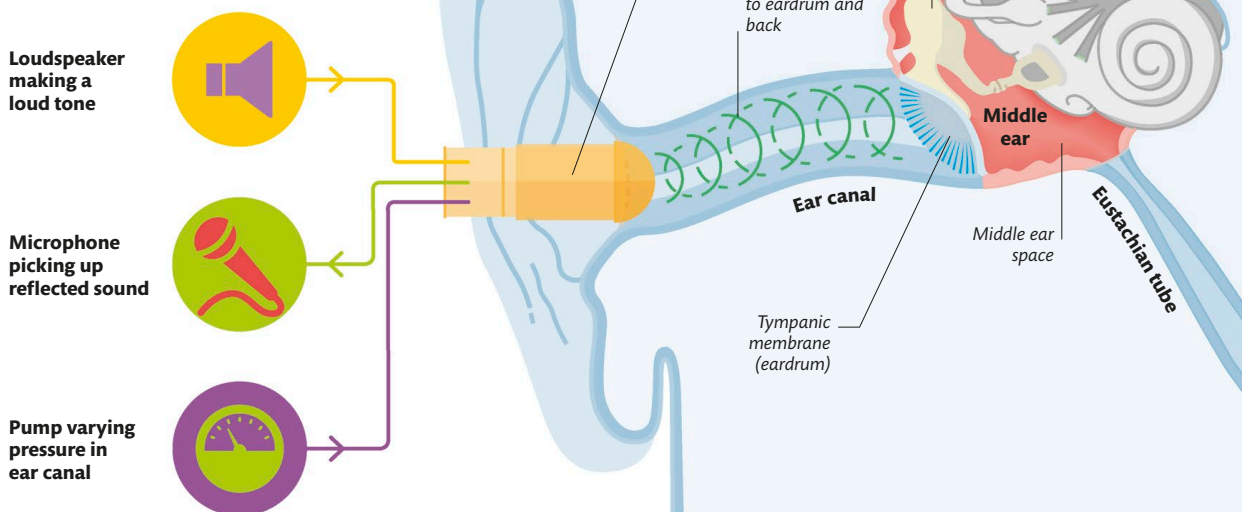


Normal tympanogram

The axes of a tympanogram show admittance (compliance) plotted vertically, while the pressure is plotted horizontally in either decapascals (daPa) or millimeters of water (mm H₂O). A peak in admittance in the box on the chart shows normal middle ear function.

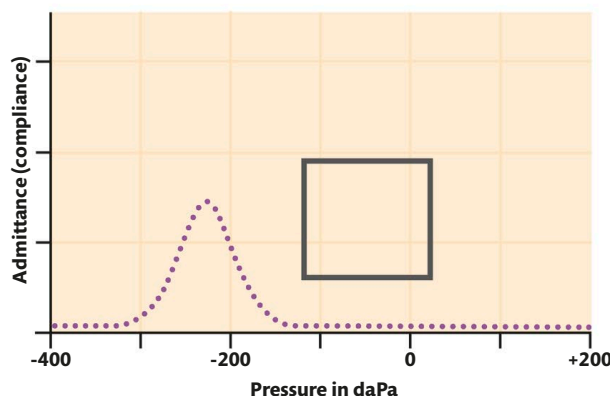
Inside the ear canal

The tympanometer probe has three components—a loudspeaker that delivers a tone, a pump that varies the pressure in the ear canal, and a microphone that measures the sound reflected from the eardrum. The sound measurement is recalculated as admittance (also called compliance), which is a measure of how much sound is passed on, based on how much is reflected.



Flat tympanogram

A flat graph, or one with reduced admittance (compliance), suggests fluid in the middle ear or a perforated eardrum. Tympanometry also measures the volume of the ear canal, and if this figure is high and the graph is flat, then a perforated eardrum is likely.



Low-pressure tympanogram

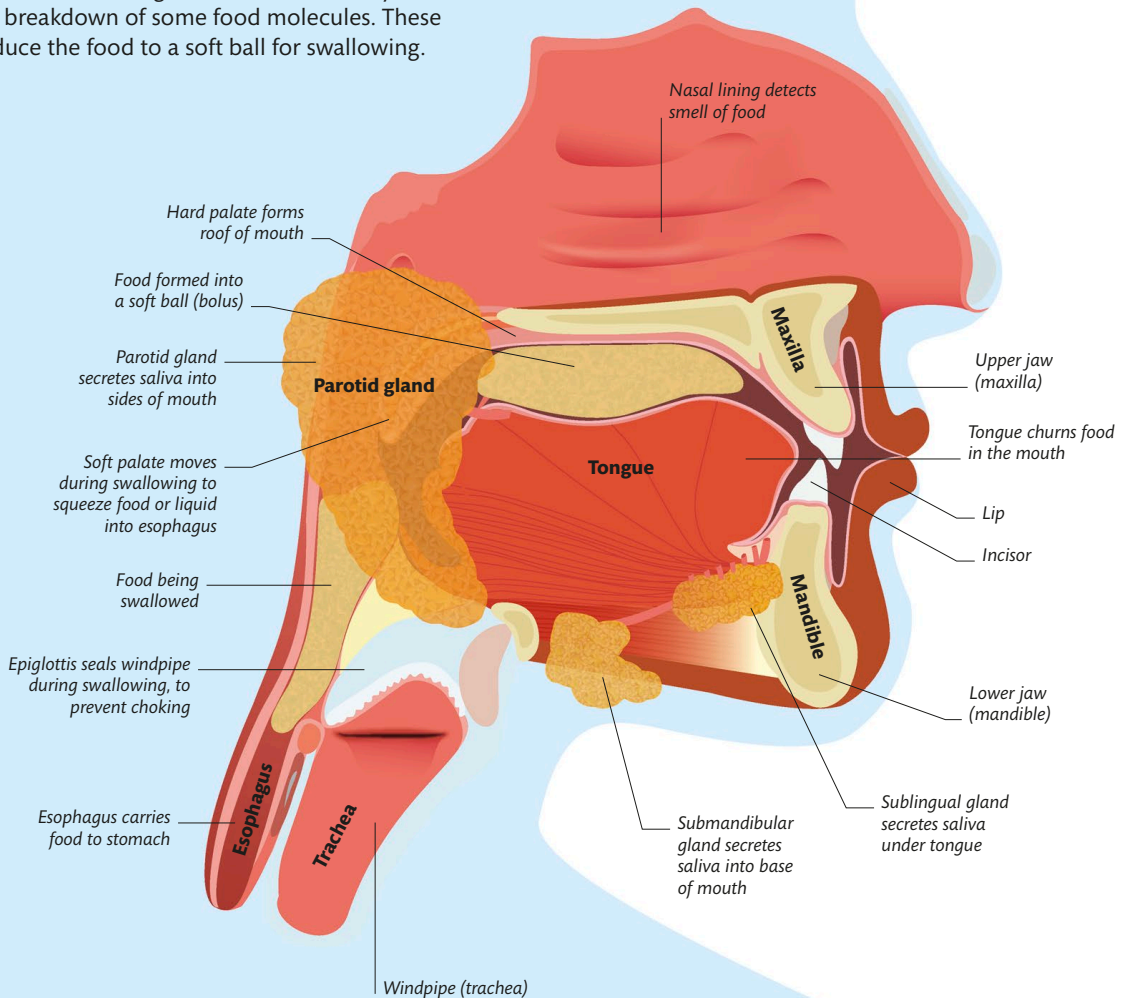
If there is normal admittance (compliance) at reduced pressure, this suggests middle ear congestion or Eustachian tube dysfunction (since the Eustachian tube is responsible for equalizing pressure in the ear and draining fluid from the middle ear).

Mouth and teeth

Digestion begins in the mouth. Our teeth start to break down food mechanically by biting and chewing, and saliva starts to break down food chemically. Proper care of the mouth can help prevent problems that could cause decay or even loss of teeth.

The structures of the mouth

When we take a bite of food, facial muscles move our jaws so our teeth can bite and chew to break down the food. The tongue moves food around so that saliva can get into it. Saliva is a fluid produced by three pairs of glands in the cheeks and under the tongue; it contains an enzyme that begins the breakdown of some food molecules. These actions reduce the food to a soft ball for swallowing.

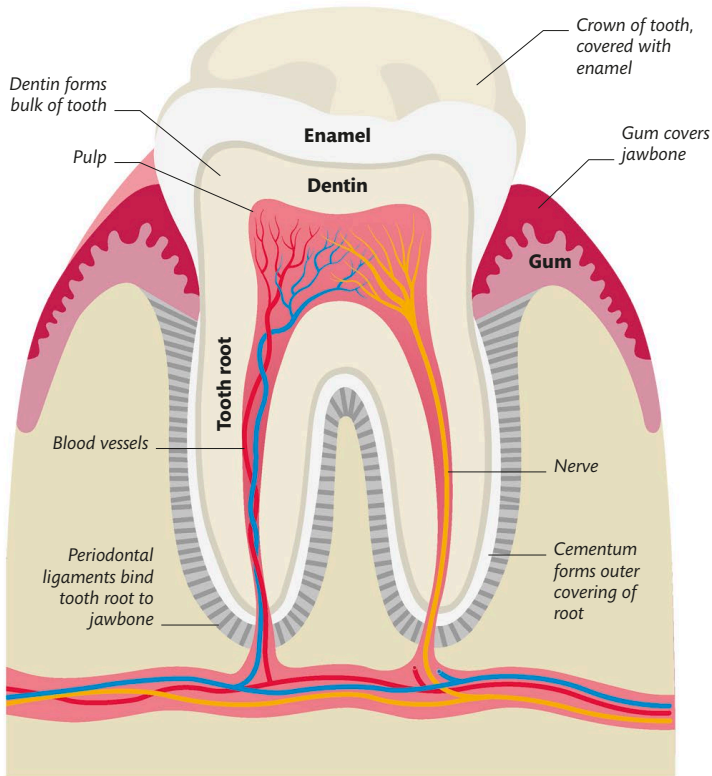


Tooth enamel

Teeth are covered by enamel, which is the hardest substance in the body, but it readily dissolves in acid, exposing the underlying parts of the tooth to bacteria and infection. Acid can come from some foods, juices, and fizzy drinks, or from bacterial plaque, which breaks down sugar to form lactic acid. If the entire thickness of enamel dissolves, it allows infection to rot the softer dentin beneath. Cavities can form as the weakened enamel collapses.



**Your bite impression
is as individual as
your fingerprint**

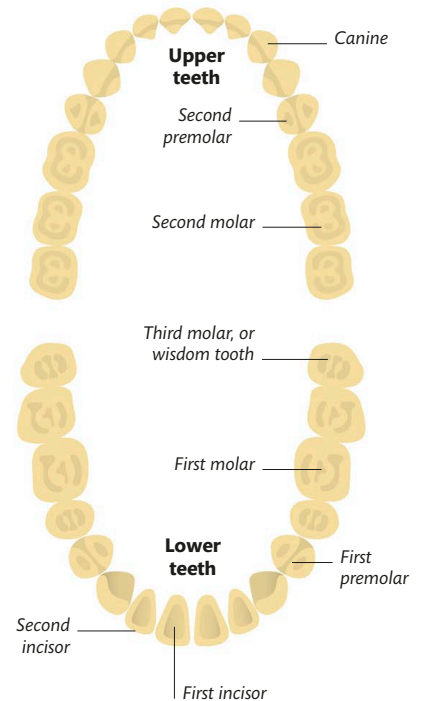


Structure of a tooth

Teeth are fixed into the jawbones by long roots. The crown (visible part) has a tough coating of enamel. Beneath this is hard material called dentin, and in the middle of the tooth is soft pulp. The gums form a seal around the bases of the teeth to keep out bacteria.

CHECKING ORAL HEALTH

Brushing your teeth every day can prevent problems such as a buildup of plaque, which can lead to tooth decay, or gum disease, which could expose the roots of your teeth to infection. You also need regular dental checks every 1–2 years. The dentist will examine your teeth and gums and remove any hardened plaque. You may be offered a scale and polish to clean your teeth, or an X-ray to assess problems such as hidden tooth decay or impacted teeth. The dentist can also advise you on diet and oral health. If you are nervous about visiting dentists, let them know before your appointment, and they will take care to put you at ease.



Biting and chewing

A full set of teeth comprises four types, each doing a specific job. At the front of the mouth, incisors bite food into pieces, while canine teeth grip and tear. Further back, inside the cheeks, premolars and molars crush food into a paste.

Dental checkup

Regular visits to the dentist should form an integral part of your health monitoring. Tooth cavities and gum disease are preventable and your dentist can not only help you keep your teeth and gums healthy, but also identify signs of decay early.

What to expect at a dental checkup

Your dentist will first ask about your general health and lifestyle habits, such as whether or not you eat a healthy diet, smoke, or are prone to clenching your teeth. They will also want to know if you are on any medication and whether you have had any known gum or tooth problems.

Your dentist will start by examining the underside of your jaw and neck, then look at, listen to, and feel the joints where the jawbone meets the skull for signs of deviation or noises that could indicate jaw problems. They will count your teeth and check each one, making a note of the condition, existing fillings or crowns, signs of decay, and the extent of plaque and tartar buildup. They will also assess the health of the gums, your tongue, and soft tissues in your mouth.

An X-ray may be taken either in the form of a small plate that is placed in your mouth, then processed on a film or digitally, or using a larger machine that moves around your head. The latter examines the top and bottom jaws and shows not only the

teeth, but also sinuses and nerve canals. Some dentists recommend repeat X-rays every few years.

Understanding the results

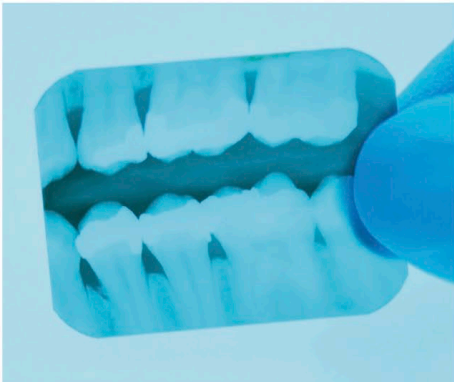
Depending on the findings, your dentist will discuss any potential treatment and/or advise you when you should have your next checkup. Plaque can cause tartar buildup on your teeth, which leads to tooth decay and gum disease. Your dentist or hygienist will clean the teeth to remove plaque and tartar. Signs of tooth decay may require further treatment. You may be referred to a specialist if the gum disease is severe or abnormalities are detected.

During the checkup

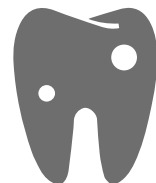
You will be given goggles to protect your eyes and a bib to protect your clothes. While your dentist examines the teeth and gums, a dental hygienist will remove moisture that accumulates.

Use of X-rays in dental health

X-rays may be used to aid diagnosis of localized tooth decay, bone loss, infection, or impacted teeth not otherwise visible to the naked eye.



Tooth decay is one of the most common of all diseases, second only to the common cold





SELF-MONITORING

Check your mouth regularly and make an appointment to see the dentist before your scheduled checkup if you notice:

- Toothache and/or increased sensitivity to hot or cold food or drinks.
- Facial swelling.
- Bleeding gums.
- Ulcers that will not heal or any unusual red or white patches that cannot be explained.

SELF-HELP MEASURES



Diet



Maintain a healthy diet



pp.146-149



Oral health



Clean teeth daily; avoid sugary foods



p.146



Alcohol and tobacco



Limit alcohol intake and do not smoke or chew tobacco



pp.150-151

Your skeleton

Our skeletal system is the framework that supports the body, protects our organs and other body structures, and enables us to move. It is formed from bone and connective tissues. There are 206 bones in all, linked together by a system of joints.

Bones and joints

Bones are living tissues, which form light but strong structures. Many bones have connective tissue called cartilage at their ends, and this reduces friction during movement, or connects certain bones (such as the ribs and sternum, or breastplate). Joints are the structures that connect one bone to another. The joints in the skull and pelvis are fused together, but most other joints allow movement;

the bones in these joints are held together by tough, fibrous connective tissues called ligaments.

Spine structure

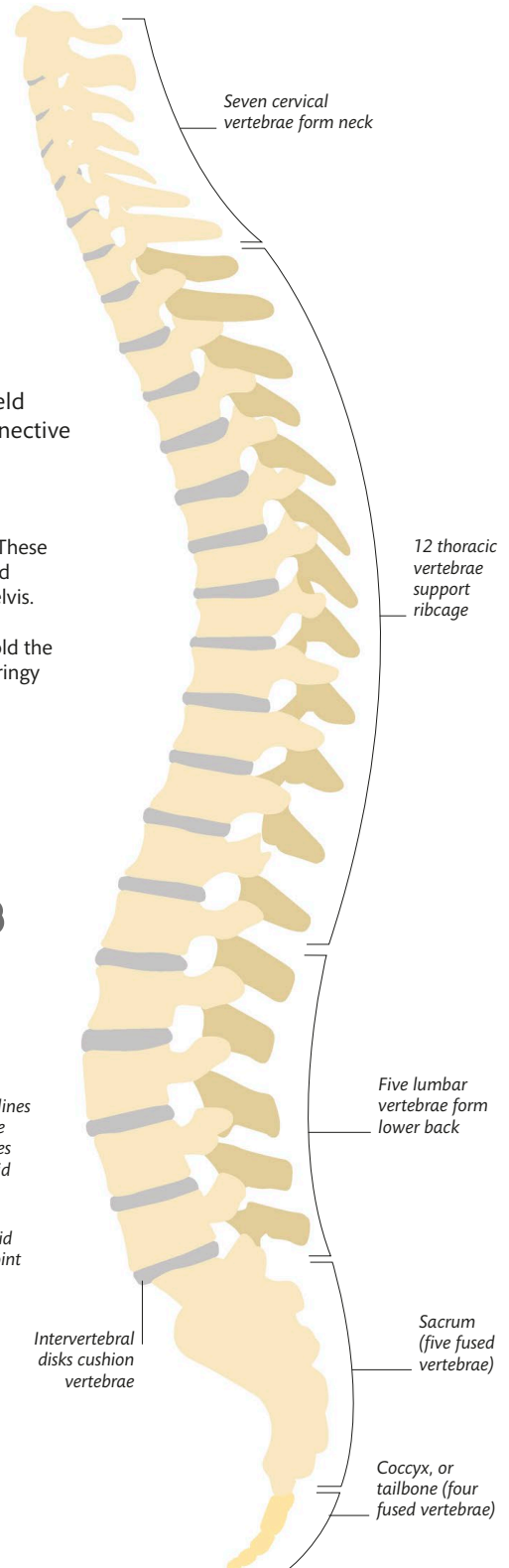
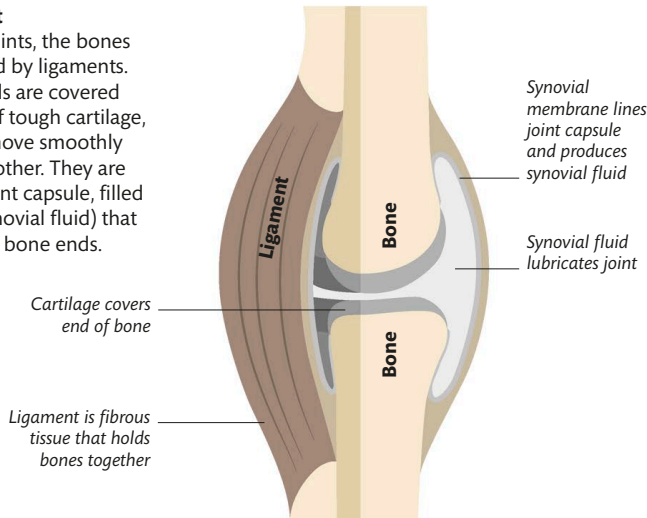
The spine consists of 33 vertebrae. These support the head, neck, ribcage, and lower back, and form part of the pelvis. The neck and back vertebrae allow bending and twisting. Ligaments hold the vertebrae together, while tough, springy cartilage disks between them act as shock absorbers during movement.

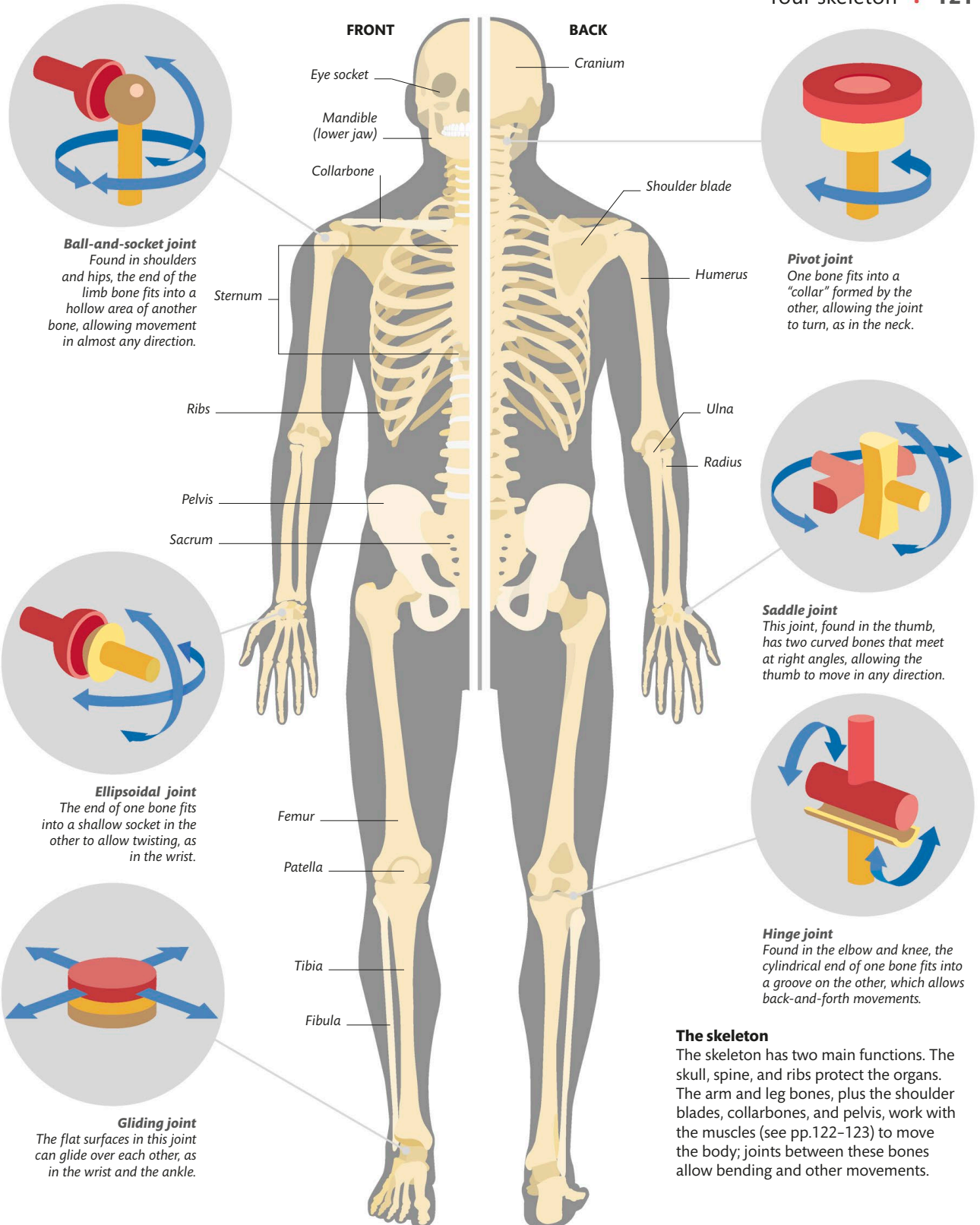
We have around 300 bones when we are born, but some of these fuse together as we grow



Inside a joint

In movable joints, the bones are connected by ligaments. The bone ends are covered with a layer of tough cartilage, so they can move smoothly against each other. They are sealed in a joint capsule, filled with fluid (synovial fluid) that lubricates the bone ends.





