educating children at home & otherwise

Key Stage 3 / Pre-IGCSE

Science Course

Welcome to Echo Education

Thank you for purchasing the Echo Education Key Stage 3 Course. This consists of over 140 lessons split over the three sciences: Biology, Chemistry and Physics. It covers all of the material in the National Curriculum for Key Stage 3 and, in school, would be covered over a period of three years from age 11-14 years.

It is formatted in a way that allows you to use it in whichever way best suits your child/children. Once you have purchased it you are welcome to use it as many times as you need to within your own family but we respectfully ask you please not to lend/forward/copy the course for other families or groups.

It is totally up to you how you use the material in the course. You can buy all the equipment suggested below and use it as a very hands-on and practical course. However if that does not suit you, we have tried, where possible, to include YouTube demonstrations of experiments to allow your child to see them in action. Or you could mix and match- do some practical work and some by watching the videos.

We have included lots of pictures, videos and practical work to keep the learning real and fun. Science is exciting and that is reflected in the course material.

You can focus on one subject at a time or run all three subjects concurrently. You can do one lesson a week or one a month or whizz through it by covering lots of lessons each week. It is totally up to you. All the material is here and can be used to fit your child's learning requirements. Personally I have used it one subject per school term and revisited it over a 2-3 year period to reinforce their learning and to build in new concepts.

We have included answers to any questions you are asked to pose to your child and all answers to the end of topic tests. These too are available to be used as best suits you and your child and their learning style – you can set them as a 'test' or a fun verbal quiz or just work through them together. This means you don't need significant existing science understanding to teach this course- the content and answers are all provided.

Each lesson also includes a list of the key terms and spellings that your child should become familiar with. As much as possible they should accurately learn how to spell these science words.

Once they have completed the key stage 3 course and when you feel they are ready they can move onto IGCSE science courses. Our website has all the information about the 2 boards and also the combined science course.

All subjects in key stage 3 science can be reinforced and supported by using the BBC Bitesize website which is available free to all.

There are no set course books to accompany this course as all the content is provided within each lesson but there are many course books and revision aids available if you feel your child requires further reinforcement in any particular area. These can be found for example on Amazon.

Each lesson has a list of suggested resources at the beginning – these are only 'suggested' as all the academic material to learn the information is provided but it is a really good idea wherever possible for children to perform practical work to help consolidate their learning. I suggest you look ahead at the start of each topic to see what equipment you may need – this may be simple supermarket purchases or more 'scientifc' equipment. Any equipment you purchase now will support further work at IGCSE. We have included a list of resources we have sourced but you are welcome to pick and choose from that list and resource your own equipment but we have tried to simplify this task for you.

We have made the lessons as practical as possible and have included different ways of learning different pieces of information – this keeps the students interested and helps them to learn in lots of different ways.

We hope you and your child/ren love learning science and enjoy these lessons. We would love to hear feedback from you about which parts they particularly enjoyed or struggled with.

Warm regards

Clare and Sam

Echo Education

www.echo.education

Suggested science equipment purchases

Please note you do not need to buy all these at once – you could wait and purchase them as you need them as you work through the course (or add them to birthday and Christmas lists for your child) Also science equipment can be purchased and shared between several home educating families. These are just suggested – please feel free to shop around. These are all useful but not essential. Anything you purchase now will continue to be useful at IGCSE.

1) ***Microscope*** e.g Amazon

http://www.amazon.co.uk/Learning-Resources-GeoVision-MicroPro-Microscope/dp/B0001FPRC0/ref=sr_1_2?ie=UTF8&qid=1434307786&sr=8-2&keywords=microscope

2) ***Chemistry set*** e.g. Amazon

http://www.amazon.co.uk/CHEMISTRY-CHILDREN-EXPERIMENTS-ACTION-SCIENCE/dp/B00BUQBKCU/ref=sr_1_2?ie=UTF8&qid=1434307943&sr=8-2&keywords=chemistry+set

3) ***Resource box***: We have asked the science providers **'Kitchen Chemistry'** to provide a box of additional resources to save you the hassle of sourcing them. They have put together an 'Echo Education Key Stage 3' box available by emailing them directly. The box contains:

125ml Methylated spirits for use in spirit burners
20ml rubbing alcohol
PH paper
125ml Dilute hydrochloric acid

125ml 6% hydrogen peroxide solution
Thermometer for test tubes
500g/5N Newton Meter

20g Iron filings
Right angled prism

This costs £26.95 plus p and p. They accept Paypal payment only

Do contact them directly at kitchenchemistry@btinternet.com

4) ***Electronics kit*** e.g. Amazon £34

http://www.amazon.co.uk/Cambridge-Brainbox-Primary-Plus-Electron-ics/dp/B001MJ2F9C/ref=sr_1_3?ie=UTF8&qid=1434311166&sr=8-3&keywords=cambridge+brainbox+electronics

5) ***Magnet set*** e.g. Amazon £13

http://www.amazon.co.uk/Edu-Science-Educational-Magnet-Set/dp/B00EIEA63K/ref=sr_1_1?ie=UTF8&qid=1434309473&sr=8-1&keywords=magnet+set

Pre-IGCSE/ Key Stage 3 Biology Course

Topics covered by this course:

Cells and Organisms

- Plant and animal cells
- Specialised cells
- Cells, tissues, organs, organ systems, organisms. Diffusion and Osmosis.
- Unicellular organisms
- The Structure of Bacteria
- Practise Questions

Human Organ Systems

- The Gas Exchange System (breathing)
- The Digestive System
- The Skeletal System
- The Muscular System
- The Nervous System
- Practise Questions

Health

- A healthy and balanced diet
- Unbalanced Diets and Deficiency diseases
- Role of exercise

- Smoking
- Asthma
- Legal and Illegal Drugs – cigarettes, alcohol and solvents
- Practise Questions

Human Reproduction

- The Male Reproductive System
- The Female Reproductive System
- The Menstrual Cycle
- From fertilisation to birth
- Sexual Reproduction in other animals
- Practise Questions

Reproduction in Plants

- Asexual and sexual reproduction and parts of a flower
- Pollination
- Seeds and Dispersal
- Practise Questions

Photosynthesis and Plant Structures

- What is photosynthesis?
- How do leaves work?
- Deciduous and Evergreen Plants

- Roots and water transport through plants
- Aerobic and Anaerobic Respiration
- Practise Questions

Interactions and Interdependences in the Environment

- Food chains and food webs
- Ecosystems and Interdependency
- Air Pollution
- Water Pollution
- Bio indicator species
- Practise Questions

Genetics, Variation and Natural Selection

- Heredity
- Genetic Diversity
- DNA
- Variation
- Natural Selection
- Practise Questions

Lesson 1: Plant and Animal Cells

Today's Important Spellings: Cell Cytoplasm Membrane Mitochondria Nucleus	Chloroplasts Chlorophyll Vacuole Microscope

Suggested resources:

- Lego model of any kind and a single lego piece
- A microscope if you own one (but not essential)
- Lime jelly – made up to double strength then cooled in small cake tin then cut into rectangle approx. 10cmx6cm (you can just use coloured card!)
- Strawberry jelly- made up to double strength and cooled in small tin and then cut into circle approx. 10cm across (or coloured card!)
- Raisins
- Strawberry laces (or cooked, cooled spaghetti)
- Cake sprinkles
- Green pepper cut into tiny pieces
- Knife

Lesson Content

The cell is the building block of all life. Everything that is or has been alive is made up of cells. Show them the lego model and explain that this is made up of little blocks – the individual lego blocks and now show just one – these are the smallest units we can break the model down into.

Living organisms have certain life processes in common. There are seven things that they need to do to count as being alive. The nym **MRS GREN** is one way to remember them:

- **M**ovement - all living things move, even plants
- **R**espiration - getting energy from food
- **S**ensitivity - detecting changes in the surroundings
- **G**rowth - all living things grow
- **R**eproduction - making more living things of the same type
- **E**xcretion - getting rid of waste made in the cells
- **N**utrition - taking in and using food

All living things are made up of cells.

Animal cell:

Give your child the strawberry jelly round and ask them to add the raisin in the centre and sprinkle some cake sprinkles around the jelly. This is an image of an animal cell.

The jelly is the body of the cell – the **cytoplasm**. It is the liquid of the cell where reactions including respiration (making energy) occur.

The raisin represents the **nucleus** of the cell. This contains the genetic information of the cell and controls its activities

The sprinkles are **mitochondria** where respiration occurs (where energy is made)

The outside of the jelly shape is the **cell membrane**. This controls what enters and leaves the cell. It is semi-permeable- this means it only allows certain molecules to pass through.

These 4 components are in all animal cells and also in all plant cells. Plant cells have 3 extra components too.

Plant Cell

Give out the green, rectangular jelly and ask them to add the same components as the animal cell first – the raisin 'nucleus' and the sprinkles as 'mitochondria'. Use the science words as often as you can and ask them to repeat them and use them too. New science words are easier to remember if we hear and say them a lot. Once they have identified the:

1) Cytoplasm
2) Nucleus
3) Cell membrane
4) Mitochondria

Now you are ready to add the components which are specific to plant cells:

5) A cell wall
6) Vacuole
7) Chloroplasts

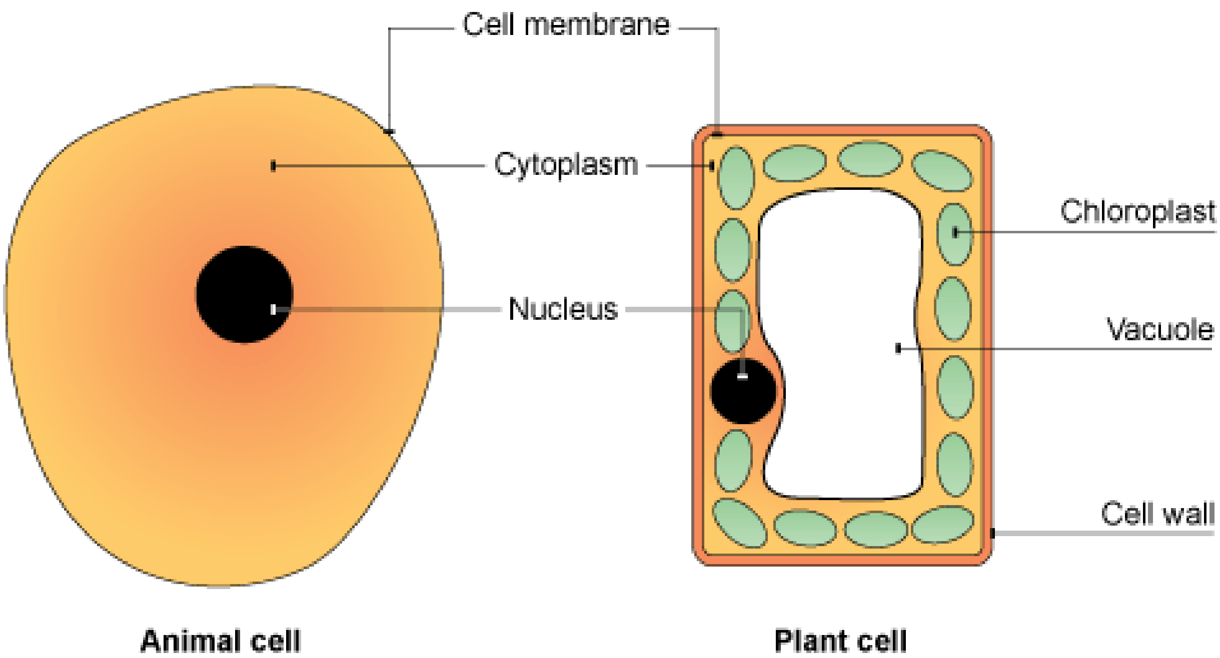
First ask the child to wrap the green plant cell jelly in a strawberry lace. This is the **cell wall**. It is a rigid structure that gives the cell support. It is made of a tough substance called **cellulose**.

Now cut a space out from the centre of the jelly. This is the **vacuole –** this is full of cell sap that stores the plants sugars and salts. Finally sprinkle the jelly with green pieces of pepper. These represent **chloroplasts** these are full of **chlorophyll** needed for photosynthesis (how plants make food from the sun and carbon dioxide.) These can be photographed, printed out and then labelled in the same way as the diagrams below.

This is how the jelly cells should look:

The child should now draw what they have made and label their diagrams using the diagram below for help with spellings. As with all scientific drawings there are a few rules that it is good to use right from the start:

1) Always use a sharp pencil
2) It must have a title
3) Use a ruler to draw lines to the components you are labelling
4) Never shade your diagram – it is an outline



- Mitochondria can be drawn as small oval structures in both cells.

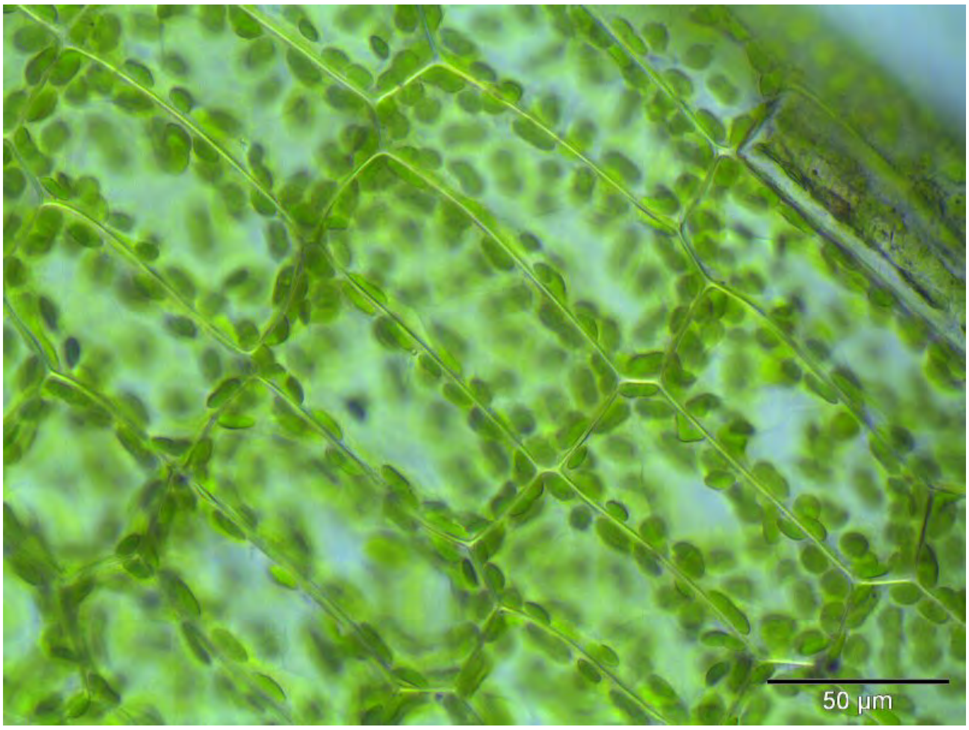
Ask your child to copy (or complete a printed copy of) this table and add their own ticks and crosses to say which components are found in which cell

Component	In Animal Cells?	In Plant Cells?	Structure and Function
Nucleus			Contains the cell's genetic information and controls its activities
Cytoplasm			The liquid inside cells where the cells reactions happen
Cell Membrane			Flexible structure on the outside of the cell that controls what goes into and out of the cell.
Mitochondria			Small structures found in the cytoplasm where respiration occurs
Cell Wall			Rigid external structure that gives the plant cell support.
Vacuole			Large section in the centre of the cell where sugars and salts are stored
Chloroplasts			Small green structures that contain chlorophyll for photosynthesis

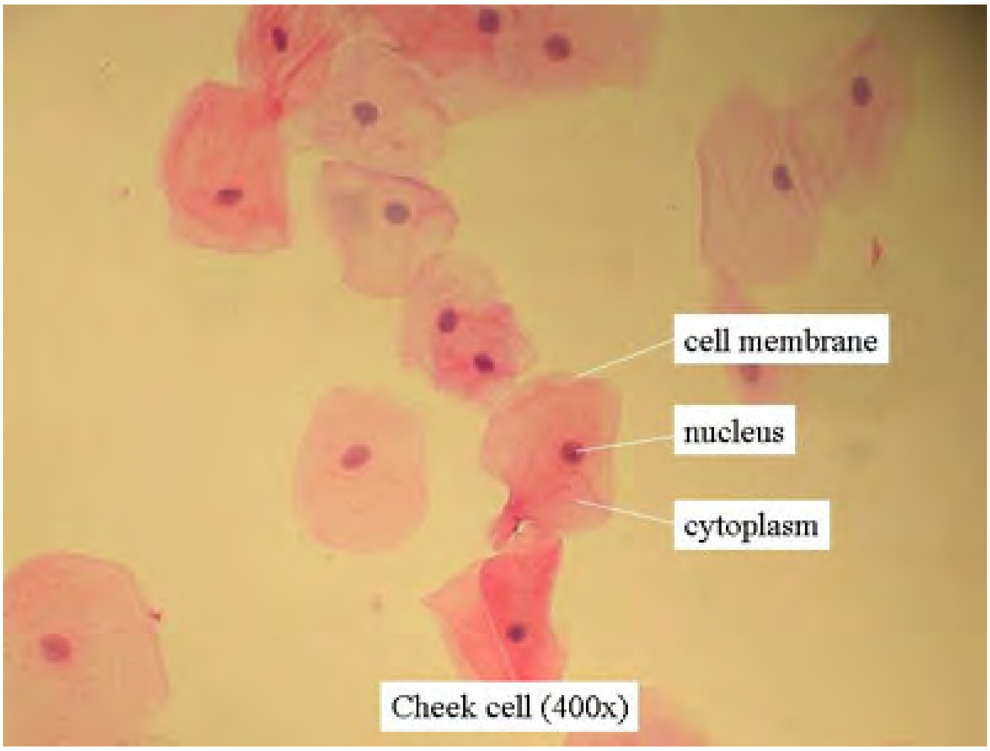
Answer:

Component	In Animal Cells?	In Plant Cells?	Structure and Function
Nucleus	Yes	Yes	Contains the cell's genetic information and controls its activities
Cytoplasm	Yes	Yes	The liquid inside cells where the cells reactions happen
Cell Membrane	Yes	Yes	Flexible structure on the outside of the cell that controls what goes into and out of the cell.
Mitochondria	Yes	Yes	Small structures found in the cytoplasm where respiration occurs
Cell Wall	No	Yes	Rigid external structure that gives the plant cell support.
Vacuole	No	Yes	Large section in the centre of the cell where sugars and salts are stored
Chloroplasts	No	Yes	Small green structures that contain chlorophyll for photosynthesis

This is how a plant cell looks under a light microscope



This is an animal cell under a light microscope



Cut out these flash cards, or make your own larger versions, and ask your child to match the description and the name of the cell component. These can be kept as used as revision/practise

Nucleus	Contains the cell's genetic information and controls its activities
Cytoplasm	The liquid inside cells where the cells reactions happen
Cell Membrane	Flexible structure on the outside of the cell that controls what goes into and out of the cell.
Mitochondria	Small structures found in the cytoplasm where respiration occurs
Cell Wall	Rigid external structure that gives the plant cell support.
Vacuole	Large section in the centre of the cell where sugars and salts are stored
Chloroplasts	Small green structures that contain chlorophyll for photosynthesis

You can follow up and reinforce this lesson on BBCBitesize, Key stage 3, Science, Biology then Life Processes
http://www.echo.education/url/bitesizecellstosystems
This includes revision text, activity and a test.

Lesson 2: Using a Microscope

Today's Important Spellings: Microscope Eyepiece Lens	Slide Cover slip

Suggested Resources:

- Microscope if you have one (see suggested resources for a good example.) It is not essential though – your child should still learn the labels and the theory
- Any sample slides your kit may include
- Onion
- Scalpel or sharp kitchen knife
- Tweezers
- Iodine to stain
- Slides and cover slips
- Pipette and water
- Anything else your child might like to experiment with - pond water, petal, vegetable, yeast, sugar, salt etc

Lesson Content – the History of the Microscope

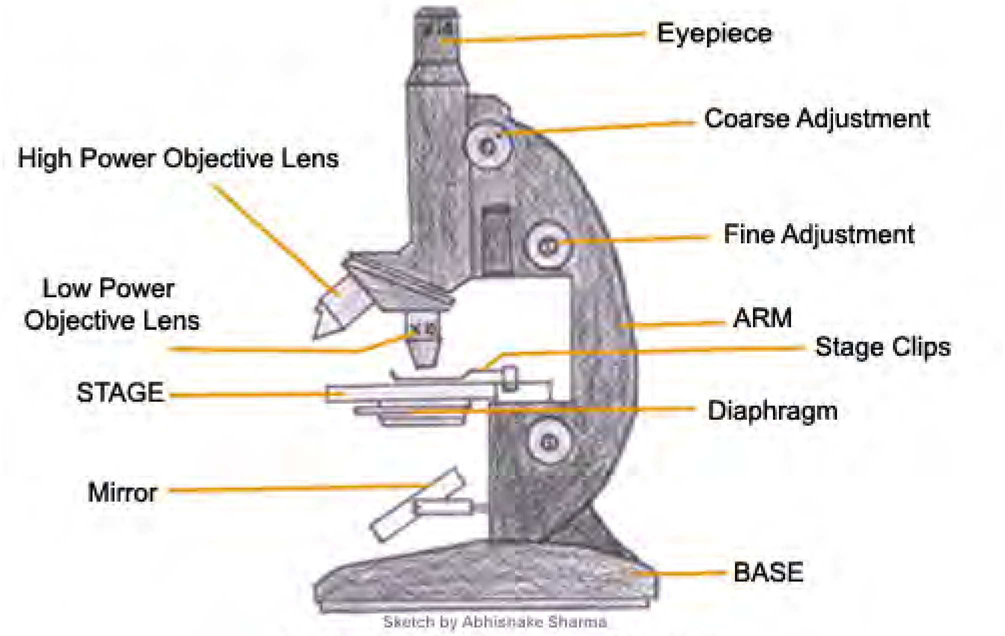
Almost all cells are too small to see with just your eyes so we use a **microscope** to see them. (If you own a microscope it is a good time to get it out and allow your child time to get used to using it.) The first microscopes were invented in the 17th century. Like many inventions today there are disputes in origins of the original inventors. The same dispute applies to who invented the microscope. Dating back to the first century when glass was first invented, the Romans were investigating the use of glass and how viewing objects through it, made the objects appear larger. Then, in the 13^{th} century an Italian, Salvino D'Armate, made the first eye glass, providing an element of magnification to one eye.

The earliest simple forms of magnification were magnifying glasses used for inspecting tiny insects such as fleas, and so were called "flea glasses".

Then, during the 1590's, two Dutch spectacle makers, Zacharias Jansen and his father Hans started experimenting with these lenses. They put several lenses in a tube and made a very important discovery. The object near the end of the tube appeared to be greatly enlarged, much larger than any simple magnifying glass could achieve by itself.

Their first microscopes were more of a novelty than a scientific tool since maximum magnification was only around 9x and the images were somewhat blurry. It was **Anton van Leeuwenhoek** (1632-1723), a Dutch draper and scientist, in the late 17th century became the first man to make and use a real microscope. He developed ways to make superior lenses, grinding and polishing five hundred and fifty lenses to make his new lens tube that had a magnifying power of 270x and could view objects one millionth of a meter (other microscopes of the time were lucky to achieve 50x magnification).

Van Leeuwenhoek made many biological discoveries using his microscopes. He was the first to see and describe bacteria, yeast plants, the teeming life in a drop of water, and the circulation of blood corpuscles in capillaries. His work was verified and developed by English scientist Robert Hooke, who published the first work of microscopic studies, “Micrographia”, in 1665. Robert Hooke's detailed studies furthered study in the field of microbiology in England and advanced biological science as a whole.



Labeled Microscope Diagram

Light Microscopes

A simple student microscope is a very basic light microscope (sometimes called a compound or optical microscope.) It is called a <u>light microscope</u> because it uses visible light to detect small objects, is probably the most well-known and well-used research tool in biology.

It works using a light source aimed toward a lens beneath the stage called the condenser, through the specimen, through an objective lens, and to the eye through a second magnifying lens, the ocular or **eyepiece**.

We see objects in the light path because natural pigmentation or stains absorb light differentially, or because they are thick enough to absorb a significant amount of light despite being colourless. The magnification of the image is simply the objective lens magnification (usually stamped on the lens body) times the ocular magnification.

The stage may be equipped with simple clips (less expensive microscopes), or with some type of slide holder. The slide may require manual positioning, or there may be a mechanical stage (preferred) that allows precise positioning without touching the slide.

If your microscope requires an external light source, make sure that the light is aimed toward the middle of the condenser. To adjust and align the microscope, start by reading the manual. Then think about what you are looking for: - How big is it? Will it be moving? Is it pigmented or stained, and if so what is its colour? Where do you expect to find it on a slide?

Start with the lowest magnification objective lens, to home in on the specimen and/or the part of the specimen you wish to examine. Start with the specimen out of focus so that the stage and objective must be brought closer together. If you are having trouble, focus on the edge of the cover slip or an air bubble, or something that you can readily recognize. The top edge of the cover slip comes into focus first, then the bottom, which should be in the same plane as your specimen. Once you have found the specimen, adjust contrast and intensity of illumination, and move the slide around until you have a good area for viewing. Ask your child to follow these instructions while using their microscope if they have one.

Proper use of the Microscope

1. When moving your microscope, always carry it with both hands (Figure 1). Grasp the arm with one hand and place the other hand under the base for support.

2. Turn the revolving nosepiece so that the lowest power objective lens is "clicked" into position.

3. Place the microscope slide on the stage and fasten it with the stage clips. You can push down on the back end of the stage clip to open it.

4. Using the coarse adjustment, lower the objective lens down as far as it will go *without touching the slide!* Note: Look at the slide and lens from the side when doing this (see Figure 2).

5. Look through the eyepiece and adjust the illuminator (or mirror) and diaphragm (Figure 3) for the greatest amount of light.

Figure 1

Figure 2

Figure 3

6. Slowly turn the coarse adjustment so that the objective lens goes *up* (away from the slide). Continue until the image comes into focus. Use the fine adjustment, if available, for fine focusing.

7. Move the microscope slide around so that the image is in the centre of the field of view and readjust the mirror, illuminator or diaphragm for the clearest image.

8. You should be able to change to the next objective lenses with only slight focusing adjustment. Use the fine adjustment, if available. If you cannot focus on your specimen, repeat steps 4 through 7 with the higher power objective lens in place. DO NOT ALLOW THE LENS TO TOUCH THE SLIDE!

9. The proper way to use a monocular microscope is to look through the eyepiece with one eye and keep the other eye open (this helps avoid eye strain). If you have to close one eye when looking into the microscope, it's ok. Remember, everything is upside down and backwards. When you move the slide to the right, the image goes to the left!

10. Do not touch the glass part of the lenses with your fingers. Use only special lens paper to clean the lenses.

11. When finished, raise the tube, click the low power lens into position and remove the slide.

Remember, microscopes are expensive scientific instruments. Handle them properly and carefully and they will last for many years!

Have a go!

Ask your child to have a go if you own a microscope – they can use the example slides provided or/and make their own.

Even if you don't own a microscope it is worth your child watching this clip to make sure they are confident with the method.

Use this YouTube clip to show you how to prepare a slide of onion cells
http://www.echo.education/url/onionslideprep

If they would like to try making cells from other things you can try

- pollen – just add a drop of water before adding the cover slip
- pond water – just a drop or two before adding the cover slip
- a tiny piece of petal or leaf etc
- anything else they would like to try – how about tiny crystals of salt or sugar?

At this stage it is all about building confidence as they use the equipment. This will take time and practise.

Lesson 3: Specialised Cells

Today's Important Spellings: Sperm Ovum Ciliated	Cilia Palisade Mitosis

Suggested resources:

- Play dough if your child learns well by 'doing' or coloured pens
- Balloon with just a little air in it

Lesson Content

Recap last lesson – can your child name the 4 parts of both animal and plant cells (*nucleus, cytoplasm, cell membrane and mitochondria*) and the 3 extra components of plants cells (*cell wall, chloroplasts and vacuole)*

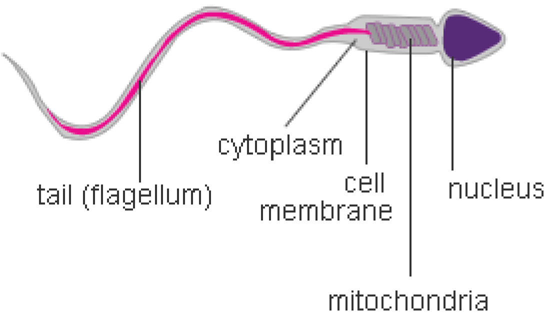
Many cells in both animals and plants have specific functions, special jobs to do, we call them **specialised cells**. They look different from one another because of the different jobs they do. We need to be able to identify them from their picture and explain what job they do.

Specialised Animal Cells:

1) Red Blood Cells

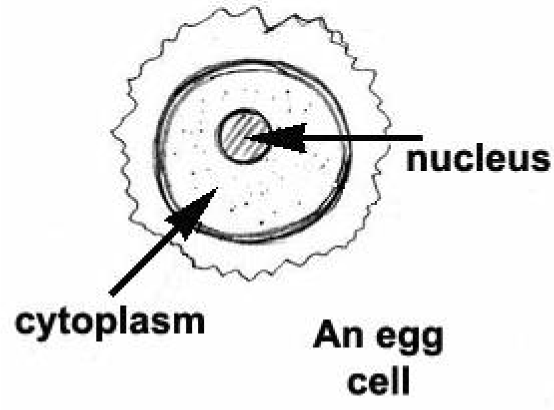
Ask your child to either form this from play dough or to draw and colour it red. It has a bi-concave shape (like a saucer) and **no nucleus** to increase the surface area to allow it to absorb as much oxygen as possible. Its job is to transport oxygen from our lungs, around our body and to take waste carbon dioxide back to the lungs to be breathed out. It is easy to identify by its colour and shape.

2) **Sperm cell**



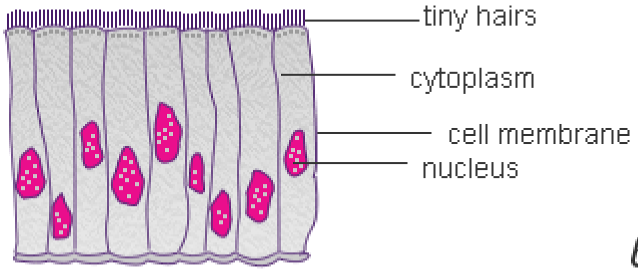
Ask the child to make this with play dough or copy it with pens.These are small and streamlined with a long tail to allow it to swim. The head contains the nucleus and enzymes to help it enter the egg cell. Behind the head is an area packed with mitochondria to allow the cell to make the energy it needs to swim.

3) **Egg cell or ovum** (this is in plants and animals)



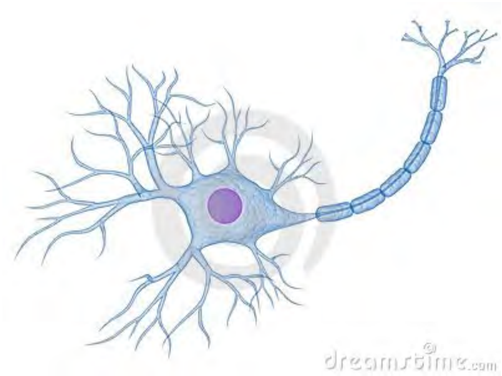
Ask the child to make or copy this cell. It is a large cell that contains an energy store for the young organism once it is fertilised. It looks like a standard animal cell.

4) **Ciliated Cells**



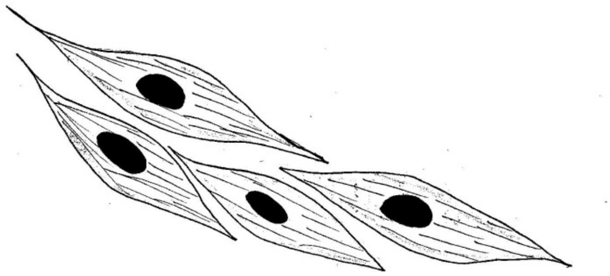
Ask your child to make or copy these cells. They are usually drawn in a line like this but could be drawn individually. They look like a standard animal cell but have small hairs on one end. They are often called **ciliated epithelial cells**. The tiny hairs are called **cilia.** They are found inside our nose and gas exchange system and the hairs wave to remove dirt and bacteria out of our lungs.

5) **Nerve Cells**



Ask your child to make or copy this one. It looks like a fallen tree! These cells can be very long (up to 2m) to carry messages around the body.

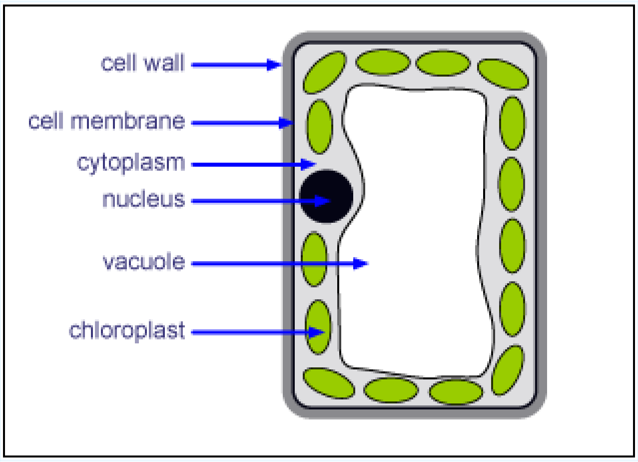
6) **Muscle Cell**



Ask your child to copy this long, thin cell. They change their length as we move.

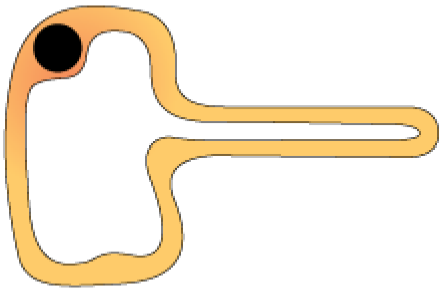
Specialised Plant Cells

1) Palisade Cells



This cell looks like the standard plant cell we made last time. It is identifiable as it green and has a cell wall and a vacuole. It is full of chloroplasts in which photosynthesis occurs so we find these cells in leaves.

1) Root Hair Cell

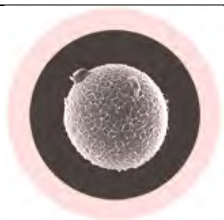


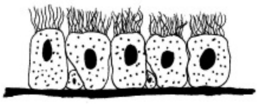
Ask your child to make or draw this cell. It looks a bit like a hammer! It is a root hair cell, found in the roots of plants. The roots need to absorb water and nutrients from the soil and to increase the surface area. To do this they have root hair cells to stick out into the soil to absorb as much water and nutrients as possible.

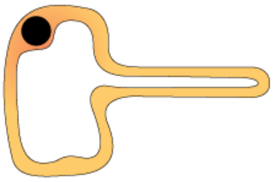
You can reinforce this with BBC Bitesize

http://www.echo.education/url/specialisedcells

To reinforce these specialised cells cut out the flash cards and ask your child to arrange them in 3 columns – the cell name, the picture and the adaption. They can stick them down once you have checked their answers!

Cell type	What does it look like?	What does it do?
Red blood cell		Has a biconcave shape and no nucleus to increase the surface area to absorb as much oxygen as possible
Sperm cell		Small and streamlined with a long tail. Lots of mitochondria for energy.
Egg cell or ovum		Large cell that contains an energy store.

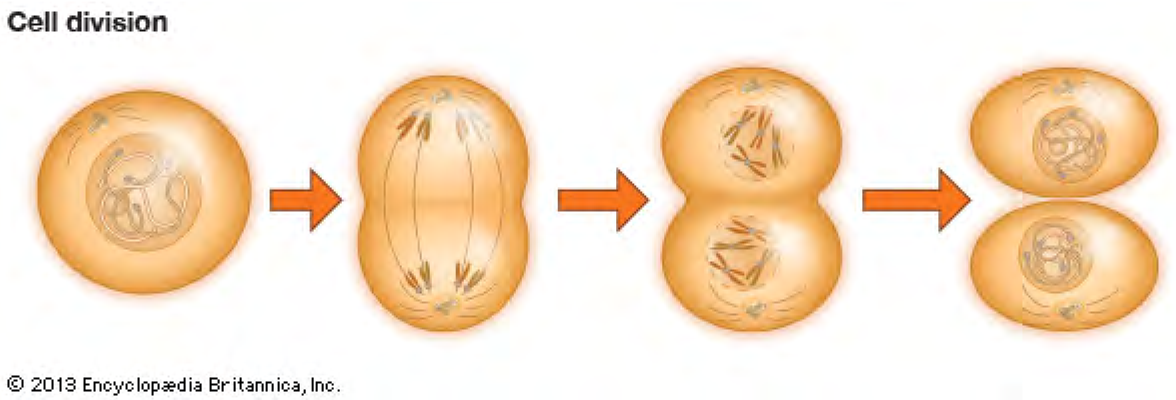
Ciliated cells		Contains tiny hair like structures (cilia) which wave to remove dirt and bacteria from our gas exchange system.
Nerve cell		Can be very long and carry messages around the body.
Muscle cell		Smooth cells that lengthen as we use them.
Palisade cell		Contains many chloroplasts full of chlorophyll for photosynthesis

Root Hair cell		Has a long hair to in-crease surface area to absorb as much water as possible

Where do new cells come from?

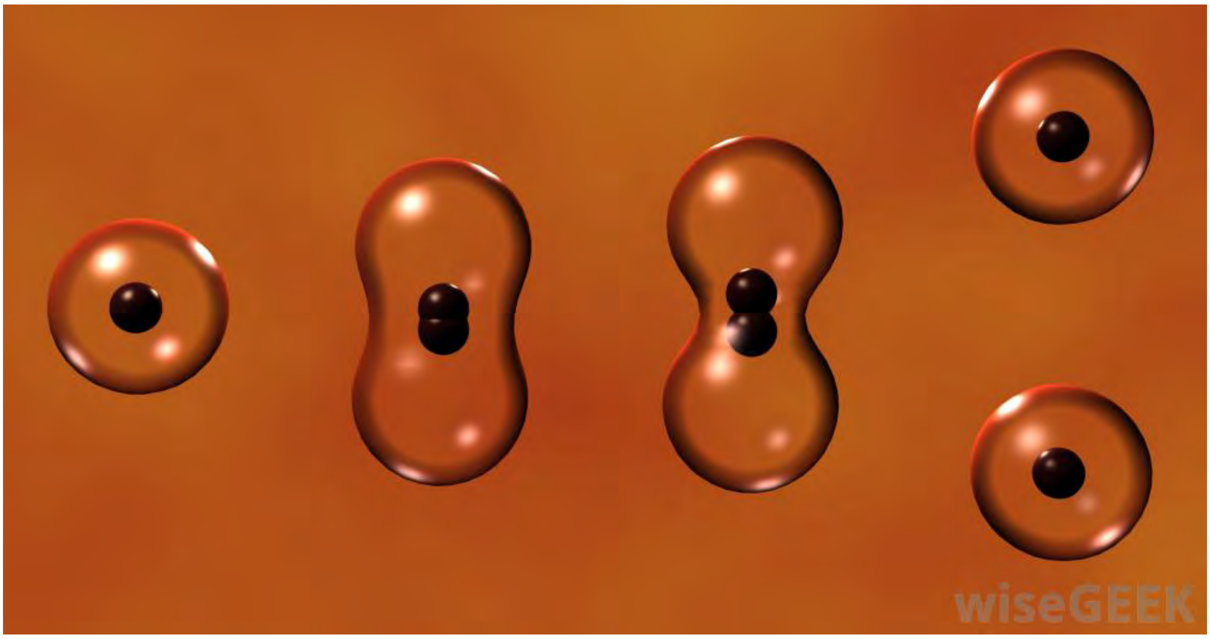
Plants and animals grow by making new cells in a process called **mitosis**.

A fully grown cell into two and the two new cells then increase in size.



The first thing that happens is that the nucleus of the adult cell divides in two. Remember that the nucleus contains all the information which tells the cell what to grow into and what to do.

As an illustration blow up a balloon with just a little air. Ask your child to gently squeeze it in the middle so that it bulges out of each side of their hand…..this is how the cell begins to divide. Then both 'bulges' be-come separate cells- direct copies of the parent cell.



This is a cell undergoing mitosis

Lesson 4: Cells to Organisms. Diffusion and Osmosis

Today's Important Spellings:	
Diffusion Osmosis Cell membrane Semi-permeable membrane	Tissues Organ Organ systems Organisms

Suggested resources:

- Cup of water
- 2x Jelly babies or dried fruit
- Any construction blocks – e.g. lego, duplo etc
- Large roll of paper (e.g wallpaper or large sheets and sticky tape. Coloured paper or pens

Lesson Content

Before you begin the lesson, give your child two jelly babies or dried fruit pieces and ask them to drop one into a glass of cold water. We will look at the results later in the lesson.

Today we are going to look at how cells join together to make up tissues, then organs then organ systems then organisms. Give out a pile of individual building blocks and explain that these will represent individual cells.

Ask your child to name you some specialised cells from last lesson (*they could choose red blood, muscle, nerve, sperm, egg, palisade. Root hair or ciliated*)

Imagine that the individual blocks are individual muscle cells. Now join some of them together to become a **tissue** – **tissues are lots of identical, specialised cells of the same type in the same place that complete the same function. Our example today is muscle tissue.**

☆ Ask your child to make a second model from the individual blocks. This is a different kind of tissue. In this case they will represent nerve tissue.

Now join the two kinds of tissue together. This is representing an **organ.**

An organ is a group of different tissues in the same place that complete the same function. In our example here the muscle and nerve tissue makes up the heart.

If working with more than one child you can ask them to join their organs together or if working with an individual child then make a second model. This represents an **organ system.**

An organ system is a group of organs that work together to complete the same function. In many animals, the circulatory system is responsible for pumping blood around their bodies.

Organisms are made from all their organ systems combined.

