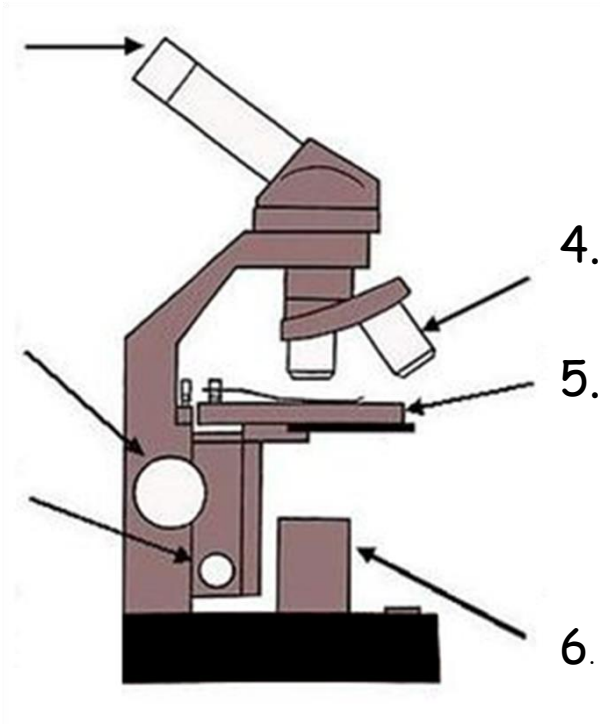
Microscopes

To look at very small things in science we use microscopes. The working parts of a microscope are shown on the diagram on the right:

1. Eye piece lens
2. Rough focus
3. Fine focus
4. Objective lens
5. Stage
6. Light source



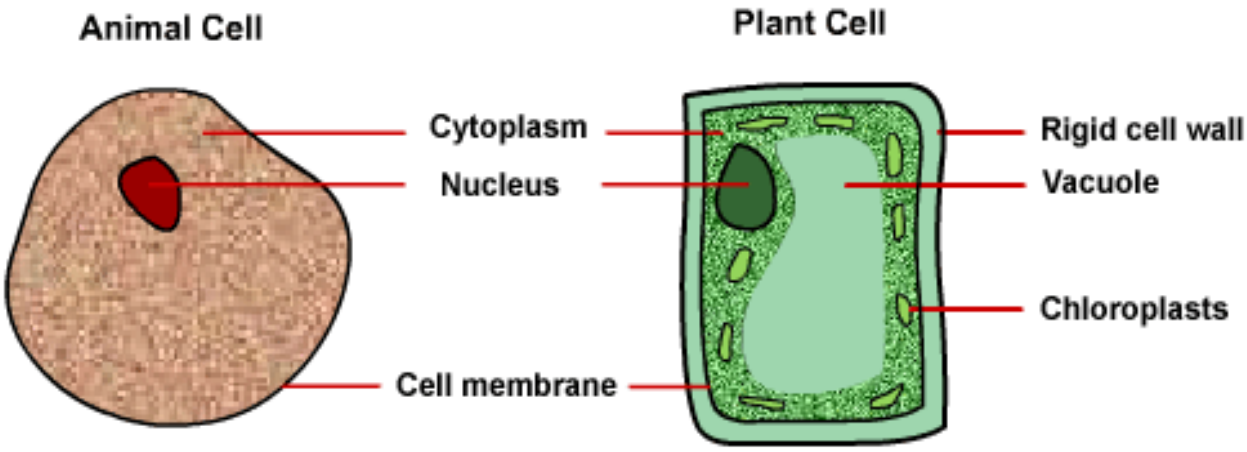
The **magnifying power** of the microscope is found by multiplying the power of the eyepiece by the power of the objective lens.
So, a 10x eyepiece with a 40x objective lens will give a total magnification of 400x.
The stage is the part of the microscope where the glass slide rests. The focus control gives a sharp picture.

Cells

The microscope allows us to examine the microscopic units of living things. These are called **cells.** Cells are the basic units of life. Every living thing is made up of one or more cells. Most animals and plants are made up of many cells. The average human body contains 6,000,000,000,000 (6 million million) cells. Some simple animals are made of only one cell, they are said to be **unicellular**. Animal and plants made of many cells are called **multicellular**.

Animal Cells

Most animal cells are microscopic— they are too small to be seen with the naked eye. They all contain a **nucleus**, which contains a chemical called DNA which contains all the information needed to make a new animal. The nucleus controls the cell activities. The cell is filled with a liquid called the **cytoplasm** which is the site of all chemical reactions. Finally the cell is covered with a tough but flexible cover called the **cell membrane** which controls the entry and exit of substances in the cell.