Your muscles

The bones of your skeleton (see pp.120–121) are moved by muscles—bundles of tissue that contract to pull on a bone. Keeping your skeleton, muscles, and connective tissues healthy will ensure that you can move freely and minimize your risk of injuries.

The masseter muscle in your jaw is the strongest muscle in the body for its size



Muscles and movement

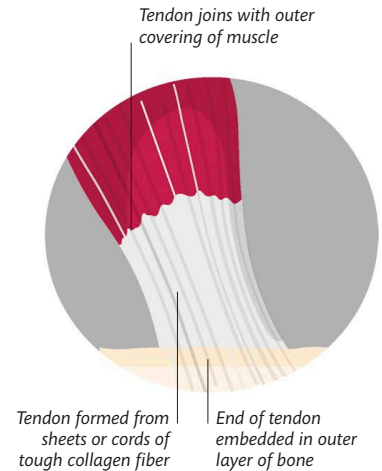
Muscles cannot push, they can only pull, so each joint needs a pair—one muscle to bend (flex) the joint and another to straighten (extend) it. As one muscle contracts, the opposite muscle relaxes. Each muscle stretches across the joint; it is attached to one bone at the end furthest from the joint, and to the other bone just beyond the joint. For example, the muscles of the upper arm are attached at the shoulder and stretch across the elbow to attach to the bones of the forearm.

CHECKING MUSCULAR AND SKELETAL HEALTH

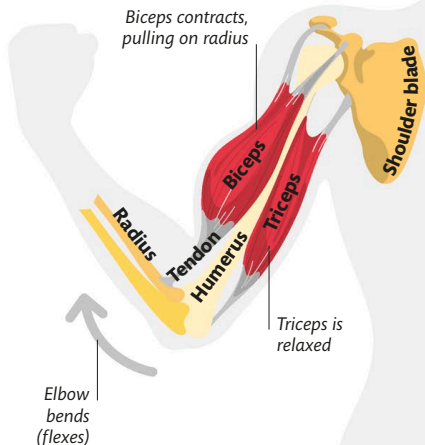
You are unlikely to need checks if you are healthy, but as you age, you lose bone density and muscle mass, which can lead to a loss of strength and risk of arthritis and fractures. To check your musculoskeletal function, the doctor may ask you how easily you can do daily activities. He or she may ask you to walk a few paces or may check your grip strength. If you have pain or stiffness, you may need an X-ray or a bone scan, or blood tests to detect calcium (resulting from excess bone breakdown) or chemicals resulting from muscle damage.

Muscle attachment

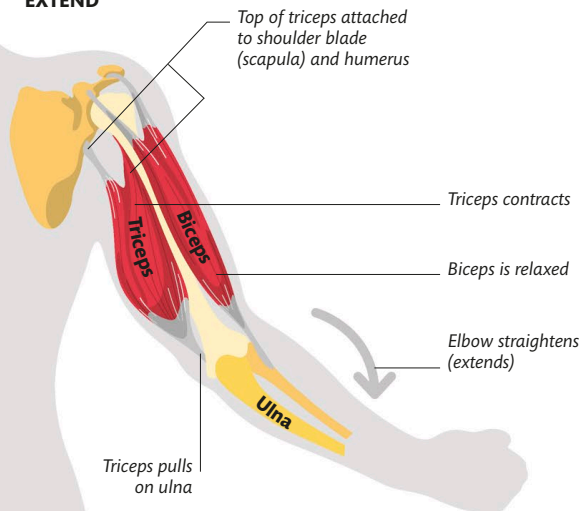
Muscles are attached to bones by strong, fibrous tissues called tendons. The ends of each tendon are anchored in the outer layer of the bone. Most tendons do not stretch, so when the muscle contracts, the bone is forced to move.

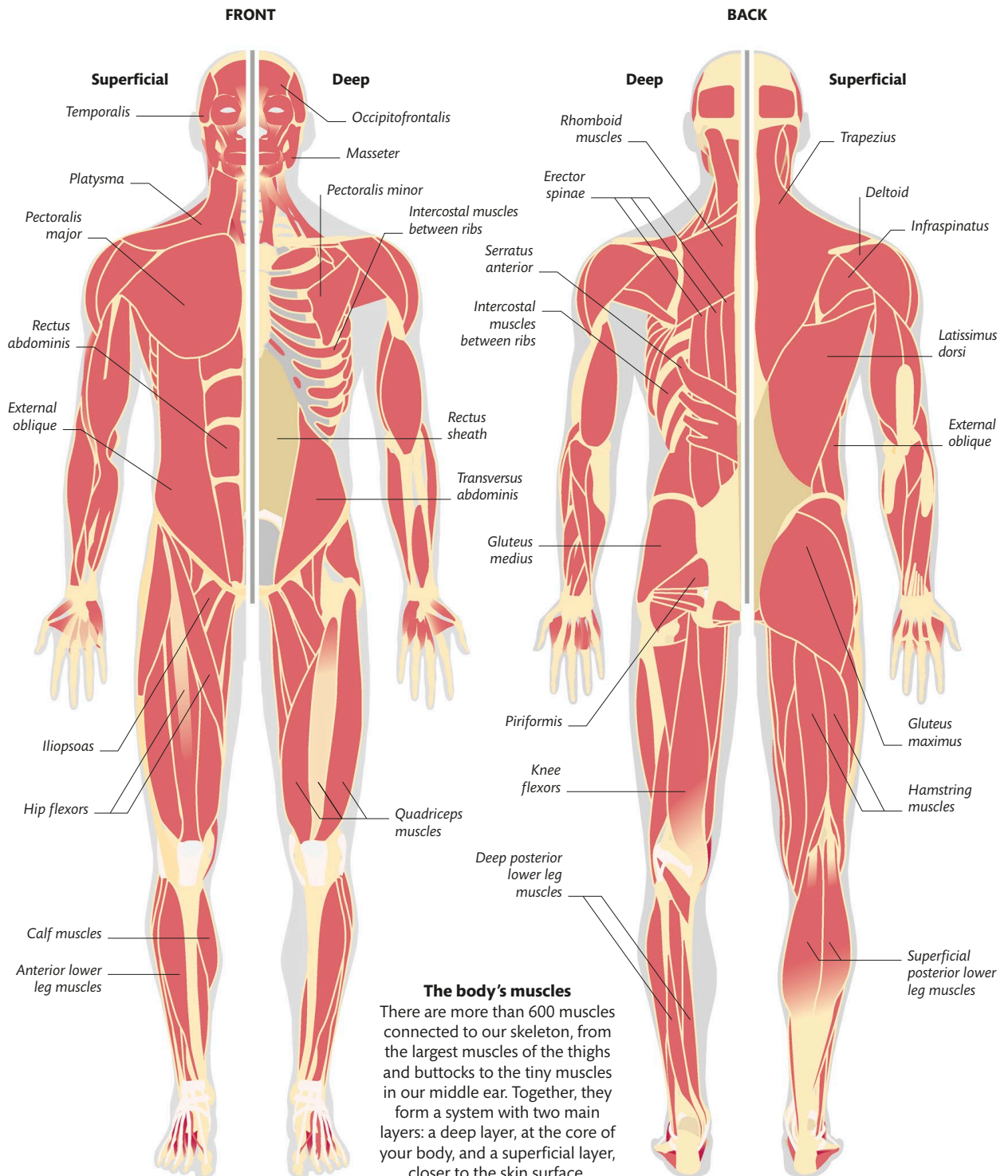


FLEX



EXTEND





Flexibility, posture, and gait

Assessing your flexibility, posture, and gait can provide useful insight into an existing condition, identify if you are at risk of developing chronic joint pain, and monitor improvements gained from training or rehabilitation programs.

Testing your flexibility

Flexibility is the ability to move a joint through its range of motion. It is determined by your bony anatomy and how well your muscles, tendons, and ligaments work around the joint. There are several ways to assess your general flexibility, as well as the flexibility of specific joints or groups of joints. The sit-and-reach test (below) is commonly used to assess the trunk, pelvis, and hamstrings. Other tests, include the “back-scratch” test to assess shoulder flexibility, and the femoral stretch, or Ely test, to assess the quadriceps in the thigh. A brief warm-up will improve the results and reliability of your flexibility assessment. Results are compared to those predicted for your age and sex and reported as excellent, good, fair, or poor.

ARE YOU TOO FLEXIBLE?

Too much flexibility, due, for instance, to excess elasticity in the tendons, can result in weak and unstable joints, or hypermobility. The Beighton score is a self-test that assesses hypermobility according to the number of “yes” answers to flexibility questions. Your score is your total number of “yes” answers to five questions, each applied to both sides of the body. Pictured below are two of the five questions.

Can you bend your elbow backward more than 10 degrees?

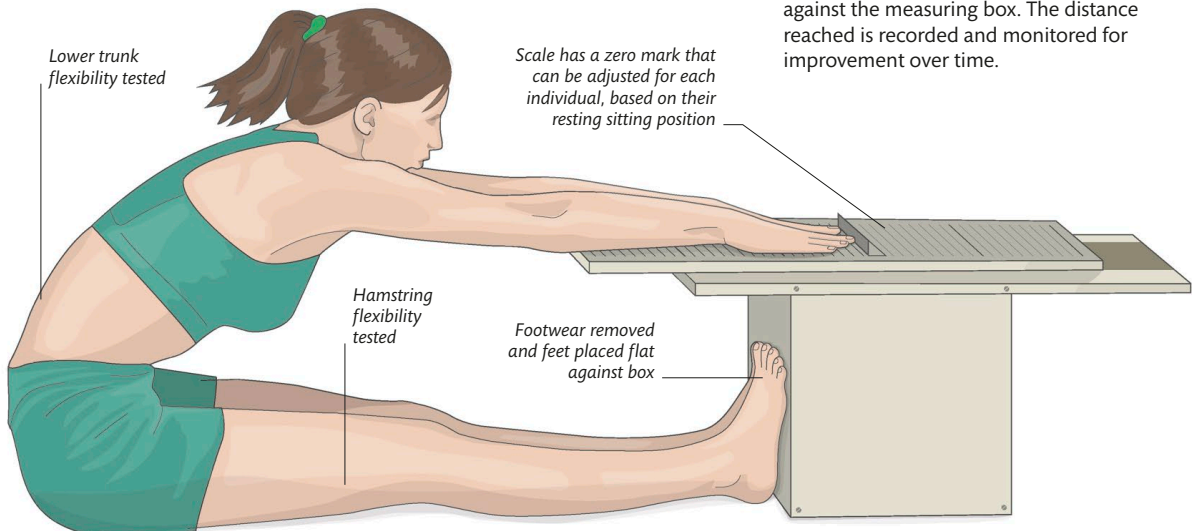


Can you bend your little finger up at 90 degrees to the back of your hand?



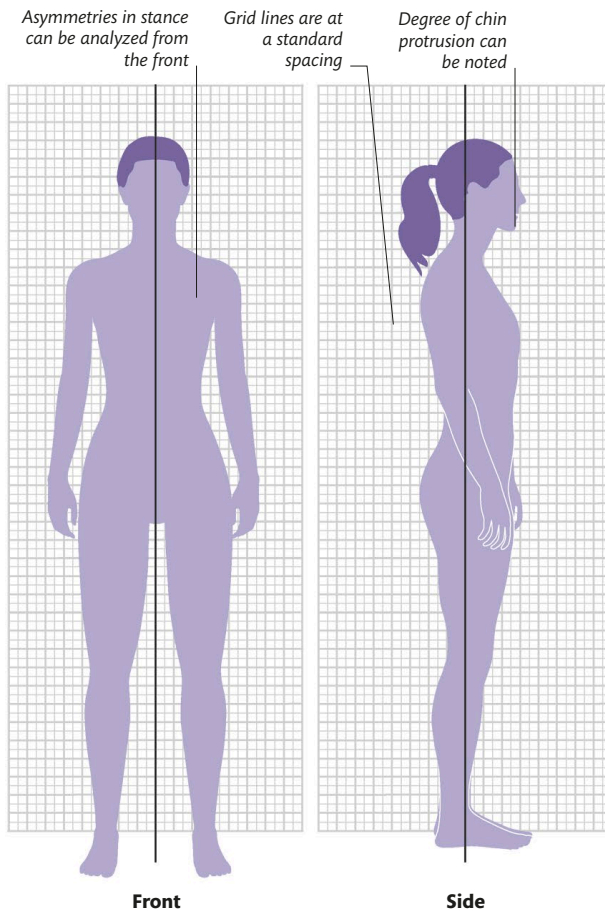
Are you flexible enough?

In the sit-and-reach test, the legs are straight and the feet pressed firmly against the measuring box. The distance reached is recorded and monitored for improvement over time.



Assessing your posture

Posture refers to your body alignment as you stand or sit. For good posture, your muscles need to hold your skeleton so it is balanced, with your spine straight but fairly relaxed. Abnormal posture may result from illness, injury, or habitual behavior, and can cause muscle imbalance and chronic joint pain. To assess your posture, you will be asked to stand (or, less commonly, sit) while the assessor examines you from the front, side, and back. Mild postural errors, such as slouching, are common and often easily correctable. Severe postural abnormalities may require further investigation or treatment by a doctor or physical therapist.

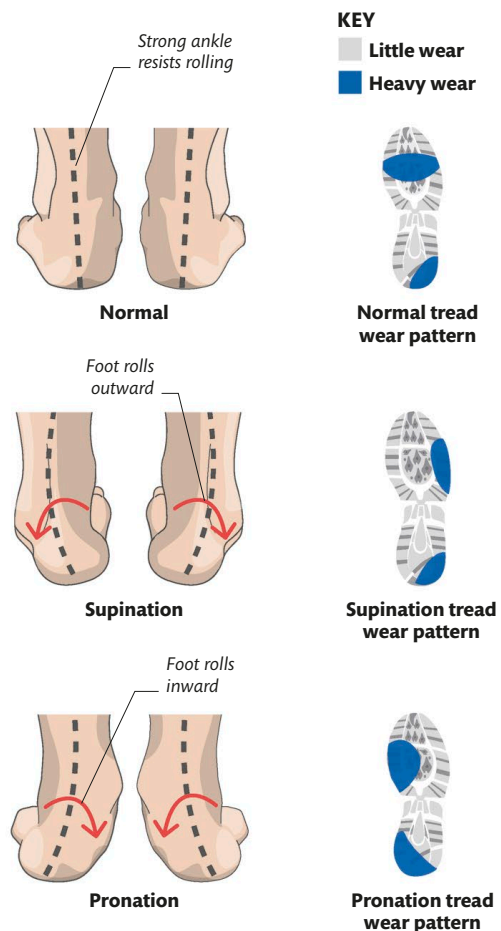


Postural analysis

A postural analysis grid chart may help the assessor identify abnormalities, such as kyphosis, scoliosis, or hyperlordosis, which are abnormal spinal curvatures. A plumb line can be used in combination with the grid.

Assessing your gait

Your gait, or your pattern of walking, is influenced by muscular strength, balance, and flexibility. It evolves from childhood to old age and is affected by illness and injuries. Gait consists of the stance phase and swing phase, each of which can be analyzed. Conventional gait assessment involves taking steps on a flat surface or treadmill. The assessor observes aspects of each phase and also inspects your shoes for wear distribution. Gait laboratories can conduct deeper analysis using optical tracking systems, force plates, and electromyography (EMG). Wearable technology may also be used to measure gait parameters.



Ankle rotation

Patterns such as pronation (foot rolls inward in stance phase) and supination (foot rolls outward in stance phase) may be identified by gait analysis. These conditions require appropriate supportive footwear.

Core components

The core comprises many elements of the musculoskeletal system. These include superficial muscles, such as gluteal and abdominal muscles (see p.123), and deep muscles, such as the pelvic floor and diaphragm, that stabilize and strengthen body structures.

Multifidus—a key deep stabilizing muscle of the spine

Diaphragm—a strong muscular roof to the abdomen

Transversus abdominis—the innermost of three sheetlike abdominal muscles

Sacrum—anchors some deep core stabilizing muscles

Pelvic floor—a sheet of muscle that supports the organs above

Core stability testing

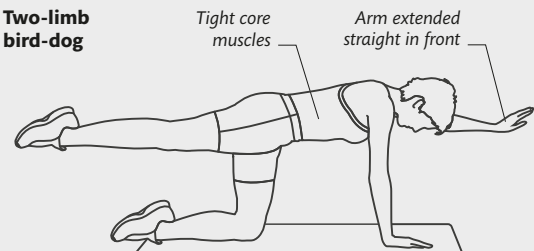
Your musculoskeletal core provides a stable foundation for all your limb movements, including activities of daily living, recreation, or sport. Maintaining strength and dynamic control of the core muscles is important for preventing injuries and for building strength in exercise and rehabilitation.

Core stability

The body's core consists of the spine, abdomen, hips, and pelvis, and the core muscles include the paraspinal, abdominal, gluteal, pelvic floor, and hip girdle muscles. Improving core stability requires training that focuses not only on strength, but also endurance, flexibility, and dynamic coordination of the active (muscles) and passive (bones and ligaments) components of the core. While a stable core provides a foundation for all movements, core instability can be implicated in numerous chronic musculoskeletal conditions.

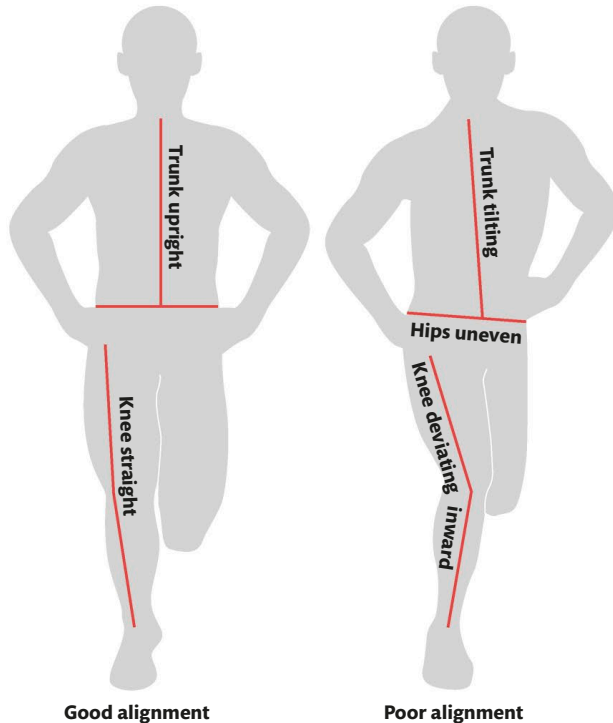
MAINTAINING CORE STABILITY

Core stability exercises can be performed without special equipment. You can build them into your daily routine to develop a strong foundation for your body. Begin with short intervals of forearm planks (body straight, facing down with elbows on the ground) and side planks (see opposite). Gradually increase duration as stability improves. Try the “bird-dog”: start on all fours and raise one limb at a time, progressing to two limbs and increasing duration.

Two-limb bird-dog

Testing core stability

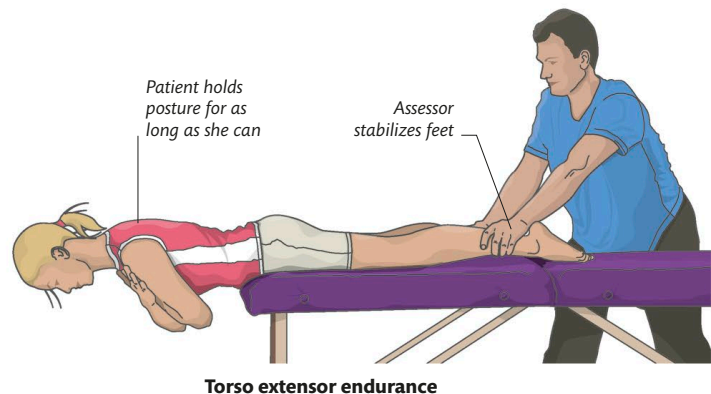
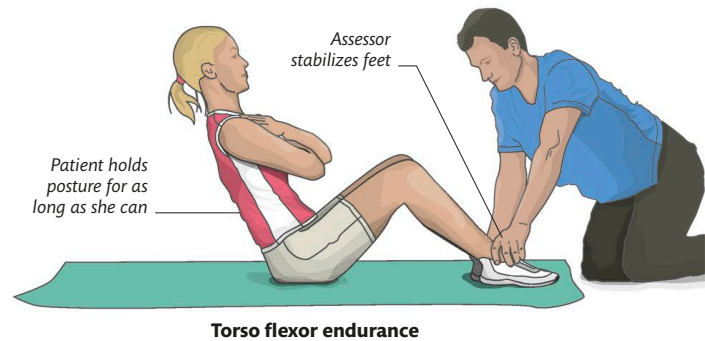
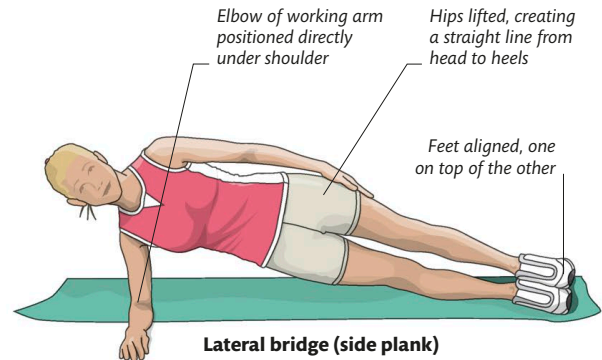
Various tests may be used to assess your core stability, including single-leg squats (see below), the lateral bridge, and the torso flexor and extensor endurance tests (see right). In these last three tests, you have to hold a specific posture for as long as you can; this period can then be compared to values from healthy individuals, or to repeat measurements taken during training or rehabilitation programs to monitor progress.