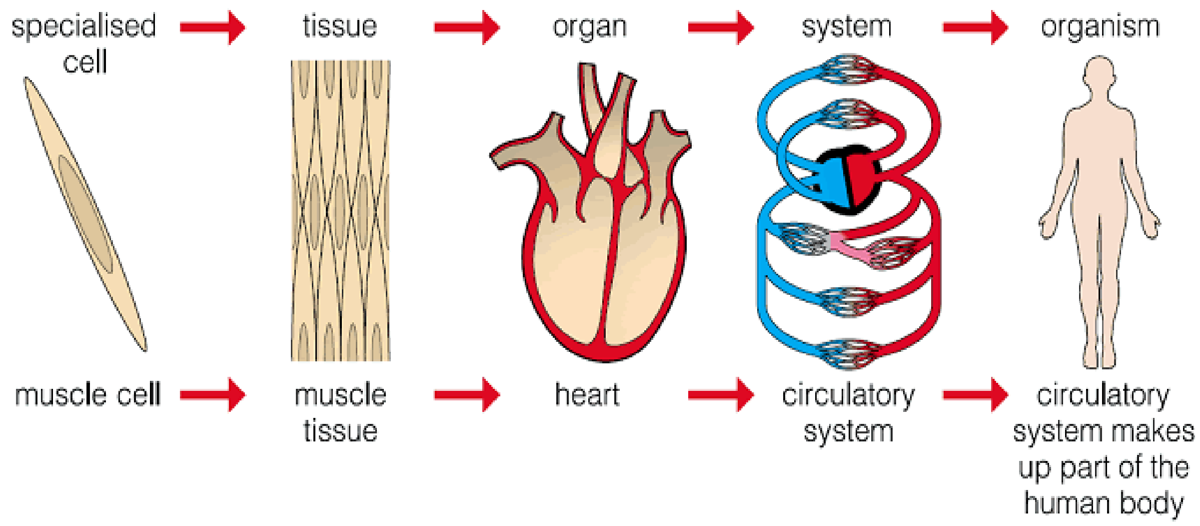
So….. **cells make up tissues…tissues make up organs….organs make up organ systems and organ systems make up organisms.**

Ask your child to draw a flow diagram (words connected by arrows) to include the words cell, tissue, organ, organ system and organism or cut out these pieces and ask your child to put them into the correct order and then stick them down:

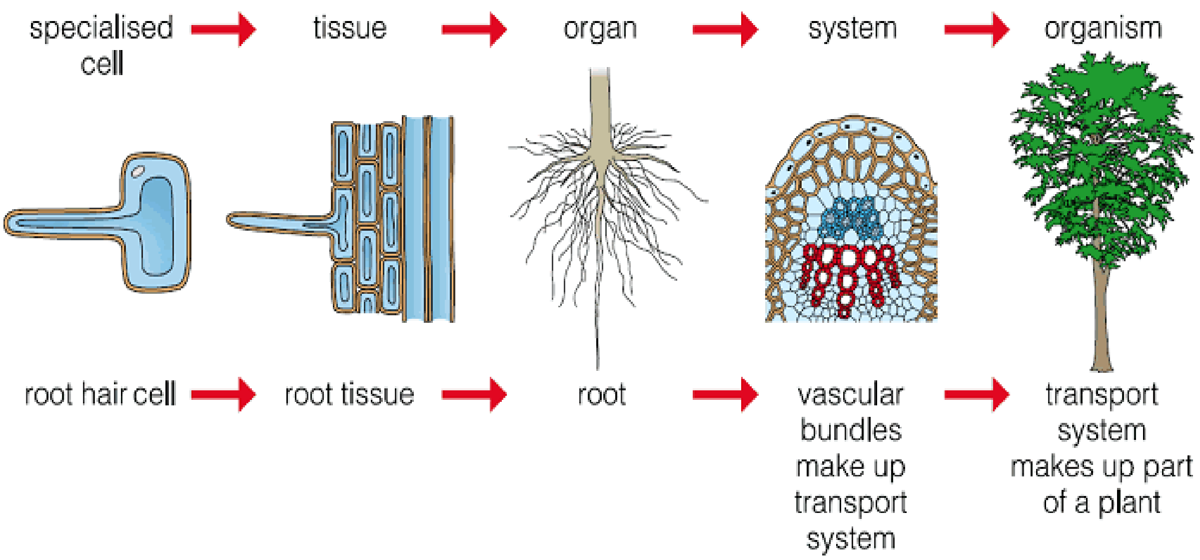
Cell
Tissue
Organ
Organ System
Organism

Some examples of specialised cells to organisms.

Animal example:



Plant example:



Cut out these words and ask your child to put them into order alongside the words cells, tissue, organs, organ system and organism. (they are currently in the correct places.)

Cell	**Muscle cell**	**Palisade cell**
Tissue	**Muscle**	**Palisade tissue**
Organ	**Heart (muscle and nerves)**	**Leaves (palisade tissue and phloem and xylem)**
Organ System	**Circulatory System**	**Food production system**
Organism	**Elephant**	**Rose bush**

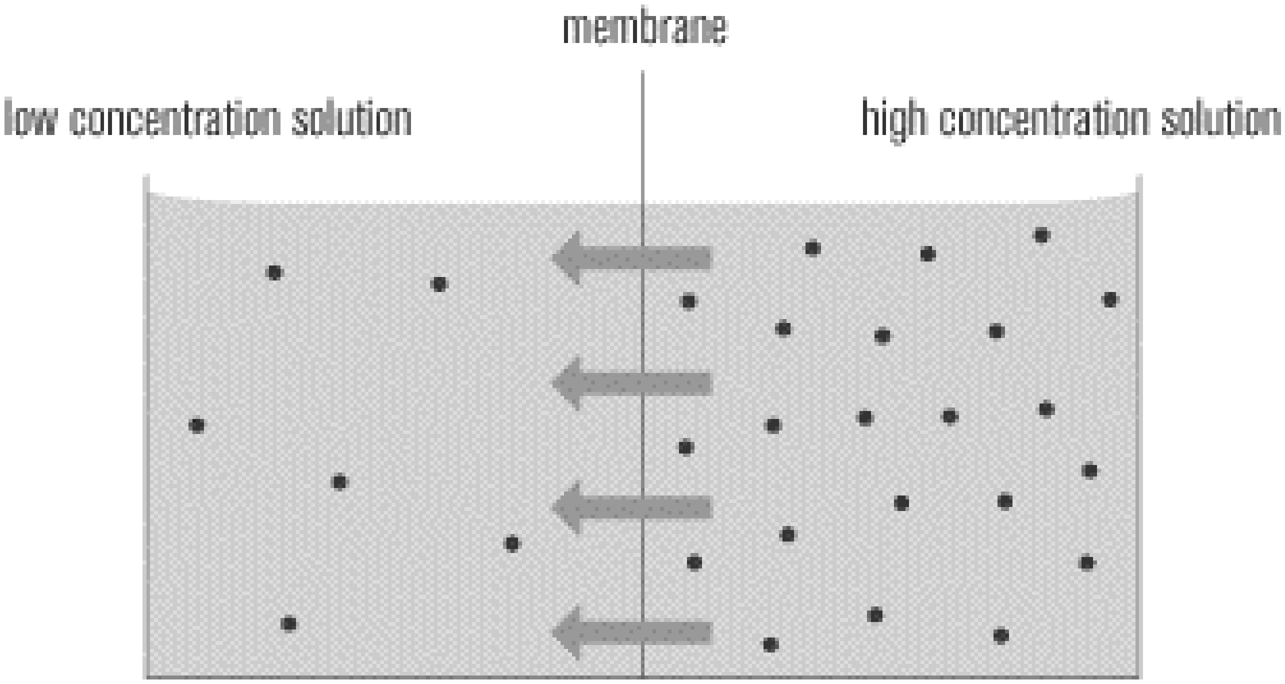
Ask your child to brainstorm as many human organs as they can think of. If they enjoy a 'race' then give them say 2 minutes to do it. They could include: heart, lungs, kidneys, liver, gall bladder, brain, skin etc

Diffusion and Osmosis

Now we will look at the jelly baby/dried fruit in the cup of water. Ask your child what they can see has happened to the object in the water. Compare it to one they haven't soaked. They should see that it has swollen or 'got bigger'. This is an illustration of what happens in a cell because of the cell membrane. It is semi-permeable – this means it selectively allows molecules to pass in and out of the cell. Water has moved into the jelly baby/fruit through the skin like water moves into a cell. Our cells don't just keep swelling though as molecules move out too!

Dissolved substances pass into and out of cells by diffusion.

Water passes into and out of cells by osmosis.

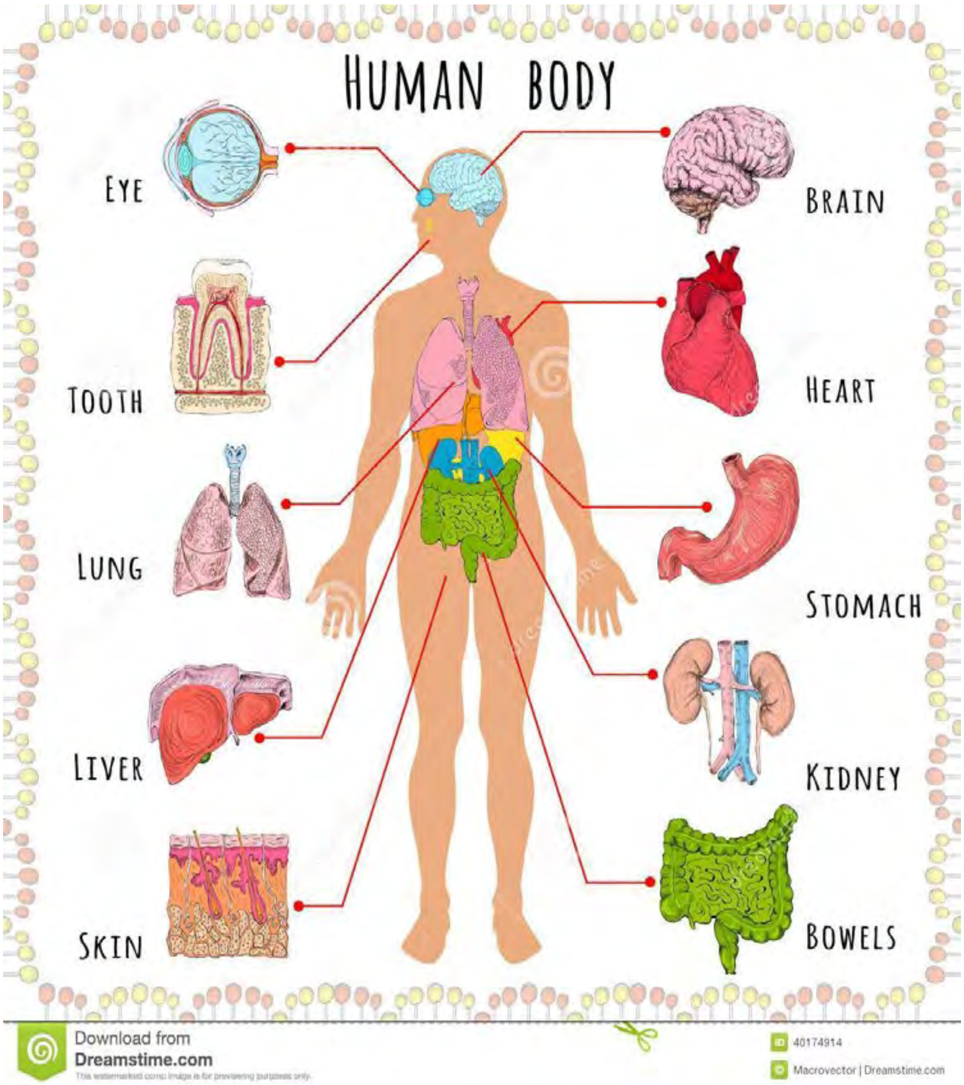


An illustration of diffusion

This is how a cell gets what it needs from our blood and passes out its waste products back into our blood. Things move through the membrane from areas of high concentration to low concentration. i.e. there is a high concentration of oxygen in our blood but a low concentration in our cell so the oxygen passes from the blood in to the cell.

Roll out a large piece of paper on the floor (the back of a wall of unwanted wallpaper works really well) or sellotape together large sheets to make the area of your child. Ask them to lie down on the paper and draw around them. Your child should research the size and position of their organs (or do it from memory) and either draw directly onto the sheet or cut them out of coloured paper and stick them on. Save this for the next topic on Human Organ systems.

It could look something like this:



Lesson 5: Unicellular organisms

Today's Important Spellings:	
Unicellular Organisms Bacteria	Archaea Protozoa Algae Fungi

Lesson Content

Some organisms exist as only one cell. They are **unicellular** (uni- meaning one, cellular meaning cell.) They are very small and the larger ones can only be seen under the higher settings of a light microscope.

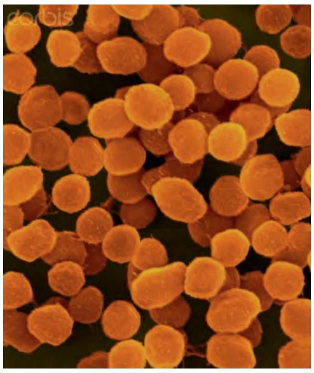
Some are very useful to us, like **yeast** which we use in the making of bread and beer but others like the **bacteria** Streptococcus can cause disease.

There are 5 types of unicellular organisms that you need to know now:

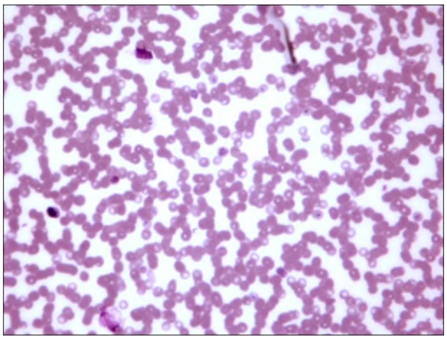
1) **Bacteria** e.g. Streptococcus which can give us a sore throat. They look like this. Ask your child to think of a way of describing this shape and to write it down next to the picture (don't focus on colour as they are all different colours depending on the stain used – just describe the shape)

2) **Archaea** e.g. Methanococcus (note the ending of the word is the same as number 1 – just substitute Methan for Stept) which lives near hot volcanic vents on the ocean floor . These look like this.

Again write a description of what your child can see



3) **Protozoa** e.g. Plasmodium which is carried by mosquitos and causes **malaria**. These look like this below. How would your child describe this?

- 

NB: About Malaria

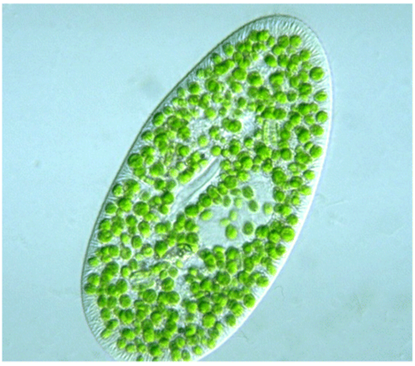
Malaria is a common infection in hot, tropical areas but can also occur (very rarely) in temperate climates. A serious illness, malaria can cause mild illness in some and life-threatening illness in others. Malaria can be cured if treated.

It is caused by parasites of the Plasmodium species, which are carried by mosquitoes infected from biting someone who already has the disease. Malaria is then transmitted to other people when infected mosquitoes bite them.

Worldwide, 300-500 million people are infected with malaria each year. Most cases occur in sub-Saharan Africa, with approximately 2 million people dying there each year. Asia, Latin America, and parts of Europe are also affected by malaria.

4) ***Algae*** *e.g.* Chlorella which is a health food. It looks like this below.

   Ask your child to describe what they see.



NB The Telegraph tells us this about Chlorella:

You wouldn't exactly call chlorella an overnight success. The health benefits of the green algae that grows in freshwater ponds in the Far East have so far been limited to those in the know, and its progress to British medicine cabinets has been slow. Since it became available in tablet form in the UK three years ago, it has achieved an almost cultish appreciation as a superfood, but now scientific research could catapult it into the mainstream.

New research from Japan suggests that this green algae could be effective in fighting major lifestyle diseases. It has been shown to reduce body-fat percentage and blood-glucose levels and help those suffering from Type 2 diabetes, obesity or heart disease. Its benefits include boosting energy, aiding digestion and fighting depression.

What excited the scientists, including the notable Carnegie Institute in Washington DC, was that this green algae proved to be almost a dream food. It is packed with protein – twice as much as spinach – and about 38 times the quantity of soybeans, and 55 times that of rice. It also contains nine essential amino acids, as well as vitamins and minerals.

These are the latest in a long line of health claims – ranging from boosting the immune system in cancer patients to improving the symptoms of irritable bowel syndrome.
Chlorella is a tiny, unicellular green algae, three to eight micrometres in diameter, which when grown in large quantities in South East Asia and Australia gives lakes and rivers a green tint. Before being used as a supplement, it must be gathered, dried to a paste, crushed to a fine emerald green powder, and converted to tiny, soft, crumbly tablets, which smell vaguely of the sea.

5) **Fungi** e.g. Yeast. It looks like this

. How would your child describe it?

Fermentation of sugars by yeast is the oldest and largest application of this technology. Many types of yeasts are used for making many foods: baker's yeast in bread production, brewer's yeast in beer **fermentation**, and yeast in wine **fermentation**.

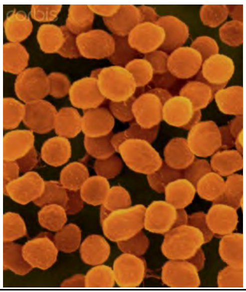
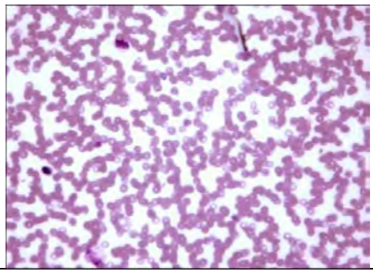
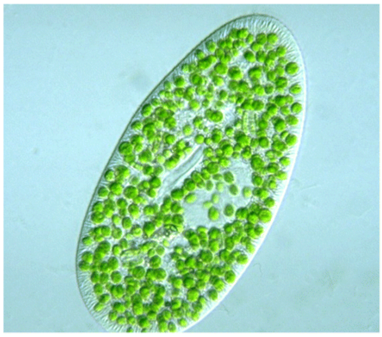
You can use their descriptions as a kind of game: 'Which unicellular organism were you describing when you said….'

NB: very important to stress:

Seaweeds are **multicellular algae** (multicellular means many celled not just one)

Mushrooms are **multicellular fungi**

☆ *You can play a pairs type game by cutting out the cards below and turning them upside down on the table. Your child needs to turn them over and find the pairs that match. They can then stick them next to each other as a record of their learning*

Bacteria	Streptococcus 
Archaea	Methanococcus 
Protozoa	Plasmodium 
Algae	Chlorella 

Fungi	Yeast 

Lesson 6: The Structure of a Bacteria

Today's Important Spellings:	
Bacteria Flagella Cytoplasm Plasma membrane Plasmid (DNA)	Chromosome (DNA) Cell wall Ribosomes

Suggested Resources:

- Sharp pencil and ruler

Lesson Content

Bacteria are one example of a **unicellular organism**. Ask your child to tell you what that means and whether they can remember the other four examples.(*unicellular organisms are just one cell in size. The other examples were fungi, protozoa, algae and archaea*)

Bacteria look very different to both an animal and a plant cell.

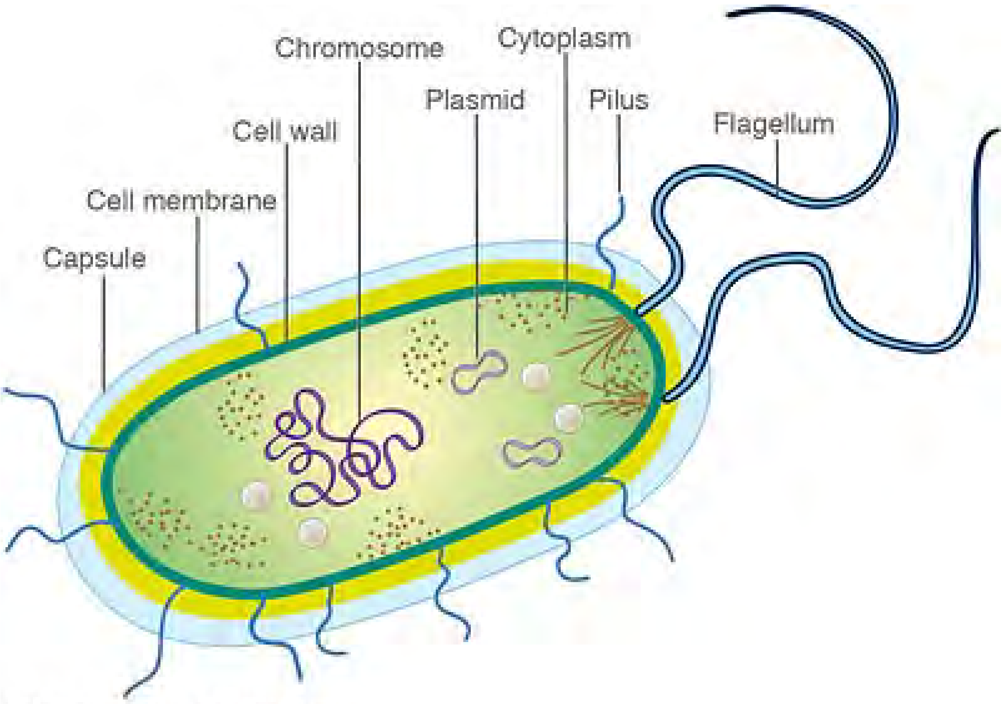


Diagram of a Bacterium

Show your child this diagram and ask them to make two lists

1) Labels you also find in animal or plant cells
2) Labels that are new
3) Labels in an animal or plant cell that are missing

(*Answers:*

1) *Cell membrane, cell wall, cytoplasm*
2) *Capsule, chromosome, plasmid, pilus, flagellum*
3) *dcNucleus, vacuole, mitochondria, chloroplasts*)

Ask your child to copy this diagram as a scientific diagram. Remind them that scientific diagrams follow these rules:

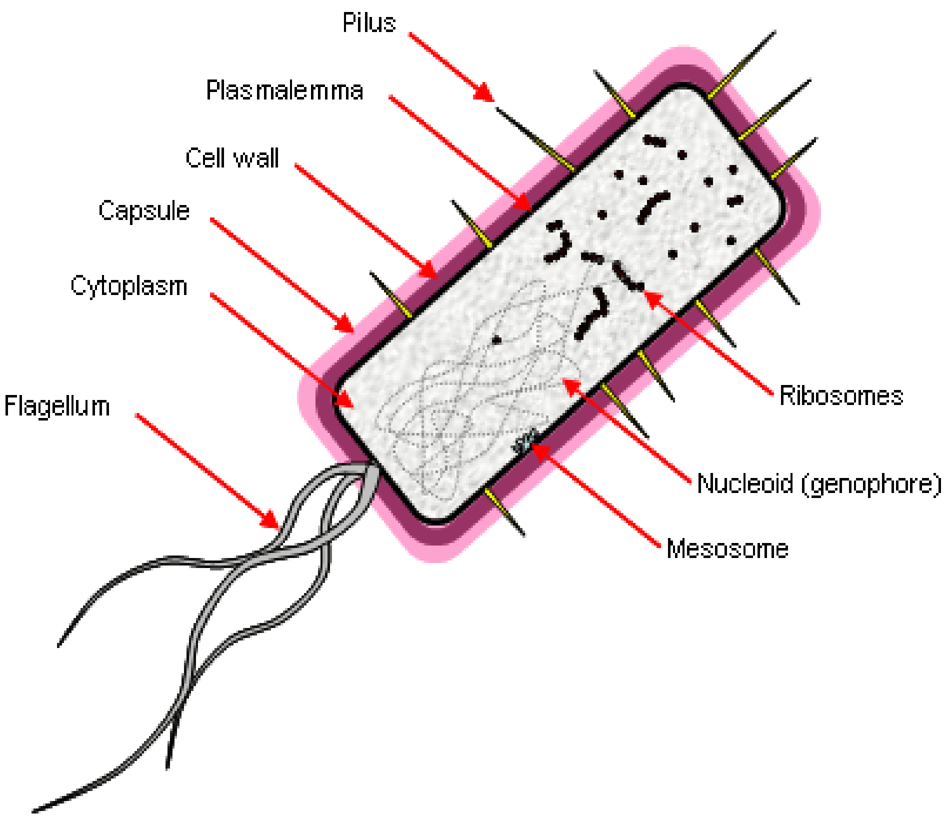
1) Always use a sharp pencil
2) It must have a title
3) Use a ruler to draw lines to the components you are labelling
4) Never shade your diagram – it is an outline

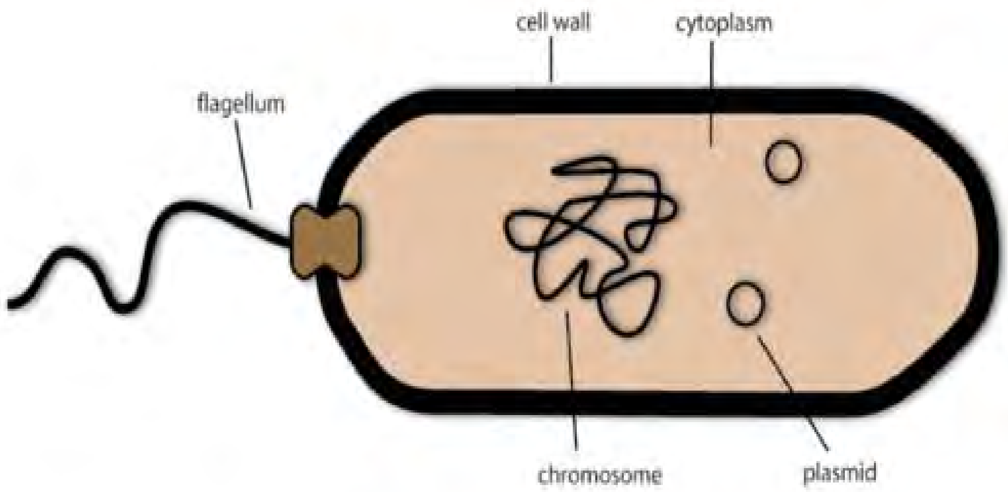
Each of the cell components has a specific function. Go through the table below of the 5 main components then copy them out as flashcards and ask your child to match the component with its structure and function. When they are happy with this ask them to draw each component from the diagram and add these into matching the flashcards.

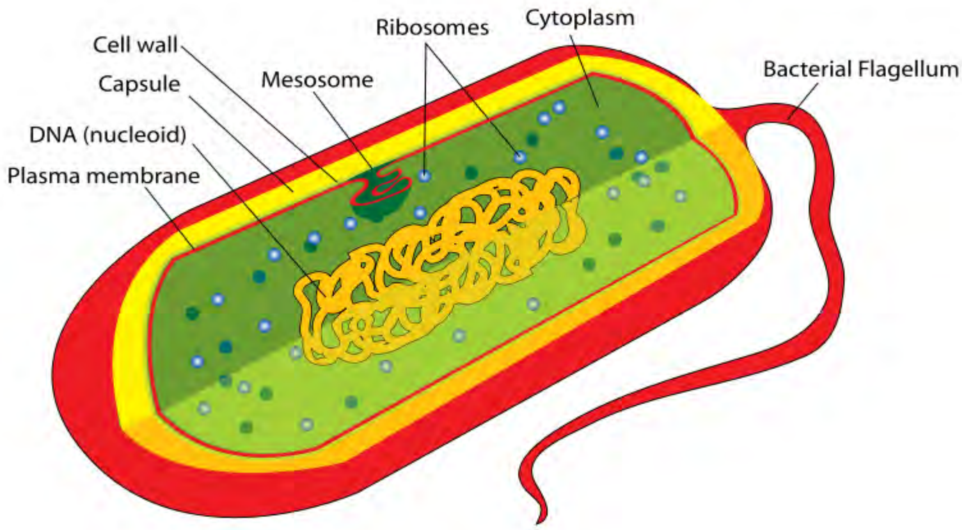
Component	Structure and Function	Space to draw the components
Chromosome (DNA)	The genetic information (DNA) of the bacterial cell is NOT found in a nucleus like it is in an animal or plant cell	
Plasmid (DNA)	Small closed circles of genetic information (DNA) that can move between bacterial cells	
Cytoplasm	The liquid inside the bacterial cell where reactions, including respiration occur	
Wall	Rigid, external structure not made of cellulose (unlike plant cells) that provide support	
Flagella	Whip-like structures that rotate for movement	

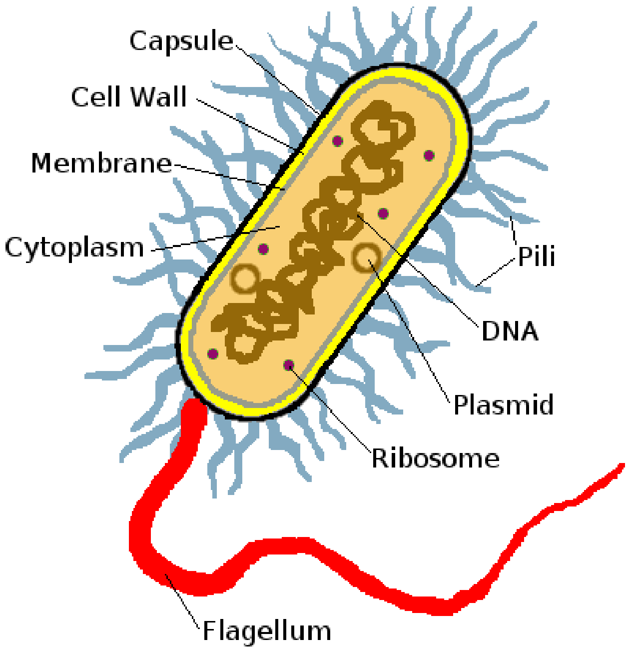
Examples of Drawings of Bacteria

Here are some examples of different ways that bacteria can be drawn. Check your child is happy to identify the different components even when drawn differently (the labels will help!)





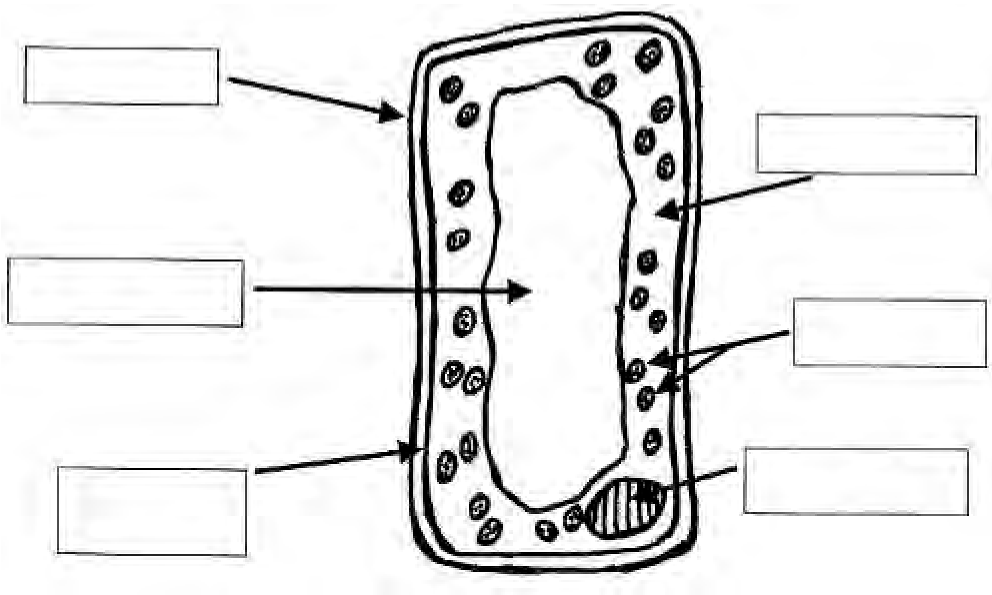

Cell wall
Capsule
DNA (nucleoid)
Plasma membrane
Ribosomes
Mesosome
Cytoplasm
Bacterial Flagellum


Capsule
Cell Wall
Membrane
Cytoplasm
Pili
DNA
Plasmid
Ribosome
Flagellum

Cells to Organisms End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) Is this an animal or a plant cell? How do you know?



2) Fill in the labels above

3) Give two ways that a sperm cell adapted for its function?

   1)

   2)

4) What piece of science equipment do you need to view cells?

5) What is the function of a cell nucleus?

6) Which of these structures is found in both plant and animal cells?

a) Mitochondria

b) Vacuoles

c) Chloroplasts

d) Cell walls

7) Name two differences between an animal cell and a bacteria

1)

2)

8) Fill in the missing words

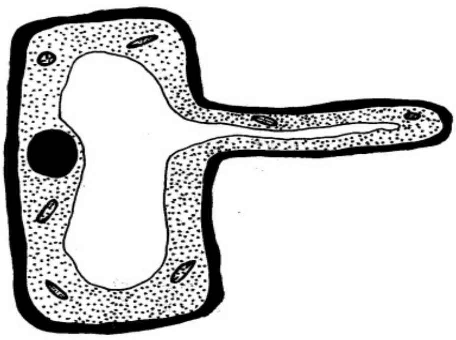
Cells make up …………………..which make up organs which make up ……………………………………………..which make up organisms.

9) By what processes do materials and water cross the cell membrane?

a)

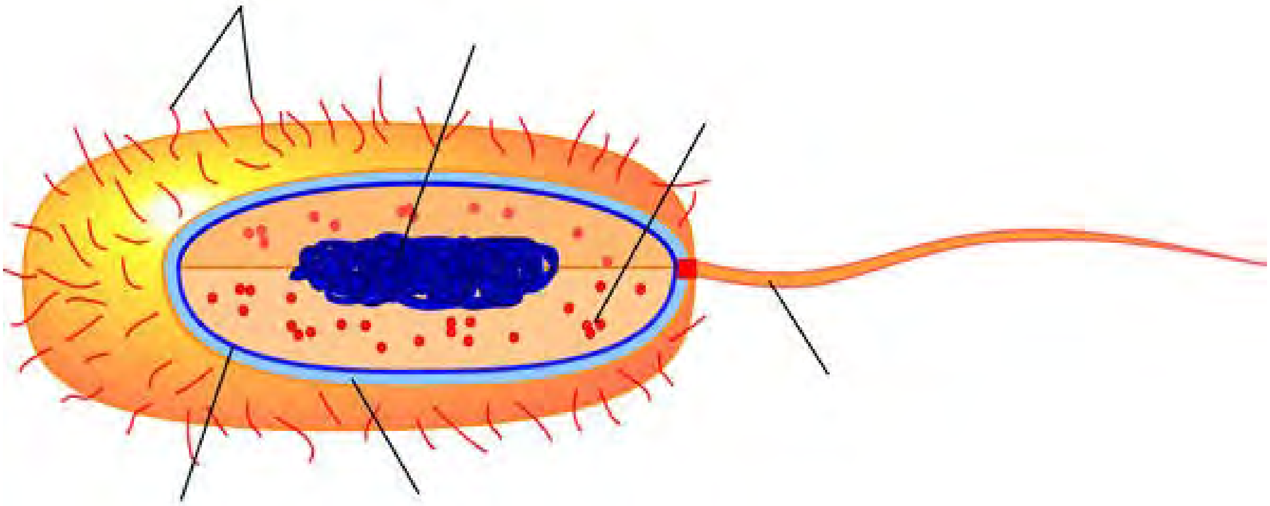
b)

10) Name this specialised cell



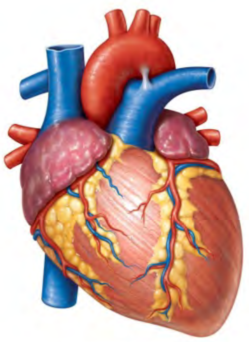
11) How is this cell adapted for its function?

12) Can you add these labels to this diagram of a bacteria: **ribosomes, chromosome DNA, flagellum, membrane, cell wall, pilli**



13) This organ is responsible for pumping blood around the body of most animals. State its name and the two types of tissue that make it up.

(b)



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Name:

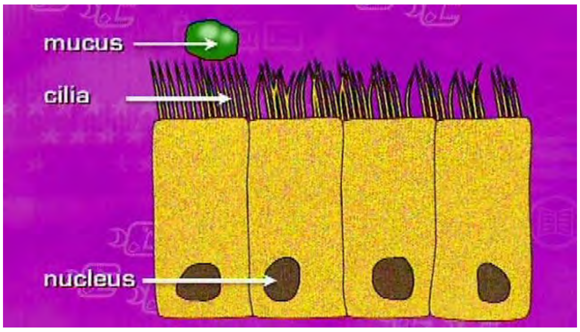
Tissues 1)

2)

14) What is the name of the jelly like substance in a cell where the chemical reactions occur?

15) What is a unicellular organism?

16) Where would you find these cells?



17) How are they adapted for their function?

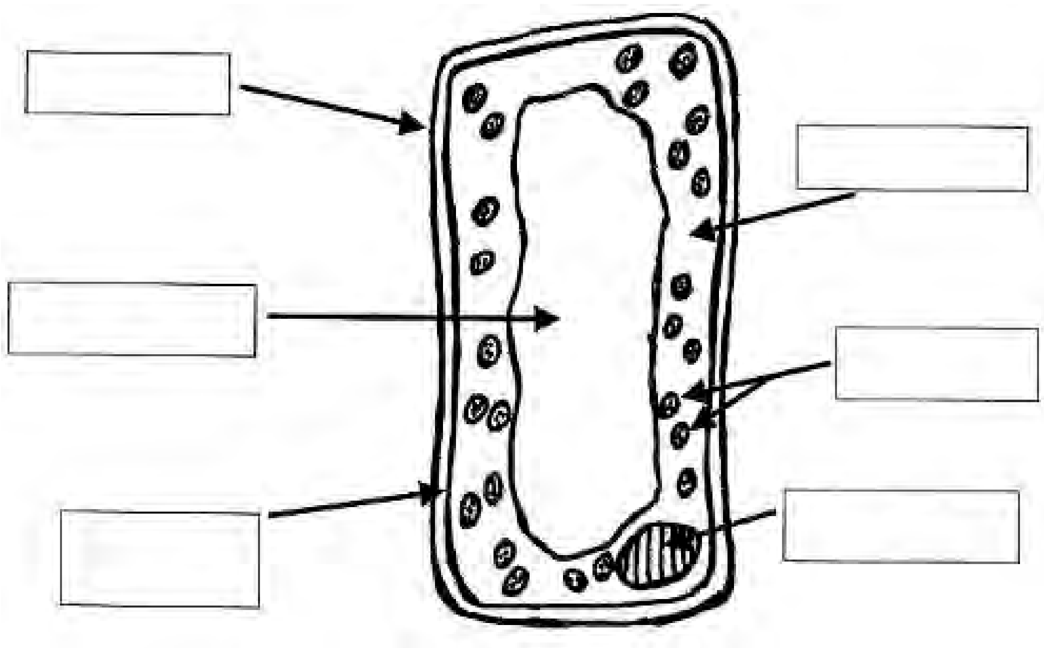
18) What is the name of the process where animal and plant cells split into two identical cells?

Answers to Cells to Organisms End of Topic Practise Questions

1) Is this an animal or a plant cell? How do you know?

Plant cell.

It has a cell wall, a vacuole and chloroplasts



2) Fill in the labels

Clockwise from top right the labels should be: - cytoplasm, chloroplasts, nucleus, cell membrane, vacuole, cell wall

3) Give two ways that a sperm cell adapted for its function?

a) It has a long tail to help it swim

b) It has enzymes in its head to help it enter the egg or 3) lots of mitochondria for energy

4) What piece of science equipment do you need to view cells?

Microscope

5) What is the function of a cell nucleus?

Controls the cell and contains the genetic information (DNA)

6) Which of these structures is found in both plant and animal cells?

a) Mitochondria

b) Vacuole

c) Chloroplasts

d) Cell walls

Answer is a) mitochondria

7) Name two differences between an animal cell and a bacteria

1) animal cell as a nucleus

2) animal cell does not have a cell wall (other answers are possible- bacteria has flagella, pilli)

8) Fill in the missing words

Cells make up tissues which make up organs which make up organ systems which make up organisms.

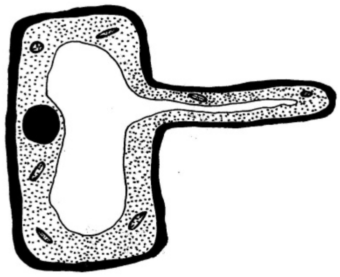
9) By what processes do materials and water cross the cell membrane?

1) Diffusion

2) Osmosis

10) Name this specialised cell

A root hair cell

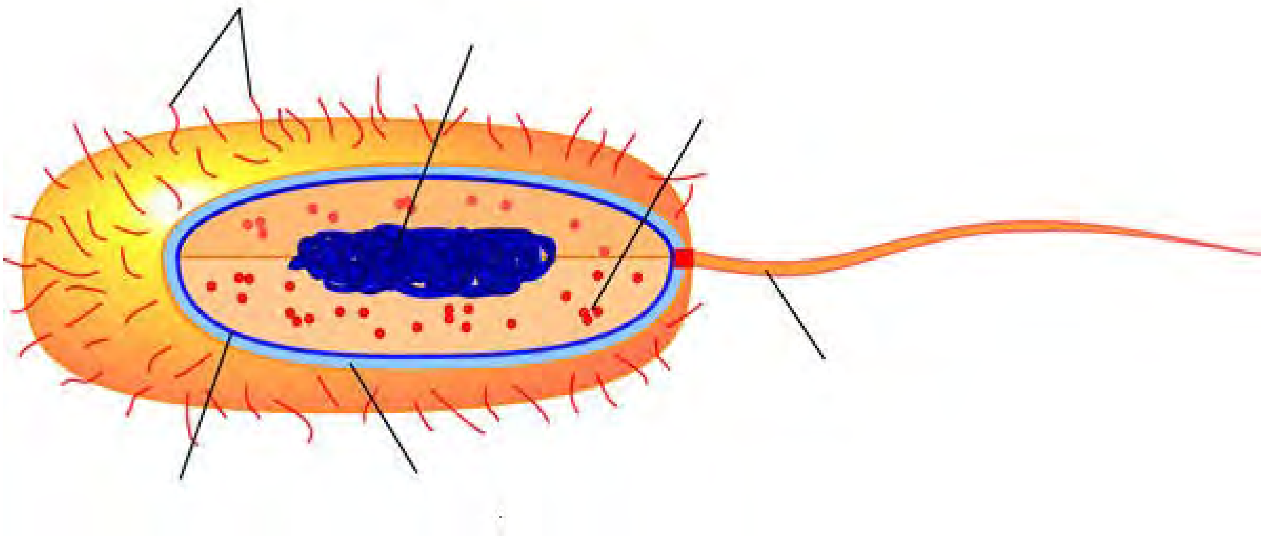


11) How is this cell adapted for its function?

