●●●○○ **Level 3 · Science** S3.3

Body systems

Your body has teams of organs for eating, breathing and moving blood, and they work together.

Find the organs and the systems they belong to. Follow food through the gut, learn what each nutrient does, build a model lung, see how gases cross into the blood, trace the blood round the body, measure pulse and breathing, and read plain facts about drugs and medicines.

YOU ARE READY FOR THIS BOOK IF

You can count your heartbeats for one minute while you rest.

One step up	S4.4 Health, disease and immunity
This book	**S3.3 Body systems**
One step down	S2.3 Bones, muscles, teeth and food

Contents

S3.3.1 Organs and systems

S3.3.2 Digestion

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S3.3.6 The heart and blood

S3.3.7 Pulse, breathing and exercise

S3.3.8 Drugs, alcohol and health

Key words, A to Z

Written and drawn by attnom. Free to read, print and share.

S3.3.1 CHAPTER 1

Organs and systems

What is inside my body, and how do all the parts work together?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** Each organ does its job alone. It needs no help from the others.
- ☐ **B** Organs work in teams, and the teams need each other.
- ☐ **C** Only the brain works. The other parts just fill the space.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.1. The skeleton is one of the body systems you will meet again here.
- Level 2, Bones, muscles, teeth and food, S2.3.3. Muscles are part of the system that moves you.

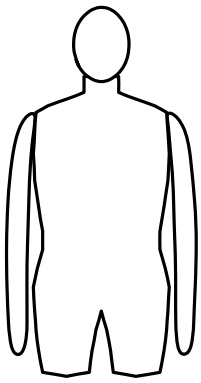
BY THE END YOU CAN

- Name the main organ systems and one organ in each
- Explain how two systems work together when you run

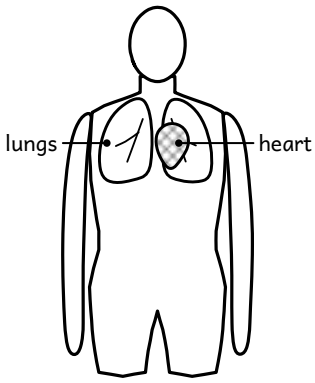
Your body is not one lump. It is made of parts, and each part has its own job. Build the picture below one step at a time.

DRAW IT FIRST

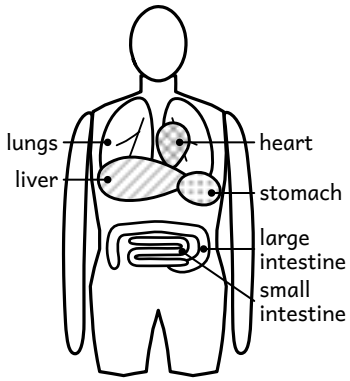
Draw the inside of the body



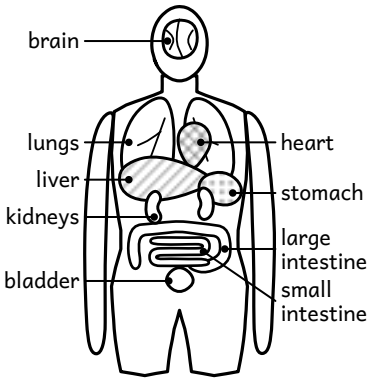
1 Draw the head, the arms, the trunk and the tops of the legs. Leave the inside empty.



2 Put in the two lungs. Put the heart between them, a little to the left of the middle.



3 Add the liver on the right, the stomach on the left, and the intestines below.

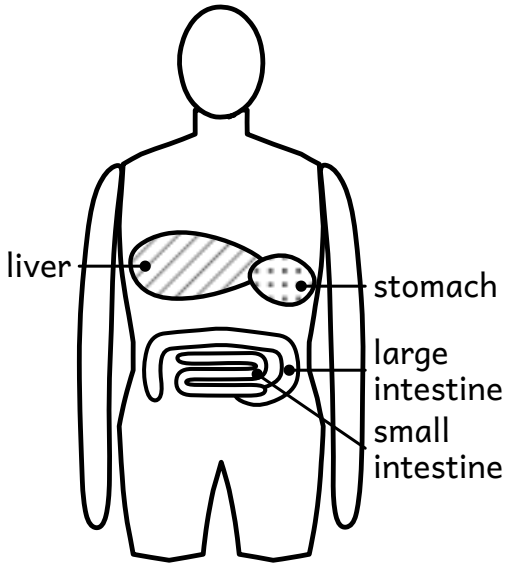


4 Add the brain in the head, the two kidneys and the bladder.

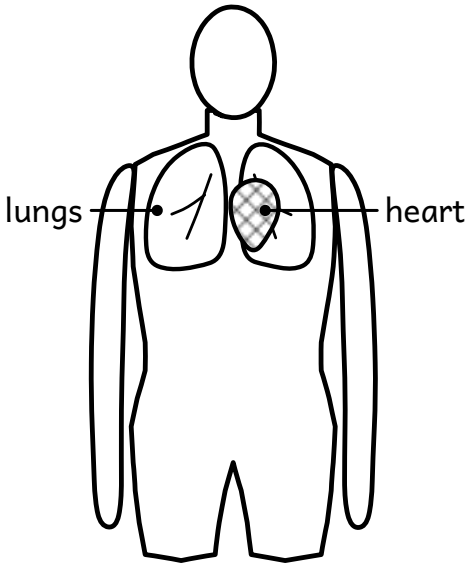
The body in the picture faces you. So its left side is on the right of the page. Its right side is on the left.

An **organ** is a part of the body with one main job. The heart is an organ. So are the lungs, the stomach and the brain.

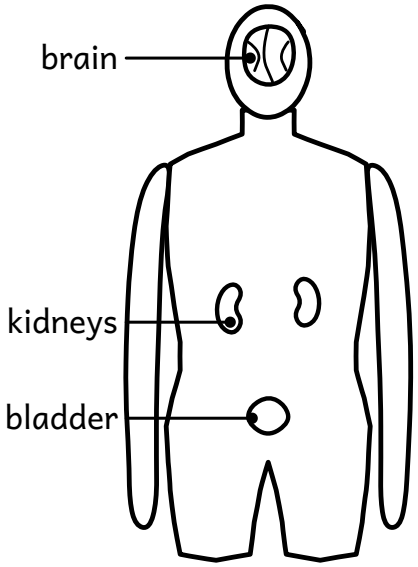
Organs work in teams. A team of organs that does a big job together is an **organ system**.



The digestive system breaks food down. The stomach and the intestines are part of it.

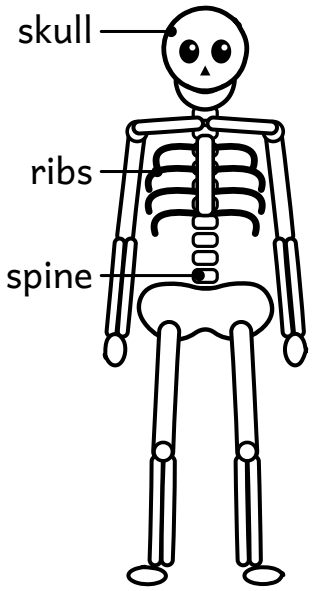


The lungs belong to the breathing system, which takes in air. The heart belongs to the circulatory system, which moves blood.



The brain is in the nervous system, which sends signals. The kidneys and the bladder are in the excretory system, which removes waste liquid. The kidneys lie at the back, one each side of the spine.

Two more systems are not in the picture. One is the reproductive system, for making new life. You can read about it in the book Growing up. The other is the skeleton and the muscles, below.



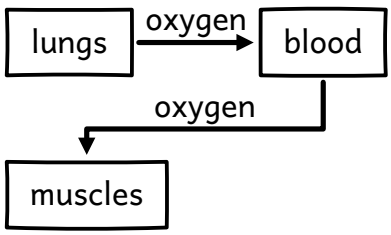
The skeleton and the muscles make the skeletal and muscular system. It holds you up and moves you. The skull guards the brain. The ribs guard the heart and lungs.

SEE IT THREE WAYS

With things

If you are well, run on the spot for one minute. Your chest moves faster and your heart beats faster. Your muscles feel warm.

As a picture



In words

The lungs take oxygen from the air. The heart pushes the blood round the body. The blood carries the oxygen to the muscles. Three systems work as one team.

TRY IT

Feel your body at work

You need: your own body, a quiet place to sit.

Be safe: Stop at once if you feel dizzy or have any pain. If you have a heart or breathing illness, ask a health worker before you run.

1. Sit still. Put one hand flat on your chest, a little to the left of the middle. Feel the beat of your heart.
2. Breathe in slowly. Feel your ribs move up and out under your hand.
3. If you are well, jog on the spot for 30 seconds. Then feel your chest again.

What you will see: After jogging your heart beats faster and you breathe faster. Two systems speed up together.

If you cannot try it, this is what happens.

you feel	organ
a beat	heart
chest rising	lungs
belly rumbling	intestines

A WRONG IDEA MANY PEOPLE HAVE

~~Each organ does its job alone.~~

Why it feels right: Every organ has its own name, its own place and its own job.

The test that breaks it: Think of running. The muscles need oxygen from the lungs. The heart must carry it there. If any one of them stopped, the runner would have to stop.

What is true: Organs work in teams called systems, and the systems need each other.

KEY WORDS

organ
a part of the body with one main job, such as the heart or the lungs.

organ system
a team of organs that does a big job together.

BACK TO YOUR GUESS

The answer is B: Organs work in teams, and the teams need each other.

Organs work in teams called systems. When you run, your lungs, heart and muscles all work together, so no part works alone.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which organ belongs to the digestive system?

   A The stomach

   B The heart

   C The brain

Answer at the back of the book.

2. The kidneys remove waste liquid from the blood. Which system are they in?

   A The breathing system

   B The excretory system

   C The skeletal system

   Answer at the back of the book.

3. What is an organ system?

   A One organ that has many jobs

   B A team of organs that does a big job together

   C All the bones in the body

   Answer at the back of the book.

4. Maya runs to catch a bus. Which two systems bring oxygen to her muscles?

   A The breathing system and the circulatory system

   B The digestive system and the nervous system

   C The skeletal system and the excretory system

   Answer at the back of the book.

5. Why does your heart beat faster when you run?

   A Only because you feel excited

   B The muscles need more oxygen, so the heart sends more blood

   C The lungs squeeze the heart

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

An organ has one main job. A team of organs is an organ system. Systems need each other. Running uses the lungs, the heart and the muscles together.

Draw: Draw a standing person. Put in the lungs, the heart, the stomach and the brain, and label each one.

S3.3.2 CHAPTER 2

Digestion

What happens to food after I swallow it?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** It stays in the stomach until the body has used all of it.
- ☐ **B** It travels through a long tube and is broken into tiny pieces on the way.
- ☐ **C** It goes straight into the blood, just as it is.
- ☐ **D** It turns into waste in the stomach, and the body takes nothing from it.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.4. Teeth do the first job of breaking food down.

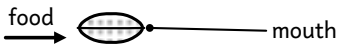
BY THE END YOU CAN

- Trace food through the mouth, gullet, stomach and intestines
- Explain why food must be broken into small pieces to be absorbed

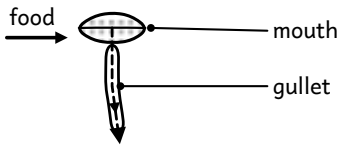
Think of a meal of rice and beans. You chew it, swallow it, and feel nothing more. But your body works on it for many hours. Draw its path first.

DRAW IT FIRST

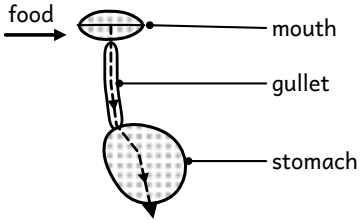
Draw the path of food



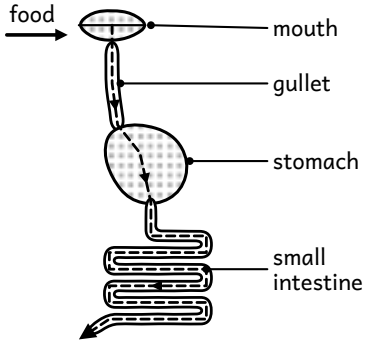
1 Draw the mouth. Food goes in here.