Single-leg squat

In this exercise, you stand on one leg, with your body straight, and then lower your body. It tests control and coordination of your hip and trunk muscles. If you struggle to keep your body straight and your pelvis level, this may indicate core instability.

 **Average, fit 21-year-olds can hold the lateral bridge for 95 seconds (men) or 75 seconds (women)**



Common tests

The lateral bridge (also known as side plank) and the torso flexor and extensor endurance tests are timed tests to assess the strength, endurance, and functional control of the front, back, and side of your core muscles. Often added to these is the prone bridge (or straight plank), which is similar to a push-up except that the forearms and hands are kept flat against the floor.

Muscle strength and endurance

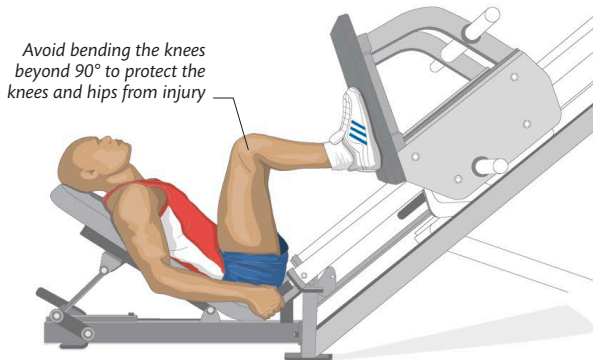
Strength and endurance are key components of muscle fitness. Building your muscles provides benefits such as improved bone mass, blood glucose control, and the ability to perform everyday activities easily. Testing muscle fitness provides information on your baseline function and identifies aspects that may benefit from targeted training.

Muscle strength

The strength of a particular muscle or muscle group is typically measured by tests in which you have to push or pull against resistance. Strength tests may be static (in which you contract your muscles without moving your limb) or dynamic (in which you move your limb to counter the resistance). The tests may involve pushing against a hard surface, resisting pressure from a doctor's or therapist's hands, or pushing or pulling against a machine. To achieve reliable results, it is helpful to warm up before the test, and begin with a weight or resistance that is 50–70 percent of your expected capacity, increasing gradually. For safety and reliability, you should use a spotter, whose role includes assisting with a lift that is beyond your ability. Results are adjusted for body weight for comparability.

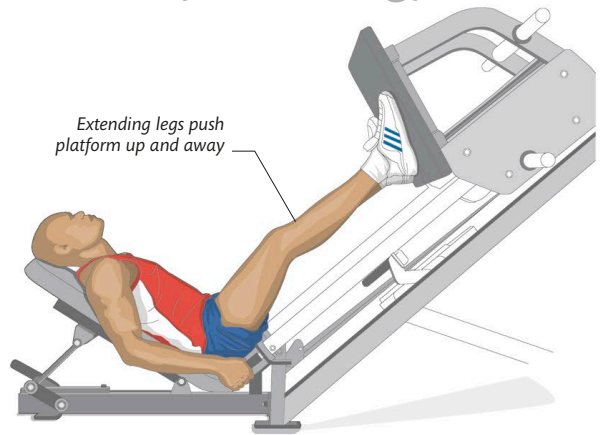
Leg press

Dynamic strength tests include the bench press for upper body and leg press for lower body muscle strength. The pictured machine is designed for the 45-degree leg press.



Avoid bending the knees beyond 90° to protect the knees and hips from injury

① Legs flexed



Extending legs push platform up and away

② Legs extended



Grip strength

A dynamometer can be used to measure grip strength. This is an example of a static resistance test. An 11 lb (5 kg) reduction in grip strength may be associated with an increased risk of illnesses such as cardiovascular disease.



Typical grip strength in men is 61–110 lb (27.5–50 kg)

Muscle endurance

Muscle endurance is the ability of a muscle or group of muscles to maintain a contraction or perform repeated contractions against resistance over a period of time. This provides information on muscle function and control.

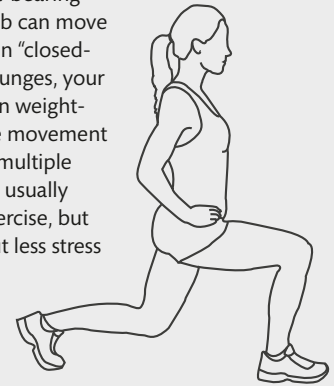
The maximum number of push-ups or sit-ups performed without rest are simple tests that may be used to evaluate upper body and abdominal muscle endurance. Resistance exercises, such as the bench press and leg press, can be adapted for endurance testing by finding your maximum number of repetitions with a specific weight. Testing muscle endurance provides insight into muscle fitness and fatigue, identifies areas in need of specific training, and may be used to diagnose or monitor some neuromuscular conditions.

Sit-up endurance

In average people, the number of sit-ups achieved varies from 27–31 in your twenties to 13–19 in your sixties. Arm position should be standardized for comparability—arms could also be crossed over the chest or pointing toward the feet.

RESISTANCE TRAINING

For effective resistance training, you need suitable exercises for your fitness level, gradual progression, adequate rest and nutrition, supervision, and appropriate professional advice. “Open-chain” exercises, such as leg extension, are performed in non-weight-bearing positions, where your limb can move freely against resistance. In “closed-chain” exercises, such as lunges, your hands and feet are fixed in weight-bearing positions and the movement involves coordination of multiple joints. Resistance training usually involves both types of exercise, but closed-chain exercises put less stress on your joints.

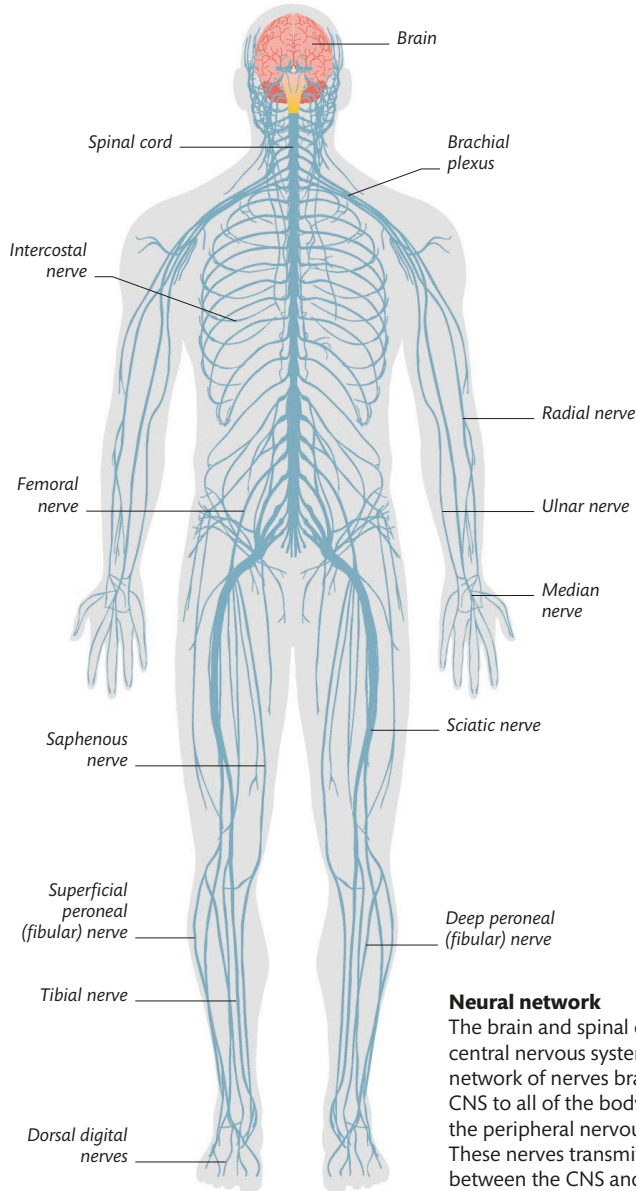


Lunge
(closed-chain exercise)



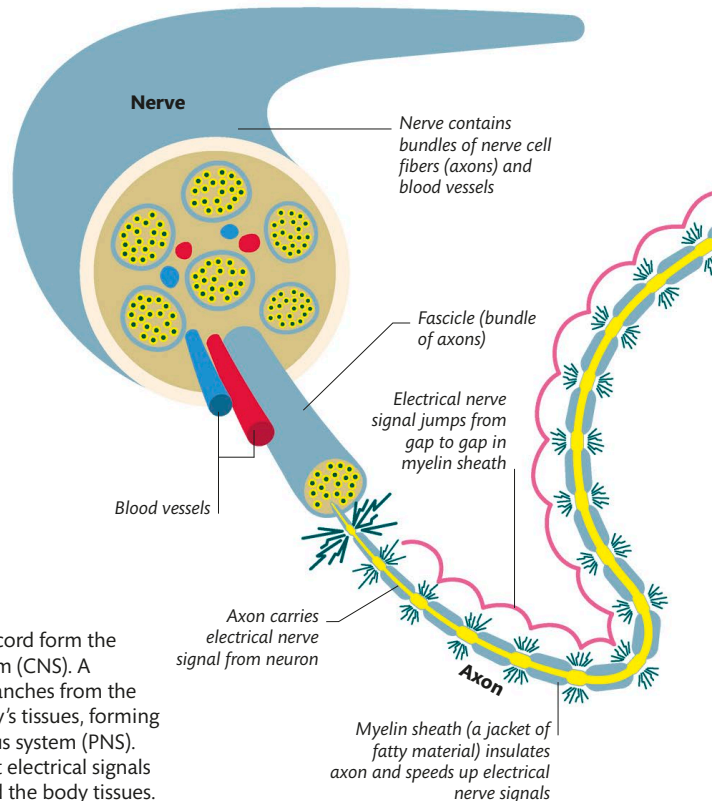
Your nervous system

The nervous system forms the communication system in your body. It comprises a network of nerve cells that transmits hundreds of electrical signals per second to control all of your physical and mental functions, from your breathing and heartbeat to complex thought.



Structure of the nervous system

At the center of the nervous system is the brain, which controls all conscious and unconscious activities. Certain nerves (cranial nerves) branch directly from the brain, but most connect to the spinal cord, the neural “superhighway” that runs up the center of the body, inside the vertebrae.



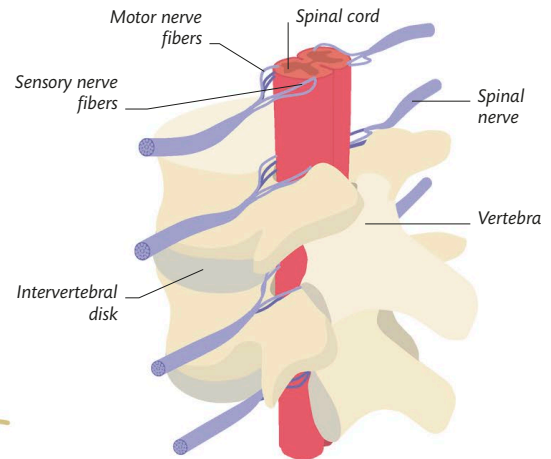
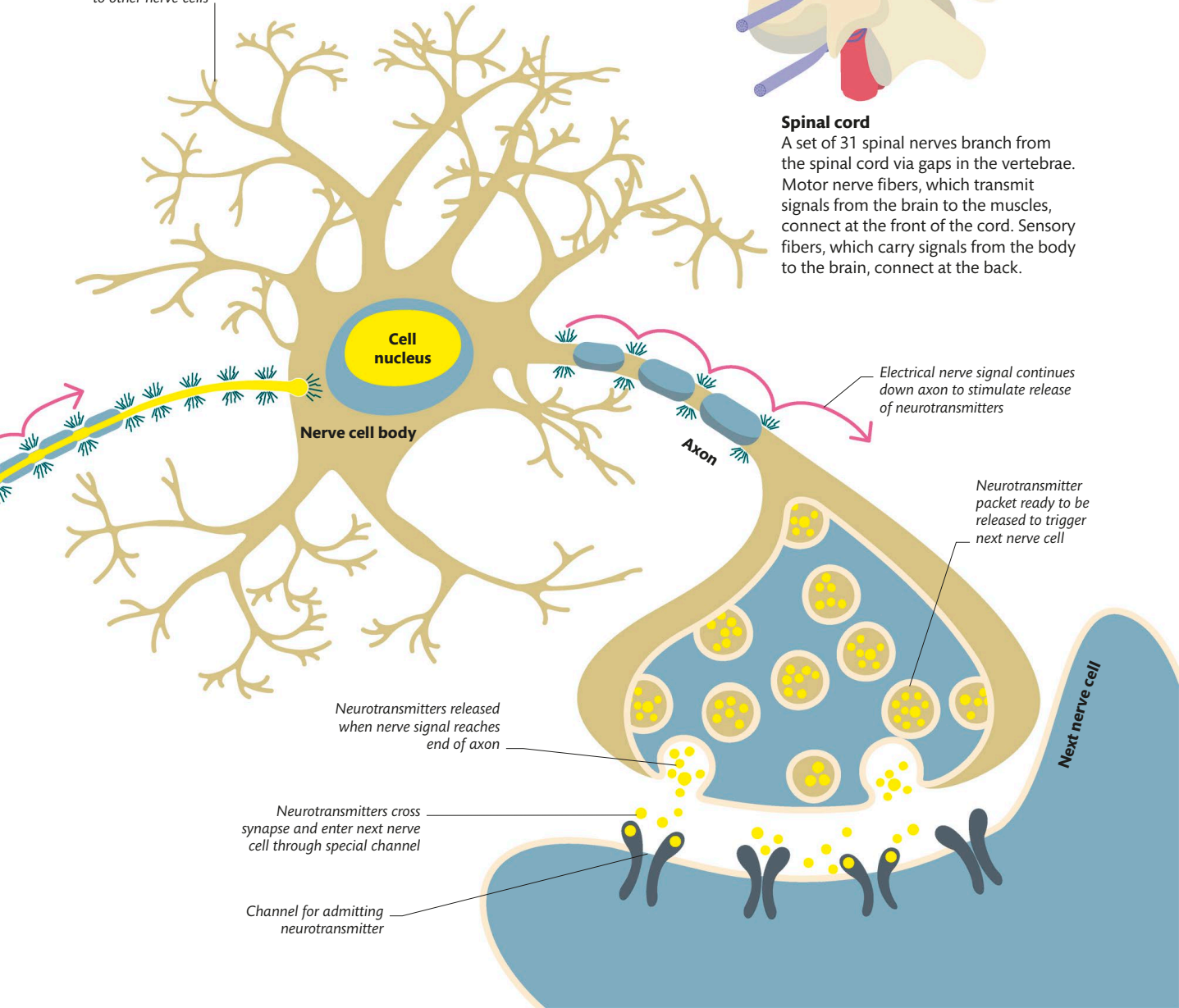
Neural network

The brain and spinal cord form the central nervous system (CNS). A network of nerves branches from the CNS to all of the body's tissues, forming the peripheral nervous system (PNS). These nerves transmit electrical signals between the CNS and the body tissues.

Transmitting nerve signals

A stimulus (such as touch) triggers an electrical charge in the body of a nerve cell (neuron). The charge travels along the axon, jumping along the spaces in the myelin covering. At the far end, it triggers the release of neurotransmitter chemicals, which cross the tiny gap (synapse) to the next nerve cell, triggering an electrical impulse in that cell.

Dendrites connect to other nerve cells



Spinal cord

A set of 31 spinal nerves branch from the spinal cord via gaps in the vertebrae. Motor nerve fibers, which transmit signals from the brain to the muscles, connect at the front of the cord. Sensory fibers, which carry signals from the body to the brain, connect at the back.

Electrical nerve signal continues down axon to stimulate release of neurotransmitters

Neurotransmitter packet ready to be released to trigger next nerve cell

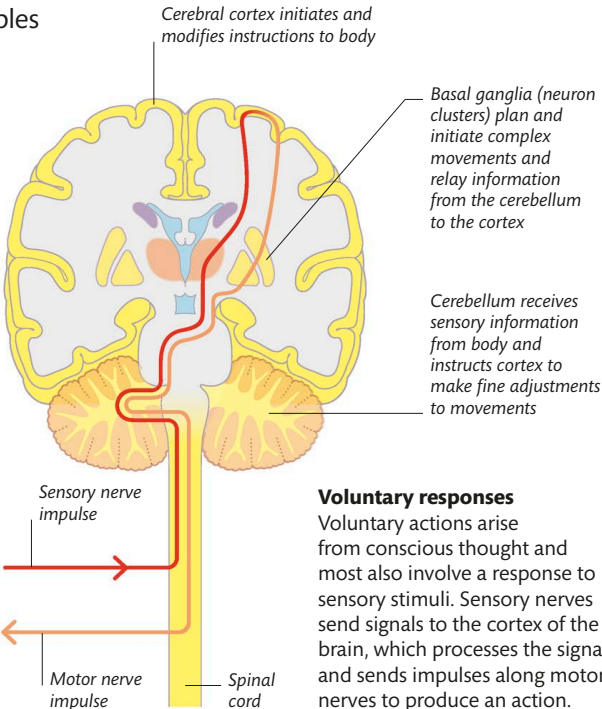
How your nervous system works

The nervous system functions in two main ways. It enables you to make deliberate, conscious movements. It also carries out the unconscious activities that keep you alive, such as regulating your breathing and heartbeat and producing rapid reflex actions.

Inputs and outputs

Both voluntary and involuntary actions result from messages passing along the nerves between the body tissues and central nervous system (brain and spinal cord). Sensory nerves send information about changes outside or inside the body to the central nervous system, which processes the information and sends out response signals along motor nerves.

Nerve signals can travel at speeds of up to 390 ft per second (120 m per second)



Voluntary responses
Voluntary actions arise from conscious thought and most also involve a response to sensory stimuli. Sensory nerves send signals to the cortex of the brain, which processes the signals and sends impulses along motor nerves to produce an action.

The autonomic nervous system

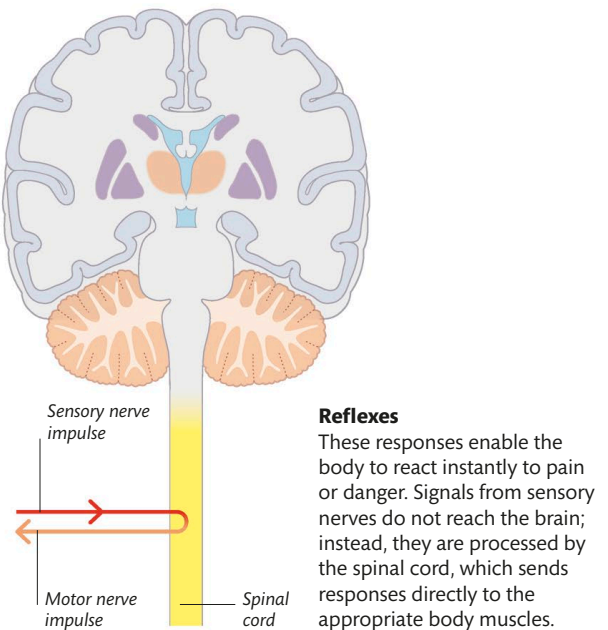
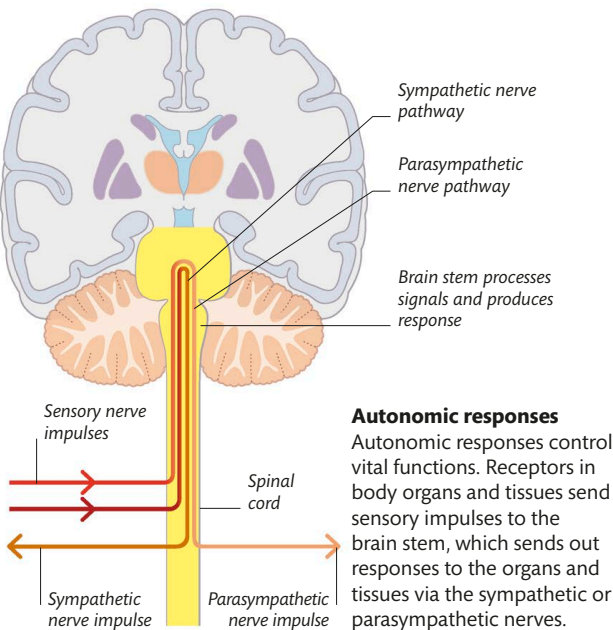
The autonomic nervous system involves the whole body. It has two parts: the sympathetic system and the parasympathetic system. Each of the two systems produces a different response in a particular part of the body. In general, the sympathetic system prepares the body for action or to cope with stress—the “fight or flight” reaction. The parasympathetic system acts to help conserve or restore energy.

Part of body affected	Sympathetic response	Parasympathetic response	
 Eyes	• Pupils widen • Tear production decreases	• Pupils constrict • Tear production increases	
 Mouth	• Saliva production decreases	• Saliva production increases	
 Digestive system	• Movement of food through intestine slows down • Production of digestive enzymes decreases	• Movement of food through intestine speeds up • Production of digestive enzymes increases	

CHECKING THE NERVOUS SYSTEM

Some changes that affect the nervous system, such as slower reactions, are just a part of normal aging. However, some symptoms, such as tingling in your hands and feet or difficulties with your balance, could be early indications of an underlying condition and should be checked by a doctor.

To test your nervous system, the doctor may first carry out simple tests, such as checking your reflexes, coordination, and senses. If the results of these tests indicate a health problem, you may be advised to have other investigations, such as tests of the electrical activity in your brain or muscles.



Part of body affected	Sympathetic response	Parasympathetic response	Part of body affected	Sympathetic response	Parasympathetic response
 Blood vessels	Arteries to muscles and brain widen; arteries to skin and digestive tract narrow	Arteries to muscles, brain, skin, and digestive tract return to normal size	 Adrenal glands	Release adrenaline and noradrenaline	Reduce production of adrenaline and noradrenaline
 Heart	Heartbeat speeds up	Heartbeat slows down	 Skin	Sweat production increases	Sweat production decreases
 Lungs	Airways widen	Airways narrow	 Urinary system	- Kidneys reduce urine output - Bladder neck squeezes shut	- Kidneys increase urine output - Bladder neck relaxes

Testing your reflexes

Reflexes are simple involuntary, or automatic, muscle reactions to stimuli that are activated to protect you from environmental dangers: for example, by quickly withdrawing your hand when it nears a flame.

