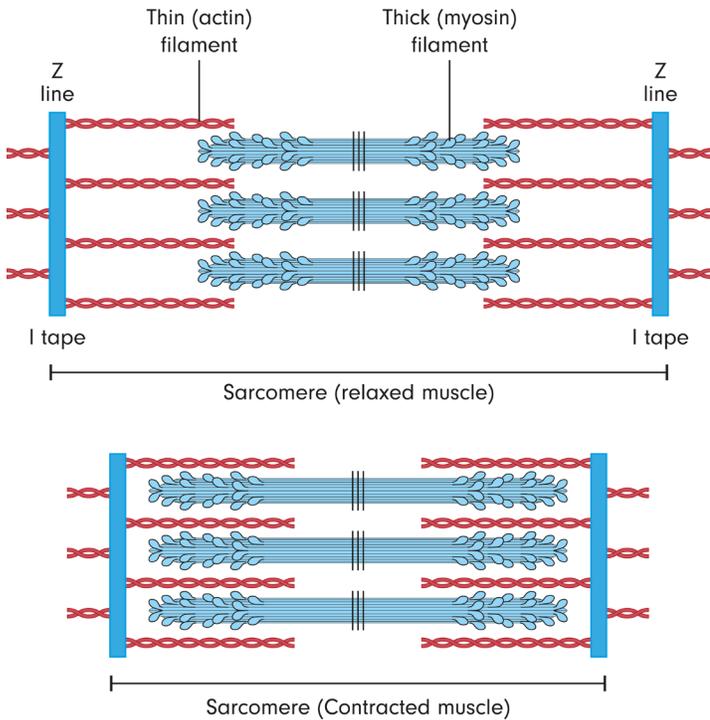


IMPORTANT PROTEINS IN YOUR BODY

MUSCLE

Muscle is a soft tissue in the body of humans and other animals. The main purpose of muscle is to produce force and motion.

Muscles are all made up of the same material. This material is a type of elastic tissue. Thousands, or even tens of thousands, of small fibers make up each muscle.



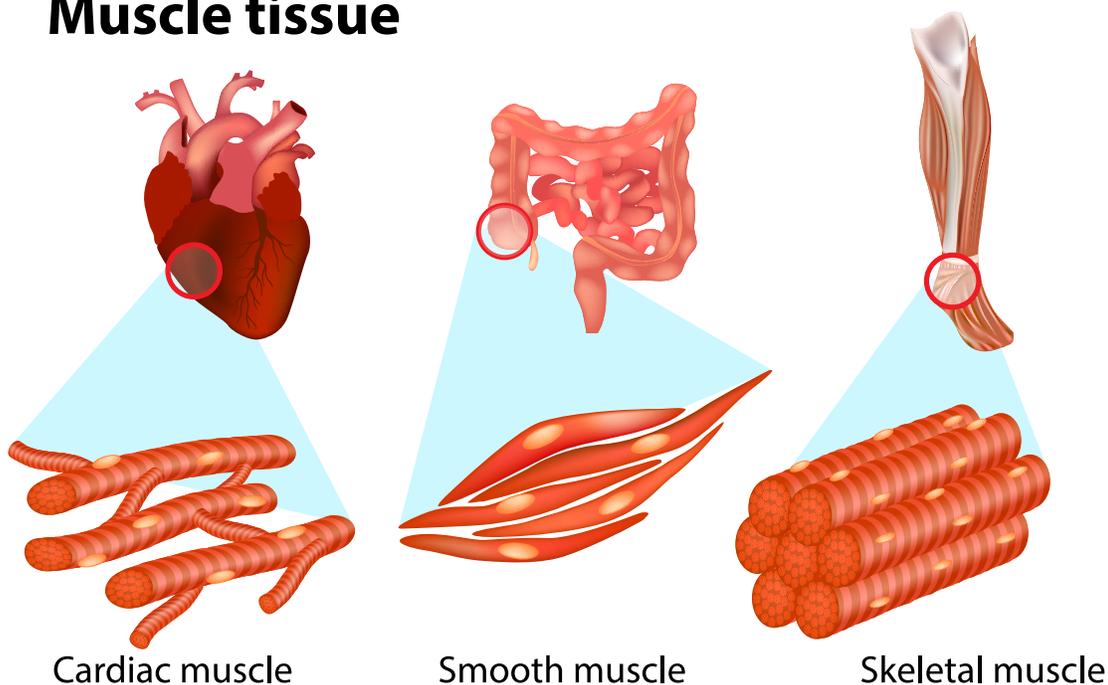
Muscles are made of two proteins called ACTIN and MYOSIN. The interaction of these two proteins are responsible for the contractions and relaxing of muscles as shown in the diagram on the left.

To **CONTRACT** means to become shorter. The muscle fibers slide together and stack up to make a fatter shape, a bit like when you shuffle a pack of cards together.

To **RELAX** means the fibers slide apart and the muscle gets longer and thinner.

Muscles contract and relax over and over to make the muscle function.

Muscle tissue



Cardiac muscle

Smooth muscle

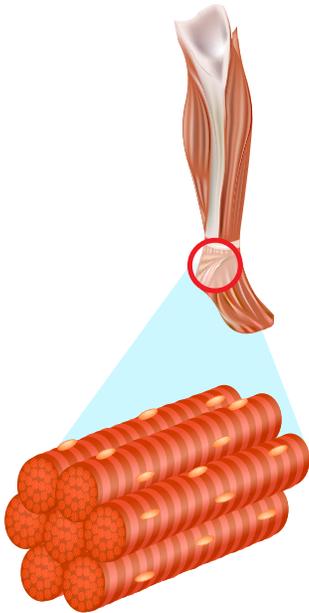
Skeletal muscle

There are three different types of muscles in your body. They are **SMOOTH** muscle, **CARDIAC** [pronounced KAR-dee-ak] muscle, and **SKELETAL** [pronounced SKEL-uh-tul] muscle.