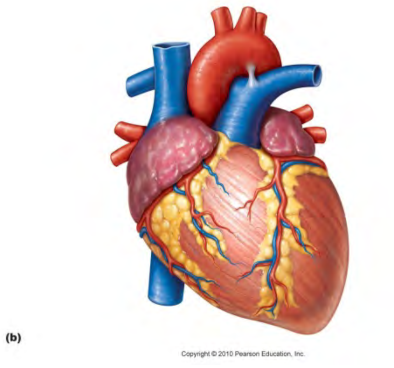
Increased surface area to absorb water from soil

12) Can you add these labels to this diagram of a bacteria: **ribosomes, chromosome DNA, flagellum, membrane, cell wall, pilli**

Clockwise from top left the labels are: pilli, chromosome DNA, ribosomes, flagellum, cell wall, membrane



13) This organ is responsible for pumping blood around the body of most animals. State its name and the two types of tissue that make it up.



Name: Heart

Tissues 1) Muscle

2) Nerve

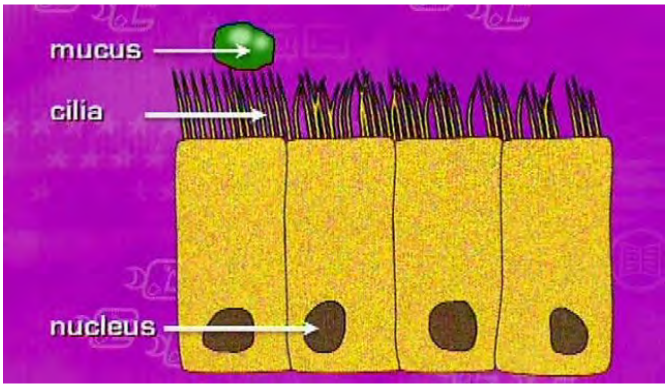
14) What is the name of the jelly like substance in a cell where the chemical reactions occur?

Cytoplasm

14) What is a unicellular organism?

An organism consisting of just one cell

16) Where would you find these cells? In our gas exchange system (any answer of nose, airways etc)



17) How are they adapted for their function?

The hairs catch and waft mucus, bacteria, dirt etc back out of our gas exchange system

18) What is the name of the process where animal and plant cells split into two identical cells?

Mitosis

Lesson 1: The Gas Exchange System (Breathing)

Today's Important Spellings: Trachea Bronchi Bronchioles Intercostal muscles	Diaphragm Ribs Alveoli (plural: Alveolus) Cartilage Ventilation

Suggested resources:

- Large cheap white t-shirt and permanent pens to draw onto t-shirt or large piece of paper or A4 body outline (below)
- Stopwatch
- Optional model of the lungs from: an old soft drinks bottle, a sheet of flexible plastic, two straws and 2 small balloons (making instructions are at the end of lesson plan)
- Cold hand mirror

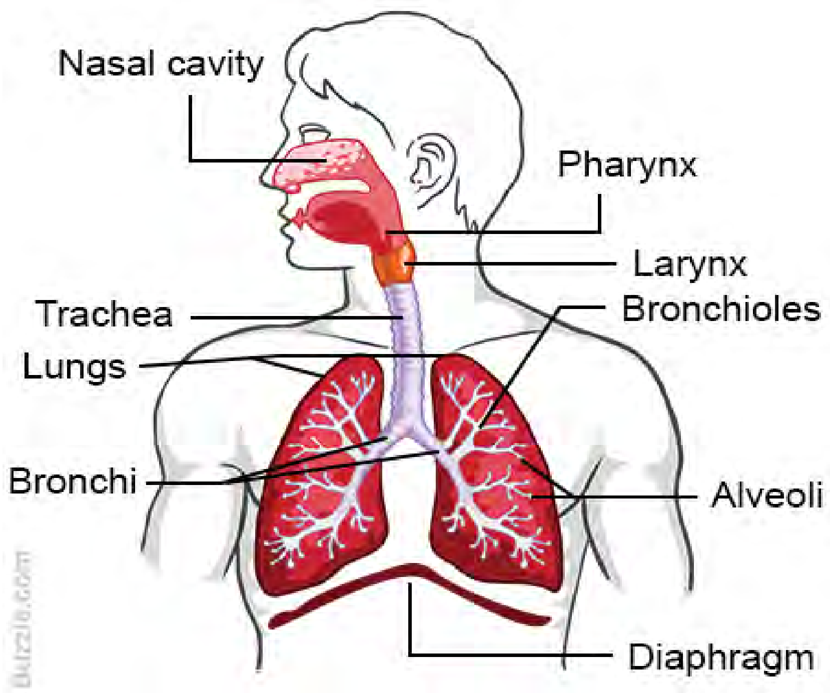
Lesson Content

Every cell in our **body needs oxygen for respiration** (making energy.) This process makes carbon dioxide which is a waste product and must be taken away from our cells. Our gas exchange system adds oxygen into our blood and removes carbon dioxide and water from it.

Ask your child what they know about how we breathe and the organs involved. Ask them how air enters our body and how many lungs we have. Check if they know any of the vocabulary involved.

Show them the diagram below and talk through how the gas exchange system works as they follow the passage of air on the diagram.

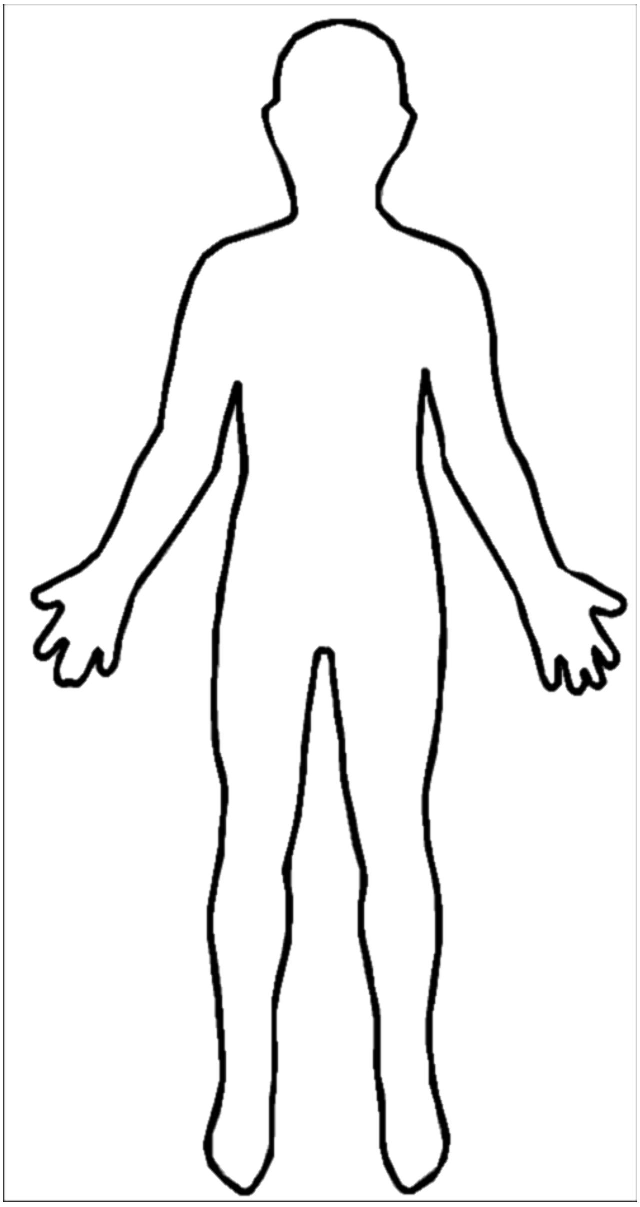
1) Air in drawn into the body through the nose and/or mouth and into the **trachea** (windpipe). The trachea is a rigid tube which leads from the back of your mouth. It has rings of tough cartilage surrounding it. If you press carefully and gently move your fingers up and down the outside of your throat at the bottom of your neck you can feel these rings of cartilage. This is to strengthen the tube and keep it open when you move your head around.
2) The trachea splits into two tubes called **bronchi** which lead to your lungs. From now on the tubes in your lungs look a little like upside down trees with the bronchi being like the trunk.
3) The **bronchi** splits into branches or **bronchioles** (like the trunk of a tree splits into branches). These are tiny tubes which divide like passages deeper into your lungs. Your lungs are not like empty balloons – they are like sponges full of tubes and air passages.
4) Each bronchiole (passage) ends in an **alveoli** or **air sac.** This is where oxygen enters the blood and carbon dioxide and water leave it.



Once you have looked at this diagram together you could try any/all of these 3 things to help reinforce their learning

a) You could dress someone in a large white t-shirt and ask another to draw on the t-shirt the gas exchange system – i.e. the trachea, the bronchi, bronchioles and the lungs themselves. You can add to this t-shirt as you go through this lesson and the other organ system lessons

b) If you prefer you could draw around the child's torso on a large sheet of paper and draw onto there or onto an A4 body outline like this one:

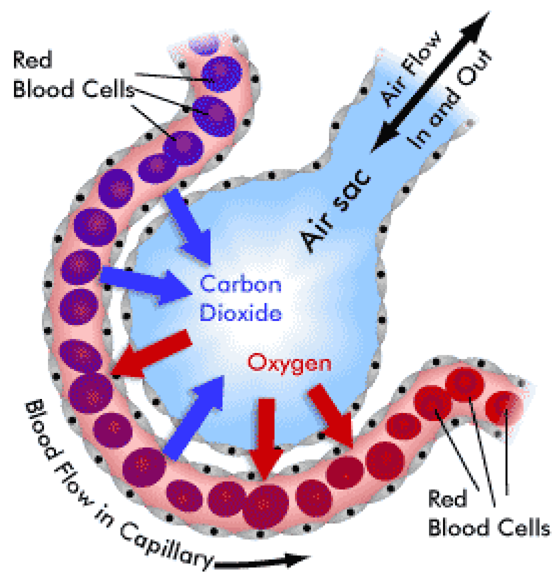


c) You can cut out/copy out this flash card game and ask them to match the organ with its function. (You can add in the diaphragm, rib and intercostal muscles after the next part of the lesson)

Trachea	This is a rigid tube leading from your mouth towards your lungs
Bronchi	Your trachea splits into two tubes that lead to your lungs
Bronchioles	These are tiny passages that divide like branches in your lungs
Alveoli (plural: alveolus)	Air sacs at the end of the bronchiole where gas exchange happens with your blood
Diaphragm	This curved sheet of muscle below your lungs contracts and relaxes as you breathe
Ribs	These are protective bones that surround your lungs, heart and other vital organs
Intercostal muscles	Muscles that run between your ribs that contract and relax when you breathe.

What happens in the alveoli?

An Alveolus (al-VEE-oh-lus)



We have about 500 million alveoli in an adult pair of lungs. They are tiny air sacs at the end of the bronchioles which increase the surface area for gas exchange. If you spread them out they would cover the size of a tennis court!

The walls of the alveoli are incredibly thin (one cell thick) and they touch the very thin walls of the blood capillaries. Oxygen and carbon dioxide (and water) move across the thin walls by **diffusion.** **<u>Diffusion is where molecules move from a higher to a lower concentration.</u>** So when blood enters your lungs it has a high concentration of carbon dioxide. By diffusion this passes across the thin walls into the alveoli as this is an area of low concentration of carbon dioxide. Now the red blood cells are ready to pick up oxygen. The oxygen moves across from higher concentration in the air breathed in into a lower concentration in the blood. Water moves across from the blood too to help keep the lining of the alveoli moist for the gas exchange. You can tell there is still water in your breath when you breathe out if you breathe onto a cold mirror. The ‘mist’ you see is water molecules**.** The alveoli have a good blood supply to allow this process to happen as quickly as possible.

How do we breathe in and out?

Ask your child to place their hands on their ribs and to take some large breaths in and out. Feel your ribs move.

1) Ask them to hold their breath – how many seconds can their hold it for before their brain kicks in and overrides this?
2) Once they have regained their breath ask them to count how many breaths they take in one minute.
3) Now ask them to run on the spot for 2 minutes and count again. Why has the number of breaths increased? (answer: your muscles need more oxygen to make energy and so you take more breath to get more oxygen into your blood to be pumped around your body)

Watch this you tube clip to explain what is happening:

https://www.youtube.com/watch?v=ylEknRf0jLU

(It is almost 8 minutes)

If you have made the balloon model now is the time to try using it to explain what is happening when we breathe in and out. NB this ONLY shows the role of the diaphragm and not the intercostal muscles moving the ribs in and out as the sides of the bottle can't move. However when you pull down the plastic as the diaphragm flattens you will see air being drawn into the balloon lungs. (details at the end of the lesson plan)

Breathing In (Inhalation)

When you breathe in, or inhale, your **diaphragm contracts (tightens) and moves downward.** This increases the space in your chest cavity, into which your lungs expand. **The intercostal muscles between your ribs also help enlarge the chest cavity. They contract to pull your rib cage both upward and outward when you inhale.** This makes the chest cavity bigger and has a lower air pressure so air is sucked in through your nose or mouth. The air travels down your windpipe and **into your lungs.**

Breathing Out (Exhalation)

When you breathe out, or exhale, your **diaphragm relaxes and moves upward** into the chest cavity. **The intercostal muscles between the ribs also relax to reduce the space in the chest cavity.**

As the space in the chest cavity gets smaller, air rich in carbon dioxide is forced out of your lungs and windpipe, and then out of your nose or mouth.

To reinforce this learning cut out the list below and ask your child to list them under two headings- breathing in and breathing out. Breathing is also called **ventilation**.

Breathing in:

Your intercostal muscles move your ribs **up** and **out**

Your diaphragm **contracts** and **moves downwards**

Your chest cavity becomes **bigger** and so has a **lower air pressure**

Air **rushes in to** your lungs

Breathing out:

Your intercostal muscles move your ribs **down and in**

Your diaphragm **relaxes and moves upwards**

Your chest cavity becomes **smaller** and so has a **bigger air pressure**

Air is forced **from** your lungs

To conclude the lesson, ask your child to explain **how we breathe and what happens inside their body when they take a breath.** They should cover all the points below:

Breathing In (Inhalation)

When you breathe in, or inhale, your diaphragm contracts (tightens) and moves downward. This increases the space in your chest cavity, into which your lungs expand. The intercostal muscles between your ribs also help enlarge the chest cavity. They contract to pull your rib cage both upward and outward when you inhale.

As your lungs expand, air is sucked in through your nose or mouth. The air travels down your windpipe and into your lungs. After passing through your bronchial tubes, the air finally reaches and enters the alveoli (air sacs).

Through the very thin walls of the alveoli, oxygen from the air passes to the surrounding capillaries (blood vessels). Red blood cells help move oxygen from the air sacs to the blood.

At the same time, carbon dioxide moves from the capillaries into the air sacs. The gas has travelled in the bloodstream from the heart.

Oxygen-rich blood from the lungs is carried back to the heart to be pumped to the rest of the body. There, the oxygen in the blood moves from blood vessels into surrounding tissues.

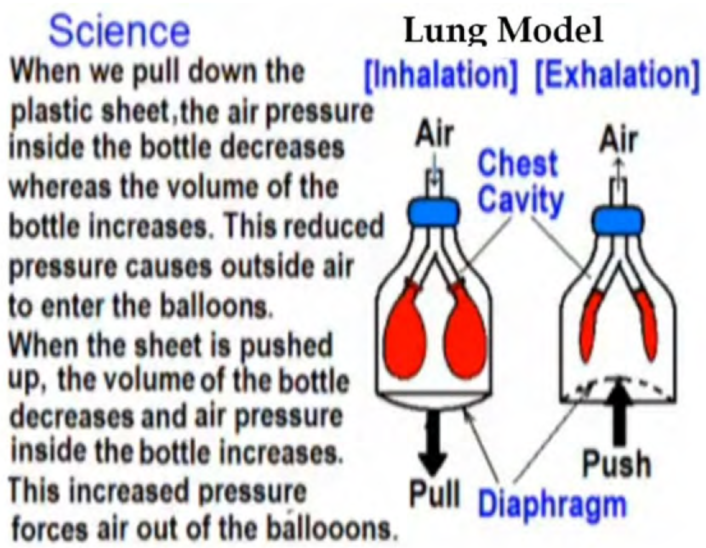
Breathing Out (Exhalation)

When you breathe out, or exhale, your diaphragm relaxes and moves upward into the chest cavity. The intercostal muscles between the ribs also relax to reduce the space in the chest cavity.

As the space in the chest cavity gets smaller, air rich in carbon dioxide is forced out of your lungs and windpipe, and then out of your nose or mouth.

How to make the lung model

YouTube clip
http://www.echo.education/url/makingalungmodel



Lesson 2: The Digestive System

Today's Important Spellings: Oesophagus Stomach Liver Pancreas Small intestine Large intestine Rectum	Anus Villi Peristalsis Enzymes:- carbohydrase, lipase, protease Bacteria

Suggested resources:

- Big white t-shirt and pens from last lesson (or large paper outline or A4 outline whichever you used)
- 9 meter length of string
- Leg of old pair of tights or a stocking with a tennis ball inside
- Straw and scissors per child

Optional: small food processor (or fork and bowl to squash food), slice of bread, small jug of water and a string food bag.

Lesson Content

We eat large, insoluble molecules of food. In our digestive system these are broken down into small molecules that can absorb into our blood and then used by our body. We call this **digestion** and the process is carried out by our **digestive system**.

Ask your child to tell you what they already know about what happens to the food they eat.

Explain that today we are going to follow the journey that our food takes as it moves through our body.

1) We take a bite of the food we are eating. This mixes in our mouth with saliva to make a bolus (ball of food ready to swallow.) Saliva contains enzymes that start to help break down the food into the nutrients we can absorb and lubricates the food to help us swallow it.

- *Illustrate: tear some bread from the slice and add some water from the jug. Pulse in the small food processor (or mash with fork)*

2) The bolus needs to be swallowed and will travel down our oesophagus (or gullet). This is the tube that connects our mouth with our stomach. To help the food ball move along this tube there is a wave of muscle called peristalsis. The lining of most of our digestive system is covered in rings of muscle and lengths of muscle along it. This means it can contract and push the food along. This is the reason that we need to eat fibre in our diet, to give the muscles something to push against.

- *Illustrate: put the ball into the top of the tights or sticking and use your hand to squeeze it down through the material. This is like the wave of peristalsis pushing the bolus down from our mouth to our stomach.*

3) The food now enters our stomach where it is mixed with stomach acid to kill microorganisms and enzymes for digestion.

<u>*Illustrate:*</u> *tear pieces of bread and put them into the food bag – add water as stomach acid and more water as enzymes. Squeeze it around to mix. To explain the job of enzymes give each child a straw and a pair of scissors. Special scissors or enzymes are needed for different nutrients. Once the right scissors act on the nutrients they can start cutting it down into small pieces that can be absorbed. Ask your child to snip the straw up into tiny pieces.*

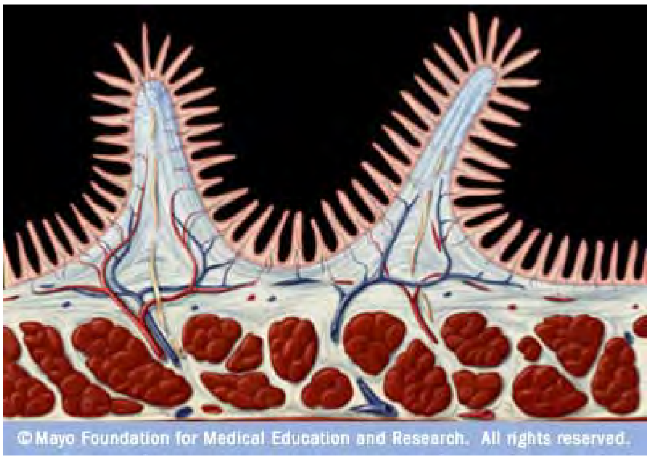
Enzymes are often called 'biological catalysts'. They can either speed up the breakdown of larger molecules into smaller ones or help to stick small molecules together. There are three types of enzyme in the digestive system and they all work on a different substrate:

Type	Location	Substrate it acts on	Breaks substrate into…
Carbohydrase	Mouth, pancreas and small intestine	Carbohydrate	Sugars
Lipase	Pancreas and small intestine	Lipids (fats and oils)	Fatty acids and glycerol
Protease	Stomach, pancreas and small intestine	Protein	Amino acids

Your stomach acid is there to kill microorganisms like bacteria so that you don't become ill. BUT there are billions of useful bacteria already inside our intestines – they help us by further breaking down carbohydrates and stop harmful bacteria from moving in.

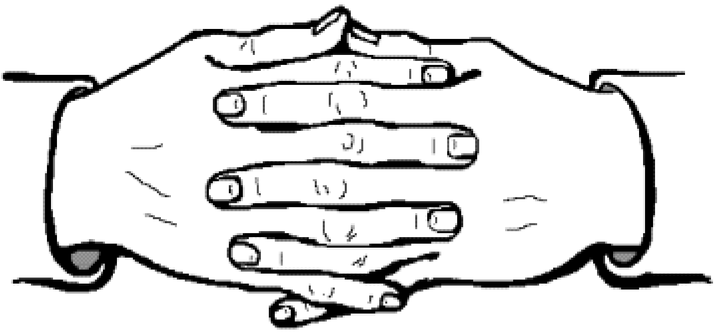
4) The **liver, gall bladder** and **pancreas** are important here as they make enzymes to help digestion.

5) Now the food in our stomach is like a 'soup'….it moves into the **small intestine**. It is called the small intestine but is really about 5 metres long. This is the main area where nutrients are absorbed into our blood stream. We need as large a surface area as possible to allow the nutrients to be absorbed. If it was just like a smooth hose pipe then the some of the food would never touch the sides. So the inner lining of the small intestine is covered in millions of tiny finger-like projections called **villi**.



The villi are about one millimetre tall and allow increased absorption into our blood by the process of diffusion again (diffusion is the process of molecules moving from an area of high to lower concentration i.e. from the small intestine into the blood stream) The villi have a very good blood supply and have a wall only one cell thick to allow for the most absorption possible.

- *<u>Illustrate</u>: gently interlock your fingers with your palms facing you and wave your fingers around – this illustrates how the villi stick into the small intestine.*



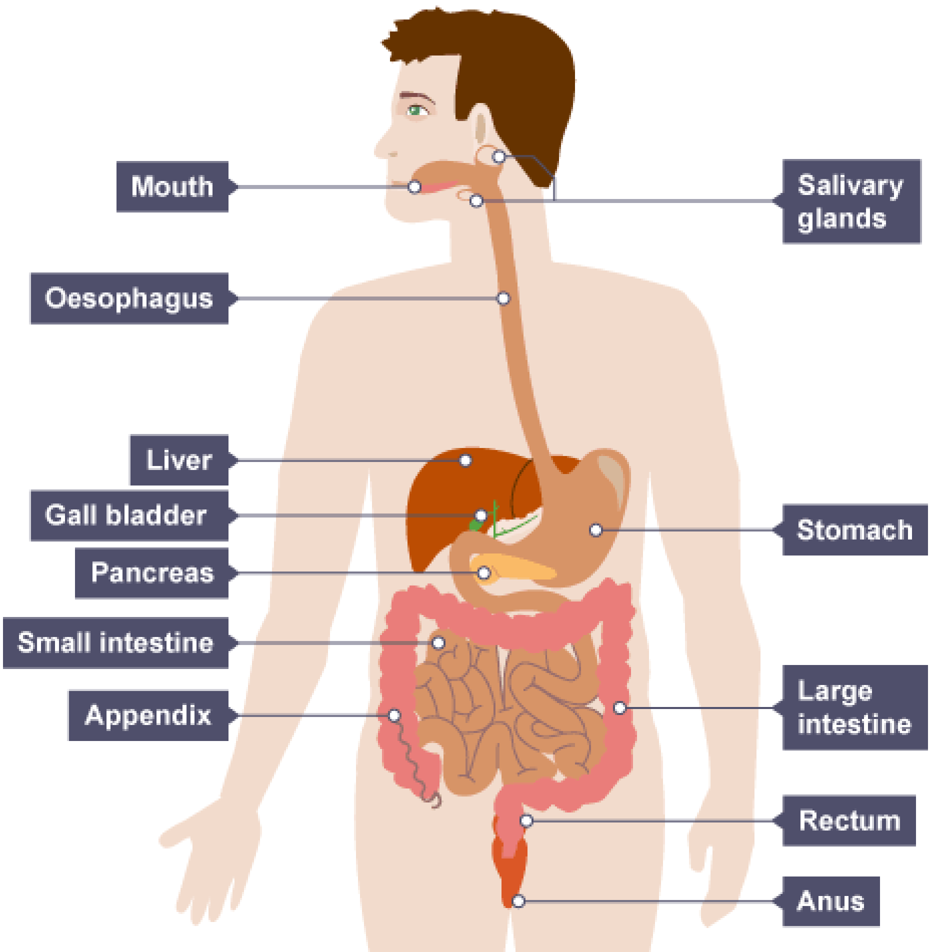
Courtesy of S. Green

6) The remains of the food moves into your **large intestine**. This is where excess water is absorbed into the blood leaving just waste material.

- *<u>Illustrate:</u> the journey your food takes is about 9 metres long – show them the string that has been pre cut to 9m. hold one end and ask them to move away until they reach the other end. This si a very long way!*

7) The **rectum** is the final section of the large intestine and it acts as a temporary store of faeces (undigested food) which leaves your body through a ring of muscle called the **anus**.

Look at this diagram and see if your child can explain the journey of food through the digestive system. Then ask them to draw the digestive system onto the t-shirt/ torso/ A4 printout from last lesson.



NB: The **appendix** is not a vital organ and medical researchers still debate its exact **function** in our bodies

Watch these YouTube clips to reinforce learning:

Digestive system

http://www.echo.education/url/digestivesystem

Digestion song

http://www.echo.education/url/digestionsong

Villi

http://www.echo.education/url/villi

Lesson 3: The Skeletal System

Today's Important Spellings:	
Bones skeleton cranium mandible sternum humerus	Ribs Ulna Radius Femur Fibula Tibia Joints

Suggested resources:

- If you have one a Skeleton dressing up costume is fun here but don't buy one just for this
- Strong sandwich bag filled with water

Lesson Content

You have **206** bones in your body that make up your skeletal system (you were born with over 300 but many have fused together)

Bones are **organs.** The smallest bones are the three tiny bones in your inner ear (the anvil, the stirrup and the hammer) and the largest one is the femur or thigh bone.

Why do we have a skeleton?

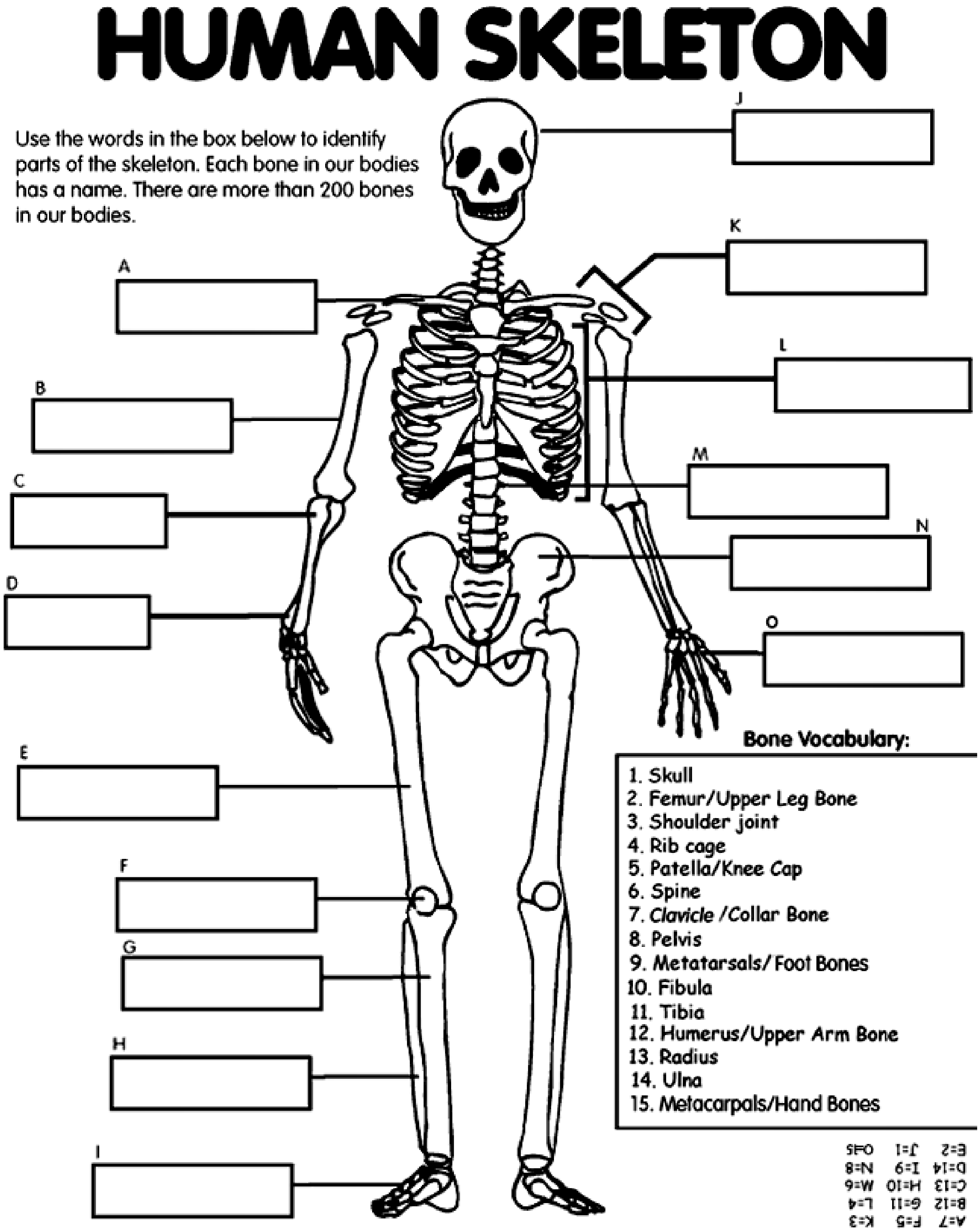
Ask your child this question. It is interesting to see what they already know and understand.

There are **4 functions** of your skeleton

1) To support your muscles and organs (otherwise we will be a big bag of skin and internal organs – show them the food bag filled with water – it has no structure)
2) To protect your internal organs from damage – e.g. your skull or cranium protects your brain
3) Our bones move when connected to our muscles and so allow us to move our bodies
4) Produce red and white blood cells in the bone marrow in the middle of our bones

Fold a large piece of paper into 4 and ask your child to draw a diagram in each section to illustrate each of the functions of the skeleton e.g. they could draw a factory with red and white blood cells coming out in boxes to show the job of the bone marrow or a person running to show movement

Ask your child to label this diagram of the skeleton. Suggest they start with the labels they are sure of and see what they have left. Then use the labelled example to check their work and to add any they are unsure of:

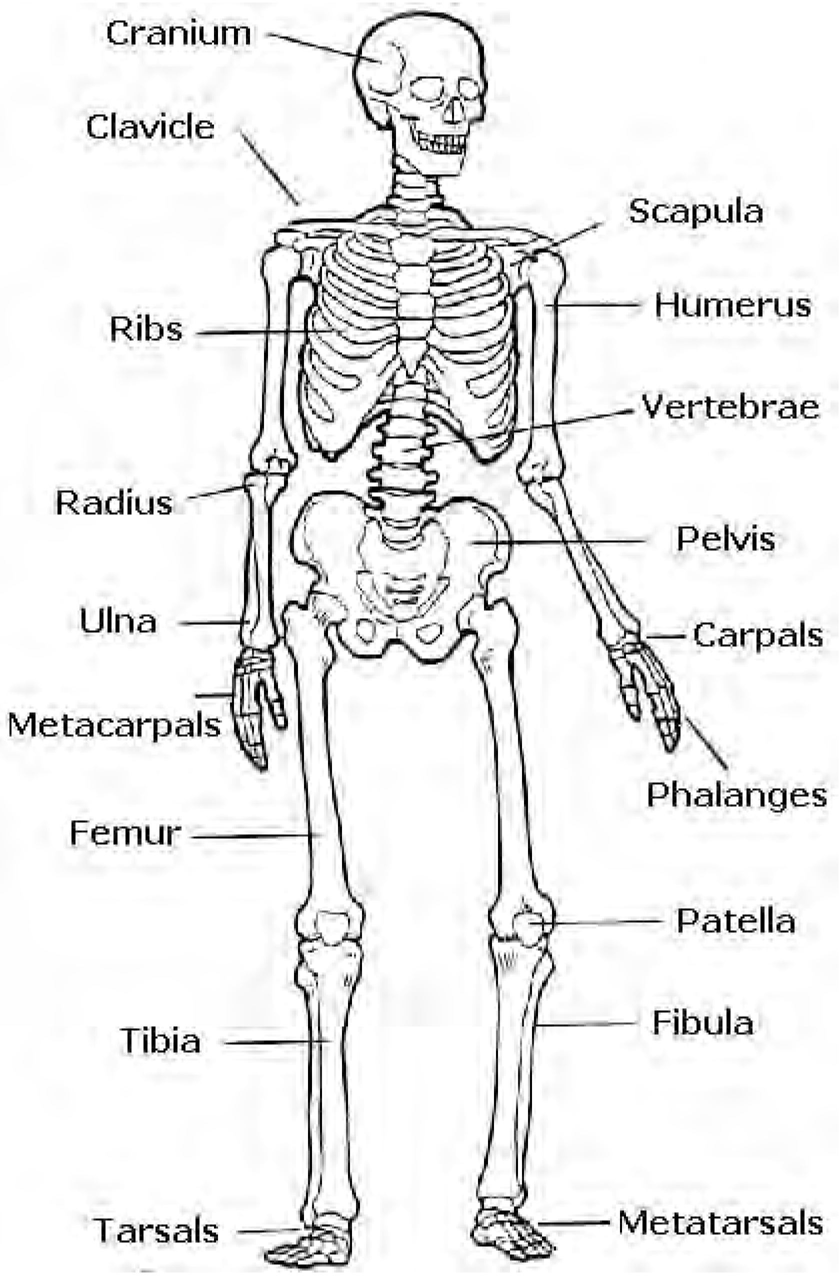


NB At this stage we start to use some more scientific words for some bones e.g. the skull is now called the cranium, the collar bone is the clavicle, the shoulder blade is the scapula etc. Ask your child to add these words to their labelled diagram using this example. Stress that spelling is important so that they learn them correctly.

Tip for naming arm bones:

The humerus ends in the funny bones. Funny things are said to be humorous.

Hold out your arm and give thumbs up – the radius is on top the ulna is underneath- u for ulna, u for underneath.


Cranium
Clavicle
Scapula
Humerus
Ribs
Vertebrae
Radius
Pelvis
Ulna
Carpals
Metacarpals
Phalanges
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals

Joints

Where bones meet

Joints are the place where two bones meet. All of your bones, except for one (the hyoid bone in your neck), form a joint with another bone. Joints hold your bones together and allow your rigid skeleton to move.

Fixed joints

Some of your joints, like those in your skull, are fixed and don't allow any movement. The bones in your skull are held together with fibrous connective tissue.

Slightly movable joints

Other joints, such as those between the vertebrae in your spine, which are connected to each other by pads of cartilage, can only move a small amount.

Synovial joints

Most of your joints are 'synovial joints'. They are movable joints containing a lubricating liquid called synovial fluid. Synovial joints are predominant in your limbs where mobility is important. Ligaments help provide their stability and muscles contract to produce movement. The most common synovial joints are listed below:

- Ball and socket joints, like your hip and shoulder joints, are the most mobile type of joint in the human body. They allow you to swing your arms and legs in many different directions.
- Ellipsoidal joints, such as the joint at the base of your index finger, allow bending and extending, rocking from side to side, but rotation is limited.
- Gliding joints occur between the surfaces of two flat bones that are held together by ligaments. Some of the bones in your wrists and ankles move by gliding against each other.
- Hinge joints, like in your knee and elbow, enable movement similar to the opening and closing of a hinged door.
- The pivot joint in your neck allows you to turn your head from side to side.
- The only saddle joints in your body are in your thumbs. The bones in a saddle joint can rock back and forth and from side to side, but they have limited rotation.

Flexibility: Joints enable your body to move

Ball and socket joints: Are the most mobile type of joint in your body

Saddle joints: Enable you to grasp things

YouTube clip to reinforce learning

http://www.echo.education/url/joints

To summarise their learning ask your child to start at their head and point to their bones naming them as they go. Ask them to tell you 4 reasons why we have bones and then to tell you what they have learnt about joints and to point to some on their body.

Lesson 4: Muscular System

Today's Important Spellings: Muscles Voluntary Involuntary Tendons Ligaments Antagonistic pairs	Biomechanics Contract Relax

Suggested resources:

- Small mirror

Lesson Contents

Ask your child:" Did you know you have about 750 muscles in your body? They do everything from pumping blood throughout your body to helping you lift your heavy backpack. You control some of your muscles, while others — like your heart — do their jobs without you thinking about them at all."

Muscles are all made of the same material, a type of elastic tissue (sort of like the material in a rubber band). Thousands, or even tens of thousands, of small protein fibres make up each muscle.

You have three different types of muscles in your body:

1) **Smooth muscle**
2) **Cardiac (heart) muscle**
3) **Skeletal muscle**.

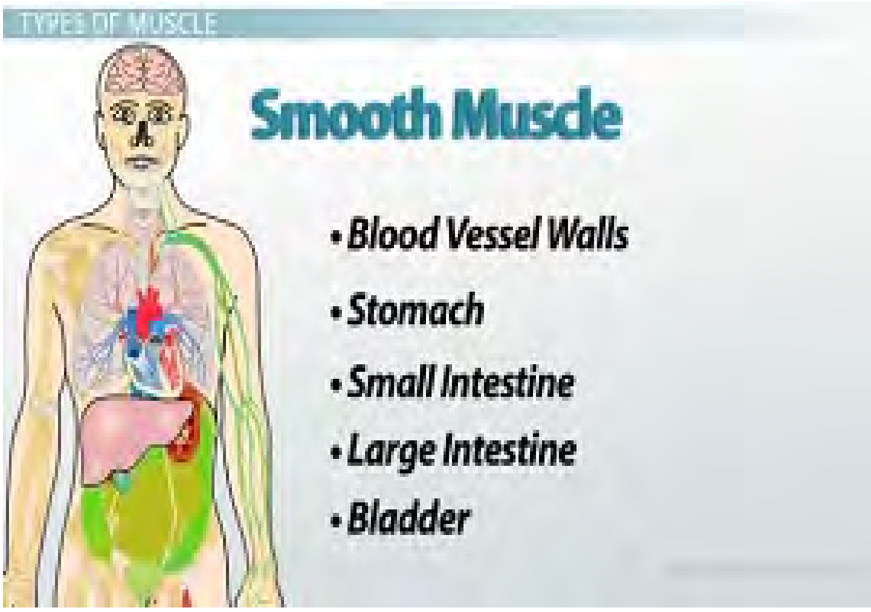
Smooth Muscles

Smooth muscles or **involuntary** muscles are usually in sheets, or layers, with one layer of muscle behind the other. You can't control this type of muscle. Your brain and body tell these muscles what to do without you even thinking about it. Smooth muscles work all over your body. In your stomach and digestive system, they contract (tighten up) and relax to allow food to make its journey through the body.

Smooth muscles are also found in your bladder. When they're relaxed, they allow you to hold in urine (wee) until you can get to the toilet. Then they contract so that you can push the urine out. These muscles are also in a woman's uterus or womb where a baby develops. There they help to push the baby out of the mother's body during labour.

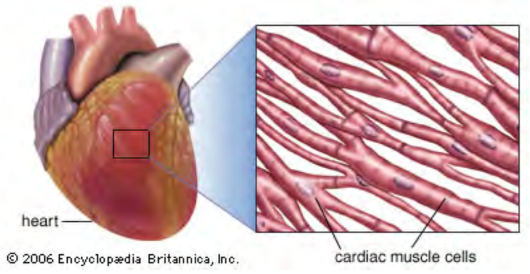
You'll find smooth muscles at work in your eyes, too. These muscles keep your eyes focused.

Ask your child to write 'Smooth Muscle' in the centre of a page and draw lines out around the words listing all the types of smooth muscle that they can remember (i.e. digestive system, bladder, womb, eyes)

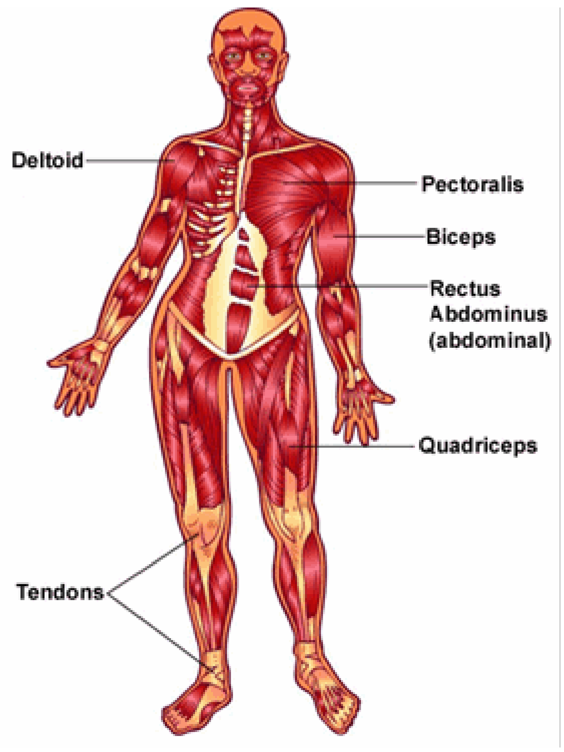


Heart (Cardiac) Muscle

The muscle that makes up the heart is called cardiac muscle. It is also known as the **myocardium**. The thick muscles of the heart contract to pump blood out and then relax to let blood back in after it has circulated through the body .Just like smooth muscle, cardiac muscle works all by itself with no help from you.



