

# Science Interactive LTD

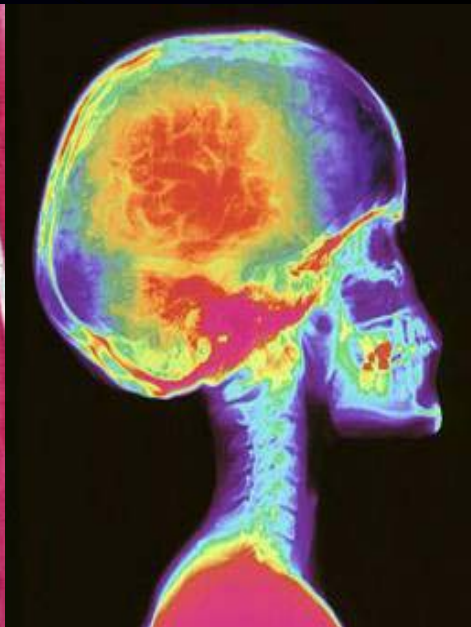
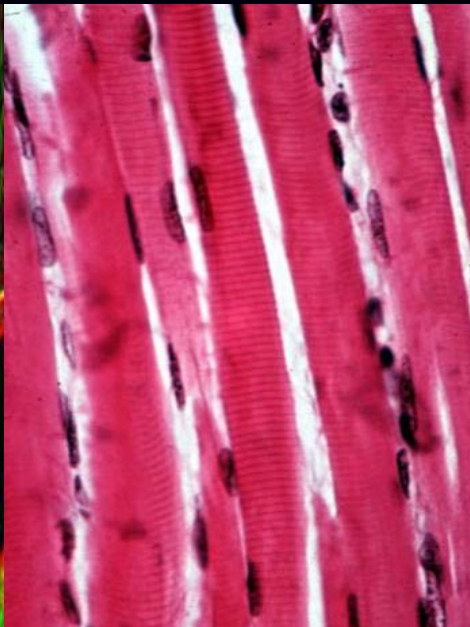
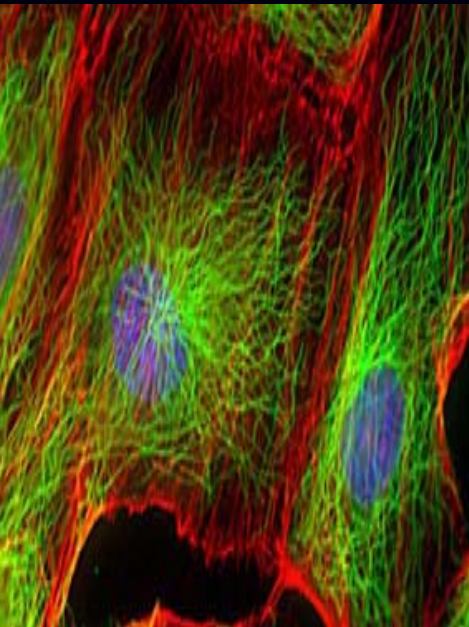
**Science base multimedia CD-ROM for PC** is a collection of **38 units or tools** totalling over **1150 PowerPoint slides**. Each unit covers a wide range of different delivery and learning styles, offering an exciting way to involve your pupils during lessons or revision sessions. All styles of teaching and learning are supported through use of **high quality images, graphics, challenging exercises** and **questions**. Units can be used in the classroom via an **interactive whiteboard**, data projector or used during individual study via a PC or **school network**.



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## Unit 38

# Cells, Tissues, Organs and Organ Systems

## Understand:

1. That cells are the basic building blocks of all life on Earth.
2. That animals and plants consists of many billions of cells.
3. Some examples of specialised cells in animals and plants.
4. That animal and plant cells contain many organelles with specific cellular functions, some shared and some different.
5. That in all organisms; cells build tissues, tissues build organs and organs build organ systems.
6. The different organ systems found in humans.
7. The different organ systems found in plants.
8. That in plants and animals, all the organ systems function together to support life in the organism.

## Keywords:

Animal, Plant, Organelles, Cell, Tissue, Organ, Chloroplast, Cell Membrane, Nucleus, Cell wall, Mitochondria, Cytoplasm, Genes, Vacuole, Function, Specialised, Organism, Cardiovascular, Nervous, Reproductive, Endocrine, Muscle, Skeletal, Excretory, Respiratory & Digestive.



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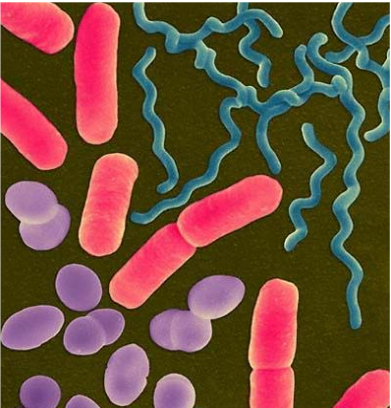



# Numbers of cells

Cells are the building blocks of all life. Unlike simple bacteria and other unicellular organisms, living organisms contain from **many millions** to **billions** of cells. Cells can have a very wide range of functions in the human body from skin cells, blood cells, muscle cells to nerve cells. Cells can only be viewed using a light microscope. Robert Hook was the first scientist to observe plant and animal cells using a simple light microscope over 300 years ago.

*List the cell types that you have observed under a light microscope ?*

## Numbers of cells in living organisms:

Word bank: function microscope

Organism	Bacteria	Insect	Small mammal	Human
Diagram				
Notes	A bacteria is a simple, single celled organism. All the bacteria found on the surface of this planet weigh more than any other species. They are very successful.	A typical insect like a fly or a bee contains many hundreds of thousands of cells. Insects have very basic organ systems that support life and allow insects to reproduce.	A small mammal, for example a rat contains many millions of cells organised into nine distinct organ systems similar to our own. <i>List these organ systems ?</i>	A human contains many billions of cells. Each hour of every day of our lives, we replace over <b>one billion cells</b> in our body. During puberty we produce even more cells.