IMPORTANT PROTEINS IN YOUR BODY

SKELETAL MUSCLE

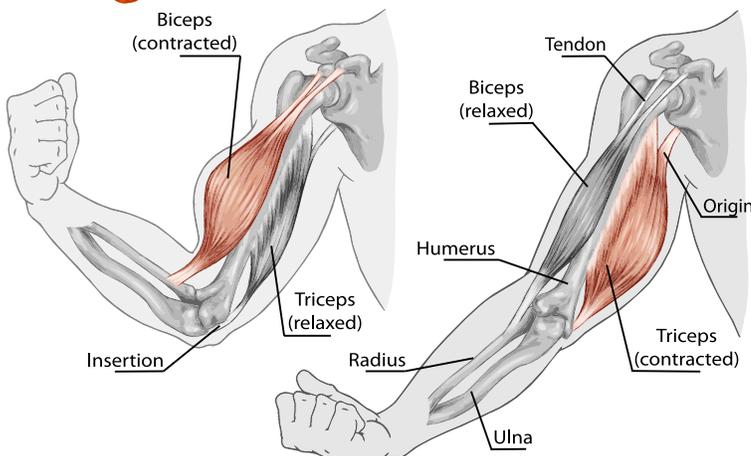
Skeletal muscle



The main muscle we think about is the SKELETAL muscle. This probably because it is the most visible type of muscle and they are muscles you control. It is hard for you to kick a soccer ball if you do not want to. You have control of most of these skeletal muscles, so they are called VOLUNTARY MUSCLES.

Skeletal muscles work with your bones to make your body move. In most cases, a skeletal muscle is attached to one end of a bone. The muscle then stretches all the way across a joint (the place where two bones meet) and then attaches to another bone.

Skeletal muscles are held to the bones with the help of TENDONS [pronounced TEN-dunz]. Tendons are cords of tough tissue and they function to connect pieces of muscle to bone.



Muscles provide the pull on the bone needed to make it move. Muscles cannot push on bones though to move bones back to their original position. That is why we have pairs of muscles to make a bone move back and forth.

In the image on the left, to bend the arm, the biceps of the arm contract while the triceps relax. If the biceps relax and the triceps contract, the arm straightens back out again.

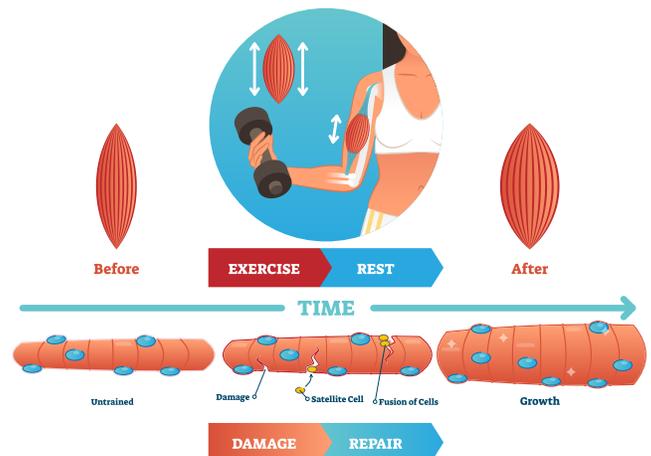
You have about 650 skeletal muscles. You are born with all the muscle fibers you will ever have. These fibers grow thicker, but you do not grow new fibers.

So when you exercise, the muscle fibers become thicker, but you do not add new muscle. Any physical activity you like to do, from dancing to playing soccer, can make you stronger because you are using your muscles when you do.

If the muscle fibers become damaged, they will also need to be repaired, but they are not replaced.

Did you know that it takes more muscles to frown than smile? It takes 43 muscles to frown, but only 17 muscles to smile. A good reason to turn that frown upside down!

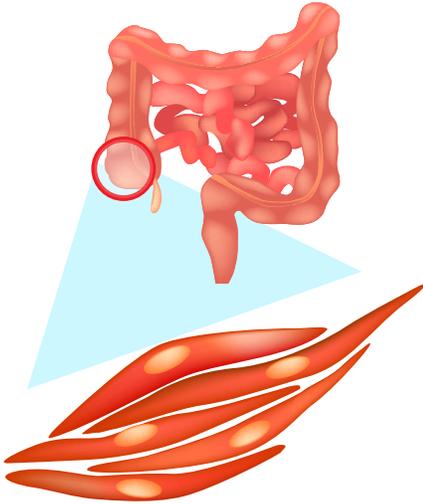
HOW MUSCLES GROW



IMPORTANT PROTEINS IN YOUR BODY

SMOOTH MUSCLE

Smooth muscle

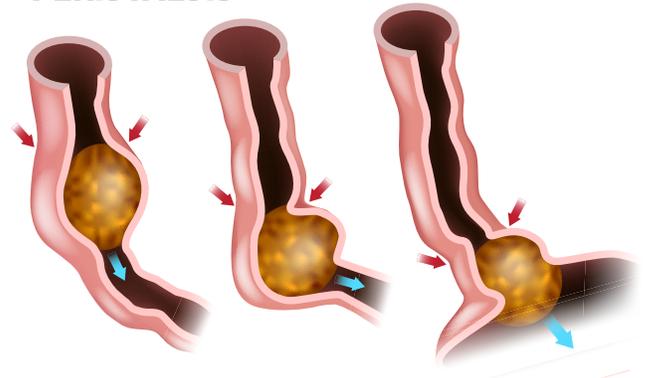


SMOOTH muscles are usually in sheets, or layers. Each layer of muscle is located behind another.

You cannot control smooth muscles. They are called **INVOLUNTARY MUSCLES** because they function without you having to think about it. Your brain and body tell smooth muscles what to do without you even thinking about it.

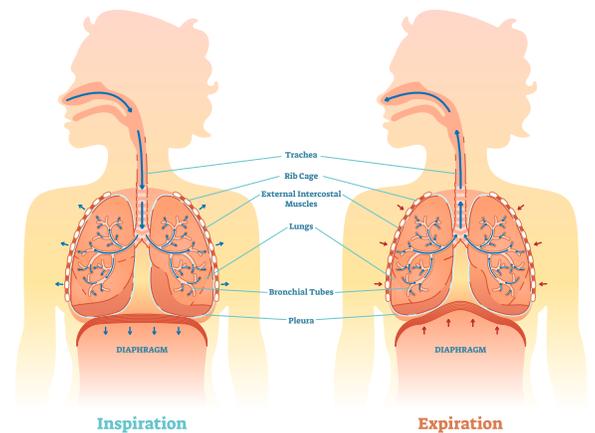
You do not need smooth muscles to walk or lift weights, but they are at work all over your body. Smooth muscles are found in your stomach and the rest of the digestive system. There they can contract (tighten up) and relax to allow food to pass through your body. This is called **PERISTALSIS**.

PERISTALSIS



Smooth muscles are also found in your bladder. When they relax they allow you to hold in urine (pee) until you get to the bathroom. Then they contract so that you can push the urine out.

