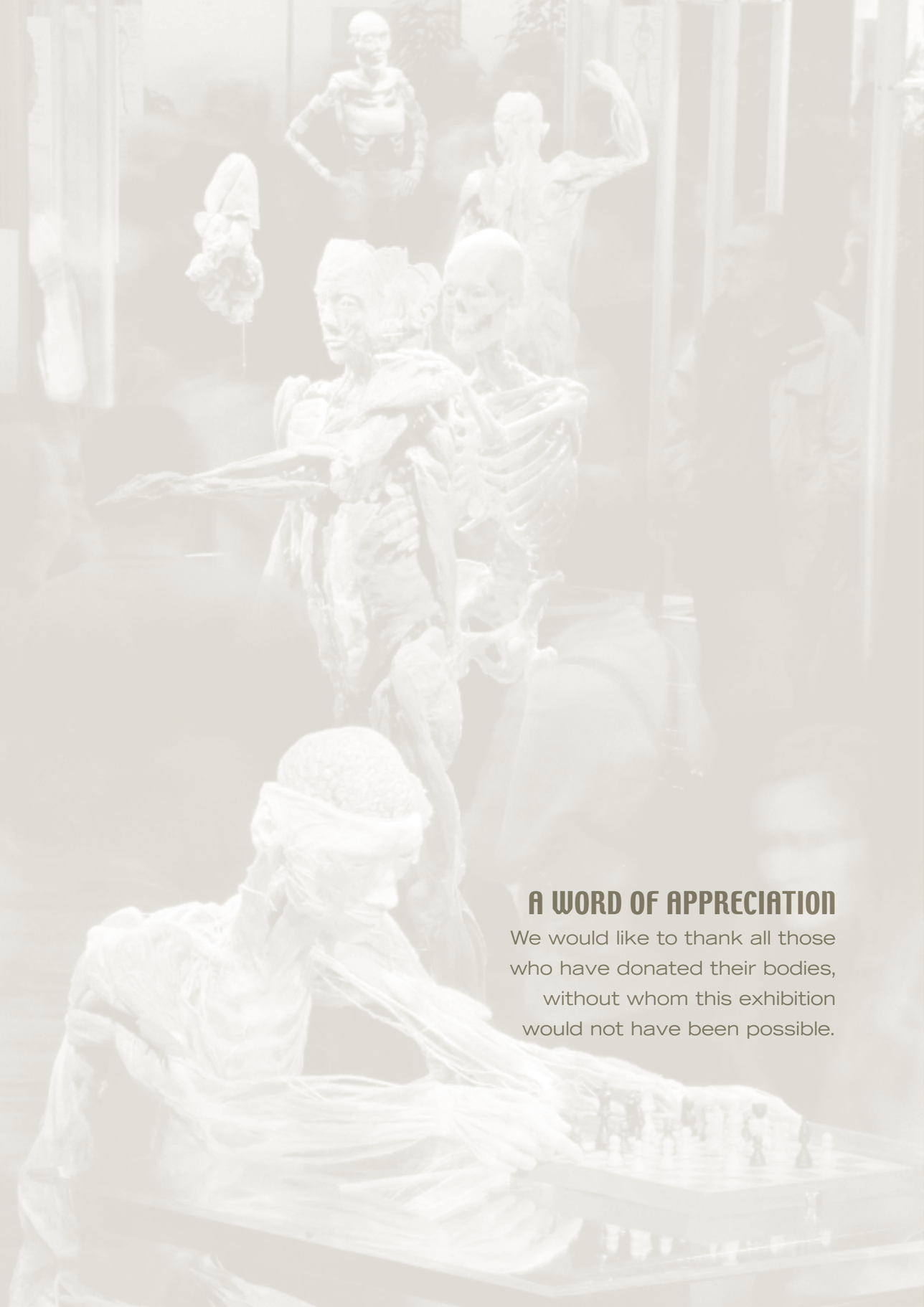
PLASTINARIUM

GUIDE for Teachers & Students



A WORD OF APPRECIATION

We would like to thank all those who have donated their bodies, without whom this exhibition would not have been possible.

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JANUARY, 2021

In everyday life,
we encounter many things and people,
but rarely ourselves. A window is missing through which,
by opening it, we can discover ourselves.

A VERY WARM WELCOME!

A letter from the curator of BODY WORLDS

DID YOU KNOW?
Dr. Gunther von Hagens hat 1977 die Plastination erfunden.

Dear teachers and students,

have you ever seen a professional basketball player seemingly hovering in the air just before he sinks the ball into the basket? Or you might look at the skiers and figure skaters at the Winter Olympics and wonder: “How do they do that?”. Our bodies are amazing. The more we learn about ourselves and how our body functions, the better we can take care of ourselves and others. And the healthier we are too – and therefore better on the football pitch, basketball or tennis court, when cycling or simply taking a short walk around the corner.

In BODYWORLDS, which were created by the physician Dr. Gunther von Hagens and myself, we want to show you how your body functions and how it is structured inside. The plastinated models on display illustrate the structure and functioning of our various body systems, such as the nervous system, the musculoskeletal system or the cardiovascular system.

If you are visiting today with your school or family, we will show you exactly what your brain and heart really look like and what happens to them when they get sick. You can see how smoking destroys your lungs, but also how your bones, muscles and ligaments work together to enable you to score goals, dance or ice skate.

The suggestions in this guide will help you find out more about your body. And then come to us at BODYWORLDS.

This is how you really get to know yourself!

Dr. Angelina Whalley

Konzeptuelle Gestalterin der KÖRPERWELTEN
und leitende Direktorin des Instituts für Plastination

INTERVIEW WITH GUNTHER VON HAGENS

Children Interview Dr. Gunther von Hagens,
Creator of BODY WORLDS & Inventor of Plastination

Were you ever scared to work with dead bodies?

Dr. von Hagens: When I was about six years old, I was very sick and nearly died. I was in hospital for many months and became very comfortable in that environment of the sick and dying. The doctors and nurses who cared for me became my heroes and I wanted to be like them. Later, when I worked in a hospital as an orderly and then a nurse, (long before I became a doctor), one of my duties was to transport the dead to the morgue. Other workers didn't like this job because it frightened them, but I was never afraid. Being afraid of death is not a good way to live.

Were the people in the exhibit old when they died?

Dr. von Hagens: The people who donated their bodies for Plastination and to educate all of us about health are of various ages. Some were old, but others were young in the prime of their life. Each person is different, not just on the outside but also on the inside. Even after more than 50 years as an anatomist, I have never seen two hearts that look the same.

Where did the idea for BODY WORLDS come from?

Dr. von Hagens: When I used to teach anatomy to students in medical school in the 1970s, I had to use illustrated anatomy atlases and picture books to show the organs and body systems. I tried to use real human organs and specimens, but at that time the specimens were preserved in blocks of plastic so you could not touch them or study the placement of the organs properly. I realised one day that if the plastic was inside the body and not outside it, the specimen would be rigid and easy to grasp, and study and work with. I was only trying to solve a problem; I wanted to educate my students so they would become better doctors, as I don't think doctors should be poking around inside your body and operating on you if they don't know important things about it.