# Plant and animal cells

All animal and plant cells have **cell parts** or **organelles** in common, for example the nucleus. Plants cells contain unique cell organelles involved in p\_\_\_\_\_. Each cell organelle performs a specific function within the cell.

Word bank: photosynthesis glucose

Cell	Animal	Plant
Diagram		


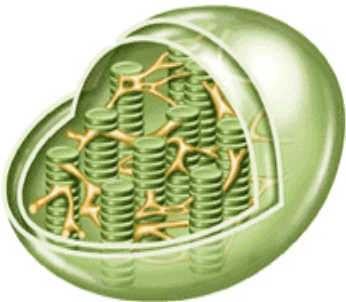
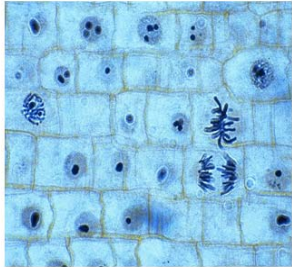
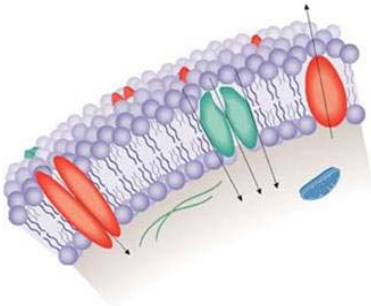
Cell part	Function
Nucleus	Controls cell activity and contains cell genes.
Mitochondria	Respires g_____ and oxygen.
Cell membrane	Gives the cell shape and controls the passage of molecules in and out of the cell.
Cytoplasm	Essential chemical reactions take place here.
Cell wall	Made from cellulose, it strengthens the cell in the plant.
Vacuole	Contains a sugary liquid called cell sap.
Chloroplast	Found in cells that carry out photosynthesis; contains chlorophyll.

# Essential cell organelles

Cell organelles, like mitochondria and chloroplasts carry out important functions in plant and animal cells. The nucleus controls the activity of the cell by building new p\_\_\_\_\_ including enzymes. It also contains DNA, the material of inheritance and is able to trigger and control the production of new daughter cells during cell division or mitosis. *Mitochondria* found in both plant and animal cells respire glucose with o\_\_\_\_\_ releasing cellular e\_\_\_\_\_, carbon dioxide and water. *Chloroplasts* found only in plant cells produce glucose and oxygen from carbon dioxide and water.

## Cell organelles in plants and animals:

Word bank: proteins oxygen energy

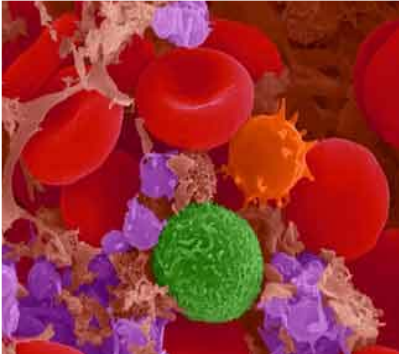

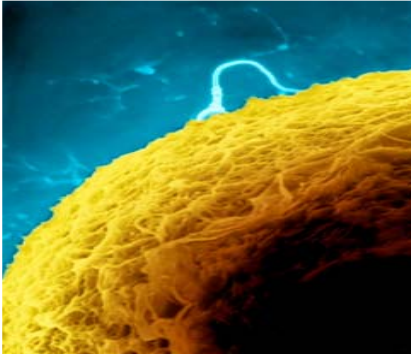
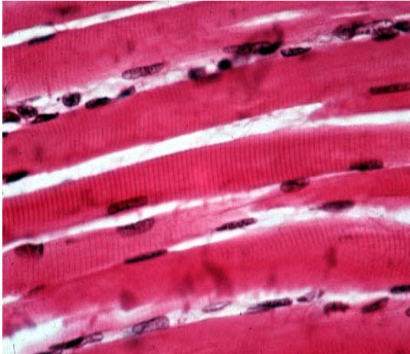
Organelle	Mitochondria	Chloroplast	Nucleus	Cell membrane
Diagram				
Function	Mitochondria are found in both plant and animal cells. They respire glucose with oxygen to release energy for cellular activities. They release CO <sub>2</sub> and water.	Found only in plant cells, chloroplast are able to combine carbon dioxide and water using the energy from light to produce glucose and oxygen.	The cell's nucleus contains the necessary genetic information or genes to produce new cells, new enzymes and new proteins. Humans have over 31,000 genes.	The cell membrane controls the passage of substances in and out of the cell. Movement of molecules happens by passive diffusion or active uptake.

# Specialised cells in animals

Cells are designed for the *specific functions* they play in the human body as part of the billions of cells that work together to support life. A *nerve cell* for example is long and t\_\_\_\_\_ and conducts e\_\_\_\_\_ impulses. A red blood cell has a large surface area and no n\_\_\_\_\_, so it can transport the maximum amount of oxygen from the lungs to the rest of the body. A muscle cells contains many more mitochondrial organelles than normal cells and are able to contract producing movement. *How is a sperm specialised to perform its function ...List three things ?*

## Specialised cells in animals:

Word bank: thin electrical

Cell	Red blood cell	Nerve cell	Sperm cell	Muscle cells
Diagram				
Notes	Red blood cells contain haemoglobin, have a biconcave shape and no nucleus. They carry oxygen from the lung surface to the rest of the body.	Nerve cells form connections with other nerve cells and are able to carry impulses along a huge neural network that connect and coordinate our actions and thoughts.	Sperm cells can propel themselves locating the female egg cell prior to fertilisation as well as carrying paternal DNA. They also have a streamlined head.	Muscle cells contract providing movement. They are also rich in mitochondria. This allows them to respire glucose with oxygen producing energy.