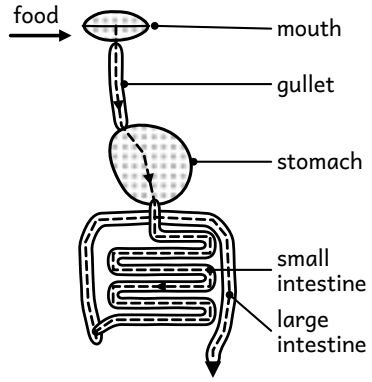
2 Draw the gullet, a tube that leads down from the mouth to the stomach.



3 Draw the stomach, a bag where food is mixed and squeezed.



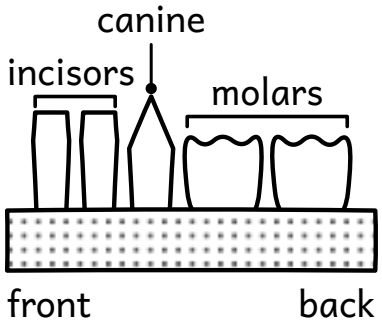
4 Draw the small intestine, a long tube in many coils.



5 Draw the large intestine round the coils. Waste leaves at the end.

Digestion is breaking food down into tiny pieces. The long tube that food goes through is called the gut. It starts at the mouth and ends where waste leaves the body.

In the mouth, your teeth cut and grind food. Saliva makes it wet and starts to break it down.



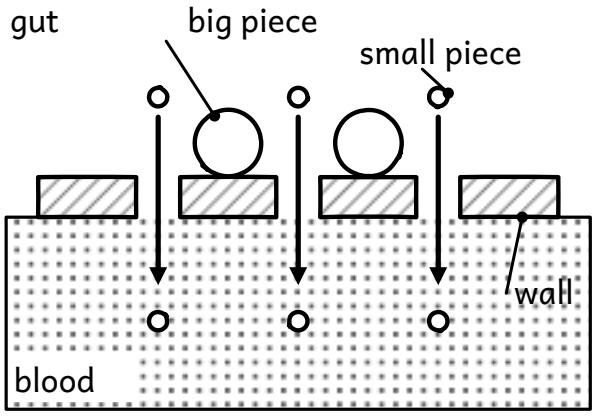
Incisors cut, canines tear and molars grind. Teeth break food into smaller pieces. This is the first step of digestion.

Next you swallow. Food goes down the **gullet**. Its muscles squeeze, in waves, and push the food along. That is why you can swallow even when you lie down.

The stomach is a stretchy bag. Its muscles squeeze the food and mix it with juices. The food turns into a thick liquid.

The **small intestine** is a very long, coiled tube. More juices break the food into the tiniest pieces here. These tiny pieces pass through the wall of the small intestine

into the blood. We say the blood ***absorbs*** them.



This is a model. In it, the gaps are wider than the small pieces and narrower than the big ones. Only small pieces get through.

What is left goes into the ***large intestine***. It takes back water. The rest leaves your body as waste.

part	job
mouth	chews
gullet	squeezes
stomach	mixes
small intestine	absorbs
large intestine	takes water

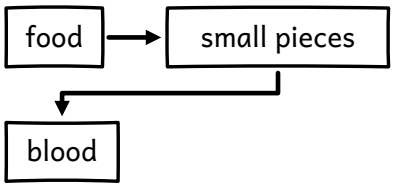
Each part of the gut has one job.

SEE IT THREE WAYS

With things

Pour rice grains and sugar water through a cloth into a cup. The sugar water goes through. The rice stays on top.

As a picture



In words

A cloth is a model of the gut wall. Only tiny pieces can pass through a cloth with tiny gaps. So food must be broken into tiny pieces before the blood can take it in.

TRY IT

A cloth for a gut wall

You need: a clean cloth, two cups, a spoon of rice, a spoon of sugar, water.

Be safe: Do not eat or drink the rice, the sugar water or anything from the cloth. Wash your hands afterwards.

1. Stir the sugar into half a cup of water until it has gone clear.
2. Hold the cloth tight over the empty cup. Pour the sugar water on to it. Watch what goes through.
3. Now pour the rice on to the cloth. Watch what happens.

What you will see: The sugar water goes through the cloth. The rice grains stay on top.

If you cannot try it, this is what happens.

you pour	result
rice	stays on top
sugar water	goes through

A WRONG IDEA MANY PEOPLE HAVE

~~Digestion happens only in the stomach.~~

Why it feels right: The stomach is big, and you can feel it fill when you eat.

The test that breaks it: Follow the picture of the gut. Food is chewed in the mouth and mixed in the stomach. Most of it is absorbed in the small intestine, which is longer than the rest.

What is true: Digestion starts in the mouth and goes on all along the gut. Most absorbing is done in the small intestine.

KEY WORDS

digestion
breaking food down into tiny pieces.

gullet
the tube that takes food from the mouth to the stomach.

small intestine
a long coiled tube where the tiny pieces pass into the blood.

absorb
to take in. The blood absorbs tiny pieces of food through the gut wall.

large intestine
the wide tube that takes back water and leaves the waste.

BACK TO YOUR GUESS

The answer is B: It travels through a long tube and is broken into tiny pieces on the way.

Food travels through a long tube called the gut. On the way it is broken into tiny pieces, and the body takes in the useful ones.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which list shows the way food goes?

   A Mouth, gullet, stomach, small intestine, large intestine

   B Mouth, stomach, gullet, large intestine, small intestine

   C Mouth, gullet, small intestine, stomach, large intestine

   Answer at the back of the book.

2. What is the job of the gullet?

   A It squeezes food down to the stomach

   B It breaks food into tiny pieces

   C It carries air to the lungs

   Answer at the back of the book.

3. In which part of the gut do most tiny pieces of food pass into the blood?

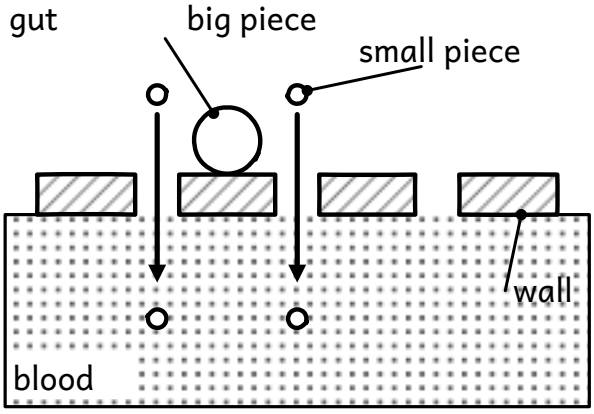
   A The stomach

   B The small intestine

   C The large intestine

   Answer at the back of the book.

4. In the model of the gut wall, which pieces cannot pass through the gaps?



   A The big pieces, because they are wider than the gaps

   B The big pieces, because they are heavier

   C The small pieces, because they are too light

   Answer at the back of the book.

5. Why must food be broken into small pieces?

   A So that the stomach can hold more food

   B So that the food goes through the gut faster

   C Only tiny pieces can pass through the gut wall into the blood

   Answer at the back of the book.

6. **From an earlier chapter**

   Which system does the stomach belong to?

   A The circulatory system

   B The digestive system

   C The nervous system

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Food goes mouth, gullet, stomach, small intestine, large intestine. It is broken into tiny pieces. Only tiny pieces pass through the gut wall into the blood.

Draw: Draw the gut as one long tube. Label the five parts and draw an arrow the way the food goes.

S3.3.3 CHAPTER 3

Nutrients and diet

Why do I need different kinds of food, and what happens if I miss one?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** All food does the same job, so any food will do.
- ☐ **B** Each kind of food does its own job, so the body needs a mix.
- ☐ **C** Only meat and sweet food are good for the body.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.5. Food groups tell you which foods belong together.
- Level 2, Bones, muscles, teeth and food, S2.3.6. A balanced diet is a mix of food from every group.

BY THE END YOU CAN

- Explain what carbohydrates, proteins, fats, vitamins, minerals and fibre do
- Name a disease caused by too little of a vitamin or mineral

Food is more than something that fills your belly. It holds **nutrients**, the parts of food that your body uses. Build the picture of what each one does.

DRAW IT FIRST

Draw what each nutrient does

nutrient	job
carbohydrate	energy
protein	growth, repair
fat	store energy

1 Write three nutrients, and one job for each: carbohydrate, protein and fat.

nutrient	job
carbohydrate	energy
protein	growth, repair
fat	store energy
vitamins	keep you well
minerals	many jobs

2 Add vitamins and minerals. They keep your body working.

nutrient	job
carbohydrate	energy
protein	growth, repair
fat	store energy
vitamins	keep you well
minerals	many jobs
fibre	moves food on
water	carries things

3 Add fibre, and water too. Your body needs both.

Carbohydrates give you energy. Rice, bread, maize and cassava are full of them. Your muscles and brain use this energy all day.

Proteins build your body and mend it when it is hurt. Beans, fish, eggs, nuts and meat have a lot of protein.

Fats and oils store energy and keep you warm. A little fat gives a lot of energy, so you need only a small amount.

Vitamins and **minerals** are needed in tiny amounts. They help the body use everything else. Vitamins and minerals give no energy themselves.

Fibre is the part of plants that your body cannot digest. It helps food move through the gut. Vegetables, fruit and whole grains have fibre.

food	rich in
rice	carbohydrate
beans	protein
oil	fat
oranges	vitamin C
milk	calcium
vegetables	fibre

Most foods hold more than one nutrient. This table names the one each food is best known for.

need	helps
vitamin C	gums and skin
vitamin D	bones
calcium	bones, teeth
iron	blood
iodine	thyroid gland

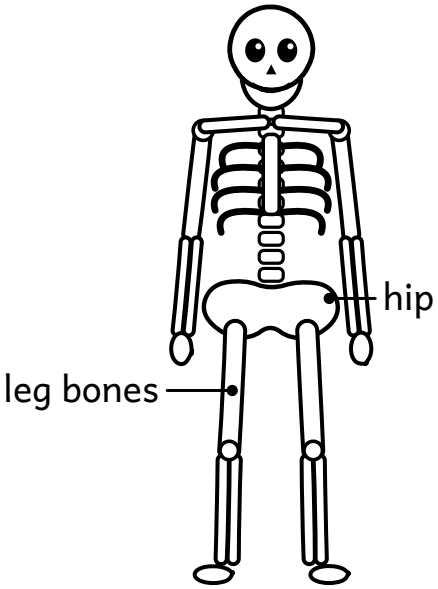
Iron helps the blood carry oxygen. Your skin makes vitamin D when sunlight falls on it. Iodine is used by the thyroid, a gland in the neck. With too little iodine the thyroid grows bigger, and the neck swells.

Too little of a vitamin or a mineral, for a long time, can make a person ill. This is a deficiency disease.

too little	disease
vitamin C	scurvy
vitamin D	rickets
calcium	rickets
iron	anaemia
iodine	goitre

Each of these diseases has a cause you can name.

Scurvy makes the gums sore and bleed, and cuts heal slowly. Rickets makes the bones of a child soft, so the legs can bend.



Leg bones hold your weight. They need vitamin D and calcium to grow hard. Without them the bones stay soft and can bend.

Anaemia makes a person pale and tired, because the blood carries too little oxygen. Goitre makes the neck swell.