But something very unusual began to happen after I began to plastinate organs and specimens. The janitors and secretaries and office workers at the university began to stop by the lab; they were fascinated by the plastinates. This was when I began to think of anatomy for lay people, which is what BODY WORLDS is. It is very different from anatomy for medical professionals because it has to be interesting and dynamic and not scary to look at.

How long does it take to prepare the bodies for display?

Dr. von Hagens: Plastination takes a very long time. A whole body can take up to 1,500 hours to prepare. The specimen which has to date taken the longest to produce is a plastinated elephant that weighs 3.2 tons and took three years to complete.

What happens to the skin once it is removed from the bodies?

Dr. von Hagens: Each body is an anatomical treasure, human remains must be handled carefully and respectfully. All human remains are cremated and buried.

How do you get people to donate their bodies?

Dr. von Hagens: I have never recruited body donors. People offer their bodies for Plastination for several reasons: they want to leave a legacy for future generations; they don't like the effects of decay and decomposition that take place after death; or they don't like traditional burials.

WAS IST PLASTINATION?

The Plastination Process

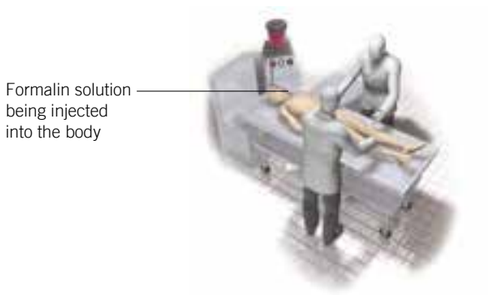
Preservation by Plastination

Plastination is a method that was developed to preserve the body and to use it for educational purposes. Like most inventions, the basic principle is relatively simple.

Specimens plastinated with silicone are cured with a special gas.

1. Embalming and Anatomical Dissection

The first step of the process
involves halting decay by pumping formalin
into the body through the arteries.
Formalin kills all bacteria and
chemically stops the decay of tissue.
Using dissection tools, the skin,
fatty and connective tissues are removed
in order to prepare the individual anatomical
structures.



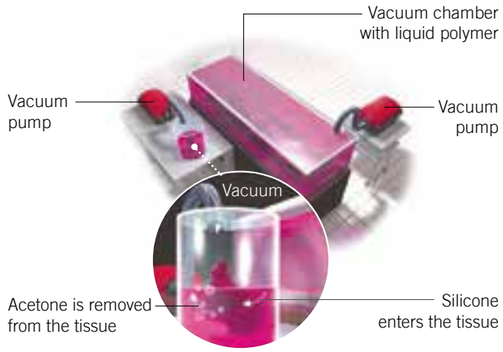
**The Plastination
process itself is based on two exchange steps:**

2. Removal of Body Fat and Water

In the first step, the body water and soluble fats
are dissolved from the body by placing it
into a solvent bath (e.g., an acetone bath).

3. Forced Impregnation

This second exchange process
is the central step in Plastination.
During forced impregnation a reactive polymer,
e.g., silicone rubber, replaces the acetone.
To achieve this,
the specimen is immersed in a polymer solution
and placed in vacuum chamber.
The vacuum removes the acetone from the specimen
and helps the polymer to penetrate every last cell.



Positioning

4. Positioning

After vacuum impregnation, the body is positioned as desired.
Every single anatomical structure is properly aligned and fixed
with the help of wires, needles, clamps, and foam blocks.

5. Curing (Hardening)

In the final step, the specimen is hardened.
Depending on the polymer used, this is done with gas, light, or heat.

Dissection and Plastination of an entire body requires about 1,500 working
hours and normally takes about one year to complete.

Slice Plastination

Slice Plastination is a special form of Plastination. First, the body is frozen
and cut into 2 to 8 millimetres thick slices. Instead of silicone, the body is
treated with polyester or epoxy resin during this process.

Courtesy of The Denver Post

FREQUENTLY ASKED QUESTIONS

What is the PLASTINARIUM?

In a lavishly restored former clothier's workshop, visitors can gain comprehensive insights into the anatomy of humans and animals, the processes of plastination and the various preparation techniques over 3,000 square metres of exhibition space. In Guben, state-of-the-art technology is used to produce teaching materials and large anatomical plastinates for the training of doctors and medical laymen.
The PLASTINARIUM, as a public area of Gubener Plastinate GmbH, makes Gunther von Hagens' democratisation of anatomy real by giving even non-medical people the opportunity to learn on real human specimens. In the learning workshop, pupils, trainees and students can deepen their anatomical knowledge in self-study on the plastinates, models, boards, computers and textbooks provided, and prepare for examinations. Doctors, professors, health professionals and medical companies also have a unique opportunity to engage in practical training and further education thanks to these entirely unique creations, as well as to carry out high-level research.

What is there to see in the PLASTINARIUM?

The PLASTINARIUM is the only one of its kind in the world. For the first time it unites under one roof the BODYWORLDS exhibition with the practical presentation of the steps involved with plastination. Visitors are guided through 4 areas:

THE HISTORY OF ANATOMY
Here there are interesting facts about the history of anatomy, preservation techniques and the development of plastination

PLASTINATION WORKSHOP
With presentation of the individual plastination steps, skeleton production, live preparation and the positioning area

VON HAGENS' GALLERY
An excerpt from our exhibition

BODYWOLDS of Animals

LEARNING WORKSHOP
with the stations on the individual body systems

What are BODYWORLDS?

The BODYWORLDS exhibitions: The original, internationally renowned BODYWORLDS: The Original Exhibition of Real Human Bodies, are the first exhibitions of their kind. They inform visitors about anatomy, physiology and health by looking at real human bodies. The exhibited specimens were preserved using plastination, the conservation process that Dr. von Hagens invented in 1977 during his work as an anatomist at the University of Heidelberg.
Since the exhibition series began in Japan in 1995, around 50 million visitors in more than 90 cities in Europe, Africa, America and Asia have seen the world's most successful exhibition.

What should visitors to the PLASTINARIUM and BODYWORLDS gain from their visit?

The exhibitions aim to inform a broad public about the inner workings and functions of the human body and to show the effects of diseases and disorders on health and their own lifestyles. The exhibitions aim to arouse public interest in anatomy and physiology and to increase knowledge in these areas in the long term.

Who should visit the PLASTINARIUM? Is a visit also suitable for children?

Everyone who wants to experience what makes us human and what distinguishes the human body in its ingenuity and aesthetics. There is no age limit for visiting the exhibition for children and young people accompanied by a parent or guardian. Parents and teachers should decide for themselves whether the children and young people in their care are sufficiently prepared to visit the PLASTINARIUM. Information material is available on the PLASTINARIUM website.

Why is it advisable for non-medical people in particular to see the exhibition?

People are more likely to live healthy lives if they understand how their bodies work and what damages them.
The PLASTINARIUM and BODYWORLDS are keen to encourage visitors to develop a greater interest in medical and related sciences. The aim is to make knowledge of the nature and function of the human body available to the general public.

Couldn't we learn human anatomy from books or models?

Genuine human specimens can show individual aspects of diseases and anatomical details in a lifelike manner, which is not possible with models or books. They also convey that each body has individual characteristics, even inside, comparable to the uniqueness of a face. In addition, real preparations are capable of generating much more fascination than plastic models.

