

EXOSKELETONS

I bet you keep your skeleton inside your body. Don't worry, I'm not judging you. I keep mine inside me as well! It might seem like the obvious thing to do, but only 10% of all animals do the same! Those of us who have our skeletons safely inside us are called vertebrates. The rest of the animal kingdom are called invertebrates. They have something called an exoskeleton. Exo comes from the Ancient Greek word for "outside". I bet you can guess where their skeleton is!

Insects are examples of animals with exoskeletons. Crustaceans such as crabs and lobsters do as well. Our bones are made up of a mixture of minerals, mainly calcium. Exoskeletons are usually made of a material called chitin. This is mixed with other minerals or proteins to make it either stronger or more flexible. All of this gives these creatures a strong but flexible outer shell. Their exoskeleton also has to do the same job as ours and keep their bodies in position. They don't have bones inside them, so they are reliant on their exoskeleton.

Our bones are constantly growing and repairing themselves. If you break your leg, it will eventually heal. Your bones are obviously much smaller as a baby than as an adult. Exoskeletons can't grow. They are stuck at the size they are, but the creature inside them does grow. To get around this, they moult. Whenever an insect grows too big for its exoskeleton, the skeleton peels away. This is often called "shedding".

At this point, the insect is vulnerable. It might take weeks for a new exoskeleton to form. It has to do all of its growing whilst the shell is still soft. Once it hardens, it will have to be shed again when the insect needs to grow.

Some insects don't live long enough to moult. Some live a lot longer and might shed their exoskeleton 8 times in their lifetime. It all depends on the species.

Most exoskeletons are made up of sections that move over each other. This allows the creature to bend and flex when it moves. If the exoskeleton was a single solid piece, the creature wouldn't be able to move.



Not all exoskeletons work like this, though. Clams, mussels and snails all have exoskeletons that we call a “shell”. These shells aren’t made of chitin but of calcium carbonate. They are different from chitin exoskeletons because they grow with the creature. They don’t get larger by expanding. Instead, they grow along the edge, gradually getting bigger.

Animals with exoskeletons don’t have the same insides as us, either. They might breathe oxygen, but they don’t have lungs. Their exoskeleton is covered in tiny holes called spiracles. These allow oxygen to flow into the creature. They don’t have blood, either. Their bodies are filled with haemolymph. They don’t have veins but they do have a heart that circulates the liquid. It doesn’t carry any oxygen around their body, but it does contain minerals that they need.

Fun fact! Insect “blood” is actually clear or very pale yellow. The red bits you see when you squish one are actually colour from their eyes! Eugh!

RETRIEVAL FOCUS

1. Where are the skeletons on invertebrates?
2. Give an example of an invertebrate with a growing exoskeleton.
3. True or false: insects have hearts.
4. Where does the red colour come from in insect blood?
5. What percentage of animals are vertebrates?

VIPERS QUESTIONS

S

How are vertebrates and invertebrates different? Give two differences.

S

How do exoskeletons still allow the creature to bend?

S

How do invertebrates grow?

V

Which word in the text is a synonym for “bendy”?

V

If something is “vulnerable”, what does it mean?



HOW WE GET ENERGY

Our bodies can't generate energy out of nothing. We need a source of fuel just like any other machine. Our fuel comes from the foods we eat and the liquids that we drink. Between them, we should try to get everything that our body needs to work. The only thing that we struggle to get from our food is vitamin D. You can get small amounts from oily fish or supplements, but we get most of it from direct sunlight. It's important to get a balance between enough sunlight for your vitamin D and too much sunlight, which is damaging to your skin.

There are three main food groups that give our bodies energy. These are carbohydrates, protein and fats. Carbohydrates are the main source of energy for humans. If we don't have enough of these in our diet, then our body will start to use proteins and fats to generate energy. That's why we lose weight when we cut down on what we eat.

Not all of the energy we create is used to keep us going. About half of it goes towards helping us grow, heal and keep our body temperature stable.

Different types of food give us different types of energy. Complex carbohydrates release their energy slowly. This keeps us feeling full for longer and can help to stop us from snacking. These are also known as "starch". You can find them in pasta, bread, rice and flour. If you can get wholemeal varieties, they are even healthier because they contain lots of fibre and less sugar. All carbohydrates are turned into sugars in the body, so the less sugar they contain, the better. Fibre slows down the process of absorbing sugar, giving your body more energy for longer.

Simple carbohydrates are burned up quickly by our bodies. These might give us a quick boost of energy, but they usually contain lots more sugar. Once we've burned through the energy, we tend to feel tired and hungry and are more likely to snack. Chocolate, fizzy drinks and biscuits all contain simple carbohydrates. Some fruits do as well, but the fibre and vitamins in them make them definitely worth eating.