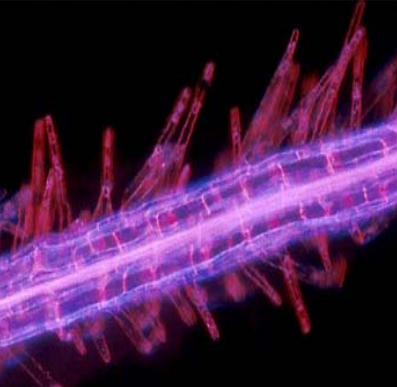
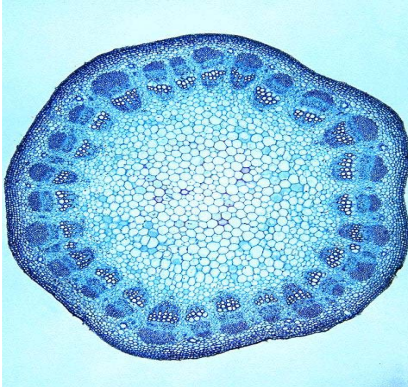

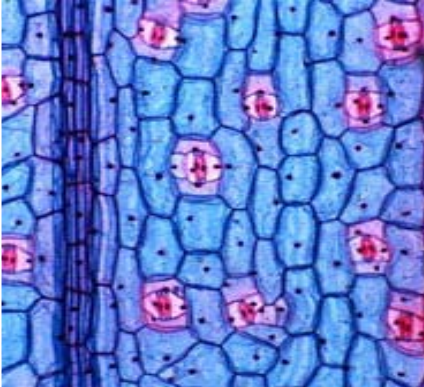


# Specialised cells in plants

As in animals, plant cells are also designed for the function they play as part of the millions of cells that work together to support life and produce food in green plants. A *root hair cell*, for example is long and extremely thin to aid the uptake of w\_\_\_\_\_ and dissolved minerals like nitrates and phosphates from the s\_\_\_\_\_. The leaf palisade cell contains many chloroplast organelles which, during photosynthesis produces glucose and o\_\_\_\_\_ from carbon dioxide and water. *Which other cells have large surface areas to aid absorption ?*

## Specialised cells in plants:

Word bank: water soil oxygen

Cell	Root hair cell	Xylem cells	Pollen cell	Stomata cell
Diagram				
Notes	Millions of root hair cells with a huge surface area take in mineral rich water from the soil for photosynthesis and healthy growth.	Water moves up the stem through the xylem vessels. They are long tubes reaching from the roots to the leaf tissue. Water moves in xylem cells by capillary action.	Pollen cells, the male gametes in plants are normally transferred to the female carpel by insects. Pollen carries the genetic information to create a new plant.	Stomata cells found on the underside of green leaves allows the exchange of water, carbon dioxide and oxygen through the leaf during photosynthesis.

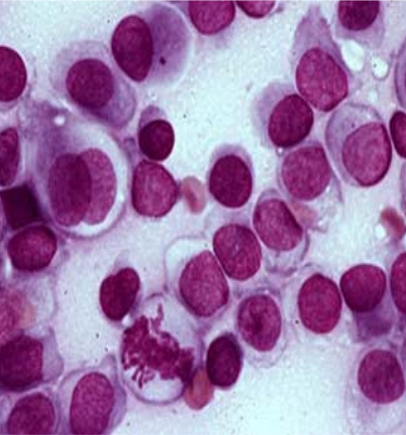


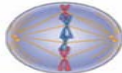
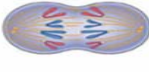


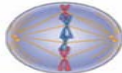
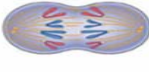


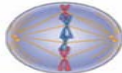
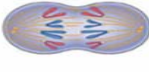



# Cell size in plants and animals

Cells in plants and animals vary in size. To visualize plant or animal cells we need to use a m\_\_\_\_\_. Animal cells on average tend to be *smaller* and *less regular* in shape, when compared to plant cells. Both plant and animal cells grow and divide before becoming too large. Cells that are too large will have a reduced *surface area* to *volume ratio*. A small surface area to volume ratio reduces the amount of o\_\_\_\_\_ and nutrients that can be absorbed across its surface. Cells must then divide or die. This is called *mitosis*.

## Cell size and mitosis:

Word bank: microscope oxygen


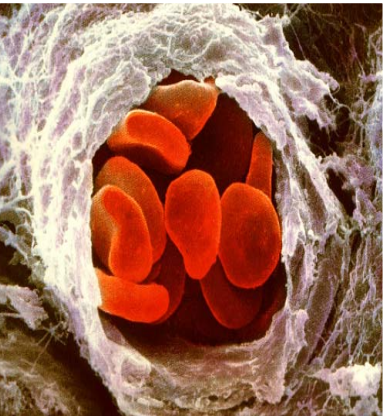
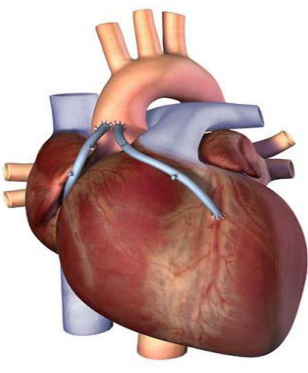
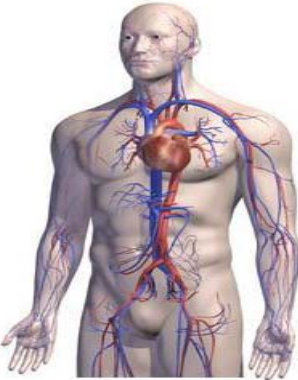
Cell	Typical animal cells	Typical plant cells	Cell division in plants and animals																
Diagram			<p style="text-align: center;"><b>Mitosis</b></p> <table border="1"> <tbody> <tr> <td>Stage one</td> <td></td> <td>2n</td> <td>Parent cell</td> </tr> <tr> <td>Stage two</td> <td></td> <td>4n</td> <td>DNA replicates</td> </tr> <tr> <td>Stage three</td> <td></td> <td>2n</td> <td>Chromosomes separate</td> </tr> <tr> <td>Stage four</td> <td></td> <td>2n</td> <td>2 Daughter cells</td> </tr> </tbody> </table>	Stage one		2n	Parent cell	Stage two		4n	DNA replicates	Stage three		2n	Chromosomes separate	Stage four		2n	2 Daughter cells
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Notes	<p>Photograph of human cheek cells. They are <i>magnified 250 times</i>. Use a ruler to measure their length. Now divide by 250 to find their real size in cm.</p>	<p>Photograph of plant palisade cells. They are <i>magnified 100 times</i>. Find their size using the same method. <i>Are they smaller or larger than human cheek cells?</i></p>	<p>As the cell volume increases, the ratio of <i>surface area</i> to <i>volume ratio</i> decreases reducing the cells' ability to allow sufficient nutrients and oxygen across the cell membrane. Cells are able to divide and clone themselves during mitosis. Over a billion cells an hour are replaced in your body by cells dividing.</p>																

