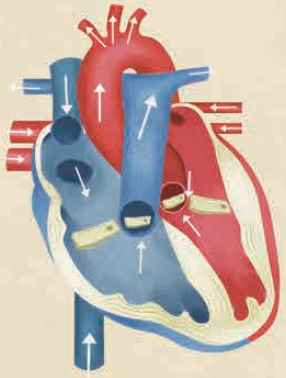
"For my Mum and Dad. Thanks for making me."
~Nicola Edwards

"To my Mum and Dad, thanks for getting me all those body books as a kid!"
~Jem Maybank

"To Ben, there's a skellington in all of us."
~George Ermos



Some images have been stylised and some explanations have been simplified to make them easier to understand.

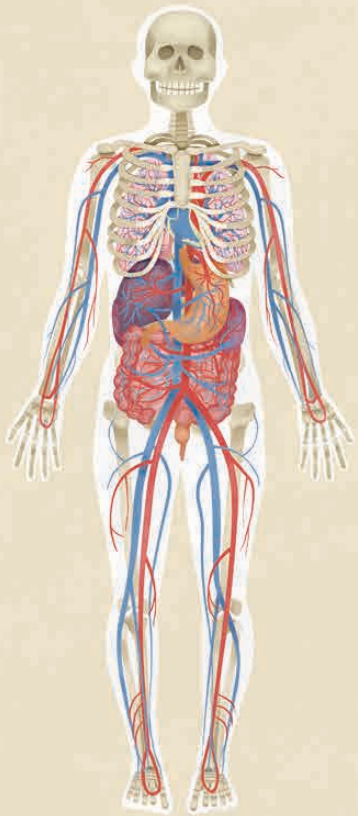
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Humanatomy