Inspiration and Expiration

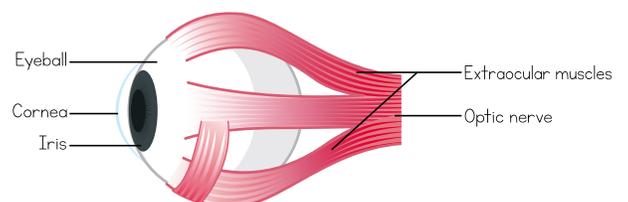


Smooth muscles are also found in the walls of **ARTERIES** and **VEINS** that carry blood throughout your body. They are also in the **RESPIRATORY** (breathing) and **REPRODUCTIVE** systems. The diaphragm is important for breathing in and out. The uterus of mothers has muscles to help deliver the baby.

You'll find smooth muscles at work behind the scenes in your **EYES** too. These muscles keep your eyes focused. The eye muscles can change the size of the iris and alter the shape of the lens so you can see clearly.

In **SKIN**, smooth muscle cells cause your hair to stand erect in response to cold temperature or fear.

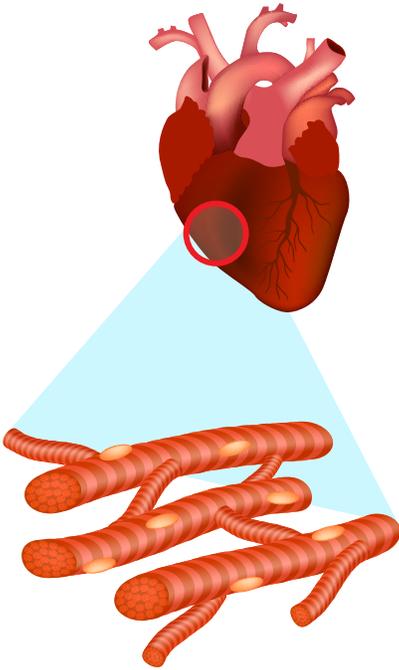
Muscles of the eye



IMPORTANT PROTEINS IN YOUR BODY

CARDIAC MUSCLE

Cardiac muscle



The muscles of the HEART are called CARDIAC MUSCLES. The thick muscles of the heart contract to pump out blood and then relax to let blood back in after it has circulated through the body.

Just like smooth muscles, cardiac muscles work all by themselves without you having to think about them. So they are referred to as INVOLUNTARY MUSCLES.

Your PULSE is a measure of how fast your heart is beating. It is the number of beats your heart makes in one minute. Your heart beats faster or slower depending on what you are doing. You can feel your pulse at certain points on your body. The easiest place to feel it is in your wrist, using the first two fingers of your other hand.

When you exercise, your heart beats more quickly. This is because your muscles are working harder and need more oxygen to keep going. Your lungs also work harder, making you breathe more quickly to get more oxygen. When you sleep, your muscles need less oxygen, so your heart slows down.

INTERESTING FACTS ABOUT MUSCLES

The largest muscle in your body is located in your bottom - the gluteus maximus.

Which is the strongest muscle? If muscle strength is regarded as the ability to use force on something, then the jaw muscle is the strongest muscle in your body.

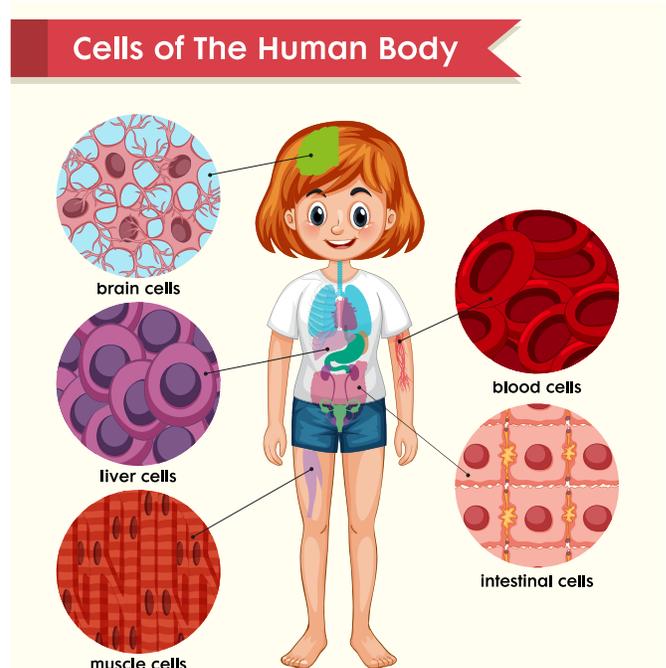
The strongest muscles in relation to the job they do would be the external muscles of the eye. These muscles are large and 100 times stronger than they need to be in relation to the small size and weight of the eyeball.

The muscle that works the hardest would be the heart muscles. During your lifetime, they will have done the most work of any other muscle.

The smallest muscle in your body is found in the inner ear and is important for you to be able to hear.

Some think of the tongue as a large muscle, but the tongue actually has 8 muscles.

Ever have a muscle cramp? That happens when a muscle has contracted but will not relax. This is often caused by dehydration. It is important to remember that muscles are about 75% water.



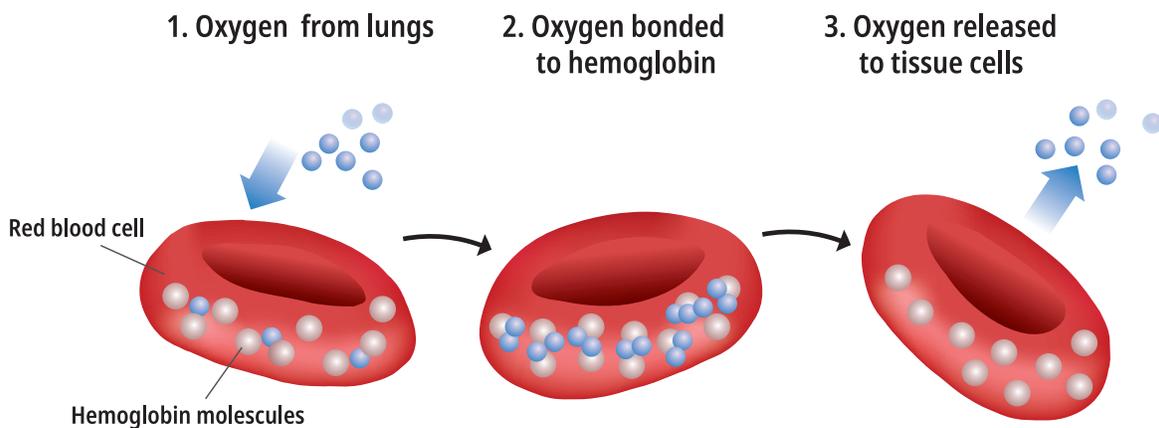
IMPORTANT PROTEINS IN YOUR BODY

HEMOGLOBIN

Hemoglobin [pronounced HEE-muh-glow-bin] is an important protein found in your red blood cells.