What to expect when tested

When sensory nerves detect danger they send a message to the spinal cord, and corresponding motor nerves carry a response straight to the relevant muscles, bypassing the brain. Doctors test certain reflexes to check that pathways are complete. They generally begin by looking at reflexes in the lower limbs as they are furthest from the spinal cord, and then look at the upper body if impairment is detected.



Babinski foot reflex test

A doctor will gently but firmly stroke the outer edge of the sole of your foot, from the heel to the base of the big toe. In a normal reaction all your toes will point down together.

Testing coordination and balance

Critical to injury prevention, balance (the ability to maintain a position) and coordination (the capacity to execute sets of movements smoothly) depend on complex interactions between organs such as the eyes and ears and many different body systems.

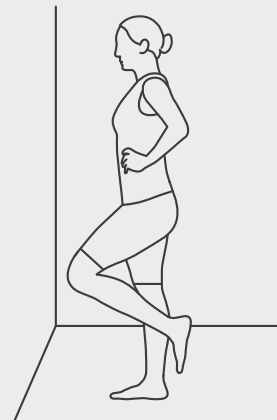
How both are assessed

Your doctor will start with a physical examination that includes checking your eyes and ears, then ask you to perform some tests. To assess balance you may be asked to walk in a straight line, touching the heel of one foot to the toe of the other with each step, and/or stand on one leg (see right)—with your eyes open, then closed.

Coordination tests might include the finger-to-nose test (see opposite). You may be asked to draw a circle with each big toe or index finger. To assess leg coordination you may sit or lie down and put the heel of one foot on your other knee and attempt to slide the heel down your shin toward the ankle. If the tests reveal abnormalities you will be referred for further tests.

BALANCING TEST

Stand on one leg (near a wall or chair in case you need support). Try to hold the position for a minute, first with your eyes open and then with them shut. Repeat with the other leg.



**Assessing the knee reflex**

While you sit on a chair or the edge of a bed with your legs hanging down, your doctor will give a sharp tap to the tendon just below the knee cap. In response, the muscles over the front of the upper leg should contract, causing the leg to "kick."

Nose-to-finger test

Your doctor will hold out a finger and ask you to focus on their face and then touch their finger, then your nose, then the finger again. You will be asked to repeat this several times as fast you can.

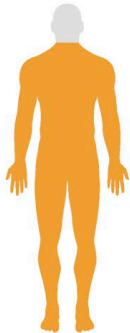
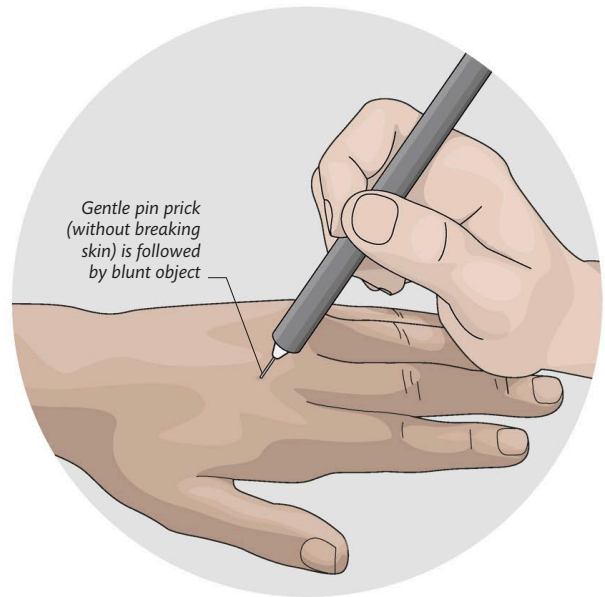
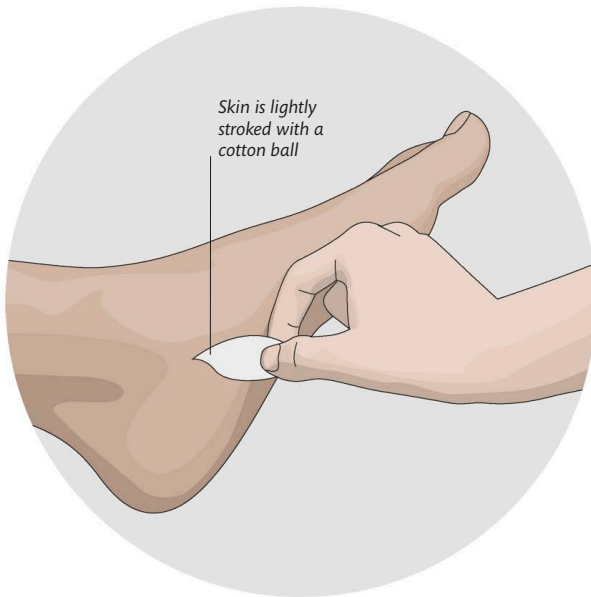
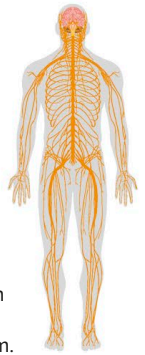


Testing sensory nerve pathways

Injury and some medical conditions, most commonly diabetes, can result in peripheral neuropathy—damage to the peripheral nerves. This damage typically causes weakness and numbness in the area of the body supplied by those nerves. The type and extent of the damage varies depending on the functions performed by the affected nerves.

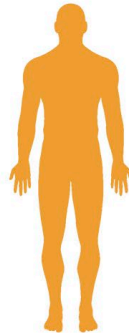
Peripheral nerves

The sensory nerves carry vital signals from the extremities to the central nervous system.



Light-touch test

This tests for areas of insensitivity that might indicate a lesion affecting a peripheral nerve. The doctor will show you what they are going to do at a point where you can feel it, then test other parts of your body, so that they can map areas of insensitivity. Your doctor will gently stroke your skin with a cotton ball and ask you to describe what you can feel.



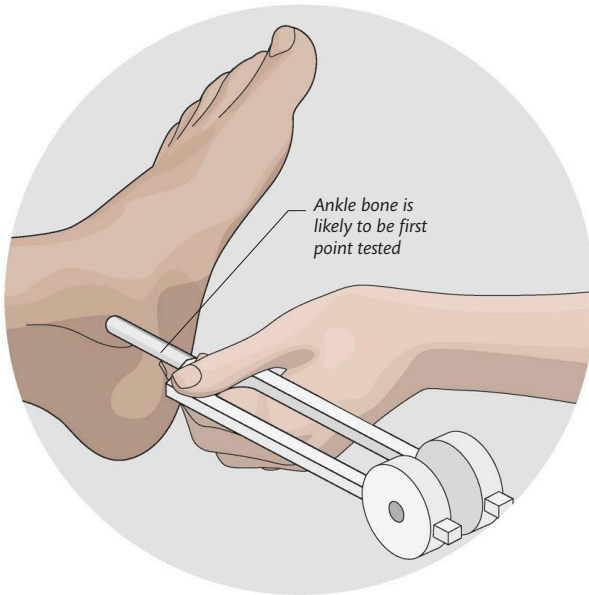
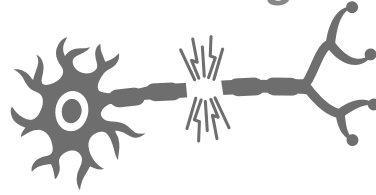
Pain-type test

Also known as the pin-prick test, this involves touching your skin alternately with a sharp, pinlike object, then a dull one, such as a round pinhead. You will be asked to identify whether it is sharp or dull—the aim is to find out if you can tell the difference. Your doctor will compare both sides of the body and, depending on the reasons for testing, may work from the feet up, or start further up the body.

WHAT HAPPENS DURING THE TESTS

Your doctor may undertake a number of checks to gain a complete picture because, although the sensations share the same spinal cord pathway, each one arises from different nerve receptors and terminates in a different part of the brain. They will probably ask you to lie down for these assessments and you will need to close your eyes for each test so you cannot anticipate the stimuli. Your doctor will compare both sides of the body, and is most likely to start with the feet and legs because these nerve pathways are longest and the first to show any loss of sensation. If sensory loss is detected, you may be referred to a specialist for further tests.

Persistent high blood sugar levels can lead to nerve damage



Vibration sensation

Vibratory sensation travels to the brain via the same pathways as those for position sense (see right) and may be diminished in people with peripheral neuropathy. Your doctor will strike a tuning fork against a hard surface, then hold it against a point where the bone is close to the surface and ask you to say whether or not you feel the vibration, and if you can, when it stops.



Position sense

This technique assesses your body's ability to know where it is in space, also known as proprioception: a factor critical to balance. Supporting your foot, your doctor will hold either side of your big toe, then move it up and down, asking you to describe where your toe is. The test will be done on both feet; depending on the findings, it may be repeated on your fingers.

How your mind works

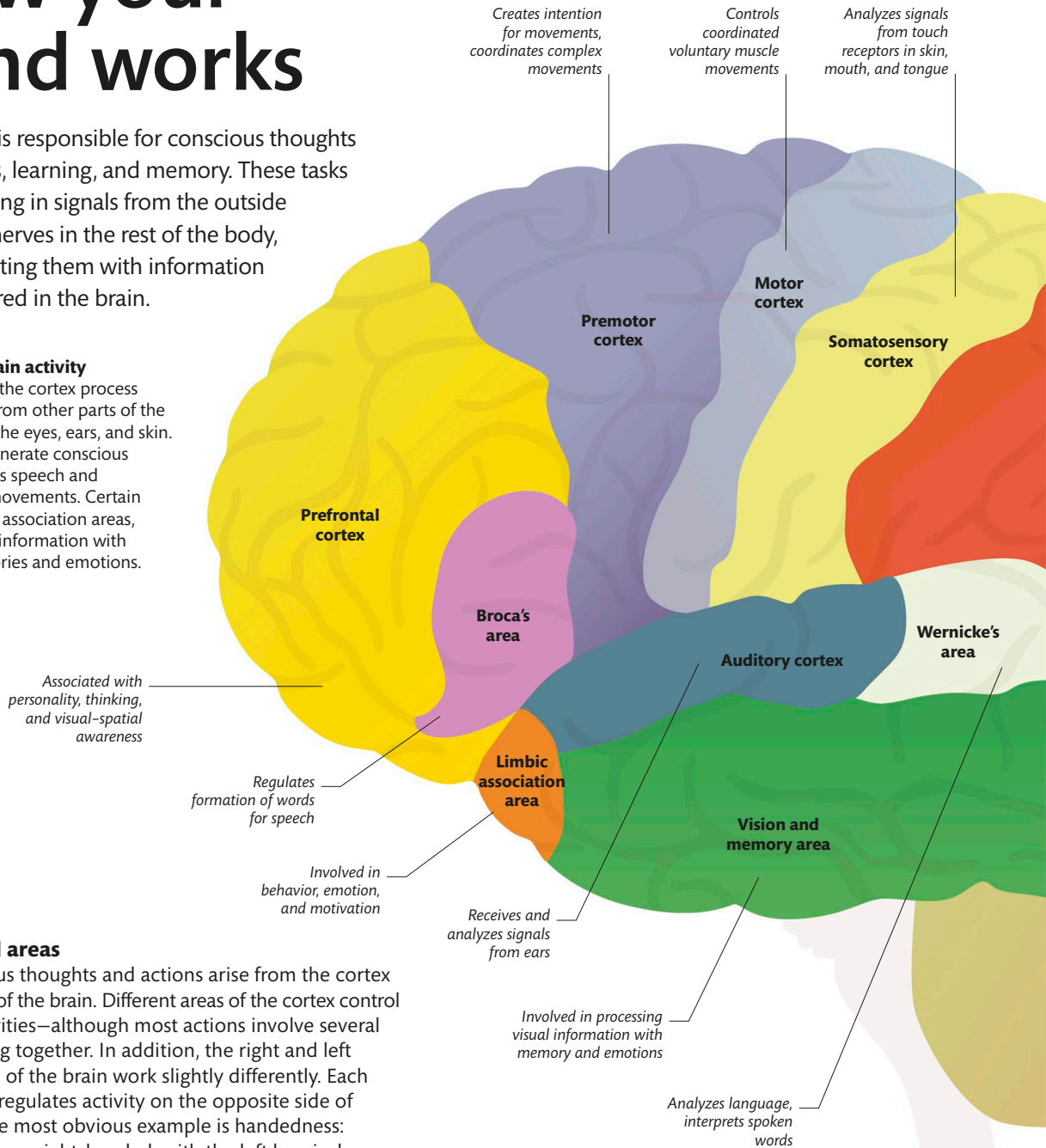
Your mind is responsible for conscious thoughts and actions, learning, and memory. These tasks involve taking in signals from the outside world, via nerves in the rest of the body, and integrating them with information already stored in the brain.

Centers of brain activity

Some parts of the cortex process nerve signals from other parts of the body, such as the eyes, ears, and skin. Other areas generate conscious actions, such as speech and coordinated movements. Certain regions, called association areas, integrate new information with existing memories and emotions.

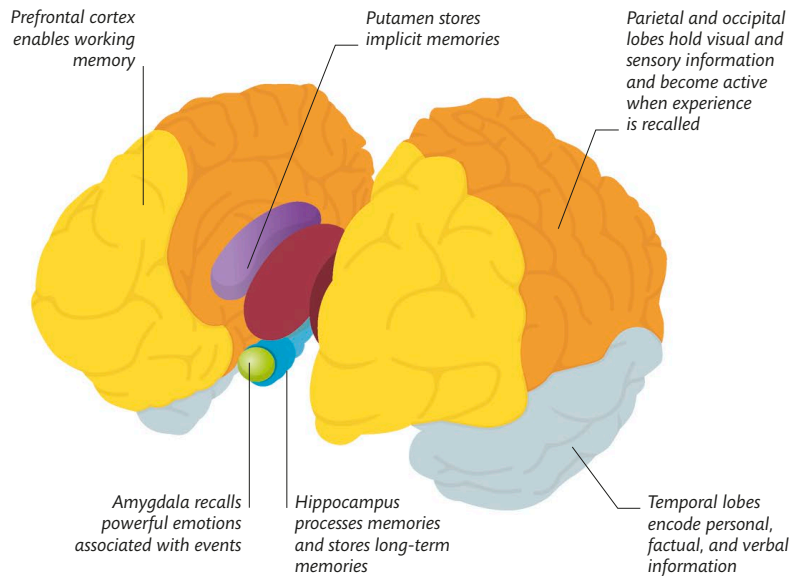
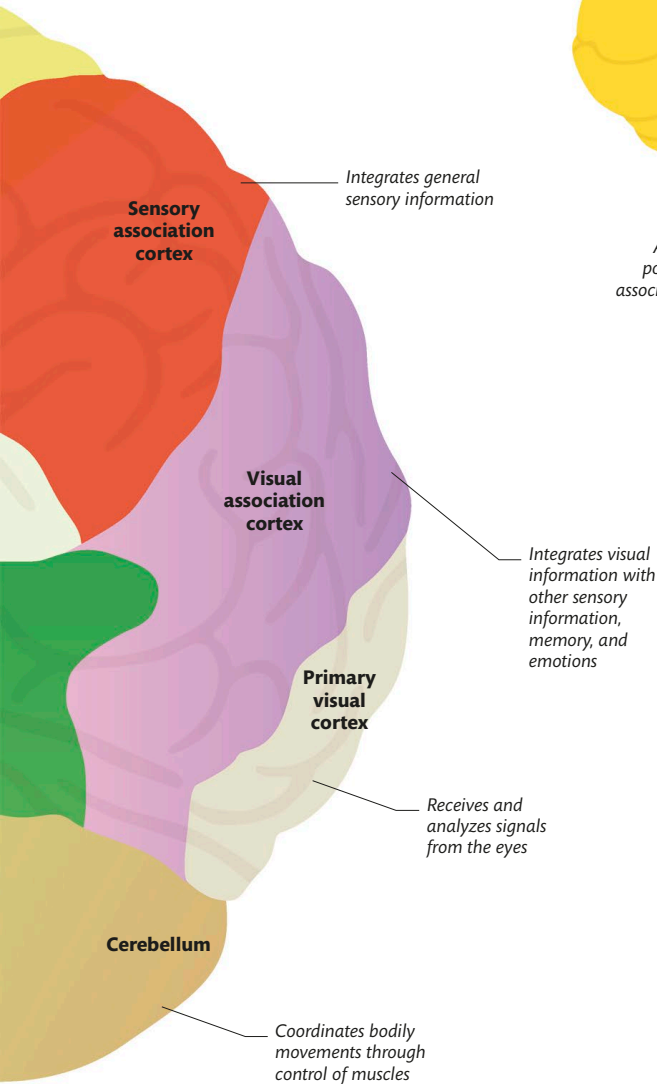
Specialized areas

Our conscious thoughts and actions arise from the cortex (outer layer) of the brain. Different areas of the cortex control specific activities—although most actions involve several areas working together. In addition, the right and left hemispheres of the brain work slightly differently. Each hemisphere regulates activity on the opposite side of the body. The most obvious example is handedness: most people are right-handed, with the left hemisphere of their brain being dominant, but about 10 percent of people are left-handed, with a dominant right hemisphere.



Memory storage

The creation, storage, and recall of memories involve several areas of the brain. The cortex processes information, while the hippocampus converts perceptions and thoughts into longer-term memories. The amygdala registers emotions, which give significance to our memories.



The record for learning to speak a new language is just 1 hour 40 minutes



Learning and memory

Memory is not just about storing data; memories are also recalled and integrated with new information. There are different forms of memory for specific tasks. Working memory holds information only as long as you need it. Declarative memories comprise factual knowledge and ideas. Episodic memories involve personal experiences. Spatial memories provide a map of your environment. Implicit memories are learned information that you can use without conscious effort, such as knowing how to drive.

CHECKING MENTAL FUNCTION

To assess your mental health, the doctor will ask you about your lifestyle—diet, sleep, alcohol or drug use, and possible sources of stress. If necessary, the doctor may also assess your risk of more serious conditions such as depression or dementia, typically by using a standardized questionnaire.

Mood analysis

Many people experience times when they feel low, but it is vital to see your doctor if you suffer from severe anxiety, or you have been feeling sad and “down” for weeks or months (depression), as both can impact on daily life.

What to expect when consulting your doctor

Your doctor will ask you some standard questions about your mood, behavior, thoughts, and lifestyle, and will want to know about any changes in the quality of these aspects of your life as well as events that might have triggered your feelings. You will be asked to describe how you feel, and how long you have felt this way, as well as physical factors that affect you, such as disturbed sleep, unexplained aches and pains, panic attacks, or comfort eating. Your doctor will also want to know if your mood impinges on social aspects of your life such as your work or relationships with others and, if so, to what extent.

SELF-HELP MEASURES			
	Diet	▶ Eat a healthy balanced diet	▶ pp.146–149
	Physical activity	▶ Exercise regularly	▶ pp.152–157
	Sleep	▶ Get a good night's sleep	▶ p.165
	Stress	▶ Learn to manage stress	▶ p.165

Dementia testing

Dementia is not a specific disease, but a term used to describe a group of symptoms associated with a decline in mental ability—memory and thinking skills—as well as behavior severe enough to interfere with your ability to perform everyday tasks.

What happens in the consultation?

Your doctor will want to know when you first became aware of the symptoms, how they are affecting you, and whether there is any family history of memory impairment. You may be asked to complete a cognitive test that assesses mental abilities, such as memory, concentration, and language skills, as well as behavior and visual perception.

This will include questions such as what is today’s date or day of the week, and where did you go to school. There will be some basic math calculations, as well as drawing tests, image identification, and problem-solving tasks. There are online sites that provide similar questionnaires you can use to assess cognitive functioning at home—but always show the doctor your results. Your doctor will also conduct a physical examination, review any medications, and may request blood tests to exclude conditions with symptoms that can be confused with dementia.

From these tests your doctor can assess whether or not your impairment is a normal part of the aging process or associated with dementia. You may also be referred for brain scans to assess the cause of the symptoms.

More than 46 million people are living with dementia worldwide



The next steps

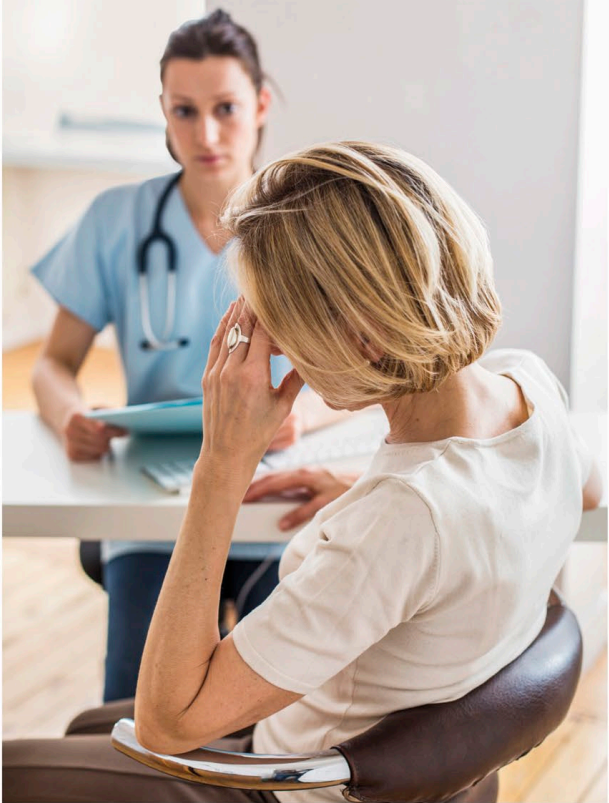
Low mood, anxiety, or depression can reduce your desire for exercise and increase the likelihood of comfort eating, or even alcohol and drug abuse, leaving you more at risk of physical problems. Your doctor will conduct an examination and may order blood tests (see p.54) to eliminate any illnesses that could be the cause of mood changes. Depending on the findings, self-help measures (left) and referral for talking therapies may be suggested.

1 in 10 people suffer from depression at some point in their lives

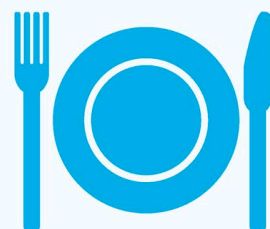


Talking to your doctor

Opening up and telling your doctor about how you really feel can be difficult, but it is essential to be honest so that he or she get a full picture and can be in a position to offer the right help.