How Your Body Works



NICOLA EDWARDS

Illustrated by JEM MAYBANK and GEORGE ERMOS



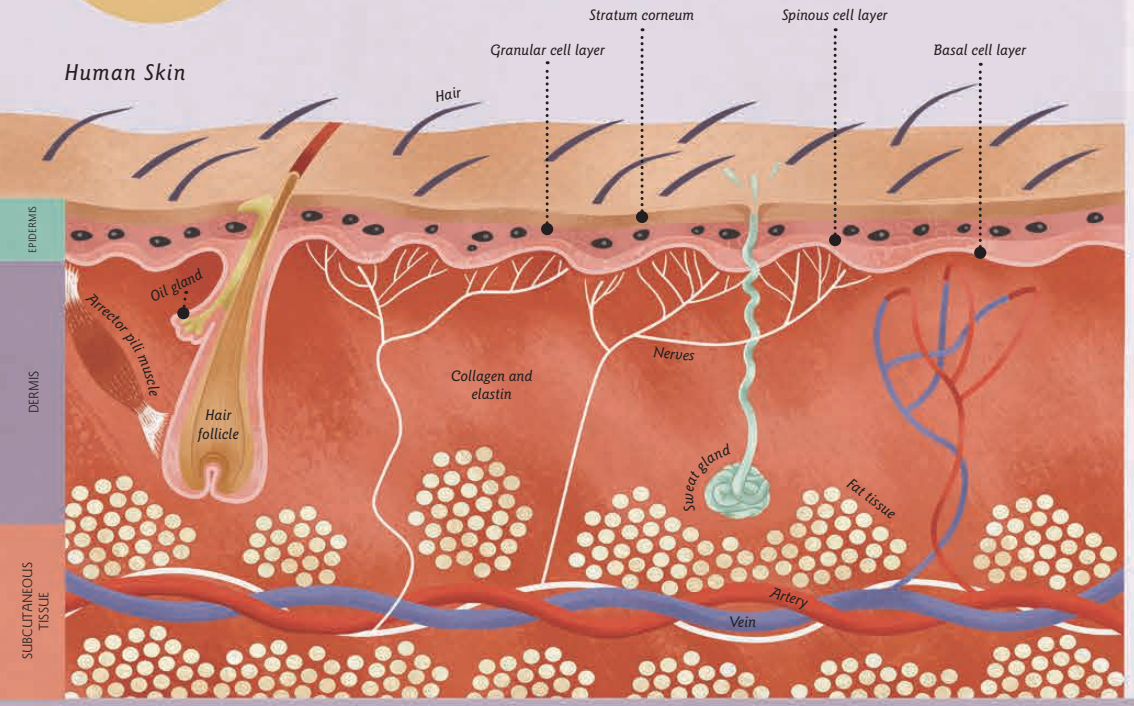
ONE

Integumentary system

Did you know?

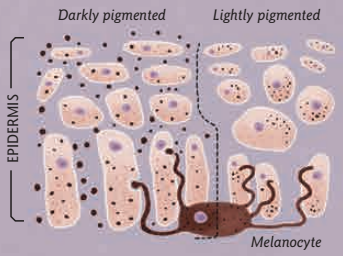
The skin is the largest organ of the body and accounts for around 16% of your body weight.

The body's integumentary system protects your insides from the outside world. It keeps germs out, regulates your body temperature and gives you the ability to touch and feel things.



Why do we have different shades of skin and why do some people have freckles?

Skin cells called melanocytes produce a colour pigment called melanin. Freckles become visible when clusters of melanin in the skin get exposed to sunlight.



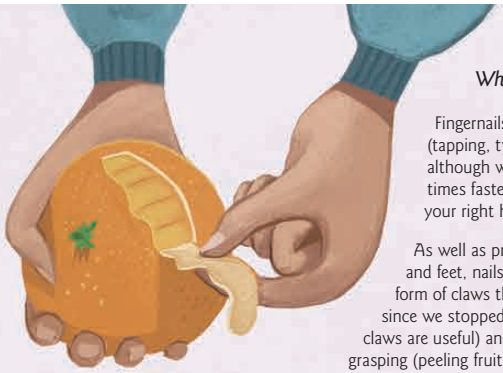
Melanin blocks the Sun's harmful UV (ultraviolet) rays from damaging the skin. Everybody has some melanin in their skin (apart from albino people) and people with more melanin have darker skins, while people with less melanin are paler.



Places with high levels of Sun exposure produce people with more melanin, and this darker skin helps people cope with the Sun and avoid painful sunburn. People from regions where there is less Sun exposure haven't needed as much melanin, which is why their skins have evolved to be paler.



Although it's not just pale people who have freckles, they are more common in people with fair skin. Just like a tan (which is also melanin at work), freckles are the body's way of defending against harmful UV rays. (They're no substitute for sun-cream though, and neither is a tan!)



What are fingernails and toenails for?

Fingernails protect our hands while we're doing all sorts of daily activities (tapping, typing, prising things open, etc.) and toenails do the same thing although we use them less. Because of this, fingernails grow three or four times faster than toenails and the fingernails on your dominant hand (i.e. your right hand if you're right-handed) grow faster than on your other hand.

As well as protecting our hands and feet, nails are basically a flatter form of claws that have developed since we stopped climbing trees (where claws are useful) and began doing more grasping (peeling fruit, using tools, etc.) where claws just get in the way!



Why do your hands go wrinkly in the bath?

When it is dry, your skin is actually coated in special oils, which moisten and protect the skin and make it semi-waterproof (so you can wash your hands without them going wrinkly). But if you soak in water long enough, these oils get washed away, and the water starts to absorb into your skin. Why does this only tend to affect hands and feet? They are more porous (which means they're designed to let in more water). Scientists believe this could be the body's way of helping us grip things more effectively when wet!



Why do we itch and why do we scratch?

Itching can be caused by all sorts of things, including bug bites, dust and medical conditions. When your brain senses the itch, it tells you to scratch to remove the irritation. But sometimes the issue is a chemical reaction happening on the skin – like a mosquito bite, so itching doesn't solve the problem.