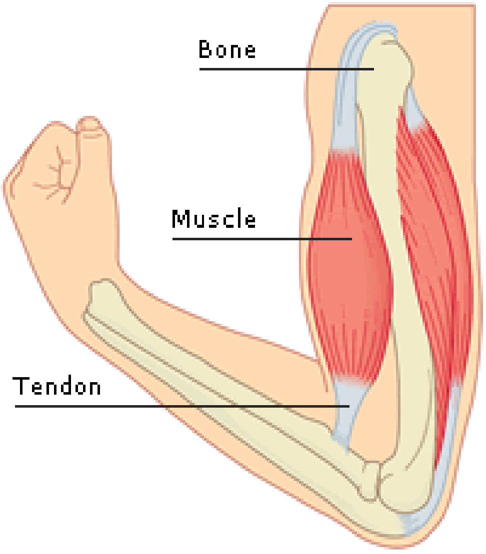
Skeletal Muscle



These are your skeletal **muscles**. They are **voluntary** muscles, which mean you can control what they do. Your arm won't reach out to wave unless you want it to. These muscles help to make up the **muscular system**— the combination of your muscles and your skeleton, or bones.

Together, the skeletal muscles work with your bones to give your body power and strength. In most cases, a skeletal muscle is attached to one end of a bone. It stretches all the way across a joint (the place where two bones meet) and then attaches again to another bone.

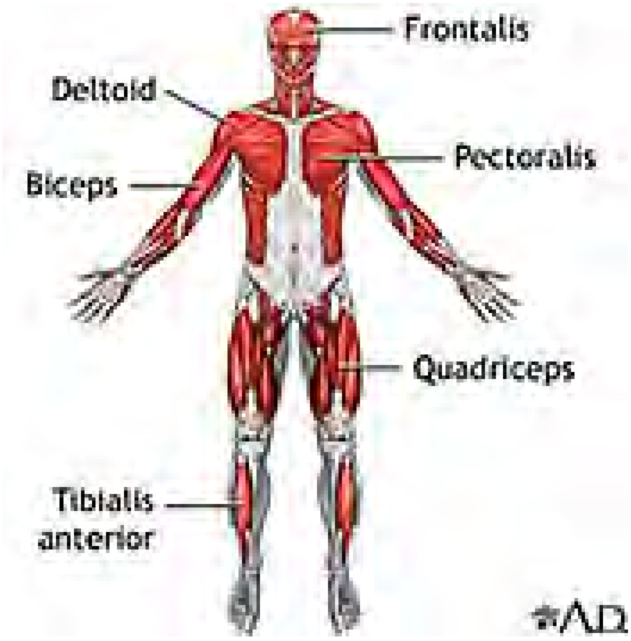
Skeletal muscles are held to the bones with the help of **tendons**. Tendons are cords made of tough tissue, and they work as special connector pieces between bone and muscle. The tendons are attached so well that when you contract one of your muscles, the tendon and bone move along with it. Tough ligaments join the two bones in the joint and stop it falling apart.



The muscles in your arm

When your muscles relax and contract they apply forces to pull your bones into specific positions, which act like levers. This is how you move. The study of how muscles and bones work together is called **biomechanics**. Different muscles apply different forces which you could measure using a newton meter.

Skeletal muscles come in many different sizes and shapes to allow them to do many types of jobs. Some of your biggest and most powerful muscles are in your back, near your spine. These muscles help keep you upright and standing tall.



Your skeleton is covered with muscles

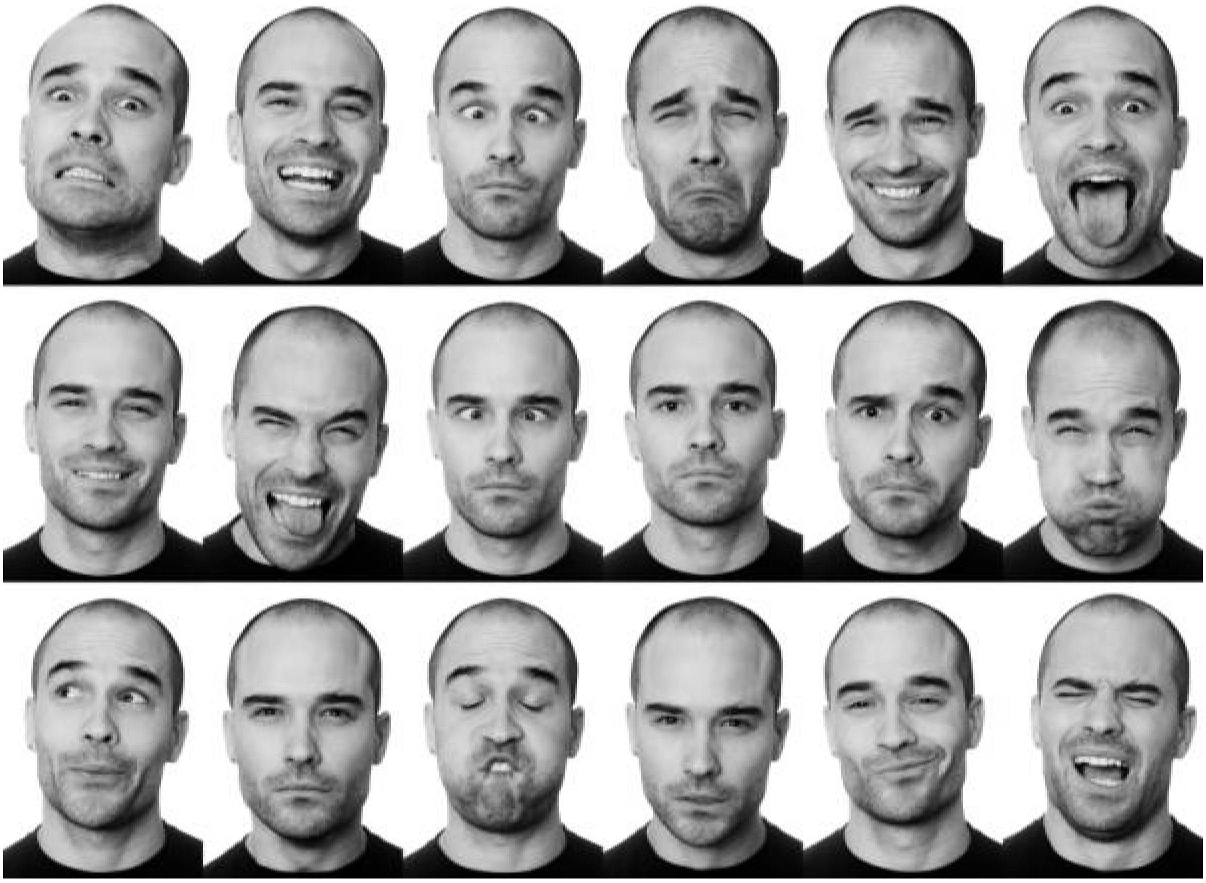
They also give your body the power it needs to lift and push things. Muscles in your neck and the top part of your back allow lots of movement. Try rotating your head around, back and forth, and up and down to feel the power of the muscles in your neck. These muscles also hold your head high.

Face Muscles

You may not think of it as a muscular body part, but your face has lots of muscles allowing you to pull lots of facial expressions!

☆ Give your child a mirror and ask them to explore their facial muscles with the variety of expressions and facial movements they can make.

Facial muscles don't all attach directly to bone like they do in the rest of the body. Instead, many of them attach under the skin. This allows you to contract your facial muscles just a tiny bit and make dozens of different kinds of faces. Even the smallest movement can turn a smile into a frown. You can raise your eyebrow to look surprised or wiggle your nose.

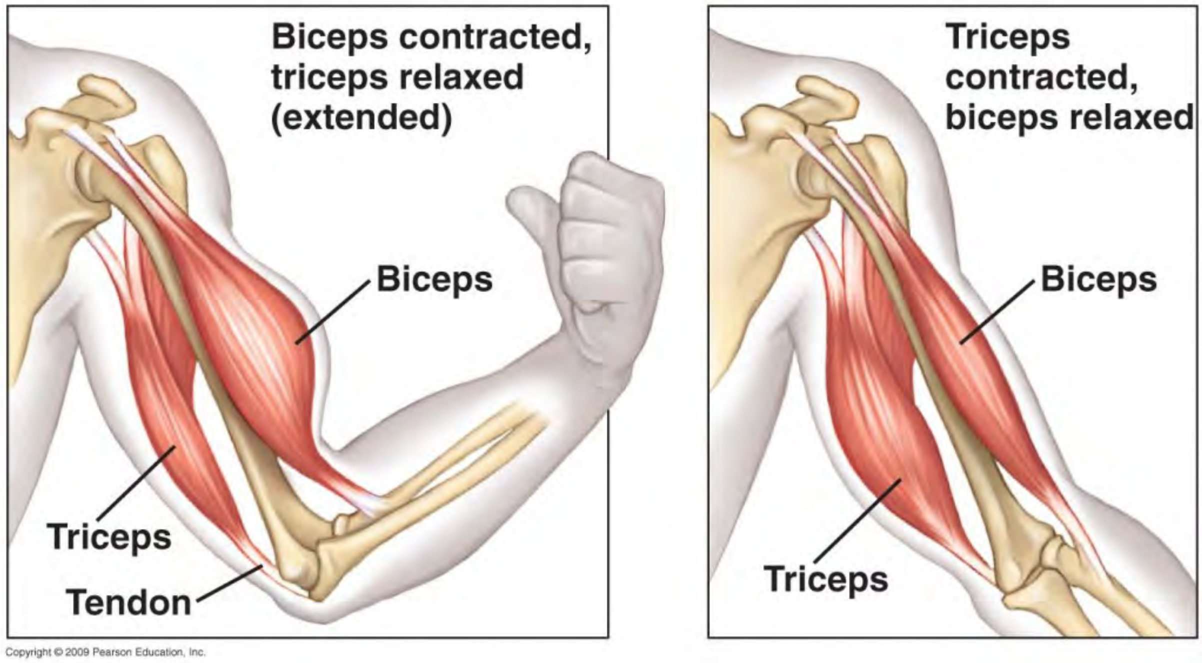


And while they're looking at their face, don't pass over their tongue — a muscle that's attached only at one end! The tongue is actually made of a group of muscles that work together to allow you to talk and help you chew food. Ask them to stick out their tongue and wiggle it around to see those muscles at work.

Antagonistic Pairs of Muscles

Muscles can only **contract** and **relax.** They cannot push back with force so they work together in antagonistic pairs opposite one another. This means that when **one contracts the other relaxes** and vice versa. A good example of antagonistic muscles is in your arm

☆ Ask your child to hold out their arm and then bend it at the elbow feeling their biceps and triceps muscles as their arm moves (see diagram below)



Summarise the lesson by asking your child to tell you the three types of muscle in the body (smooth, cardiac and skeletal.) Which are voluntary and involuntary muscles with an example of each. Can they explain what is happening to the muscles in their arm when they bend and straighten their arm at the elbow?

Lesson 5: The Nervous System

Today's Important Spellings:	
Nervous system Nerve Brain	Spinal cord Peripheral nerves

Lesson Introduction

Start today with a YouTube video clip to explain the nervous system (it starts out looking too simple and childish but bear with it – the content is great)

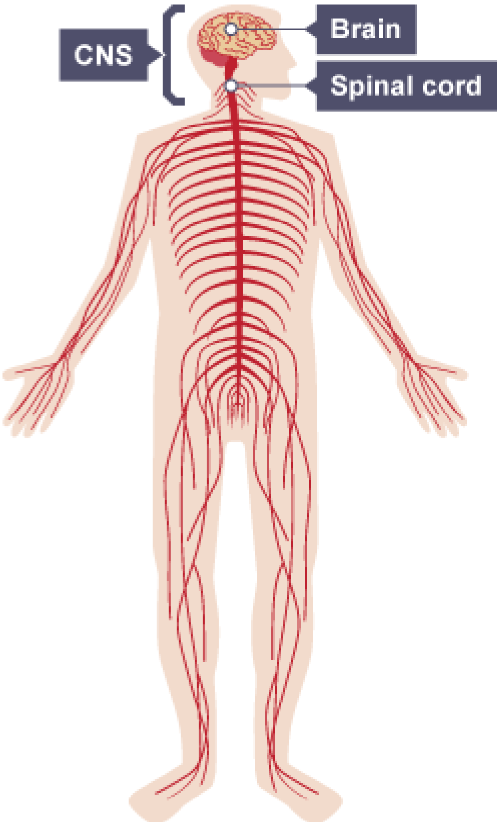
http://www.echo.education/url/thenervoussystem

Watch it through and then watch it a second time asking your child to make notes as they go along (this is a really useful skill to develop) They may need to see it a couple of time or pause it as they go along to help with this.

The **nervous system** is a system in the body which sends signals around the body. It lets people and animals respond to what is around them. The **central nervous system** (CNS) is:

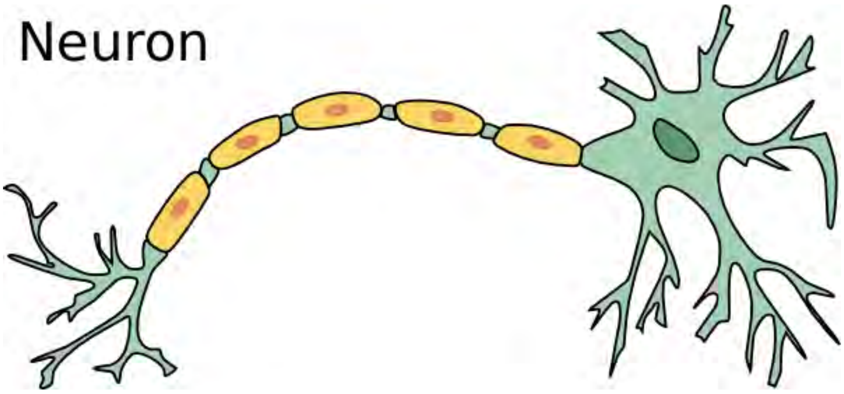
- the **brain**,
- the **spinal cord**,
- **nerves**.

It is there to coordinate movement and to pass on the input of the senses to our brain.

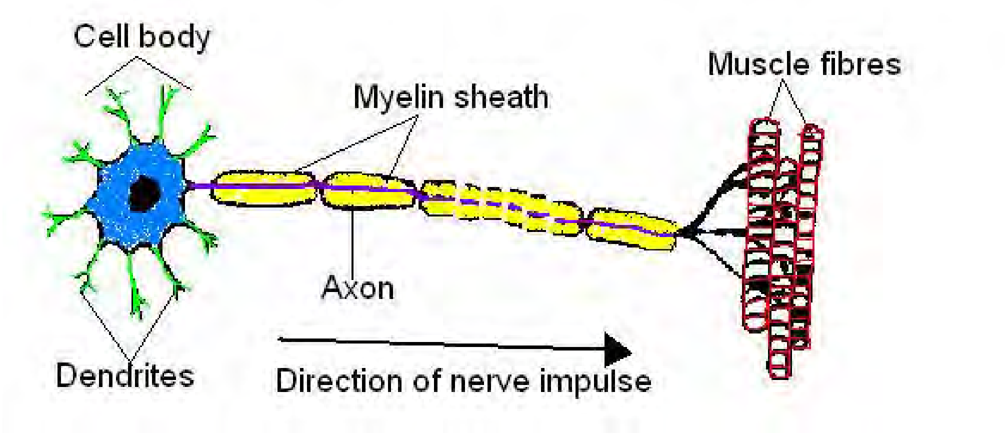


A diagram of the central nervous system

It is made up of **neurons** and cells called **glia** among other things. Glia cells keep the neurons safe and healthy.

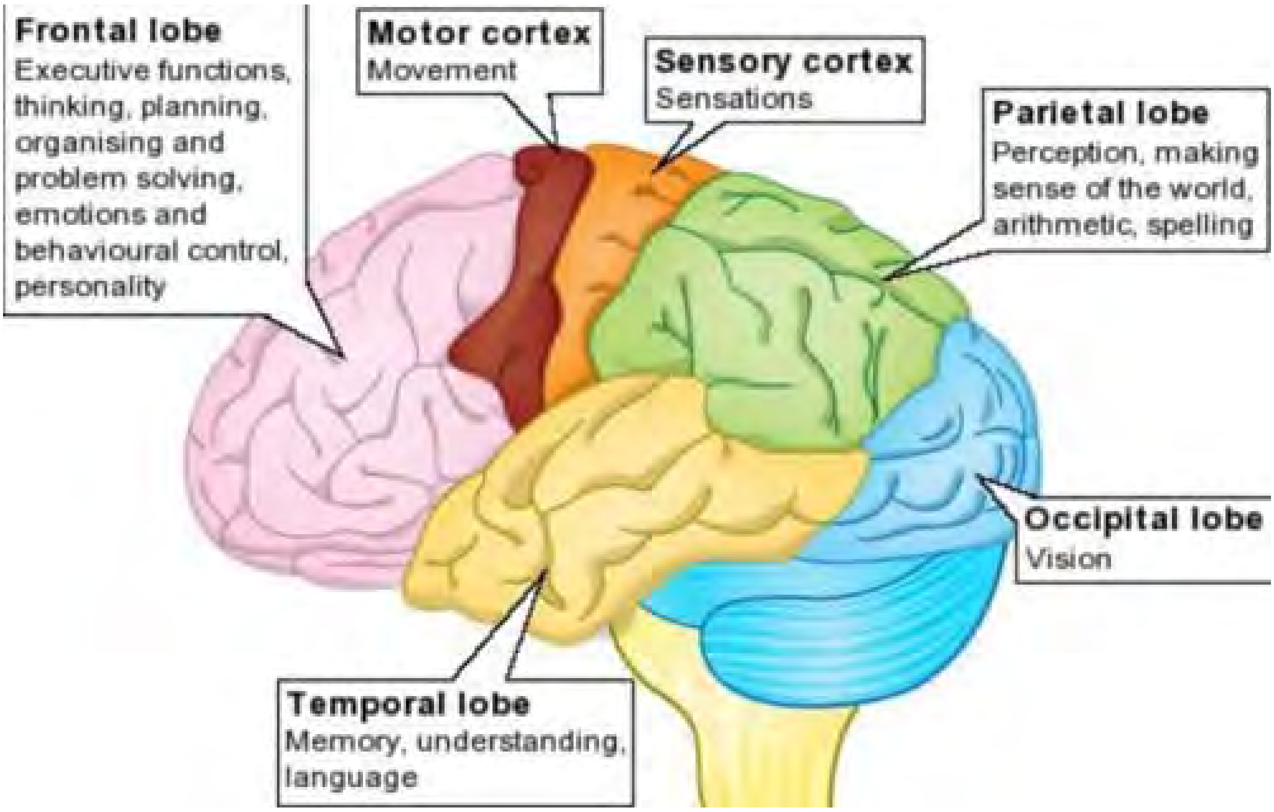


A neuron looks like this



This is how the neuron and muscles fit together

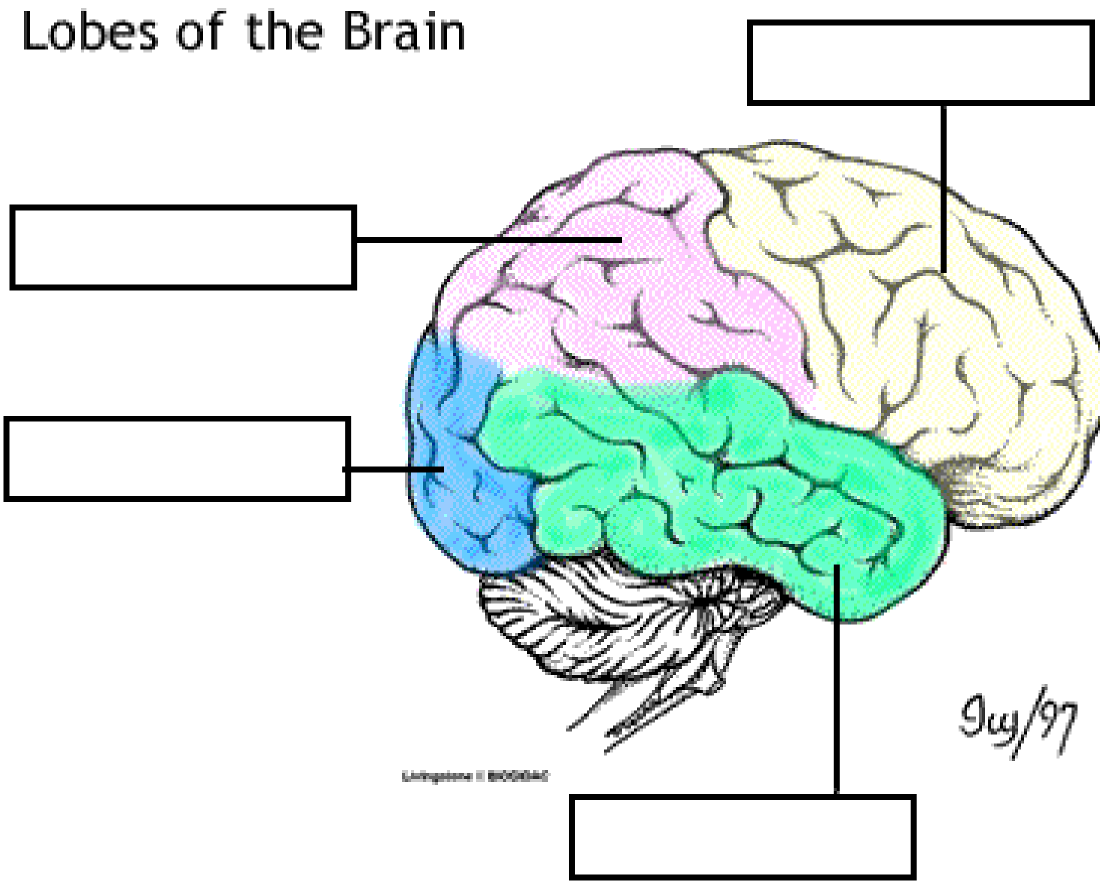
The brain has billions of nerve cells to help us think, walk, and breathe. The nervous system can react in 1/100 seconds to a stimulus. The stimulus is the messenger that sends letters to the part of your body that is experiencing or has experienced danger or surprise. It also sends these signals to your brain, for help to think of other ideas to protect and/or absorb the danger and/or surprise in that area of the body.



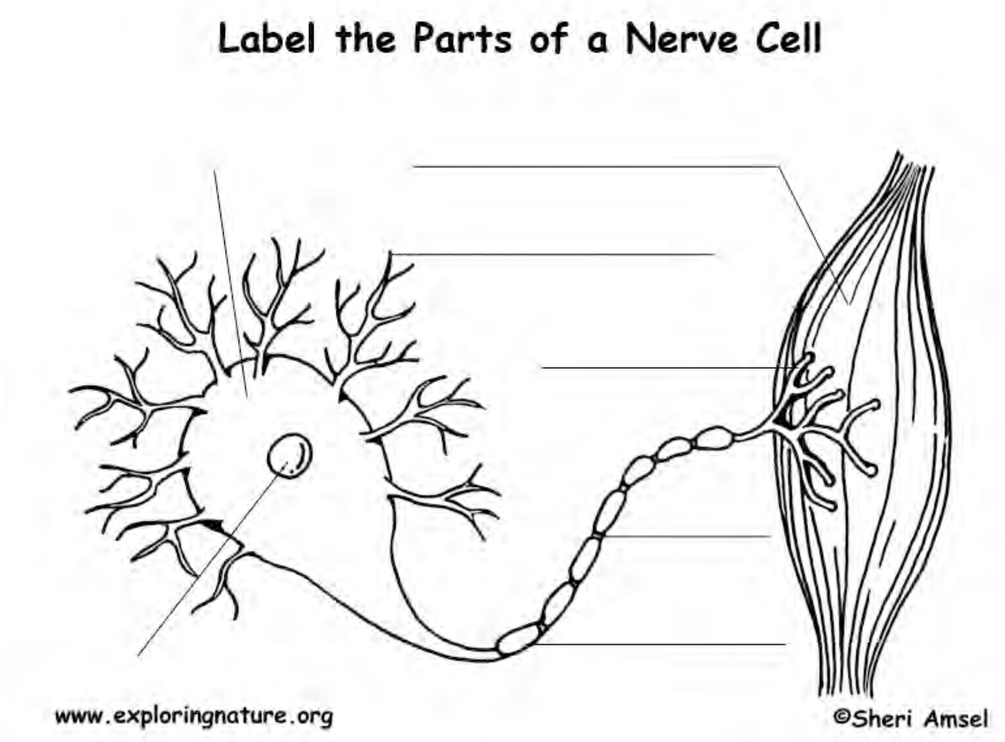
This is a diagram of your brain and what the different parts of it control

Print out the following diagram of the brain and ask them to use the diagram above to label the parts and what they control. The tricky part is that the diagram below is facing the opposite way!

And then do the same with the parts of the nerve cell


Lobes of the Brain

and


Label the Parts of a Nerve Cell
www.exploringnature.org
©Sheri Amsel

Human Organ Systems End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) This is a picture of your humerus. State 2 functions of this bone

a)

b)

2) Joints occur where bones meet. State their function

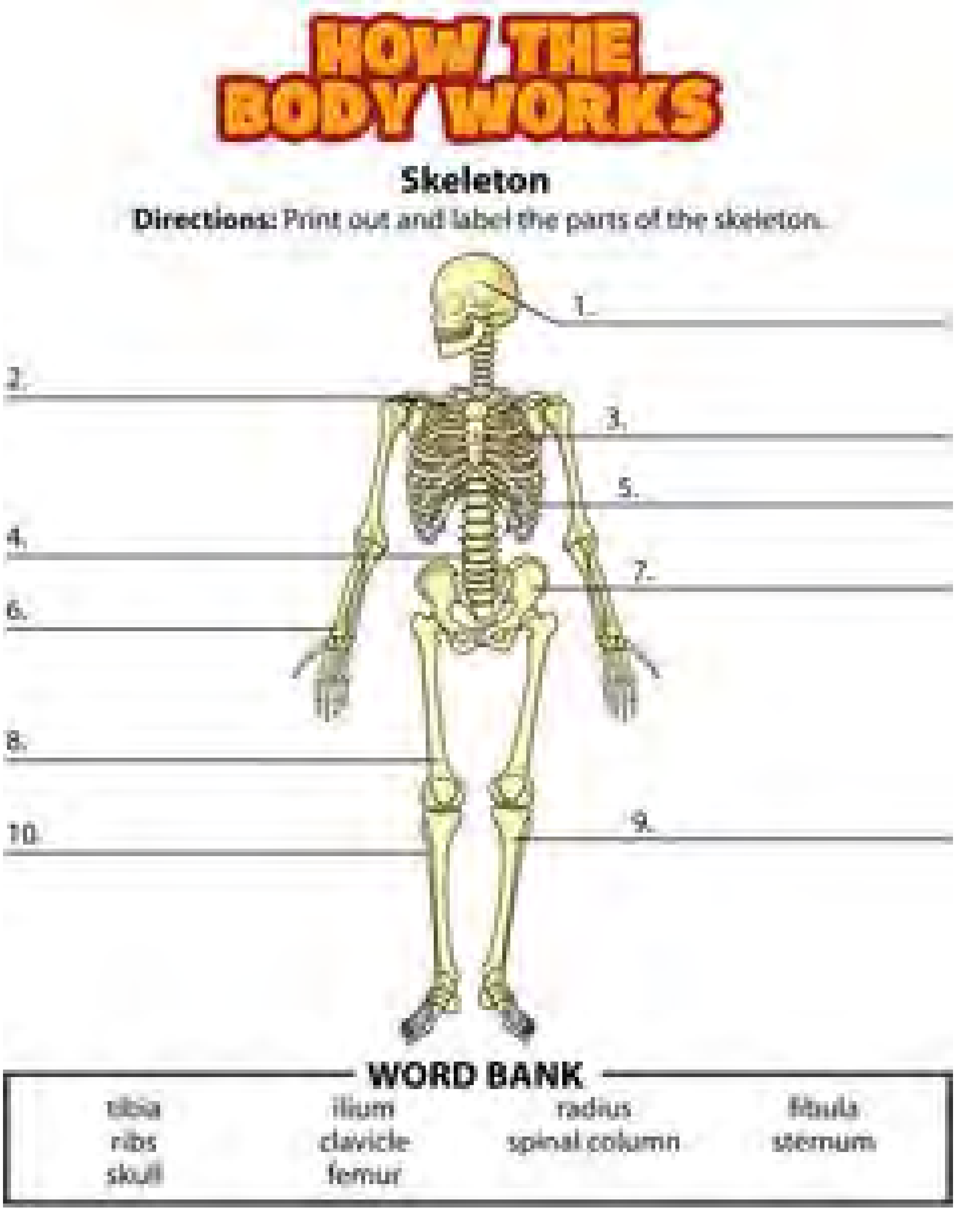
3) Give an example of a ball and socket joint

4) Describe 2 specific parts of the skeletal system and which vital organs they protect

a)

b)

5) Label these parts of your skeleton



6) What are muscles able to do?
   a) Pull
   b) Push
   c) Push and pull

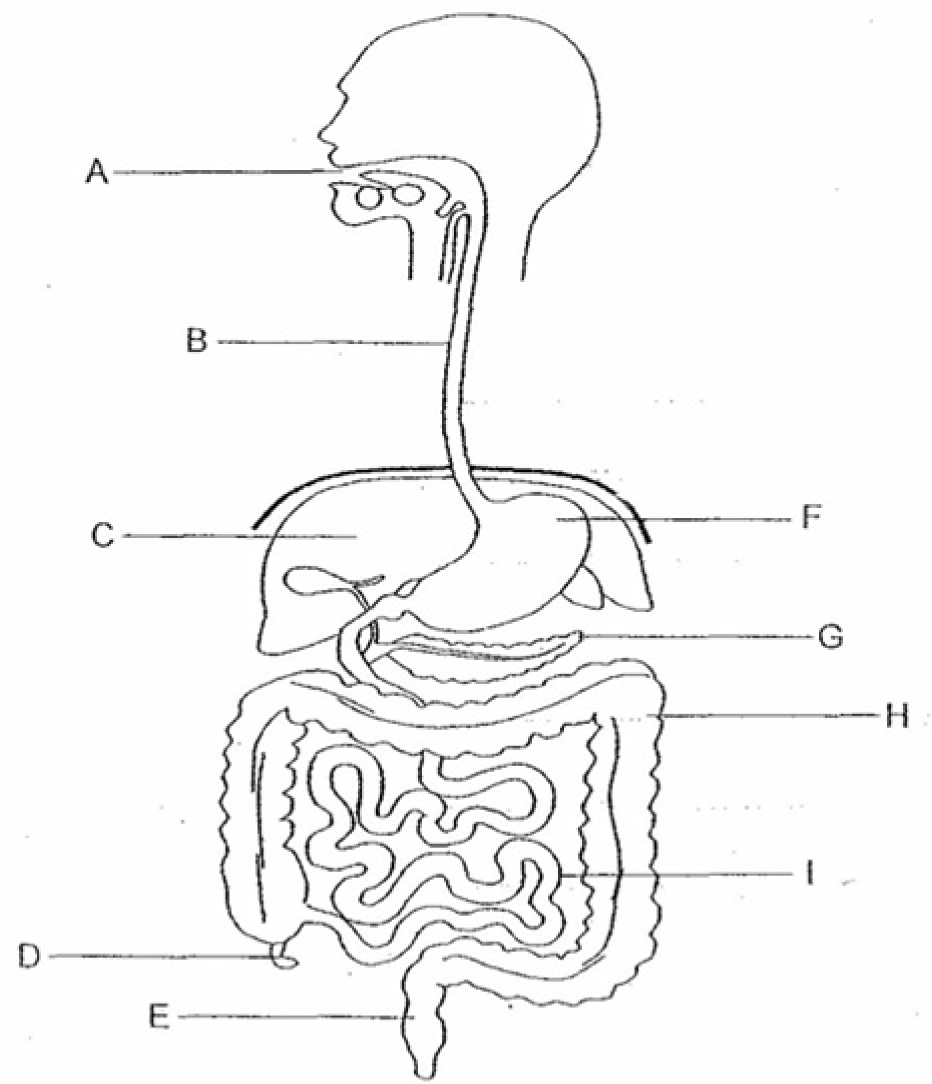
7) What is an antagonistic pair of muscles?

8) Name an involuntary muscle

9) When one muscle in an antagonistic pair is contracting what is the other one doing?

10) What attaches muscles to bones?

11) Label these parts of the digestive system



A-
B-
C-
D-
E-
F-
G-
H-
I-

12) What is peristalsis and how does it aid digestion?

13) How does carbohydrase help digestion?

14) What is the job of the villi in the small intestine?

15) What is the purpose of the gas exchange system in humans?

16) Complete this order of the passage of air in the body

Mouth
Trachea
??
Bronchioles
??

17) Label the arrows to this diagram to show the movement of substances in and out of the blood.

18) Together the brain, spinal cord and nerves make up the ……………………………………………………………………..

Human Organ Systems End of Topic Practise Questions

ANSWERS

1) This is a picture of your humerus. State 2 functions of this bone

a) To produce red and white blood cells

b) To allow us to stand/ or move (any 2 of these three)

2) Joints occur where bones meet. State their function

   They allow the skeleton to move

3) Give an example of a ball and socket joint

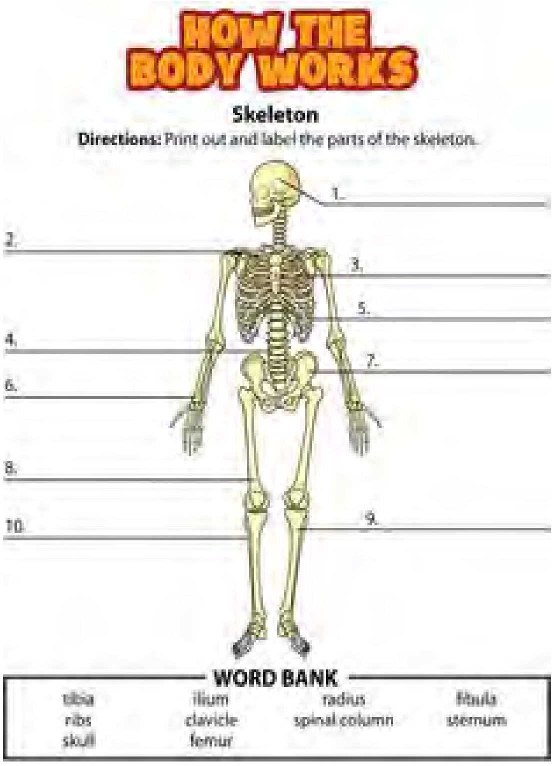
   Hip or shoulder

4) Describe 2 specific parts of the skeletal system and which vital organs they protect

a) Ribs – heart/lungs etc

b) Cranium or skull - brain

5) Label these parts of your skeleton



1- skull

2-clavicle

3-sternum

4-spinal column

5-ribs

6-radius

7-illium

8-femur

9-tibia

10-fibula

6) What are muscles able to do?

d) Pull

e) Push

f) Push and pull

7) What is an antagonistic pair of muscles?

Muscles that work in pairs – when one relaxes the other contracts

8) Name an involuntary muscle

Any internal organ's muscles e.g. heart

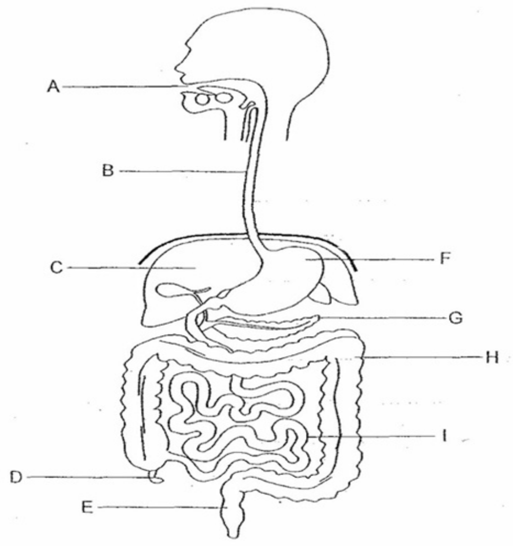
9) When one muscle in an antagonistic pair is contracting what is the other one doing?

Relaxing

10) What attaches muscles to bones?

Tendons

11) Label these parts of the digestive system



A- mouth

B-oesophagus
C-liver
D-appendix
E-rectum
F-Stomach
G-pancreas
H-large intestine
I-small intestine

12) What is peristalsis and how does it aid digestion?

Peristalsis is a series of wave-like muscle contractions that moves food along the digestive system.

13) How does carbohydrase help digestion?

It is an enzyme that breaks down carbohydrates into sugars

14) What is the job of the villi in the small intestine?

To increase the surface area of the small intestine to increase absorption of nutrients

15) What is the purpose of the gas exchange system in humans?

To remove carbon dioxide from our blood stream and to add oxygen to our blood to be taken to our cells

16) Complete this order of the passage of air in the body

Mouth
Trachea
Bronchi
Bronchioles
Alveoli

17) Label the arrows to this diagram to show the movement of substances in and out of the blood.

The arrows leaving the blood stream should be labelled carbon dioxide and those going into the blood should say oxygen

18) Together the brain, spinal cord and nerves make up the central nervous system

Lesson 1: A Healthy and Balanced Diet

Today's Important Spellings:	
Carbohydrates Proteins Lipids Vitamins	Minerals Dietary Fibre Balanced diet Energy Calories

Suggested resources:

- Ask your child to write a food diary for the day before this lesson (this isn't to 'judge' as balanced or not but to give them something to look at to look at food groups
- Paper plates
- Coloured pens
- Access to your kitchen cupboards

Lesson Content

The key to a healthy balanced lifestyle is:

- eating the right amount of food for how active you are
- eating a range of foods – this is what balanced means
- exercise regularly
- not drink excessive alcohol, smoke or take other drugs

The range of foods in your diet should include:

1. plenty of fruit and vegetables
2. plenty of bread, rice, potatoes, pasta and other starchy foods (choosing wholegrain varieties when possible)

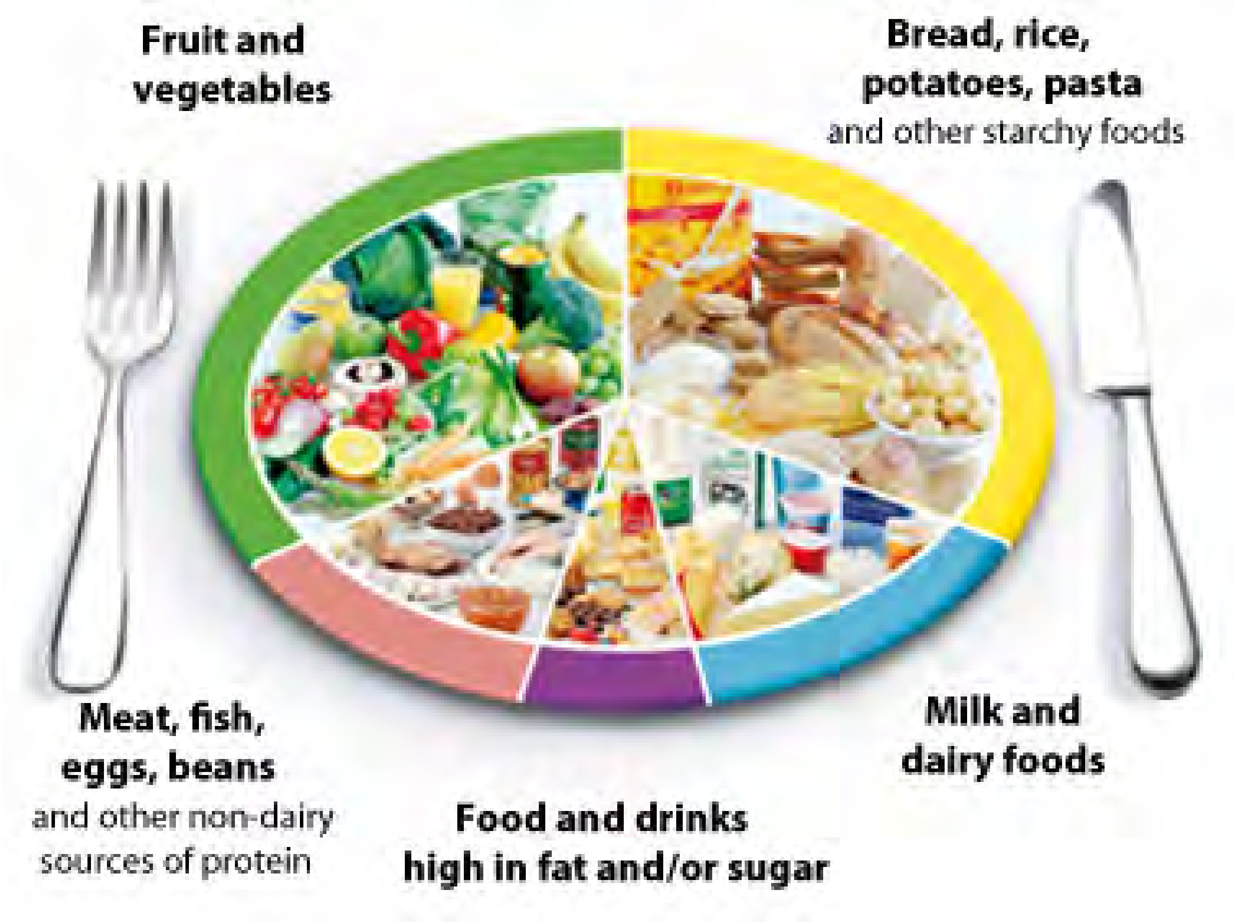
3. some milk and dairy foods (choosing lower-fat varieties when possible)

4. some meat, fish, eggs, beans and other non-dairy sources of protein

5. just a small amount of foods high in fat and sugar

For more information, see the Eatwell plate below that shows:

- the different types of food you need to eat
- how much of what you eat should come from each food group



Give your chid a paper plate and ask them to design a meal which follows these guidelines, section it into areas and draw it onto the plate. Discuss what they have chosen and why.