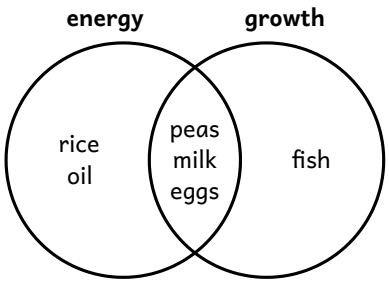
A mixed diet helps to prevent them. Sunlight on the skin gives vitamin D. Where food has too little iodine, salt with iodine added prevents goitre. Anaemia has other causes too. A health worker can test and advise.

SEE IT THREE WAYS

With things

Write down everything you ate yesterday. Put each food under energy or growth. Some foods belong in both.

As a picture



In words

Carbohydrates and fats give energy. Proteins help you grow and mend. Peas, milk and eggs hold both kinds, so they sit in the middle.

TRY IT

Find the fat

You need: 3 pieces of plain paper, a few drops of cooking oil, water, a slice of raw potato.

Be safe: Do not eat the potato or taste the oil. Wash your hands after you have touched them.

1. Put a drop of oil on one piece of paper. Put a drop of water on the second. Rub the cut face of the potato on the third.
2. Leave all three for an hour in a warm place. Hold each one up to the light.
3. Look for a mark that lets the light through and does not go away.

What you will see: The oil leaves a clear greasy mark. The water dries away. The potato leaves a damp mark that dries away. Fat leaves a clear mark that stays.

If you cannot try it, this is what happens.

on paper	later
oil	clear mark
water	dries away
raw potato	dries away

A WRONG IDEA MANY PEOPLE HAVE

~~Vitamins give you energy.~~

Why it feels right: People who feel tired are often told to take vitamins.

The test that breaks it: Energy comes from carbohydrates and fats. A person who eats vitamins but no rice, bread or oil would still run out of energy.

What is true: Carbohydrates and fats give energy. Vitamins and minerals help your body work, and they give no energy.

KEY WORDS

nutrients
the parts of food that the body uses.

carbohydrates
nutrients that give energy, such as the starch in rice and bread.

proteins
nutrients that build the body and mend it.

vitamins
nutrients needed in tiny amounts to keep the body working.

minerals
nutrients such as iron and calcium, needed in small amounts.

fibre
the part of plants that helps food move through the gut.

BACK TO YOUR GUESS

The answer is B: Each kind of food does its own job, so the body needs a mix.

Each nutrient has its own job. The body needs a mix of them, and too little of one can make a person ill.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which nutrients are needed in tiny amounts, to keep the body working?

   A Fats

   B Vitamins and minerals

   C Fibre

   Answer at the back of the book.

2. Which nutrient helps your body grow and mend?

   A Protein

   B Carbohydrate

   C Fibre

   Answer at the back of the book.

3. What does fibre do?

   A It gives a lot of energy

   B It builds the muscles

   C It helps food move through the gut

   Answer at the back of the book.

4. Which pair of nutrients gives your body energy?

   A Vitamins and minerals

   B Fibre and water

   C Carbohydrates and fats

   Answer at the back of the book.

5. A child who gets too little vitamin D or calcium can have soft, bent bones. What is this disease called?

   A Scurvy

   B Rickets

   C Goitre

   Answer at the back of the book.

6. A girl is pale and tired. Her blood carries too little oxygen, because she gets too little iron. What is this called?

   A Anaemia

   B Scurvy

   C Rickets

   Answer at the back of the book.

7. **From an earlier chapter**

   Which part of the gut takes back water from what is left of the food?

   A The gullet

   B The stomach

   C The large intestine

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Carbohydrates and fats give energy. Proteins build and mend. Vitamins and minerals help the body work. Fibre moves food on. Too little iron, iodine or a vitamin can cause disease.

Draw: Draw a table of six nutrients, with one job and one food beside each.

S3.3.4 CHAPTER 4

Breathing

How does air get into my chest when I breathe in?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The lungs are muscles. They pull the air in by themselves.
- ☐ **B** The ribs and a sheet of muscle make the chest bigger, so air flows in.
- ☐ **C** The nose and mouth push the air in.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.1. The ribs are part of the skeleton.
- Level 3, Particles, S3.5.5. Squeezed air pushes harder on its walls, and it pushes into places where the air is squeezed less.

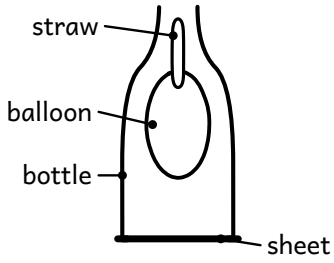
BY THE END YOU CAN

- Make a model lung with a plastic bottle and a bag
- Explain how the ribs and diaphragm move air in and out

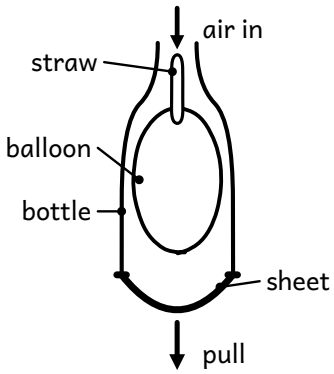
You breathe all day and all night, and you hardly think about it. How does the air get in? A model will show you. Build it up one step at a time.

DRAW IT FIRST

Draw the model lung



1 Draw a bottle with no bottom. Hang a balloon inside it on a straw. Stretch a sheet across the open end.



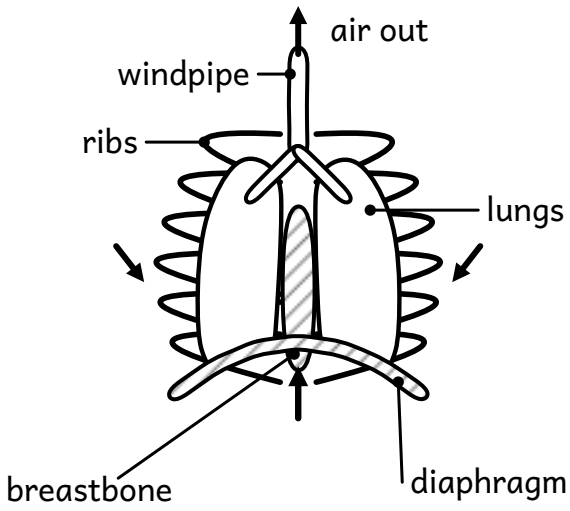
2 Now pull the sheet down. The room inside gets bigger, and the balloon fills with air.

In the model, the bottle stands for your chest. The balloon is a lung, the straw is the **windpipe**, and the sheet is the **diaphragm**.

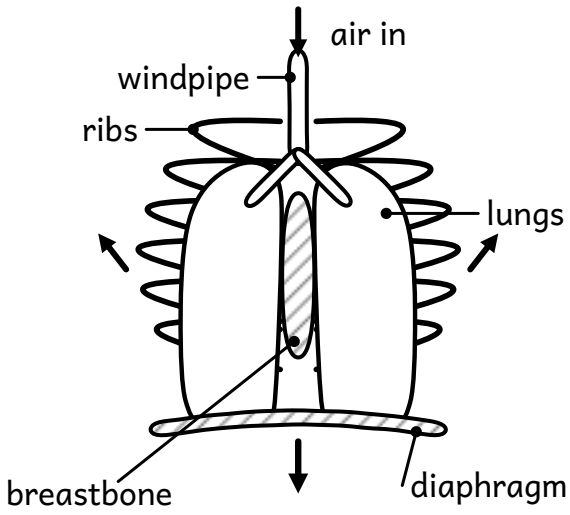
Pull the sheet down and the room inside gets bigger. The air in the bottle, round the balloon, is spread thinner, so it squeezes the balloon less. Air from outside squeezes more, so it pushes in through the straw and blows the balloon up.

Push the sheet up and the room gets smaller. The air is squeezed, and it flows out through the straw.

Your chest works the same way. The **lungs** are two soft bags full of tiny air spaces. They have no muscles that move them. They are filled and emptied by the movement of the chest around them.



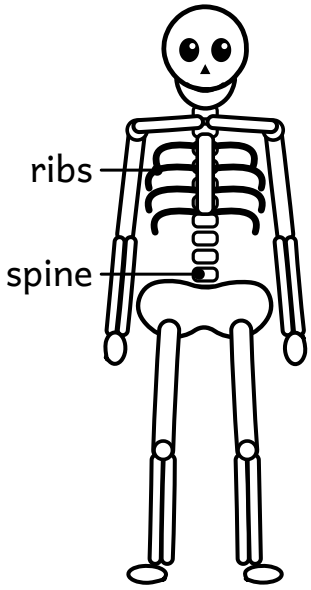
Breathing out. The diaphragm domes up. The ribs move down and in. The chest gets smaller.



Breathing in. The diaphragm tightens, flattens and moves down. The ribs move up and out. The chest gets bigger.

The diaphragm is a sheet of muscle under the lungs. When you breathe in, it tightens, flattens and moves down. The muscles between your **ribs** lift them up and out.

The chest gets bigger, so the air inside the lungs is squeezed less. Its pressure falls, and air from outside flows in. When you breathe out, these muscles relax. The diaphragm goes back up into a dome, and the ribs drop. The chest gets smaller and air flows out.



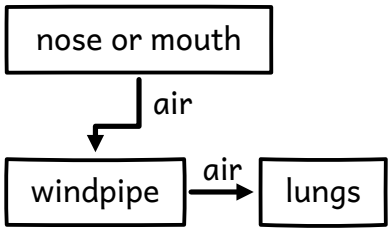
The ribs make a strong cage round the lungs. They can still move a little, so the chest can grow bigger.

SEE IT THREE WAYS

With things

Put your hands on the sides of your ribs. Breathe in slowly. Feel your ribs move out. Breathe out and feel them go back.

As a picture



In words

Air goes in through the nose or mouth. It goes down the windpipe and into the lungs. It comes out the same way. This is **breathing in** and **breathing out**.

TRY IT

Make a model lung

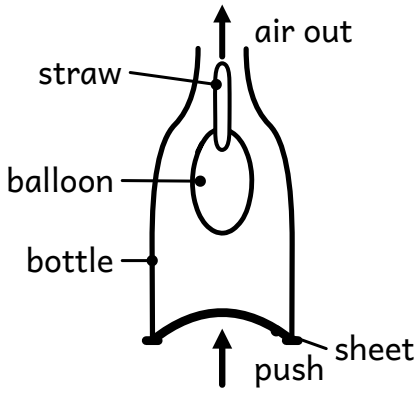
You need: a clear plastic bottle, a balloon, a straw or a short tube, a strong plastic bag, string and tape, a grown up to cut the bottle.

Be safe: A grown up must cut the bottle, because the cut edge is sharp. Cover it with tape. Never put the straw or the balloon in your mouth. Keep balloons and bags away from small children.

1. A grown up cuts the bottom off the bottle. Cover the cut edge with tape.
2. Push the straw into the neck of the balloon. Tie it tight with string.
3. Push the straw through the neck of the bottle, so the balloon hangs inside. Seal the neck with tape, so air can only move through the straw.
4. Tape the plastic bag over the open end of the bottle, a little loose. Tape a small tab to the middle of the bag, to pull it by.
5. Pull the tab down, gently. Then push the bag up, gently. Watch the balloon each time.

What you will see: When you pull the bag down, the balloon fills. When you push the bag up, the air comes out of the balloon.

If you cannot try it, this is what happens.



A WRONG IDEA MANY PEOPLE HAVE

~~The lungs are muscles that pull air in.~~

Why it feels right: Your chest moves when you breathe, and the lungs are inside it.

The test that breaks it: In the model, nothing pulls on the balloon. It fills only because the room around it grows. Your lungs work the same way.

What is true: The lungs have no muscles that move them. The diaphragm and the rib muscles change the size of the chest. Then air flows in or out.

KEY WORDS

lungs
the two soft bags in the chest that fill with air.

windpipe
the tube that takes air from the nose and mouth to the lungs.

ribs
the curved bones that make a cage round the lungs.

diaphragm
the sheet of muscle under the lungs.

breathing in
taking air into the lungs. The chest gets bigger.

breathing out
pushing air out of the lungs. The chest gets smaller.

