

Bone

Introduction to the Skeletal System

The adult human body is made up of several bones; 206 bones to be exact! All these bones make up the skeletal system which has three main functions.

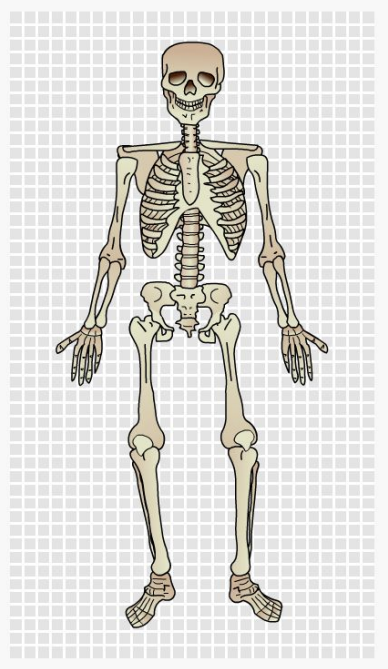


Babies are born with 300 bones, of which some attach/fuse together so that an adult human has 206 bones.

1. Gives the body the right shape.
2. Allows the body to move the way we do.
3. Protects important organs from injury.

Without the skeletal system the human body would be a pile of mush on the ground.

Keep reading to learn more about your bones, how they become injured, and how to treat these injuries.

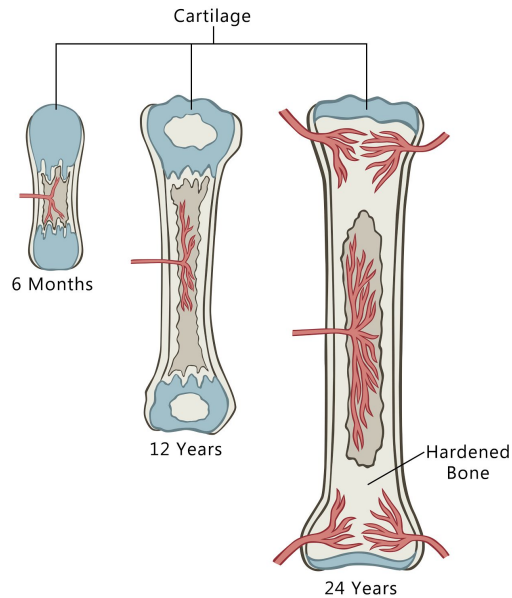


Anatomy of the Bone

Like the other organs in our body, many bone cells group together to form the bone tissue. Thus, all bone tissue is living tissue that needs food and oxygen. The nutrients allow the bone tissue to break down old tissue and regrow new tissue.

Wiggle the tip of your nose with your finger. Your nose bends because it is made of a soft material called **cartilage**.

Before you were born, your whole skeleton was made up of this cartilage. Cartilage is a flexible type of connective tissue related to bone. As you grew the cartilage acted as a frame onto which specialized cells attached. Some of these cells broke down the cartilage while the others replaced it with new bone cells. **Blood vessels** grew with the new bone feeding them with oxygen and important nutrients such as calcium.



Remember, as you continue to grow some parts of your skeletal system will remain as cartilage. Touch your ears, can you bend them? Like your nose the ears are also made of cartilage. Touch your knee cap, can you wiggle it? Your knees need to be strong to support your body weight and keep the body's shape as you move around. Imagine if your ears were made of bone like in your kneecaps. Sleeping in a comfortable position would be much harder!

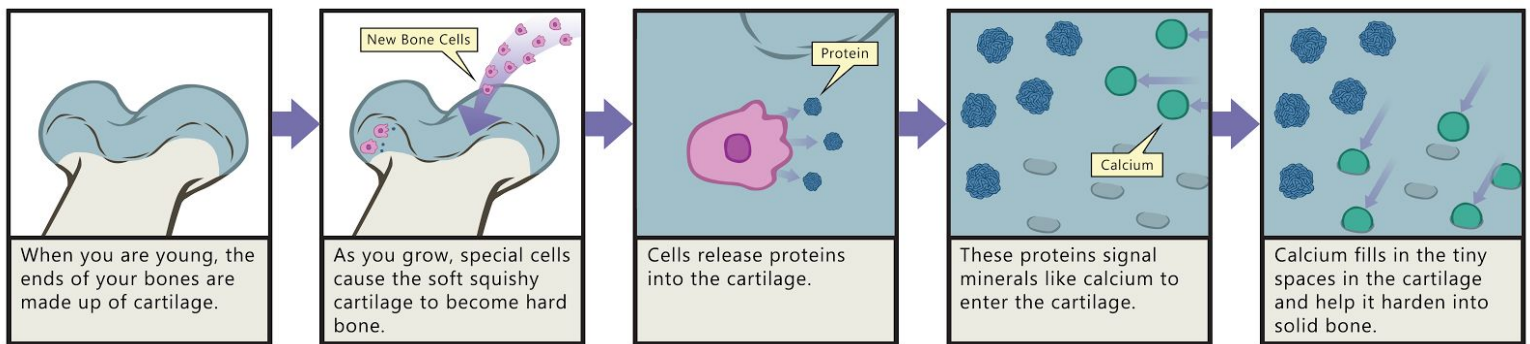
How does soft tissue like cartilage become hard bone tissue?