Red blood cells pick up oxygen while in the lungs. The oxygen is bonded to the hemoglobin found in the red blood cell. The blood then travels to where the oxygen is needed and it is released from the hemoglobin.

Ever look at a map? It shows the roads going here and there. Your body has a type of highway system. It is called the circulatory system. The roads are called ARTERIES and VEINS. Arteries usually look red while veins usually look blue. The arteries carry blood away from the heart while veins return blood to the heart.



Sickle Cell Anemia

Ever hear of Sickle Cell Anemia?

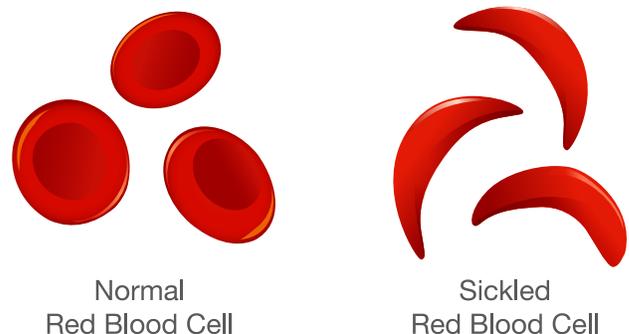
Sickle cell disease affects red blood cells. Normal red blood cells contain hemoglobin A. People with sickle cell disease have red blood cells containing an abnormal type of hemoglobin. These red blood cells become sickle shaped, (that is, shaped like a crescent). These red blood cells have difficulty passing through small blood vessels. People with sickle cells disease have both normal and abnormal hemoglobin.

Sickle cell disease affects about 70,000 people in the United States. It affects one in every 375 African Americans. People from Latin America, the Mediterranean, and other parts of the world can also have this disease.

People with sickle cell can experience pain when sickle shaped cells clog small blood vessels. This

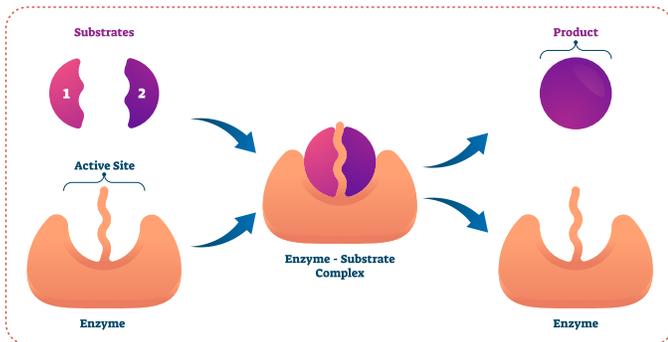
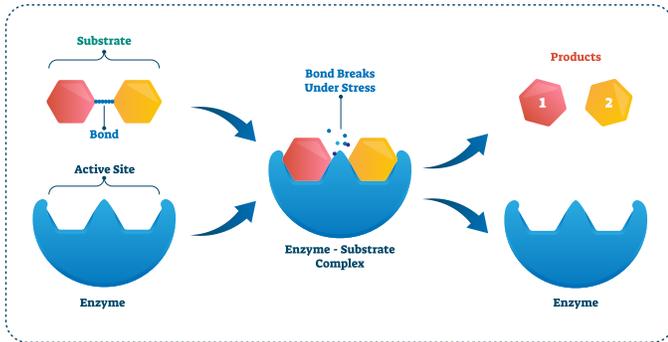
deprives the body of adequate blood and oxygen. Pain most often occurs in the arms, legs, chest, and abdomen. Only about 20% of people with sickle cell will experience pain.

A common complication of sickle cell disease is abnormal function of the spleen. This can result in an increased risk of infection in the blood, bones, lungs, and urinary tract.



IMPORTANT PROTEINS IN YOUR BODY

ENZYMES



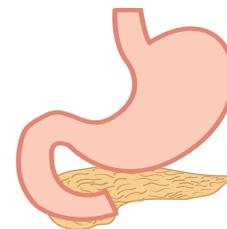
There are special proteins in your cells that make things happen very fast. These special proteins are called ENZYMES. Enzymes are important for speeding up chemical reactions. There are millions of chemical reactions that happen in your body every day. These reactions need to happen very fast if you are going to survive.

Enzymes have an area known as the ACTIVE SITE. The SUBSTRATE is the molecule that the enzyme acts on. The substrate attaches to the active site and can get broken into component parts. Other enzymes bring together different substrates and make them one molecule. So enzymes can build up molecules or break them down.

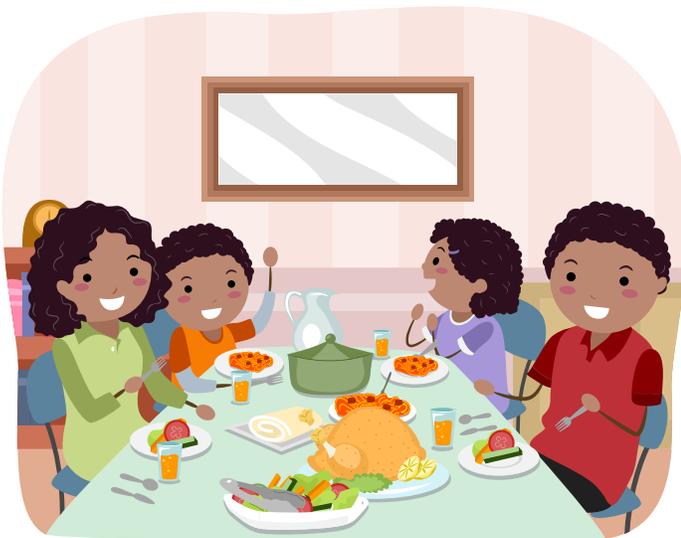
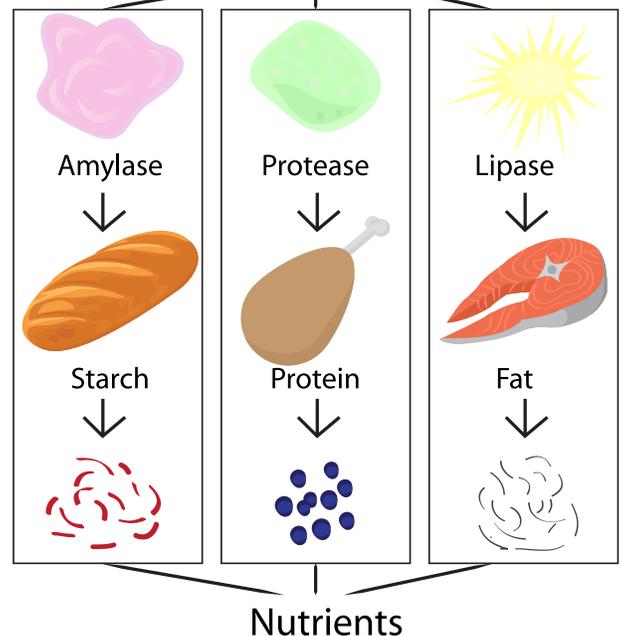
The enzymes are not damaged during the reaction. They can be used over and over.