So why does scratching feel good? Well, it's partly because we scratch a larger area of skin than the itchy part, so the scratching feeling distracts us, and partly because scratching causes the brain to release seratonin, a mood-controlling chemical, which makes us feel better... before making us itch even more! So before you get scratching, remember that unless you dislodge the hair or bug that was causing the itch, scratching is only going to make things worse.

Why do we sweat and what makes it smell?

Our bodies create sweat (a mix of mainly water and salt created by glands in our skin) to cool us down. Skin feels cooler when it's wet and, when the sweat evaporates, it takes some of the heat with it. So why do we also sweat sometimes when we're nervous? Scientists think it might be because slippery creatures are harder for predators to catch! Sweat itself is actually odour-free, but a smell can be created when sweat reacts with bacteria on our skin.



Did you know?

Rhino horns are made of keratin, just like your fingernails, toenails and hair!

How does skin heal itself? And what are scabs and scars all about?

1.



When you cut or scratch your skin, its tissues get damaged. To repair them, your skin makes strong protein fibres called collagen, which act like a bridge over damaged tissues.

2.



To protect this area while it's working on healing, a temporary crust (a scab) forms over the wound. This will eventually dry out and fall off when the skin is better.

3.



When it does, the new skin underneath might be a slightly different colour – that's a scar. Some scars fade and disappear with time while others are permanent evidence of how the body heals itself.

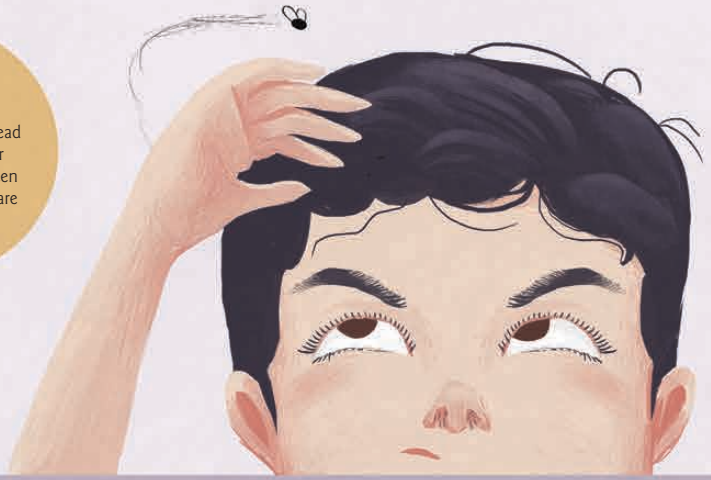
What is hair? Why do we have it and how does it grow?

Hair is made of keratin, which is a protein that also makes fingernails and toenails! It begins under your skin at the root, inside little tubes called follicles, where tiny blood vessels feed the hair and keep it growing. By the time the hair surfaces from the skin, the part you can see (the shaft) is dead, which is why it doesn't hurt to get your hair cut.

The hair on our bodies and heads keeps us warm, and our head hair also protects us from the Sun. Our eyelashes, eyebrows and nose hairs help keep bugs, dust and other unwanted items out of our eyes and nose. Plus a tickly feeling in your hair is a warning that something might need swatting away. So all in all, hair is pretty useful stuff!

Did you know?

The average human head is covered with over 100,000 hairs. Between 50 and 100 of these are shed every day.



Why does a bruise turn different colours?

Bruises change colour as the body processes the injury and goes through the healing process.



You start off with a RED bruise, caused by fresh blood leaking into your tissues. (If you have a deep bruise, you might already have passed the red stage by the time you can see the bruise.)

Then the bruise turns BLUE when the blood loses the oxygen it was carrying (this happens within a few hours of the bruising).

Next, over a few days, the bruise will turn PURPLE or even BLACK. This happens as the damaged blood cells break down and a protein called haemoglobin (which contains iron) is released into the injured area.