# Levels of organisation in humans

Similar cells performing similar functions are organised into **tissues**, for example *muscle tissue is made from identical muscle cells*. An **organ** consists of different tissues working together to perform a specific function, for example *the heart is a collection of tissues like muscle, valves and tendons*. These tissues all work together, to pump blood continuously around the human body. Different **organs** work together as part of an organ system. There are nine organ systems supporting life in humans. *List the nine organ systems found in the human body and give their function ?*

## Cells, tissues, organs and organ systems:

Word bank: oxygen carbon white

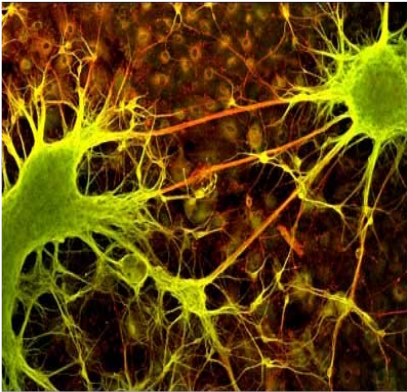

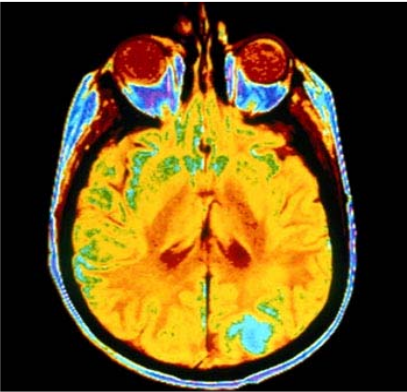

Part	Cells	Tissues	Organs	Circulatory system
Diagram				
Notes	Cells like skin or sperm are highly specialised and are designed to do their job within the human body. <i>List 3 specialised cells ?</i>	Tissues like blood, muscle, skin and bone are a collection of cells working together to perform specific tasks in the human body.	Organs like the brain, heart, stomach and skin are a collection of tissues that function together. Many organs build an organ system.	The are nine organ systems within the human body that perform very specific roles that help support life. <i>Name these organ systems ?</i>

# The nervous system

The nervous system controls and coordinates all your conscious and subconscious actions. It coordinates different parts of your body so that they can work together to bring about the correct r\_\_\_\_\_. The main parts of the *nervous system* include your b\_\_\_\_\_, spinal column, peripheral nerves and sense organs, for example the eyes, ears and nose. The main building block of the nervous system is the *neuron* or *nerve cell*. *What is the other system which controls your body's actions ?*

## Nervous system:

Word bank: response brain

Cell	Nerve cell	Tissues	Organs	Nervous system
Diagram				
Notes	Nerve cells are very different from other cells. Their shape reflects their function. Part of the cell is stretched to form the axon which carries electrical signals.	Nervous tissue forms a complex number of pathways allowing communication from peripheral sensors to the brain and effectors like muscles and endocrine glands.	The brain is able to coordinate all actions of the nervous system. It is responsible for sensing stimuli, the environment, coordinating all reflexes, intelligence, our memory and speech.	The nervous system consists of the brain, the spinal cord and the many peripheral nerve cells. Together they function to coordinate and control all the aspects of human emotion and behaviour.

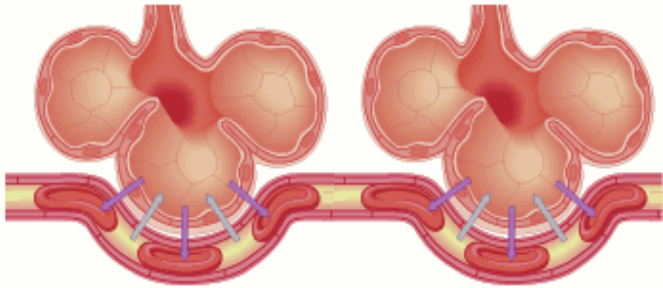
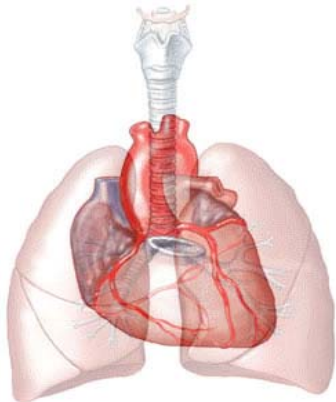
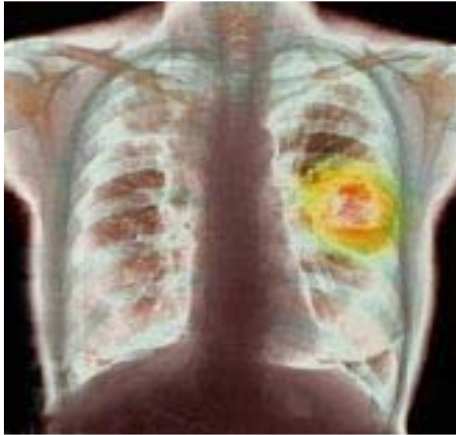


# The respiratory system

The respiratory system allows the exchange of gases between the lung surface and the atmosphere. The lungs are a collection of tubes including *alveoli tissue* which allows *oxygen* to diffuse into the blood and *carbon dioxide* to diffuse from the blood into the lung space. Each alveoli (air sac) is surrounded by a rich supply of blood capillaries to transport blood gases to and from bodily tissues. The average lung capacity of an adult male is around 5.5 litres. Lance Armstrong, the cyclist, who recently won seven Tour de France cycle races, has a lung capacity in excess of 7 litres. Females have a smaller lung capacity because of their smaller body mass.