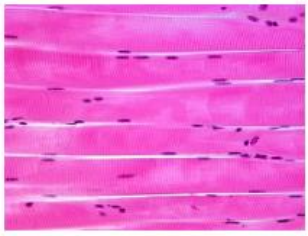


Plant Cells

Plant cells are very similar to animal cells, containing a nucleus, cytoplasm and a cell membrane. They also contain a tough and rigid **cell wall** which supports the cell. At the centre of the cell there is the **vacuole** which supports the cell, stores water and solutes. **Chloroplasts** are present in green plants to trap light energy for making food by photosynthesis.

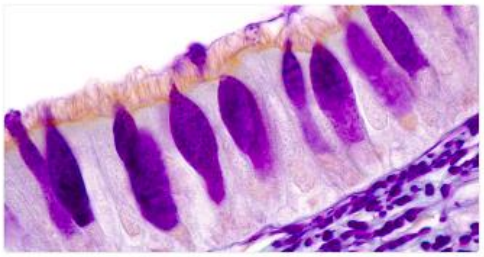
Variety of Cells

In order to carry out all functions, animals and plants require a variety of cell types (around 200 in humans) with different structures and functions.



Muscle cells

Leaf cells



Goblet cells in stomach

Body Systems and the Associated organs

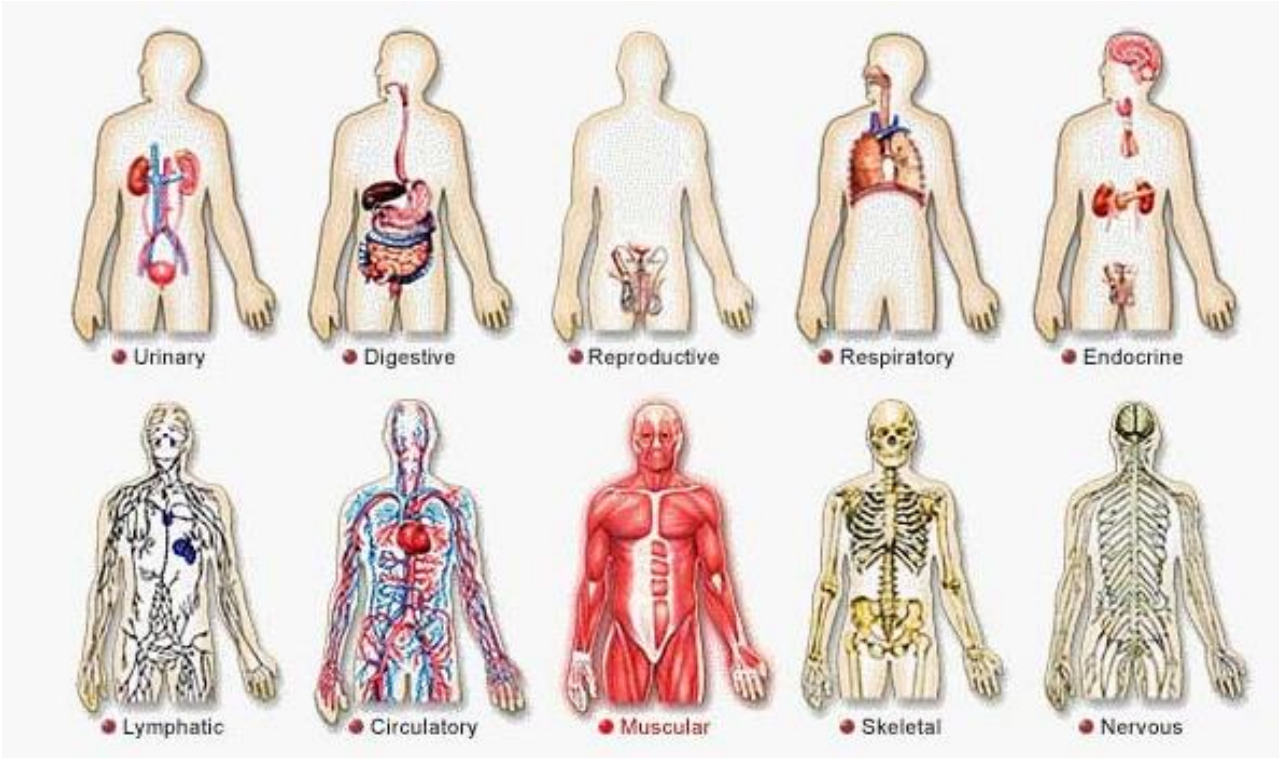
Organisation in the Body

Cells > Tissues > Organs > Systems > Body

What is a body system?

A group of organs that work together to perform a certain task. The human body is made up of several body systems working together.