DIFFERENTIATING BETWEEN AGE-RELATED CHANGES AND DEMENTIA	
Age-related changes	Signs and symptoms of dementia
Occasionally forgetting words, names, or events, but recalling them later. Cannot remember a conversation that took place a year ago	Forgetting recently learned information, conversations, or a recent event. Repeatedly telling the same story or asking the same question
Occasionally becoming confused about the day of the week	Losing track of days, dates, and seasons. Forgetting where you are or even how you got there
Intermittent loss of interest in regular activities, family, or work, which are normally enjoyed	Starting to withdraw completely from favorite pastimes, social groups, and regular activities
Occasionally making poor decisions or showing lack of judgment	Persistent poor financial judgment, loss of interest in personal care
Sometimes losing possessions, but able to retrace steps to find them	Putting items in unusual places and inability to retrace steps to find them; you may accuse others of stealing your possessions
Developing age-related vision problems such as cataracts	Cannot differentiate colors or detect movement and “sees” things that are not there
Occasionally needing help with familiar tasks such as resetting a clock or recording TV programs	Is no longer able to complete normally familiar tasks
Sometimes making errors calculating finances	Unable to work with numbers and follow plans/instructions/recipes
Developing routines and specific ways of doing things and becoming irritable if routine is disrupted	Becoming generally confused, suspicious of others, depressed, fearful, and easily upset for no reason





**Optimizing
your health**

Vaccinations

Vaccination is an effective method of protecting against a range of potentially serious infectious diseases. Many vaccines are offered as part of the recommended vaccination schedule, but some are routinely offered only to special groups or at particular ages. In addition, boosters or additional vaccines may be recommended for travel to certain regions.

How does vaccination work?

Vaccines provoke the immune system into producing antibodies (also known as immunoglobulins) against specific infectious diseases. The degree of protection varies among different vaccines. Some provide reliable long-term immunity, whereas others may not give full protection, long-lasting protection, or, for some, any protection at all. For example, influenza vaccines usually protect only against particular strains of the virus expected to spread during the upcoming flu season. Based on these predictions, effectiveness typically varies from 40% to 60%. Serious adverse effects of vaccines are rare and, for most

people, the benefits far outweigh the risks. However, certain vaccines are not generally recommended for certain groups, such as pregnant women or those with weakened immune systems; your doctor will be able to advise you if any vaccines are not suitable for you.

Vaccines provide active immunity against specific infections, but it is also possible to create passive immunity, by injecting immunoglobulins (antibodies) from humans or animals who have been exposed to the disease. However, immunoglobulins do not stimulate the body to produce its own antibodies, and so their protection is short-lived.

COMMON TRAVEL VACCINATIONS			
The vaccinations recommended for travel depend on where you intend to visit. Wherever you plan to go, you should make sure you have been immunized against diphtheria, tetanus, polio, and measles, and have had booster doses if necessary.		Also ensure that other routine vaccinations are up to date. The table below details the more common travel vaccinations, but recommendations may change from time to time, so you should obtain up-to-date information in plenty of time before traveling.	
Infection	How and when given	When most effective	Period of protection
● Cholera	1 oral dose	90% effective 10 days after 2nd dose	6 months
● Hepatitis A	2 injections, 6–18 months apart (up to 36 months apart for Canada)	2 weeks after 1st dose	2nd dose protects for at least 20 years
● Hepatitis B	3 injections, over a period of 6–18 months	After 3rd dose	At least 20 years
● Japanese encephalitis	2 injections, 28 days apart	28 days after 2nd dose	Unknown
● Meningitis A, C, W135 and Y	1 or 2 injections	After 1 month	About 5 years
● Rabies	3 injections, 1 week between 1st and 2nd doses, 2 or 3 weeks between 2nd and 3rd doses	After 3rd dose	Those at continued risk should be tested every 6 months and boosted if titer is low. Frequent travelers should be tested every 2 years.
● Typhoid	1 injection or 4 oral doses, each dose on an alternate day	2 weeks after injection, or 7–10 days after last oral dose	Injection: about 2 years. Oral vaccine: about 5 years
● Yellow fever	1 injection	80–100% effective within 10 days; 99% within 30 days	At least 10 years

COMMON VACCINATIONS

Vaccination against many potentially serious infections is offered routinely, mostly during childhood. Some vaccines are not offered to everybody, but only to those who are in specific at-risk groups, such as people with certain long-term

health conditions or health-care workers. The table below details the most commonly recommended vaccines. Timing and doses vary depending on where you live. See your health-care provider.

Vaccination	When given	Number of doses
● Hepatitis B (Hep B)	Birth, 1–2 months, 6–18 months	2 or 3
● Rotavirus (Rot, RV1, RV5)	2, 4, 6 months; 65 and older	2 or 3
● Diphtheria, tetanus, pertussis (DTaP)	2, 4, 6, 15–18 months, 4–6 years	5
● Haemophilus influenzae type b (Hib)	2, 4, 6, 12–15 months	3 or 4
● Pneumococcal conjugate (Pneu-C-13, PCV13)	2, 4, 6, 12–15 months; 65 and older	3 or 4
● Polio (IPV)	2, 4, 6–18 months, 4–6 years	4
● Influenza (Inf, IIV, LAIV)	Annually 6 months and older	1 or 2
● Measles, mumps and rubella (MMR)	12–15 months, 4–6 years	2
● Chickenpox (varicella) (VAR)	12–15 months, 4–6 years	2
● Hepatitis A (Hep A)	12 months or older, 6 months between doses (US only)	2
● Meningococcal conjugate (Men-C-C)	12 months (Canada only)	1
● Meningococcal conjugate (Men-C-ACYW)	11–13 years (also 16 years, US only)	2
● Tetanus, diphtheria, pertussis (TDaP)	12–14 years (US), 14–16 years (Canada); every 10 years in adulthood, and with each pregnancy (US only)	1
● Tetanus, diphtheria (Td)	Every 10 years in adulthood (Canada only)	1
● Human papillomavirus (HPV)	11–13 years	2 or 3
● Pneumococcal polysaccharide 23-valent (Pneu-P-23, PPSV23)	65+ years	1 (Pneu-P-23 and PPSV23 at least 1 year apart)
● Herpes zoster (shingles) (HZV, RZV, ZVL)	50+ years	1

A healthy diet

The human body requires a range of nutrients in order to function. The food we eat must provide sufficient protein, carbohydrate, fat, fiber, vitamins, minerals, phytonutrients, and water to sustain all physiological functions from energy production, growth, repair, and defense, to cell communication, digestion, cognition, and psychological well-being.

The essential nutrients

Protein provides the body with amino acids needed for growth, repair, and energy. Carbohydrates—our main source of energy—also contain fiber, essential for cardiovascular and digestive health. Monounsaturated, polyunsaturated, and saturated fats are important sources of fatty acids.

Essential fatty acids (omega-3 and omega-6) are used in maintaining cell structure; synthesizing hormones; and absorbing vitamins A, D, E, and K. Vitamins and minerals provide antioxidants and enable the body to perform a wide variety of functions, from hormone production to absorbing and transporting nutrients.

Broccoli contains almost twice as much vitamin C as an orange of the same weight

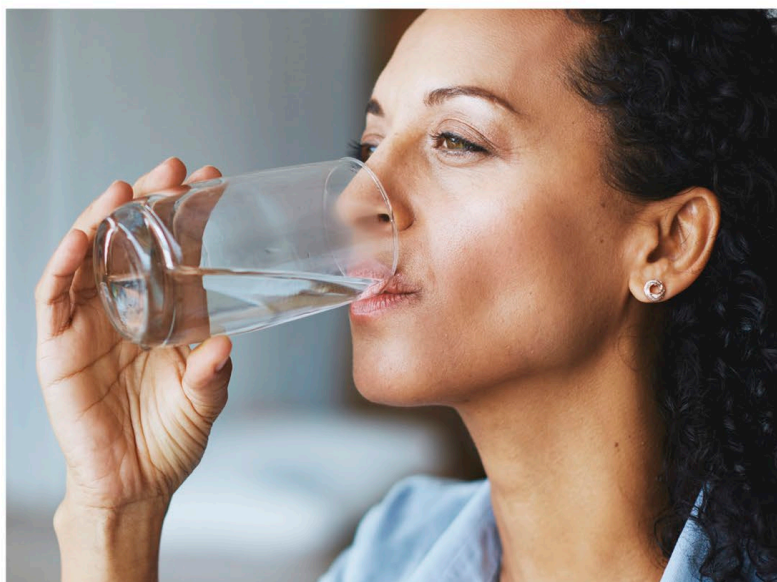


Stay hydrated

It is recommended that you drink six to eight glasses of fluid a day, with water as the main source. Milk, tea, coffee, and sugar-free drinks (not sodas or cordials, as they have a high sugar and calorie content) count, too. Limit fruit juices and smoothies to 5 fl oz (150 ml) per day (one portion). Limit your intake of alcoholic drinks, because these act as a diuretic and increase dehydration.

Hydrate with water

Water regulates body temperature, carries nutrients, removes waste products, and lubricates your joints—even low levels of dehydration can have a negative impact on both physical and mental well-being.



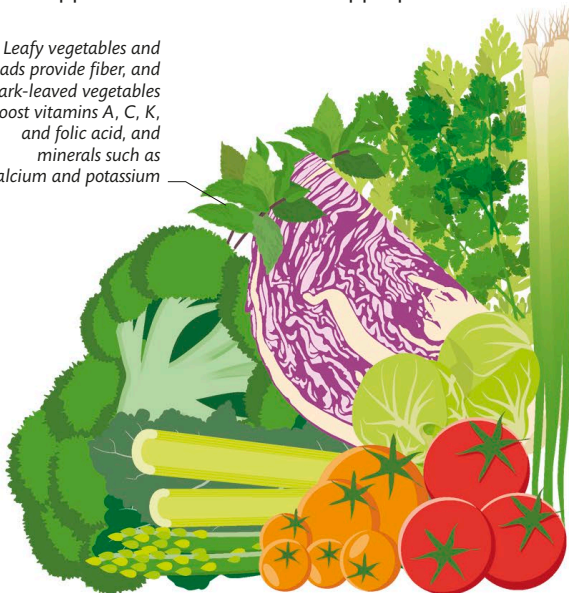
CARING FOR TEETH AND GUMS

- Brush your teeth at least twice a day to minimize plaque buildup. Clean between your teeth with floss or interdental brushes to keep gums clean. Attend regular dental checkups (see pp.118–119).
- Use a fluoride toothpaste to help build strong teeth and reduce risk of tooth decay.
- Limit your consumption of sugary food and drinks (including alcohol, see p.150), as sugar is the main cause of tooth decay.
- Foods containing calcium (dairy products, almonds, green leafy vegetables, canned fish) and phosphorus (eggs, fish, poultry, cheese, whole grains) promote strong teeth and bones.
- Consume a wide variety of fresh vegetables and fruit containing vitamin C, as this is essential for gum health.

Balance and variety

By consuming a wide variety from the four food groups shown below you will be eating enough of the essential nutrients to maintain a good level of health. In some circumstances, when individual nutritional demand is increased, after injury or illness for example, nutrient supplementation may be beneficial. Ideally, talk to a nutrition health care professional to find out which supplements will be safe and appropriate.

Leafy vegetables and salads provide fiber, and dark-leaved vegetables boost vitamins A, C, K, and folic acid, and minerals such as calcium and potassium



Root vegetables and wholegrains release energy slowly and provide more fiber and nutrients than refined carbohydrates—limit white bread and pasta



Eating a “rainbow” of colored fruit (2 portions) and vegetables (5 portions) provides a variety of vitamins, minerals, and essential plant nutrients



FATS AND OILS

Prioritize oily fish, avocados, nuts, seeds, and their oils as your main sources of essential fatty acids. They also provide vitamin E, and the minerals selenium, magnesium, and zinc. Limit saturated fats as they are associated with an increased risk of cardiovascular disease. Trans fats—produced when unsaturated fats are hydrogenated—should be avoided.



Choose fish, poultry, eggs, pulses, nuts, seeds, and tofu as your main protein sources. Limit dairy, eat only lean red meat, and avoid processed meats

Adapting your diet

Sometimes it is necessary to adapt your diet to manage a condition such as excess weight gain, or to improve your health. To achieve this you may need to adjust quantities and ratios of the food groups, reduce your calorie intake, and/or make healthier food choices.

Why change your diet?

There are many benefits of changing your diet. Not only can it bring about increased energy levels and improved digestion, mood, and quality of sleep, but it can also reduce the risks of conditions such as obesity, osteoarthritis, cardiovascular diseases, cancers, and type 2 diabetes. But adjusting the balance of nutrient groups is not always straightforward. For example, lowering blood cholesterol is not as simple as avoiding fats. There are different types of cholesterol; the potentially damaging very-low- and low-density lipoprotein (VLDL and LDL), and the beneficial high-density lipoprotein (HDL). Your body needs cholesterol, but it is the HDL to LDL ratio that is important as HDL helps remove LDL from the blood. By increasing your intake of beneficial fats and reducing animal fats, you can help increase HDL and lower LDL.

WEIGHT MANAGEMENT

To lose weight, your energy intake must be less than your energy expenditure. To help achieve this, reduce your calorie intake and increase consumption of nutrient-dense foods (see below). Adjust your portion sizes, consume fewer refined carbohydrates, and less saturated fat (see opposite). In addition, your exercise level and its intensity may need to be increased (see pp.152–155).

Worldwide, more than 39% of adults are overweight and 13% are obese

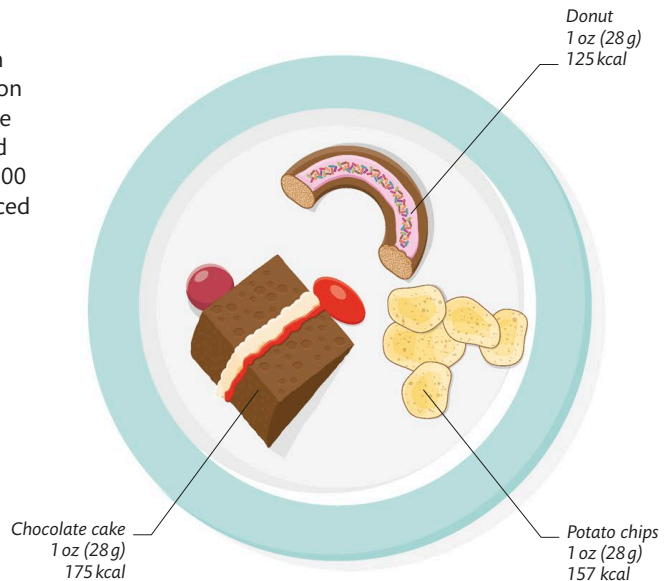


Energy and nutrient density

Energy provided by foods is most commonly reported in calories (kcal). Your calorie requirements are calculated on physical activity levels and your basal metabolic rate—the energy needed for basic functions, such as breathing and maintaining a heartbeat. Adult males require around 2,500 kcal and females 2,000 kcal per day, from a healthy balanced diet of food and drinks, but this also varies with age.

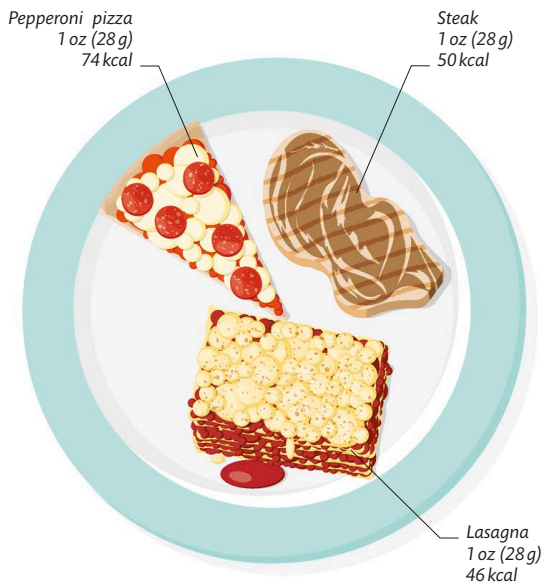
Nutrient density can vary

Look at the nutritional quality of your foods, not just the number of calories. Choose foods that are dense in nutrients rather than energy to get the best quality and balance for your needs. These plates show how different foods can vary in their calorie content (energy density) and nutrient density.

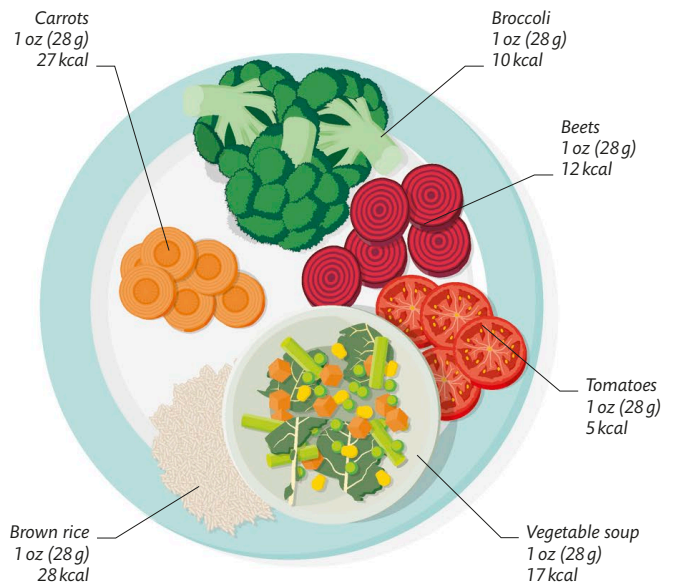


High energy and low nutrient density

Change	Health benefits	Foods to eat	Foods to reduce or avoid
Reducing saturated fat	- Reduces total blood cholesterol and LDL - Reduces risk of cardiovascular diseases - Helps weight management - Improves mental health and cognitive function	- Steamed or boiled foods - Essential fatty acid omega-3 rich foods, such as oily fish, nuts, seeds, and avocados - Plant-based protein foods like pulses, soy, quinoa	- Fried or roasted foods - Fatty red meats - Processed meats - Cakes, pastries, and chocolate - High-fat dairy products such as hard cheese, cream, ghee, butter - Limit low-fat dairy products to a small yogurt or glass of milk or matchbox-size piece of cheese
Reducing salt	- Lowers blood pressure - Reduces risk of cardiovascular diseases	- Homemade fresh foods; make your own stocks, sauces, and gravies - Flavor foods with pepper, herbs, and spices instead of using salt - Choose snacks or canned foods with no added salt	- Ready-prepared meals - Processed and cured meats such as ham, sausages, bacon, salami - Salty snacks like chips and nuts - Foods with added salt—check labels as these can include less obvious products like bread and cereals
Reducing refined carbohydrates, or “free” sugars	- Helps weight management - Helps energy and mood balance - Reduces risk of type 2 diabetes - Improves digestion and dental health - Improves immune health	- High-fiber foods, such as fresh vegetables and fruit - Wholegrain varieties of bread and pasta - Alternative grains, such as quinoa, brown rice, spelt, rye, buckwheat, or oats	- High-sugar foods such as cakes, cookies, pastries, and sweets - White breads and pasta - Foods with added sugar - Sugar-sweetened drinks (they also contain few nutrients), and limit fruit juice and alcohol



Medium energy and medium nutrient density



Low energy and high nutrient density

Alcohol, tobacco, and drugs

Learning about the effects alcohol, tobacco, and drugs can have on the body can help you make healthier life choices. Each one carries its own risks, and all can have a detrimental effect, not only on your physical health, but also on your mental well-being.

About alcohol

Alcohol is the most commonly used addictive substance. While light to moderate drinking may have some benefits, they are relatively small, and do not apply to everyone. It is recommended that you limit your intake to no more than 14 units (see below) per week, ideally less, spread over at least three days, and that you have several alcohol-free days per week. If you do not drink alcohol, do not start just because you think there might be health benefits.

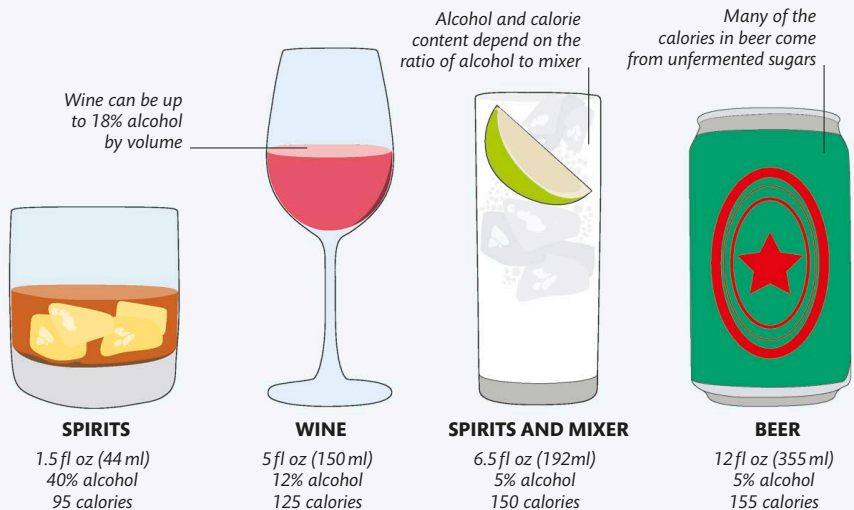
In the short term, excessive alcohol use impairs judgment and causes accidents that can result in injury and complications such as pneumonia from aspiration of vomit. In the long term, heavy use can result in numerous detrimental effects on both mental and physical health, from depression, alcohol dependence, and addiction to liver failure, cardiovascular disease, brain damage, dementia, and many cancers.



Worldwide, 13.5 percent of the deaths in the 20–39 age group are related to alcohol use

WHAT IS A DRINK?

Guidelines as to what constitutes a standard drink vary from one country to another, typically ranging from 0.35 fl oz (8 g) of alcohol in the UK to 0.6 fl oz (14 g) in the US. Although all the drinks shown here contain 0.6 fl oz (14 g) of alcohol, they vary considerably in their calorie content (see p.148). Alcohol has almost as many calories as pure fat. Alcoholic drinks also contain sugars, which add to their calorie count and contribute to weight gain.





Tobacco use

Whether you smoke it or chew it, tobacco is not only addictive, but it also increases your risk of developing serious health problems, including many cancers. Smoking can also reduce fertility, prematurely age your skin, and harm the health of those around you. Giving up tobacco can be difficult, but the good news is that after only one year of not smoking, your risk is reduced by half. To make it easier to quit:

- Your doctor can prescribe medication that reduces withdrawal symptoms and eases cravings.
- Join a support group and/or find a “quit buddy” who wants to stop, and ask your friends and family to help you.