Are there also animals on display in the PLASTINARIUM?

In "Von Hagens' Gallery", we show a part of our BODYWORLDS of Animals exhibition. Thanks to the revolutionary plastination technology, it has become possible to aesthetically prepare and permanently preserve even the largest animals. Visitors to Guben can also see this for themselves. Two full-size giraffes can currently be admired in the gallery area. With its long neck, the giraffe is the tallest living land animal. You can also see a bone-vessel shape from the ostrich, a torso slice from the elephant, the internal organs of the reindeer, numerous small specimens such as fish, squid, lobster, pigeon, chicken, mouse, frog, etc., as they are also treated in biology lessons in the lower grades at school. You can also see slice plastinates of a lion, crocodile, horse, ostrich and others.

What is Plastination?

Plastination was invented in 1977 by Dr. Gunther von Hagens, a physician and scientist. The plastination process is a ground-breaking conservation method which allows the decay of the dead body to be stopped and long-term, durable anatomical preparations to be produced for scientific and medical training.
During the plastination process, all body fluids and soluble fats are removed from a preparation. The next step is vacuum-forced impregnation, in which the body fluids are replaced with reactive resins and elastomers. Afterwards the hardening takes place with light, heat or certain gases. This results in solid, odourless and permanently durable preparations. Further information about plastination can be found at www.plastinarium.de.

Where do the specimens on display come from? Do we find out anything about the identity of the plastinate or what the people died from?

Our exhibitions are made possible thanks to the generosity and initiative of body donors. Body donors are persons who have decreed that their bodies may be used after their death for medical and scientific education in the exhibitions. All

of the bodies and the majority of the specimens come from body donors in the IfP body donation programme. Individual organs, the foetuses and special preparations representing unusual changes originate from old anatomical collections or from morphological institutes. As agreed with the body donors, no information on their identity or causes of death will be revealed. The exhibitions focus on the bodies themselves, not on the associated personal information.

Why are the plastinates shown in active and true-to-life poses?

The poses of the plastinates have been carefully designed and thought through and have educational purposes. Each pose depicted demonstrates different anatomical features and characteristics. For example, the athletic poses serve to depict the muscle system during sport. The poses enable visitors to associate the plastinate more realistically with their own bodies.

Has the exhibition been examined from an ethical point of view?

Prior to the first exhibition in North America (in 2004), an independent ethical review was commissioned by the Museum California Science Center in Los Angeles, and by a distinguished committee of theologians, ethicists, academics and doctors. This ethical assessment of the origin of the bodies in the BODYWORLDS and in the PLASTINARIUM is available on the BODYWORLDS website.

What materials does the PLASTINARIUM provide for teachers and parents?

Teachers will be provided with information material to prepare their class visit. The information material can be downloaded from the PLASTINARIUM website at www.plastinarium.de. The PLASTINARIUM offers teachers the opportunity to visit the exhibition free of charge in advance so that they can get an idea of the exhibition before visiting with their school classes.

Is there an audio guide?

An audio guide is not available in the PLASTINARIUM. Visitors can get to know the PLASTINARIUM in different ways. You have the option to walk through the exhibition on your own or book a guided tour. Groups of 20 people or more can also visit the PLASTINARIUM outside regular opening hours by appointment, Monday to Thursday, with or without a guided tour. Guided tours take place by appointment only and for groups of 10 or more people. The duration of the tour is approx. 2 hours and includes the anatomy history, the plastination workshop with preparation and positioning and the learning workshop.
For guided tours we recommend a maximum group size of 20 people. Guided tours are offered in German, Polish and English.

How long can you stay in PLASTINARIUM?

There is no limit to the length of stay in the exhibition during our opening hours. We recommend setting aside about two hours for the visit. The duration depends on how long you look at the individual specimens and whether you wish to read all of the information available. Once you have left the exhibition, you cannot re-enter.

Is photography and/or filming permitted in the PLASTINARIUM?

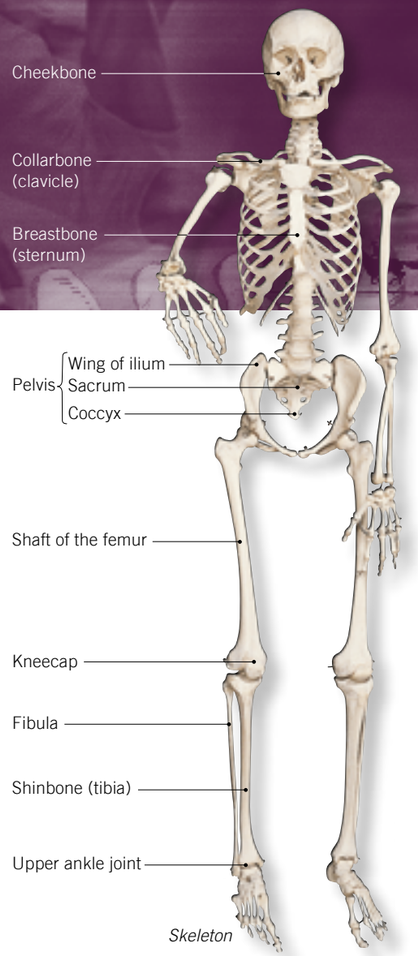
Photography and filming for private purposes only is permitted in all PLASTINARIUM premises. Please take pictures without flash and do not take pictures of staff. Journalists and media representatives are permitted to write editorial reports and, following prior authorisation, to take photographs and create film material.

Exhibition tour with facts about the human body

The exhibitions by Gunther von Hagens use plastination science to show visitors how the human body is constructed. The exhibition also explains how different anatomical systems function in the human body. This guide for teachers and students deals with several of the systems shown in the exhibition, ncluding the musculoskeletal and respiratory systems, the digestive tract, the nervous system and the cardiovascular system.

THE LOCOMOTIVE SYSTEM

Motion Happen



Skeleton

The locomotive system makes movement possible. It consists of the bones that make up the skeleton, the joints that hold the bones together, and the muscles that contract and relax to actually make you move.

The skeleton is the framework of the body, and is made up of bones and cartilage. Bone is made mostly of calcium, which is why it is important to eat calcium-rich food to keep your bones strong.

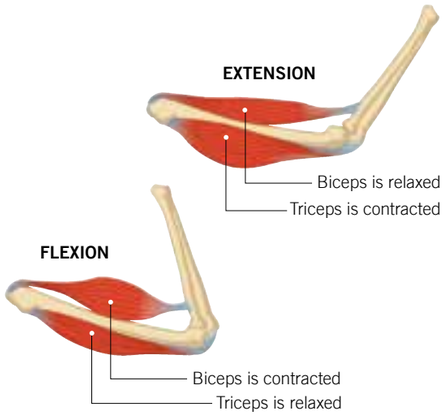
Inside the bone is sponge-like matter called bone marrow. This makes bones light so people can move easily, but strong enough to support body weight. Bone marrow also produces red and white blood cells. Red blood cells have haemoglobin and carry oxygen. White blood cells produce antibodies to attack bacteria, infections, and diseases.

The skeleton has many jobs. It provides protection to internal organs, it supports the body and gives it its shape, and it provides a place for muscles to attach.
Bones are important to almost every movement we make. Bones couldn't move a pencil, though, without help from muscles. Muscles consist of cells that contract.