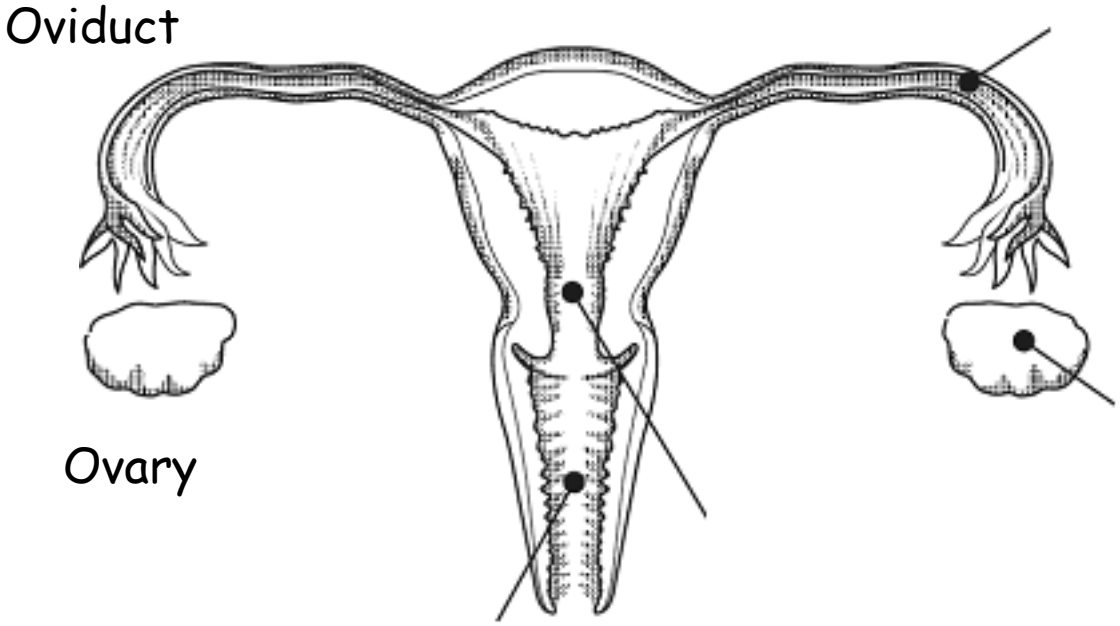
An **organ** is a structure that is composed of different kinds of tissue that performs a specific job. Tissue is made up of a group of specialised cells that cooperate to perform a specific job, e.g. muscle tissue is made up of muscle cells.


Urinary
Digestive
Reproductive
Respiratory
Endocrine
Lymphatic
Circulatory
Muscular
Skeletal
Nervous

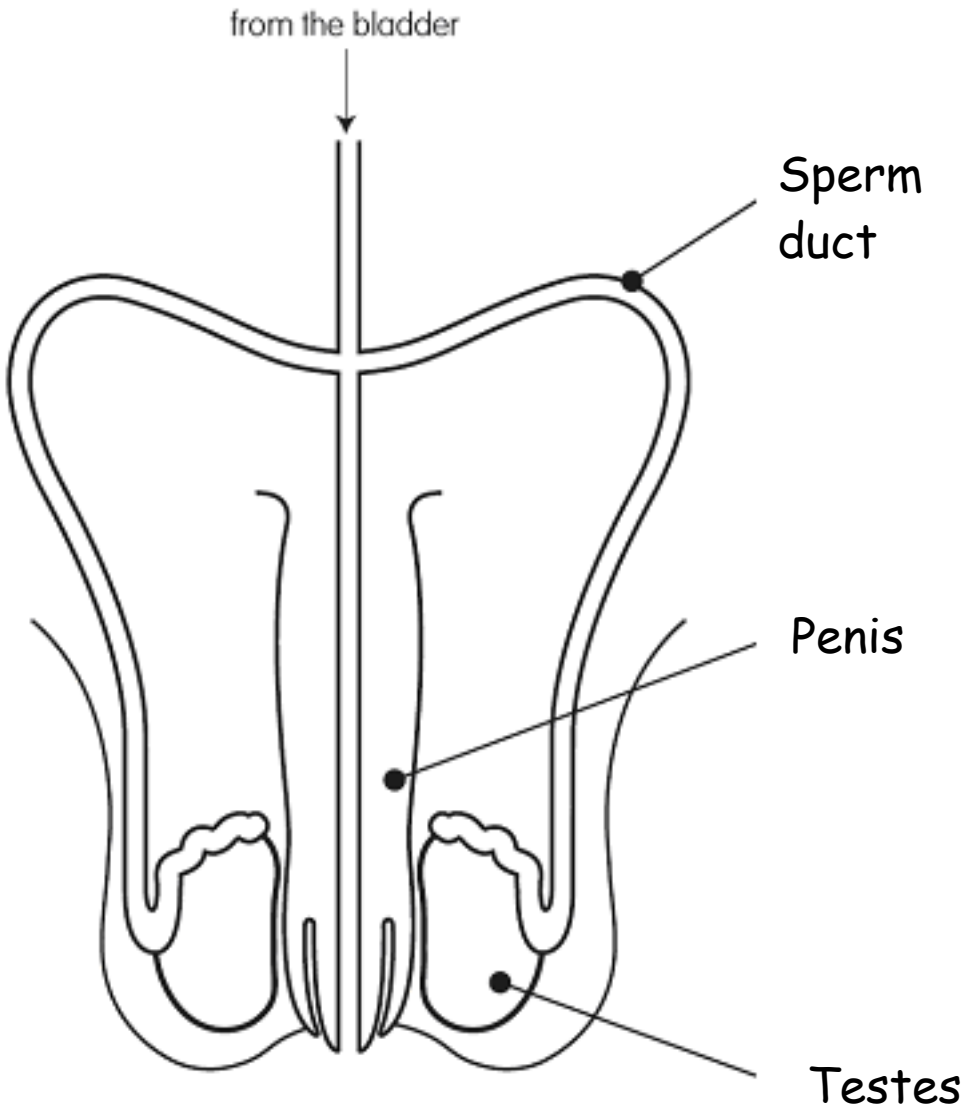
SYSTEMS	ORGANS	FUNCTIONS
Respiratory	lungs, nasal, bronchi, trachea, diaphragm, bronchioles	intake of oxygen and removal of carbon dioxide from body
Nervous	spinal cord, brain, nerves, skin, eyes, ears, tongue, nose	control of body activities and the reaction to stimuli
Digestive	stomach, liver, teeth, tongue, pancreas, intestine, oesophagus, skin, kidneys, bladder, ureters,	break down of food and absorption for use as energy and controls water balance
Reproductive	pituitary gland, adrenal gland, thyroid gland, sex organs	production of hormones and body regulation
Skeletal and muscular	bones, muscles	protection and movement
Circulatory	blood, blood vessels, heart,	transport of nutrients, metabolic wastes, water, salts, and disease fighting cells
Immune	skin	protection of body from injury and bacteria, maintenance of tissue moisture, holds receptors for stimuli response