## Respiratory system:

Word bank: tissue capillaries

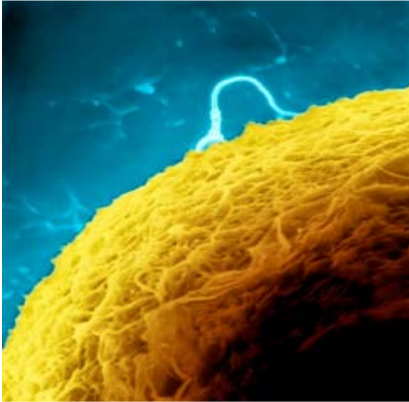

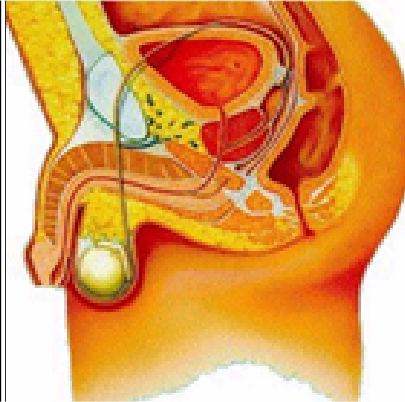
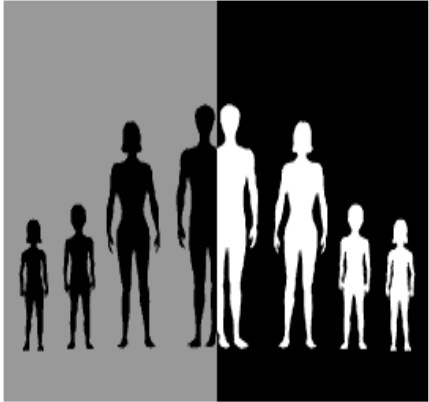
	Alveoli cells and tissues	Organs	Respiratory system
Diagram			
Notes	Alveoli cells are thin and moist to help gaseous exchange. There are many millions in a single lung, exchanging oxygen and carbon dioxide. The alveoli tissue has a large surface area to allow gaseous exchange between blood tissues and the atmosphere.	The lungs are a collection of tubes and alveoli tissue, all working together to supply the rest of the body with oxygen. The lungs also excrete carbon dioxide.	Other organs like the ribs, intercostals muscles and the diaphragm all function together during breathing, allowing the exchange of gases.

# The reproductive system

The reproductive system in males and females contain the organs that produce the sex cells or *gametes*: From puberty, males continuously produce sperm and females produce and release eggs, once monthly. Fertility is normally acquired during puberty when the t \_\_\_\_\_ begin to produce sperm and the o \_\_\_\_\_ begin to produce and release eggs. In males over *400 million sperm* are released during sexual intercourse. *Give three ways in which the sperm cell is specialised?*

## The reproductive system:

Word bank: testis ovaries


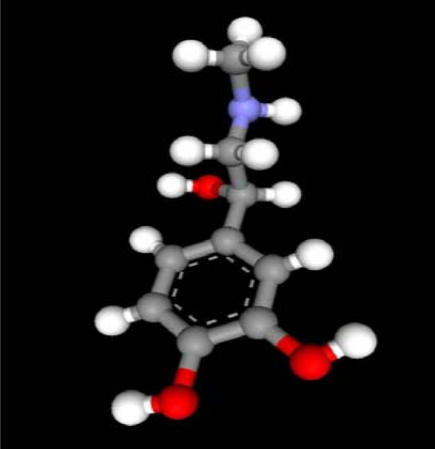
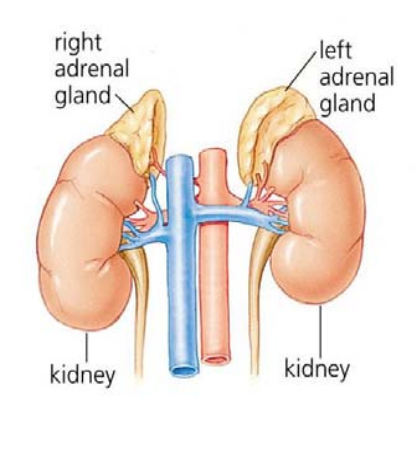
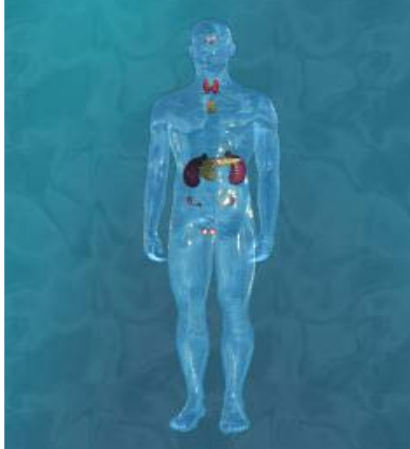
	Sperm cells	Testis tissue	Testis	Reproductive system
Diagram				
Notes	Many millions of sperm cells are released during male ejaculation. Only one sperm is needed for fertilisation to take place for the formation of the zygote and embryo.	Testis tissue make sperm every day. The sperm pictured above are stored before they travel through the sperm tube during ejaculation.	The testis are kept outside the body to keep their temperature low. Another function of the testis is to produce the male sex hormone testosterone.	The role of the male reproductive system is to produce, store and deliver millions of sperm cells to the female reproductive system during sexual intercourse.