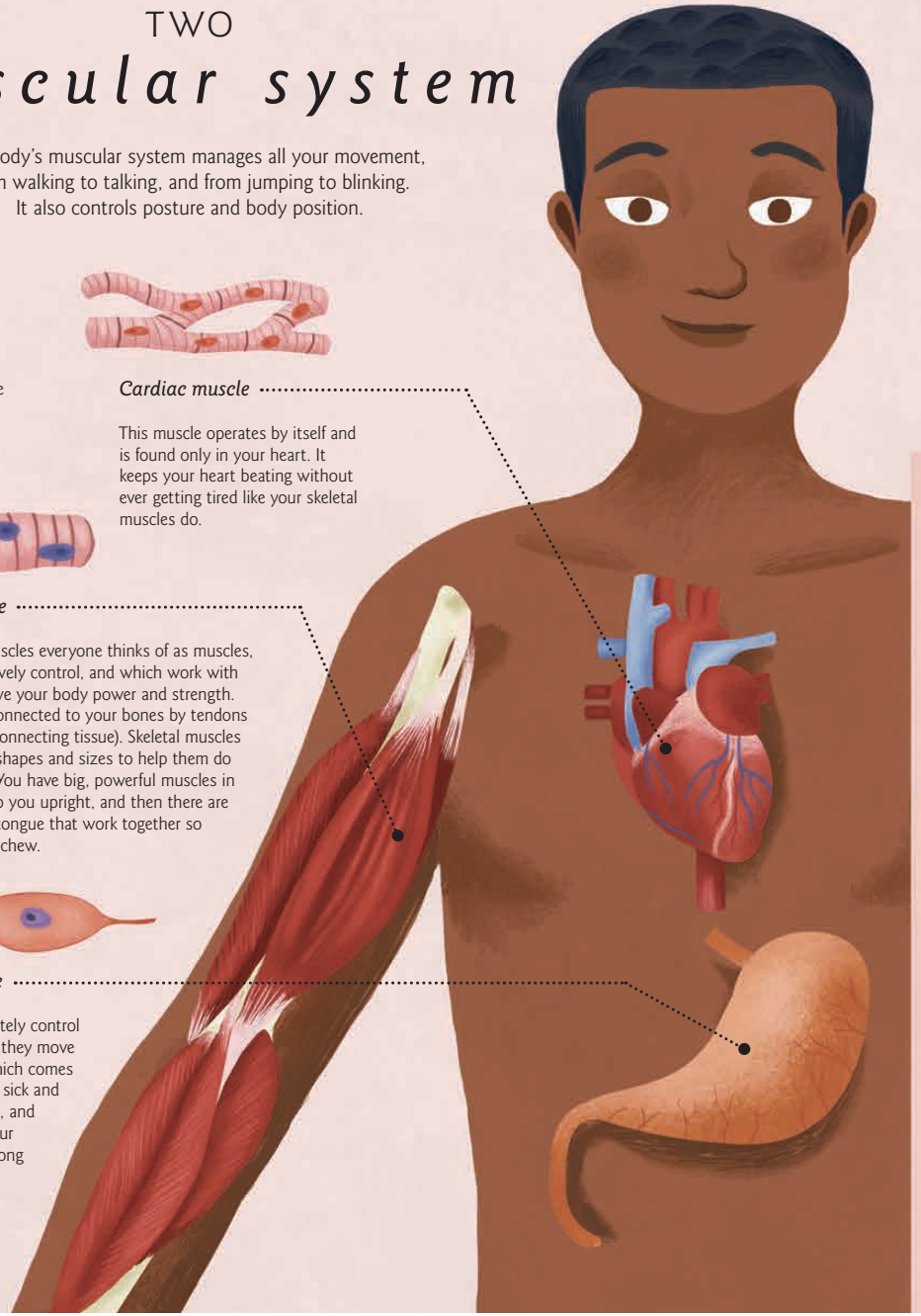
Now the bruise begins to heal and starts to go GREEN, as the haemoglobin breaks down into a chemical called biliverdin.

Finally, the bruise will start to go YELLOW, as the haemoglobin breaks down into a chemical called bilirubin. The yellow will fade as your body heals completely, and then your skin will be back to normal!