Risks associated with drugs

The effects of drugs vary considerably, depending on the substance. But repeated use of many can lead to addiction that not only has a negative impact on relationships and daily life, but also results in painful withdrawal symptoms when a person stops using them. Long-term use of any drug can leave you susceptible to serious health problems, ranging from cardiovascular disease to blood-borne infections, and is linked to severe mental-health issues. But with the right help it is possible to be drug free; start by talking to your family doctor or local drug clinic.

Nicotine-replacement therapy

The addictive substance in cigarettes is nicotine. If used correctly, chewing nicotine gum (or wearing patches) provides your body with enough nicotine to reduce the withdrawal symptoms experienced when you stop smoking.

ELECTRONIC CIGARETTES

Also known as e-cigarettes, these are battery-powered devices that mimic the effect of smoking. The user inhales the nicotine as a vapor (“vaping”) instead of breathing in the toxic tar and carbon monoxide from burning tobacco. There is evidence that e-cigarettes can help people give up smoking, although the effects of long-term use—possibly including nicotine addiction—are not clear.

Devices and flavorings



Keeping fit

Keeping fit begins with reducing sitting time and spending more time being active. Any activity that gets you moving and using your muscles can be considered exercise. Before starting a training program, get the green light from your doctor.

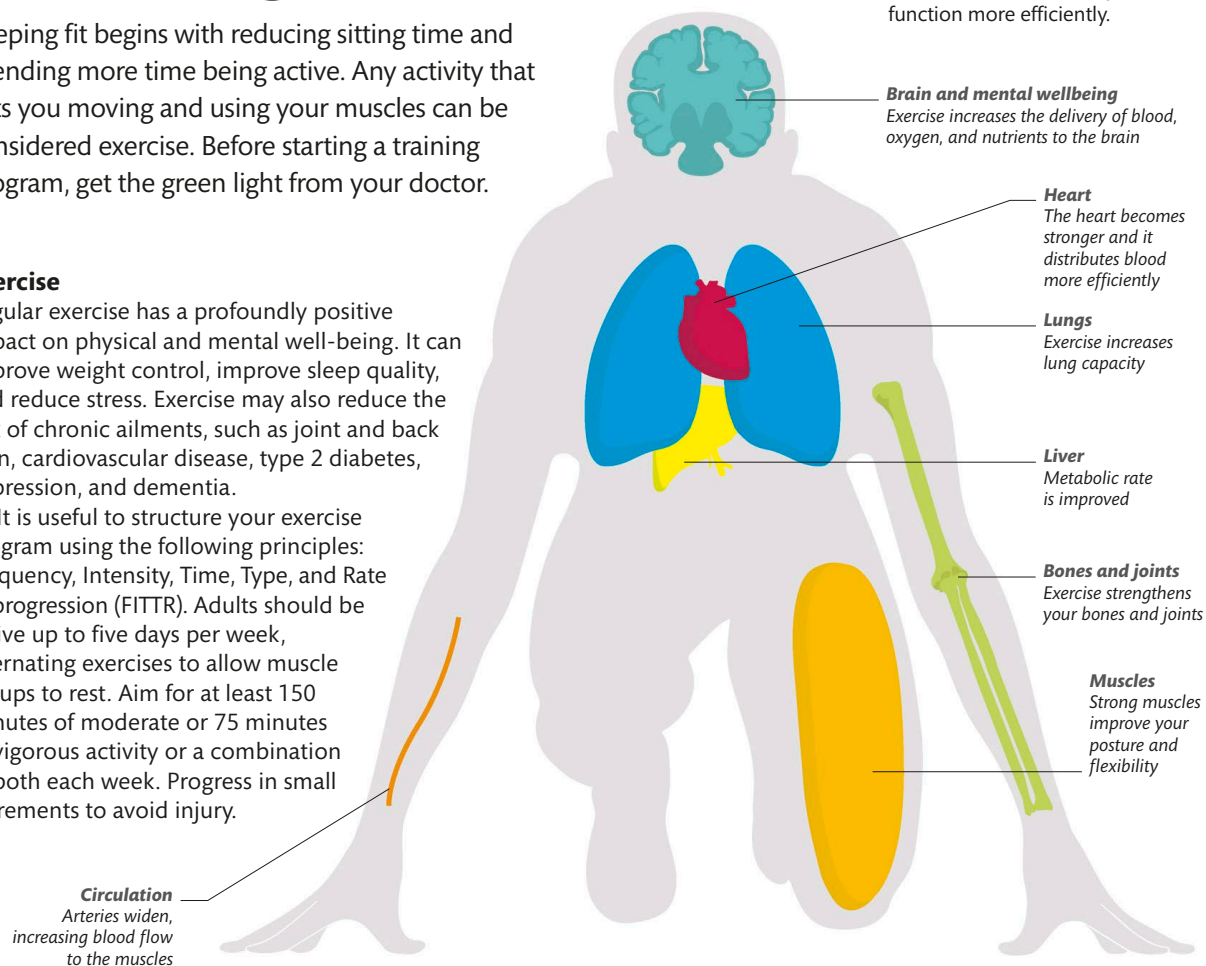
Exercise

Regular exercise has a profoundly positive impact on physical and mental well-being. It can improve weight control, improve sleep quality, and reduce stress. Exercise may also reduce the risk of chronic ailments, such as joint and back pain, cardiovascular disease, type 2 diabetes, depression, and dementia.

It is useful to structure your exercise program using the following principles: Frequency, Intensity, Time, Type, and Rate of progression (FITTR). Adults should be active up to five days per week, alternating exercises to allow muscle groups to rest. Aim for at least 150 minutes of moderate or 75 minutes of vigorous activity or a combination of both each week. Progress in small increments to avoid injury.

Benefits of exercise

Regular exercise benefits many parts of the body, making it function more efficiently.



TIPS FOR SUSTAINING AN EXERCISE PROGRAM

- Understand the benefits of exercise and the program you are following.
- Practice exercises or sports that you enjoy.
- Set achievable goals.
- Be efficient and build exercise or physical activity into your daily routine.
- Be consistent—small increments each week lead to big improvements in the long run.
- Monitor your progress. Wear a fitness tracker or keep a log of goals achieved.
- Rest for 24-48 hours to reduce your risk of injury. Remember, you can rest some muscle groups while exercising others.
- A healthy diet is essential (see pp.146-147).
- Challenge your friends and encourage each other.
- Seek professional advice when necessary.

Strengthen your muscles and bones

Resistance training improves muscle strength, which is necessary for all activities; helps build and maintain strong bones; and also assists in the control of blood pressure, blood glucose, and body weight. It can be performed at home or at the gym two days per week and may include lifting weights, using resistance bands, push-ups, sit-ups, or even gardening. Aim to work hard enough so that another repetition of the activity would be difficult to complete.

Exercise for cardiovascular health

Activities that improve endurance and cardiovascular fitness include walking, running, cycling, swimming, climbing stairs, and participating in sports. Moderate activity increases your heart and respiratory rate, but you're able to talk, and you will have a light sweat after 10 minutes. Vigorous activity raises your heart rate, makes you breathe hard and fast, you cannot say more than a few words without pausing, and you sweat after a few minutes.

Maintaining flexibility

Activities that improve balance, flexibility, and agility include yoga, Pilates, tai chi, and stretching, and should be done on at least two days a week. These are complex activities requiring controlled coordination of numerous muscles groups, which help develop postural stability and, in older adults, help reduce the risk of falls (see p.156). These types of activity are also ideal for mental rest and reflection.

Healthy heart and lungs

Swimming and cycling are good exercises for fitness and endurance without placing impact stress on the joints. Taking time to warm up and cool down may reduce strain on the muscles in the shoulders, back, and thighs.



Exercise for special groups

Appropriate physical activity will greatly benefit people suffering from a health condition or who are getting older. However, such groups require a specifically targeted and supervised training program.

When can I exercise?

Remaining active and preserving health becomes increasingly important with age or in the context of chronic conditions, where immense physical and mental health benefits may be achieved. For example, exercise may preserve the cardiac function in patients with cardiovascular disease such as angina, resistance training

helps maintain bone mass and manage osteoporosis, and stretching and agility exercises maintain range of motion and improve joint function in people with arthritis. In these scenarios, exercise programs must be individualized. Appropriate professional advice, supervision, and monitoring can improve success and safety.

MONITORING YOUR ACTIVITIES

Wearable devices have become highly sophisticated tools for tracking health metrics, such as heart rate, physical activity, sleep patterns, and calorie intake. These devices provide useful information for monitoring improvements in your health and the body's response to exercise.



Exercise together

Exercise with another person, so that there is support available should either of you need it.

Know your limits

Exercise frequency, intensity, time, type, and rate of progression (FITTR, see p.152) will depend on the individual's baseline ability. Clinical evaluation—and possibly exercise testing—prior to starting an exercise or rehabilitation program are essential and provide insight into the level at which exercise can be initiated safely. Consideration is also given to factors, such as medication or pacemakers, that may influence the body's response to exercise. Two useful metrics to monitor intensity include your current heart rate as a percentage of your maximum heart rate, and rate of perceived exertion.

Your maximum heart rate can be calculated by subtracting your age from 220



Training under supervision

A training plan devised by a professional, such as a personal trainer or physical therapist, will ensure that you do the exercises that are right for you and do them correctly.

SPECIAL CONSIDERATION

Seek medical advice before starting any exercise program to ensure that you do exercises that are safe and most beneficial. Stop the activity and seek help immediately if you feel dizzy; feel ill; or experience any pain, including muscular or chest pain.

Chronic illness	Special considerations	Good exercises to consider
Diabetes	• Monitor blood glucose levels to prevent hypoglycemia. • Keep hydrated. • Monitor heart rate and blood pressure. • Pay extra attention to foot care and ulcer prevention. • Exercise with a partner.	• Resistance training • Aerobic exercises
Cardiovascular disease	• Some medication (such as beta blockers) or pacemakers may influence your heart rate during exercise. • Exercise under supervision and stop activity if symptoms occur.	• Moderate intensity cardiovascular exercise and resistance training
Obesity	• To lose weight, exercise should be combined with dietary changes. • Take extra care to prevent injuries.	• Focus on aerobic activities
Osteoporosis	• Take extra care to prevent falls.	• Pilates, tai chi • Weight-bearing and resistance exercises
Arthritis	• Reduce repetitive joint impact. • Use appropriate equipment, e.g. well-cushioned, shock-absorbing shoes. • Adequate warm-up and cool-down can minimize pain.	• Prioritize exercises that encourage joint range of motion • Low impact activities such as walking, swimming, or cycling • Include functional activities, such as sit-to-stand and step-ups
Cancer	• Start with light intensity exercise for short durations. • Modify exercise type and intensity around the time of treatment. • Avoid physical inactivity. • Bone metastases may require reduction of impact activities.	• Depends on type of cancer and treatment • Team sports (e.g. cycling or bowling)

Safeguarding your bones and muscles

Bones and muscles are dynamic tissues that remodel continuously to accommodate for the forces they endure. The potential size and strength of bone and muscle tissue is determined by genetics. However, you can take steps yourself to maintain and strengthen your bones and muscles, such as following a healthy diet and exercising regularly.

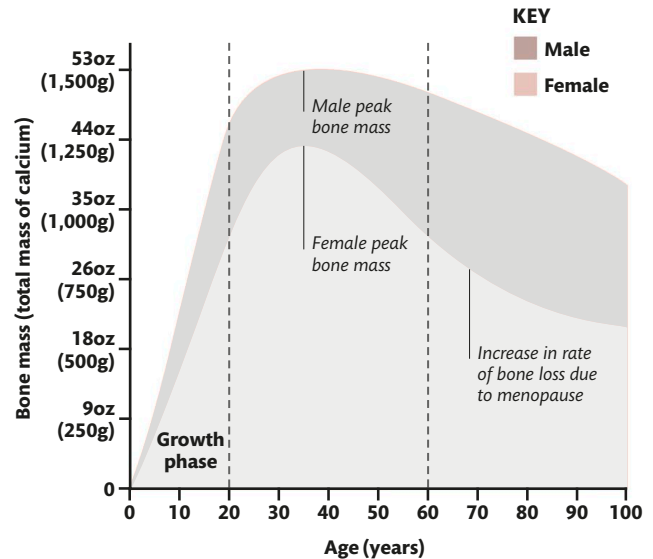
Healthy bones

Bone mass declines steadily with age. Postmenopausal women may also lose bone mass due to hormonal changes. Osteoporosis occurs when bone mass decreases to the level at which fractures can occur without significant trauma. To maintain optimum bone mass it is important to:

- Be active
- Get enough protein, calcium, and vitamin D in your diet
- Maintain a healthy BMI (see pp.24–25)
- Avoid smoking
- Reduce your alcohol intake
- Maintain your balance, agility, and coordination to prevent falls (see below)

Decreasing bone mass

This chart shows how bone mass (related to the amount of calcium stored in the bones) naturally decreases with age. Changes may not be apparent in your daily life, so seek advice from your doctor regarding your osteoporosis risk.



Preventing falls and injuries

Reduce your risk of having a fall with exercises that build strength, balance, and agility, such as yoga or tai chi. Other steps include avoiding or reducing alcohol consumption, having your sight tested, and reviewing medication to see whether side-effects make a fall more likely. Minimize hazards at home by removing clutter and exposed cables, use nonslip rugs for slippery surfaces, ensure that there is adequate lighting, mop up spills immediately, and use appropriate footwear.

Right way to lift heavy objects

Prevent back strain when lifting heavy objects by using your leg muscles to lift the weight. Bend your knees and keep the back straight when lifting, and try to make the lift a smooth movement.



Strengthening exercises

Weight-bearing exercises, with appropriate impact, and muscle-strengthening exercises maintain strong bones and stimulate muscle growth. On most days, healthy adults should include 20–30 minutes of moderate impact activity—people with osteoporosis should spend 20 minutes on lower impact exercises. Prolonged sitting should be avoided. For guidance:

- Low impact—walking, stair climbing.
- Moderate impact—dancing, jogging, running, team sports, racket sports, skipping.
- High impact—basketball, jumping jacks, track events.

Strengthening muscles requires movement against resistance, such as exercises with free weights, resistance bands, or using body weight. Remember to warm up, stretch, and gradually build up strength to avoid injury.

Appropriate impact

Basketball can place a lot of stress on the bones and joints, so care should be taken when playing. However, it is good exercise to help maintain coordination, agility, and balance.

Healthy diet

As part of a healthy, balanced diet (see pp.146–147), adequate protein, calcium, and vitamin D intake are essential for strong bones and muscles. Adults require at least $\frac{3}{25}$ oz (700 mg) of calcium every day. Older adults and breastfeeding women require up to $\frac{1}{25}$ oz (1.25 g) of calcium per day. Vitamin D helps the body absorb and utilize calcium effectively, and can be obtained through safe sun exposure (10–30 minutes per day), dietary sources (such as oily fish, eggs, and fortified cereals), or taking supplements.

Keeping your skin healthy

Your skin performs a wide range of different tasks for your body, from helping to maintain body temperature to making vitamin D—vital for bone health—when exposed to the sun.

Day-to-day skin health

Everything you do, from eating and drinking to sleep and stress, can affect your skin. A good, balanced diet that includes fruit, vegetables, and foods with natural oils (see pp.146–149) helps keep skin healthy. Drinking plenty of fluids keeps it hydrated, and avoiding alcohol, or sticking to the recommended limits, can prevent dehydration. Manage your weight, but avoid crash diets as repeatedly losing and regaining weight can take its toll on your skin. Do not smoke (or quit if you do)—it prematurely ages skin by damaging the collagen that provides elasticity and strength.

Learn to manage stress (see p.165) as uncontrolled stress can trigger conditions such as eczema. Poor sleep is another trigger. However, a good night's sleep (see p.165) boosts blood flow to the skin, aiding repair and regeneration.

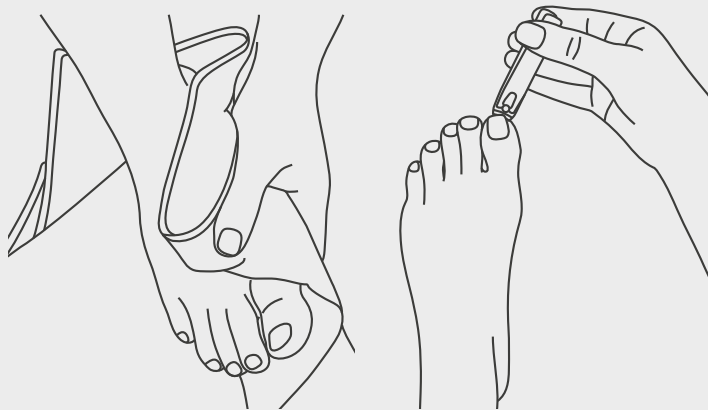
Wash daily to prevent skin infections, but avoid strong soap products as these can disrupt the balance of natural oils in your skin. If you have very dry skin, you can use emollients as a soap substitute. Use daily moisturizer with UV protection. Check your skin regularly and report any unusual coloration or marks to your doctor (see pp.98–99).

Preventing infection

Areas of skin-to-skin contact where the environment is warm and moist, such as in the groin or underarms, can be susceptible to fungal infections, so ensure you dry them carefully after washing. Keep areas of damaged skin, such as bites or scratches, clean and, if necessary, covered to prevent bacterial infections from developing.

FOOT-CARE ESSENTIALS

- Check your feet for sore patches, redness, or numbness at least once a week—or more often if you have diabetes or circulatory problems.
- Keep your feet cool and dry—fungal foot infections like athlete's foot thrive in warm, moist environments. Dry feet thoroughly after washing.
- In hot weather, wear open, well-ventilated footwear made from nonsynthetic and breathable materials.
- Change your shoes regularly—always after sports activities—and wear absorbent, cotton socks.
- Apply moisturizer to dry skin, especially around the heels, to prevent cracked skin.
- Warts and plantar warts (see p.99) are caused by the human papillomavirus (HPV), and spread by skin-to-skin contact and contact with contaminated surfaces, so wear flip-flops in communal bathing areas and avoid sharing footwear or towels.



**Dry feet and check
between the toes**

**Cut toenails
straight across**



Use a strong sunscreen

Apply plenty of sunscreen with sun protection factor (SPF) 30 (50 for very pale skin) and good UVA protection 30 minutes before you go out. Reapply every two hours, or right after swimming.

Protect skin from ultraviolet light

Ultraviolet (UV) radiation from sun rays (or tanning beds and sunlamps) damages the skin and is the main cause of skin aging and skin cancer (see pp.98–99). It is important to protect your skin to reduce the risk of skin damage.

- Apply a strong sunscreen—but remember it is only a filter; it does not block all the rays. You can get sunburn from indirect rays as well as direct sunlight.
- Cover your skin and wear UV-blocking sunglasses.
- Stay in the shade, especially between 11 am and 3 pm when the sun is at its highest.
- Do not use tanning beds and sunlamps.

Wear a wide-brimmed hat

Choose a hat with at least a 2–3 in (5–7.5 cm) brim because it offers better protection to areas often exposed to intense sun, such as the scalp, ears, eyes, forehead, and nose.



Ear health

Maintaining good general health through diet and fitness can minimize the risk of conditions that can lead to hearing problems and reduce the likelihood of age-related hearing loss. However, exposure to loud noises can damage your inner ear and lead to irreversible hearing loss.

Protect your hearing

More than half of the cases of hearing loss are preventable. Make sure your vaccinations are up to date (see pp.144–145), as many infections can cause hearing problems. Keep your ears clean and dry to prevent infections; wear ear plugs when swimming, or in the shower if necessary.

Be mindful of the level of noise in your surroundings. Resist the temptation to increase the volume on your headphones, speakers, or television. Wear ear protection if you work in a noisy environment or use loud equipment like drills for DIY at home. Professional musicians can use vented ear plugs that allow a controlled level of sound in, while also protecting their ears.

 **More than 1 billion young people globally risk developing hearing loss through exposure to loud music**

Reusable ear plugs

Use these to protect your ears in water, or even to aid sleep. Clean your ear plugs regularly to minimize the risk of developing an ear infection.



Ear protection

These are designed to protect your hearing from hazardous noise pollution, especially in the workplace. They each carry a rating that indicates the level of protection offered.

CLEANING YOUR EARS

The ear canal (see p.110) is protected by ear wax, but too little or too much can cause ear infections. Wipe your outer ear with a washcloth and warm water, but the ear canal is self-cleaning, so never put anything, especially not a cotton swab, inside it as you can push wax further in, or even damage the eardrum. If you have a buildup of wax, a few drops of olive oil twice a day for a few days will soften it and it should fall out. Over-the-counter ear drops made to loosen earwax are also available. Consult your doctor if this does not help.

Eye health

A nutritious, balanced diet packed with colorful fruits and leafy green vegetables rich in vitamins and minerals (see pp.146–147), and adequate sleep are essential for eye health. Have regular eye checkups (pp.102–109) to detect any vision problems, and because signs of some underlying health problems can be seen in your eyes.

Take care of your eyes

- Maintain good hygiene to prevent infection. Wipe around your eyes with cotton balls and warm water, using a separate pad for each eye. Remove all your eye makeup before you go to bed.
- Quit smoking and limit your alcohol intake as both are known to increase the risk of eye disease.
- Wear sunglasses in bright sun. Wraparound sunglasses are useful if

you are susceptible to hay fever, and dark goggles are essential in the snow, even on a cloudy day.

- If you are doing any DIY or work in an environment where there is dust or chemicals, always wear goggles. Never touch your eyes after working with harmful products.
- When working at a computer screen, take a break every 20 minutes and look at an object at least 20 ft (6 m) away for at least 20 seconds.



Wraparound safety goggles

Wear these if there is a risk of dust, particles, or chemicals entering your eyes. Make sure they fit securely before you start.

Sunglasses make a difference

UV radiation from the sun's rays (or a tanning bed) can cause a variety of eye conditions, including cataracts. Choose good-quality dark glasses with a safe level of UV protection; ideally wear a wide-brimmed hat, too.

Vitamins A and C help preserve good eyesight



Sexual health

Sex is an important part of life, affecting your physical, mental, emotional, and social well-being. Being in good sexual health also means staying safe by being well-informed, careful, and respectful to both yourself and others.