# The endocrine system

The endocrine system synthesises and releases hormones into the b\_\_\_\_\_ to coordinated many basic functions in the human body. The *endocrine system* includes the pituitary and hypothalamus, the thyroid, testis, ovaries, adrenals and pancreas. Hormones are chemicals that act on target tissues that are away from their site of production. Insulin and glucagon control blood g\_\_\_\_\_, with both hormones being produced and released by the p\_\_\_\_\_. *How do doctors use hormones to increase and decrease fertility in women ?*

## The endocrine system:

Word bank: blood glucose pancreas

	Hormones	Adrenalin	Adrenal glands	Endocrine system
Diagram				
Notes	Adrenalin is a hormone that can elevate our stress levels as well as help us 'flight or fight' when at severe risk or danger.	Adrenaline is a typical hormone. It is dissolved in blood plasma and travels around the body searching for target tissues like the heart and muscle.	The adrenal glands which produce adrenalin are found on your kidneys. They produce adrenalin in response to your state of mind.	The endocrine system produces and releases hormones that coordinate many basic functions in the body. It is most active during puberty.



# The excretory system

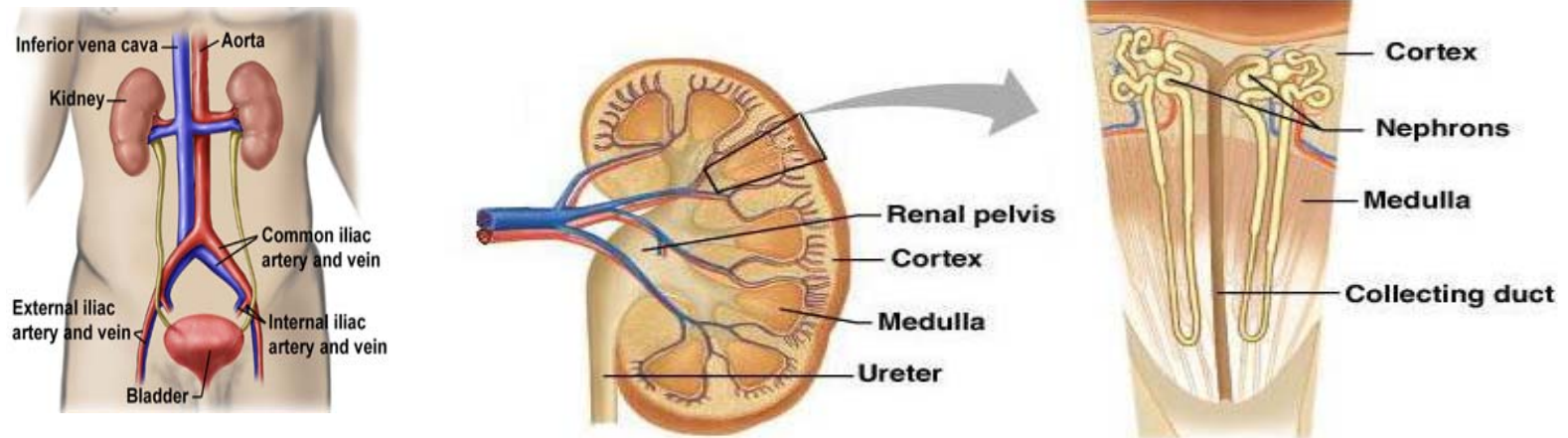
Like other organ systems, the excretory system is a collection of c\_\_\_\_, tissues and organs. Its main function is to control *water* and *salt* levels in the b\_\_\_\_\_ and bodily tissues and *excrete urea* from the breakdown of excess protein by the liver. If urea is allowed to remain and build up inside the body, it can prove fatal. The kidneys remove waste c\_\_\_\_\_ like urea from the blood by filtration. These waste substances, such as urea are removed from the body as urine.

## The excretory system:

Word bank: cells blood chemicals

### Overview of the excretory system

#### Diagram



#### Notes

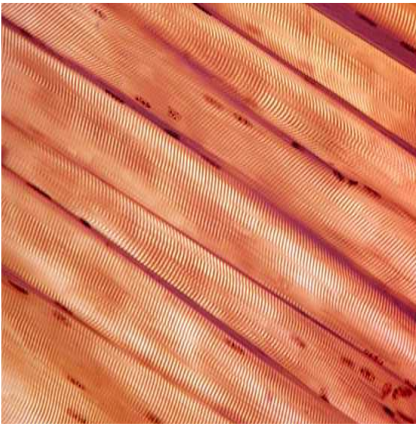

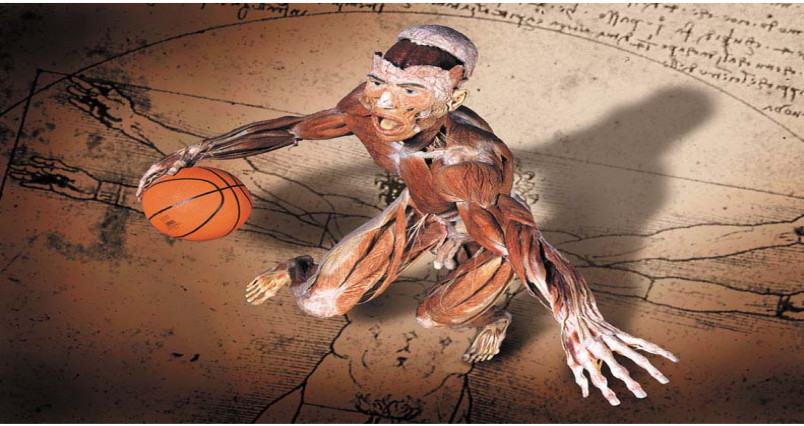
The organs of the excretory system all function together to clean the blood, store and get rid of urine. The bowman's capsule collects the blood filtrate containing urea, salt and water. There are thousands of tiny nephrons inside the kidney which function together to clean the blood. Urea is completely removed from the blood, with excess salt and water. This then forms urine which is then stored in the bladder. *What happens to you if your kidneys fail ?*