Reproduction in Humans

In humans the female gamete (sex cell), the **egg** is produced in the ovaries. Normally only one egg is released every month. If this egg is not fertilised within 24 hours of being released from the ovary it will die.



In humans the male gamete (sex cell), the **sperm** is produced in the testes. The sperm travels from the testes in the sperm tube to the penis.

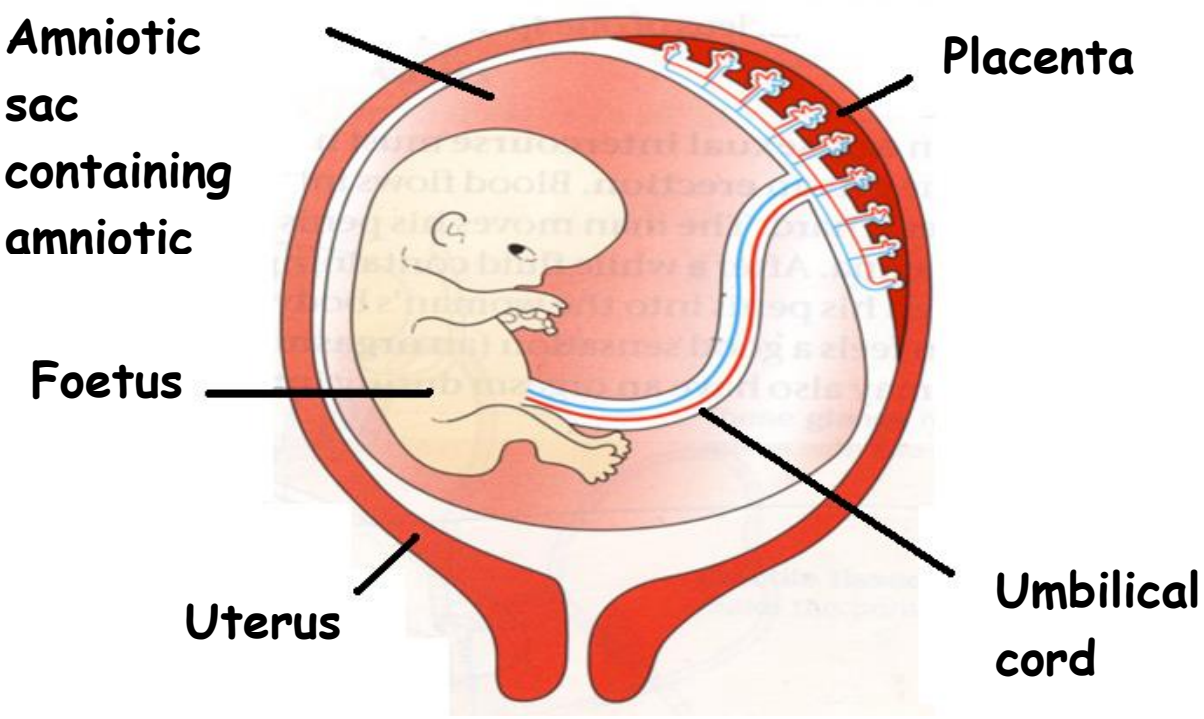


Fertilisation

Fertilisation is the fusion of the male gamete nucleus and female gamete nucleus which occurs in the oviduct.