You have many different types of enzymes in your body. Some enzymes help you digest the food you eat, releasing the nutrients in the food. For example, amylase breaks down starch. Protease breaks down protein and lipase breaks down fat.

Other enzymes help with the chemical reactions within your body cells. This is called cell metabolism.



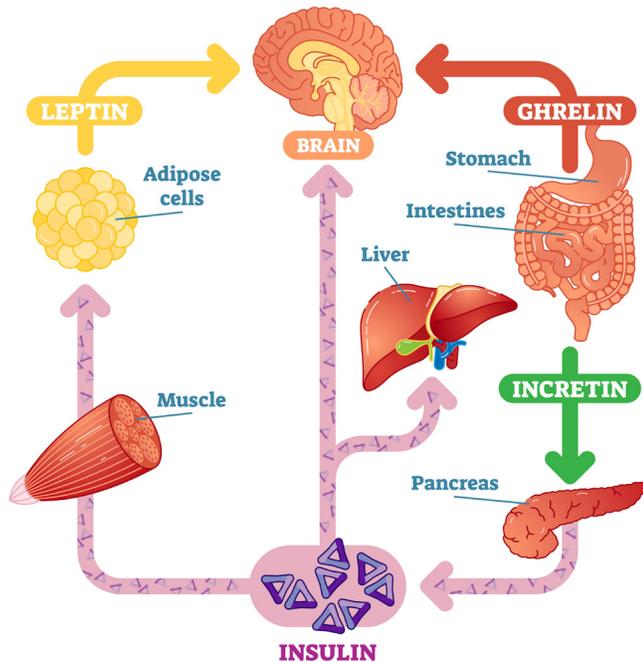
Working enzymes



IMPORTANT PROTEINS IN YOUR BODY

HORMONES

APPETITE AND HUNGER HORMONES

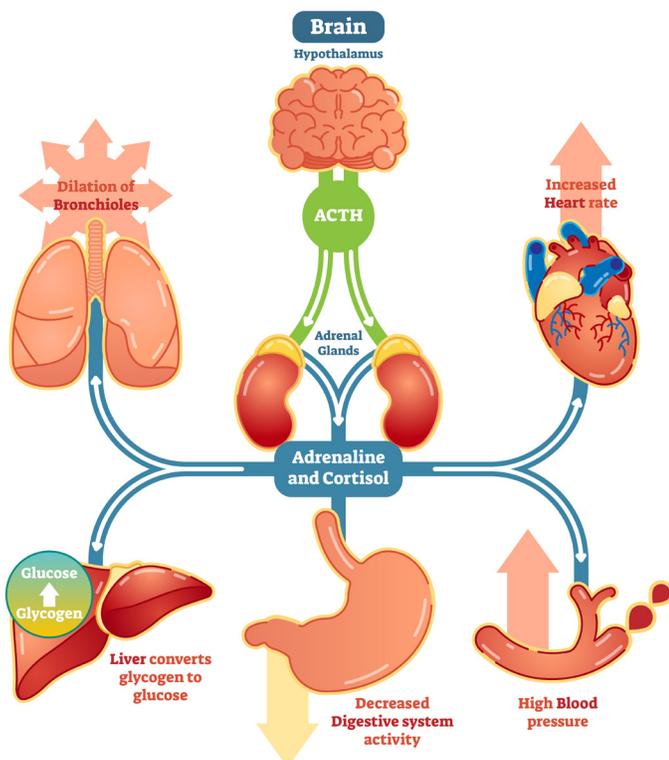


HORMONES are special proteins your body makes to help it do certain things. Special organs, called ENDOCRINE [pronounced en-duh-kruhn] ORGANS, release hormones in response to special triggers like light levels and blood sugar levels. The hormones act as messengers that act on other organs in the body.

For example, the diagram on the left shows how you know when it is time to eat.

GHRELIN (short for growth hormone releasing peptide) is produced mostly by the stomach when it is empty. Ghrelin tells the brain that your body is low on energy and it is time to eat. Once you eat, INCRETIN is produced. Incretin is a hormone that stimulates INSULIN secretion by the pancreas. Insulin is an important hormone for the regulation of blood sugar levels. That sugar, called glucose, is the body's main source of fuel. LEPTIN is a hormone produced by fat cells. This hormone tells the brain that you have eaten enough and it is time to stop. A leptin deficiency leads to obesity as people do not know when they are full and should stop eating. This shows that obesity has a genetic basis and is not always due to life style.

STRESS RESPONSE SYSTEM



Have you ever heard of the flight or fight response? This is when you get stressed and your body either fights and helps you get away. When you are in danger, the HYPOTHALAMUS in your brain secretes ACTH which is a hormone that tells the ADRENAL glands to secrete ADRENALINE and CORTISOL. These hormones make your liver convert glycogen to glucose; your lungs become more efficient so you can get more oxygen; your heart rate goes up so that the glucose and oxygen are circulated to all the body parts that need them; the activity of your digestive system decreases; and your blood pressure increases. All these responses make it possible for you to either fight or run away.