Ask your child to design a poster using these Healthy eating Tips to put up on the wall of a local café/restaurant. They can choose one or more tips to focus on.

Healthy eating tips

1. Base your meals on starchy foods as these give you energy. Choose wholegrain varieties (or eat potatoes with their skins on) when you can: they contain more fibre.
2. Eat at least five portions of a variety of fruit and vegetables a day.
3. Eat more fish. Eat at least two portions of fish every week, including one portion of oily fish such as mackerel or sardines
4. Cut down on saturated fat and sugar.
5. Eat less salt – no more than 6g a day for adults. For tips on how to do this, see Say no to salt.
6. Get active and be a healthy weight.
7. Drink plenty of water, about six to eight glasses of water (or other fluids) every day.
8. Don't skip breakfast because it gives you the energy you need for the day.

Food Groups

Print and cut out these flash cards. Each time your child mentions one of the groups present them with the card and see if you can name any food that go in that group and ask your child to write them on the back. Discuss why they are important in a healthy diet (info chart is below flash cards)

Carbohydrates
Proteins
Lipids (Fats and Oils)

Vitamins
Minerals
Dietary Fibre

Food Groups

What are they called?	What do they do for you?	Where do you find them?
Carbohydrates	They give you energy.	**Potatoes, rice, cereals, pasta, bread** and some **fruit** and **vegeta-bles.**
Proteins	They help your body grow and repair itself.	**Meats, poultry, fish, dairy prod-ucts, egg** sand **beans.**
Lipids (Fats and Oils)	They provide en-ergy and help in building up your body.	**Dairy products, red meats,** some **poultry** and **fish.**
Dietary Fibre	It helps you di-gest your food.	**Cereals, fruit, bread** and **vege-tables.**
Minerals	Iron is good for the blood. Calcium is good for your bones. Magnesium is good for your nerves.	**Fresh fruit** and **vegetables.**

Vitamins e.g. vitamin A, B, C, D, E	They are good for your skin, bones and teeth.	**Dairy products (milk, eggs and butter), fresh fruit** and **vegetables.**

Ask your child to go into your kitchen and see if they can bring you 2 examples of each food group and place them next to the flash cards

Photograph and print out what they bring

Look at the food diary they wrote and see if they can write which food groups are represented by each item they ate (sometimes it will be more than one e.g. a bowl of cereal and milk or a sandwich) Use the food groups chart to help them if they get stuck.

The Importance of water

Water isn't included as a food group as it isn't a food but as three quarters of the human body is made up of water and all chemical reactions you need to keep you alive all occur in the cytoplasm of your cells which is almost all water we must drink plenty.

Energy Requirements

Different foods have different amounts of energy in them. The energy found in any food item has to be listed in the nutritional information section of the packaging.

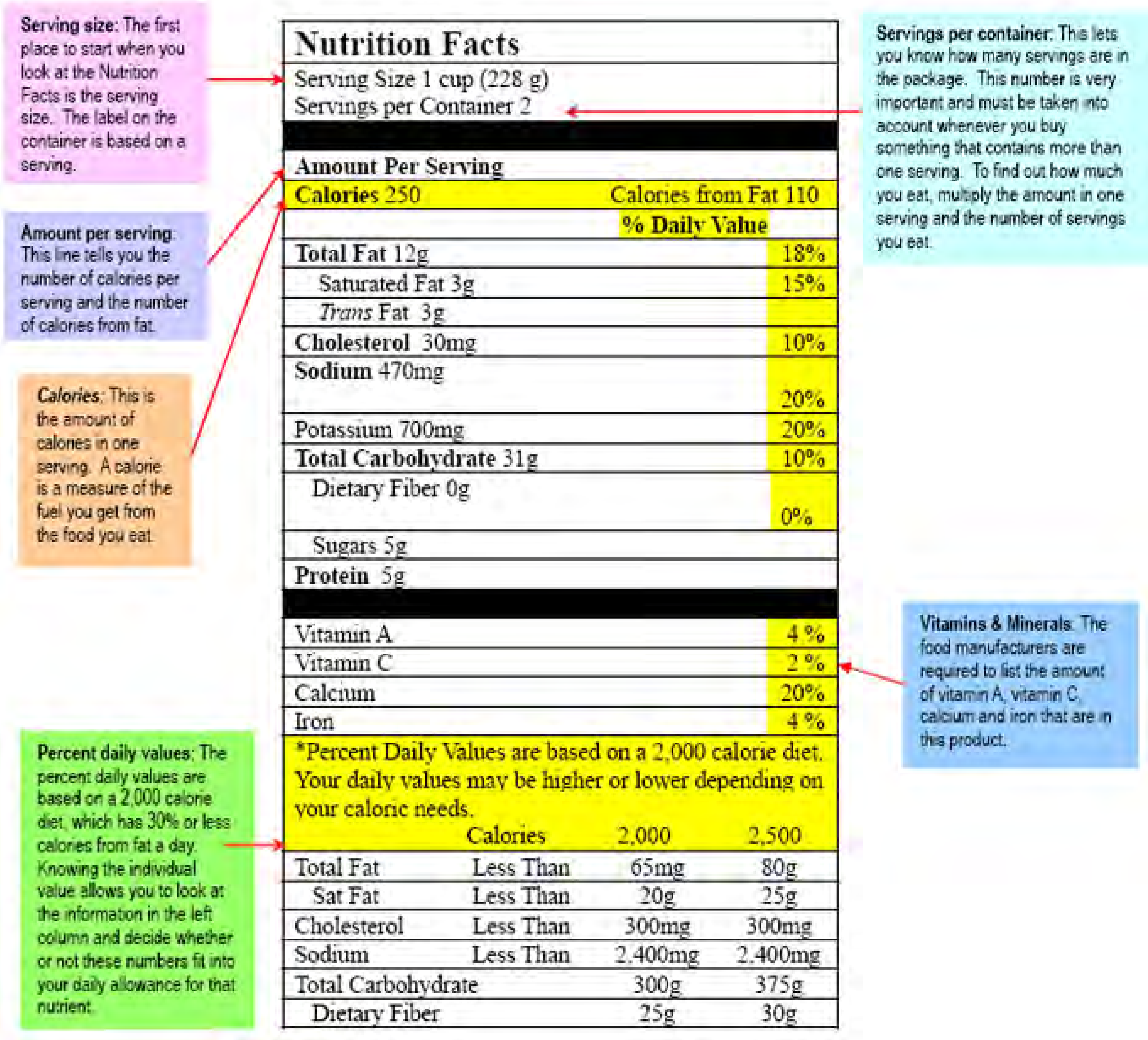
Energy is often measured in **calories** but the correct units are **kilojoules** (1000 **joules** make up a kilojoule) Different people require different amounts of energy a day depending on whether they are an adult or a child and how active they are.

Age	Male	Female
0 to 3 months	545	515
4 to 6 months	690	645
7 to 9 months	825	765
10 to 12 months	920	865
1 to 3 years	1230	1165
4 to 6 years	1715	1545
7 to 10 years	1970	1740
11 to 14 years	2220	1845
15 to 18 years	2755	2110
19 to 50 years	**2550**	**1940**
51 to 59 years	2550	1900
60 to 64 years	2380	1900
65 to 74 years	2330	1900
74+ years	2100	1810

☆ Ask your child to use this chart to look up the calorie requirements for

a) A toddler girl age 3
b) A boy baby age 4months
c) A teenage girl age 16
d) A middle aged man age 45
e) An elderly lady aged 78

Have a look at this label with your child and discuss what information it tells you about this product. Does this look like a product they should eat a lot of and regularly or not? What do they think?



Now ask your child to choose an item from your kitchen and to study the label telling you the same information. They could cut and stick the label onto a piece of paper and copy the idea of the image above drawing arrows to the information given.

To summarize the lesson ask your child to name the 6 food groups and how your body uses them and to explain what we mean by a 'balanced diet'.

Lesson 2: Unbalanced Diets and Deficiency Diseases

Today's Important Spellings:	
Unhealthy Unbalanced Obesity Malnutrition Starvation	Deficiency Diseases Ricketts Scurvy Anaemia

Lesson Content

A diet is referred to as unhealthy or unbalanced if

1) Someone eats too little or too much food generally or
2) Someone eats the right amount of food but the wrong amounts of each food group

It is important that we think about people living both in this country and other countries across the world when we think about unbalanced diets.

Too little food can lead to

- Weight loss
- Malnutrition and eventually starvation
- Always feeling tired
- Reduced immunity to infection
- Poor concentration
- Depression

Eating too much food or not exercising enough can lead to

- Weight gain and eventually **obesity**

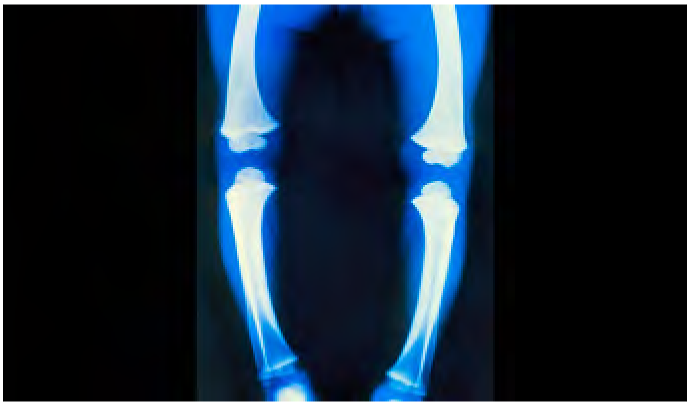
Obesity can lead to:

- Type 2 diabetes (where you can't regulate the amount of sugar in your blood)
- Heart disease
- Some cancers
- Strokes

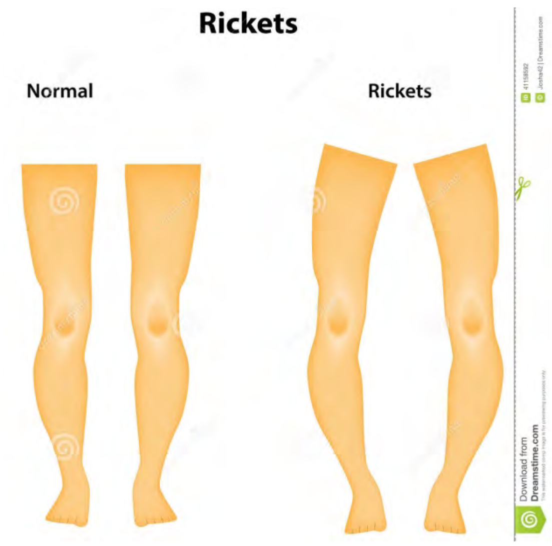
Deficiency Diseases

A **deficiency disease** occurs when your body doesn't have enough specific **vitamins** or **minerals.**

If you don't have enough **calcium** you could get **ricketts.** This is a softening of the bones which can lead to fractures and deformity

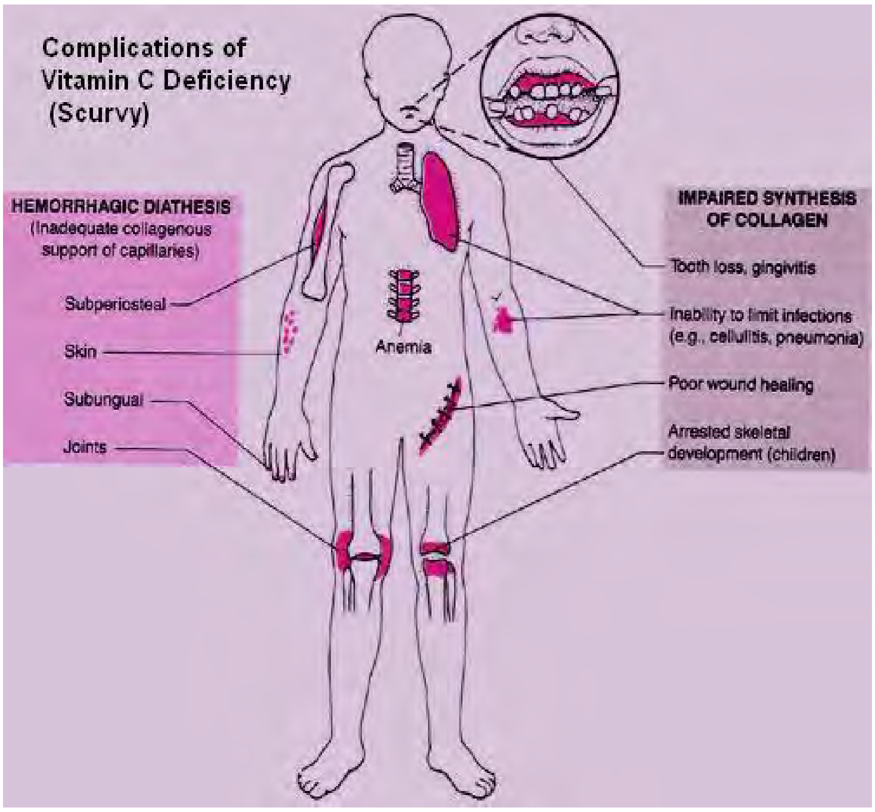


This is an x-ray for someone with rickets



This is the effects of ricketts

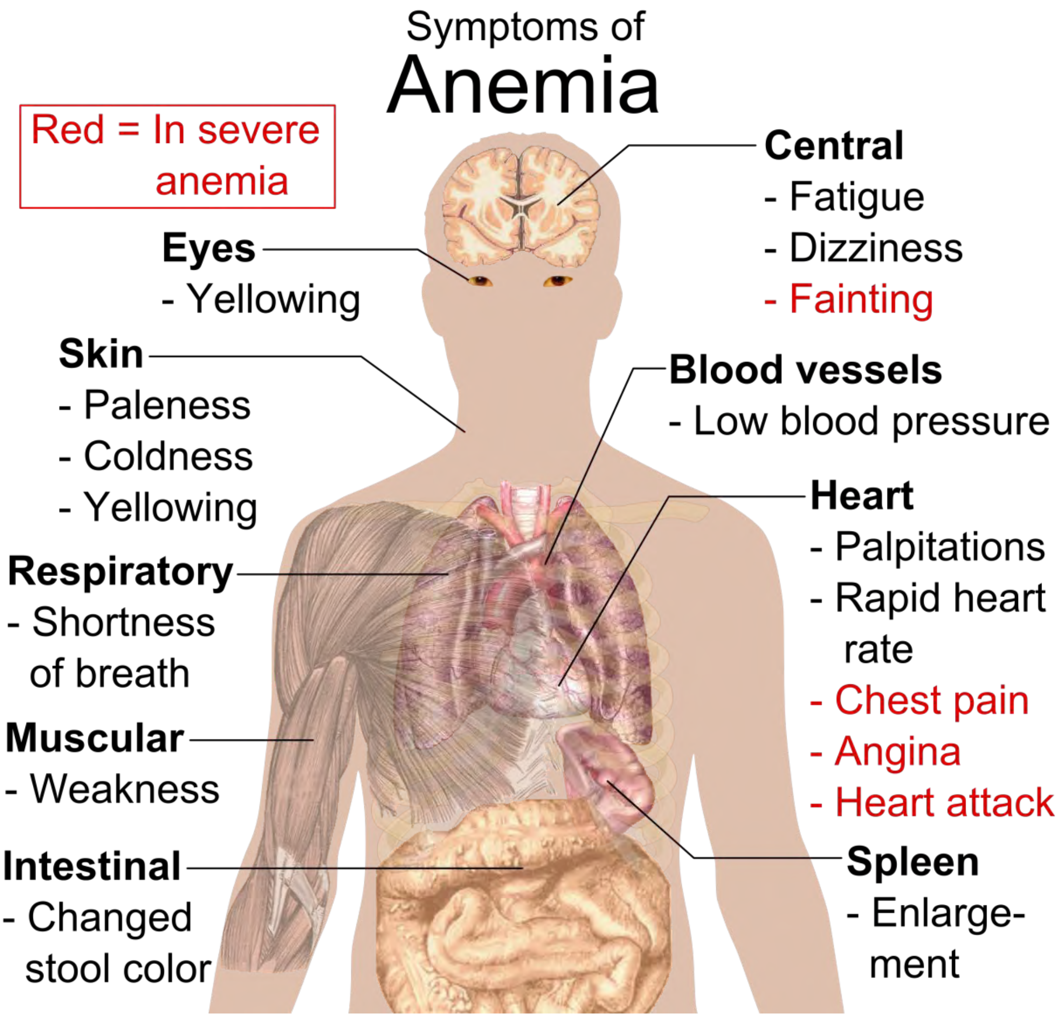
A lack of **vitamin C** can lead to **scurvy**. The symptoms of scurvy are tiredness, spots on the thighs and legs and painful, bleeding gums



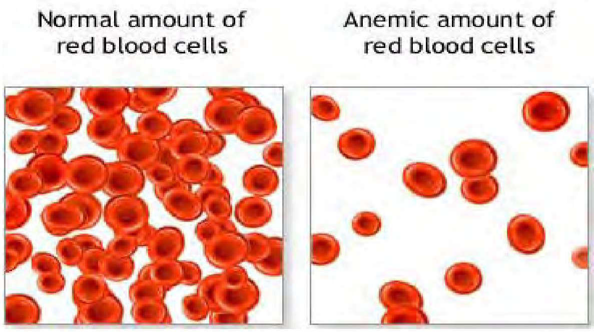
The effects of scurvy

Sailors in the 17th century offered suffered from scurvy because they didn't eat enough fresh fruit and vegetables on long sea voyages.

If your diet is deficient in **iron** it can lead to **anaemia** which can lead to tiredness, weakness and paler skin



Anemia is caused by a lack of red blood cells



Ask your child to make up flash cards for themselves from the table below. They should write the name of the disease and key vitamin or mineral on one side and the negative health effects on the other side. They should use them to test themselves.

Vitamin or Mineral	Disease	Symptoms
Calcium	Ricketts	Softening of bones leading to fractures and deformity
Vitamin C	Scurvy	Tiredness, spots on thighs and legs and painful, bleeding gums
Iron	Anaemia	Tiredness, weakness and paler skin

Lesson 3: The Role of Exercise

Today's Important Spellings:	
Stamina Breathing Exercise Regular Flexibility	Tendons Muscles ligaments

Lesson Content

There are so many benefits of regular exercise including:

1: Exercise controls weight

Exercise can help prevent excess weight gain or help maintain weight loss. When you engage in physical activity, you burn calories. The more intense the activity, the more calories you burn.

2: Exercise combats health conditions and diseases

Regular physical activity can help you prevent or manage a wide range of health problems and concerns, including stroke, metabolic syndrome, type 2 diabetes, depression, certain types of cancer, arthritis and falls.

3: Exercise improves mood

Physical activity stimulates various brain chemicals that may leave you feeling happier and more relaxed. You may also feel better about your appearance and yourself when you exercise regularly, which can boost your confidence and improve your self-esteem.

4: Exercise boosts energy

Regular physical activity can improve your muscle strength and boost your endurance. Exercise and physical activity deliver oxygen and nutrients to your tissues and help your cardiovascular system work more efficiently.

5: Exercise promotes better sleep

Regular physical activity can help you fall asleep faster and deepen your sleep.

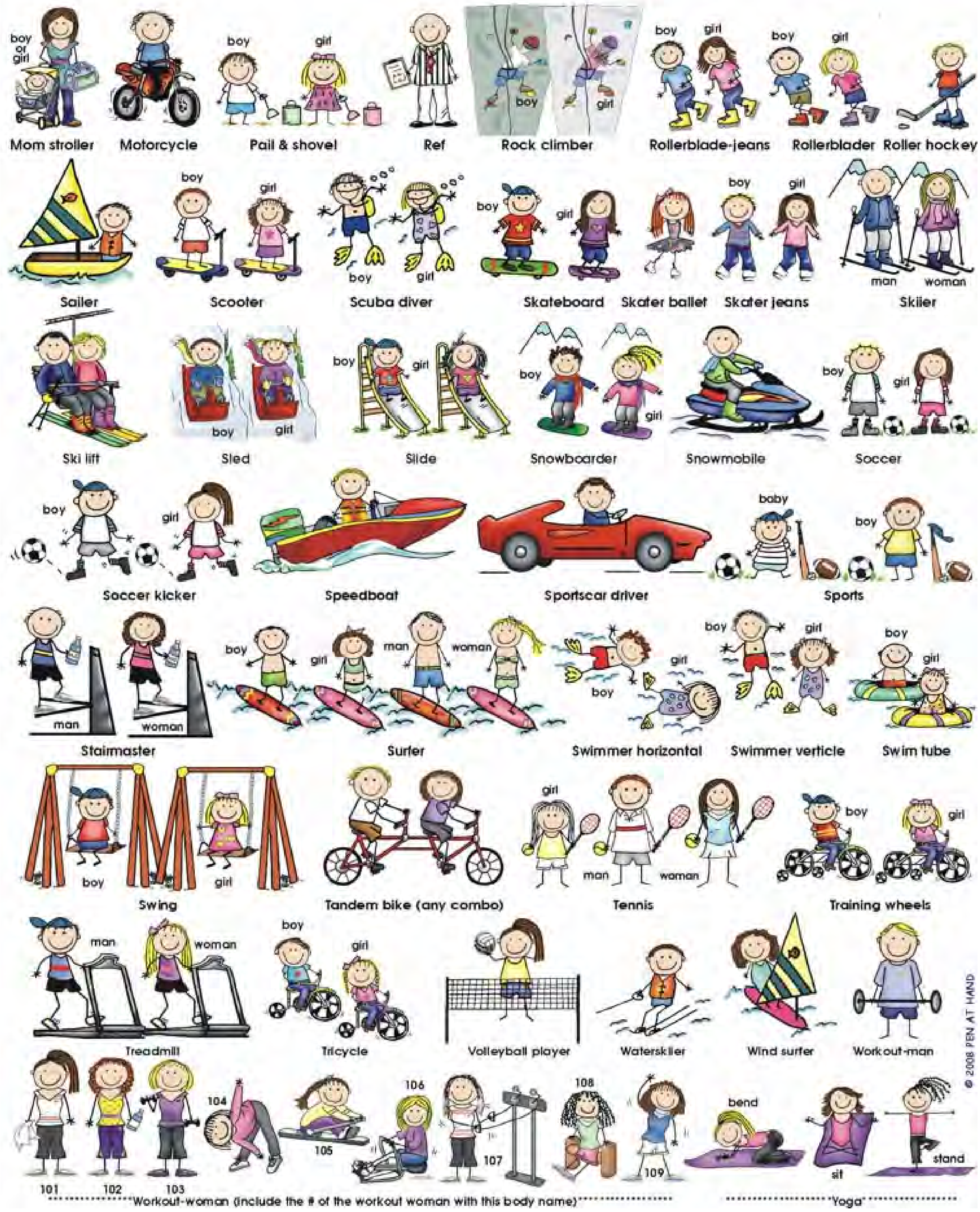
6: Exercise can be fun

Exercise and physical activity can be a fun way to spend some time. It gives you a chance to unwind, enjoy the outdoors or simply engage in activities that make you happy. Physical activity can also help you connect with family or friends in a fun social setting

The bottom line on exercise

Exercise and physical activity are a great way to feel better, gain health benefits and have fun**. As a general goal, it is advised that you aim for at least 30 minutes of physical activity every day**. If you want to lose weight or meet specific fitness goals, you may need to exercise more. Remember to check with your doctor before starting a new exercise program, especially if you haven't exercised for a long time, have chronic health problems, such as heart disease, diabetes or arthritis, or you have any concerns.

Ask your child to research a form of exercise that they like the sound of or are interested in trying. They could write a report or draw a poster or even give that exercise a try! They might choose rock climbing or netball or running or hockey. Anything at all. If you are doing this lesson with a group of children they could feed back their research to one another. They should include the health benefits of regular exercise in their write up.



You could then play the alphabet game with sports and activities i.e. you start with an exercise or sport beginning with a, your child should do b, then you do c etc. it might go:

Athletics, Basketball, Canoeing, Dance etc

Lesson 4: Smoking

NB: You may need to alter the content of this lesson to be sensitive to your own situation. The curriculum is very strong in its negative coverage

Today's Important Spellings:	
Nicotine Alveoli	Cilia cells Chronic obstructive pulmonary disease

Lesson Introduction

If we are looking at the health of our gas exchange system we need to look at all the negative effects of smoking.

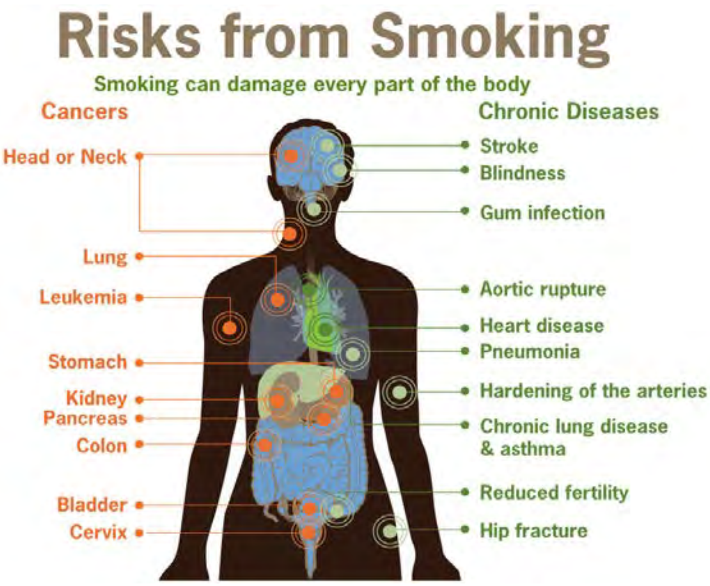
Smoking causes:

- cancer of the lungs, mouth and throat.
- It breaks down the walls of the alveoli, reducing the surface area and so making gas exchange harder.
- Smoking damages the cilia cells which line the airways to move mucus out of the lungs causing coughing. This can eventually lead **to chronic obstructive pulmonary disease (COPD)**
- Increases the chances of heart disease, strokes and other cancers
- Reduces your fertility
- Can prematurely age your skin
- It costs a lot of money
- Other people find it antisocial

You can choose to represent this information in a number of ways:

1) An anti-smoking poster for a local youth group

2) A health poster for a local doctors surgery



or

3) a mind map of effects of smoking e.g.

Lesson 5: Asthma

Today's Important Spellings: Asthma Inhaler Steroids	Bronchioles

Lesson Content

Asthma (said: AZ-muh) is a condition that affects a person's breathing. Inside the lungs are airways called **bronchioles**. When someone suffers from asthma, some of the smallest tubes can swell and narrow, making it harder for air to get through.

Recapping breathing

Ask your child to revise how we breathe by telling you the process:

When you breathe in, air enters your nose or mouth, then goes to the windpipe, also called the trachea. From there, the air travels into the lungs through the bronchi and then the bronchioles. These airways divide like branches of a tree and get smaller and smaller until they reach the end of the line.

At the end of the smallest airways are the alveoli (say: al-VEE-oh-lye), tiny sacs deep in the lungs. That's where your lungs take oxygen out of the air and move it into your blood — an important step because every part of your body needs oxygen to keep working like it should. The whole process goes in reverse when you exhale, sending carbon dioxide out of your body.

What is asthma?

Someone with asthma can have trouble breathing because the airways are sensitive. They work normally sometimes, but other times they might swell and narrow. So breathing gets harder because the tubes close in a little bit, like a straw that's being squeezed. The swollen airways can make extra mucus, causing the tubes to get sticky.

The Symptoms of Asthma

Someone with asthma may wheeze (make a whistling sound), cough, and feel tightness in the chest. An asthma attack can get worse if they don't use asthma medicine and the patient can find it impossible to breathe. After an asthma attack, the airways almost always return to the way they were before, although it can take several days.

Treatment for asthma

Anyone with asthma should be able to lead a full and unrestricted life. The treatments are effective in most people and should enable you to keep the condition under control.

INHALERS

Asthma medicines are usually given by inhalers. These are devices that deliver medication directly into the lungs as you breathe in. This is an effective way of taking an asthma medicine as most goes straight to the lungs, with very little ending up elsewhere in the body. Each inhaler works in a slightly different way.

Some inhalers are pressurised canisters – similar to a spray deodorant or an air freshener. You press the inhaler while breathing in, so the vapour containing the medication can pass into your lungs.

Some inhalers are not pressurised canisters but contain the medication in dry powder form, usually in a capsule that is punctured when the inhaler is "primed".

An example of an asthma inhaler

SPACERS

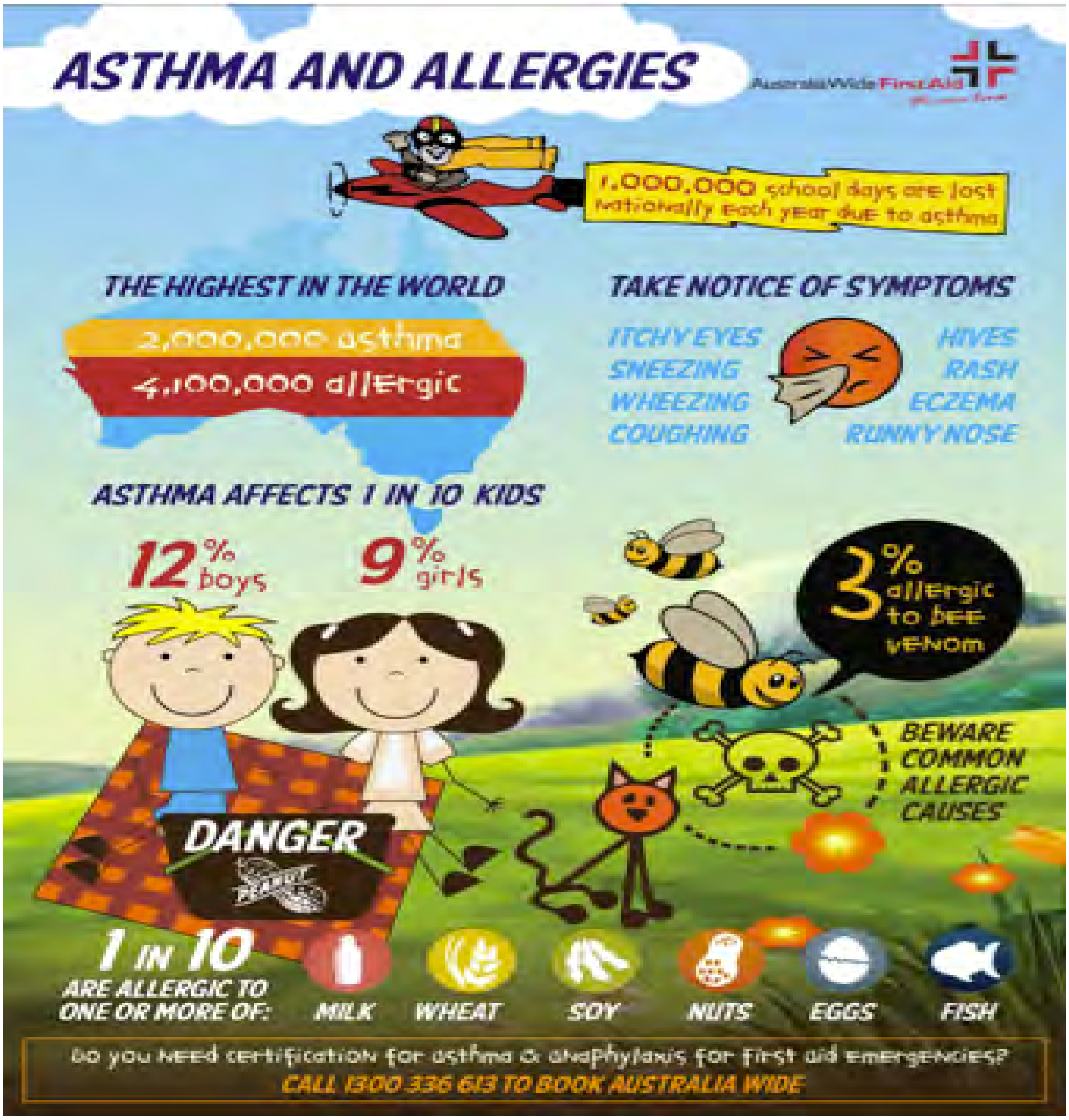
Pressurised canister inhalers can work better if given through a **spacer** which is a hollow plastic or metal container with a mouthpiece at one end and a hole for the inhaler at the other.

When using a spacer, the vapour from the inhaler is released into the container. The medicine is held in the spacer while you breath in and out inhaling the medicine. You should then hold in your breath before relaxing so the vapour has time to settle in your lungs.

This can make the medication more effective because much more of it reaches your lungs and much less stays in your mouth or is swallowed, where it has no effect on your lungs. These spacers are often given to small children to help them take the medication effectively.

An example of an inhaler attached to a spacer

Your child could represent this information as an asthma fact sheet perhaps for a child newly diagnosed with asthma. They could research additional facts or just use those given here



Lesson 6: Legal and Illegal Drugs

Today's Important Spellings:	
Stimulants Medicine Intoxicate Performance enhancing Depressants	Hallucinogens Painkillers Recreational drugs

Lesson Content

A drug is a substance taken as

- a medicine
- to intoxicate or
- to enhance performance.

So drugs can either be **useful or harmful**.

They can be grouped according to whether they are **legal or illegal** or according to their effect on the body.

Recreational drugs are not prescribed by a doctor and are taken to alter your mood.

Here is a list of the types of drug, their effects and some examples

Type of Drug	Effect on the body	Examples
Depressant	Slows down brain Activity	Alcohol Solvents Temazepam
Hallucinogen	Alters what we see or hear	Cannabis LSD
Painkiller	Blocks nerve impulses	Aspirin Heroin
Performance Enhancer	Improves muscle development	Anabolic steroids
Stimulant	Increases brain activity	Nicotine Caffeine Ecstasy

Classification of drugs

Some drugs are **legal**:

- tobacco
- alcohol
- caffeine

Others are **illegal**, or must **only be prescribed by a doctor**. Some prescription drugs are mistreated and taken for recreational use, rather than for medical reasons. They become illegal under these circumstances.

Illegal drugs are classified from **Class A to Class C.** Class A drugs are the most dangerous, with the most serious penalties for possession or dealing. Class C are the least dangerous, with the lightest penalties, but this does not mean they are safe to use.

- Class A: these include **heroin, cocaine, ecstasy and LSD**
- Class B: these include **cannabis, amphetamine and barbiturates**
- Class C: these include **anabolic steroids and ketamine**

You can ask your child to make flash cards from the table above – on one side out the name of the drug and the group it belongs to. On the other side write the negative effects of the drug. These can be used to revise and test themselves.

Cigarettes:

About 114,000 people die every year as a result of smoking-related illnesses. All cigarettes sold now carry a prominent health warning.

Cigarettes contain about **4,000 different chemicals**, many of which are harmful to the body.

Nicotine is the **addictive** substance in tobacco smoke. It reaches the brain within 20 seconds and creates a dependency so that smokers become addicted.

Carbon monoxide combines with the **haemoglobin** in red blood cells and so **reduces the ability of the blood to carry oxygen**. This puts extra strain on the circulatory system, and can cause an increased risk of heart disease and strokes.

Smoking during pregnancy is very dangerous. It reduces the amount of oxygen available to the growing fetus. This leads to an increased risk of

- miscarriage and premature birth
- low weight of babies at birth

Carcinogens are substances that **cause cancer**. Tobacco smoke contains many carcinogens, including tar. Smoking increases the risk of lung cancer, mouth cancer and throat cancer.

Alcohol

The alcohol in alcoholic drinks is called **ethanol**. It is found in

- **wines,**
- **beers**
- **spirits**

It is a **depressant**. This means that it slows down signals in the nerves and brain.

There are legal limits to the level of alcohol that drivers and pilots can have in the body. This is because alcohol impairs the ability of people to control their vehicles properly.

Short term effects

Alcohol has short-term effects

- sleepiness
- impaired judgment,
- impaired balance
- impaired muscle control.

This leads to blurred vision and slurred speech.

Long term effects

The long-term effects of alcohol include **damage to the liver and brain**. The liver removes alcohol from the bloodstream, as it is a toxic chemical. Over time, alcohol consumption can lead to liver damage called **cirrhosis.**

Solvents

Solvents are harmful chemicals that dissolve solutes. **Some people inhale these harmful chemicals.** They can cause **instant** and **permanent** damage to your lungs, liver, brain and kidneys. They can cause hallucinations and change your personality or behaviour.

Your child can write up this lesson in a number of ways :-

1) a safety poster for s youth group
2) a safety leaflet to be given out to teenage children
3) a newspaper article warning of one of these drugs
4) a warning card to be included with the sale of cigarettes/alcohol/medication

Health: End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) State three food groups on this plate of fish and chips and mushy peas.

a)
b)
c)

2) Why do we need to eat protein?

3) Sailors in the 17th century often suffered from a deficiency disease. Name the disease and its symptoms and why sailors often suffered from it.

4) Name three effects that smoking has on your gas exchange system?

   a)

   b)

   c)

5) Name two benefits of regular exercise

a)

b)

6) Name the symptoms of asthma and how it is treated

7) Which group of drugs do caffeine and cocaine belong to?

8) What is the difference between the legal status of the drugs in question 7?

9) Name one effect of excess alcohol consumption

10) What does the calorie content of a food tell us about that food?

Health: End of Topic Practise Questions

ANSWERS

1) State three food groups on this plate of fish and chips and mushy peas.

a) protein in the fish
b) carbohydrate in the chips
c) vitamins in the peas

(also accept fat/oil!)

2) Why do we need to eat protein?

For repair and growth

3) Sailors in the 17th century often suffered from a deficiency disease. Name the disease and its symptoms and why sailors often suffered from it.

Scurvy. Bleeding gums and sores on legs. They didn't eat enough fresh fruit and vegetables

4) Name three effects that smoking has on your gas exchange system?

a) Damages the alveoli

b) Damages the cilia hairs

c) Lung cancer (there are possible other answers)

5) Name two benefits of regular exercise

a) weight loss

b) increased fitness (other answers are possible)

6) Name the symptoms of asthma and how it is treated

Difficulty in breathing/wheezing. Treated with steroid inhaler

7) Which group of drugs do caffeine and cocaine belong to?

Stimulants

8) What is the difference between the legal status of the drugs in question 7?

Caffeine is legal but cocaine is illegal

9) Name one effect of excess alcohol consumption

Any from: blurred vision, drunkenness, vomiting etc

10) What does the calorie content of a food tell us about that food?

How much energy is in a set amount of that food.

Lesson 1: The Male Reproductive System

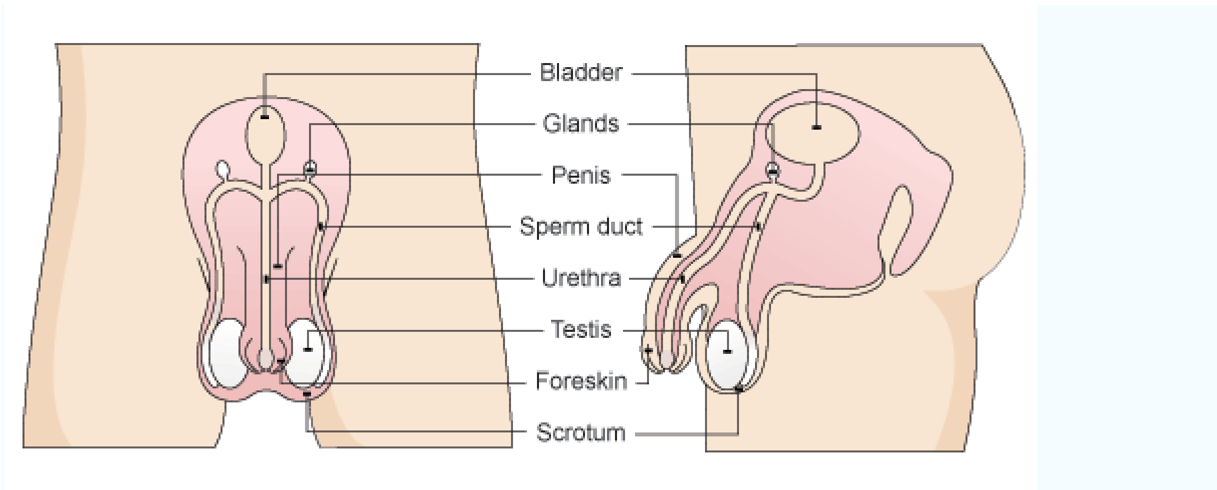
Today's Important Spellings:	
Penis Foreskin Urethra Bladder Glands (seminal vesicles)	Sperm Duct (Vas deferens) Testes Scrotum Prostate

Lesson Content

The male reproductive system

The male reproductive system contains:-

1) Testes
2) Glands
3) Sperm ducts
4) Urethra
5) Penis



Testes

There are two testes (singular is testis) which are contained in a bag of skin called the **scrotum.** Their functions are:

1) To produce millions of sperm, the male sex cell
2) They make male sex hormones which affects the way a man's body develops

Sperm duct and glands

The sperm pass through the sperm ducts called **vas deferens** and they mix with fluid produced by the glands (**seminal vesicles**.) This fluid gives the sperm cells nutrients. This mix of sperm and fluid is called **semen**. **The prostate gland** is shaped like a donut, weighs about an ounce and is the size of a chestnut. It is just below the bladder, behind the pubic bone and just in front of the rectum. The prostate wraps around the urethra, which is the tube that carries urine from the bladder to the penis. The prostate helps to control the flow of urine. The tubes from the testicles carry sperm up to the prostate where sperm is mixed with the seminal vesicle and prostatic fluids.