If the egg cell is fertilised it will continue down the oviduct until it reaches the uterus. The fertilised egg cell will then attach to the wall of the uterus. The egg cell continues to divide and develop to form

a foetus. The growing foetus is shown in the diagram:



The foetus gets all the food and oxygen it needs from its mother's blood via the **placenta**. These substances
dissolve into the baby's blood and travel to the baby through the **umbilical cord**. Waste products from the baby's blood are removed into the mother's blood via the placenta.

The baby grows inside a fluid filled sac called the **amniotic sac**. This is filled with amniotic fluid, a liquid which cushions the growing foetus. The time from fertilisation until birth is called the **gestation**

period. In humans this is nine months. Smaller animals generally have shorter gestation periods, whilst larger animals such as elephants have longer gestation periods.

When the baby is ready to be born the amniotic sac ruptures and the fluid drains away. The strong muscles of the uterus then contract, helping to push the baby out of the uterus into the vagina (birth canal). After the baby is born the umbilical cord is cut.

There are a **number of risks** to a developing foetus. These include: smoking, diseases, poor diet, alcohol & medication.

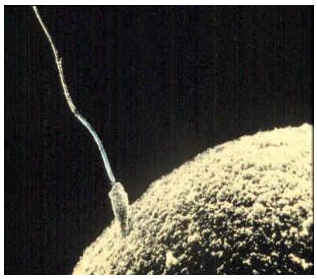
Twins

Non- identical twins form when 2 eggs are released and both are fertilised by two different sperm

Identical twins are formed when the fertilised egg (zygote) immediately splits into 2 identical zygotes.

One sperm enters the egg.

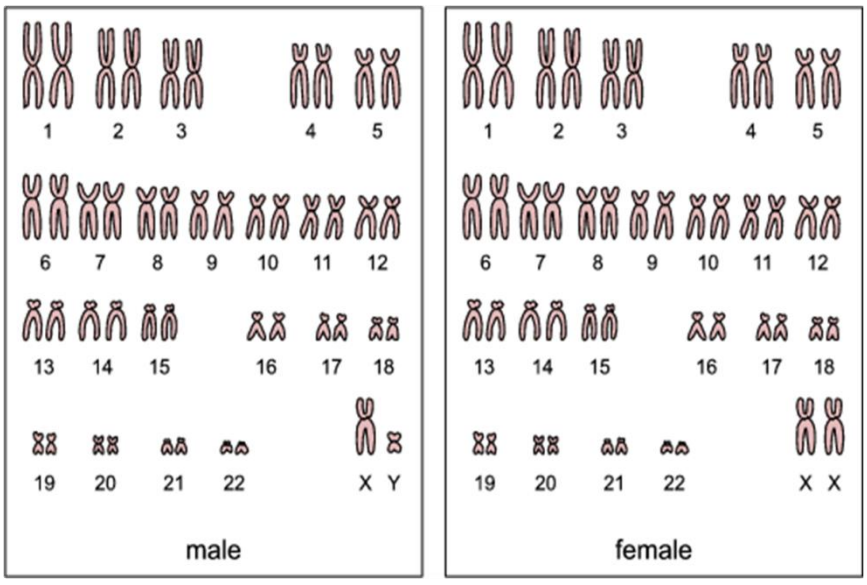
The nuclei join and the egg is fertilised.



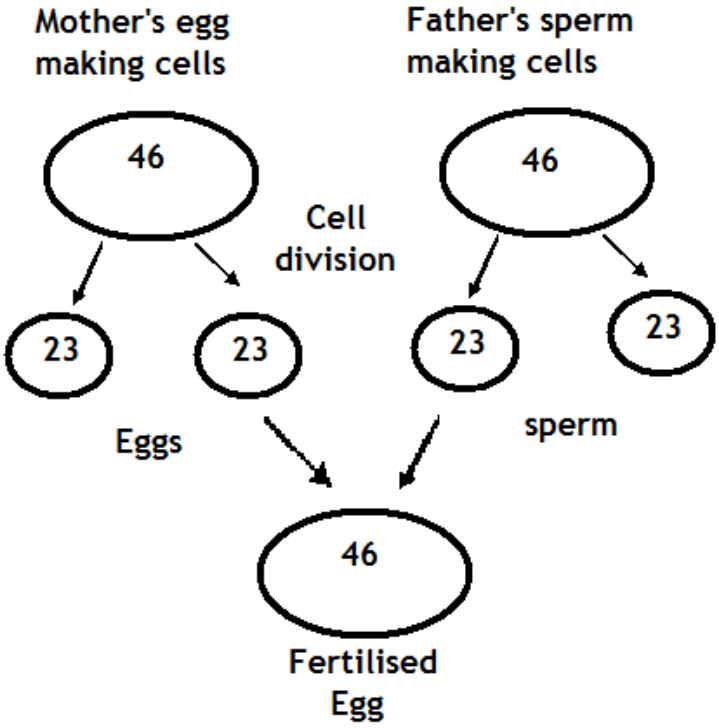
Genetics

Genetics is the **study of inheritance**. Inside the **nucleus** of most living cells (including sex cells) there is a special set of **instructions**, which holds the plans for making a new baby. These instructions are found on structures called **chromosomes**, which look like tiny pieces of thread. You can see a full set of human chromosomes in the diagram below.