BACK TO YOUR GUESS

The answer is B: The ribs and a sheet of muscle make the chest bigger, so air flows in.

The lungs have no muscles. A sheet of muscle called the diaphragm and the ribs make the chest bigger. Then air flows in.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. In the bottle model, which part stands for the diaphragm?

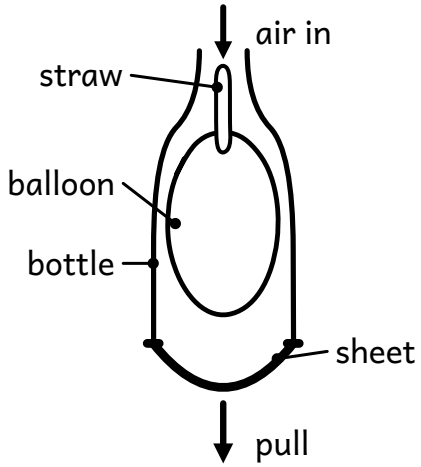
   A The sheet over the open end

   B The balloon

   C The straw

   Answer at the back of the book.

2. In the model, what happens to the balloon when the sheet is pulled down?



   A It fills with air

   B It gets smaller

   C It stays the same size

   Answer at the back of the book.

3. When you breathe in, what do the diaphragm and the ribs do?

   A The diaphragm moves down and the ribs move up and out

   B The diaphragm moves up and the ribs move down and in

   C They stay still while the lungs pull in air

   Answer at the back of the book.

4. Why does air flow into the chest when the chest gets bigger?

   A The lungs pull the air in with their own muscles

   B The nose and mouth push the air in

   C The bigger room squeezes the air less, so air flows in from outside

   Answer at the back of the book.

5. Which path does air take on its way in?

   A Nose or mouth, gullet, lungs

   B Nose or mouth, windpipe, lungs

   C Mouth, windpipe, stomach

   Answer at the back of the book.

6. **From an earlier chapter**

   Which tube takes food from the mouth to the stomach?

   A The windpipe

   B The gullet

   C The large intestine

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The lungs have no muscles. Breathing in, the diaphragm moves down and the ribs move up and out. The chest gets bigger and air flows in. Breathing out is the reverse.

Draw: Draw the bottle model with the sheet pulled down. Label the straw, the balloon, the bottle and the sheet.

S3.3.5 CHAPTER 5

Gas exchange in the lungs

How does the oxygen in the air get into my blood?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The air goes straight into the blood, and the blood carries it round.
- ☐ **B** Oxygen passes through the very thin walls of tiny air sacs into the blood.
- ☐ **C** The heart takes the oxygen out of the air.

IF THIS FEELS HARD, READ THIS FIRST

- Level 3, Particles, S3.5.2. Gases spread out from where there is more of them to where there is less.

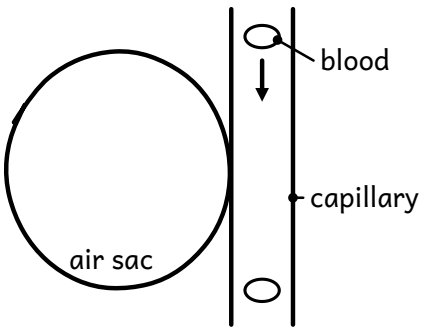
BY THE END YOU CAN

- Explain how oxygen enters the blood and carbon dioxide leaves it
- Explain how smoke from tobacco and cooking fires harms the lungs

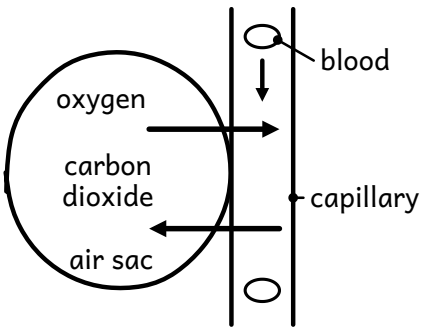
Breathing brings air into your chest. But the air is not the part your blood needs. It needs one gas in the air. Draw the place where it passes in.

DRAW IT FIRST

Draw an air sac and a capillary

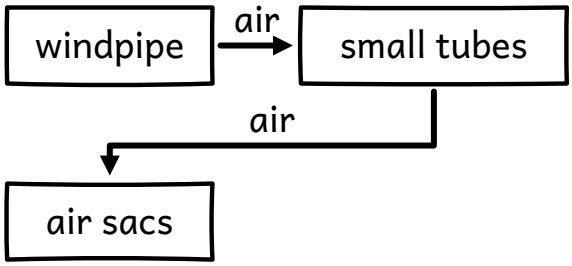


1 Draw a tiny air sac with a very thin wall. Draw a capillary, a narrow tube of blood, right against it.



2 Draw an arrow for oxygen into the blood, and an arrow for carbon dioxide out of the blood.

Your lungs hold millions of tiny **air sacs**. Each one is like a very small balloon, wrapped in a net of **capillaries**. A capillary is a blood tube so thin that blood cells pass through it in single file.



The windpipe splits into smaller and smaller tubes. Each ends in a cluster of air sacs.

The wall of an air sac and the wall of a capillary are both very thin. The blood is very close to the air.

The blood that comes to the lungs has used up some of its oxygen. It holds a lot of carbon dioxide, a waste gas. The air in the sacs has plenty of oxygen and little carbon dioxide.

Gases spread from where there is more of them to where there is less. So oxygen passes from the air sac into the blood. Carbon dioxide passes from the blood into

the air sac. This swap is **gas exchange**. You breathe the carbon dioxide out.

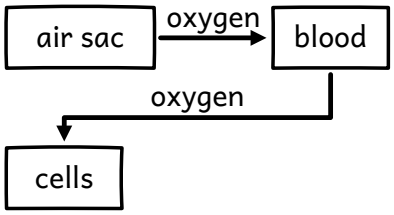
Air holds about 21 parts in 100 of oxygen. Breathed-out air has less oxygen and more carbon dioxide. It still holds about 16 parts in 100 of oxygen.

SEE IT THREE WAYS

With things

Put a hand on your chest and breathe in deeply. The air goes towards your air sacs. The blood then carries its oxygen to every cell, even in your fingers.

As a picture



In words

Oxygen passes from an air sac into the blood. The blood carries it to every cell. Carbon dioxide makes the trip the other way.

Why does the body want oxygen? Every cell uses it. In **respiration**, a cell uses oxygen to release energy from sugar. It makes carbon dioxide and water as waste.

In words: sugar + oxygen → carbon dioxide + water, and energy is released. Respiration happens in every cell. Breathing is only how the air gets in and out.

breathing	respiration
in the chest	in every cell
moves air	frees energy

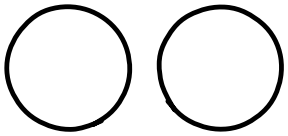
Breathing and respiration are two different things.

Smoke harms the lungs. Tobacco smoke holds a sticky tar, poisons, and a drug called nicotine that is hard to give up. It damages the lining of the tubes. It breaks down the walls between air sacs. Then there are fewer, bigger sacs with less surface, so less oxygen can pass in. It also holds a gas that takes the place of oxygen in the blood. Then the blood carries less. It harms people who breathe it near a smoker.

Smoke from a cooking fire indoors harms the lungs too. Wood, charcoal or dung can all give smoke that causes coughing and lung disease. Children and the person who cooks are at most risk. Never burn charcoal in a closed room, even when you see no smoke. It makes a poison gas that you cannot see or smell.



air sacs of healthy lungs



air sacs harmed by smoke

Many small sacs give a large surface. After smoke damage there are fewer, bigger sacs, so less oxygen can pass into the blood.

smoke from	what helps
tobacco	stay away
cooking fire	let smoke out
cooking fire	cook outside

A window, a door or a chimney lets the smoke out. Keep small children away from the smoke. Never burn charcoal in a closed room. A health worker can advise.

TRY IT

Mist from your breath

You need: 2 spoons, a cup of cold water, a dry cloth.

Be safe: Use only cold water from the tap or a jar. Do not blow on anything hot. Do not put a spoon in your mouth.

1. Put both spoons in the cold water for one minute. Dry them with the cloth.
2. Hold one cold spoon close to your mouth. Breathe out slowly on to it.
3. Hold the other cold spoon the same way, in the room air, for the same time. Do not breathe on it.

What you will see: A thick mist forms on the spoon you breathed on. The other spoon stays clear, or mists only a little. Breath is warm and carries much water.

If you cannot try it, this is what happens.

spoon	you see
breathed on	thick mist
room air	little or none

A WRONG IDEA MANY PEOPLE HAVE

~~We breathe in oxygen and breathe out only carbon dioxide.~~

Why it feels right: People say that oxygen goes in and carbon dioxide comes out.

The test that breaks it: The air sacs take only some of the oxygen from each breath. The rest is breathed out again.

What is true: Breathed-out air has less oxygen and more carbon dioxide than breathed-in air. It still holds some oxygen.

KEY WORDS

air sacs
the tiny bags at the ends of the lung tubes. Gases pass in and out of the blood here.

capillaries
the thinnest blood tubes. They wrap round the air sacs.

gas exchange
oxygen passing into the blood while carbon dioxide passes out.

respiration
what every cell does to release energy from sugar, using oxygen.

BACK TO YOUR GUESS

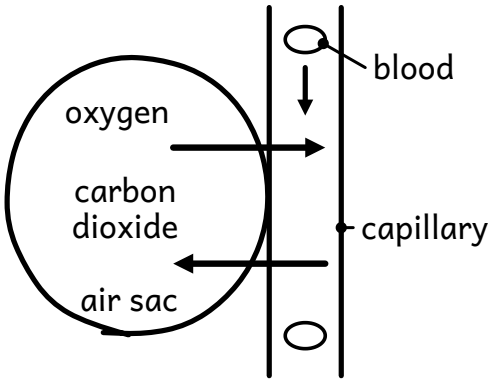
The answer is B: Oxygen passes through the very thin walls of tiny air sacs into the blood.

The lungs hold millions of tiny air sacs. Oxygen passes through their thin walls into the blood, and carbon dioxide passes the other way.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. In the picture, which way does oxygen go?



A From the air sac into the blood

B From the blood into the air sac

C It cannot cross, because the wall stops gases

Answer at the back of the book.

2. Which gas leaves the blood in the lungs, and is breathed out?

   A Oxygen

   B Carbon dioxide

   C Air

   Answer at the back of the book.

3. Why are air sacs good at passing gases into the blood?

   A Their walls are very thin and there are millions of them, each close to a capillary

   B They are strong muscles that push the gas in

   C They are big and hold air for later

   Answer at the back of the book.

4. Where does respiration happen?

   A In the lungs only

   B In every cell of the body

   C In the windpipe

   Answer at the back of the book.

5. How does smoke harm the lungs?

   A It only gives a short cough, which then goes away

   B It damages the tubes and breaks down air sac walls, so less oxygen can pass in

   C It makes the lungs stronger, like exercise

   Answer at the back of the book.

6. Smoke from a cooking fire indoors can harm the lungs. What helps?

   A Let the smoke out, and keep small children away from it

   B Breathe through the mouth only

   C Nothing is needed, because only tobacco smoke is harmful

   Answer at the back of the book.

7. **From an earlier chapter**

When you breathe in, what does your diaphragm do?

A It moves up and makes a dome

B It moves down and flattens

C It does not move at all

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Oxygen passes from the air sacs into the blood. Carbon dioxide passes out. Respiration happens in every cell. Smoke harms the lungs.

Draw: Draw one air sac with a blood tube beside it. Add an arrow for oxygen in and an arrow for carbon dioxide out.

S3.3.6 CHAPTER 6

The heart and blood

Where does my blood go, and what does it carry?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** Blood goes from the heart to the body, and then it is used up.
- ☐ **B** Blood goes round and round in a loop, past the lungs and the body.
- ☐ **C** Blood goes to the lungs and stays there until you breathe out.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.7. You counted your pulse there. Here you learn what a pulse is.