Muscles and bones are connected by tendons, which are similar to ropes. When a muscle contracts, it pulls the tendon, which then tugs on the bone, and everything moves.

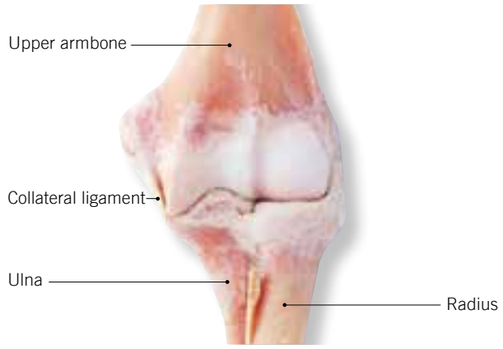
Although it may seem easy to do something like throw a ball, it's actually complicated when looked at inside the body. To make the motion of throwing, many muscle groups in the shoulders, arms, chest, abdomen, and even legs must be used! Each of these groups must work together with nerves in order for motion to occur. And all this happens in a fraction of a second!

Voluntary muscles are used when you throw a ball. These are the muscles we can control. People also have involuntary muscles, which we cannot control, such as the heart and the stomach.



COOL FACT

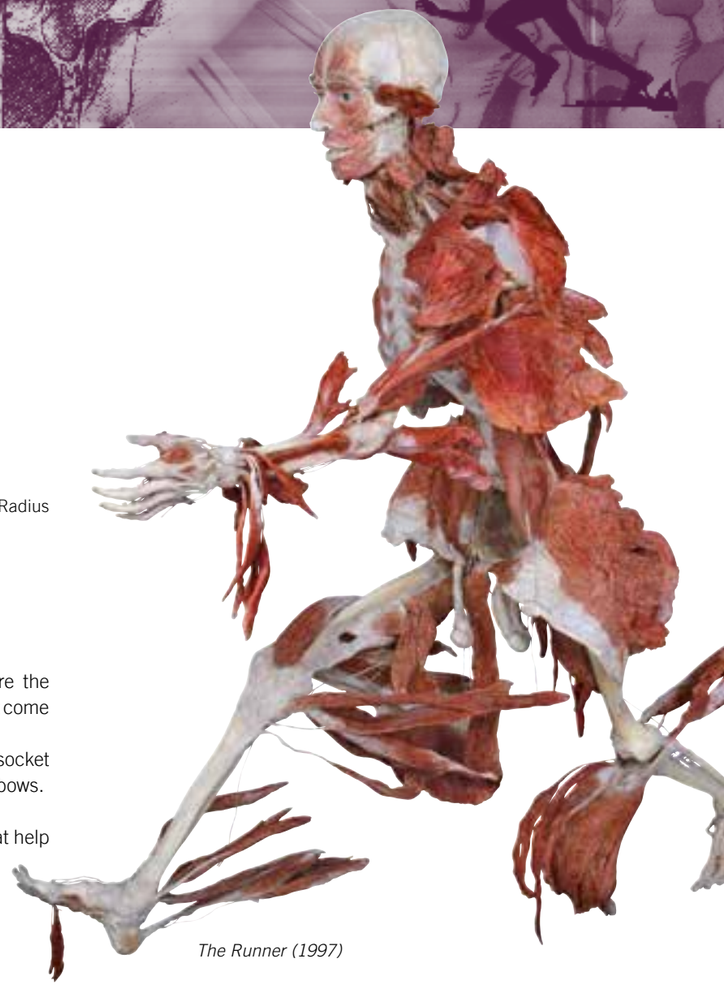
At birth, humans have 300 bones. As a baby grows, however, many of the smaller bones fuse together so that adults have just 206 bones.



Elbow joint, viewed from the front

Another important part of the locomotive system are the joints. Joints are positioned between major bones that come together and help you to move and bend.
There are different kinds of joints, including ball and socket joints in the hips and hinge joints at the knees and elbows.

Joints are surrounded by capsules containing fluid that help the bones move smoothly.



The Runner (1997)

LEARNING IN THE PLASTINARIUM

The bones of the human skeleton give the body both strength and structure. A strong and healthy skeleton is important for every person for both work and recreation. Think of three things that you do every day that involve the use of certain bones.

COOL FACT

The nervous system carries messages from the brain to other parts of the body at more than 400 kilometres per hour.

THE NERVOUS SYSTEM

The Messenger and the Boss

The nervous system is the system of the body that controls movements, thoughts, and emotions throughout the body. Without it, you wouldn't be able to function!

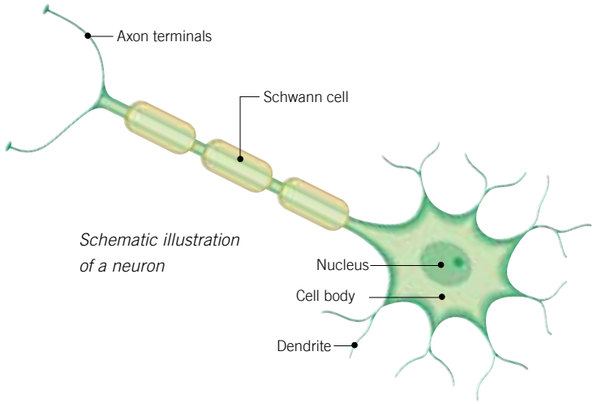
There are two parts to the nervous system: the central nervous system and the peripheral nervous system.

The central nervous system includes the brain and the spinal cord. They work together with nerves to send messages back and forth between the brain and the rest of the body.

The brain controls the system. It has five parts: the cerebrum, the cerebellum, the brain stem, the pituitary gland, and the hypothalamus.

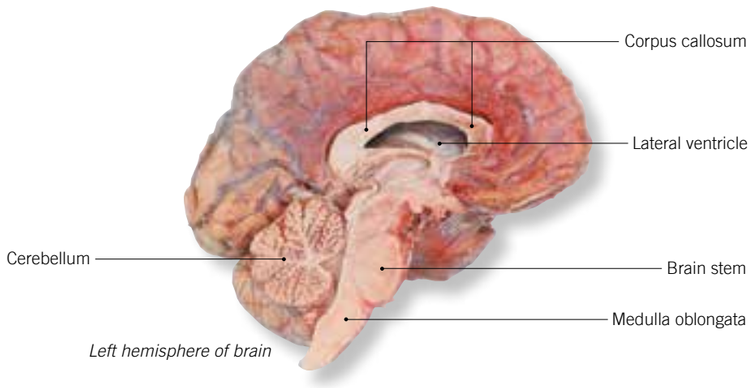
The cerebrum is the biggest part of the brain and controls thoughts, language, and voluntary muscles, which are the muscles you can control. You also use the cerebrum when you think hard and when you need to remember things.

The cerebellum is a lot smaller than the cerebrum, but still very important. It controls balance, movement, and coordination. If it weren't for the cerebellum, you wouldn't be able to stand without falling!



Schematic illustration of a neuron

The brain stem connects the rest of the brain to the spinal cord. It's the part in charge of major things that keep you alive like breathing, blood pressure, and digesting food. Unlike the cerebrum, the brain stem controls the involuntary muscles – the ones that work without you thinking about it, such as the heart and stomach.