There are **23 pairs** of chromosomes in human cells. This means that there are **46 single** chromosomes in human body cells. The 23rd pair of chromosomes are the sex chromosomes and determine a person's sex. Females have 2 X chromosomes (XX) and males have an X and a Y chromosome (XY).



Instead of having a normal full set of instructions, the sex cells only have half a set.



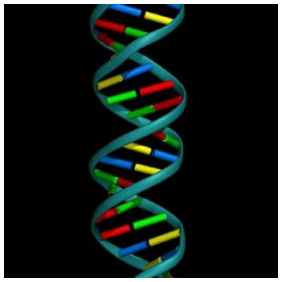
They must somehow get a full set in order to make a new baby. This happens when the egg and sperm meet at **fertilisation**.

A fertilised egg has 23 chromosomes from the father and 23 from the mother. It will grow in to a baby, which has **inherited** half its features from its mother and half from its father.

The chromosomes contain genes which decide features like eye colour, hair type, skin colour and height. The egg from the mother will always have an X chromosome, the sperm from the father will have either an X or Y chromosome.

If a sperm with an X chromosome meets an egg with an X chromosome then the baby will have two X chromosomes and so be female.

DNA in cells is actually double strands of DNA in a double helix. DNA is made up of 4 bases: A,T,C,G. Together they form pairs:
A always pairs with T
C always pairs with G



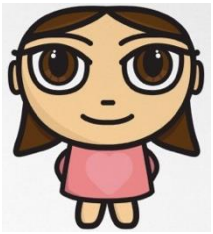
DNA is unique to each person. Scientists can analyse DNA using a process called **electrophoresis** to help solve crimes.

This is called a DNA profile.
DNA profiling can also be used for paternity tests and to check for genetic disorders, such as cystic fibrosis.

Genes

Genes code for proteins which control characteristics such as hair colour and eye colour. Because we have 2 copies of each of our 23 chromosomes, this means we have 2 copies of each gene. We have over 30,000 genes in our DNA.

If you have 2 copies of the gene for blue eyes then plainly you will have blue eyes. Should you have 2 copies of the gene for brown eyes then you will have brown eyes. But what if you have 1 copy of the gene for brown eyes and 1 copy of the gene for blue eyes? Will you have 1 brown eye and 1 blue eye? No, you will have brown eyes.



Brown Eyes

The girl might have 2 copies of the gene for brown eyes. Or might have 1 gene for blue and 1 for brown.

Blue Eyes

The girl must have 2
copies of the gene for blue eyes.

Dominant and Recessive Genes

The gene for brown eyes seems to dominate the gene for blue eyes. We say that the gene for brown eyes is **dominant** and the gene for blue eyes is **recessive**. There are many other examples.

The gene for curly hair is dominant and the gene for straight hair is recessive. A person with straight hair

must have 2 copies of the gene for straight hair. A person with curly hair could have either:
i) 2 copies of the gene for curly hair OR
ii) 1 copy of the gene for straight hair and one copy of the gene for curly hair

Continuous and Discrete Variation

All living things show variation. People show variation in height and hair colour, ability to roll tongues, are right or left handed and have different masses. Scientists say that there are 2 types of variation. Continuous and discontinuous.