Practice safer sex

Of paramount importance in good sexual health is making an effort to prevent unintended pregnancies, as well as avoiding sexually transmitted infections (STIs)—and seeking care and treatment promptly if they do develop. There is a wide range of contraceptives available to prevent pregnancy; the choice largely depends on your medical history and your lifestyle. Alcohol and drug use can reduce inhibitions and impair judgment, so avoiding them reduces

the chances of engaging in risky behavior. The most effective way to avoid an STI is to use a condom (male or female), and to limit the number of sexual partners. When used correctly, condoms prevent the transmission of STIs,

Making the most of your sex life

Talking—and more importantly, listening—to each other about your feelings, preferences, and desires can bring you closer together and make sex more fulfilling.



such as HIV, chlamydia, and gonorrhea, that are spread by genital fluids. They can reduce the risk of infections that are spread by skin-to-skin contact, like genital herpes, syphilis, and human papillomavirus, only if the condom covers the infected area. If you are using condoms, avoid oil-based moisturizers and petroleum jelly as they can damage them or cause them to tear—it is safer to use water-based lubricants.

Regular screening is important

Some people experience symptoms of STIs, such as unusual discharge or bleeding, sores, rashes, or itching, but many have no symptoms, so if you are changing partners or have multiple partners, it is a good idea to have regular screening. See your doctor or visit a sexual health clinic prior to initiating sexual contact with a new partner; if your protection was inadequate, for example, a condom split; or you suspect your partner might have an STI. Prompt diagnosis and treatment is essential as some infections can cause cancers or spread into the pelvis, causing inflammation that can lead to infertility. If you are diagnosed with an infection, it is important to tell current or previous sexual partners.



Stay safe

Enjoy your sexuality in a way you are comfortable with. If either of you has been diagnosed with an STI, then avoid penetrative sex until your treatment has been completed.



Contraception choices

Options range from condoms and/or daily pills, to longer-lasting implants and injections. Talk to your doctor about what is best for you.

It is estimated that
between 6 and 9
billion condoms are
sold every year



MAXIMIZING FERTILITY

Maintaining good health through diet (see pp.146–149) and exercise (see pp.152–155) is a key way to maximize fertility. Being overweight or underweight can also affect ovulation—the optimal body mass index (BMI) for conception is between 20 and 25 (see pp.24–25). Smoking has been shown to reduce fertility in females and has been linked to poor semen quality. Women planning to conceive are advised to avoid alcohol as it not only affects fertility, but it also poses a risk to the unborn child. Men should not exceed the recommended daily maximum alcohol intake as excessive amounts can affect sperm quality—hot baths have been found to affect male fertility, too. Likewise, recreational drug use should be avoided.

Psychological health

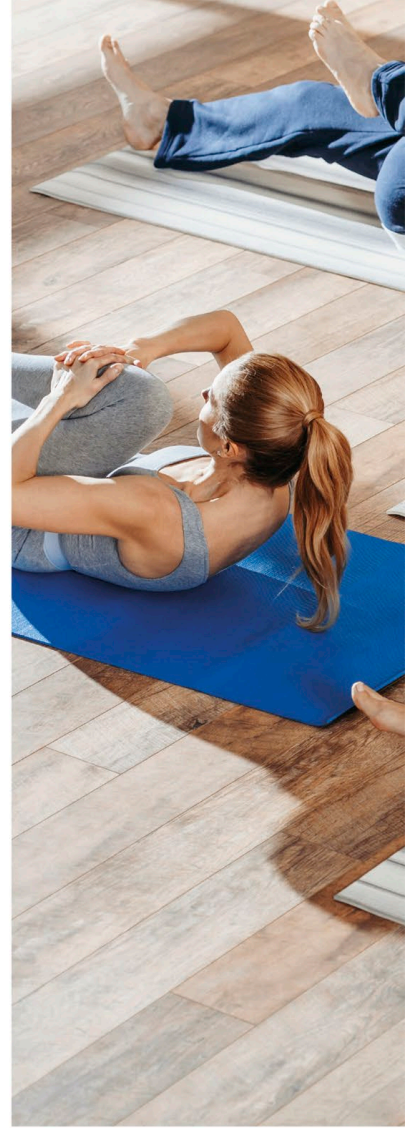
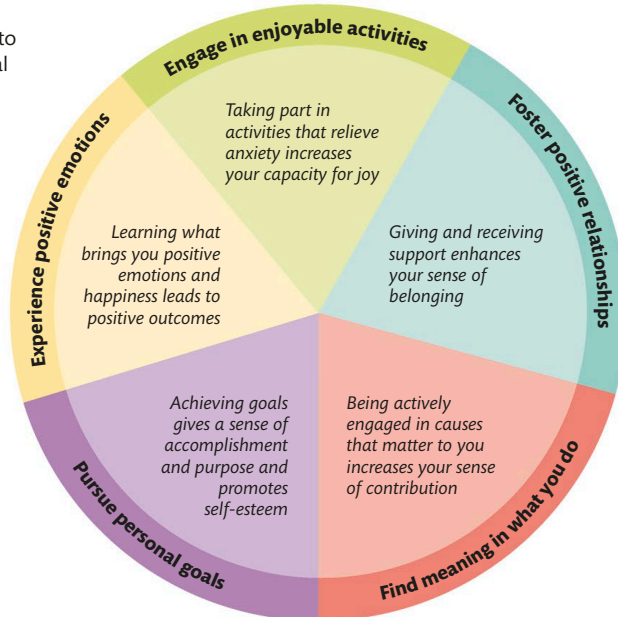
Maintaining a healthy mental state is as important as maintaining physical health. If you struggle with physical health problems, you are more at risk of mental health issues; likewise, inability to deal with stress and anxiety can increase your susceptibility to illness.

Live life well

Scientific research shows that there is a strong mind-body connection—how you think affects how you feel, which in turn affects how you behave. Psychological health is affected by numerous factors, many of which you control. Exercise and a healthy diet (see pp.146–149 and 152–155) contribute to mental well-being, as will learning to manage stress and making sure you have enough good-quality sleep. Social factors, or how well and how much you connect with others, can also play a significant role. Conversely, smoking and alcohol or drug consumption have a negative impact (see pp.150–151).

Promoting positive emotions

We are all intrinsically motivated to seek happiness. This psychological model defines the five elements essential to your well-being. By gaining an understanding of each one and taking steps to pursue them in your thoughts and actions, you can enhance your resilience, which also helps protect you from stress and anxiety.



Making social connections

Humans are social animals with a natural desire to connect to others. Taking part in physical activity classes not only improves physical health, enhances mood and confidence, and gives you a sense of accomplishment, but also provides you with a source of company.

30 minutes of low-intensity aerobic exercise daily helps positive mood





Ensure you have a good night's sleep

The body needs around seven hours of sleep a night in order to repair, rest, and recover from the day—without, it is difficult to cope with everyday stress. If you do not sleep well, try making a few changes:

- Make your bedroom a calm, relaxing place to be and leave TVs, phones, and tablets outside the room—the “blue” light stimulates the brain, preventing sleep.
- Having a bedtime routine can stimulate the sleep hormone melatonin, enhancing your chances of sleeping well; set your alarm to wake up at a regular time.
- Eat your last meal 2 to 3 hours before bedtime, so that your body can digest the food before you fall asleep.
- Avoid exercising within four hours of bedtime as this stimulates the stress hormone cortisol, preventing sleep.
- Wear an eye mask to shut out any distracting light.

Learn to manage stress

Under stress, the brain releases the stress hormone cortisol. Over time, high levels of this hormone can raise blood pressure, disrupt sleep, and seriously affect your mental health. Try a few of the following tips to reduce the levels.

- Exercising regularly can relieve mental stress and anxiety.
- Find a support network, friend, or family member to confide in; talking about feelings can reduce anxiety.
- Consider which specific situations or people increase your stress levels, so you can avoid, anticipate, or learn to manage them better.
- Restrict time on social media; comparing your real life to the “curated” ideal life of others can lead to depression.
- Use breathing exercises to help you relax. When you are feeling anxious, stop, sit down, and breathe in for a count of 4 and out for a count of 8; repeat until relaxed.





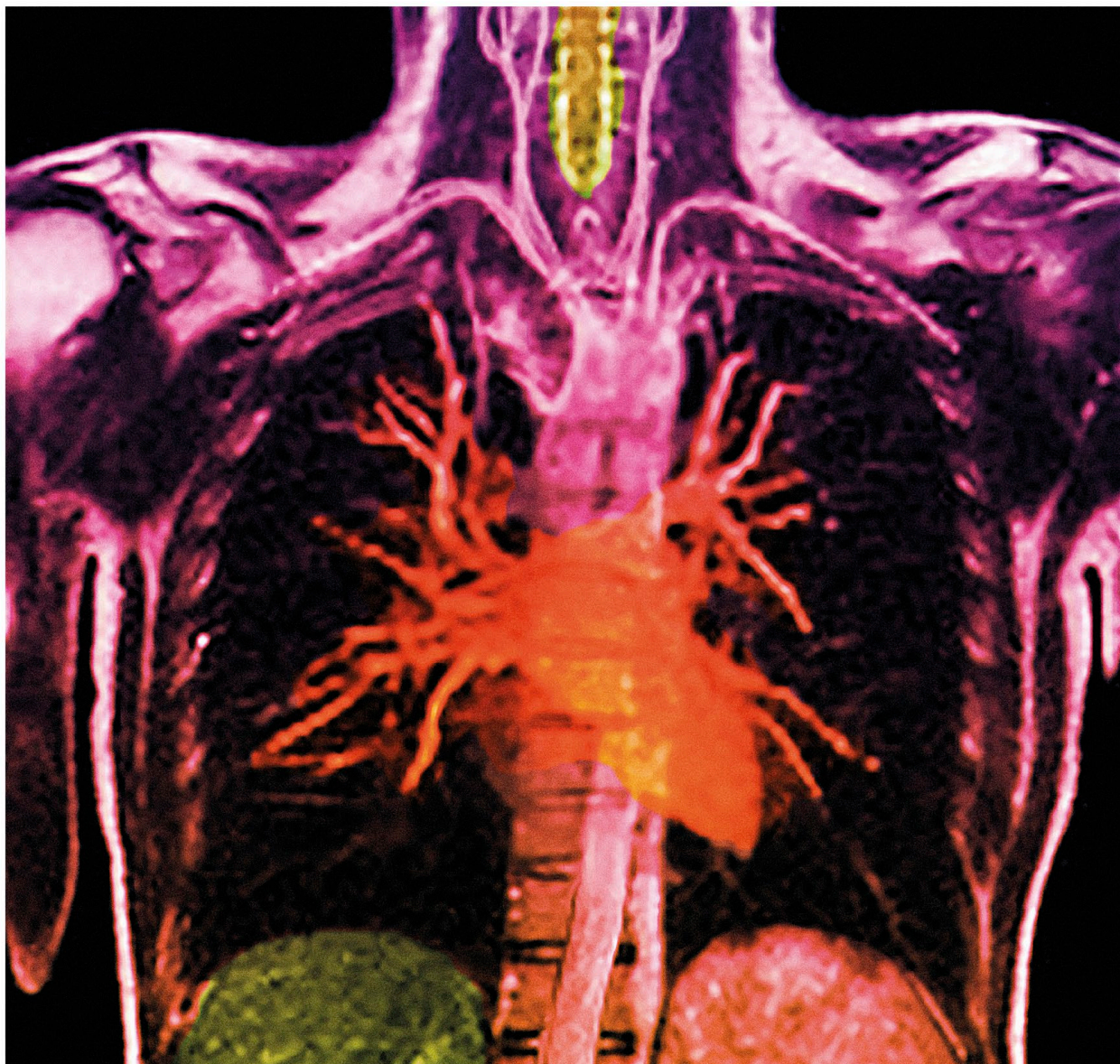
**Other tests and
your records**

Other medical tests

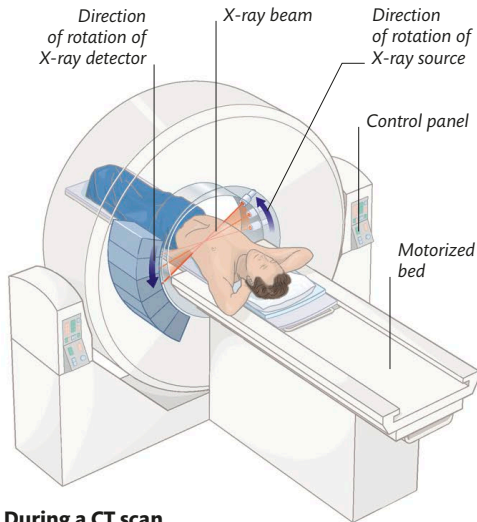
There are a large number of medical tests that can be used to assess your health, screen for early indications of disease, or diagnose disorders after symptoms have appeared. The following pages outline some of the more common procedures used primarily for diagnosis.

Chest scan

This color-enhanced MRI scan of the chest shows the heart (large red area in the center) and blood vessels in a healthy man.



CARDIOVASCULAR AND RESPIRATORY SYSTEM TESTS



During a CT scan

You lie on a table that moves you into the scanner. The X-ray source and detector rotate around you as the scan is performed.

Chest CT scan

A CT (computed tomography) scan is an image made using X-rays passed through the body at different angles. A computer processes the X-ray information to create a cross-sectional image of internal structures. Sometimes, a special substance (a contrast material) may first be injected to make tissues more clearly visible. Chest CT scans may be carried out to investigate tumors, narrowed or blocked airways, or structural problems in your heart or nearby blood vessels.

Chest MRI scan

In MRI (magnetic resonance imaging), a strong magnetic field stimulates your cells to emit radio signals, and a computer processes the signals to create detailed images of body structures. In some cases, a contrast medium may be used to make tissues show up more clearly. A chest MRI may be used to investigate problems such as tumors, or abnormalities in your lungs, heart, blood vessels, or blood flow. For an MRI scan, you lie on a table inside a tunnel while the scan is being performed.

MRA

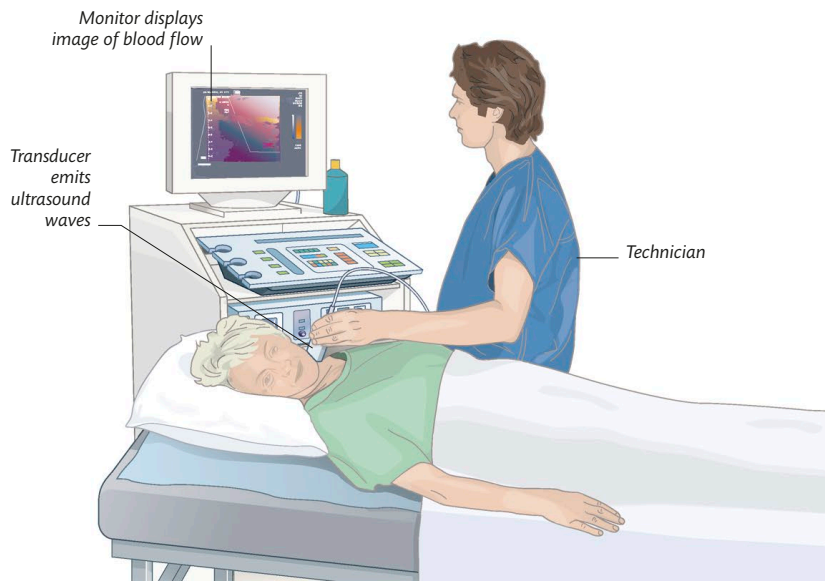
Angiography is used to image the blood vessels. MRA (magnetic resonance angiography) is a form of MRI (below, left). It is often carried out using a special substance (a contrast material) injected before the scan to make your blood vessels show up more clearly. However, sometimes it is performed without using a contrast medium. MRA is used to investigate problems that may be causing reduced blood flow, such as narrowed, blocked, or damaged arteries, or abnormal blood-vessel structures. A chest MRA may be used to look at the coronary arteries, aorta (the main artery from the heart), or pulmonary arteries (supplying blood to the lungs).

Carotid artery Doppler scan

This procedure is a special type of ultrasound scanning that uses very high-frequency sound waves to produce images of blood flow in the carotid arteries (the major arteries in the neck supplying blood to the brain). The images appear instantly and in real time, so your blood can be seen as it flows through the arteries. The technique can be used to investigate possible strokes by revealing any blockages, narrowed areas, or other problems that restrict blood flow to the brain.

Scanning the carotid arteries

Gel is applied to your neck, then a transducer is moved over your skin to scan the arteries. The procedure is quick and painless.

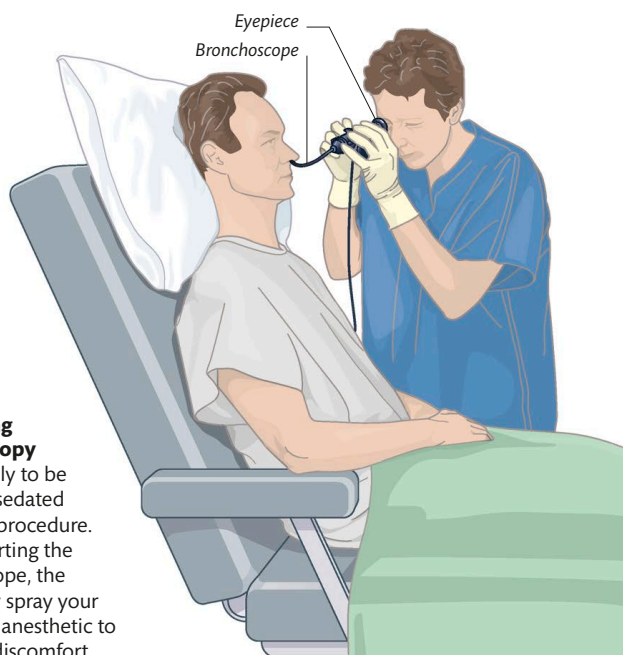


Angiography

Angiography is X-ray imaging of the heart and blood vessels. It may be used to help detect problems such as a narrowed coronary artery or an aneurysm (a bulge in a weakened area of artery wall). A thin, flexible, hollow tube (catheter) is inserted into an artery at your groin or wrist and guided to the area to be examined. A contrast dye (a substance that blocks X-rays) is then injected through the catheter, so that the heart structure and blood vessels will show up clearly, and X-rays are taken as the dye flows through the structures.

Bronchoscopy

In this test, a thin, flexible viewing tube called a bronchoscope is inserted into your nose or mouth and guided down to the airways in your lungs. The tube has a light and a camera at its tip, which enables the doctor to view your airways directly, either through an eyepiece or on a monitor. Bronchoscopy can reveal problems such as inflammation or tumors. Instruments can be passed down the tube to remove foreign objects or take tissue samples (biopsies).



Undergoing bronchoscopy

You are likely to be awake but sedated during the procedure. Before inserting the bronchoscope, the doctor may spray your throat with anesthetic to lessen the discomfort.

BLOOD AND IMMUNE SYSTEM TESTS

Blood tests for allergy

If you develop signs of an allergic reaction, such as runny nose, itchy eyes, or a skin rash, the doctor may order a blood test to find the cause. In an allergic reaction, your immune system overreacts and makes too much of a type of antibody known as immunoglobulin E (IgE). Testing a sample of your blood for the presence of IgE can reveal whether or not your symptoms are due to an allergy. Different varieties of IgE are produced in response to specific allergens, and if your symptoms are due to allergy, your blood may also be tested for allergen-specific varieties of IgE to pinpoint the precise substance that is causing the allergic reaction.

Exclusion diet testing for allergy

A food allergy or intolerance can cause symptoms such as bloating, abdominal pain, diarrhea, nausea, vomiting, wheezing, sneezing, skin rash, and itchy eyes. Your doctor may advise a food elimination diet to find the specific food or foods responsible. This involves avoiding the suspect food or ingredient (such as a food additive) for two to six weeks to see if your symptoms improve, then reintroducing that food or substance to see if the symptoms return. If symptoms do diminish or disappear then reappear when the food is reintroduced, allergy or intolerance to that food is probably the cause. Your doctor may ask you to keep a food diary during this time to see how your symptoms progress. You should only follow an exclusion diet under medical supervision.

Tumor marker tests

Tumor markers are substances (most commonly proteins) that the body produces in response to cancer or that are produced by the cancer cells themselves. These markers can be found in blood, urine, other body fluids, feces, and certain body tissues. Your doctor will take a sample of a body fluid (often blood) or tissue and send it to

a laboratory for specialized testing to detect the presence and levels of tumor markers. Doctors may use tumor marker tests to help in diagnosing a cancer, and also to plan and monitor the progress of treatment.

DIGESTIVE AND ENDOCRINE SYSTEM TESTS

Digestive system MRI

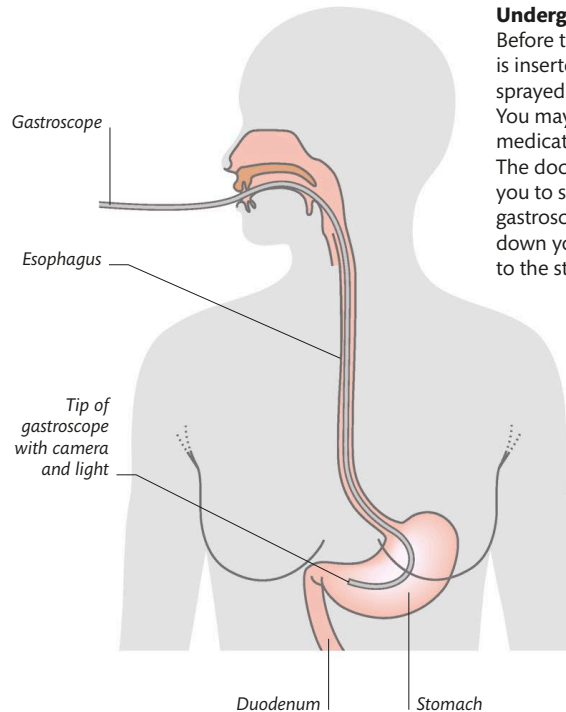
MRI (magnetic resonance imaging) scans of the abdomen and pelvis use a strong magnetic field and radio waves to provide images of your digestive tract (mouth, throat, esophagus, stomach, small intestine, and large intestine); digestive organs, such as the liver and pancreas; and other structures associated with the digestive system, such as blood vessels. A doctor may order an MRI scan of the digestive system to identify or assess problems such as tumors, narrowing or blockages in the digestive tract, or changes due to diseases such as cirrhosis of the liver, pancreatitis (inflammation of the pancreas), or inflammatory bowel disorders, such as Crohn's disease or ulcerative colitis. For some types of MRI scan, you may be asked to drink a substance (known as a contrast medium) before the scan so that particular structures will show up more clearly on the scan.