Left hemisphere of brain

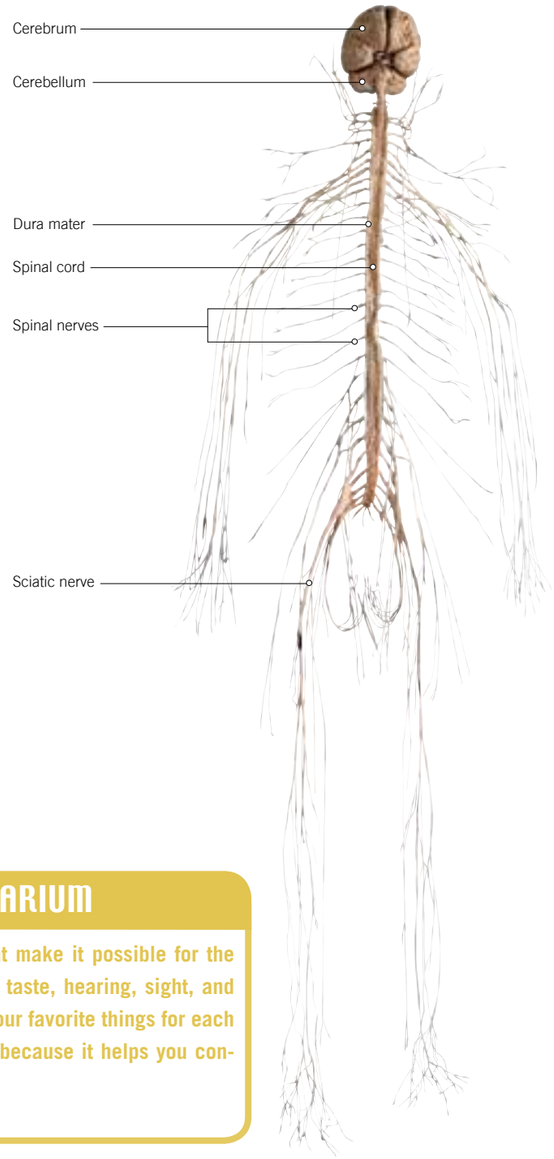
The tiny pituitary gland produces and releases hormones into the body – hormones like those that help you grow and change.

Finally, the hypothalamus regulates your body temperature, your emotions, and hunger and thirst.

The brain has many jobs, but it needs help from nerves and the spinal cord, too. Every action you do happens because your brain, your nerves, and your spinal cord work together.

The nervous system includes millions and millions of neurons, which are microscopic cells. When you do something, messages travel from the neurons to your brain.
The peripheral nervous system is composed of the nerves and neurons that go outside the central nervous system to operate the body's limbs and organs. It is here that everything gets connected.

Next time you take a test, drink a glass of water, laugh, or do anything at all, thank your nervous system. Actually, you can thank it right now since it just helped you read this!



LEARNING IN THE PLASTINARIUM

The nervous system carries messages to the brain that make it possible for the body's five senses to work. The five senses are touch, taste, hearing, sight, and smell. Explore the five senses by writing about one of your favorite things for each sense. For example you may enjoy listening to music, because it helps you concentrate. This relates to your sense of hearing.

THE RESPIRATORY SYSTEM

Oxygen In, Carbon Dioxide Out

COOL FACT

Your left lung is a bit smaller than the right to leave room for your heart.

The organs of the respiratory system work together, along with other body systems, to ensure that the cells of the body receive the oxygen they need to live.

When you breathe in, the muscles of your chest expand. Your diaphragm lowers and creates lower air pressure in your lungs than in the world outside. This causes air to enter through the nose or mouth.

Once air enters, it travels past your esophagus, sometimes called the "foodpipe," and is moistened as it goes down the trachea, or "windpipe," into the lungs. As the air enters the lungs, the lungs expand outward.

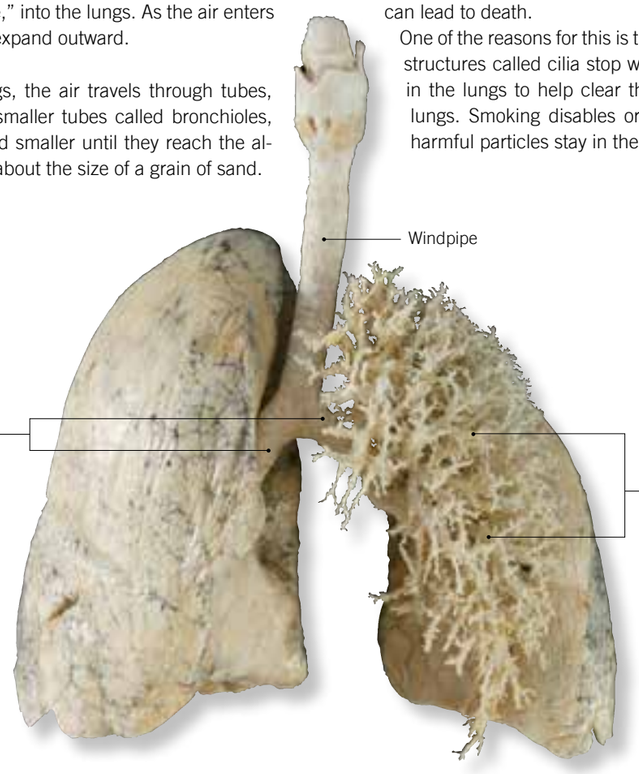
Once inside the lungs, the air travels through tubes, called bronchi, into smaller tubes called bronchioles, which get smaller and smaller until they reach the alveoli which are sacs about the size of a grain of sand.

It is through the walls of the alveoli that the oxygen in the air you breathe enters the body's blood, which flows past the alveoli. The blood receives the oxygen and, in return, passes carbon dioxide into the alveoli.

The cells of your body need oxygen to live, and carbon dioxide is the waste of things the cells do. Your red blood cells are little workers that carry the oxygen to the cells and take the carbon dioxide away.

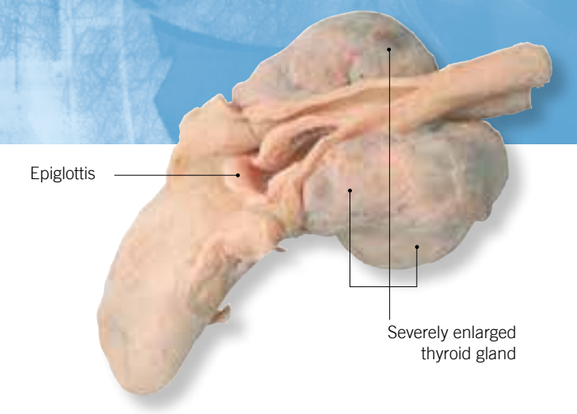
Smoking, as we all know, makes the lungs less healthy and can lead to death.

One of the reasons for this is that smoking makes little structures called cilia stop working. Cilia move within the lungs to help clear things out that enter the lungs. Smoking disables or even kills them. Then harmful particles stay in the lungs.



Lungs showing the bronchial tree in the left upper lobe

Another bad effect of smoking is that chemicals from cigarettes will build up in the lungs, and the delicate alveoli can become thickened, swollen, and unable to exchange oxygen and carbon dioxide with the blood in a healthy way. This condition leads to emphysema.