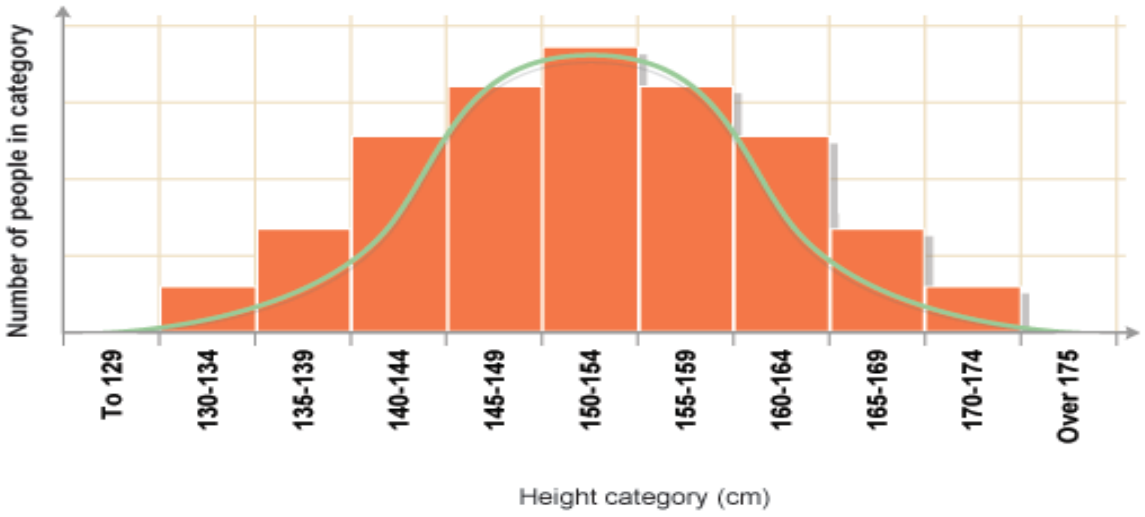
Continuous variation

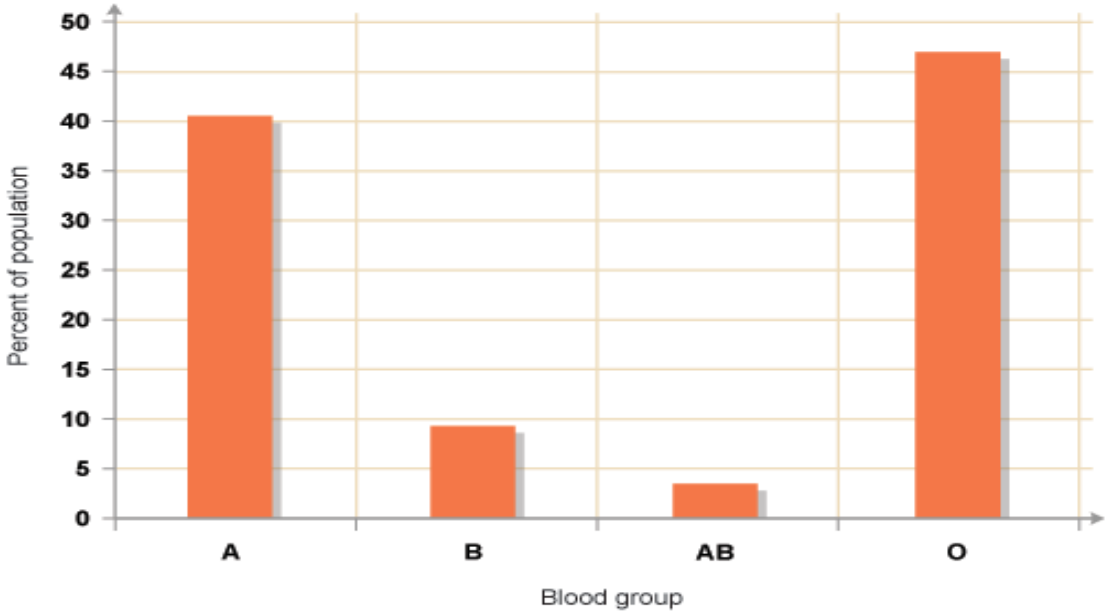
This is best explained by looking at height.
People have a range of heights. If we measure the height in cm of all the pupils in a class and draw a graph the data may represent a bell-shaped curve.

Discrete Variation

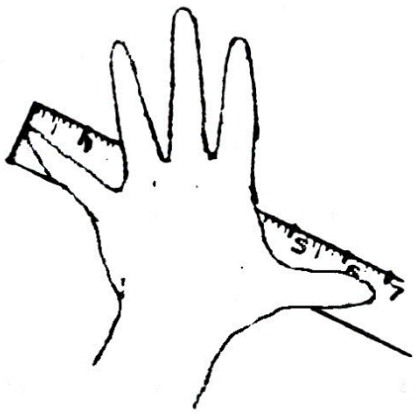
This is where the data does not exist in ranges but can be used to divide a population into distinct groups.
An example could be the type of blood group.

Eg. A, B, AB or O. a person belongs to.

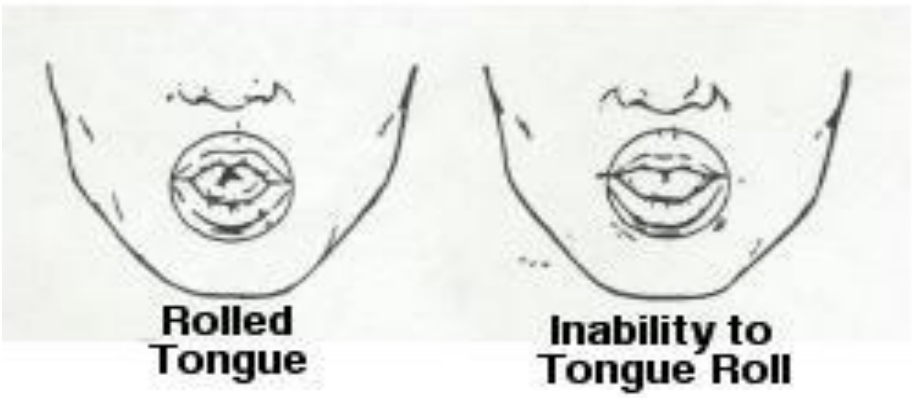




Measuring **handspan** is an example of demonstrating **continuous** variation.