When you eat your food, your chewing starts the process of digesting your



food. This is carried on in your stomach. Carbohydrates are broken down into sugars, proteins into amino acids and fats into fatty acids. These are then absorbed by your cells. If you have more energy than your body needs, it is stored as body fat. That's why eating too much makes us put on weight.

It may seem backwards, but lots of exercise can also give us lots more energy. Lots of your energy is spent recovering and keeping your vital systems going. When you exercise regularly, your cardiovascular system and muscles become stronger and more efficient. That means that you need less energy to keep them working, so it can be used for other things. Exercising regularly and eating a balanced diet are the best ways to make sure that your body has all of the energy that you need.

RETRIEVAL FOCUS

1. Do our bodies create energy out of nothing?
2. Which type of food is broken down into sugars?
3. Which type of food gives us amino acids?
4. Where does digestion start?
5. Which type of carbohydrate is in chocolate?

VIPERS QUESTIONS

S

How does fibre help to keep you going for longer?

V

What does the word "generate" mean in this context?

S

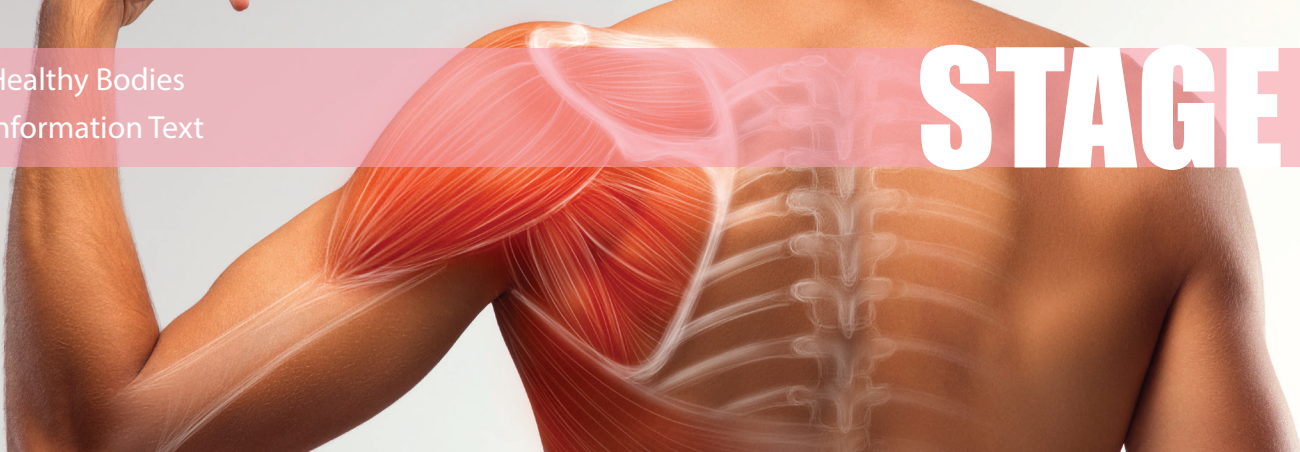
Why are complex carbohydrates better for us than other kinds?

V

If something is "vital", what does it tell you?

S

How does exercise give you more energy?



MUSCLES

You may know them as the bulging things on weightlifters' arms, but muscles are everywhere in your body. They control everything you do, from blinking your eyes to beating your heart. Without them, we wouldn't be able to survive. You have over 600 muscles in your body, and they all coordinate to help you get through the day.

Every muscle is made of the same material. Thousands of tiny fibres make up each muscle by forming an elastic tissue. These are great at pulling, but they have no strength to push. Muscles work in tandem with other muscles to move your bones. A flexor muscle pulls on a joint to bend it, while an extensor muscle relaxes. To straighten the joint back out, the extensor pulls, and the flexor relaxes.

You have three different types of muscle across your body. Smooth muscles are usually laid out in sheets rather than big bulging muscles. They are sometimes called involuntary muscles because they move without you thinking about it. They work to make your stomach digest food. You have them in your bladder to help you hold in your urine until you get to the toilet. Your eyes rely on smooth muscles to focus. Imagine having to think about all of those things all of the time. You'd never get anything else done!

Your cardiac muscle is the one that makes up your heart. Luckily, you don't have to think about using this one, either. Can you imagine having to remember to make your heart beat? Your cardiac muscle contracts to pump blood out and relaxes to allow blood in.