Enlarged thyroid gland (goiter)

Non-smoker's lungs

Smoker's lungs

Think about it

Plants take the carbon dioxide that we release and use it, creating oxygen, which we need. We in turn take oxygen and turn it into carbon dioxide, which plants need. This is what is called a symbiotic relationship – one that is good for both organisms. Try to think of other ways in which humans interact with nature in symbiotic relationships.

LEARNING IN THE PLASTINARIUM

A healthy respiratory system makes it possible for people to live active lives. Smoking causes problems for the respiratory system. Make a list of five reasons why people shouldn't smoke.

THE CARDIOVASCULAR SYSTEM

The Body's Great Pump

The heart is the central organ of the cardiovascular system and it doesn't look much like the drawings found on Valentines. Cardio means heart, and the cardiovascular system is essential to our survival.

The cardiovascular system is sometimes referred to as the circulatory system because it's responsible for the circulation of blood through the body. It consists of the heart, which is a muscular pumping device, and a closed system of vessels called arteries, veins, and capillaries.
The cardiovascular system's vital role is to provide a continuous and controlled movement of blood through the thousands of miles of microscopic capillaries that reach every tissue and cell in the body.

Human survival depends on the circulation of blood to the organs, tissues, and cells of your body.

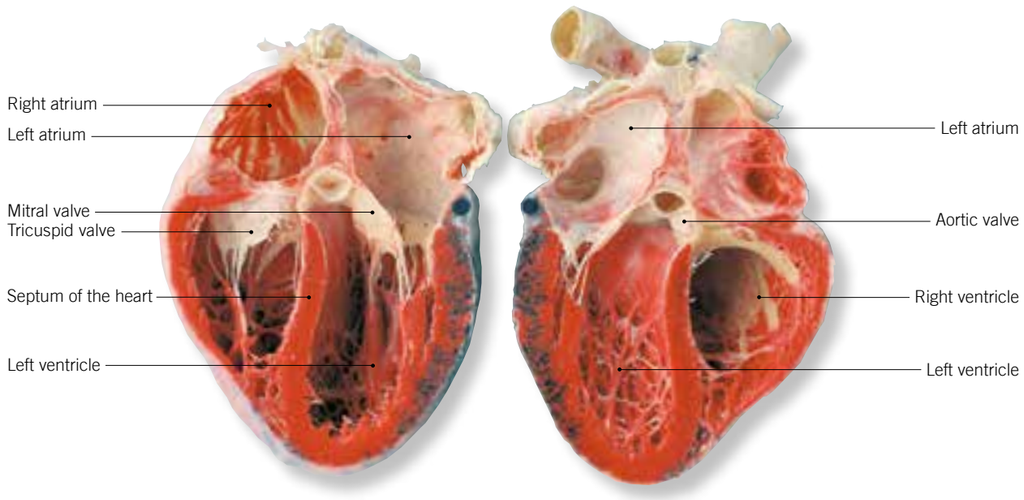
Arteries carry blood enriched with oxygen away from the heart and veins carry blood that has used up its oxygen back to the heart. Through the heart and lungs, the blood gets a fresh supply of oxygen and delivers it to the rest of the body.

Twenty major arteries make a path through the tissues of the body. Then they branch out into smaller vessels called arterioles. These branch further into the capillaries, most of which are thinner than a hair – some so tiny, in fact, that only one blood cell can move through at a time.

Once the blood in capillaries delivers oxygen and nutrients, it picks up carbon dioxide and other waste. Then blood moves back through wider vessels, called venules. These eventually join to form veins, which deliver the blood back to your heart to pick up oxygen.

If all the vessels of this network were laid end to end, they would extend about 96.500 kilometres, far enough to circle the Earth more than twice!

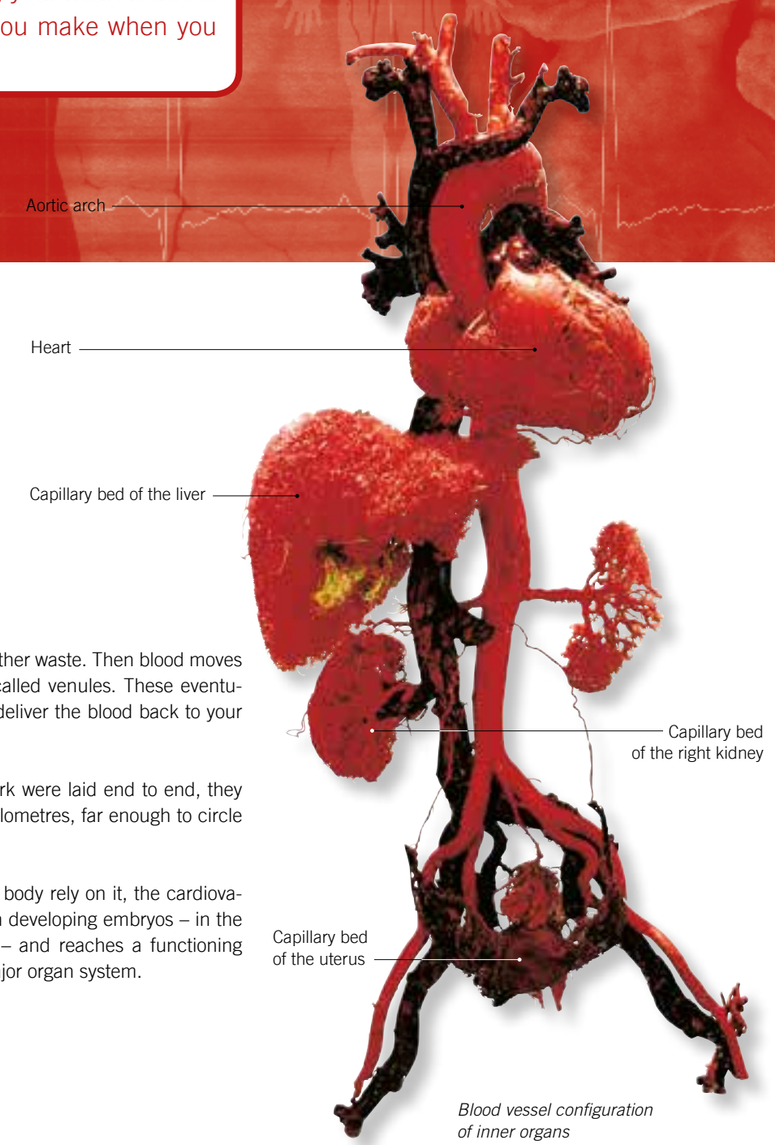
Because all the tissues in the body rely on it, the cardiovascular system appears early in developing embryos – in the fourth week after fertilisation – and reaches a functioning state long before any other major organ system.



Heart, opened longitudinally

COOL FACT

At every stage of life, your heart is about the size of the fist you make when you close your hand.