Penis and urethra

The penis has two functions:

1) To allow urine to pass out of the man's body
2) To pass semen into the vagina of a woman during sexual intercourse

The tube inside the penis is called the urethra and it is this tube that carries either urine or semen. The two do not mix because of a ring of muscle.

Ask your child to fill in the sheet below adding the correct word next to each description (the answers should be in order, scrotum, seminal vesicles, testicles, penis, prostate gland, urethra, vas deferens, bladder and foreskin.

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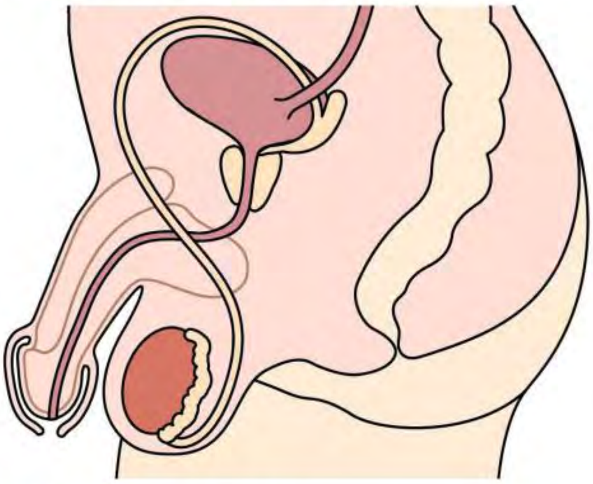
Activity Sheet 3

Facts about the male
reproductive system

Use the words below to label the diagram. Then write each word next to its definition.

- Foreskin
- Penis
- Urethra
- Scrotum
- Seminal Vesicles
- Prostate Gland
- Testicles
- Bladder
- Vas Deferens



Definitions

________________ Sac of skin that holds the testicles just underneath the penis

________________ Two glands on either side of bladder that secrete seminal fluid

________________ Two oval shaped organs contained in the scrotum, which produce the male hormone testosterone and sperm (also called the testes)

________________ The tube-like sex organ of males which hangs outside of the body

________________ A gland near the bladder that adds fluid to semen

________________ The tube that at different times carries urine and semen out of the body

________________ The thin long tubes through which sperm travel from the testicles, and where sperm are mixed with other fluid to make semen

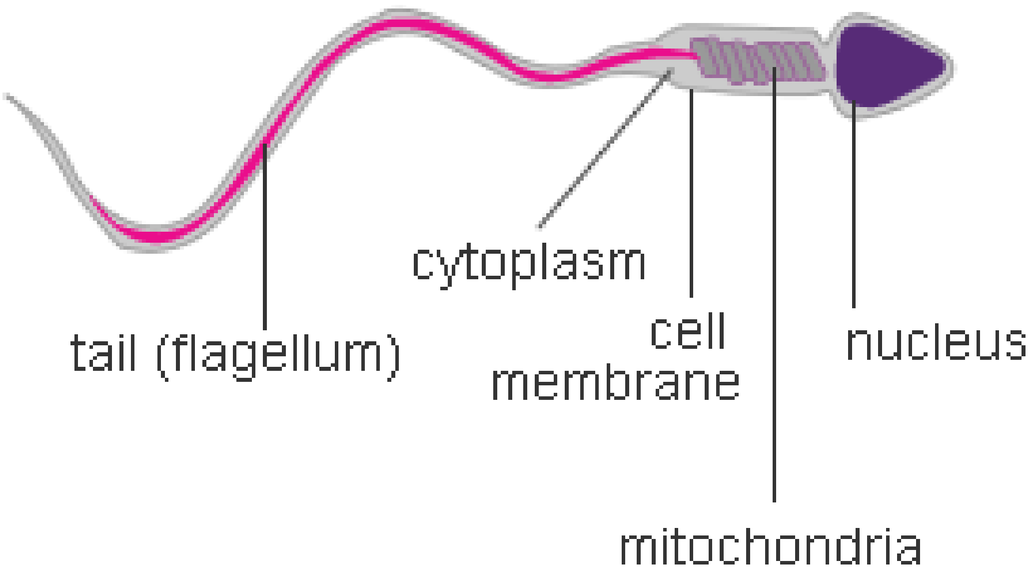
________________ A sac inside the abdomen that holds urine

________________ The skin around the head of an uncircumcised penis

Recap opportunity:

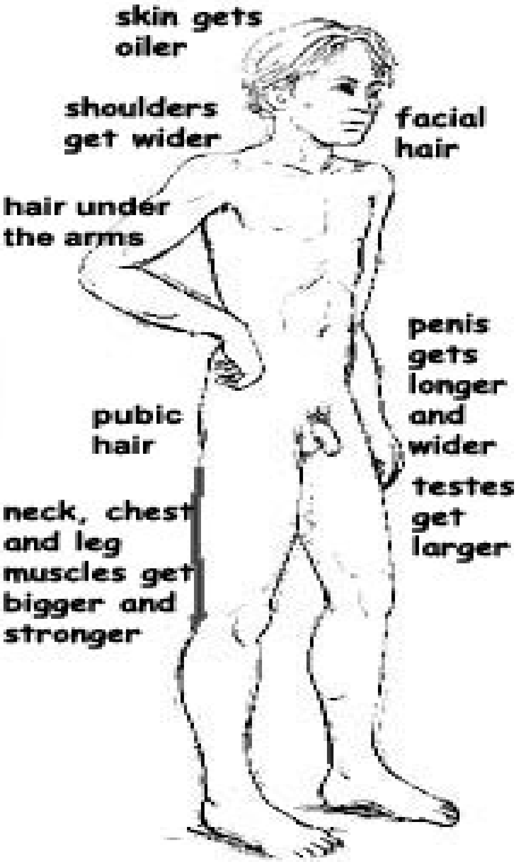
The male sex cell is the **sperm** cell. It has three parts –

1) a head with enzymes which allow it to bury into the egg cell (or ovum). The head contains the nucleus with all the genetic material.
2) Behind the head is an area packed with mitochondria to provide energy for the cell
3) The tail is there to allow the sperm to swim to the ovum inside the female's body.



Changes that occur to the male body during puberty.

Boys' changes



1) Boys gain weight.

2) Shoulders get wider.

3) Muscles start to get bigger and stronger.

4) Boys get an 'Adam's apple'. This is the larynx or voice box getting larger and sticking out at the front of the throat. A boy's voice may seem to be all over the place, squeaky then deep or even sound like it is cracking. This is perfectly normal - when the larynx has finished growing the voice will sound 'normal' again and probably a bit **deeper** than before.

5) Penis gets longer and wider.

6) Testes (or testicles) get larger.

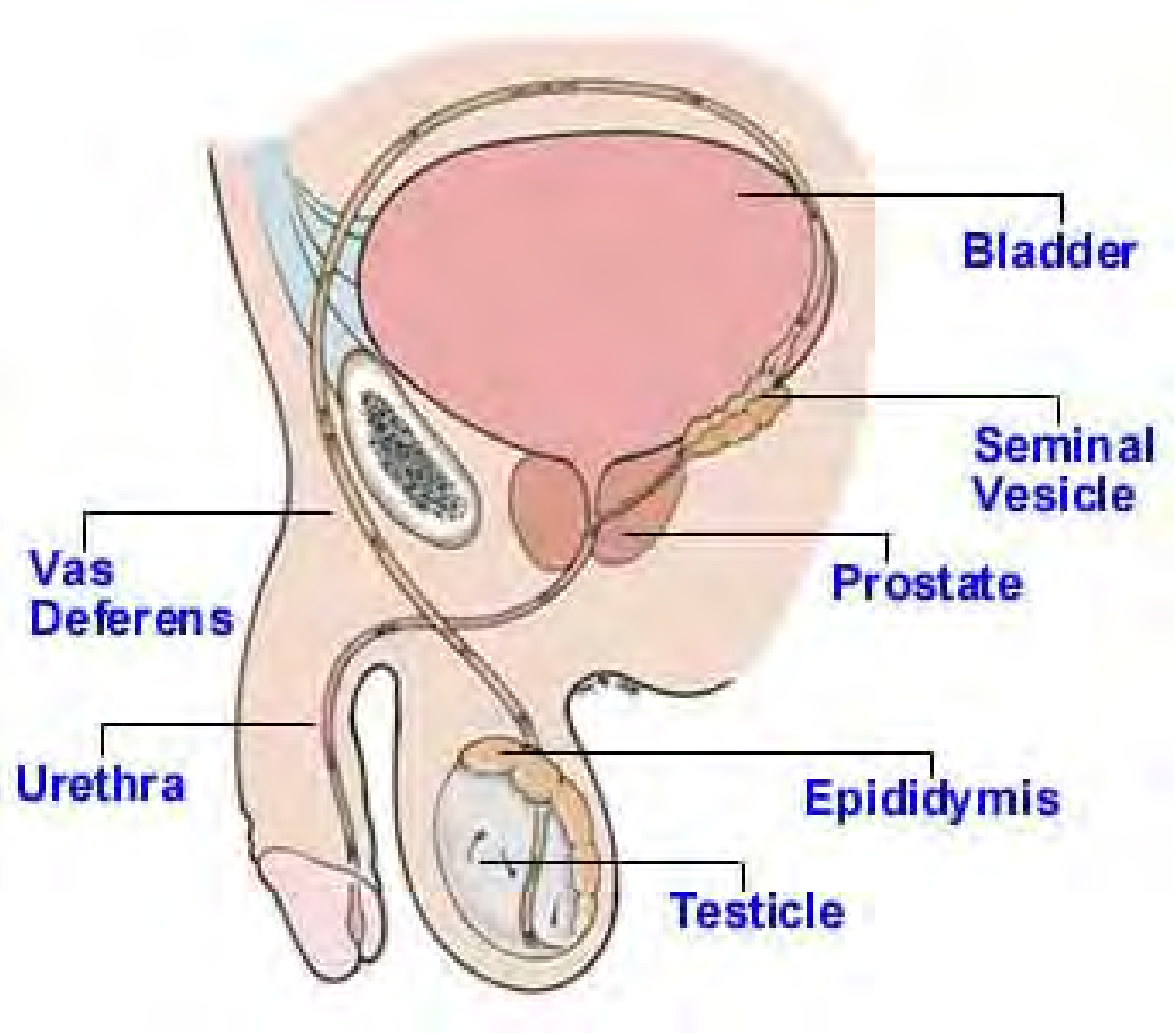
7) Breasts look like they're developing a bit! (Don't worry this is quite normal and usually goes away by the end of puberty.)

8) Hair grows on the face as well as the body. Usually it's pretty thin at first but gets stronger and darker towards the end of puberty.
9) Boys get erections sometimes when they are nervous or excited and other times when it just happens by itself! This can be a bit embarrassing at first but other people don't usually notice them as much as an individual does!

10) Boys may have 'nocturnal emissions' or wet dreams while they are sleeping. The 'wet' stuff is semen and they haven't wet the bed! It is also a normal part of growing up

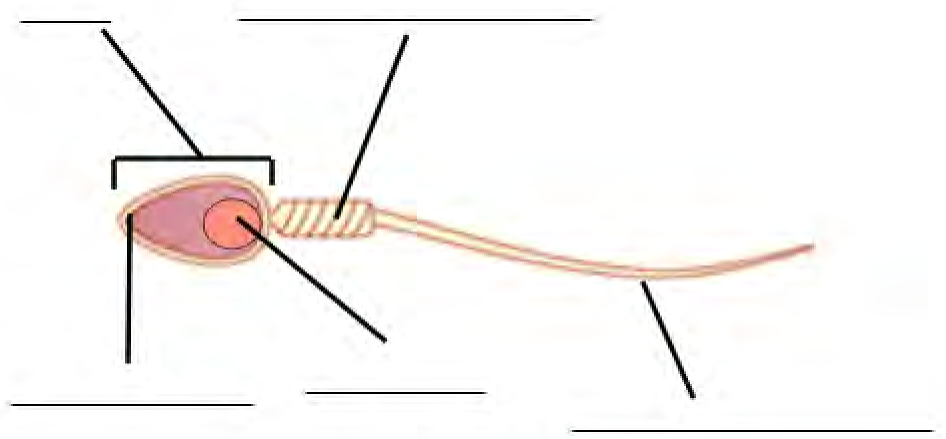
Lesson summary:

Ask your child to go through this diagram of the male reproductive system and tell you what each part does.



Label this sperm cell using the words:

- Head
- Tail
- Mitochondria
- Nucleus
- Enzymes



Ask your child to name 5 changes that happen to the male body during puberty

Lesson 1: The Female Reproductive System

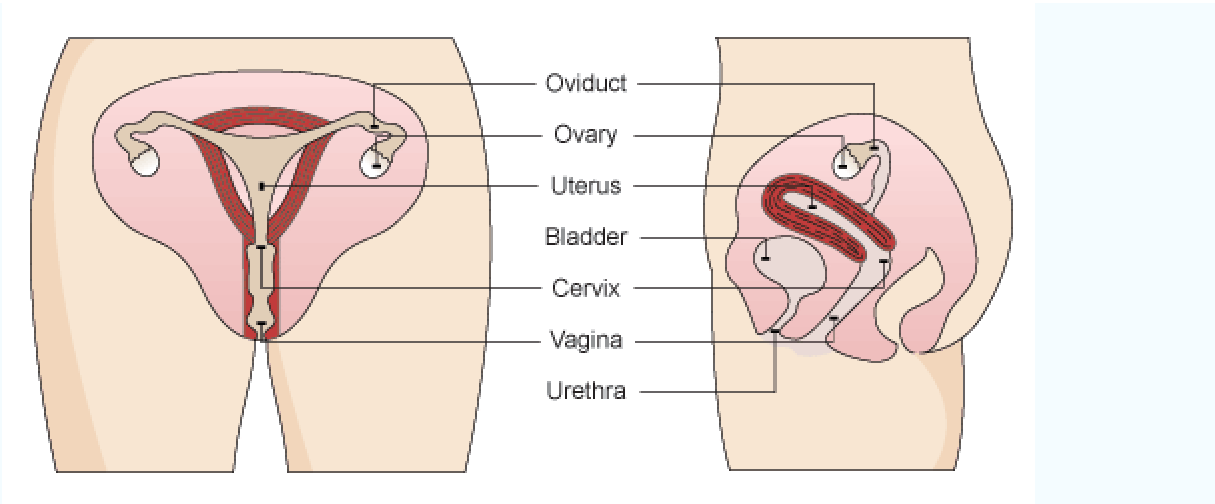
Today's Important Spellings:	
Fallopian tube Ovary Uterus (womb) Cervix	Vagina Ovum Endometrium

Lesson Content

The Female Reproductive System

The female reproductive system consists of :

1) Ovaries
2) Egg tubes (fallopian tubes)
3) Uterus (or womb)
4) Cervix
5) Vagina



Ovaries

There are two **ovaries** which contain hundreds of undeveloped eggs (female sex cells) or **ova** (singular **ovum**.) Women are born with these eggs in their bodies which is different from men who produce new sperm continually.) One ovary releases an ovum (egg) every 28 days or so, the following month the next ovary releases an egg.

Fallopian Tubes (egg tubes)

Each ovary is connected to the uterus by a **fallopian tube**. This is sometimes called an **oviduct**. The fallopian tubes are lined with **cilia** or tiny hairs. Each month one ovary releases a mature egg. The cilia's job is to waft the egg along the tube and into the uterus.

The Uterus and Cervix

The uterus is also called the womb. It is a muscular bag with a soft lining called the endometrium. The uterus is where a baby develops until it is born. The cervix is the ring of muscle at the bottom of the uterus. It stays closed and keeps the baby in the womb until it is born. In labour the cervix stretches and opens and allows the baby to pass through during birth.

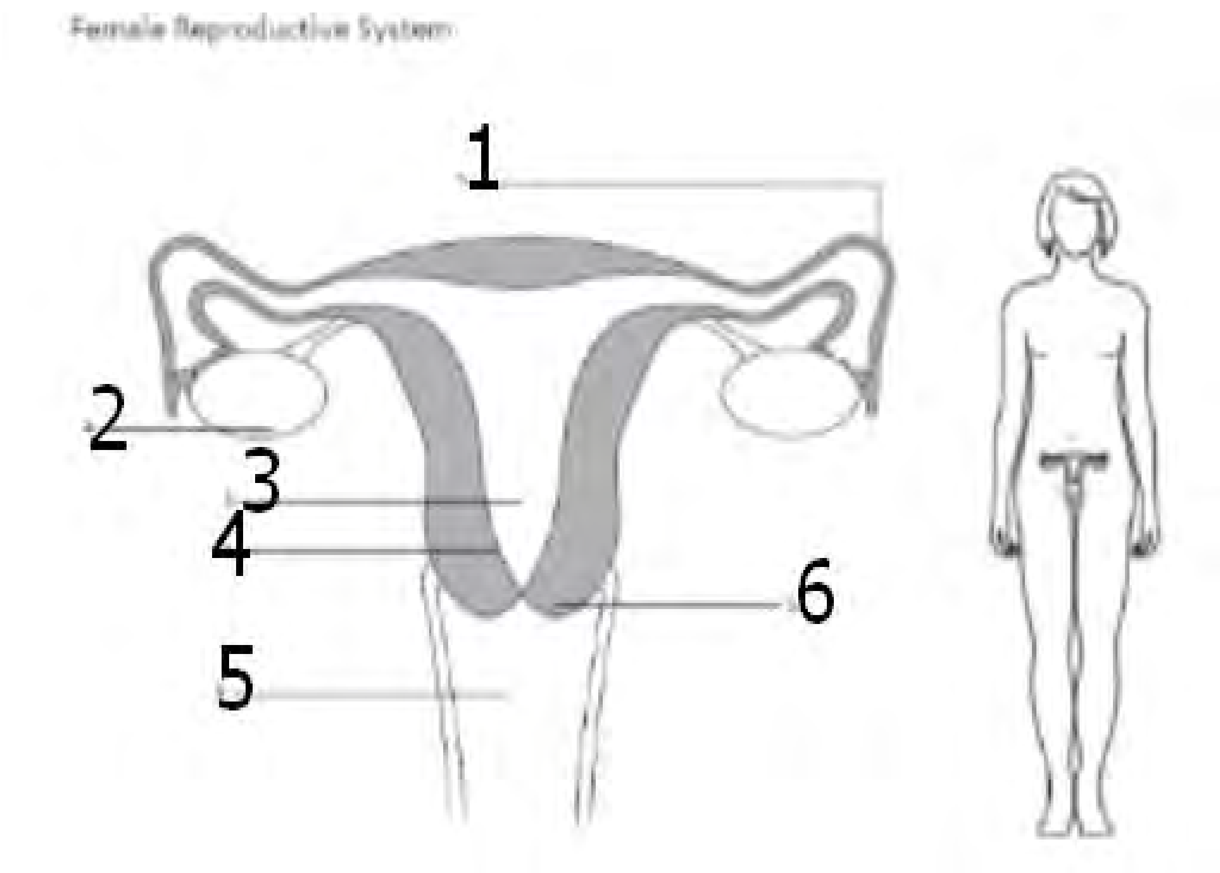
Vagina

The vagina is a tube of muscle that leads from the cervix to the outside of the woman's body. It has two roles:

1) During sexual intercourse the man's penis goes into the vagina.
2) During birth a baby passes through the vagina to the outside world.

The opening to the vagina has folds of skin called labia that meet to form a vulva. The urethra (tube from the bladder that carries urine) also opens into the vulva but it is separate from the vagina.

Ask your child to label this diagram:



Answers:

1- Fallopian tube
2- Ovary
3- Uterus (womb)
4- Endometrium (lining of uterus)
5- Vagina
6- Cervix

Ask your child to fill in the words alongside the definitions below (the correct order should be:- cervix, fallopian tubes, ovary, uterus, vagina, endometrium)

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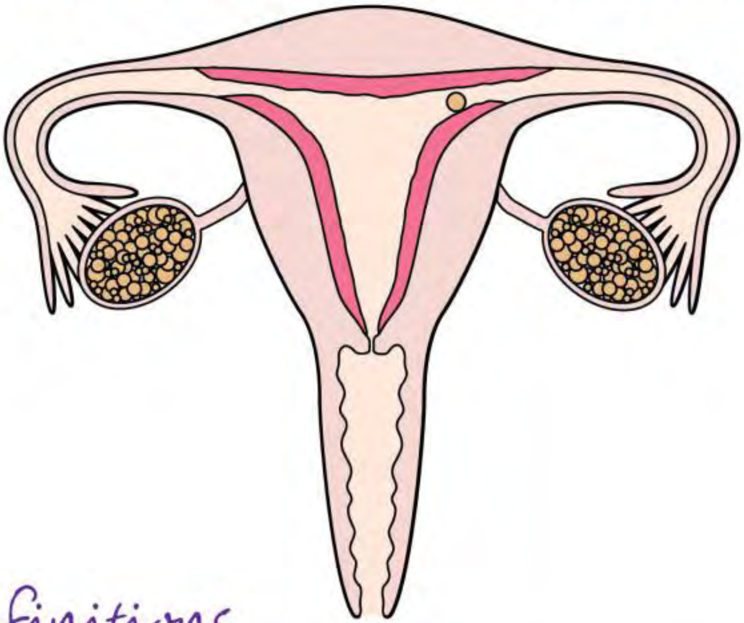
Activity Sheet 2

Facts about the female reproductive system

Use the words below to label the diagram. Then write each word next to its definition.

- Fallopian Tubes
- Ovary
- Uterus
- Cervix
- Vagina
- Endometrium



Definitions

______________________ The lower part of the uterus that has a small opening into the vagina

______________________ The two tubes which link the ovaries and uterus

______________________ Two glands on either side of the uterus that release female sex hormones, estrogen and progesterone, and ova (eggs)

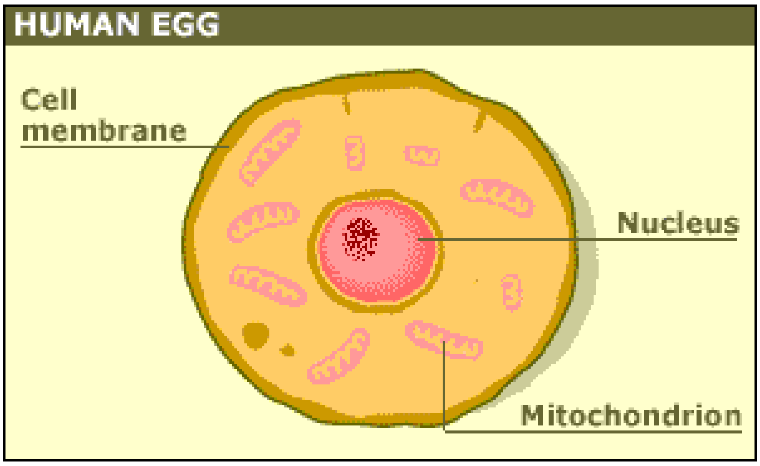
______________________ The hollow muscular organ that holds and nourishes the fetus

______________________ The passageway of muscles that joins the uterus to the outside of the body

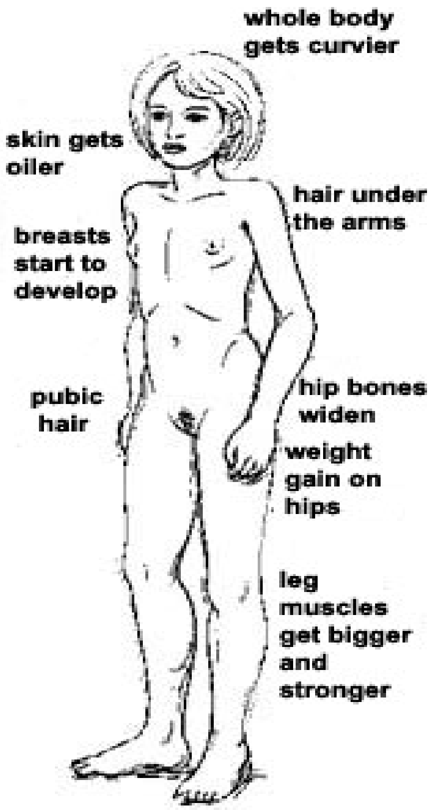
______________________ The thick soft lining that grows on the inside of the uterus each month

Recap opportunity

The female sex cell is the ovum or egg



Changes that occur in the female body during puberty

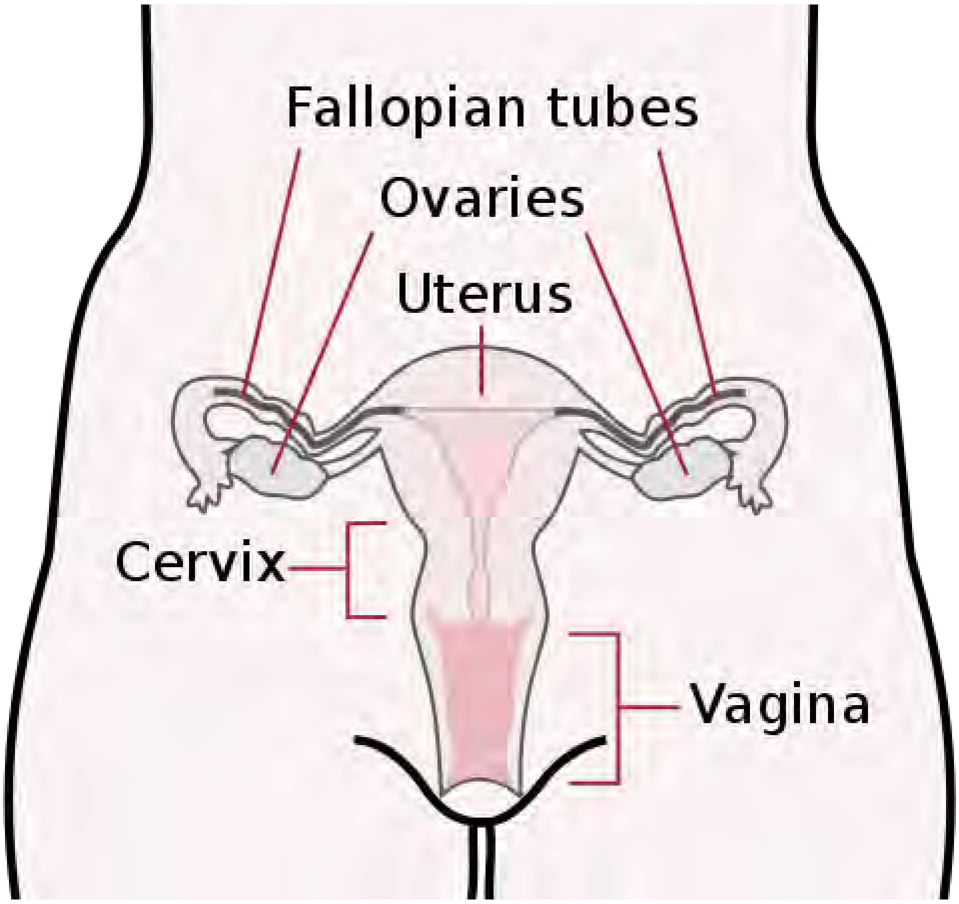


1) Girl's bodies become curvier and hip bones widen.
2) There is weight gain, particularly on the hips. This does not mean you have to start a diet to lose weight. In fact you would be unhealthy if you did not put on some weight. It just means that you are getting a womanly shape. Just continue to eat healthy foods and get regular exercise.
3) Muscles get bigger and stronger, but they do not show up as much as boys' muscles.
4) Breasts start to develop. First there is a small swelling under the nipples, and then the whole breast area starts to get bigger.
5) Menstruation or monthly periods start.

6) Girls may get some whitish jelly from their vagina before or in between periods. (Don't worry it's just the body's way of cleaning itself.)

Lesson summary:

Ask your child to explain the function of the labels on this diagram



Ask them to name 5 changes that happen to a girl's body during puberty

Lesson 3: The Menstrual Cycle

Today's Important Spellings:	
Menstrual cycle Hormones Period	Endometrium Oestrogen Progesterone

Lesson Content

Between the approximate ages of **13** (after puberty) and **50**, women undergo a regular **cycle approximately every 28 days** unless they become pregnant. It is called the **menstrual cycle** and prepares the woman's body in case she does become pregnant. The cycle is controlled by the hormones **oestrogen and progesterone**.

Watch this YouTube clip about the Menstrual cycle

http://www.echo.education/url/menstruation

The female reproductive system includes a cycle of events called the **menstrual cycle**. It lasts about 28 days, but it can be slightly less or more than this. The cycle stops while a woman is pregnant. These are the main features of the menstrual cycle.

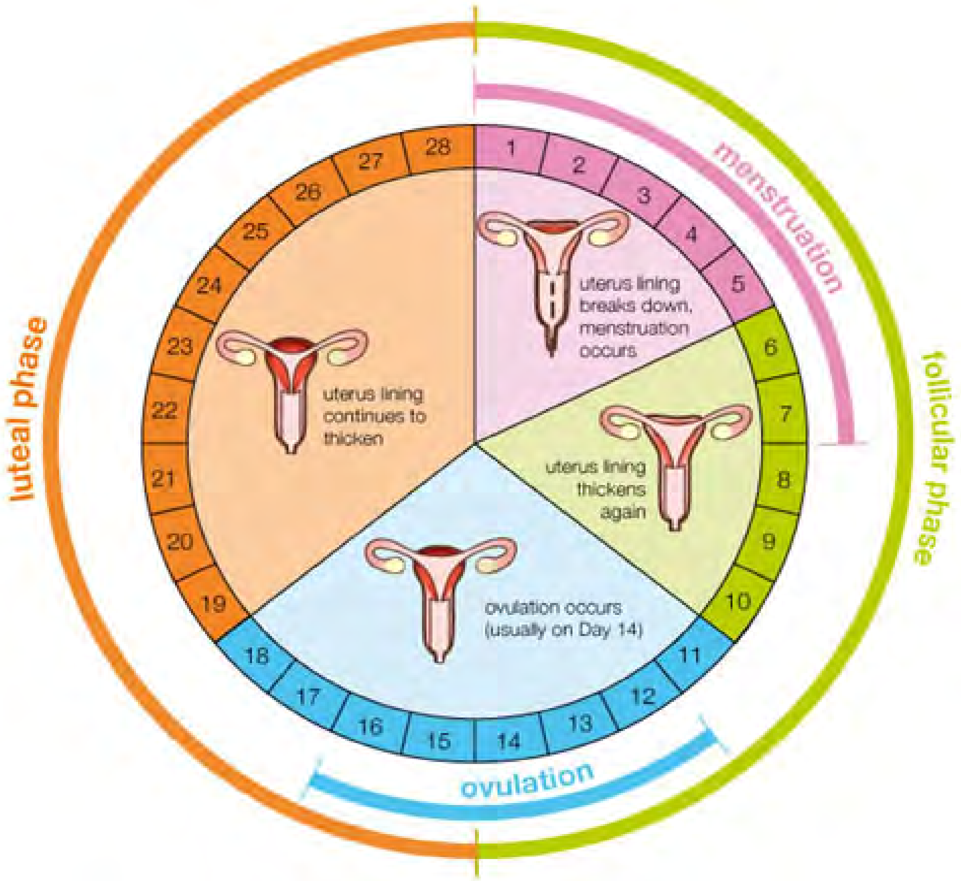
1) The start of the cycle, day 1, is when bleeding from the vagina begins. This is caused by the loss of the lining of the uterus, with a little blood. This is called menstruation or having a period.

2) By the end of about day 5, the loss of blood stops. The lining of the uterus begins to re-grow and an egg cell starts to mature in one of the ovaries.

3) At about day 14, the mature egg cell is released from the ovary. This is called ovulation. The egg cell travels through the egg tube towards the uterus.

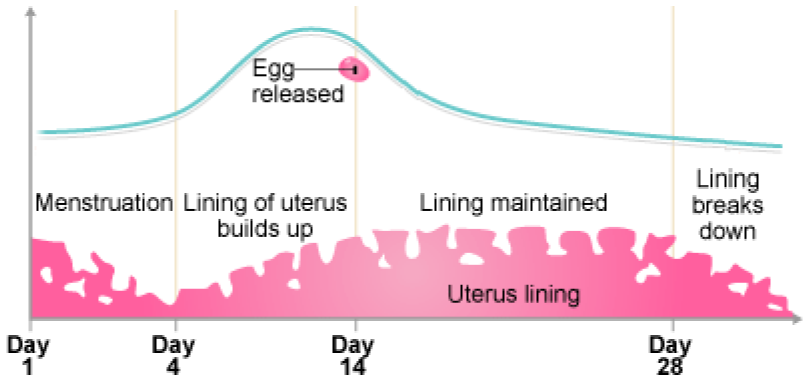
4) If the egg cell does not meet with a sperm cell, the lining of the uterus begins to break down and the cycle repeats.

5) If the egg cell meets and joins with a sperm cell, it is fertilised. It attaches to the lining of the uterus and the woman becomes pregnant.

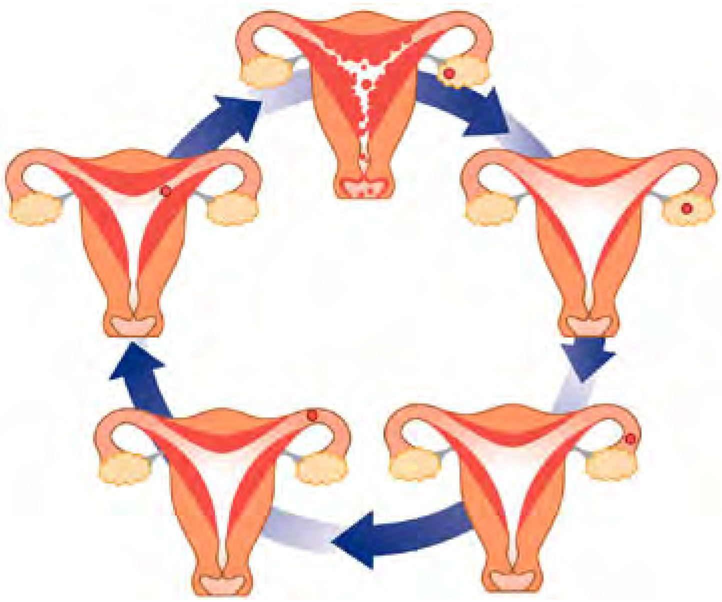


An illustration of the menstrual cycle

Ask your child to explain what they see starting at day 1 when the period begins



The pattern of uterus lining building and loss during menstruation



The endometrium (womb lining) during a typical month

Cut out the table below and ask your child to reform the table matching the approximate days with what happens

Days 1-4	Bleeding starts as the lining of the uterus is released from the vagina. This is the start of menstruation or having a period.
Days 4-14	The blood vessels lining the uterus thicken in preparation for a fertilised ovum (egg) to embed and develop into a baby
Day 14	An ovum is released from an ovary and so women are most likely to become pregnant on or just after this day
Day 14-28	The lining of the uterus remains thick in preparation for the fertilised ovum to embed and develop into a baby

Lesson 4: From Fertilisation to Birth

Today's Important Spellings:	
Sperm Ovum Gametes Fertilisation Pregnancy Zygote	Embryo Fetus Gestation Placenta Umbilical cord Amniotic fluid Contractions

Suggested resources

- Jam jar full of water containing a chicken egg with lid tightly screwed on

Lesson Content

Start by watching this amazing YouTube clip. It is 12 minutes long but is remarkable! Fertilisation to birth

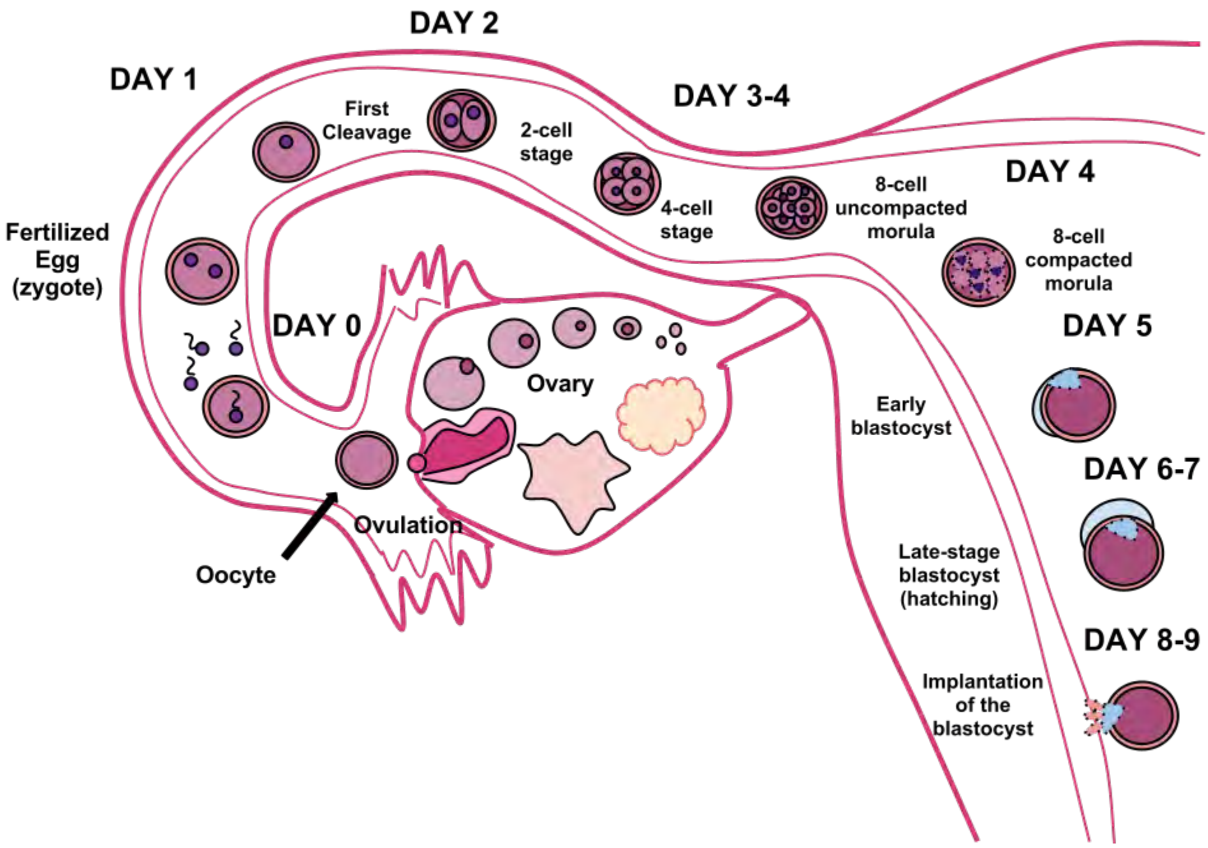
http://www.echo.education/url/fertilisationtobirth

Fertilisation

During sexual intercourse the man's penis releases semen into the woman's vagina during ejaculation. **Sperm** cells are the male reproductive cells and travel in **semen** from the penis and into the top of the vagina. Together sperm and ovum cells are called **gametes** or sex cells. These special cells contain exactly half of the genetic information of almost all other body cells.

The sperm enter the uterus through the cervix and travel to the egg tubes. If a sperm cell meets with an egg cell there, fertilisation can happen. **Fertilisation happens when an egg cell meets with a sperm cell and joins with it.**

The fertilised ovum is called a **zygote**. About a day after fertilisation this single cell will divide into two and then keep on doubling. After several more days it becomes an **embryo**. It continues to be wafted along the fallopian tube by cilia hairs. Once it reaches the uterus it attaches to the lining and begins to develop into a foetus and finally a baby.



Fertilisation to implantation

Development of the foetus

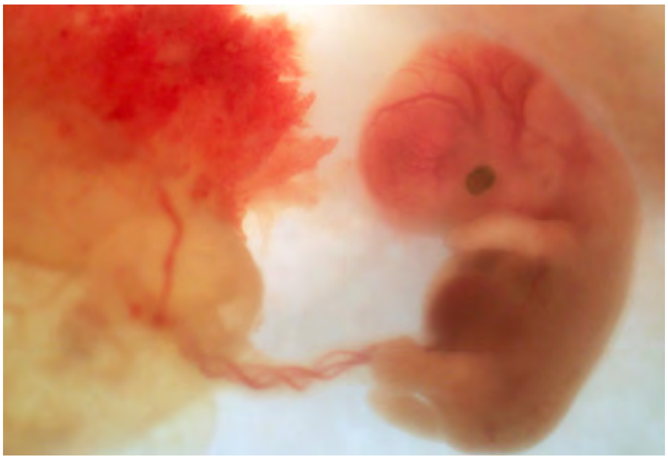
The foetus relies upon its mother as it develops. These are some of the things it needs:

- Protection
- Oxygen

- Nutrients (food and water).
- It also needs its waste substances removing.

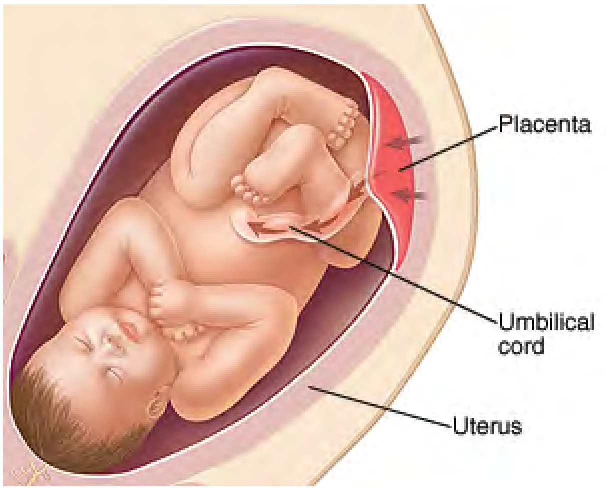
The foetus is protected by the uterus and the **amniotic fluid,** a liquid contained in a bag called the amnion or **amniotic sac.**

Demonstrate the role of the amniotic fluid by asking your child to gently shake the jam jar filled with water and lid screwed on tightly, and see how the chicken egg doesn't get smashed inside. They can then try to shake it a little harder. The egg represents the baby and is safe inside the jam jar (amniotic sac)



A developing foetus

The **placenta** is responsible for providing oxygen and nutrients, and removing waste substances. It grows into the wall of the uterus and is joined to the foetus by the **umbilical cord.**



Developing baby in the womb

The mother's **blood does not mix with the foetus's blood**, but the placenta lets substances pass between the two blood supplies: oxygen and nutrients **diffuse** across the placenta from the mother to the foetus. Waste substances, such as carbon dioxide, diffuse across the placenta from the foetus to the mother.