# The skeletal-muscle system

The *skeletal-muscle* system protects, supports and moves the human body. The main tissue types of the skeletal muscle system are muscle, t\_\_\_\_\_, ligaments and bone tissue. In the very long bones, inside the spongy tissues, all blood cells including *red blood cells* are also made. The skeleton, together with over 350 pairs of muscles allows movement of the body. Muscles work in pairs, for example the *triceps* and *b\_\_\_\_\_* move the lower arm. They work in pairs because muscles cannot push they can only contract or pull.

## The muscle system:

Word bank: tendon biceps

	Muscle cells	Humans as vertebrates	Muscle skeletal system
Diagram			
Notes	Muscle cells and tissues form long narrow striated tubes. There are three types of muscle tissue, cardiac, smooth and skeletal. They all work by contracting.	Ligaments, bone, tendon, muscle and cartilage are all found in the many joints that make up the skeletal muscle system and allow movement in the human body.	Inside the long bones of the legs is the marrow or spongy tissue which makes all our blood cells including white and red blood cells. The human muscle system contains 206 bones, over 350 muscles that contribute to protecting, supporting and moving the human body. <i>Why are there more bones found in newborn babies?</i>

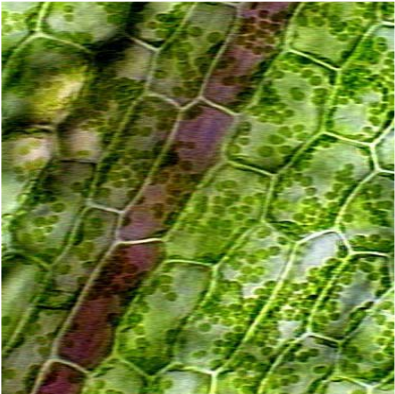





# Levels of organisation in plants

In plants, as in animals, similar cells performing similar functions are organised into tissues. Leaf palisade tissue consists of identical palisade cells functioning together to enable photosynthesis to occur. Palisade tissue alongside other tissues are found in the leaf. A leaf is an organ made up of many different tissues. Different organs work together as part of the entire plant organism. There are *four* distinct organs in a typical plant: The root system, the stem system, the leaf system and the reproductive system. *Name the function of each of the four organ system found in green plants ?*

## Cells, tissues, organs and organ systems in plants:

Word bank: leaf tissue

	Cells	Tissues	Organs	Organism
Diagram				
Notes	Cells are highly specialised and are designed to do their job within the plant. <i>List 3 specialised cells found in green plants ?</i>	Tissues like the palisade layer or stomata tissue are a collection of cells working together to perform specific tasks in the plant.	Organs are a collection of tissues like the leaf. Many separate organs build an organ system. <i>List 3 organs in the plant.</i>	The are four organ systems that support life in plants. All perform specific roles. <i>Which of these systems do not support photosynthesis ?</i>

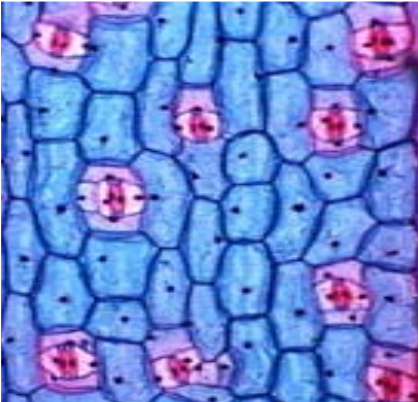

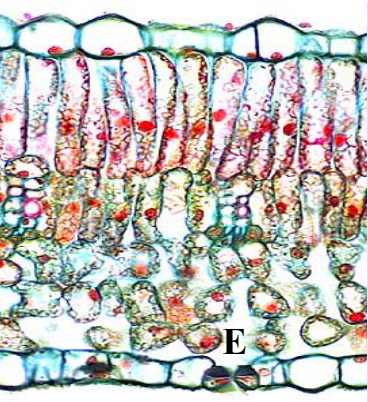



# Plant leaf system

A number of cells and tissues within the plant leaf play a role during photosynthesis whereby, water and carbon dioxide are used to produce g\_\_\_\_\_ and o\_\_\_\_\_. *Palisade cells* containing green c\_\_\_\_\_ are the main site of glucose production. *Xylem tissue* supplies water from the root and *phloem tissue* which transports glucose around the plant. Gaseous exchange during photosynthesis and respiration is controlled by the *stomata cells*. *Why are the stomata cells found only on the underside of the leaf?*

## Plant leaf system:

Word bank: glucose oxygen chloroplast

	Stomata cells	Xylem tissue	Plant leaf	Leaf system
Diagram				
Notes	Stomata found on the underside of the plant leaf allows gaseous exchange and water transpiration. They open during the day and remain closed during the night.	The xylem tissue transports water and minerals like nitrates from the root system to the leaf system via the plant stem. Phloem tubes transport sugary sap all around the plant.	The leaf is a collection of tissues: A: Upper epidermis B: Palisade layer C: Spongy mesophyll D: Lower epidermis E: Stomata	The leaf system is a collection of leaves that work together producing glucose and oxygen from water and carbon dioxide using the energy from the sun during daylight hours.