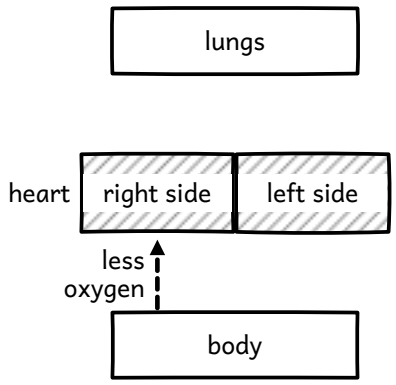
BY THE END YOU CAN

- Trace the path of blood through the heart, lungs and body
- Name what blood carries, such as oxygen, food and waste

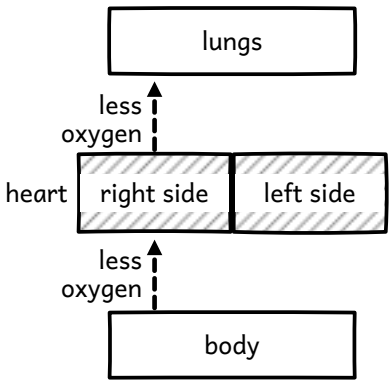
Put a hand on your chest. The beat you feel is your heart. The heart is a strong muscle that pushes blood round your body, all day and all night. Draw the loop first.

DRAW IT FIRST

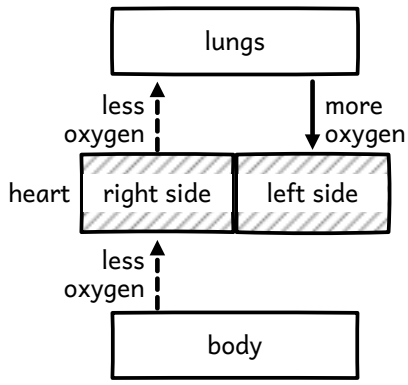
Draw the loop of blood



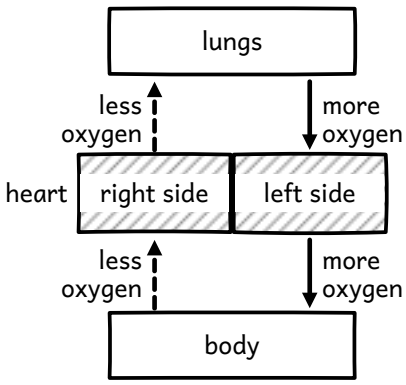
1 Draw three boxes: the body, the heart in two halves, and the lungs. Add an arrow from the body to the right side of the heart.



2 The right side pumps the blood to the lungs. Add that arrow.



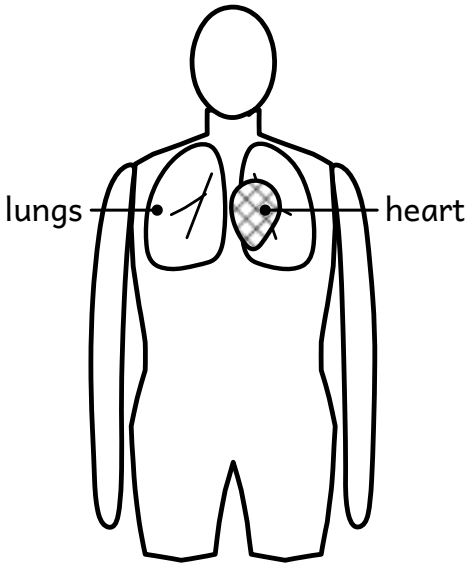
3 In the lungs the blood takes up oxygen. It goes to the left side of the heart.



4 The left side pumps it round the body. This closes the loop.

The picture is a plan, not a map of the real heart. It shows the order. The right side of the heart is on the left of the page, because the body faces you.

Dashed arrows are blood with less oxygen. Solid arrows are blood with more oxygen. The blood goes through the heart twice on each trip round the body.



The heart sits between the lungs, a little to the left of the middle. It is about as big as your fist.

The heart is made of muscle. Each time it squeezes, it pushes blood along. One beat is one squeeze. The two sides squeeze together.

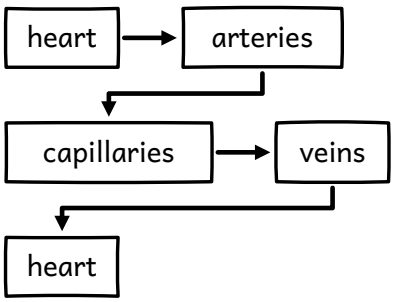
Blood moves in tubes called **blood vessels**. **Arteries** carry blood away from the heart. **Veins** bring blood back to it. **Capillaries** are the tiny tubes between them. Gases and food pass in and out through their thin walls.

SEE IT THREE WAYS

With things

Put two fingers on your wrist, below the thumb. Press gently. The beat you feel is the push of the blood along an artery.

As a picture



In words

Blood leaves the heart in arteries. It passes through capillaries. It returns to the heart in veins. Each push of the heart is felt as a pulse.

---

blood carries	to
oxygen	the cells
nutrients	the cells
carbon dioxide	the lungs
waste	the kidneys

Blood is a delivery service. It picks up from one place and drops off in another.

Blood picks up oxygen in the lungs. It picks up nutrients from the small intestine. It collects waste from the cells and drops it at the lungs and the kidneys.

part	job
red cells	carry oxygen
white cells	fight germs
plasma	carries food
platelets	close cuts

Blood has a liquid part, called plasma, and cells in it. Plasma also carries waste.

TRY IT

Feel your pulse

You need: your own hand and wrist, a quiet place to sit.

Be safe: Press gently. Never press hard on your neck.

1. Sit still for a minute. Turn one hand palm up.
2. Lay two fingers of the other hand on the wrist, in line with the thumb. Do not use your thumb, because it has a pulse of its own.
3. Press gently until you feel a small beat. Then put your hand flat on your chest and feel the beat there.

What you will see: You feel a beat at your wrist and a beat in your chest. They keep time, because each beat of the heart pushes blood along your arteries.

If you cannot try it, this is what happens.

place	you feel
wrist	a beat
chest	a beat

A WRONG IDEA MANY PEOPLE HAVE

~~Blood is blue inside the body until air touches it.~~

Why it feels right: Veins look blue under the skin, and some pictures draw them blue.

The test that breaks it: At a clinic, a health worker takes blood from a vein straight into a closed tube. The blood in the tube is dark red, and no air has touched it.

What is true: Blood is always red. It is bright red with more oxygen and a darker red with less. The skin makes veins look blue.

KEY WORDS

blood vessels
the tubes that blood moves in.

arteries
blood vessels that carry blood away from the heart.

veins
blood vessels that bring blood back to the heart.

capillaries
the tiniest blood vessels, where gases and food pass in and out.

BACK TO YOUR GUESS

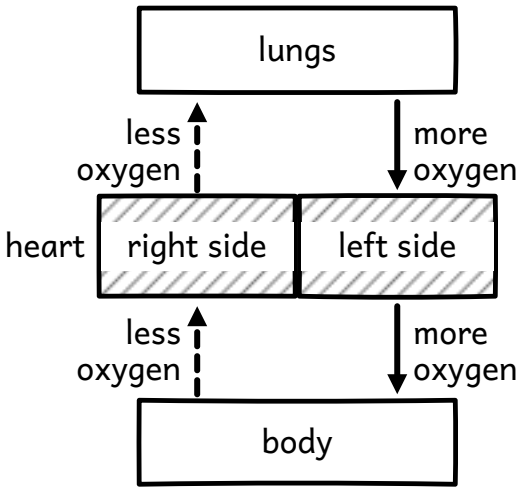
The answer is B: Blood goes round and round in a loop, past the lungs and the body.

Blood goes round and round in a loop. It passes through the heart, then the lungs, then the heart again, then the body.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which part does blood go to just after it leaves the right side of the heart?



A The lungs

B The body

C The left side of the heart

Answer at the back of the book.

2. What does the blood do in the lungs?

A It picks up oxygen and gives up carbon dioxide

B It picks up food

C It gives oxygen to the muscles

Answer at the back of the book.

3. What does the blood carry from the small intestine to the cells?

A Nutrients

B Carbon dioxide

C Oxygen

Answer at the back of the book.

4. Which blood vessels carry blood away from the heart?

   A Veins

   B Capillaries

   C Arteries

   Answer at the back of the book.

5. Why is the heart in two halves, like two pumps?

   A One half is a spare, in case the other stops

   B One half pumps blood and the other half pumps air

   C One half sends blood to the lungs and the other sends it to the body

   Answer at the back of the book.

6. **From an earlier chapter**

   Which gas passes from the air sacs into the blood?

   A Carbon dioxide

   B Oxygen

   C Smoke

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Blood goes body, heart, lungs, heart, body. Arteries carry it away from the heart and veins bring it back. Blood carries oxygen, food and waste. Blood is always red.

Draw: Draw the loop of blood: body, right side, lungs, left side, with arrows. Show less oxygen with dashes.

S3.3.7 CHAPTER 7

Pulse, breathing and exercise

Why do my heart and my breathing speed up when I run?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The heart beats faster, but my breathing stays the same.
- ☐ **B** Both speed up, because my muscles need more oxygen.
- ☐ **C** Both speed up only because I feel afraid.
- ☐ **D** My lungs have run out of air, so I must gasp.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.7. You counted your pulse there. Here you also count breaths and draw a chart.
- Level 2, Tables and charts. You will make a table and a bar chart.

BY THE END YOU CAN

- Measure pulse and breathing rate before and after exercise
- Show the results in a table and a bar chart
- Explain why both rates rise during exercise

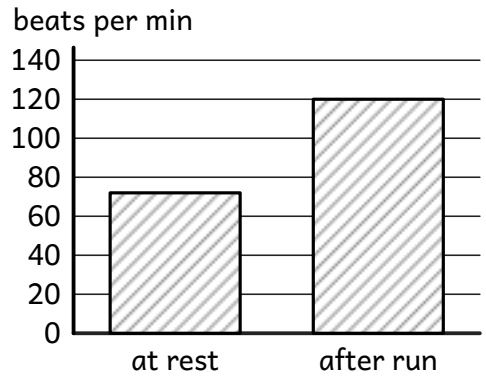
Your body keeps count of its own work. The **pulse** is how many times your heart beats in one minute. The **breathing rate** is how many breaths you take in one minute. Here are the results of one test. Draw them first.

DRAW IT FIRST

Draw the results of the test

time	beats per min
at rest	72
after run	120

1 Write the two pulse counts in a table, with the unit, beats per minute, at the top.



2 Draw a bar for each count. The taller bar is the faster pulse.

Amina sat still, then counted the beats at her wrist for 15 seconds. She ran on the spot for one minute and counted again, at once. A **bar chart** shows the same numbers as bars. The taller bar is the larger number.

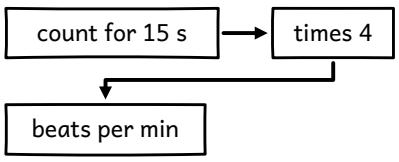
A minute is four lots of 15 seconds. So a count in 15 seconds, times 4, gives **beats per minute**.

SEE IT THREE WAYS

With things

Find your pulse at the wrist. Count the beats for 15 seconds. Multiply the count by 4.

As a picture



In words

There are four lots of 15 seconds in one minute. So the count in 15 seconds, times 4, is the pulse for a whole minute.