Recap: diffusion is where substances move from an area of high concentration to low concentration.

If a pregnant woman chooses to lead an unhealthy lifestyle by smoking cigarettes or drinking alcohol, for example, the toxins she takes in are likely to be passed directly to the baby. This can lead to adverse effects on the baby including it being born prematurely.

Developed baby in the uterus

Fetal Development *(Weeks 9-38)*

Weeks 9-15

- Reproductive organs form
- Tooth buds appear
- Eyelids form
- Fetus is very active
- Brain activity can be detected

Fetus at 18 weeks

Weeks 16-26

- Brain develops rapidly
- Alveoli form in the lungs
- Internal parts of the eyes and ears form
- Eyebrows, eyelashes, and nails appear
- Muscles develop

Weeks 27-38

- Body fat increases rapidly
- Bones complete their development
- Head hair gets coarser and thicker
- Brain is continuously active

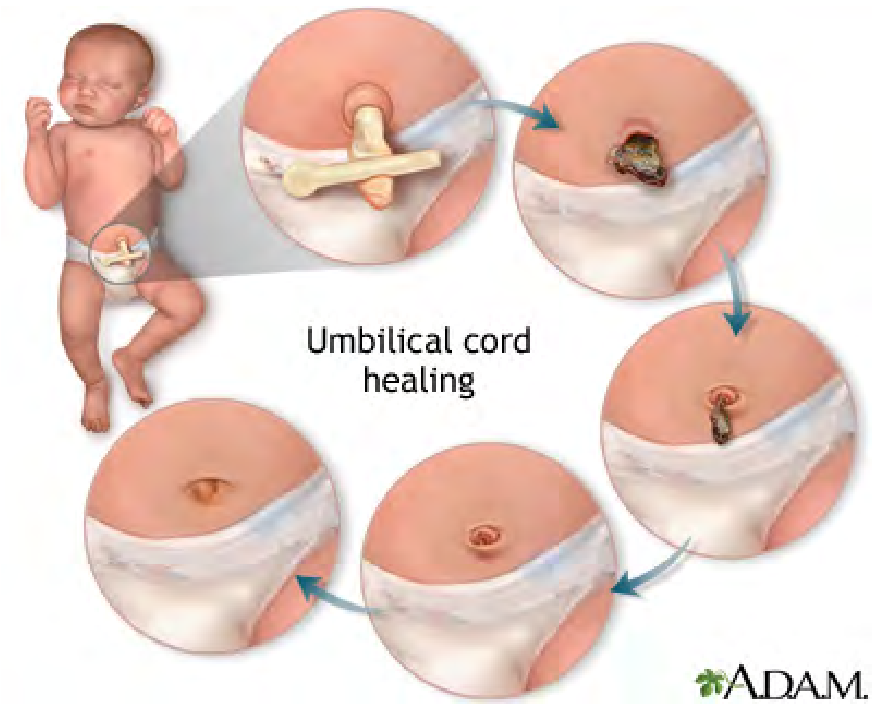
Birth

After nine months (**40 weeks**) the baby is ready to be born.

1) The cervix relaxes
2) Muscles in the wall of the uterus contract powerfully, pushing the baby out of the mother's body through the cervix and vagina. These contractions are known as ‘labour pains’.
3) One early warning sign that birth is imminent is often that the amnion breaks and the amniotic fluid is released through the vagina. We say a woman’s ‘waters have broken’ when this happens.

Once the baby is out of the mother’s body the midwife clamps the umbilical cord and then cuts it from the placenta. This clamp and cut is done close to the baby’s belly button. The baby breathes air for the first time and usually starts to cry. Finally the placenta and the rest of the umbilical cord pass out of the woman's vagina and labour has finished.

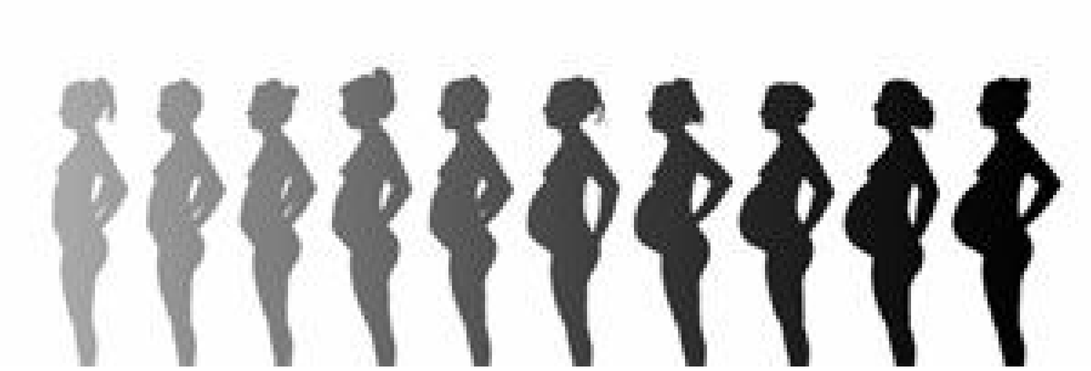
Cutting the umbilical cord of a newborn baby



How the umbilical cord heals

Watch this YouTube clip to reinforce pregnancy learning

http://www.echo.education/url/pregnancy



How a mother's body changes during pregnancy

This is how the foetus develops during pregnancy

Ask your child to write an account of fertilisation to birth. This could be from the foetus' point of view, or a flow diagram or just a factual account -whatever they prefer. Encourage them to include as much detail as they can.

Lesson 5: Sexual Reproduction in other Animals

Today's Important Spellings:	
Vertebrates Invertebrates Mammal Amphibians Reptiles	Fish Bird Internal External

Lesson Content

Recap: can your child remember the 2 groups that the animal kingdom is divided into?

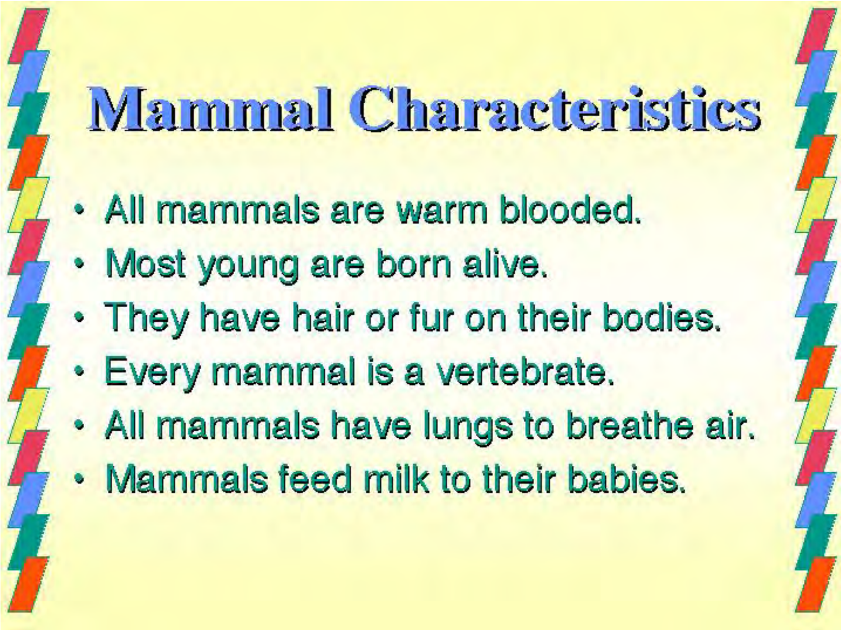
1) Vertebrates (with a backbone)
2) Invertebrates (without a backbone)

There are 5 classes of vertebrates – can your child name them?

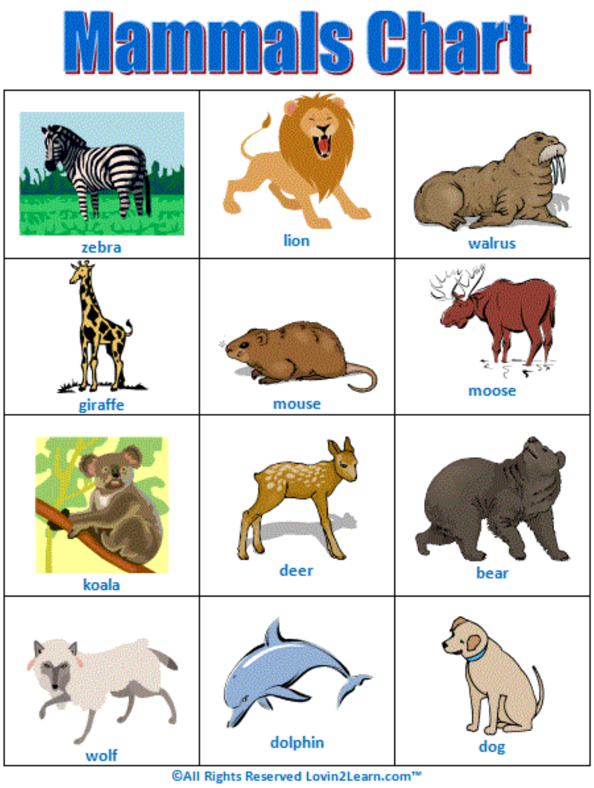
1) Mammals
2) Amphibians
3) Reptiles
4) Fish
5) Birds

Mammals

Here are the characteristics of mammals:



Here are some examples of animals that below to the mammals group



Examples of mammals

Your child needs to be able to name examples of mammals as well as mammal characteristics

Fertilisation

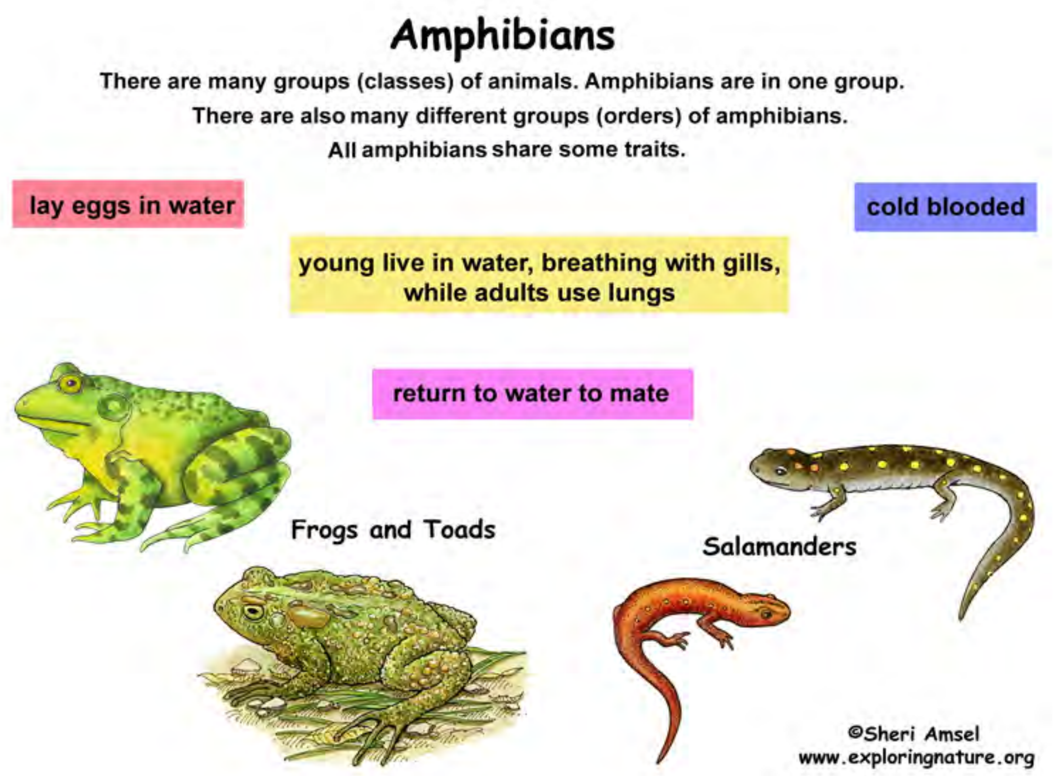
In mammals fertilisation is **INTERNAL** (inside the female's body). Mammals give birth to **live young.**

Care for young

Mammals often care for their young for longer than other animals. They feed milk to their young and protect them.

Amphibians

Examples and characteristics



Fertilisation

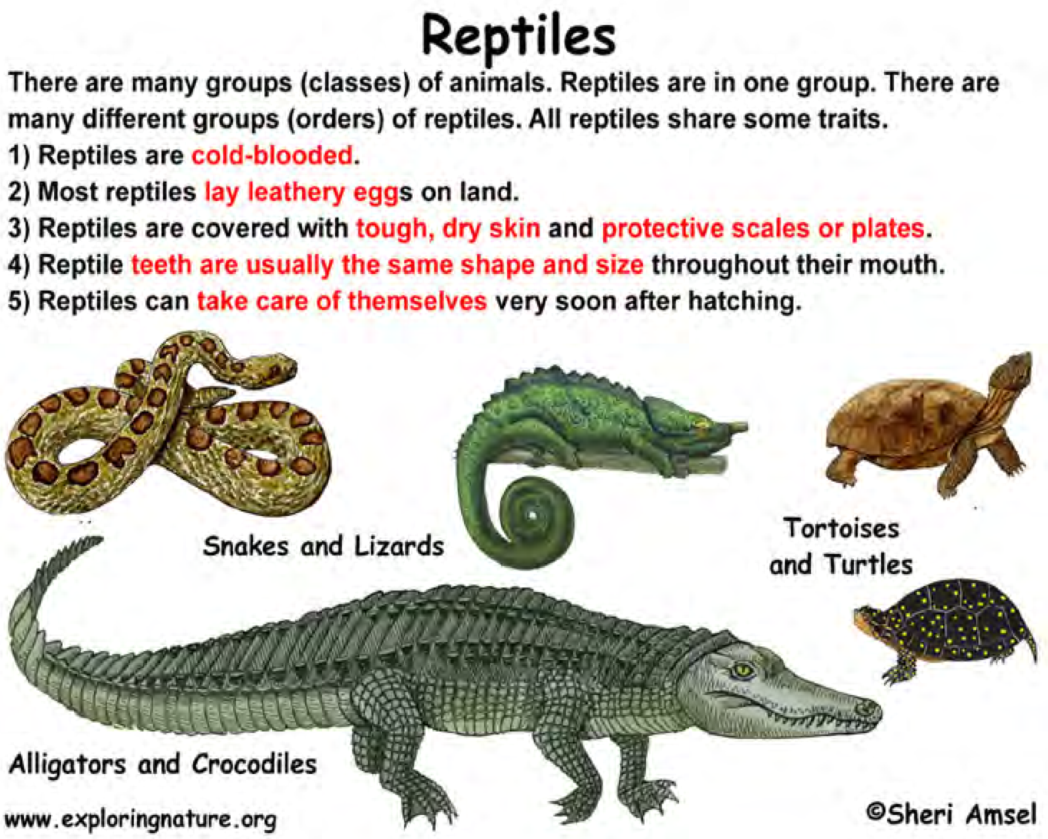
In amphibians fertilisation is **<u>EXTERNAL (</u>**it happens outside of the female's body.) The female lays a large number of eggs (ova) in water. They are fertilised by the male in the water.

Care for young.

In amphibians there is usually **no adult care** for the young

Reptiles

Examples and characteristics:



Fertilisation

In reptiles fertilisation is **<u>INTERNAL</u>** (it happens inside the female's body. Reptiles lay a small number of ova on land.

Care for Young

In reptiles there is usually **no care** for the young

- 

Fish

Examples:

Characteristics

Fertilisation

In fish fertilisation is **EXTERNAL** (outside the female's body). The female lays a large number of eggs in the water and they are fertilised there by the male.

Care for Young

In fish there is usually no care for the young

Birds

Examples and characteristics:

•

Fertilisation

In birds fertilisation is **INTERNAL** (inside the female's body) They layer fewer eggs in a nest or on land.

Care for Young

Often birds will care for their young until they fly the nest

Summary:

Internal fertilisation:

- Mammals
- Birds
- Reptiles

External Fertilisation

- Amphibians
- Fish

Invertebrates

Invertebrates include

- Insects
- Worms
- Carbs
- Snails
- Octopus

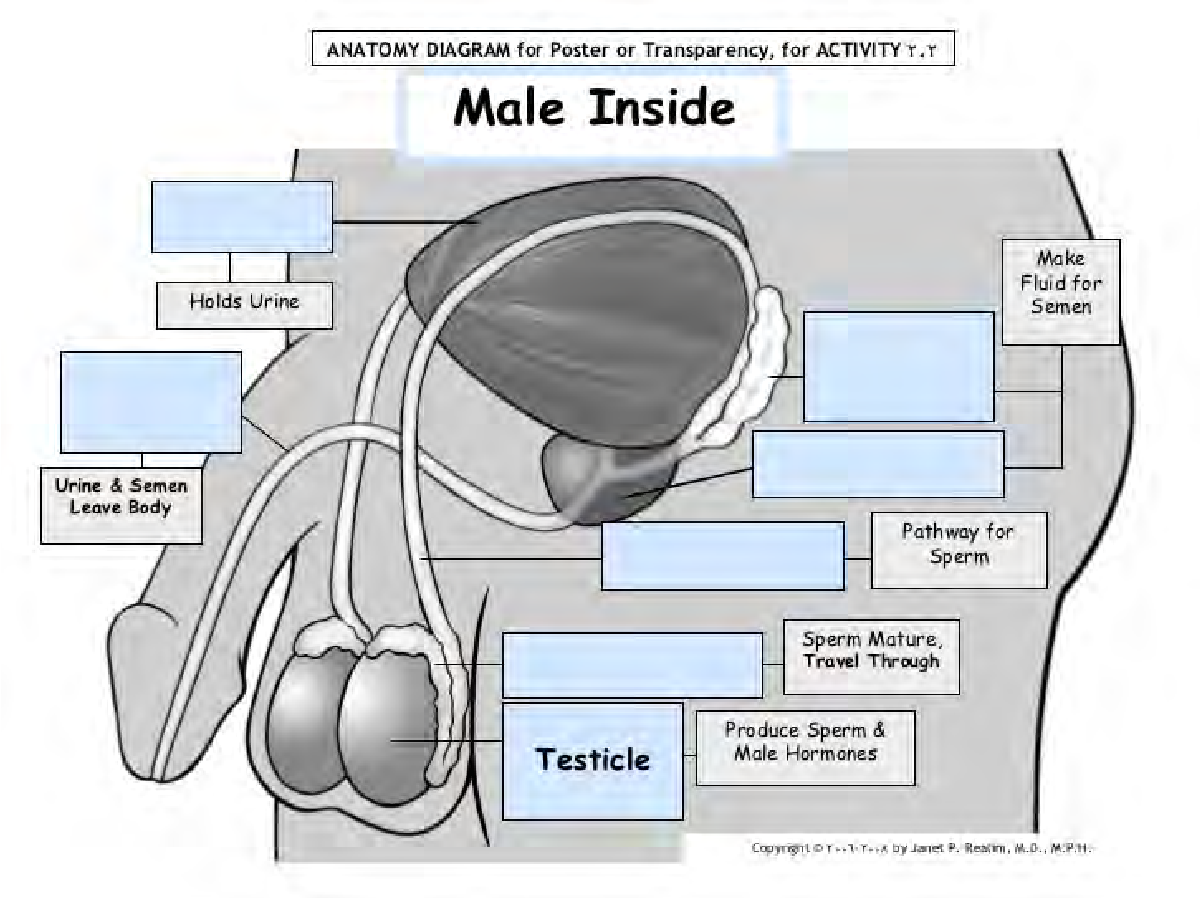
Invertebrates make up 96% of animal species. Like vertebrates, most reproduction is sexual so involves the production of gametes (sex cells) Invertebrates possess a range of different reproductive strategies.

Ask your child to produce a set of flash cards, one for each of the 5 classes of vertebrates. On one side they should write the group name, some examples and the characteristics of that animal group. On the other side they should write where fertilisation occurs and how they care for their young.

Human Reproduction End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1. Fill in the missing words



2. What are the two functions of the penis?

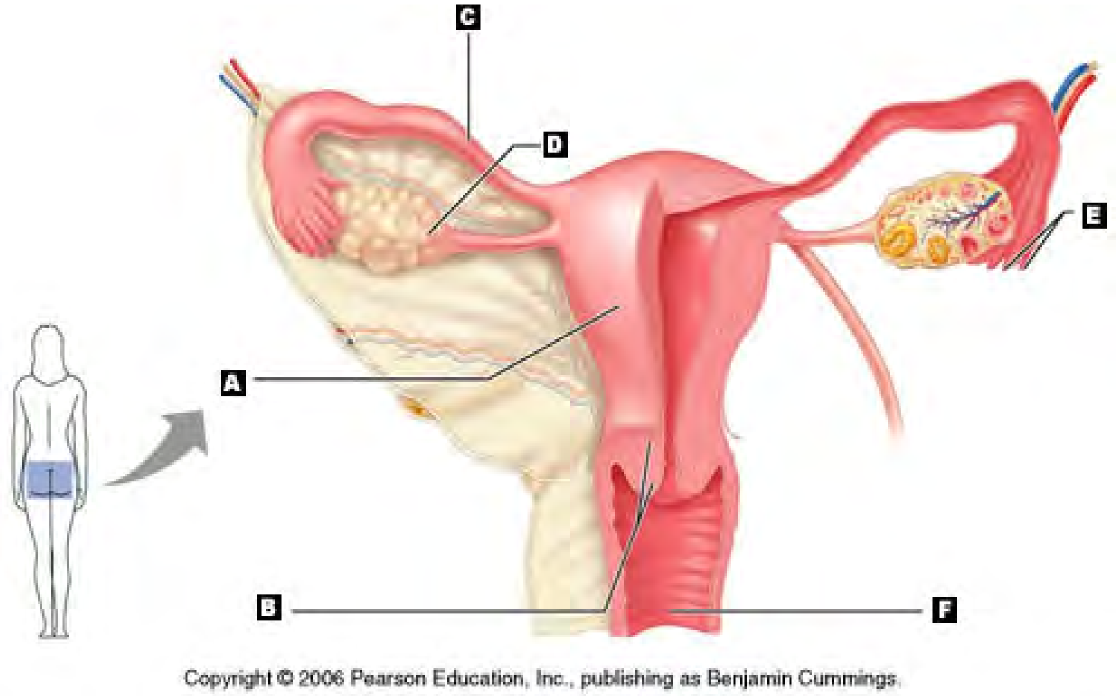
   a)

   b)

3. What is the function of the sperm duct (or vans deferens)?

4. Why do sperm needs lots of mitochondria?

5. Label this diagram



A-

B-

C-

D-

E-

F-

6. What happens on Day 14 of the menstrual cycle?

7. Why is smoking and drinking not recommended for pregnant women?

8. What is fertilisation?

9. How long is an average pregnancy?

10. State the 3 groups of organisms that use internal fertilisation

a)
b)
c)

11. Name a group of vertebrates who care for their young

12. What happens to a boy's voice during puberty?

13. Where does fertilisation occur in humans?

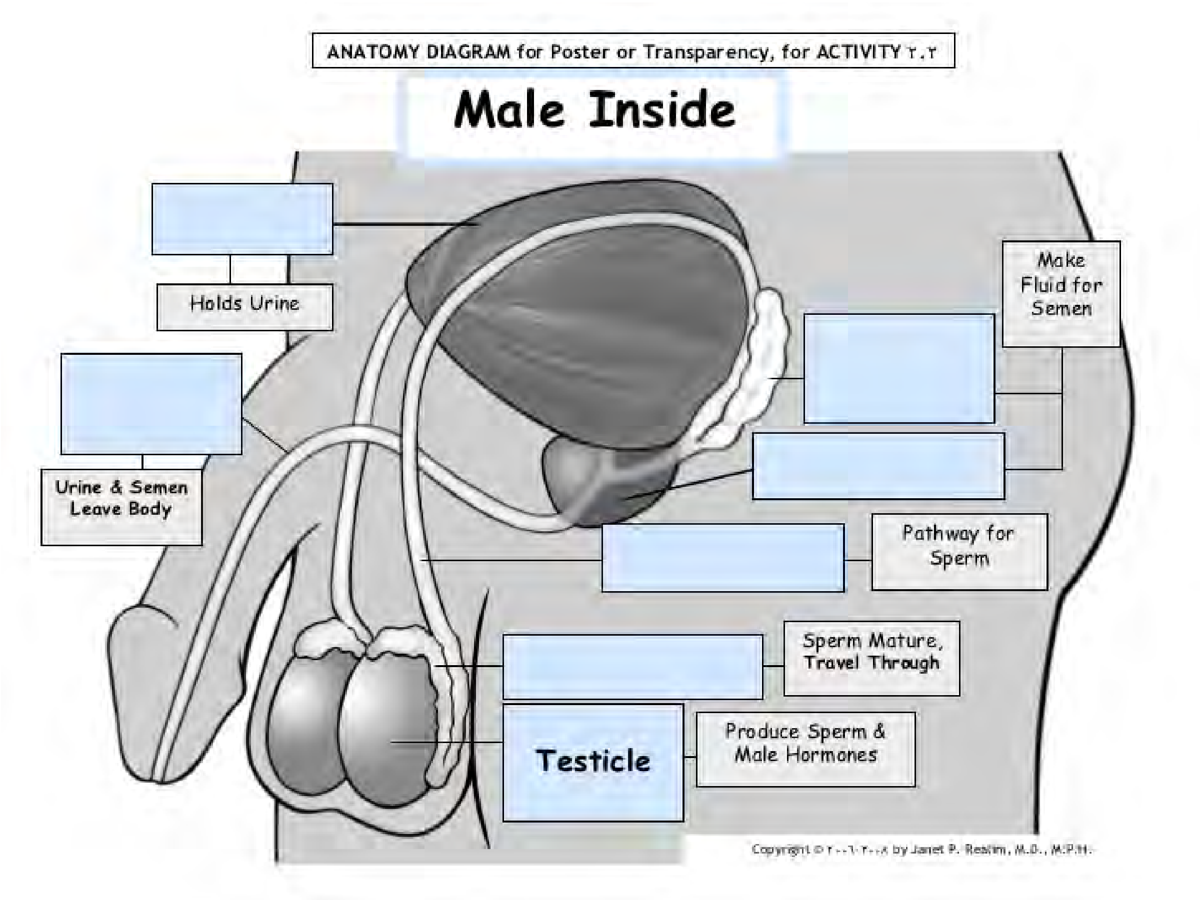
14. Where does the embryo develop in the female?

15. When in a girl's life does the menstrual cycle begin?

Human Reproduction End of Topic Practise Questions

ANSWERS

1. Fill in the missing words



Answers clockwise starting top right are:

Seminal vesicles or glands

Prostate

Sperm duct (or vas deferens)

Sperm duct

Urethra

Bladder

2. What are the two functions of the penis?

a) path of urine leaving the body

b) path of sperm leaving the body

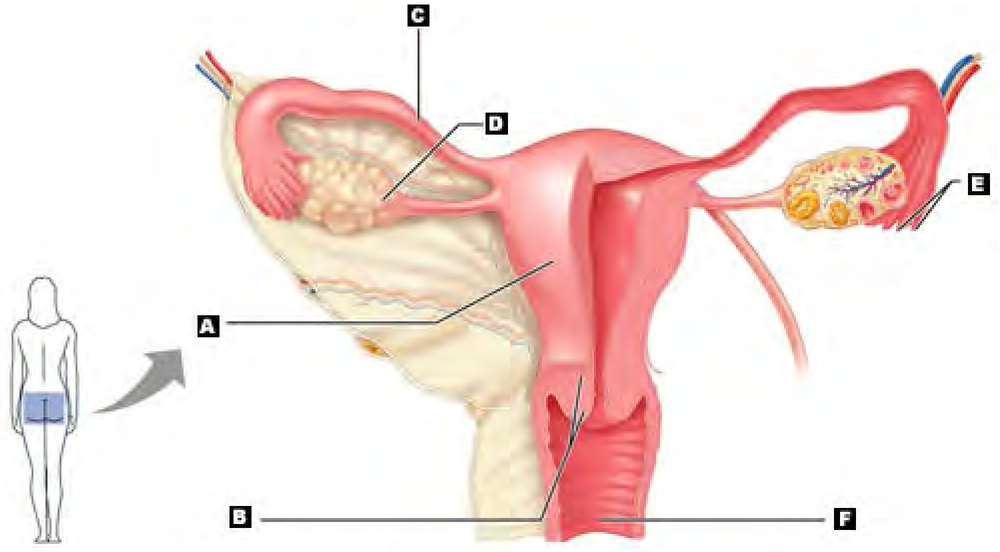
3. What is the function of the sperm duct (or vans deferens)?

Take sperm from testicles to urethra

4. Why do sperm needs lots of mitochondria?

They need lots of energy to swim to the egg (ovum)

5. Label this diagram



A- Uterus (or uterine wall)

B- cervix

C- Fallopian tube

D- Ovary

E- End of fallopian tube

F- Vagina

6. What happens on Day 14 of the menstrual cycle?

The egg is released from the ovary

7. Why is smoking and drinking not recommended for pregnant women?

The toxins can pass into the baby

8. What is fertilisation?

When the nucleus of the sperm and ovum join together

9. How long is an average pregnancy?

9 months or 40 weeks

10. State the 3 groups of organisms that use internal fertilisation

a) mammals

b) reptiles

c) birds

11. Name a group of vertebrates who care for their young

Mammals or birds

12. What happens to a boy's voice during puberty?

It deepens/ gets lower

13. Where does fertilisation occur in humans?

In the Fallopian tubes

14. Where does the embryo develop in the female?

In the uterus /womb

15. When in a girl's life does the menstrual cycle begin?

At puberty/about the age of 13

Lesson 1: Asexual and Sexual Reproduction

Today's Important Spellings: Asexual reproduction Sexual reproduction Stamens Carpels Petals Pollen	Sepals Anther Stigma Style Ovary Filament Ovum

Suggested resources

- A flower per child. Something like a tulip or lily which has clear male and female parts
- Strip of coloured card
- Sellotape or sticky backed plastic
- Sharp small kitchen knife or scalpel

Lesson Content

Plants can either reproduce:

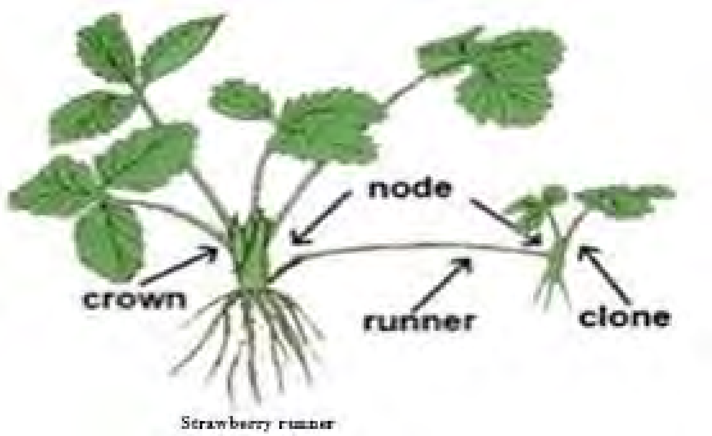
- **sexually** by the formation of gametes (male and female sex cells) followed by fertilisation
- **asexually** -they can make genetically identical copies of themselves

Asexual reproduction

An example of a plant that reproduces asexually is a **spider plant**

A spider plant with its runners

Spider plants produce <u>tiny runners</u> which eventually snap leaving a new plant a short distance from the parent. **There is only one parent plant and the offspring are genetically identical to one another and their parent.**



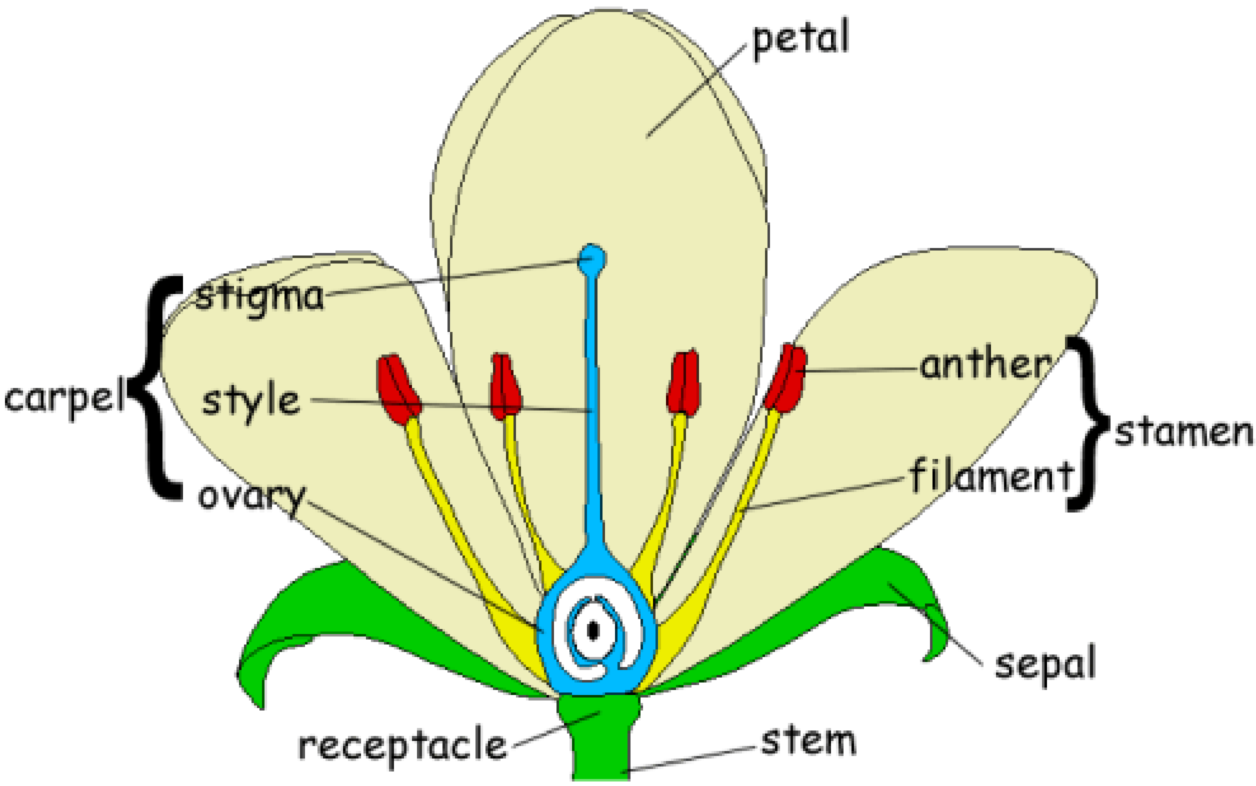
A diagram of a strawberry plant

Other examples are strawberry plants and creeping buttercup.

Sexual Reproduction in Plants

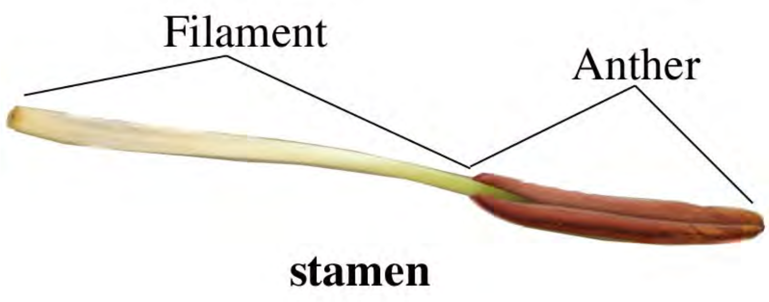
Most plants produce male and female gametes (sex calls) We call the male cell '**pollen**' and the female cell an '**ovum**' or plural is ova (the same word as in animals.)

Flowers are the reproductive organs of many plants. They contain both the male and female sex cells.



A diagram of a flower

The **male** parts of the flower contain the male gametes in the pollen. They are made up of the **filament** (stalk) and the **anther** (head covered in pollen) together we call them the **stamen** (*tip: remember this by stamen- men is male*)



The male part of the flower (the stamen)

The female parts of the flower are the **ovary** containing the **ova (**eggs), above that is the **style** (stalk) and then the **stigma** which is the landing point for the pollen *(tip: remember this by stigMA- Ma is another word for mum- a lady)* Together that are the **carpel** (sometimes you will see it labelled as the **pistil** which is the plural)

The female part of the flower – the carpel

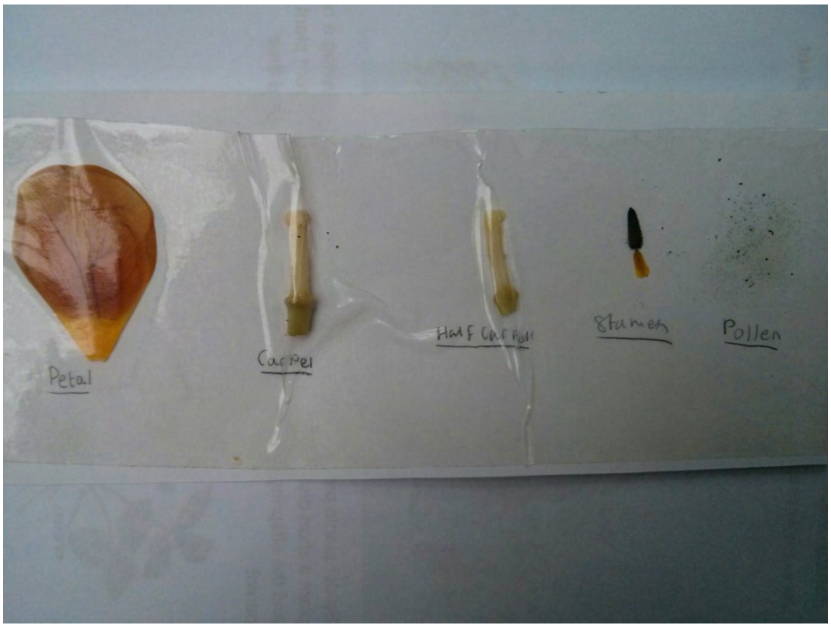
☆ Ask your child to look at these photos of flowers and try to identify the part of the flower. The more they use these words the more familiar they become with them

Ask your child to apply what they have learnt by dissecting a real flower. They should take the flower they have been given and firstly remove the petals. The nicest way to represent their dissection is to take a strip of coloured card and to lay a strip of sellotape along the middle. This should be tucked under at each end to hold it in place.

Lay a couple of petals on the sellotape at one end. Now use the sharp knife or scalpel to cut the stamen at the base. Stick one whole stamen on the sellotape and then cut the anther off the top and stick an anther and a filament separately onto the sellotape. Before moving on ask your child to label each part underneath.

Now focus on the female part of the plant – the carpel. If they can, slice it down the middle from top to bottom. Can they see any ova inside the ovary? (These can't usually be seen but it is good to look and to know where to look) Now cut the ovary (swollen part at the base) from the style, stick to the sellotape then stick the style and the stigma onto the sellotape and label them. Stick the flower parts down either with sticky back plastic or strips of sellotape to hold them down.

The finished work should look a bit like this



An example of the dissected flower

Watch this YouTube clip to consolidate their learning on parts of a flower

http://www.echo.education/url/partsofaflower

Flower parts song

http://www.echo.education/url/flowerpartssong

NB You will sometimes see **sepals** labelled – these are the usually green covering of the bud which curl back one the flower starts to open.

Lesson 2: Pollination

Today's Important Spellings: Stamens Carpels Petals Pollen Sepals Anther	Stigma Style Ovary Filament Ovum

Suggested resources

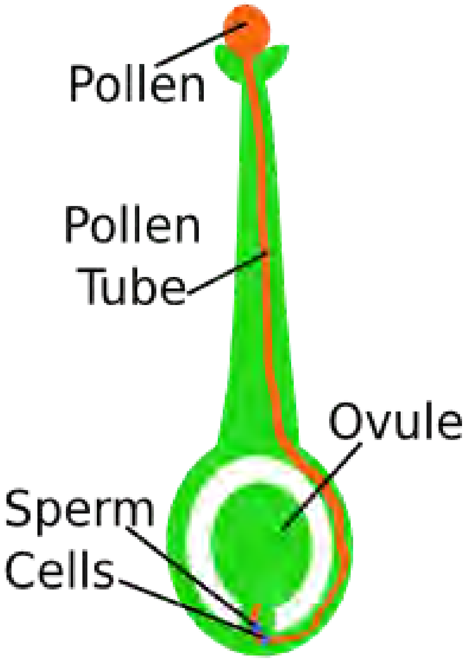
- A flower per child. Something like a tulip or lily which has clear male and female parts
- Cotton bud

Lesson Content

Look at your child's dissected flower from the last lesson and go over the vocabulary and clarify the male and female parts.

They should say something like this:

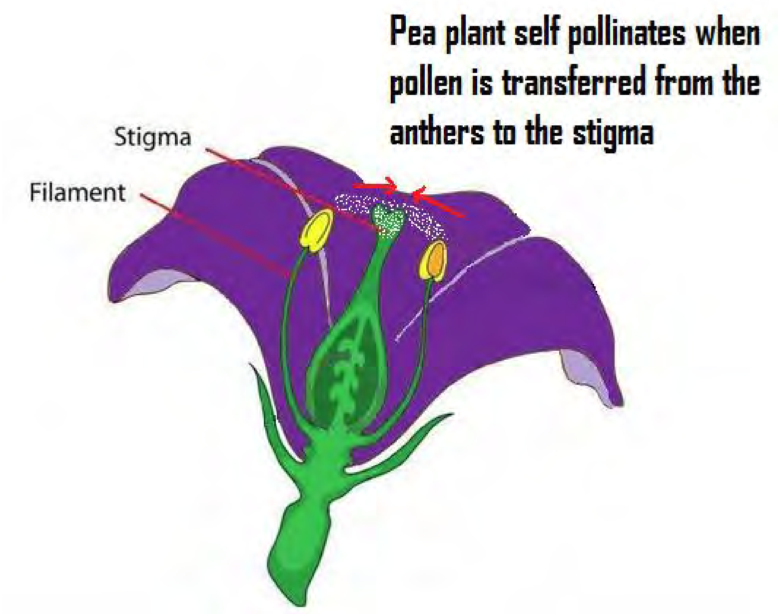
Pollination occurs when the male gamete, pollen, meets the female gametes, the ova (or egg). **Pollen from the anther must reach the carpel.** First it touches the stigma. Here, a **pollen tube** is formed and this grows down through style to the ovary and the pollen nucleus travels down this tube. When it reaches the ovary, the nucleus of the pollen and ova fuse and this is **fertilisation**. This fertilised ovum now becomes a **seed**. The ovary now develops into a fruit and surrounds the seeds.