The process of **bone renovation** replaces the soft cartilage with harder bone tissue. New cells approach the cartilage frame and group together around it. The new cells release molecules called **proteins** into their surrounding which attracts calcium and other minerals. These nutrients help the soft cartilage transform into solid bone.

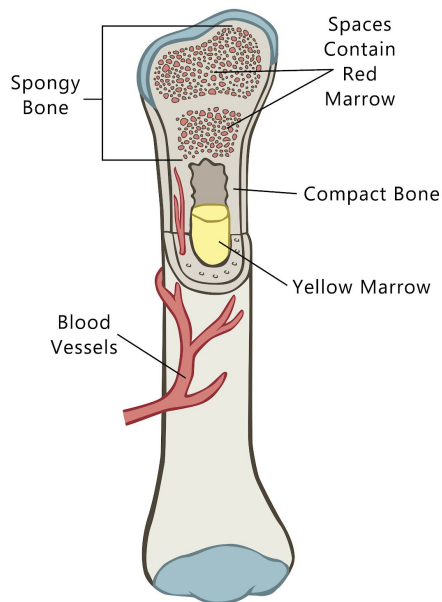
The environment surrounding body cells is called the **extracellular matrix**. The extracellular matrix is made up of molecules and minerals produced by the body cells. The structure of the extracellular matrix changes according to the type of body cells it surrounds. For example, the new bone cells produce proteins that attract more calcium and other minerals to harden the

extracellular matrix in bone tissue. But the extracellular matrix in cartilage to be more flexible than in bone as it has a different extracellular matrix.

The process of bone renovation does not only take place in young bones. Even after you finish growing taller, your body keeps renovating your bone so that it remains strong and healthy. This process takes place everyday! One type of cell digests old bone material, while another builds newer, healthier bone.



Bones are full of blood, cells, and activity!



The outside of your bones is strong and hard. The inside of the bone is covered with millions of capillaries. Capillaries are thick blood vessels that supply cells with oxygen and important nutrients. In the center of the bone is the red bone marrow. The bone marrow is a factory producing young cells known as stem cells.

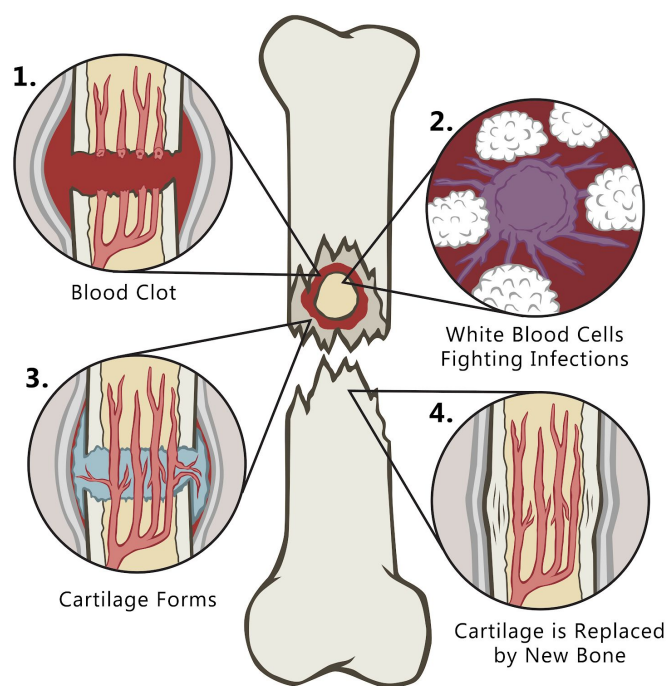
Stem cells have the ability to become different types of cells needed by the body. For example, they can become heart cells, brain cells, blood cells, bone cells etc. In children all bones have marrow in them. But in adults only

some bones such as the pelvis, skull, ribs, sternum, collarbones, and the ends of long bones have marrow.

Remember! Bones are always changing- old cells are removed and new cells become bone in the process of bone renovation.

Bone Injury

Bones are strong and can support your body weight. Yet too much pressure in one area can cause a bone to break. A hard fall off your bike or a bad collision on the soccer field can cause your bones to break. Although a bone fracture is very painful, the body is prepared to fix the break!



How can my body fix a break?