In symbols

18 × 4 = 72

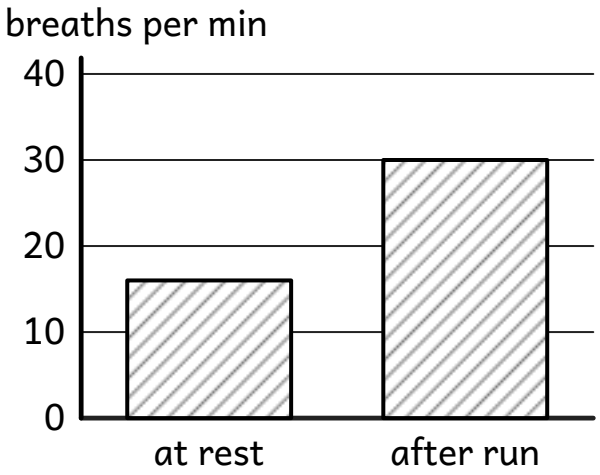
WORKED EXAMPLE

Amina counts 18 beats in 15 seconds at rest. What is her pulse in beats per minute?

1. A minute is four lots of 15 seconds.
2. So multiply the count by 4.
3. 18 × 4 = 72.

Answer: 72 beats per minute

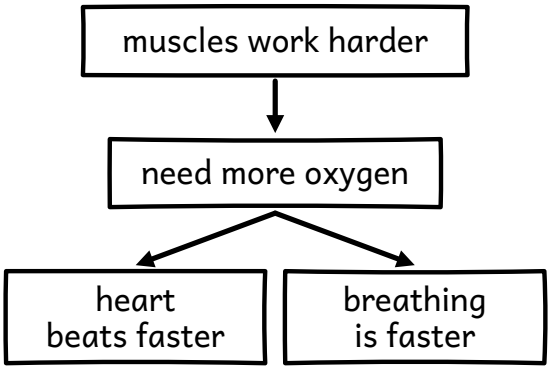
Breathing is counted the same way. One breath is one breath in and one breath out. Kofi counted his breaths for 30 seconds and multiplied by 2.



Kofi took more breaths each minute after his run.

Everyone is different. A resting pulse is not the same for every person, and there is no one right number. The best test is you against you: compare your own pulse at rest and after exercise.

Both rates went up. Here is why. Working muscles use oxygen faster and make more carbon dioxide. The blood must carry oxygen to them quickly, so the heart beats faster. The lungs must take in more air and clear the carbon dioxide, so you breathe faster. The heart does not make you breathe faster. Both answer the same need.



The muscles need more oxygen, so the heart and the lungs both speed up. Neither one speeds up the other.

After you rest, both rates slow down again. A fair test counts for the same time each time. It starts when you have been still for a few minutes.

TRY IT

Test your pulse and breathing

You need: a clock or a watch with a second hand, paper and a pencil, a quiet place to sit.

Be safe: Exercise only if you feel well. Stop at once if you feel dizzy or have pain. If you have a heart or breathing illness, ask a health worker first.

1. Sit still for a few minutes. Count your pulse for 15 seconds, then count your breaths for 30 seconds. A friend can count your breaths for you. Write both numbers down.
2. If you are well, jog on the spot for one minute. Then sit down and count again at once.
3. Multiply the pulse count by 4 and the breath count by 2. Draw a table and a bar chart of your own results.

What you will see: Your pulse and your breathing are both higher straight after you run. They slow down again as you rest.

If you cannot try it, this is what happens.

time	beats in 15 s
at rest	18
after run	30

time	breaths in 30 s
at rest	8
after run	15

A WRONG IDEA MANY PEOPLE HAVE

~~Everyone has the same resting pulse, and there is one right number.~~

Why it feels right: A book or a chart often gives just one number.

The test that breaks it: Ask a few people to count their pulse at rest. Each count may differ, and all of them may be well.

What is true: A resting pulse differs from person to person. Compare your own pulse at rest and after exercise.

KEY WORDS

pulse
the number of times your heart beats in one minute, felt as a beat at the wrist.

breathing rate
the number of breaths you take in one minute.

beats per minute
the unit of pulse. A count in 15 seconds, times 4, gives it.

bar chart
a chart where the height of each bar shows an amount.

BACK TO YOUR GUESS

The answer is B: Both speed up, because my muscles need more oxygen.

Both speed up because working muscles use oxygen faster. The heart sends more blood and the lungs take in more air.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Amina counts 18 beats in 15 seconds while she sits still. What is her pulse in beats per minute?

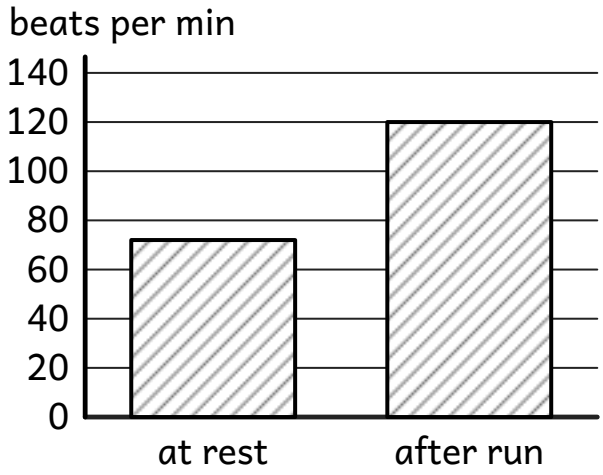
   A 22 beats per minute

   B 72 beats per minute

   C 18 beats per minute

   Answer at the back of the book.

2. The chart shows Amina's pulse. At rest it is 72 beats per minute. After a run it is 120. How many beats per minute higher is it after the run?



   A 192 beats per minute

   B 120 beats per minute

   C 48 beats per minute

   Answer at the back of the book.

3. Kofi counts 8 breaths in 30 seconds while he sits still. How many breaths per minute is that?

   A 4 breaths per minute

   B 16 breaths per minute

   C 8 breaths per minute

   Answer at the back of the book.

4. Which is a fair way to compare your pulse at rest with your pulse after a run?

   A Count for 15 seconds at rest and for 30 seconds after the run, then compare the two counts

   B Count only after the run

   C Count for the same time each time, after sitting still for a few minutes

   Answer at the back of the book.

5. Why do you breathe faster when you run?

   A Your lungs have run out of air

   B To cool the blood down

   C The muscles use oxygen faster and make more carbon dioxide, so more air must pass through

   Answer at the back of the book.

6. **From an earlier chapter**

   You feel your pulse at your wrist. What are you feeling?

   A The push of blood along an artery, with each heartbeat

   B Blood flowing back along a vein

   C The bones of the wrist moving

   Answer at the back of the book.

7. Ravi counts 21 beats at his wrist in 15 seconds. What is his pulse in beats per minute?

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Pulse is beats per minute. Count for 15 seconds and multiply by 4. Both pulse and breathing rise in exercise, because muscles need more oxygen.

Draw: Draw a table of your pulse at rest and after a run. Then draw a bar chart of it.

S3.3.8 CHAPTER 8

Drugs, alcohol and health

What do tobacco, alcohol and medicines do to my body?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** Anything a doctor gives you is safe, in any amount.
- ☐ **B** A medicine helps only in the right amount. Too much can harm.
- ☐ **C** Tobacco and alcohol only harm the person who uses them.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Bones, muscles, teeth and food, S2.3.7. Keeping the body well is the idea behind this chapter too.

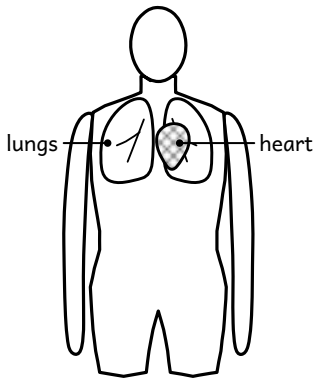
BY THE END YOU CAN

- Explain how tobacco, alcohol and other drugs harm body systems
- Explain why medicines must be taken only as directed

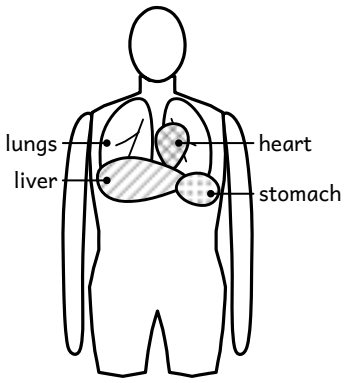
A **drug** is anything, other than food, that changes the way your body works. Some drugs are medicines. Others are tobacco, alcohol and drugs that some people use for the way they feel. This chapter gives plain facts. Build the picture of what they harm.

DRAW IT FIRST

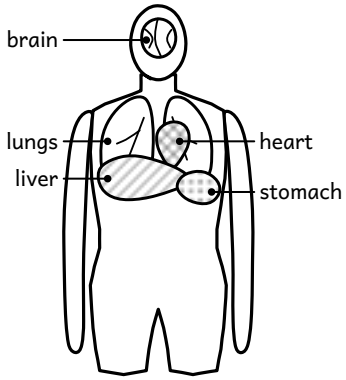
Draw what each one can harm



1 Draw the lungs and the heart. Tobacco harms both.



2 Add the liver and the stomach. Alcohol harms both.



3 Add the brain. Alcohol and other drugs change how it works.

Tobacco smoke harms the lungs. You read about this in the last chapters. It also makes the heart and the blood tubes work harder. Tobacco holds nicotine, a drug that makes a person want more. Chewed tobacco harms the mouth. Tobacco smoke also harms people who breathe it near a smoker.

Alcohol is a drug that slows the brain. A person who has drunk alcohol reacts more slowly, loses balance and judges badly. This is why alcohol and driving never mix.

The liver breaks alcohol down. Drinking a lot, for years, can badly damage the liver. It also harms the stomach, the heart and the brain. Young bodies are still growing,

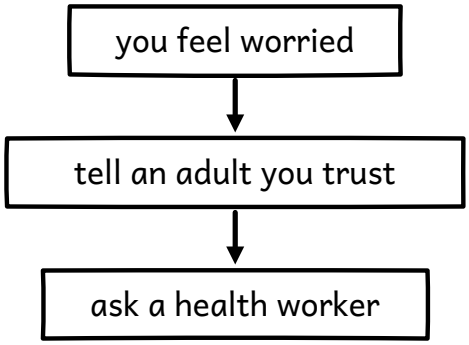
so they are harmed more. Alcohol is also harmful during pregnancy.

Other drugs affect the brain and the nervous system. Some make the heart race. Some slow the breathing. A drug from an unknown source can be especially dangerous, because nobody knows what is in it.

substance	harms
tobacco	lungs, heart
alcohol	liver, brain
other drugs	brain, heart

Each one can harm more than the organs named here. These are the main ones.

A drug can lead to **addiction**. This means the body and mind come to need it, and stopping is very hard. Addiction is a health problem. It is not a weakness, and nobody should be shamed for it.



Worried about a drug, for yourself or for a friend? You can always tell an adult you trust, or ask a health worker.

Someone may have taken a drug and be very sleepy. They may not wake, or may have trouble breathing. Get help at once, and stay with them. Tell an adult near you, or call the emergency number in your place.

A **medicine** is a drug that treats or prevents an illness. A medicine helps only when it is taken the right way. The amount you take each time is the **dose**.

SEE IT THREE WAYS

With things

With an adult, read the label on a medicine box. Find how much to take, how often, for how long, and the last safe day.

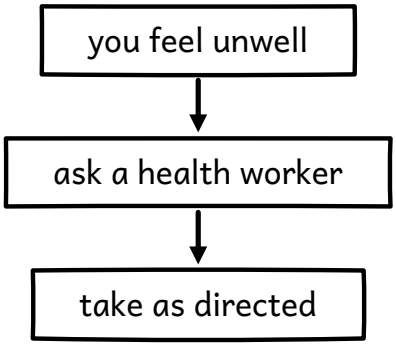
As a picture

label	tells you
dose	how much
how often	times a day
how long	number of days
use by	last safe day

In words

Too little medicine may not work. Too much can poison the body, for example the liver. So take a medicine only as the label or a health worker says.

Take only the medicine that was meant for you. Never share it. Never take more to feel better sooner. Keep medicines where small children cannot reach them.



The order matters. Ask first, then take the medicine the way you are told.