The ability of whether or not you can **roll your tongue** is an example of **discrete** variation.



Body Systems and Cells learning outcomes

At The End Of This Topic You Should Know:

Cells

- ☐ Identify the stage, objective lens, and eyepiece and focus control on a microscope.
- ☐ The magnification of a microscope is calculated by multiplying the magnification of the objective lens and eyepiece.
- ☐ All living things are made of cells, which are the basic unit of life.
- ☐ Most cells are so small (0.1mm) that they can only be seen with a microscope.
- ☐ Be able to identify the nucleus, cell membrane, cell wall, vacuole, chloroplast and cytoplasm in a plant cell.
- ☐ Be able to identify the nucleus, cell membrane and cytoplasm in an animal cell.
- ☐ In addition to a nucleus, cell membrane and cytoplasm, plant cells also have a vacuole, cell wall and chloroplasts.
- ☐ Describe the functions of the nucleus, cell membrane, cell wall, vacuole, chloroplast and cytoplasm.
- ☐ Some organisms are made up of only one cell (i.e. bacteria and *Amoeba*) and are called unicellular organisms.
- ☐ Other organisms are made up of many cells and are called multicellular organisms.

Body Systems

- ☐ The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.
- ☐ Each organ system has a specific role in the body e.g. the digestive system digests food.
- ☐ Organ systems may contain several organs e.g. digestive system contains the stomach, small intestine, large intestine.
- ☐ Organs are made up of different tissue types e.g. muscle tissue.
- ☐ Groups of specialised cells cooperate to form a tissue, such as a muscle.
- ☐ Specialised cells perform specific functions in multi-cellular organisms
- ☐ Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

Fertilisation and embryonic development

- ☐

- A young animal, growing inside an egg or its mother is called an embryo.

☐ Animals produce two types of sex cells (gametes).

☐ The male gamete in animals is called a sperm cell and is produced within the testes.

☐ The female gamete in animals is called the egg cell (ovum) and is produced within the ovaries.

☐ Fertilisation takes place in the oviduct (fallopian tubes).

☐ When the egg is fertilised by a sperm cell it will begin to grow into a new animal.

☐ The fertilised egg (zygote) divides into a ball of cells and is then called an embryo.

☐ In mammals, the young grows and develops inside the mother's womb (uterus).

☐ The embryo's blood flows though the umbilical cord to the placenta and back again.

☐ The embryo obtains its food and oxygen from the mother's blood via the umbilical cord, which is attached to the placenta.

☐ The exchange of food and oxygen happens in the placenta.

☐ The baby's waste products pass from the baby to the mother through the umbilical cord.

☐ The developing baby is cushioned in a bag, called the amniotic sac filled with amniotic fluid.

☐ The length of time a young animal spends growing and developing within its mother's womb is called the gestation period.

☐ The gestation period in humans is 9 month (approximately 40weeks).

☐ Alcohol, smoking and drugs can cause risks to the embryo.

DNA and Genetics

☐ Continuous variation relates to characteristics which can be measured i.e. height, hand span, body mass etc.

☐ Discontinuous variation relates to characteristics which can not be measured and can be used to split a population into distinct groups i.e. ability to roll tongue and blood group.

☐ The study of inheritance is called genetics.

☐ Information which determines our characteristics like hair and eye colour is stored in chromosomes, which are found in the nucleus of living cells.

☐ All living organisms have a characteristic number of chromosomes, called the chromosome complement.

☐ Normal human cells have 46 chromosomes.

☐ Sperm and egg cells have only 23 chromosomes.

☐ Chromosomes are structures which are made up of thousands of genes, joined in a particular order.

☐ Genetic information is organised into genes, which are made of DNA.

☐

- Genes code for proteins that determine our appearance i.e. eye colour and control our cells' activities.

☐ The sex of a baby is determined by the 23rd pair of chromosomes called the sex chromosomes. Two X chromosomes will produce a girl, an X and Y chromosome will produce a boy.

☐ Genes can be dominant or recessive and know the meaning of these terms.

☐ Humans have approximately 30 000 genes.

☐ DNA is found in all living organisms.

☐ DNA contains the chemical code for genetic information, like a set of instructions to make a living organism.

☐ DNA has a double helix structure, which means that it is made up of two strands, like a ladder that has been twisted into a spiral.

☐ DNA contains 4 chemical bases: A, G, T, and C.

☐ A always pairs with T; G always pairs with C.

☐ The order of these chemical bases on a DNA molecule carries a unique genetic code, like a set of blue-prints for an entire organism.

☐ Every human has their own unique DNA, apart from identical twins.