TWO

Muscular system

The body's muscular system manages all your movement, from walking to talking, and from jumping to blinking. It also controls posture and body position.



How do muscles work?

The body has three types of muscle:

Cardiac muscle

This muscle operates by itself and is found only in your heart. It keeps your heart beating without ever getting tired like your skeletal muscles do.



Skeletal muscle

These are the muscles everyone thinks of as muscles, the kind you actively control, and which work with your bones to give your body power and strength. They're usually connected to your bones by tendons (cords of tough connecting tissue). Skeletal muscles come in various shapes and sizes to help them do all sorts of jobs. You have big, powerful muscles in your back to keep you upright, and then there are muscles in your tongue that work together so you can talk and chew.

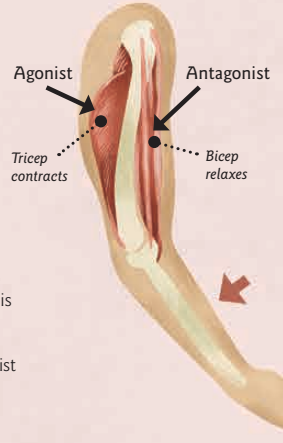


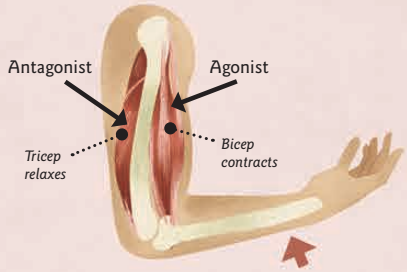
Smooth muscle

You can't deliberately control smooth muscles; they move automatically (which comes in handy if you're sick and need to throw up, and they also keep your eyes focused, among other things).

How do we move?

Once we decide we want to move, our brain sends signals through our nervous system to our skeletal muscles. Our muscles then work in opposite pairs, pulling (or contracting) and relaxing to create movement. One muscle is called the agonist or the 'prime mover' and this one contracts. The other is called the antagonist and this one relaxes.





Let's look at the way your tricep and bicep work together to make your arm move. To pull your lower arm up, your bicep contracts or shortens and your tricep relaxes or lengthens. If you want to drop your lower arm down again, your tricep contracts and your bicep relaxes.

What is the strongest muscle in the body?

There are a few contenders:

The muscle with the most force is the calf muscle, which allows us to stand, walk, run and dance. If the calf muscle wasn't always pulling, we would constantly be falling over!





The muscle that can put the most pressure on things is the jaw muscle, which helps us bite our way through all sorts of things.

The tongue might not be the most powerful muscle, but it does get points for being versatile. It is elastic and forceful and allows us to do a variety of things like speak and eat.





The most hard-working muscle is definitely your heart, which pumps blood at a steady rate throughout your life and beats over 40 million times a year!



Why do you shiver when you're cold?

When you're cold, little sensors in your skin send signals to your brain, which sends messages to your nerves telling your muscles to twitch. This twitch works like exercise to raise your body temperature and warm you up.

Did you know?

The biggest muscle in the human body is the gluteus maximus – that's the bottom!

THREE

Skeletal system

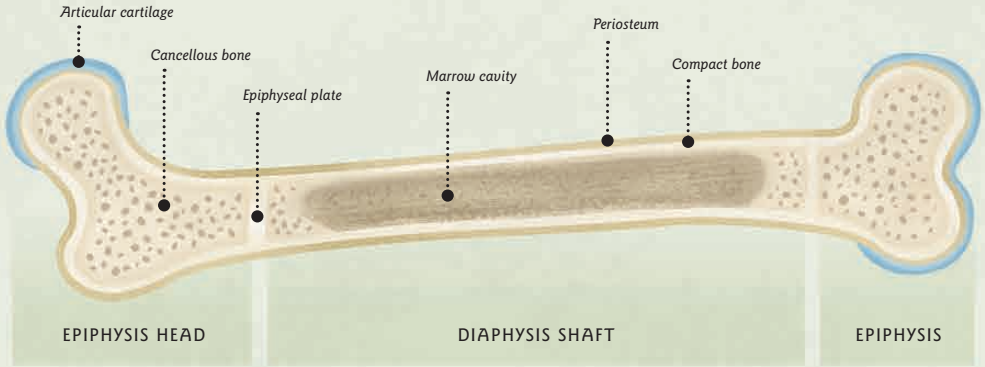
The body's skeletal system is a framework of bones that gives you your shape, helps you to move and protects your internal organs.