TRY IT

Read a medicine label

You need: an empty medicine box or packet, given by a grown up, paper and a pencil.

Be safe: Use an empty box only. Never taste, smell or take any medicine as part of an activity. Keep real medicine where small children cannot reach it.

1. Ask a grown up for a medicine box that is empty. Put the box on the table in front of you.
2. Find the dose, how often it is taken, and the use by date.
3. Write each one in a table like the example in the picture.

What you will see: The label tells you exactly how much, how often and until when. It leaves nothing to guess.

If you cannot try it, this is what happens.

look for	example
dose	5 mL
how often	3 times a day
use by	a date

A WRONG IDEA MANY PEOPLE HAVE

~~If a little medicine helps, more will help more.~~

Why it feels right: More of a good thing often seems better.

The test that breaks it: The label gives one dose for a reason. Above that amount a medicine can harm the body. Too much of a common pain medicine, for example, can damage the liver.

What is true: Take a medicine only as a health worker or the label says. More is not better, and it can be harmful.

KEY WORDS

drug
anything, other than food, that changes how the body works.

medicine
a drug that treats or prevents an illness.

dose
the amount of a medicine to take each time.

addiction
a strong need for a drug that is very hard to stop.

BACK TO YOUR GUESS

The answer is B: A medicine helps only in the right amount. Too much can harm.

A medicine helps when it is taken as directed. Too much, or the wrong one, can harm. Tobacco and alcohol can harm other people too.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Who can tobacco smoke harm?

   A The smoker, and people who breathe the smoke nearby

   B Only the smoker

   C Nobody, if the smoker uses only a little

   Answer at the back of the book.

2. What does alcohol do to the brain?

   A It slows the brain down, so reactions and balance get worse

   B It wakes the brain up and makes thinking sharper

   C Nothing. It only affects the stomach

   Answer at the back of the book.

3. Which organ breaks alcohol down, and can be badly damaged by drinking a lot for years?

   A The bladder

   B The liver

   C The skin

   Answer at the back of the book.

4. A person finds it very hard to stop using a drug. Which is true?

   A It means they are weak and have only themselves to blame

   B It is a health problem, and a health worker can help without shaming them

   C They could stop at any time, if they only tried

   Answer at the back of the book.

5. A label says to take one spoon of a medicine three times a day. Dev feels no better. What should he do?

   A Take two spoons each time, to work faster

   B Tell an adult and ask a health worker, and not take more

   C Share it with a friend who feels the same

   Answer at the back of the book.

6. **From an earlier chapter**

   Which part of the lungs does tobacco smoke damage, so that less oxygen can pass into the blood?

   A The ribs

   B The air sacs

   C The diaphragm

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Tobacco, alcohol and other drugs can harm the lungs, heart, liver and brain. Addiction is a health problem. Take a medicine only as directed. Ask a trusted adult or a health worker for help.

Draw: Draw the lungs, heart, liver and brain. Under each one write a drug that can harm it.

Key words, A to Z

Every key word in this book, what it means, and the chapter that teaches it.

absorb
to take in. The blood absorbs tiny pieces of food through the gut wall. S3.3.2

addiction
a strong need for a drug that is very hard to stop. S3.3.8

air sacs
the tiny bags at the ends of the lung tubes. Gases pass in and out of the blood here. S3.3.5

arteries
blood vessels that carry blood away from the heart. S3.3.6

bar chart
a chart where the height of each bar shows an amount. S3.3.7

beats per minute
the unit of pulse. A count in 15 seconds, times 4, gives it. S3.3.7

blood vessels
the tubes that blood moves in. S3.3.6

breathing in
taking air into the lungs. The chest gets bigger. S3.3.4

breathing out
pushing air out of the lungs. The chest gets smaller. S3.3.4

breathing rate
the number of breaths you take in one minute. S3.3.7

capillaries
the thinnest blood tubes. They wrap round the air sacs. S3.3.5, S3.3.6

carbohydrates
nutrients that give energy, such as the starch in rice and bread. S3.3.3

diaphragm
the sheet of muscle under the lungs. S3.3.4

digestion
breaking food down into tiny pieces. S3.3.2

dose

the amount of a medicine to take each time. S3.3.8

drug
anything, other than food, that changes how the body works. S3.3.8

fibre
the part of plants that helps food move through the gut. S3.3.3

gas exchange
oxygen passing into the blood while carbon dioxide passes out. S3.3.5

gullet
the tube that takes food from the mouth to the stomach. S3.3.2

large intestine
the wide tube that takes back water and leaves the waste. S3.3.2

lungs
the two soft bags in the chest that fill with air. S3.3.4

medicine
a drug that treats or prevents an illness. S3.3.8

minerals
nutrients such as iron and calcium, needed in small amounts. S3.3.3

nutrients
the parts of food that the body uses. S3.3.3

organ
a part of the body with one main job, such as the heart or the lungs. S3.3.1

organ system
a team of organs that does a big job together. S3.3.1

proteins
nutrients that build the body and mend it. S3.3.3

pulse
the number of times your heart beats in one minute, felt as a beat at the wrist. S3.3.7

respiration
what every cell does to release energy from sugar, using oxygen. S3.3.5

ribs
the curved bones that make a cage round the lungs. S3.3.4

small intestine
a long coiled tube where the tiny pieces pass into the blood. S3.3.2

veins
blood vessels that bring blood back to the heart. S3.3.6

vitamins
nutrients needed in tiny amounts to keep the body working. S3.3.3

windpipe
the tube that takes air from the nose and mouth to the lungs. S3.3.4

Answers

S3.3.1. Organs and systems

1. **The stomach**

   The stomach breaks food down, so it is part of the digestive system.

   - **If you chose B:** The heart moves blood, so it is in the circulatory system. The digestive system handles food. Go to S3.3.1.
   - **If you chose C:** The brain sends signals, so it is in the nervous system. The digestive system handles food. Go to S3.3.1.

2. **The excretory system**

   The excretory system removes waste. The kidneys and the bladder are in it.

   - **If you chose A:** The breathing system takes in air. It does not make waste liquid. Go to S3.3.1.
   - **If you chose C:** The skeletal system is the bones. Kidneys are soft organs with another job. Go to S3.3.1.

3. **A team of organs that does a big job together**

   The stomach, the liver and the intestines are a team. They make up the digestive system.

   - **If you chose A:** Each organ has one main job. A system is a team of organs. Go to S3.3.1.
   - **If you chose C:** Bones are one system, but a system is any team of organs, not only bones. Go to S3.3.1.

4. **The breathing system and the circulatory system**

   The lungs of the breathing system take in oxygen. The heart and blood of the circulatory system carry it to the muscles.

   - **If you chose B:** The digestive system handles food. Oxygen comes in with the air we breathe and moves in the blood. Go to S3.3.1.
   - **If you chose C:** Bones hold the body up and the excretory system removes waste. Neither carries oxygen. Go to S3.3.1.

5. **The muscles need more oxygen, so the heart sends more blood**

   Working muscles use oxygen quickly. A faster heart sends them more blood, and the blood brings more oxygen.

   - **If you chose A:** Excitement can speed the heart, but running does it too. Your muscles need more oxygen, and the heart must carry it. Go to S3.3.1.
   - **If you chose C:** The lungs do not squeeze the heart. The heart is a muscle that beats by itself, faster when the body needs more. Go to S3.3.1.

S3.3.2. Digestion

1. **Mouth, gullet, stomach, small intestine, large intestine**

   Food goes in at the mouth and down the gullet to the stomach. Then it goes through the small intestine and the large intestine.

   - **If you chose B:** The gullet comes before the stomach, and the small intestine comes before the large one. Check the picture of the gut. Go to S3.3.2.
   - **If you chose C:** Food is mixed in the stomach first. The small intestine comes after it. Go to S3.3.2.

2. **It squeezes food down to the stomach**

   The gullet has muscles that squeeze in waves and push the food down to the stomach.

   - **If you chose B:** The gullet only carries food. Teeth, stomach and small intestine break it down. Go to S3.3.2.
   - **If you chose C:** Air goes down the windpipe. The gullet is a different tube, and it carries food. Go to S3.3.2.

3. **The small intestine**

   The small intestine is long and coiled. Its wall lets tiny pieces of food through into the blood.

   - **If you chose A:** The stomach mixes and squeezes the food. Most absorbing is done further on. Go to S3.3.2.
   - **If you chose C:** The large intestine takes back water. The pieces of food were absorbed before this. Go to S3.3.2.

4. **The big pieces, because they are wider than the gaps**

   The gaps are narrower than a big piece, so it stays on top. A small piece is narrower than a gap, so it goes through.

   - **If you chose B:** Weight does not decide it. A heavy piece that is small enough would still pass. Width does. Go to S3.3.2.
   - **If you chose C:** The small pieces do pass through. They are narrower than the gaps. Go to S3.3.2.

5. **Only tiny pieces can pass through the gut wall into the blood**

   The gut wall acts like a wall with tiny gaps. Only very small pieces can get through it into the blood.

   - **If you chose A:** The stomach holds the same amount either way. The reason is in the wall of the small intestine. Go to S3.3.2.
   - **If you chose B:** Speed is not the reason. Big pieces would still not pass into the blood. Go to S3.3.2.

6. **The digestive system**

   The stomach and the intestines are organs of the digestive system.

   - **If you chose A:** The circulatory system moves blood. The stomach is in the system that handles food. Go to S3.3.1.
   - **If you chose C:** The nervous system sends signals. The stomach is in the system that handles food. Go to S3.3.1.

S3.3.3. Nutrients and diet

1. **Vitamins and minerals**

   Vitamins and minerals are needed in tiny amounts. They help the body use everything else.

   - **If you chose A:** Fats store energy and keep you warm. Their job is different from the job of vitamins and minerals. Go to S3.3.3.
   - **If you chose C:** Fibre helps food move through the gut. It is not one of the tiny-amount nutrients. Go to S3.3.3.

2. **Protein**

   Proteins are the building nutrient. Beans, fish and eggs have a lot of them.

   - **If you chose B:** Carbohydrates give energy. Protein is the nutrient that builds and mends. Go to S3.3.3.
   - **If you chose C:** Fibre helps food move through the gut. It does not build the body. Go to S3.3.3.

3. **It helps food move through the gut**

   Fibre is the part of plants that cannot be digested. It stays in the gut and helps push the food along.

   - **If you chose A:** Your body cannot digest fibre, so it gives no energy. Carbohydrates and fats do. Go to S3.3.3.
   - **If you chose B:** Protein builds muscle. Fibre has a different job. Go to S3.3.3.

4. **Carbohydrates and fats**

   Carbohydrates and fats are the energy nutrients. Rice and oil are good sources.

   - **If you chose A:** Vitamins and minerals help the body work, but they give no energy themselves. Go to S3.3.3.
   - **If you chose B:** Neither fibre nor water gives energy. Your body cannot get energy from them. Go to S3.3.3.

5. **Rickets**

   Bones need vitamin D and calcium to grow hard. Without enough of them they stay soft and can bend.

   - **If you chose A:** Scurvy comes from too little vitamin C, and it makes the gums sore. Go to S3.3.3.
   - **If you chose C:** Goitre comes from too little iodine, and it makes the neck swell. Go to S3.3.3.

6. **Anaemia**

   Iron helps the blood carry oxygen. Too little iron gives anaemia, and the person feels pale and tired.

   - **If you chose B:** Scurvy is the disease of too little vitamin C. The pale, tired blood in this case is from too little iron. Go to S3.3.3.
   - **If you chose C:** Rickets is the disease of soft bones. It comes from too little vitamin D or calcium. Go to S3.3.3.

7. **The large intestine**

   The large intestine takes water back into the body. What is left leaves as waste.

   - **If you chose A:** The gullet only squeezes food down to the stomach. Go to S3.3.2.
   - **If you chose B:** The stomach mixes and squeezes the food. It does not take back water. Go to S3.3.2.