IMPORTANT PROTEINS IN YOUR BODY

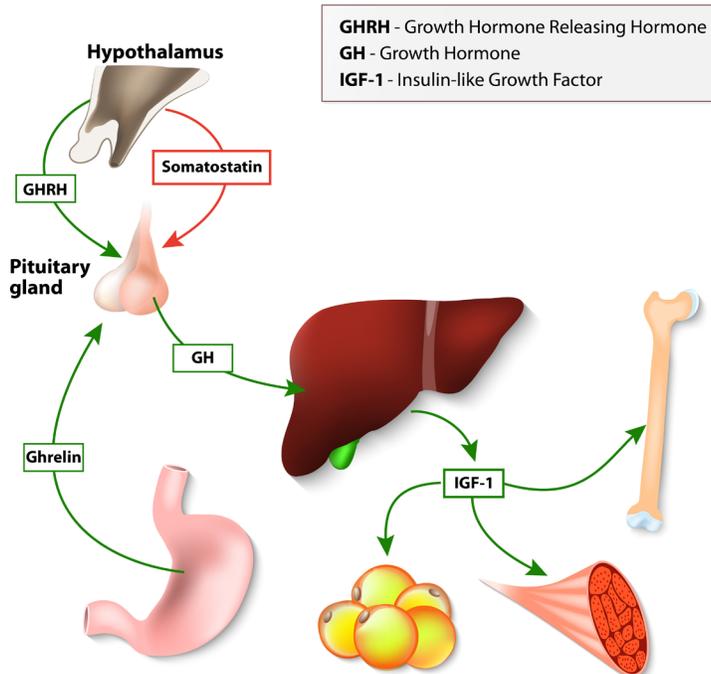
HORMONES

Hormones also tell you when to go to sleep and when to wake up. MELATONIN is released from the PINEAL GLAND in the brain when less light is coming into the eye (that is, when it is getting dark out). Melatonin acts to make you sleepy, telling you it is time to go to bed.

CORTISOL levels build up in your body while you sleep. When it reaches the right level, cortisol tells you it is time to get up. Have you ever notice that you wake up every morning at the same time? Or just before your alarm goes off? This is because of your hormones!



GROWTH HORMONE



Your body even needs hormones to tell it to grow. The HYPOTHALAMUS in the brain secretes GROWTH HORMONE RELEASING HORMONE (GHRH) to tell your PITUITARY GLAND to secrete GROWTH HORMONE (GH). The growth hormone acts on the liver to release INSULIN-LIKE GROWTH FACTOR (IGF-1) which works on the various tissues involved in you getting bigger.

PUBERTY [pronounced PYOO-ber-tee] is the time when your body begins to develop and change as you move from kid to adult. It is hormones that result in girls developing breasts and boys starting to look more like men. At this time your body will grow faster than any other time in your life, except for when you were a baby.

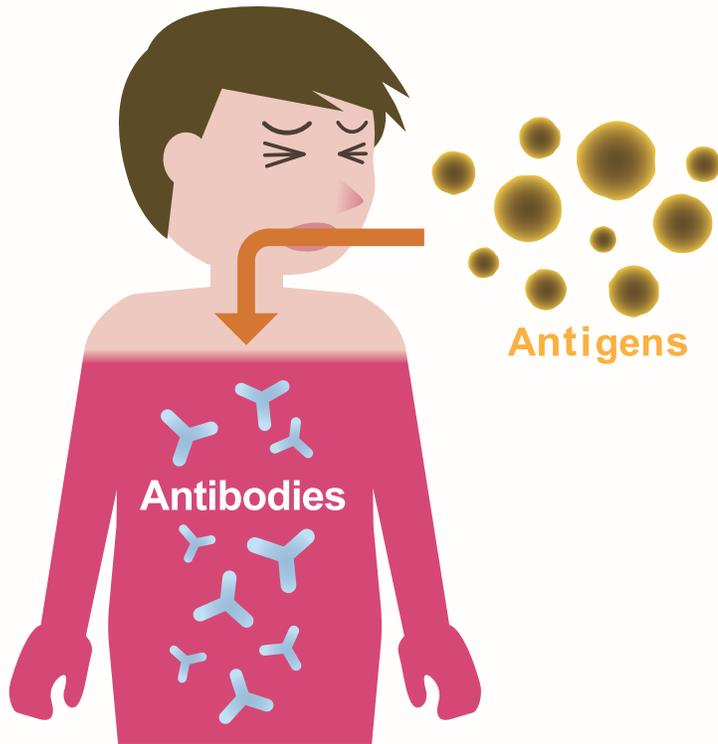


Communication is important! Hormones are part of our body's communication system. It is called the ENDOCRINE SYSTEM. The endocrine system helps messages travel throughout your body so that your body can do all the things its needs to do.

There are four main parts of the endocrine system. They are the endocrine glands, hormones, bloodstream, and receptors. Glands make and send hormones through the bloodstream to specific receptor sites on target organs.

IMPORTANT PROTEINS IN YOUR BODY

ANTIBODIES



HUMORAL IMMUNITY

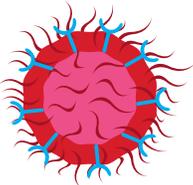
Your IMMUNE SYSTEM helps to protect you against diseases caused by tiny invaders (called PATHOGENS) such as viruses and bacteria. Scientists call these invaders ANTIGENS. Antigens trigger the immune system to do battle. One of the main immune responses is the production of Y-shaped proteins called ANTIBODIES.

In order for the immune system to work properly, it needs to know which cells are good cells and which are bad. To do so, antibodies have specific binding sites that will only bind with certain parts of antigens. The antibodies can only attack antigens that fit with those specific binding sites.

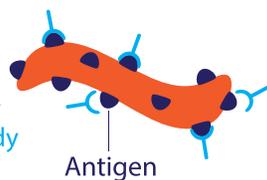
As shown in the image below, antibodies each have a specifically designed binding site that will only bind with the antigen that has a marker that matches up perfectly.

As shown in the image on the left, each antibody is specific for a single antigen. So if your body is invaded by more than one pathogen, different antibodies are produced for each.

Lymphocyte



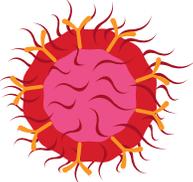
Bacteria



Antibody

Antigen

Lymphocyte



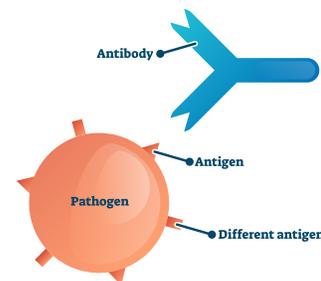
Bacteria



Antibody

Antigen

ANTIGENS



IMPORTANT PROTEINS IN YOUR BODY

COLLAGEN

COLLAGEN [pronounced KOL-uh-juhn] occurs throughout your body. In particular, collagen is in your tendons, ligaments, skin, cornea of the eye, cartilage, bone, blood vessels, the gut, and the material between your vertebrae.