Fecal microscopy

If you have severe diarrhea due to food poisoning or a suspected digestive infection, your doctor may ask you to provide a sample of feces for analysis. In the laboratory, a small amount of the feces is examined under a microscope to look for parasites, such as worms, or for parasite eggs or larvae. The sample will also be examined to check for harmful bacteria, or to detect white blood cells, which can indicate infection.

Gastroscopy

In gastroscopy (or EGD), a thin, flexible viewing instrument (called a gastroscope) is passed down your throat to view the esophagus (gullet), stomach, and duodenum



Undergoing gastroscopy

Before the gastroscope is inserted, anesthetic is sprayed into your throat. You may also be given pain medication or a sedative. The doctor will then ask you to swallow as the gastroscope is passed down your esophagus to the stomach.

(the first part of the small intestine). The gastroscope has a light and a camera at the tip; the camera sends images to a monitor. Gastroscopy is used to investigate problems of the upper digestive tract, such as indigestion, difficulty swallowing, stomach ulcers, bleeding, or narrowing of the esophagus. The gastroscope can also be used to take tissue samples, remove growths or foreign objects, or treat bleeding or narrowed areas.

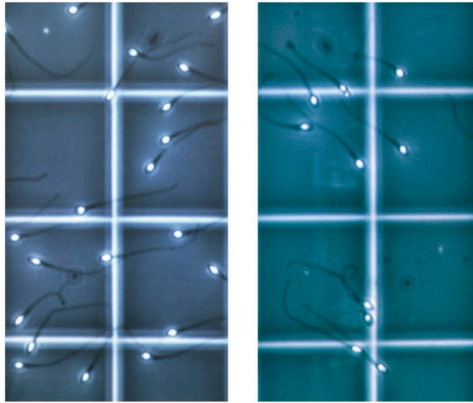
Thyroid scanning

In a thyroid scan, you are given a small amount of a radioactive substance, usually iodine (which the thyroid gland easily absorbs), by injection or by mouth. You will have to wait for one or more hours while the iodine is absorbed. Your throat is then scanned with an instrument called a gamma camera, which detects the radioactivity from the iodine and produces an image of your thyroid gland. Thyroid scanning may be used to detect tumors or nodules in the thyroid, or after thyroid cancer surgery to detect any remaining cancer cells.

REPRODUCTIVE SYSTEM TESTS

Sperm count

A sperm count is considered normal if there are more than 15 million sperm per milliliter of semen, with over 50 percent of the sperm able to swim effectively and over 30 percent of normal shape.



Normal sperm count

Low sperm count

Semen analysis

If a couple is struggling to conceive, their doctor may advise fertility tests. For the man, this involves a semen analysis to check the sperm. He provides a semen sample, which is sent to a laboratory where it is examined under a microscope to assess the number and health of the sperm. A low sperm count, or sperm that are abnormally shaped or not moving, can indicate a fertility problem. Men may also have semen analysis after a vasectomy, to check that they no longer have sperm in their semen.

Blood tests for sex hormones

Both men and women produce the sex hormones testosterone and estrogen, but testosterone levels are naturally higher in men, and estrogen levels are higher in women. Blood tests to assess levels of testosterone, estrogen, and progesterone (a sex hormone produced only by women) may be used to investigate infertility; detect a sex hormone-producing tumor; or investigate erectile dysfunction in men, or menstrual problems or polycystic ovary syndrome in women. They may also be carried out to investigate early or delayed puberty in either sex, or premature menopause in women. In addition to checking levels of the sex hormones themselves, blood tests may also be carried out to check levels of luteinizing

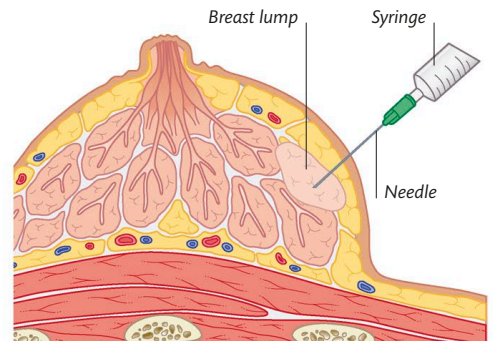
hormone (produced by the hypothalamus) and follicle-stimulating hormone (produced by the pituitary gland), because they help regulate production of the sex hormones.

Breast ultrasound scanning

If you find a lump in your breast, or if a lump is detected during a mammogram, an ultrasound scan of the breast may be carried out to investigate further. In this test, high-frequency sound waves are used to image the breast tissue. It can reveal the difference between fluid-filled cysts (which show as dark areas) and solid lumps (which appear pale). Ultrasound scanning may also be used for guidance in tests such as a breast biopsy (see below). Ultrasound is quick, safe, and painless.

Breast biopsy

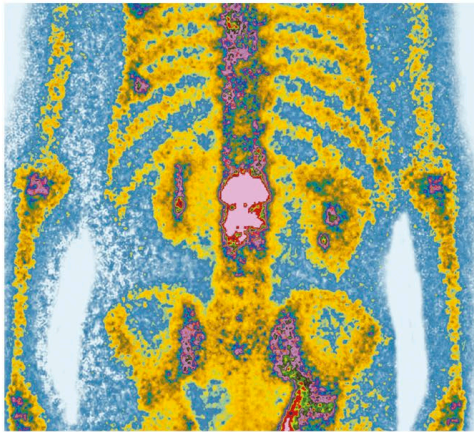
Biopsy involves taking a tissue sample for analysis. For a breast lump, you may have fine-needle aspiration, in which a thin needle is inserted into the lump to draw out a sample of cells or fluid. Other forms of biopsy include needle biopsy and punch biopsy, which involve taking larger samples; you may be given a local anesthetic for these. The biopsy samples are then examined under a microscope to check for cancer. If you have a cyst, removing the fluid during the biopsy should make the cyst subside.



Fine-needle aspiration of a breast lump

The lump is located by touch or ultrasound. A fine needle is inserted into it, and fluid or cells are drawn into the syringe.

SKIN AND SKELETAL SYSTEM TESTS



Bone density scan

This scan has been colored to reveal areas of low (pink), medium (violet), and high (yellow) bone density. The large pink area in the spine indicates an area affected by osteoporosis.

Bone density scan

Also known as DEXA scan, this procedure uses low-dose X-rays to assess the density of the bones. It is primarily used to diagnose osteoporosis, a condition that makes the bones weak and liable to break. Your doctor may advise a bone density scan if you are at risk of developing osteoporosis: for example, if you are a post-menopausal woman; if you smoke; if you have a kidney, liver, or thyroid disorder; or if you are taking medication that may cause bone loss, such as corticosteroids.

Skin biopsy

A skin biopsy involves taking a sample of abnormal skin to help diagnose diseases such as skin cancer, bacterial or fungal infections, or disorders such as psoriasis. A local anesthetic is applied to the abnormal area and a sample is removed by scraping (shave biopsy) or cutting into deeper skin layers (excisional biopsy). In some cases, an entire lesion, such as a mole, may be removed. A small area of surrounding normal skin is usually also removed. The sample is then examined under a microscope for diagnosis.

NERVOUS SYSTEM TESTS

Brain imaging

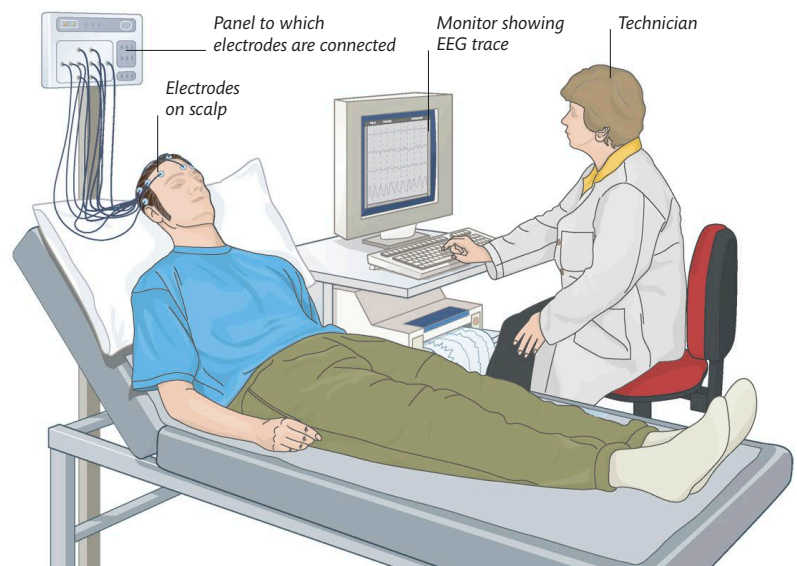
Techniques such as computed tomography (CT) scanning or magnetic resonance imaging (MRI) can be used to show the structures of the brain and reveal tumors or injured areas. Scans can also be used to show brain activity. For example, functional MRI (fMRI) can be used to show areas of increased activity when the brain performs various tasks. Positron emission tomography (PET scanning) may also be used to image brain activity. It involves injecting a radioactive tracer into a vein and then using a special scanner to detect the levels of radiation given off by different areas of the brain; the higher the radiation level, the more active the brain area.

EEG

Electroencephalography (EEG) is the measurement of electrical activity in the brain. It may be used to investigate seizures; sleep, memory, or behavior problems; or brain damage. Electrodes are attached to your scalp to detect brain activity, which is displayed as a tracing while you perform various tasks. Disorders show as abnormal EEG patterns.

Having an EEG

An EEG typically takes about 30 minutes and is painless. You will be asked to perform various simple tasks, such as opening and closing your eyes, while your brain activity is recorded.



Autonomic nervous system tests

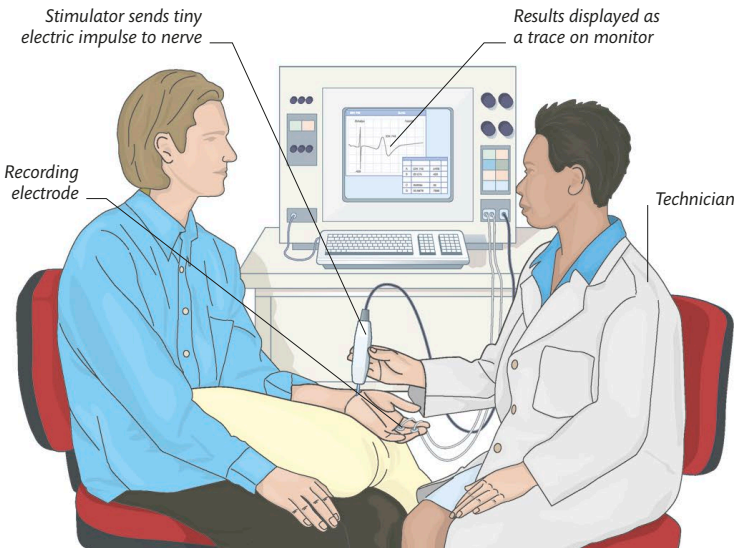
The autonomic nervous system (ANS, see pp.132–133) controls many of the body's unconscious functions, such as the heartbeat and blood pressure. Problems affecting the ANS can cause various symptoms, such as fainting when you stand up, and may occur alone or as part of a disorder, such as Parkinson's disease. Tests to assess ANS function involve measuring your blood pressure, heart rate, and heart rhythm while you perform different exercises, including deep breathing, the Valsalva maneuver (blocking your nose and mouth and blowing out), and the tilt-table test (lying on a table as it is tilted through a series of angles).

Nerve conduction studies

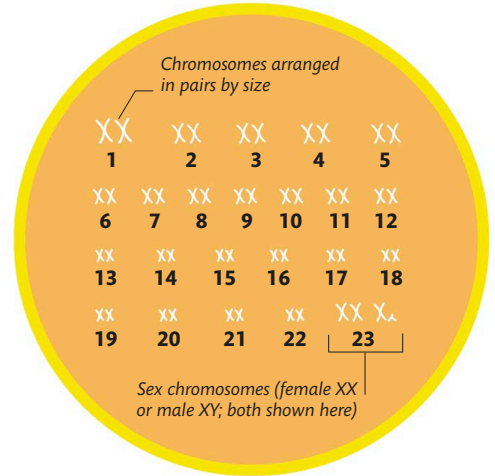
These studies are used to investigate any disorder or injury that may disrupt nerve signals between your brain and limbs. They involve two tests, usually done together. In electromyography (EMG), a fine needle is inserted into a muscle to record the nerve signals while the muscle is resting and when it is active. Nerve conduction testing involves stimulating a nerve and then measuring the speed at which the nerve response signals travel along the nerve. The results of both tests are shown as traces on a monitor.

Nerve conduction testing

A technician stimulates a specific nerve and electrodes on your skin further along the path of that nerve detect the signals the nerve sends out. A computer analyzes the signals and displays them as a trace.



CHROMOSOME AND GENE TESTS



Viewing the chromosomes

Chromosomes from a sample of blood or tissue are stained so that their shapes show up clearly. They are viewed under a microscope and sorted into 22 pairs of autosomes (non-sex chromosomes) and a single pair of sex chromosomes (XX for a female, or XY for a male) to produce an arrangement called a karyotype.

Chromosome tests

In normal body cells, the genetic material (DNA) is divided into 46 chromosomes, consisting of 22 pairs of autosomes (non-sex chromosomes) and one pair of sex chromosomes. In some disorders, however, a person is born with an extra, missing, or abnormal chromosome. Examples include Down syndrome (also called trisomy 21), in which there is an extra copy of chromosome 21, and Turner's syndrome, in which a female has only one X chromosome instead of two, or one normal and one abnormal X chromosome. Chromosome testing is usually carried out only on people with signs of a chromosomal disorder, couples at risk of passing on a disorder, women who have repeated miscarriages, or unborn or newborn babies. A sample of blood (or amniotic fluid from a pregnant woman) is sent to a laboratory, where the chromosomes are separated and sorted by size to reveal any problems with their number or structure.

Gene tests

Some inherited conditions, such as cystic fibrosis and sickle cell disease, are caused by abnormalities in specific genes. You may be offered testing if your doctor suspects you have such a condition, if any close family members have a known or suspected genetic condition, or if you are at risk of passing on a genetic disorder to your children. Gene testing may also sometimes be offered to check for the presence of specific genes that are associated with an increased risk of developing certain conditions, such as the BRCA1 and BRCA2 genes associated with an increased risk of breast cancer. Commercial tests for many genetic conditions are also available. Testing usually requires only a blood sample or a scraping of cells from inside your cheek. For pregnant women, a sample of amniotic fluid or placental tissue may be used. The sample is sent to a laboratory, where it is processed to reveal any genetic abnormalities in the unborn baby. The results of gene tests may be difficult to interpret so it is advisable to discuss them with a genetic counselor.

PSYCHOLOGICAL TESTS

Dependency assessment

Dependency is a problem with controlling your use of alcohol or drugs, or with behavior such as compulsive sexual activity or gambling. It can be difficult for somebody to recognize dependency in themselves but there are various tests available to identify dependency and assess its severity. A doctor may ask questions about your lifestyle and may also use special questionnaires designed to give an insight into dependent behavior. If alcohol or substance dependency is the problem, tests on your urine, blood, or hair may be carried out to determine the levels of alcohol or other substances in the body. Tests of organ function, such as liver-function tests (see p.71), may also be performed to check whether or not you have organ damage. The results of all these tests can be used as a basis for a personal care plan.



Sleep analysis

If you are suffering from a persistent inability to sleep, disturbed sleep patterns, or a problem such as snoring, your doctor may refer you to a sleep center. There, specialists will assess you and may arrange tests to investigate specific aspects of your sleep. Some tests can be done at home, such as oximetry (wearing a monitor on your finger to measure blood oxygen levels while you sleep, see p.51), which may be used to detect problems such as obstructive sleep apnea. In this condition, the walls of the throat relax and become narrowed during sleep, which interrupts breathing and may also cause snoring. For other tests, such as polysomnography, you will have to stay in the sleep center overnight. Polysomnography shows when you fall asleep and which stages of sleep you pass through. It also measures several basic body functions, such as your breathing, and your brain activity. You may be monitored with a video camera, to show your sleep position and any unusual activity patterns. Further tests may be carried out the day after your sleep, to assess your level of wakefulness.

Polysomnography

In this test, you sleep at a sleep center. You are connected to various monitors to measure your brain waves, eye movements, muscle activity, heart rate, and breathing.

Health screening options

It can be challenging to decide which health checks to have and when to have them. Here is information on the most commonly recommended screenings in the US and Canada, which may help make you aware of possible options to consider.

Common tests

In the US, multiple organizations or bodies publish recommendations, but they are not all presented in one comprehensive document. In Canada the recommendations are implemented differently in different provinces depending on local facilities and which tests will be covered by your province's health care coverage program. Many screening programs relate to cancer prevention, cardiovascular/metabolic screens (blood pressure, cholesterol, blood glucose, and weight), psychiatric (for example, depression), congenital newborn tests, and infectious disease.

In the US and Canada, most people rely on the recommendations of their primary care physician, who may recommend tests at annual physicals. In addition, there may be legally required checks for specific jobs. Some employers may require employees to have various checks as a condition of employment.

The information below gives examples of recommendations for key optional health checks for adults in the US and Canada. Not included are screening tests for specific groups with special health needs, such as pregnant women or people with diabetes. Individual health needs differ, and the information here is not intended as a substitute for expert

medical advice. It is also important to be well informed about what is available and appropriate for you, and you should always consult a health care professional about your own personal health matters.

BLOOD AND CIRCULATORY SYSTEM



- **Blood pressure.** Blood pressure (along with height, weight, waist circumference, and body fat percentage) is a key indicator of cardiovascular health. The US recommends checks for all adults, but especially older adults, every one to two years. In Canada, blood pressure is usually checked as an adult during a routine doctor visit. The frequency of checks depends on age and other health factors, but checks are generally advised at least once every two to three years.

- **Blood glucose.** Blood glucose is an indicator of risk for diabetes. In the US, testing is recommended from 45 years old for those at risk of prediabetes or of developing diabetes in the future. In Canada, testing is generally advised from the age of 40.

- **Blood cholesterol.** In the US, there are several different published guidelines for cholesterol screening. The American College of Cardiology/American Heart Association recommends a screening fasting lipid panel—total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides—every 4 to 6 years for adults aged 20-78. In Canada, testing is generally advised every two years for adults over 40, although the recommended frequency depends on individual health factors.

- **Abdominal aortic aneurysm.** There is no formal screening for this condition in most countries. However, in the US and Canada, an ultrasound scan for abdominal aortic aneurysm is available on request for people ages 65-75 who have ever smoked or may otherwise be at risk for this condition.

DIGESTIVE SYSTEM AND ORAL HEALTH



- **Colorectal cancer screening.** Older adults are generally recommended to be screened for colorectal cancer, typically either with a fecal test or

colonoscopy (direct examination of the colon with a flexible viewing tube under general anesthesia). In the US, annual screening is advised for men and women between the ages of 50 and 75. A first colonoscopy should be done at age 50 and repeated in 10 years or less depending on results. In Canada, men and women over the age of 50 are advised to have a fecal test every two years or colonoscopy every 10 years, depending on results.

- **Dental checkup.** In the US, it is recommended to have regular dental checkups anywhere from once every six months to once every year, depending on the health of the individual's teeth and gums. In Canada, the general recommendation is to have a dental checkup once or twice a year.

MUSCULOSKELETAL SYSTEM AND SKIN



- **Bone density scan.** In the US, women are advised to have annual bone density scans to check for osteoporosis from the age of 65, and men from the age of 70. In Canada, bone density scans are recommended for men and women over 65.

- **Skin cancer check.** Visit a doctor or dermatologist if you notice a change in the appearance of your moles (for example, in their size, shape, or color) or if you develop any new moles. These changes may indicate melanoma, a type of malignant skin cancer. People at higher risk for melanoma—those with light hair and eyes and fair skin, a family history, a history of sunburns

or tanning bed use, who have more than 50 moles, etc.—are often advised to have an annual check with a dermatologist. The advice is the same in Canada.

REPRODUCTIVE SYSTEM



- **Cervical screening.** In the US, screening for cervical cancer is recommended every 3 years with cervical cytology alone in women aged 21 to 29 years. For women aged 30 to 65 years, screening is recommended every 3 years with cervical cytology alone, every 5 years with high-risk human papillomavirus (hrHPV) testing alone, or every 5 years with hrHPV testing in combination with cytology. In Canada, women aged 25–69 are advised to have a cervical screening test once every three years.

- **Breast cancer screening.** In the US, the American Cancer Society recommends annual breast cancer screening for women aged 45–54, with a choice to begin screenings between ages 40 and 44; then once every two years for women aged 55 and older. In Canada, women aged 50–75 are offered breast cancer screening once every two years.

- **Sexually transmitted infections.** In the US, the Centers for Disease Control and Prevention recommends that all individuals aged 13–64 be tested at least once in their lifetime for HIV, and once a year for anyone who practices unsafe sex. Screening for gonorrhea and chlamydia is recommended in sexually active women age 24 years or younger and

in older women who are at increased risk for infection. Screening for syphilis infection is recommended for persons who are at increased risk for infection and pregnant women. In Canada, annual screening for chlamydia and gonorrhea is recommended for sexually active people under 25; for those older than 25 and who are at risk of infection, screening every three years is advised. Screening for HIV is also recommended for all those at risk of infection.

EYES AND VISION



- **Eye tests.** In the US, it is generally advised to have an eye test every two years. However, additional screenings are also advised. These include a baseline eye disease screening at age 40 for those not showing symptoms and not in an at-risk category (for example, due to a family history of eye disease such as glaucoma). In the US, the National Institutes of Health also recommends an annual dilated eye examination from the age of 60 onward. In Canada, eye tests are recommended every five years between the ages of 20 and 39, every two years between the ages of 40 and 64, then annually for those aged 65 or older. This includes a dilated eye examination and test for glaucoma and other eye diseases as needed.

It is useful to keep a record of vaccinations, noting information such as that in the example below. You can copy the charts to record information about every member of the family.

[illegible]

Many people find it useful to keep a record of their weight to ensure they remain a healthy weight or to monitor weight changes. You can copy the blank chart and use a copy for each person. If you want to calculate your body mass index, see pp.24-25.

Blood pressure record

This chart enables you to record blood pressure (see pp.28-31) however frequently you need to measure it. If you are taking it at home, do it at the same time of day every time as blood pressure fluctuates throughout the day.

[illegible]

This chart enables you to record the medical check-ups you and other members of your family have had. You can copy the blank charts and use a copy for each member of the family.

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