S3.3.4. Breathing

1. **The sheet over the open end**

   The sheet is pulled down and pushed up. In the body, the diaphragm moves down and up in the same way.

   - **If you chose B:** The balloon stands for a lung. It is filled by air, not pulled by muscle. Go to S3.3.4.
   - **If you chose C:** The straw stands for the windpipe. Air goes through it. Go to S3.3.4.

2. **It fills with air**

   The room inside gets bigger, so air flows in through the straw and fills the balloon.

   - **If you chose B:** Pulling the sheet down makes more room, not less. A smaller balloon is what you see when the sheet is pushed up. Go to S3.3.4.
   - **If you chose C:** The room grew, so air from outside flows in. The balloon cannot stay the same size. Go to S3.3.4.

3. **The diaphragm moves down and the ribs move up and out**

   These two movements make the chest bigger, and air flows in.

   - **If you chose B:** That is what happens when you breathe out. Breathing in makes the chest bigger. Go to S3.3.4.
   - **If you chose C:** The lungs have no muscles that pull. The diaphragm and the ribs move. Go to S3.3.4.

4. **The bigger room squeezes the air less, so air flows in from outside**

   The bigger room squeezes the air in the chest less. Air from outside is squeezed more, so it pushes in.

   - **If you chose A:** The lungs have no muscles that move them. They are filled by the chest getting bigger. Go to S3.3.4.
   - **If you chose B:** The nose and mouth only let the air through. The air flows in because of the bigger room. Go to S3.3.4.

5. **Nose or mouth, windpipe, lungs**

   Air goes in through the nose or mouth, down the windpipe and into the lungs.

   - **If you chose A:** The gullet carries food to the stomach. Air goes down the windpipe. Go to S3.3.4.
   - **If you chose C:** Air goes to the lungs. The stomach is for food. Go to S3.3.4.

6. **The gullet**

   The gullet squeezes food down to the stomach. The windpipe is next to it, but it carries air.

   - **If you chose A:** The windpipe carries air to the lungs. Food goes down a different tube. Go to S3.3.2.
   - **If you chose C:** The large intestine comes at the end of the gut, after the stomach. Go to S3.3.2.

S3.3.5. Gas exchange in the lungs

1. **From the air sac into the blood**

   The air in the sac has more oxygen than the blood, so oxygen passes into the blood.

   - **If you chose B:** That is the way carbon dioxide goes. Oxygen goes into the blood. Go to S3.3.5.
   - **If you chose C:** The walls are very thin, so gases do pass through them. Go to S3.3.5.

2. **Carbon dioxide**

   The blood brings carbon dioxide from the cells. It passes into the air sacs and is breathed out.

   - **If you chose A:** Oxygen goes the other way, into the blood. The blood needs it for the cells. Go to S3.3.5.
   - **If you chose C:** Air is a mix of gases, and it does not go into the blood. One gas in it does. Go to S3.3.5.

3. **Their walls are very thin and there are millions of them, each close to a capillary**

   A thin wall and a close blood tube let gases pass easily. Millions of sacs give a very large surface.

   - **If you chose B:** Air sacs have no muscles. The gases spread through the wall by themselves. Go to S3.3.5.
   - **If you chose C:** Air sacs are tiny. There are millions of them, and that gives a large surface. Go to S3.3.5.

4. **In every cell of the body**

   Every living cell uses oxygen to release energy from sugar. That is respiration.

   - **If you chose A:** The lungs are where gases swap. Respiration is what each cell does with the oxygen. Go to S3.3.5.
   - **If you chose C:** The windpipe only carries air. Respiration happens inside cells. Go to S3.3.5.

5. **It damages the tubes and breaks down air sac walls, so less oxygen can pass in**

   Smoke breaks down the walls between air sacs. There are fewer, bigger sacs with less surface, so less oxygen can pass into the blood.

   - **If you chose A:** A cough is only a sign. Smoke damages the tubes and the air sacs, and that harm can last. Go to S3.3.5.
   - **If you chose C:** Exercise makes muscles stronger. Smoke only harms the lungs, and the lungs have no muscles to train. Go to S3.3.5.

6. **Let the smoke out, and keep small children away from it**

   A window, door or chimney lets smoke out, so you breathe less of it. Children are at the most risk.

   - **If you chose B:** Smoke still goes down the windpipe into the lungs, whichever way you breathe. Go to S3.3.5.
   - **If you chose C:** All smoke harms the lungs. Smoke from a cooking fire indoors does too. Go to S3.3.5.

7. **It moves down and flattens**

   The diaphragm tightens, flattens and moves down. The chest gets bigger and air flows in.

   - **If you chose A:** That is what it does when you breathe out. Go to S3.3.4.
   - **If you chose C:** The diaphragm moves each time you breathe. It is the main muscle for breathing. Go to S3.3.4.

S3.3.6. The heart and blood

1. **The lungs**

   The right side pumps blood to the lungs. There it picks up oxygen.

   - **If you chose B:** Blood goes to the body after the left side of the heart, not the right side. Go to S3.3.6.
   - **If you chose C:** Blood must go to the lungs first. Only then does it reach the left side. Go to S3.3.6.

2. **It picks up oxygen and gives up carbon dioxide**

   The air sacs and the capillaries swap gases. Oxygen goes into the blood and carbon dioxide goes out.

   - **If you chose B:** Blood picks up food in the small intestine, not in the lungs. Go to S3.3.2.
   - **If you chose C:** The muscles get their oxygen later, when the blood has gone round the body. Go to S3.3.6.

3. **Nutrients**

   The tiny pieces of food pass into the blood in the small intestine. The blood carries them to every cell.

   - **If you chose B:** Carbon dioxide travels from the cells to the lungs, the other way. Go to S3.3.6.
   - **If you chose C:** Oxygen comes from the lungs, not from the small intestine. Go to S3.3.6.

4. **Arteries**

   Arteries carry blood away from the heart. The pulse you feel at the wrist is the push along an artery.

   - **If you chose A:** Veins bring blood back to the heart. Think of them as the return road. Go to S3.3.6.
   - **If you chose B:** Capillaries are the tiny tubes between arteries and veins. Go to S3.3.6.

5. **One half sends blood to the lungs and the other sends it to the body**

   The right side pumps to the lungs and the left side pumps to the body. The blood goes through the heart twice on each trip.

   - **If you chose A:** Both halves work all the time. Each has its own job. Go to S3.3.6.
   - **If you chose B:** The heart pumps only blood. Air is moved by the chest. Go to S3.3.6.

6. **Oxygen**

   The air in the sacs has more oxygen than the blood, so oxygen passes into the blood.

   - **If you chose A:** Carbon dioxide passes out of the blood. Oxygen goes in. Go to S3.3.5.
   - **If you chose C:** Smoke is not a gas the body wants. It harms the lungs. Go to S3.3.5.

S3.3.7. Pulse, breathing and exercise

1. **72 beats per minute**

   A minute is four lots of 15 seconds. 18 × 4 = 72.

   - **If you chose A:** You added 4 to the count. A minute holds four lots of 15 seconds, so you must multiply by 4. Go to S3.3.7.
   - **If you chose C:** That is the count for only 15 seconds. A minute is four times as long. Go to S3.3.7.

2. **48 beats per minute**

   Subtract the pulse at rest from the pulse after the run. 120 − 72 = 48.

   - **If you chose A:** You added the two pulses. To find how much higher one is, subtract the smaller from the larger. Go to S3.3.7.
   - **If you chose B:** That is her pulse after the run. The question asks how much higher it is than her pulse at rest. Go to S3.3.7.

3. **16 breaths per minute**

   A minute is two lots of 30 seconds. 8 × 2 = 16.

   - **If you chose A:** You divided by 2. A minute is two lots of 30 seconds, so you multiply by 2. Go to S3.3.7.
   - **If you chose C:** That is the count for only 30 seconds. A minute is twice as long. Go to S3.3.7.

4. **Count for the same time each time, after sitting still for a few minutes**

   A fair test changes only one thing. Here the only change is the run. So the counting time and the resting start stay the same.

   - **If you chose A:** The two counts cover different times, so you cannot compare them directly. Count for the same time each time. Go to S3.3.7.
   - **If you chose B:** You need a count at rest to compare with. One count alone shows no change. Go to S3.3.7.

5. **The muscles use oxygen faster and make more carbon dioxide, so more air must pass through**

   Working muscles need more oxygen and give out more carbon dioxide. Faster breathing brings the oxygen in and takes the carbon dioxide out.

   - **If you chose A:** The lungs do not run out. Working muscles use oxygen faster, so you take in more air. Go to S3.3.7.
   - **If you chose B:** Breathing faster is not for cooling. Sweating does that. The reason is oxygen and carbon dioxide. Go to S3.3.7.

6. **The push of blood along an artery, with each heartbeat**

   Each time the heart squeezes, it pushes blood along the arteries. You feel that push as a pulse.

   - **If you chose B:** Veins bring blood back smoothly. The beat you feel comes from the heart pushing blood out along an artery. Go to S3.3.6.
   - **If you chose C:** Bones do not beat. The beat is the push of blood in an artery, and it keeps time with the heart. Go to S3.3.6.

7. **84 beats per minute**

   21 × 4 = 84.

S3.3.8. Drugs, alcohol and health

1. **The smoker, and people who breathe the smoke nearby**

   Tobacco smoke harms the lungs of anyone who breathes it, not only the person who lights it.

   - **If you chose B:** Smoke spreads in the air. People near a smoker breathe it too, and it can harm their lungs. Go to S3.3.5.
   - **If you chose C:** Tobacco smoke carries harm at any amount. Less smoke means less harm, but not none. Go to S3.3.5.

2. **It slows the brain down, so reactions and balance get worse**

   Alcohol slows the nervous system. A person who has drunk it reacts more slowly and loses balance.

   - **If you chose B:** Alcohol can feel as if it helps, but it slows the brain. A person is less able to think, react and balance. Go to S3.3.8.
   - **If you chose C:** Alcohol passes into the blood and reaches the brain. It slows the brain as well as harming the stomach. Go to S3.3.8.

3. **The liver**

   The liver breaks alcohol down. Years of heavy drinking can scar it and stop it working.

   - **If you chose A:** The bladder stores urine. It does not break alcohol down. Go to S3.3.8.
   - **If you chose C:** The skin does not break alcohol down. The liver does. Go to S3.3.8.

4. **It is a health problem, and a health worker can help without shaming them**

   Addiction is an illness. People get better with help from a health worker and from people who care.

   - **If you chose A:** Addiction is a health problem. It is not a weakness, and shame makes it harder to ask for help. Go to S3.3.8.
   - **If you chose C:** A drug can change the body so that stopping is very hard. Help makes it much more likely they can stop. Go to S3.3.8.

5. **Tell an adult and ask a health worker, and not take more**

   The dose on the label is the safe amount. If the medicine is not working, a health worker can say what to do next.

   - **If you chose A:** More than the dose can harm the body. A medicine works only at the right amount. Go to S3.3.8.
   - **If you chose C:** A medicine is meant for one person. The right dose for Dev may be wrong for a friend. Go to S3.3.8.

6. **The air sacs**

   Smoke breaks down the walls between air sacs. Fewer, bigger sacs have less surface, so less oxygen can pass into the blood.

   - **If you chose A:** The ribs are bones that guard the lungs. The smoke does its harm inside, in the tubes and air sacs. Go to S3.3.5.
   - **If you chose C:** The diaphragm is a muscle under the lungs. The smoke harms the tubes and the air sacs where gases cross. Go to S3.3.5.

About this book

For learners who can read a page alone and use the four operations. In many schools this fits children of about 11 to 13, and older learners can use it too. Activities use the learner's own body, a clock, cups, paper, a bottle and a balloon. A grown up cuts the

bottle for the model lung. Exercise is always optional, and anyone with a heart or breathing illness asks a health worker first. A learner can work alone: every exercise has its answer and the reason for it.

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