# Plant reproduction

Pollination is the transfer of pollen, the male sex cells from the a \_\_\_\_\_ of the stamen by b \_\_\_\_\_ or insects to the surface of the female c \_\_\_\_\_. Once the pollen sex cells have landed on the female carpel, *pollination* has been achieved. Flowering plants contain both female and male reproductive organs and can either self or cross pollinate. Following *fertilisation*, where the ovule and pollen cell fuse, the seed begins to develop surrounded by the swollen ovule which forms the f \_\_\_\_\_ . It is the function of the fruit to disperse the seed.

*What is this organ's role in the plant life cycle ?*

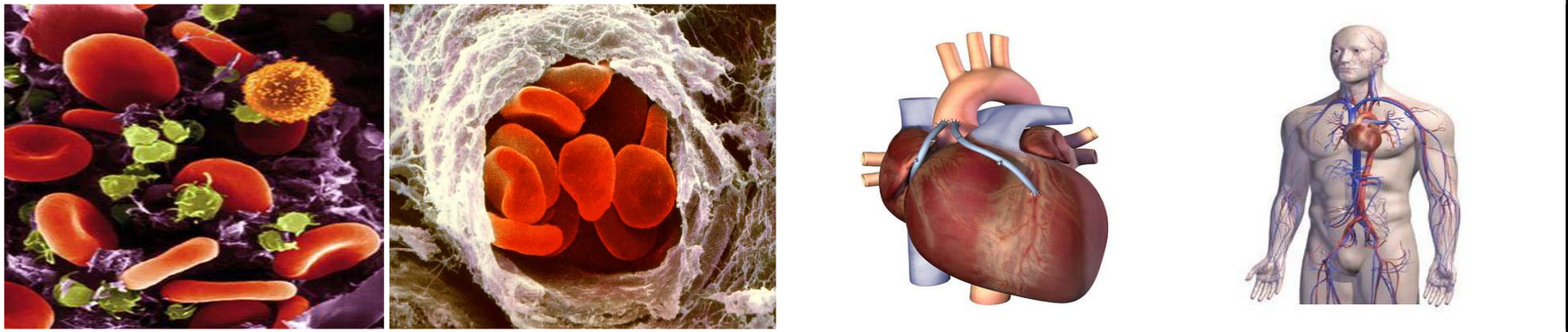
## Plant reproductive system:

Word bank: anther bees carpel fruit

	Pollen cells	Female carpel	Male anther	Reproductive system
Diagram				
Notes	Pollen, the male sex cells contain the paternal genes and are held on the anther which is part of the male stamen.	The egg cells or ovules contain the maternal genes and are held in the ovule, part of the female carpel.	The stamen is the plant male reproductive organ which contains many millions of microscopic pollen cells.	Flowering plants have both male and female reproductive organs. Plants can self or cross pollinate.

# Extension questions and homework

- 1: Define the following terms: **Organelle, Specialised, Cell, Tissues, Organ, Organ-systems & Organism.**
- 2: Look at the four pictures below. Complete the table.




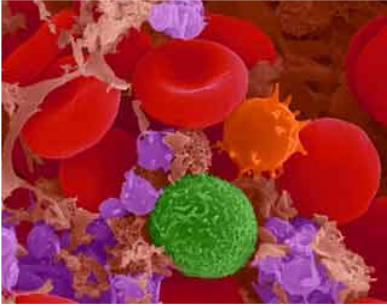
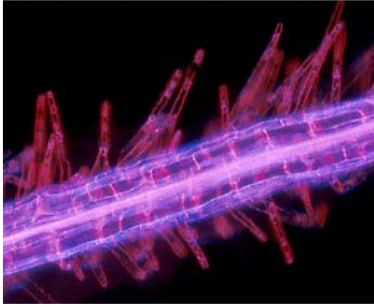
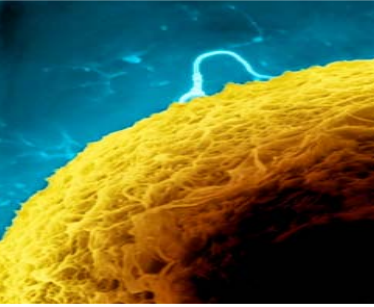
Name	Examples	Definition	Function
Cell			
Tissue			
Organ			
Organ system			

- 3: Match the specialised cells or tissue with their organs and organ systems:

Red blood cell	Gullet stomach & intestines	Digestive system
Nerve cell	Lungs and windpipe	Circulatory system
Villi tissue	Ovaries, oviducts & Uterus	Excretory system
Neprhon tissue	Brain & spinal cord	Reproductive system
Alveoli tissue	Heart & Blood vessels	Nervous system
Egg cell	Kidney & bladder	Respiratory system



- 4: Look at the information in the table below. Explain the function of each of the specialised cells and explain how its structure allows it to perform its function:

<i>Cell</i>	<i>Nerve cell</i>	<i>Red blood cell</i>	<i>Root hair cell</i>	<i>Sperm cell</i>
Function	_____	_____	_____	_____
Diagram (Label parts)				

- 5: What is the function of each of the following cell parts.
- (i) Nucleus (ii) Cytoplasm (iii) Cell membrane (iv) Cell wall (v) Chloroplast (vi) Vacuole.
  - What substance is contained in the chloroplasts.
  - Write a summary of what happens in the chloroplast and why this is important to all living things.
- 6: Complete the following:

Cells are the basic building blocks of life. Many cells are highly \_\_\_\_\_ so they can perform a specific function. A red blood cell has no \_\_\_\_\_ and a biconcave shape to carry the maximum amount of oxygen from the lungs to the rest of the body. A tissue is a collection of similar cells for example muscle tissue or \_\_\_\_\_ tissue which protect against disease and dehydration. An organ is a collection of tissues working together with many other organs in an organ system. There are \_\_\_\_\_ organ systems in the human body that perform all the necessary functions to support life.

Internet:

Go to [google.co.uk](http://google.co.uk) and find about how cells replace themselves by mitosis during periods of growth and repair. Also find out about blood and its cells. Why can we call it a 'liquid tissue.'