The other type of muscles you have are called skeletal muscles. These are the muscles that are connected to your skeleton. They are also the muscles that most people mean when they talk about how muscular somebody is. They are the muscles that you can see from the outside. All of your skeletal muscles are voluntary. That means that you control when you use them. They aren't just there to lift heavy boxes or to kick a ball. Skeletal muscles hold your skeleton in place. People with muscular disabilities might not be able to walk or control their bodies.



Muscles aren't connected directly to your bones. They are joined with special tissues called tendons. These are extremely tough. They have to remain connected even when your powerful muscles tug hard on the bones. Sometimes, they break. Athletes often tear the tendons in their knees and ankles.

One place where you might not expect to find muscles is your face. Many of these don't attach to your skull. Instead, they attach to other parts of your skin. This is why you can make tiny movements in your face. Humans have used facial expressions to communicate since they evolved. Your tongue is also a group of muscles, although they are only attached at one end. Without your tongue you wouldn't be able to talk or eat.

VOCABULARY FOCUS

1. Which word describes something that you can control?
2. Which word describes something that you can't control?
3. Find and copy a word that means "work together".
4. What impression do you get of a muscle from the word "bulging"?
5. Which word means "gets tighter": contracts or relaxes?

VIPERS QUESTIONS

R

How many muscles do you have?

S

What is the difference between flexor and extensor muscles?

R

How do muscles help your eyes?

S

What is different between facial muscles and other skeletal muscles?

R

What do athletes often injure?



NUTRITION

The petrol that you put into a car has to be perfectly balanced to get the best performance from it. If it's dirty or mixed with grit, the car won't work. The same is true of your body. The food and liquids that you put into your body are the only source of energy that it gets. If they aren't the highest quality, then your body isn't going to perform as well as it can.

Making sure that you get the best foods is the job of a "nutritionist". They look at the different foods out there and work out how healthy they are. They sometimes carry out blood tests. These can be used to see if somebody is missing certain vitamins and minerals. Without them, your body can start to go wrong. For instance, if you don't have enough iron, then you can feel exhausted.

You need to eat a varied diet to get the best mix of foods. We all know that vegetables are good for us, but if you only ate lettuce, you wouldn't be healthy at all! We need to get a mix of carbohydrates and protein as well as vegetables and even some fat. It should be the right kind of fat, though. Too much saturated fat can clog your arteries and be deadly. You get saturated fat in butter, dairy products and things like cakes and pastries.

Vitamins and minerals are essential for lots of different processes in your body. You get these from lots of different food types. Iron is particularly common in meats and dark green leafy vegetables. Vegetarians and vegans might need to keep a close eye on their iron levels because they aren't getting any from meat.

One of the most worrying foods in our diet is salt. We need a tiny amount of salt to help our nerves do their jobs. Too much salt is very bad for us. Scientists think that we need about half a gram of sodium (a part of salt) to stay healthy, but any more than two grams is unhealthy for children.

Even foods that we think are healthy can be bad for us. We all know that we shouldn't eat too much sugar. Children shouldn't have more than 24 grams of sugar per day, but a can of cola can have 36 grams in it! Fruit also contains sugars. Eating fruit isn't a problem because you won't get too much sugar that way, but drinking fruit juice can be unhealthy. A glass



of fresh orange juice can contain as much as 21 grams of sugar! Fruits also contain lots of healthy fibre, which helps counteract the sugar. Many nutritionists recommend cutting out the fruit juice and eating the fruit instead.

You may have heard that you need to eat 5 portions of fruit and veg each day. It's called your "5-a-day". However, that is just a recommendation in the UK and the USA. Canada recommends 7-10 portions per day. France goes for a minimum of 10 as well. Lots of nutritionists are now pushing other countries to aim for 10 as well.

SUMMARY FOCUS

1. Why is getting the right nutrition important?
2. Why is it important to eat the right type of fat?
3. Why might too much fruit juice be harmful?
4. How do nutritionists help us?

VIPERS QUESTIONS

R

How many portions of fruit and vegetables are recommended in France?

P

Why might some countries recommend more fruit and vegetables than the UK?

V

Which word in the text means "very tired"?

R

Is it healthy to just eat one kind of food?

R

How much salt do we need?



SKELETONS

Your skeleton is what keeps you upright and alive. Your bones do a lot more than just stop you from being a floppy mess! Your skeleton is made up of 206 bones. Every one of them has a job to do. If even a single bone is broken, it can make the simplest tasks a lot more difficult.