How many bones are there in our bodies?

When babies are born, they have about 300 bones, but some of these fuse together to form the 206 bones that adults have.

How do our bones grow?

Some of a baby's bones are made from a flexible tissue called cartilage. This tissue grows throughout childhood and is slowly replaced by bone, with the help of a mineral called calcium (which we eat and drink in things like dairy products, kale and broccoli). Around the age of 25, this growth stops and your skeleton is fully formed.



Did you know?

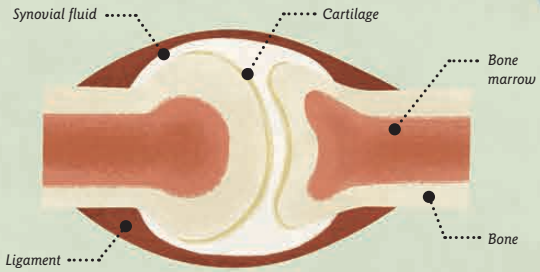
More than half your bones are in your hands and feet.

Joints

The place where two bones meet is called a joint. Most of our joints are synovial joints, like those in our shoulders, hips, knees, ankles, toes, elbows and fingers. These help us move around.

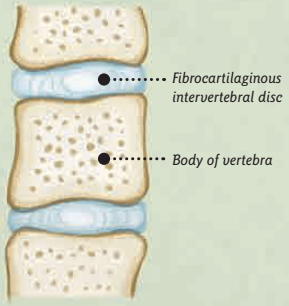
Did you know?

The only bone you can deliberately move is your lower jawbone.



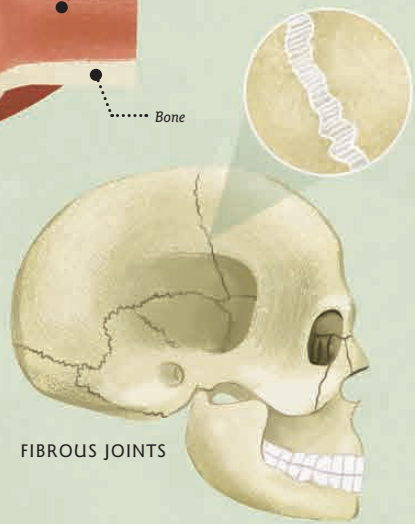
SYNOVIAL JOINTS

Cartilaginous joints like these in your spine don't move as much as your synovial joints:



CARTILAGINOUS JOINTS

Your stiffest joints are your fibrous joints, like these in your skull, which move just enough to let you grow over time.



FIBROUS JOINTS

How does a broken bone heal?

1. After a bone breaks, a blood clot, followed by tissue called a callus, form around it.



2. Then new strings of bone cells start to grow on both sides of the break line towards each other...



3. ...until the break closes up and the callus is absorbed by the new cells.



4. Bones are so good at healing themselves that sometimes you can't even tell on an X-ray a few months after a break that it ever happened. Pretty amazing!



Are teeth made of bone?

Teeth and bones have a lot of similarities. They're both hard, white and contain lots of calcium, and they're also both part of your skeletal system. But there are some important differences. Unlike bones (which are mostly made of a protein called collagen) teeth are made of pulp tissue which contains nerves and another tissue called dentine. The dentine is covered with enamel, which is the hard, shiny layer you can see on your teeth. Unlike bones, teeth cannot repair themselves when they get damaged, so it's important to take good care of them.