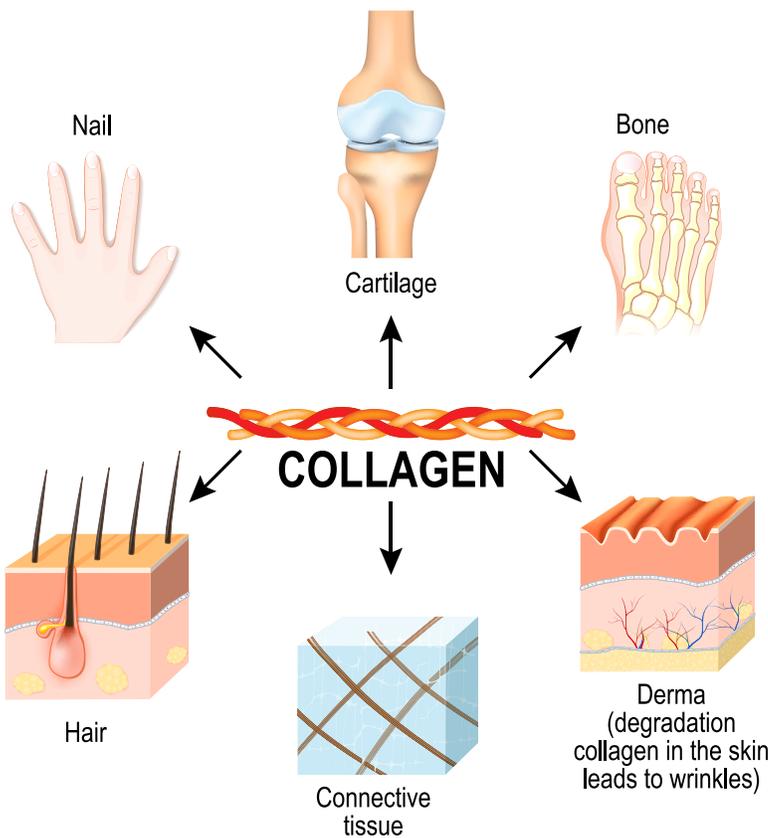
Collagen is a group of naturally occurring proteins found only in animals (That is, plants do not have collagen). There are 16 different types of collagen.

Collagen is the main component of connective tissue and is the most abundant protein in mammals. It makes up 25-35% of all the protein in your body.

When compared on a gram-for-gram basis, some collagens are stronger than steel!

Collagen production declines with age. Exposure to cigarette smoke and Ultraviolet light will also decrease collagen levels.

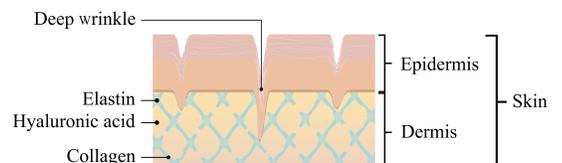
Gelatin is used in the food industry and is collagen from livestock that has been irreversibly broken down.



Younger Skin



Older Skin



IMPORTANT PROTEINS IN YOUR BODY

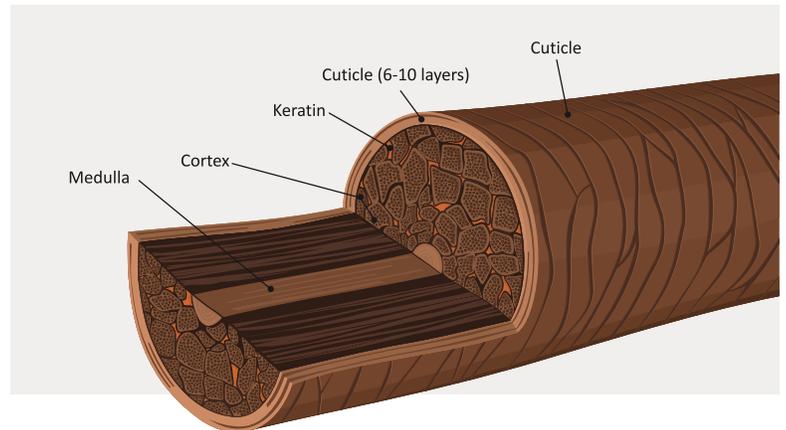
KERATIN

KERATINS [pronounced KER-uh-tins] are the main components of structures that grow from the skin, like hair. Keratin is an important component of hair whether you have straight red hair, blond curly locks, or black twisty braids.

Keratins are a family of fibrous proteins. They are tough and insoluble. Aside from being an important component of your hair, they are also in your finger and toe nails.

For other animals, keratins are the main components of horns, hooves, claws, shells (such as for a tortoise), beaks, and feathers. Keratins are also in the wool of sheep.

HAIR STRUCTURE - HAIR SHAFT



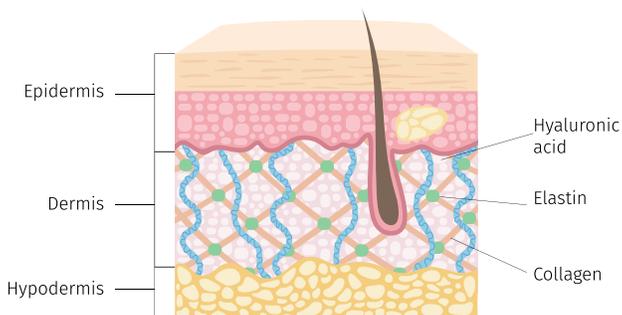
ELASTIN

ELASTIN [pronounced EE-last-in] is a protein found in connective tissues throughout your body. Most notably, it is in the skin.

Elastin sounds much like 'elastic.' That is because the elastin protein is flexible and gives many tissues their elasticity. If you pinch the skin on your arm and then release it, the skin will snap back into place. It is the elastin that makes your skin able to do this.

Elastin is also a crucial part of the lining of the arteries and veins of the circulatory system. Changes in our bodies cause our blood pressure to increase and decrease throughout the day. It is important that the arteries and veins can adjust to the changes in pressure. The elastin protein gives the circulatory system its ability to adjust.