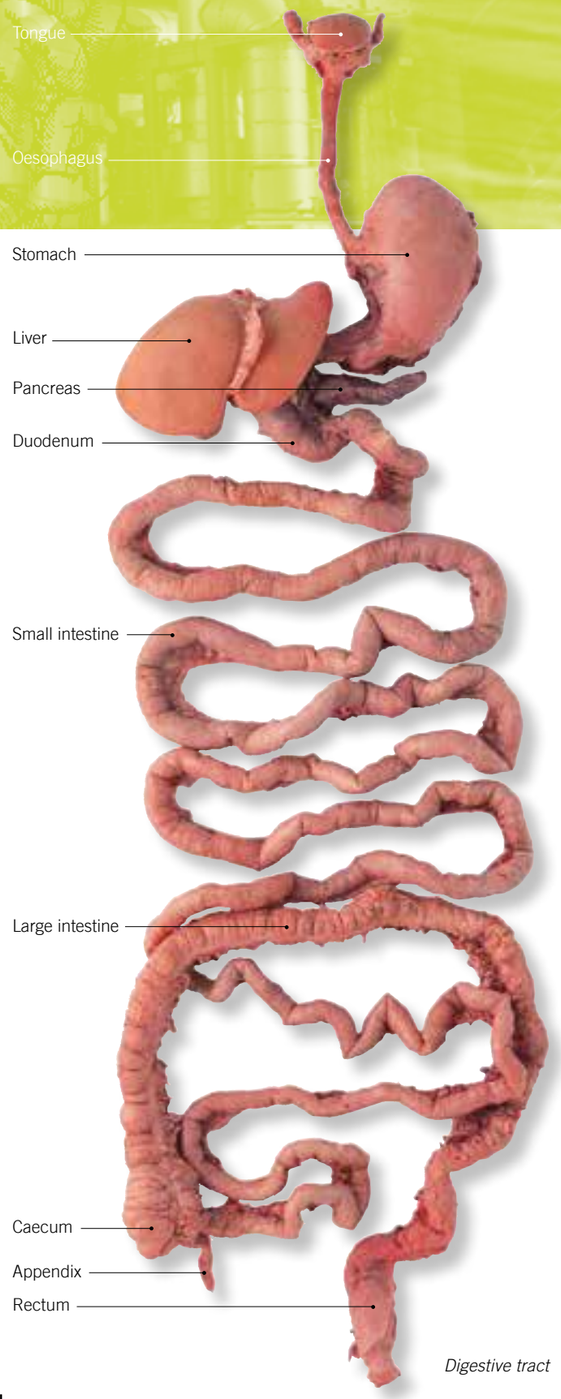
Blood vessel configuration of inner organs

LEARNING IN THE PLASTINARIUM

The cardiovascular system is delicate and can be affected by many things. Fats and cholesterol, for example, can slow or even block the flow of blood in the body. Fats and cholesterol enter the body as food, and that is one way people are encouraged to limit the amount of fatty or oily foods they eat. Think of ten fatty foods and ten healthier options. For example, you may think of a doughnut as a fatty food and toast as an alternative.

THE DIGESTIVE SYSTEM

Converting Food Into Energy



Digestive tract

The body's digestive system converts the food you eat into the energy you need to live.

The journey through your digestive system is a long one for food. It starts in the mouth, where teeth grind and tear the food into small pieces. Saliva then wets and softens the food, and begins to dissolve carbohydrates. Once the food is properly mashed and wet, it is pushed by muscle action into the pharynx, or throat, and down the esophagus, which leads to the stomach.
When food reaches the stomach it is mixed and broken down further by acids the stomach produces. The stomach protects itself from these acids by secreting a layer of mucus that lines the inside of the stomach.

Some things, such as water and sugars, can be absorbed right out of the stomach and into the bloodstream. The things that need more digestion have further steps ahead of them. When the stomach has made the food a liquid, the food passes through a valve into the small intestine.
The small intestine has a large surface area because it contains villi. Villi are tiny little structures like very short hairs that stick out into the small intestine. Through the walls of the villi nutrients from food pass into the bloodstream. The bloodstream carries the nutrients to your cells so they can live.

Once all the useful nutrients have been taken from food in the small intestine, the unusable parts pass into the large intestine, or colon.

In the large intestine, water is extracted from the waste and the material hardens into faeces. The feces are passed out of the body when you go to the toilet.

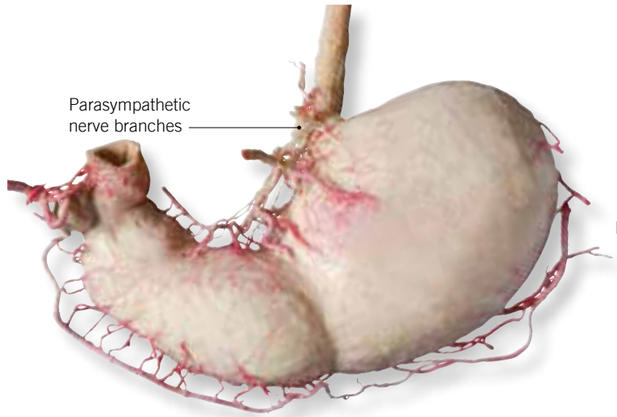
COOL FACT

Your mouth makes about litre of saliva each day, and you produce a total of about seven litres of digestive juices.

Blood vessel configuration of the liver (rear view)

Digestive helpers
The pancreas, liver, and gallbladder are all organs that do things important to the digestive system. The pancreas makes enzymes that help digest proteins, fats, and carbohydrates. The liver makes bile, which helps the body absorb fat.

Bile is stored in the gallbladder until it is needed. Enzymes and bile travel into the small intestine through ducts. Interestingly, people don't really need the gallbladder. If it is removed, the bile just flows right into the small intestine and does its job.



Stomachs of varying size and shape

LEARNING IN THE PLASTINARIUM

The digestive system breaks down the food that supplies the human body with energy. What foods would you eat if you needed energy for sports or active recreation?
Pick five foods you think would be good sources of energy. Then pair off and research your foods. Were they all healthy choices for getting the energy you needed?

EMBRYONIC & FOETAL DEVELOPMENT

Life begins with a single cell, or zygote, after the father's sperm fertilises the mother's egg.

The zygote contains the human genome, the individual blueprint of a human being. It consists of the parents' gene pairs, organised in chromosomes. This special set of chromosomes, which has never existed before and will never be recreated, determines the characteristics and traits of the conceived human being.

The first weeks
Roughly 30 hours after fertilisation, a microscopic human egg begins to divide into two identical daughter cells. Twins will develop if these two cells separate from each other. Most of the time, however, the complete embryo will remain intact and migrate down the Fallopian tube, settling in the uterus on the sixth day. Pregnancy will last an average of 260 days from that point.

Zygote or fertilised egg (400 times magnified).

The embryo, suspended in amniotic fluid and surrounded by foetal membranes, is linked to the maternal blood supply via the umbilical cord and placenta. During the first four weeks, the embryo is roughly 4 millimetres long and will grow to 3 centimetres by the end of the eighth week, when it will weigh approximately 4 grammes. All of the organs will be in place by the end of this period, after which the developing child is referred to as a foetus. The length and weight of the foetus then begins to increase significantly as it proceeds through further complex stages of development.

Week 13 to 14
Coordinated movements will begin, although the mother is not yet able to feel them. The relatively large head will straighten up, the lower extremities are already well developed, and the toenails will begin to grow.