Did you know that you have two types of bones? Cortical bones are dense and strong. These are the bones that give your body strength. They make up the structure of your skeleton. You also have trabecular bones. These are sponge-like and flexible. They still protect important parts of your body, but they aren't as rigid. Your skull and ribs are made up of trabecular bone. This allows them to bend a bit more before they break. That's important because a broken skull or ribs can be incredibly dangerous.

Over millions of years, humans have developed these bones to strike a balance. Trabecular bone is lightweight and flexible, but it isn't as strong as cortical bones. Cortical bones are tough, but they aren't flexible. That means that they break more easily. It's much easier to break your arm or leg than it is to break your skull. If your whole skeleton was made up of cortical bones, your organs wouldn't be protected. Your pelvis, ribs and skull would break a lot of the time. That could be fatal.

On the other hand, it wouldn't be any good if your whole skeleton was trabecular bones. These aren't strong enough to support the weight of your body. Having flexible bones in your legs and spine would make walking very difficult and probably painful.

Your bones aren't fixed for life. When they are born, babies have 300 bones in their bodies (adults have 206). They don't lose them like they lose their teeth. Instead, some bones fuse together. These bones continue to join together until you are about 20 years old. Lots of these are in your skull.

The bones in your skeleton aren't evenly distributed. Adults have 206 bones, and over half of them are in their hands and feet. Together, they contain 106 bones! You have 14 bones in your face and another 8 in the rest of your skull. Your spine contains 33. That only leaves 45



bones for the rest of your body!

Bones work as part of a team. Nearly every single bone in your body is connected to at least one more. The only one that isn't is the hyoid bone in your throat. This is the bone that holds your tongue in place, so it's pretty important!

It might be obvious, but bones come in all sizes. The biggest is the femur in your leg. It joins your knee to your hip. The smallest is the stapes, which is a tiny bone inside your ear canal. Without it, you'd be deaf.

Our skeleton means that humans are classed as vertebrates. Vertebrates have a skeleton inside their body, which is covered with tissue and skin. That might seem pretty standard, but only 10% of all animals are vertebrates! The rest are invertebrates, which have their skeleton on the outside. Insects are examples of invertebrates!

VOCABULARY FOCUS

1. Which word in the first paragraph means "standing vertically"?
2. Which word is a synonym for "easiest"?
3. Find and copy a phrase that means "aim to make things equal".
4. What does "fatal" mean?
5. Which word in the text means "normal" or "average"?

VIPERS QUESTIONS

R

Which type of bone is strongest?

S

Why isn't your whole body made of a single type of bone?

R

Which bone is the largest in your body?

R

Where might you find the smallest bone in your body?

I

Where are most bones in your body?

Answers - Exoskeletons:

1. Outside their body
2. Snail, mussel or clams
3. True
4. Their eyes
5. 10%

S: Vertebrates have their skeletons inside, invertebrates outside. Vertebrates have blood, invertebrates have haemolymph. Vertebrates breathe through lungs, invertebrates through spiracles. Vertebrate skeletons grow with them, invertebrate exoskeletons don't.

S: They are made up of segments that slide over each other

S: They shed their old exoskeleton and grow whilst their new one hardens

V: Flexible

V: It is at risk

Answers - How We Get Energy:

1. No
2. Carbohydrates
3. Proteins
4. In the mouth / chewing
5. Simple

S: It slows down how quickly your body absorbs sugar

V: Create energy

S: They break down more slowly, keeping us fuller for longer

V: It is very important

S: Your systems become more efficient so use less energy. This gives you more energy for elsewhere.

Answers - Muscles:

1. Voluntary
2. Involuntary
3. Coordinate
4. They are large and noticeable
5. Contracts

R: Over 600

S: Flexors bend a joint, extensors straighten it out

R: They help you to focus / blink

S: Facial muscles aren't always attached to bones

R: Tendons

Answers - Nutrition:

1. A varied diet means that you will have all of the different things that your body needs to run properly. Without it, you won't have enough energy to survive
2. Too much of the wrong type of fat can clog your arteries and be deadly
3. Fruit juice contains lots of sugar and no fibre, so it is as bad as eating any other kind of sugar
4. They look at what we eat and what need to eat and can help us to stay healthy

R: 10

P: Accept answers that are relevant to the text. Part of the actual answer is that the World Health Organisation and UK government didn't think they could get us to eat more than that. It was also rumoured to link nicely to being able to count on one hand.

V: Exhausted

R: No

R: Half a gram

Answers - Skeletons:

1. Upright
2. Simplest
3. Strike a balance
4. Deadly
5. Standard

R: Cortical

S: It would be too fragile or too flexible, it needs the balance of both

R: Femur

R: Ear

I: Hands and feet