SKIN STRUCTURE

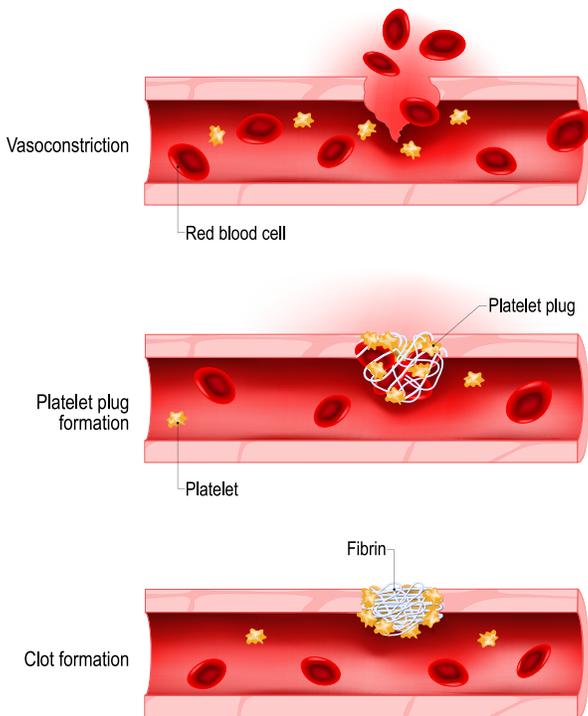


IMPORTANT PROTEINS IN YOUR BODY

FIBRIN

FIBRIN [pronounced FY-brin] is a protein involved in the clotting of blood. If you cut yourself and blood starts to come out, fibrinogen produced in the liver is activated and forms fibrin. Fibrin then starts the clotting process to stop the flow of blood. The fibrin also forms connections between PLATELETS.

All the interlocking between platelets, fibrin, and other blood components results in a plug and a scab forms.



MYELIN

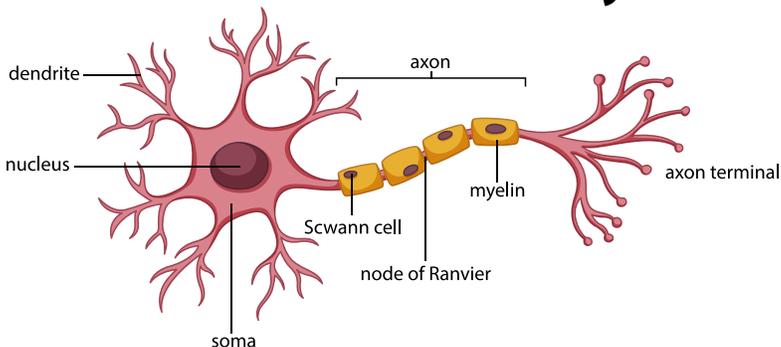
MYELIN [pronounced MAI-uh-luhn] is a substance that coats the nerve cells (neurons) in the brain and the rest of the central nervous system. This coating is known as the myelin sheath.

Myelin is made of about 80% fat and 20% protein. The main function of myelin is to speed up the transfer of electrical messages in the nervous system.

When people have multiple sclerosis (MS) the myelin sheath has been damaged and scars form. As messages travel from the brain they sometimes get stuck or slowed down by these scars. When this happens, the other parts of the body cannot always do what the brain is telling them to do. As a result, some people with MS have trouble walking or talking.

If someone in your class has MS, you cannot catch it from them, so just treat them like everyone else.

Neuron Anatomy

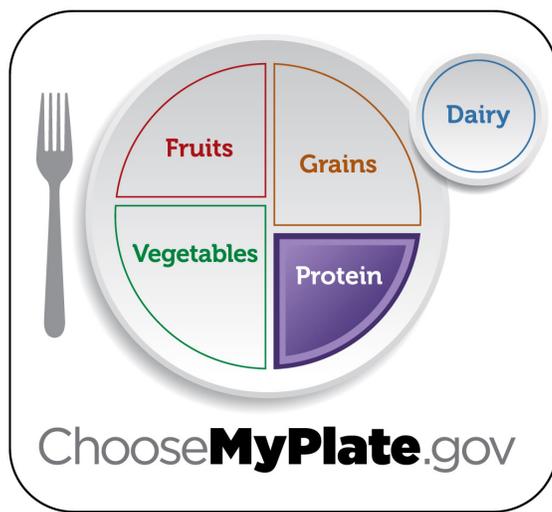
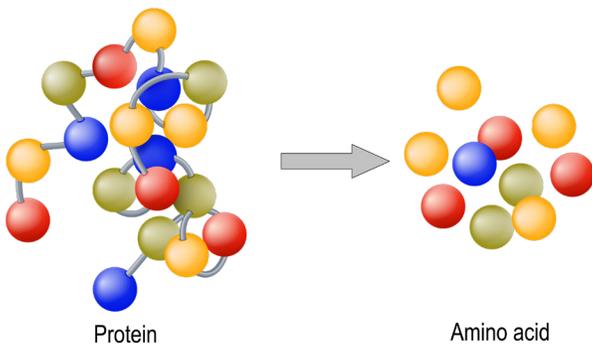


IMPORTANT PROTEINS IN YOUR BODY

SUMMARY

- Twenty percent of your body is made up of protein.
- There are many different kinds of protein in your body - all are important for you to live, be healthy, and be active.
- There are three types of muscles: skeletal, cardiac, and smooth.
- The cardiac and smooth muscles functions without you even thinking about it, or even being aware of it.
- Hormones are proteins that control when you get up, go to bed, get hungry, and feel full - and repeat daily.
- Antibodies are proteins that are important in protecting you for disease.
- Hemoglobin is a protein that carries oxygen to your body cells.
- Proteins are in your skin and hair.
- Ligaments are made of protein and they hold your bones together at the joints.
- Tendons are made of protein and they attach muscles to your bones.
- Nerve cells have a myelin sheath which has protein. The myelin sheath is important for the proper functioning of your nerves.
- Fibrin is a protein that is important in blood clotting so that you do not bleed to death if you cut yourself.
- Proteins are in your skin - and your skin holds your body parts together!

Digestion of protein



- Proteins are made up of building blocks called amino acids
- Each type of protein has its own unique chain of amino acids.
- Some amino acids **MUST** be provided in your diet (called essential amino acids).
- Some amino acids can be converted to other amino acids as the need arises (called non-essential amino acids because your body can make them, but the building blocks to make them must still be in the diet).
- The proteins you eat are broken down in your digestive tract into their individual amino acids which are then used by your body to produce the different proteins you need for your body to function.
- One quarter of your plate should be filled with protein.
- Dietary proteins are classified as either complete proteins or incomplete proteins.
- Complete proteins supply all the essential amino acids to the body. Animal sources of protein such as a fish, meat, poultry, eggs, and dairy products contain complete proteins.
- Incomplete proteins only supply some of the essential amino acids. Plant proteins such as soybeans and quinoa also contain complete proteins. Non-animal foods such as nuts, beans, legumes, and tofu, contain incomplete proteins.