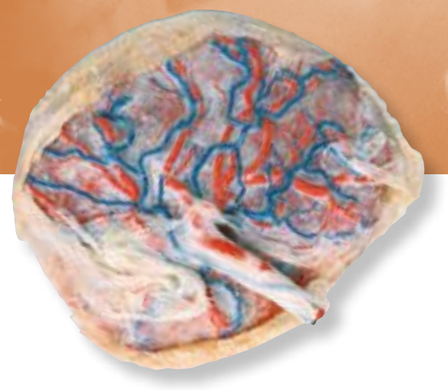
Week 15 to 16
The foetus is now 15 centimetres long and can weigh up to 200 grammes. Its gender can be detected via ultrasound, and its skeleton will show up clearly on x-rays. Its legs have begun to grow larger, and its head is smaller relative to its body as a whole. Foetal blood begins to develop in the liver. Ovaries have already developed in female foetuses.

Week 17 to 18
Foetal growth has slowed; the weight of the foetus has increased to 300 grammes. The skin is still thin because the (white) subcutaneous fatty tissues have not yet developed. Brown fatty tissues have, however, begun to form; these will allow the small organism to produce its own heat. The uterus has developed in female foetuses. Mothers may feel the foetus move from this point on.

Week 19 to 20
Toward the end of this phase, the foetus will be 28 centimetres long and will weigh up to 460 grammes. The body and head of the foetus are now covered with fine hair (known as lanugo), which contains little pigment.

COOL FACT

When a pregnant woman consumes alcohol, the alcohol level in the blood of her foetus will be the same as in her own.



Placenta. On the surface of the fetal side, the arteries and veins of the umbilical cord vessels branch out.

Week 21 to 24
The foetus begins to gain weight more rapidly again, and its proportions are becoming more like those of a baby. Rapid eye movement has begun, and fingernails will start to grow. The skin is still red and wrinkled. The lungs, however, are now capable of breathing, if insufficiently, because there is not yet any coordination between them and the nervous system. As a result of this lack of coordination, the exchange of gases (especially CO_2 exhalation) cannot be ensured to a sufficient extent, thereby leading to an oxygen deficiency, which can cause more or less severe damage to the brain if the baby is born at this stage.

LEARNING IN THE PLASTINARIUM

Many factors influence the development of an unborn baby. How do environmental influences affect the child? What circumstances in the life of the mother have a positive or negative effect, or can even harm the baby? How do these influences actually reach the foetus? Discuss these questions in class.

Week 25 to 28
The lungs are now fully capable of breathing, which means that the foetus is capable of living outside the womb. During week 26, the eyes can open, and subcutaneous fatty tissue developed by this point has given the body a more rounded shape. Until this point, the spleen has been producing blood; during week 28, bone marrow will take over this function. A foetus will now weigh more than 1 kilogramme.

Week 29 to 32
The foetus's body will grow to over 42 centimetres, and its weight will increase to 1.5 to 2.1 kilograms. The fingernails will grow to the tips of the fingers, and the skin will now be pink and smooth. The eyes will respond to light by means of the pupillary reflex, and the hands will respond to stimulus with a 'grasping' reflex.

Eight-week-old embryo.

ART IN SCIENCE

The Beauty of the Body

LEARNING IN THE PLASTINARIUM

Understanding how the body works is important in many professions. Think about what you want to be when you grow up, and write a short sentence or paragraph explaining why anatomy could be important in the job, and why.

BODY WORLDS exhibitions teach us a lot about the science and anatomy of the human body. They also teach about the form and art of the human body.

Studies of anatomy have always been an important part of art education. Artists who know how the human body is put together and how its muscles work are better able to portray people in painting, sculpture, and other art forms.

This knowledge is important, even if artists choose to represent the human form in abstract ways.

In the BODY WORLDS exhibits, Dr. Gunther von Hagens has positioned human figures to reveal how the body is put together and how it performs different tasks. He has also presented human figures in ways that highlight different body systems, such as muscles, internal organs or nerves, and blood vessels.

The scientific choices he has made give us a new way to understand how human bodies work. At the same time, he has revealed how beautiful the form and systems of the human body are.

As visitors go through the exhibits, they learn the science and biology of anatomy. They also get to experience the artistic qualities of anatomy. This gives the exhibits appeal to all students, not just those in science classes.

Think like an artist

Artists sometimes like to focus on one aspect of a figure. In art, this may be done by emphasising one feature of a person, or showing the subject from an unusual angle or perspective.

Explore this idea by thinking about someone in your family. Reflect on what this person is like, or what you admire about him or her. Then think about what you would focus on if you were to portray this person in an artwork. Draw a sketch of your artwork and explain your ideas to the class.

Photography as art

Newspaper photographers often are asked to take photo portraits of people in the news. These portraits often could be considered photographic artworks. Look through the news and features sections for several days and cut out photos portraying people. Pick the one you like the most and explain to the class what makes the portrayal effective or artistic in your eyes. Finish by giving the photo a title, and explain it to classmates.

Sports anatomy

Coaches need to know how to evaluate the physical skills and talents of players. These talents often are based on anatomy. Pick an athlete you admire. Then think about the different body systems explored in this guide. Write out which systems contribute most to the success of this athlete.

THE BODY DONATION PROGRAMME

Thoughts on plastination and your own body

COOL FACT

Plastination takes a very long time. A whole body can take up to 1,500 hours to prepare.

All of the specimens in Gunther von Hagens' BODY-WORLDS and PLASTINARIUM are genuine. They come from people who, during their lifetime, declared that their bodies could be used after their death for the training of doctors and for public education.

"The exhibitions are above all a joint project of the donors, me, and everyone who visits the exhibitions," says von Hagens. "All of humanity owes something to the donors, because without them our exhibitions would not exist."

In order to be sure that all donors choose to donate voluntarily, the Institute of Plastination requires from all of them that they sign an official permission form. In it, donors declare that they have made their decision "uninfluenced and voluntarily" to donate their bodies "for the anatomical research and education (...) of students and especially the public".

They must also tick answers to certain questions that arise from plastination. This ensures that they understand the full implications of their decision.

"I agree to any use of my body as long as it is only for the purposes of medical training, research or treatment by doctors and other medical institutions" is one example of such a statement.

Or "I agree that my plastinated body may be used for medical education of non-medical people and for this purpose may be shown in public (e.g. in a museum)"

Donors to the Institute of Plastination also have the option to donate usable organs before plastination to save lives.

Talk about it

Discuss in class whether you would have your body or that of a relative plastinated for educational or exhibition purposes. Discuss whether you think it is a good idea to exhibit plastinates in public. Which points speak "for" and which "against"?

Possible discussion points

- What do you think about organ donation and what are the reasons for becoming an organ donor?
- What motives might donors have for donating their bodies to plastination?
- What role do the feelings and opinions of relatives and friends play in the decision to have yourself plastinated?
- What do you think about the idea of having a member of your immediate family plastinated?
- What can you learn during a visit to PLASTINARIUM or what have you already learned?

LEARNING IN THE PLASTINARIUM

After the discussion, summarise the general atmosphere in the classroom in the style of a news article as it appears on the front page of a newspaper. Discuss how newspaper reporters need to weigh all the information against each other before drawing general conclusions. Then compare your summaries with each other. How similar are they? Where are the differences? Why do these differences exist?

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