When a bone is broken, so are the blood vessels inside. These bleed, making a clot around the break. Special cells in the clot clean the break to prevent infection. Then new bone is made

through the process of bone renovation to heal the injury. First young cells from the bone marrow form cartilage; just like in your ear and nose. Another kind of cell then moves into the break to eat up the cartilage, while still another kind of cell forms new bone.

Healing a broken bone is very similar to growing bone in the first place! The body is prepared to continuously renew the bone with the process of bone renovation so it produces an entire crew of cells to repair old bone tissue that can also fix broken bone tissue.

This makes bone tissue unique because the new bone is just as strong as the bone was before it broke! Other tissues in the body, such as skin and heart muscle, can not heal as well and form scars in the places where they heal.

Remember! Although bones are sturdy enough to support most activities, they can break.

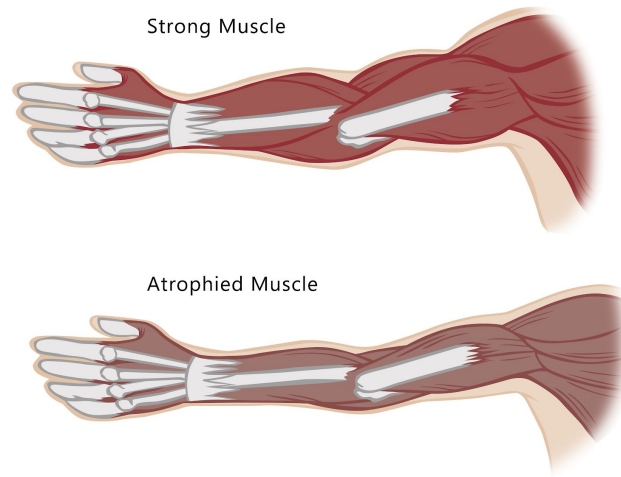
Modern Treatments

Even though the body can heal broken bones itself, doctors can help prepare the body for the work it has to do.

Doctors can identify bone fractures by taking an x-ray of the injured area. If the two pieces of the fracture fits together correctly, then the doctor will put a cast around it.

What does the cast protect?

A cast is a hard casing that protects the fracture and prevents movement of the broken bones. The re-growing bone is not able to take the pressure of strenuous activity. The cast protects the flexible new cartilage as it becomes strong bone.



Even though the pain of the fracture stops, it takes about six weeks for a bone fracture to heal. During this time the body puts the bone back together through the process of bone renovation. To review the process of bone renovation, see *Biology of the Bone and Bone Injury*. While the newly formed clump of cartilage becomes bone, it is fragile.

Due to the lack of use, muscles around the fracture become weak during the six weeks of healing. So after the cast comes off, you will have to do light exercises to strengthen your muscles before doing your usual activities.



The X-ray above shows a pin, that was surgically implanted to hold the two bones together while they heal.

How is a more severe break fixed?

Sometimes a cast may not be enough! Accidents may cause severe fractures which occur when the bone breaks into several pieces or the broken pieces move away from each other.

When this happens doctors will take x-rays of the fracture to see whether the ends or pieces of the bone line up. If they don't, they must realign the bones. To realign the bones doctors perform surgical procedures where

they can insert a metal pin or screw to pull the bones back into place and keep them in place.

Alternatively, pins can be placed through the skin and bone. In order to hold these external pins in place, they are attached to a metal structure outside the body, such as a rod.

Any of these treatments for a broken bone only prepare the body for what it can do on its own: bone renovation!

Remember! Casts can help guide bone growth as the body repairs a broken bone.

Regenerative Medicine in the Bone

Regenerative medicine can help you heal faster! With the help of regenerative medicine, your body will be able to fix a broken bone in three weeks instead of six!

To help speed up the natural process of bone renovation and re-growth, doctors are studying ways of supplying extra cells to the body. Doctors can harvest young cells from the bone marrow of the patient. These young cells - stem cells - divide quickly and have the potential to become brain, blood, bone, or heart cells. In the lab, growth factors are added to the young cells to help them grow into bone tissue and multiply. Finally, these young cells are injected back into the patient's broken bone. The young cells grow new bone much more quickly than if the bone healed on its own.

Regenerative medicine can also help heal fractures that have produced a wide gap between two fragments of bone. If the gap is too wide for capillaries to span, the new tissue can't survive since it can't be reached by oxygen and nutrients. Doctors place a support structure that mimics the feel of cartilage - a scaffold - in the gap, which provides support for new blood vessels to grow into. Then, stem cells are placed near the structure. The scaffold is eventually replaced with strong new bone.

How can regenerative medicine help me?

Regenerative medicine helps healing happen faster by using young cells, also called stem cells, from the bone marrow.

Remember! Regenerative medicine helps healing happen faster by adding young cells, also called stem cells, from the bone marrow.