A diagram of the pollen growing a pollen tube to the ovule

Self-pollination occurs when pollen from the anther is transferred to the stigma of the **same plant**. You can reinact this by rubbing your cotton bud onto the anther and once you can see pollen grains on the tip you can rub this on the stigma of the same flower.

Pollen on a cotton bud



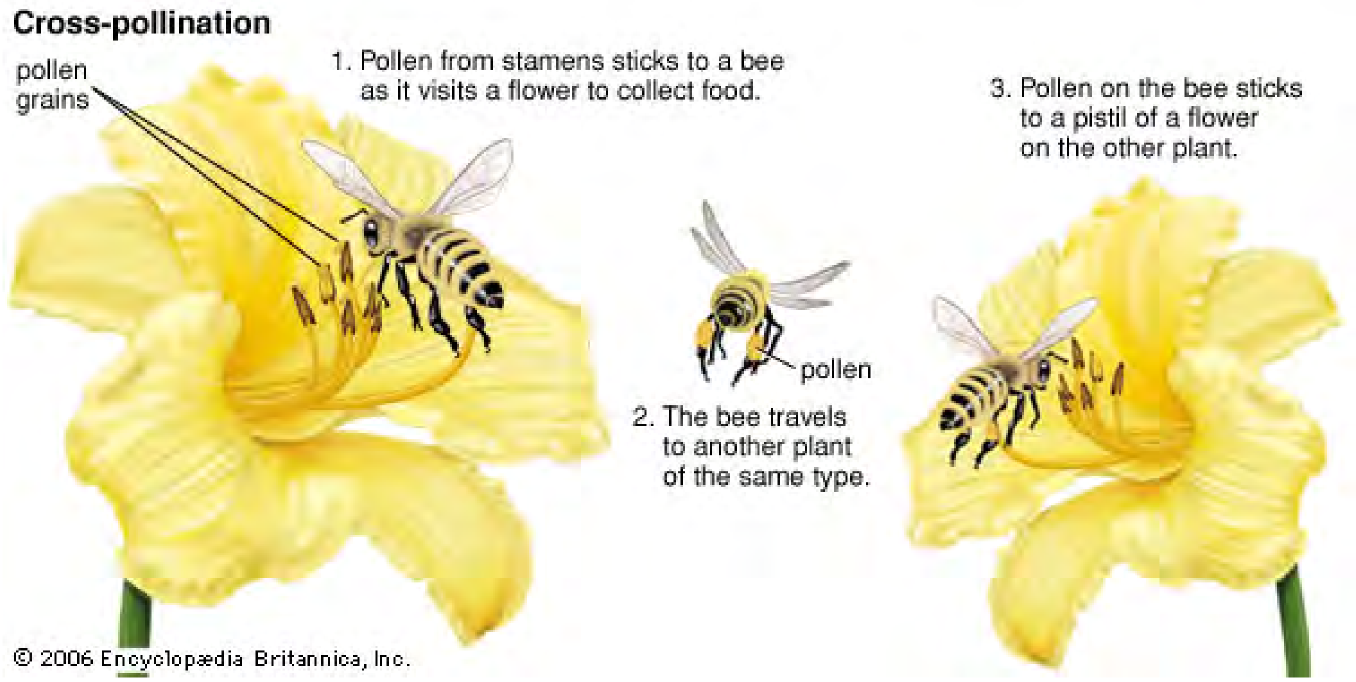
Self-pollination in a pea plant

Cross-pollination occurs when pollen from the anther of one plant is transferred to the **stigma of another plant**. The pollen reaches a different plant in 2 ways

1) By insect (insect pollination)
2) By the wind (wind pollination)

Insects are attracted to the flower by bright colours or strongly scented nectar. Insects drink this nectar as a source of food.

Nectar dripping from a flower



A diagram to illustrate cross pollination by insects

Insect pollinated flowers and wind pollinated flowers

Wind pollinated flowers are different in structure from insect pollinated ones. You need to be able to explain the main differences. This table will help to make these clear for you.

Insect Pollinated	*Wind Pollinated*
The petals are brightly coloured and large to attract insects	**The petals are small and dull coloured – brown or green as they don't need to attract insects**
The flowers are often sweet scented to attract insects	**No scent needed**
The flowers often produce nectar to feed insects	**No nectar needed**
There is less pollen – as there is less wastage	**There is lots of pollen because there is lots of wastage**
The pollen is sticky to spikey to stick to the insect	**The pollen is light and smooth so it doesn't clump together and travels on the wind easily.**

The anthers are firm and are found inside the flower to brush against the visiting insect	The anthers are loosely attached and dangle outside the flower to release pollen into the wind
The stigma has a sticky coating for the pollen to stick to	The stigma is feathery or net – like to ctachthr pollen as it drifts by

An example of an insect pollinated flower

An example of a wind pollinated flower (releasing pollen)

We rely heavily on insects to pollinate our crops and would not have enough food without them.

Watch these YouTube clips

http://www.echo.education/url/flowerpollination

http://www.echo.education/url/privatelifeoffloweringplants

http://www.echo.education/url/windpollination

Ask your child to collate some pictures of insect and then wind pollinated flowers. Make sure they fulfil the criteria above. Discuss which group they belong to and how you know (i.e. bright colours and scented versus dull brown or green etc.)

Lesson 3: Seeds and Dispersal

Today's Important Spellings:	
Dispersal Germinate	

Lesson Introduction

Watch these YouTube clips to introduce the topic of seed dispersal

http://www.echo.education/url/seeddispersal1

http://www.echo.education/url/seeddispersal2

Recap last lesson when we looked at fertilisation:

- This happens when a pollen grain lands on the stigma.
- A pollen tube grows down the style to the ovary and the nucleus of the pollen fuses with the ova.
- Seeds are formed.
- All seeds have an embryo inside them and a plant may have many seeds where lots of ova were fertilised by lots of different pollen grains.
- Each seed can grow into a new plant if the conditions are correct.
- The seed also acts as a food store to provide the embryonic plat with the initial energy needed to germinate and grow.
- Seeds are surrounded by a protective coat.

Seed dispersal

Seeds are dispersed (spread) away from each other and from the parent plant so that there is less competition for nutrients, light, space etc. The commonest methods of seed dispersal are:

- ***wind*** e.g. dandelion, sycamore fruits are light and have extensions which act as parachutes or wings to catch the wind

Dandelion seeds

- ***animal -internal*** e.g. tomato, plum, raspberry, grape have brightly coloured and succulent fruits which contain seeds with indigestible coats which allow the seeds to pass through the animal undamaged

Tomato seeds

- ***animal external*** e.g. goose grass, burdock, the fruits have hooks which attach them to the fur of passing animals.

Seed hooks

- ***explosive/ self propelled*** e.g. pea pod. The pod burst open when ripe projecting the seeds away from the plant.

Exploding seed pod

Ask your child to take large sheet of paper (A3 if possible) and fold it into 4. Label each quarter with one of the seed dispersal methods – wind, animal internal, animal external and explosive and find examples of each type.

Plant Reproduction End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) Give the two different way that plants can reproduce and give an example for each

   a)

   b)

2) The carpel is the female part of the flower. Name the three parts that make up the ***carpel***

   a)

   b)

   c)

3) What is the male gamete called in flowers?

4) What happens when the pollen grain lands on the stigma?

5) Name the two ways that pollen can move from one flower to another

   a)

   b)

6) What do we call it when a flower pollinates its own flower?

7) Name three ways that seeds can be dispersed and give an example of each

   a)

   e.g.

   b)

   e.g.

   c)

   e.g.

8) Why is it worrying that the number of bees are declining?

Plant Production End of Topic Practise Questions

ANSWERS

1) Give the two different ways that plants can reproduce and give an example for each

a) asexually e.g. strawberry plant (other examples are possible)

b) sexually e.g rose (other examples are possible)

2) The carpel is the female part of the flower. Name the three parts that make up the ***carpel***

a) ovary
b) style
c) stigma

3) What is the male gamete called in flowers?
Pollen

4) What happens when the pollen grain lands on the stigma?
A pollen tube grows down to the ovary and the pollen nucleus travels down this

5) Name the two ways that pollen can move from one flower to another

a) insects
b) wind

6) What do we call it when a flower pollinates its own flower?

Self-pollination

7) Name three ways that seeds can be dispersed and give an example of each

a) wind
e.g. dandelion

b) animal internal
e.g. tomato

c) animal external
e.g.burdock

also accept explosion e.g pea pod
Other plant examples are acceptable

8) Why is it worrying that the number of bees are declining?

We rely on bees to pollinate lots of our plants. There would not be enough food in the world if there were no bees.

Lesson 1: What is Photosynthesis?

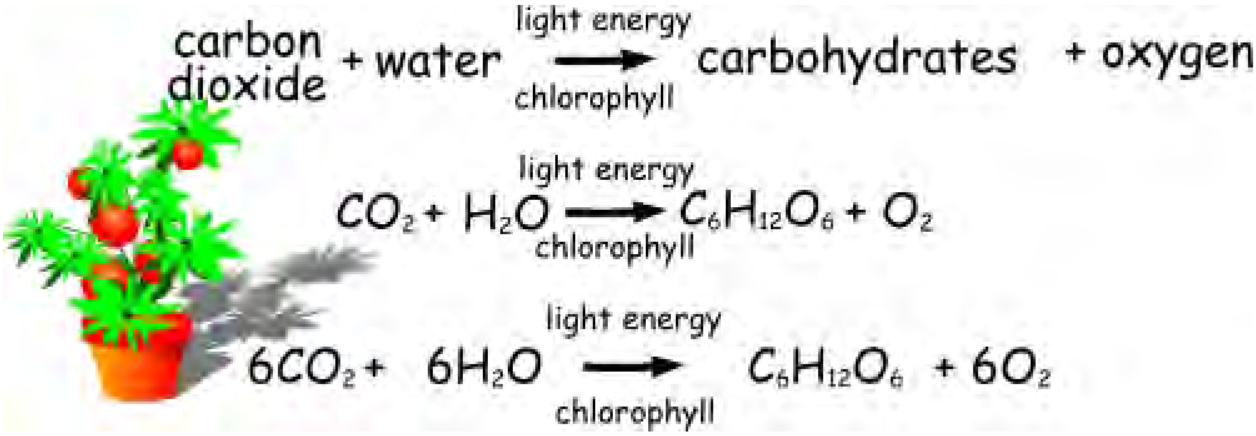
Today's Important Spellings: Photosynthesis Chlorophyll Chloroplasts Carbon dioxide	Glucose Oxygen

Lesson Contents

Photosynthesis is a chemical reaction which occurs in the **green or red parts of plants** –

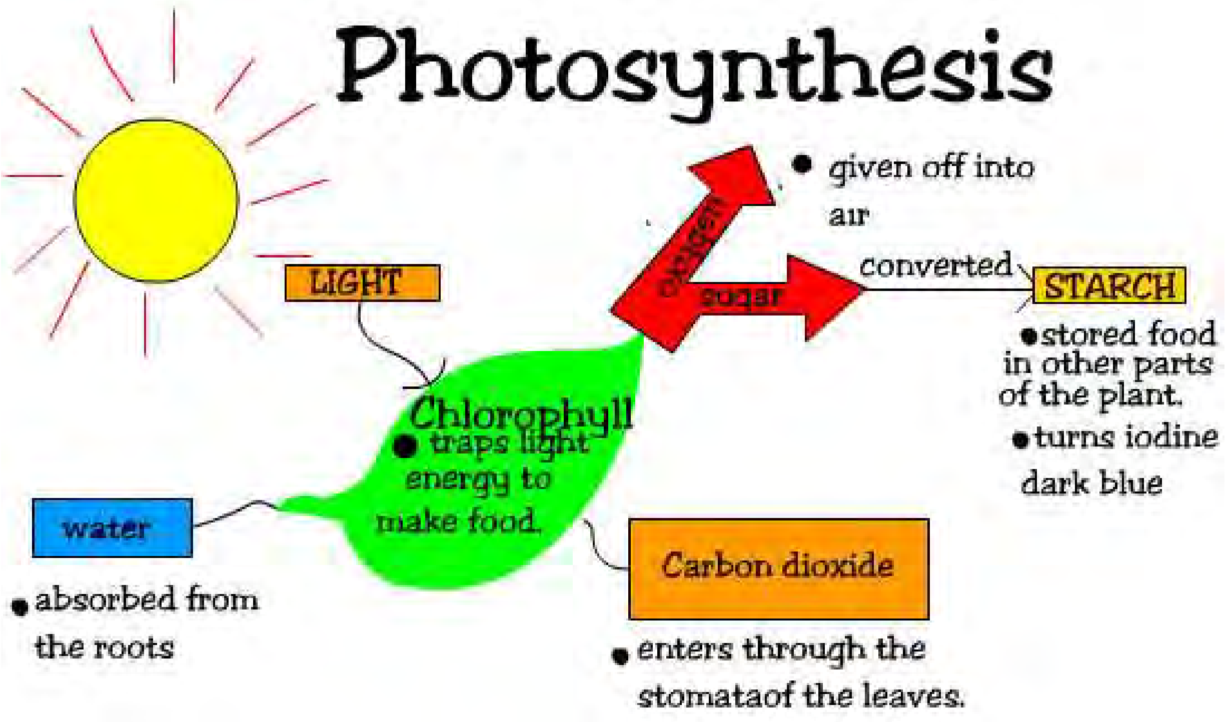
- **Leaves**
- **Shoots and**
- **Some stems**

- It happens in plants that live both on **land and in the water.**
- Most plants are green because of the pigment **chlorophyll** which occurs in the **chloroplasts** in their cells. There is chlorophyll in red leaves too it is just harder to see.
- Photosynthesis can only occur in chloroplasts.
- **Photosynthesis is how plants make their food (glucose)**



Word and chemical equations for photosynthesis

- Plants take in **carbon dioxide** through the pores (holes) in their leaves and **water** in through their roots.
- They use **sunlight** that is absorbed by their leaves to produce their **food (glucose**) and **oxygen** as a by-product. They don't need the oxygen so they release it back into the atmosphere.



A diagram of photosynthesis

Uses of glucose in plants

Plants use the glucose they make for

1. Respiration (making energy)
2. Formation of cellulose to make new cell walls
3. Stored as starch
4. Forming proteins for growth and repair

NB Photosynthesis can only occur where there is green chlorophyll so not in the white parts of these leaves

A variegated leaf

Watch this YouTube clip to help consolidate your child's learning and to introduce a few new words to be covered in the following lesson.

http://www.echo.education/url/photosynthesis

Ask your child to copy the equation for photosynthesis and to draw their own diagram to illustrate the process using arrows going in and out of the leaf

Lesson 2: How do leaves work?

Today's Important Spellings:	
Photosynthesis Chlorophyll Chloroplasts Carbon dioxide Stoma and stomata	Glucose Oxygen Stomata Palisade cells Deciduous Evergreen

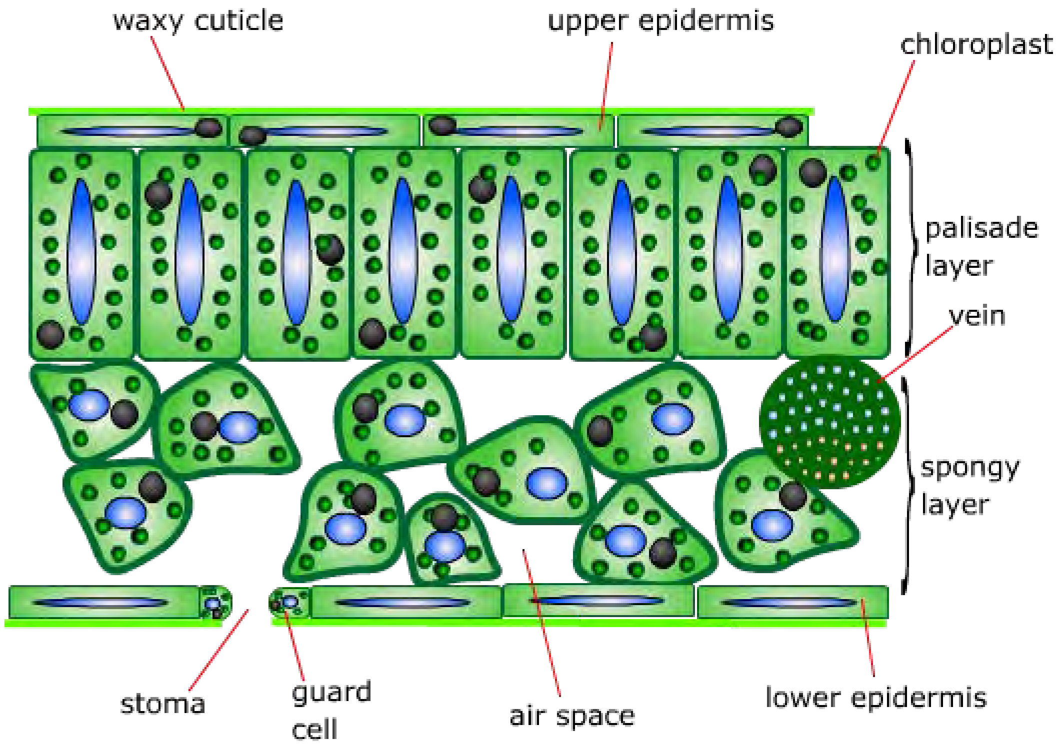
Lesson Content

Watch the YouTube clip from the end of last lesson as your recap and introduction to this lesson

http://www.echo.education/url/photosynthesis

Leaves of plants are the major site of photosynthesis and are adapted to maximise this process. Plants in the shade tend to have larger, darker leaves packed full of chlorophyll, while those in bright sunlight tend to have smaller, lighter green leaves.

Some light green leaves



A cross section of a leaf

- The **waxy cuticle** over the surface is there to minimalize water loss from the leaf's surface.
- The next layer down is full of **palisade cells** which are full of **chloroplasts** for photosynthesis. They are lined up tightly to maximise the light.
- The leaf is full of air spaces to maximise the diffusion of carbon dioxide into the leaf and oxygen and water vapour out.
- The leaf has tiny holes on the underside called **stomata** (singular is a **stoma**) to control the volume of gases that can diffuse in and out of the leaf and for water vapour to leave the leaf. **Guard cells** control the stomata opening and closing.
- Leaves are wide to maximise the surface area and therefore maximise the amount of sunlight hitting the leaf
- Leaves are thin to allow gases to diffuse into the leaf more easily

Adaptation

2.20 describe the structure of the leaf and explain how it is adapted for photosynthesis

Leaf Structure	Adaptation for photosynthesis
Cuticle	Stops the leaf from losing water (remember, water is used in photosynthesis)
Epidermis	Transparent protective layer. Protects the leaf without inhibiting photosynthesis.
Palisade cells	Are packed full of chloroplasts. Are long and thin so light has to pass through as many chloroplasts as possible.
Air Spaces	Increase the surface area inside the leaf to maximise gas exchange across the surface of the Spongy Mesophyll cells
Stoma	Allow exchange of CO_2 and O_2
Guard Cells	Allow the stoma to open and close to stop the leaf losing too much water
Vein (containing Xylem)	Brings a steady supply of water to the leaf.

A chart of leaf structure and their adaption

Ask your child to copy the diagram of the inside of a leaf and label their drawing. As with all scientific drawings they should:

- Use a sharp pencil
- Give it a title
- Do not shade or colour the drawing
- Where possible use horizontal lines to label

Cut out these cards and you read the descriptions from the table above. Your child must find and hold up the card with the correct leaf structure

Cuticle
Epidermis
Palisade cells
Air spaces

Stoma
Guard cells
Vein containing xy-lem

Watch these YouTube clips

http://www.echo.education/url/leafadaption

http://www.echo.education/url/leafadaption2

Lesson 3: Deciduous and Evergreen Plants

Today's Important Spellings:	
Deciduous Evergreen Cactus	

Lesson Content

Deciduous and Evergreen Plants

Plants can be categorised into two groups depending on whether they keep their leaves all year round or lose them in winter.

Evergreen plants keep their leaves all year round (hence "ev-er…green"). They

- Usually grow near the equator where there is lots of sunshine all year round e.g.

- Or they have thin, pine needles to survive cold, dark winters e.g.

- Or they have spines like cacti to survive in hot, dry places e.g.

Evergreen plants can be referred to as **coniferous.**

Deciduous Plants drop their leaves in winter. They

- Usually live away from the Equator where there are shorter, duller days in winter
- There is not enough light for them to keep their leaves so they drop them and slow down their growth (a bit like hibernation) during that time.
- This also helps them save water

A tree in each of the UK's four seasons

Watch this YouTube clip to consolidate your child's learning

http://www.echo.education/url/deciduousandevergreen

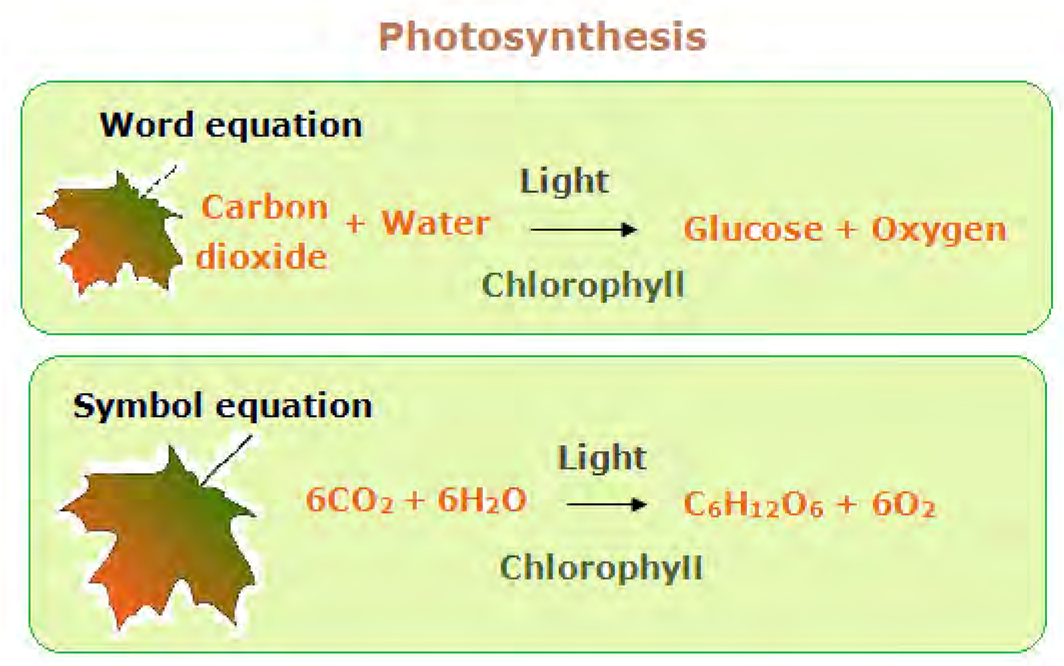
You could walk around a local park or large garden and look at the leaves of different plants. Look for patterns of where the plants grow and their leaf shape, size and colour. You could take photos of what you find and put together a report.

Lesson 4: Roots and Water Transport Systems through Plants

Today's Important Spellings:	
Root Hair Cells Xylem Transpiration	Phloem Stomata Evaporation

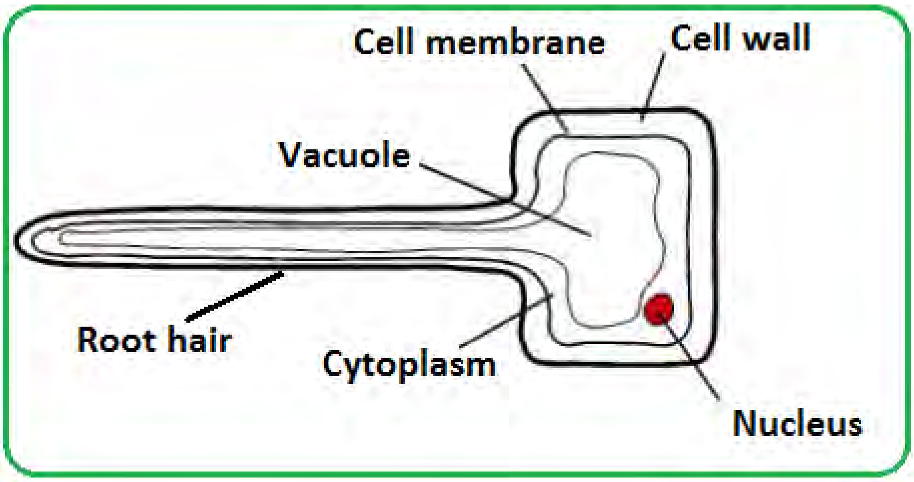
Lesson Content

Ask your child to recap the process of photosynthesis



For photosynthesis to happen the leave MUST have water. This water comes from the soil and the plant absorbs water and dissolved mineral nutrients though **root hair cell** in their roots (it does not enter the leaf from rain.)

Recap: this is what a root hair cell looks like



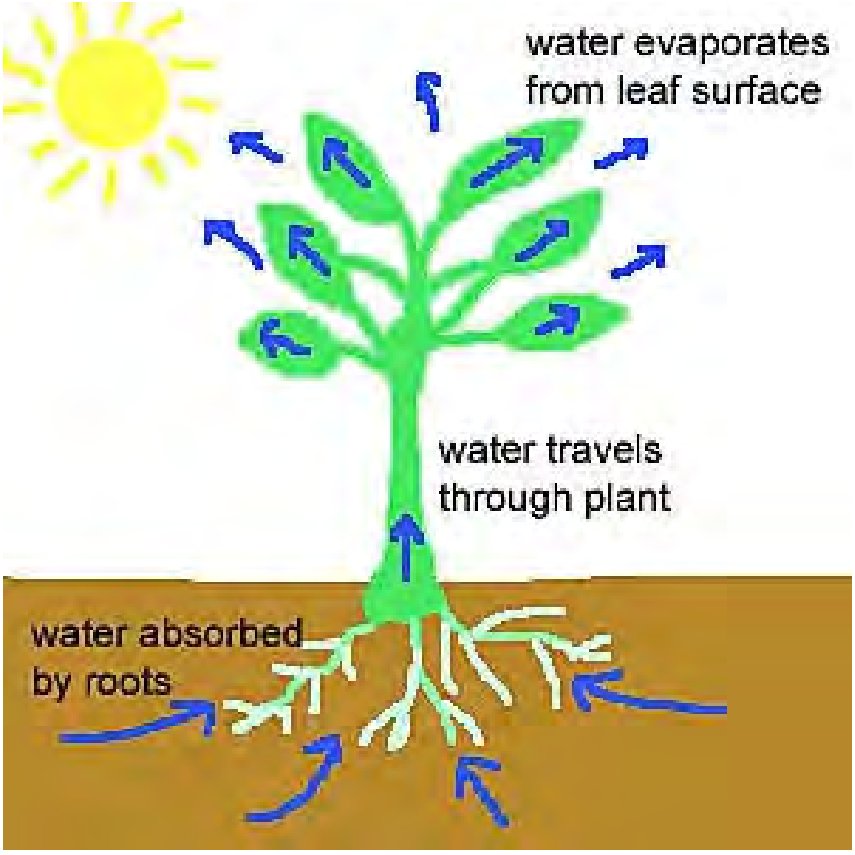
A diagram of a root hair cell

The root hair cells increase the surface area so that the plant can absorb more water.

A seedling with tiny roots

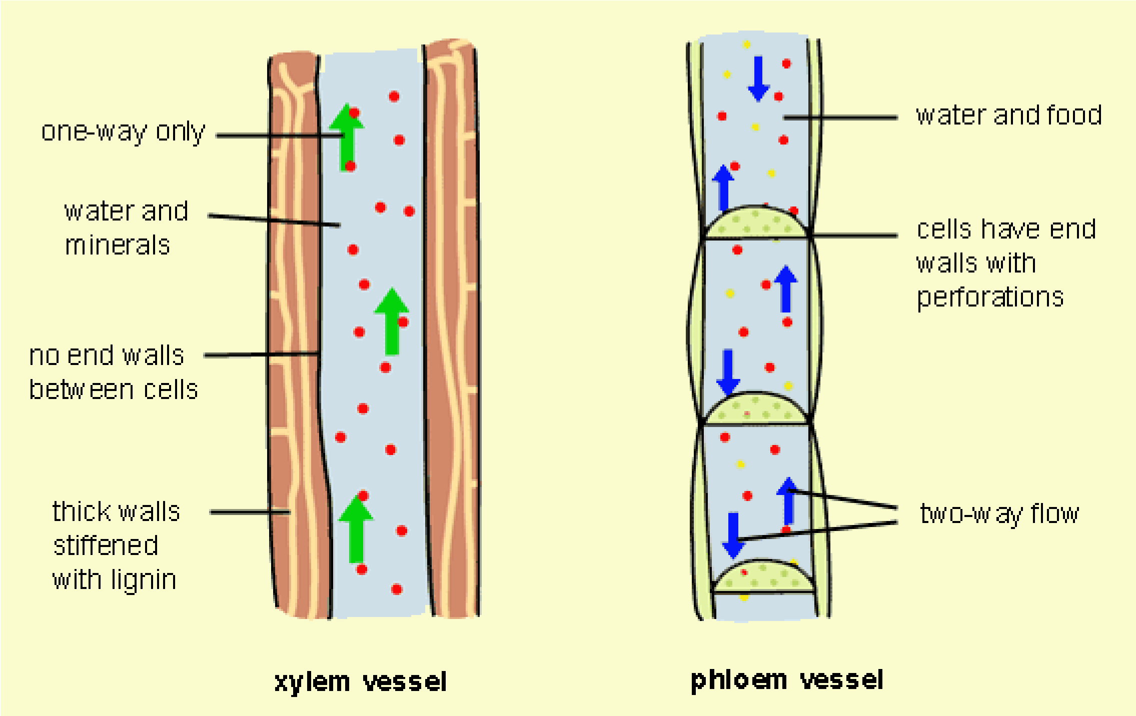
Here you can see all the roots of this newly germinated seedling. They reach out into the soil around the plant and absorb water and nutrients.

Once absorbed into the root hair cells the water and dissolved mineral salts flow up the plant through special tubes called **xylem.** The water moves up though the xylem to the leaves where it is used for photosynthesis or evaporates out of the leaf through the **stomata** (pores). This evaporation pulls the water up through the plant in a constant stream called **transpiration.** Without evaporation of some water transpiration would stop and no water would reach the leaves for photosynthesis.



There are a second set of tubes inside plants that transport the glucose away from the leaves after it has been made by photosynthesis. These tubes are called **phloem.** The phloem moves the glucose to where it will be stored in the plant as **starch**. It is **often stored in the roots** like in potatoes or in fruit.

This is the inside of xylem and phloem tubes. Water only moves one way through plants – upwards from root to the leaves. Sugars move around the plant and so phloem are a 2 way system.



Watch these YouTube clips

Xylem and Phloem (some of this they will not need to learn for key stage 3 so just focus on what has been in this lesson)

http://www.echo.education/url/xylemandphloem

Transpiration David Attenborough

http://www.echo.education/url/transpiration

Lesson 5: Aerobic and Anaerobic Respiration

Today's Important Spellings:	
Aerobic Respiration Anaerobic Respiration	Fermentation Microorganisms

Suggested resources

- Conical flask or test tube
- Balloon
- Fast action yeast
- Sugar
- Warm water

Lesson Content

Start by recapping the 7 life processes all living things do. They are remembered by the letters **MRS GREN**

Movement

Reproduction

Sensitivity

Growth

Respiration

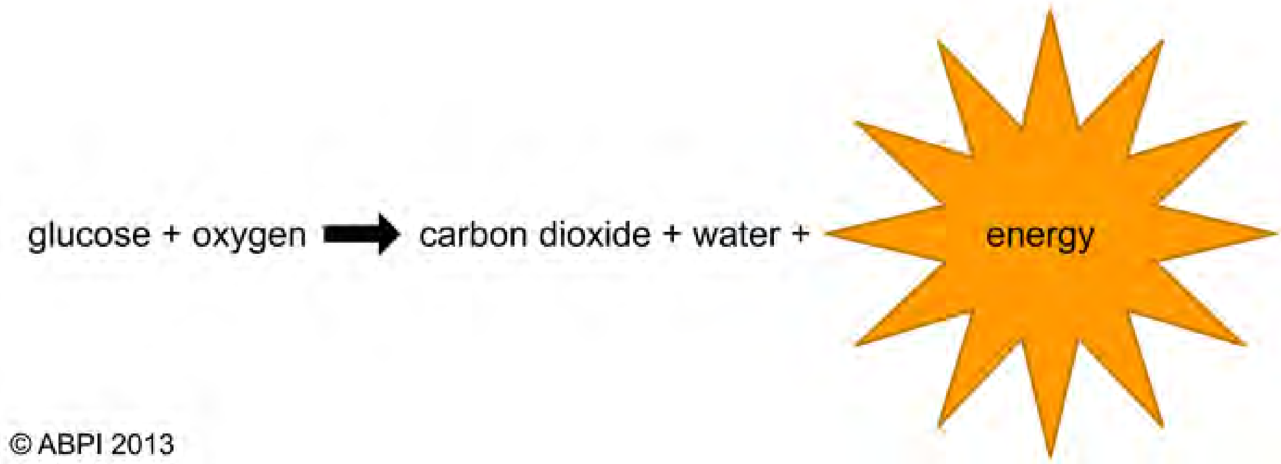
Excretion

Nutrition

ALL living cells in plants, animals and microorganisms (except viruses) release energy from glucose. This is called respiration. Organisms use this energy from respiration for the other 6 life processes.

Respiration uses glucose and oxygen and produces carbon dioxide and water and **ENERGY**.

Aerobic Respiration



A word equation for respiration

Cell Respiration Formula

$$C_6H_{12}O_6 + 6O_2 \Rightarrow 6CO_2 + 6H_20 + ATP$$

Glucose Oxygen Carbon Dioxide Water Energy

A chemical equation for respiration

NB ATP is energy

This form of respiration takes place in the presence of oxygen and is called aerobic respiration. It happens in all of our cells all day every day.

Anaerobic Respiration In Humans

However respiration can happen **without oxygen**. This usually occurs when you are exercising vigorously for a long period. This is called **anaerobic respiration.**

BUT this process only releases about 5% of the energy of aerobic respiration. The remainder of the energy is stored as **lactic acid**. This builds up in muscles making them feel 'rubbery' and leads to cramp.

A word equation for anaerobic respiration glucose $\longrightarrow$ lactic acid + energy

$$C_6H_{12}O_6 \longrightarrow 2C_3H_6O_3 + \text{energy}$$

A chemical equation for anaerobic respiration

Ask your child to make small cards of all the reactants and products in both aerobic and anaerobic respiration. Mix them up and then arrange them to give the correct equations for both aerobic and anaerobic respiration.

Recovery after Anaerobic Respiration

When you finish exercising it takes a few minutes to catch your breath. You breathe quickly and deeply to replenish the oxygen used up in exercise. This is called excess **post-exercise oxygen consumption** (EPOC.) This oxygen reacts with the lactic acid to release the rest of the energy and relieve the cramp.

lactic acid + oxygen ➡ carbon dioxide + water + energy

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A word equation for releasing energy from lactic acid

So…during exercise

1. During strenuous exercise your breathing and pulse rate increase to provide your muscles with more oxygen
2. If you use all this oxygen you can only respire anaerobically which leads to lactic acid production and cramp
3. After a short period of rest your body will replenish your oxygen levels and you can return to aerobic respiration

Anaerobic Respiration in Microorganisms

Anaerobic Respiration (that is respiration without oxygen) in some microorganisms, fungus, yeast and some bacteria, is not the same as in humans and other animals. It is called **fermentation.**

Fermenting yeast

The microorganisms complete fermentation to release energy needed for them to grow. The waste products are **ethanol and carbon dioxide**.

Figure 3–Fermentation of glucose to carbon dioxide and ethanol

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \longrightarrow 2\,\underset{\text{Carbon Dioxide}}{CO_2} + 2\,\underset{\text{Ethanol}}{C_2H_5OH}$$

- **Ethanol** is a type of **alcohol** and yeast is used to ferment plant sugars to make this alcohol.

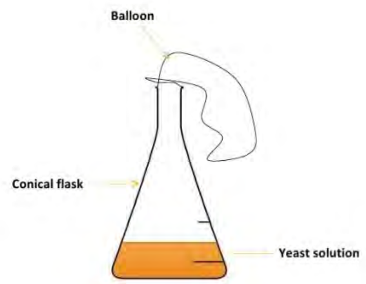
- **Beer is made from fermented cereal grains and wine from fermented grapes.**

- Yeast is also used to make **bread** and the carbon dioxide produced gives us the bubbles in our bread. Bread does not contain alcohol because we do not leave the yeast long enough to form it before we bake the bread and kill the yeast.

You can see the holes in bread caused by the gas produced during fermentation

Experiment: to illustrate the carbon dioxide gas given off my fermenting yeast you can carry out this simple experiment

1) To your conical flask or test tube add a teaspoon of yeast, a teaspoon of sugar and a little warm water to make a runny consistency.
2) Swirl the contents to mix
3) Stretch the balloon over the top and leave it to ferment



Set your experiment up like this

You should find that you see bubbles being produced and the balloon will inflate on the top of the flask.

You can ask your child to remember the test for carbon dioxide gas (if you have covered this in Chemistry) – it is to bubble the gas through limewater which will turn from clear to cloudy/milky

Photosynthesis End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) State the two products of photosynthesis
   a)

   b)

2) Which gas is needed for photosynthesis to occur?

3) Why do cells respire?

4) Complete the 7 processes that all living things do:

   Movement
   R
   Sensitivity
   G
   R
   Excretion
   N

5) We use yeast to make 2 important commercial products – what are they?
   a)
   b)

6) What are the two products made in respiration?
   a)
   b)

7) Where does the water for photosynthesis come from?

8) What component in the plant cell makes it green and is needed for photosynthesis?

9) What is the name of the small pores that allow gases to enter and leave a leaf?

10) What is the function of the cell wall and what is it made from?

11) How are roots adapted to increase water adsorption?

12) Which gas must be present for aerobic respiration to occur?

13) What product is made during anaerobic respiration which then builds up in the muscles?

14) What condition in someone who has exercised vigorously is caused by this build up?

15) What provides energy for photosynthesis? Why does photosynthesis not happen at night?

16) What is the name of the tubes that carry the sugars produced by photosynthesis around the plant for storage?

17) What are the main photosynthetic organs of plants?

18) If you were doing an experiment to test the rate of photosynthesis of a water plant and were testing this by counting the number of oxygen bubbles released by the plant…..would you expect the number of bubbles to increase or reduce as you move a lamp closer to the water plant?

19) What name do we give to plants that lose their leaves during winter?

20) Evergreen plants are often found near to the equator. Why?

Photosynthesis End of Topic Practise Questions

ANSWERS

1) State the two products of photosynthesis
a) glucose
b) oxygen

2) Which gas is needed for photosynthesis to occur?

Carbon dioxide

3) Why do cells respire?
To release energy for all 6 other life processes

4) Complete the 7 processes that all living things do:

Movement
Reproduction
Sensitivity
Growth
Respiration
Excretion
Nutrition

5) We use yeast to make 2 important commercial products – what are they?
a) Bread
b) Beer

6) What are the two products made in respiration?
a) carbon dioxide
b) water

7) Where does the water for photosynthesis come from?

The roots – it moves in through the roots and up through the xylem in the plant called the transpiration stream.

8) What component in the plant cell makes it green and is needed for photosynthesis?
Chlorophyll found in chloroplasts in the green parts of the plant.

9) What is the name of the small pores that allow gases to enter and leave a leaf?
Stomata

10) What is the function of the cell wall and what is it made from?
Supports the cell and is made from cellulose

11) How are roots adapted to increase water adsorption?
They have root hair cells to increase the surface area

12) Which gas must be present for aerobic respiration to occur?

Oxygen

13) What product is made during anaerobic respiration which then builds up in the muscles?
Lactic acid

14) What condition in someone who has exercised vigorously is caused by this build up?

Cramp

15) What provides energy for photosynthesis? Why does photosynthesis not happen at night?

Sunlight. There is no sunlight at night so no photosynthesis

16) What is the name of the tubes that carry the sugars produced by photosynthesis around the plant for storage?

Phloem

17) What are the main photosynthetic organs of plants?

Leaves

18) If you were doing an experiment to test the rate of photosynthesis of a water plant and were testing this by counting the number of oxygen bubbles released by the plant…..would you expect the number of bubbles to increase or reduce as you move a lamp closer to the water plant?

Increase as more light means a faster rate of photosynthesis and so a faster rate of oxygen production

19) What name do we give to plants that lose their leaves during winter?

Deciduous

20) Evergreen plants are often found near to the equator. Why?

There is lots of sunlight all year round

Lesson 1: Food Chains and Food Webs

Today's Important Spellings:	
Population Habitat Chlorophyll Producers Organisms	Consumers Food chain Food web Pyramid of numbers

Lesson Content

Food chains

The **organisms** in a **habitat** form a community of different **populations**.

- A garden pond is an example of a habitat. Within it there are populations of water weed,
- lilies
- sticklebacks
- newts
- frogs
- dragonflies
- water beetles.

The **community** is all the organisms living in the pond.

The pond is able to sustain a community because each organism uses another one for food. Providing none of the populations get too large and take over, the community remains in balance.

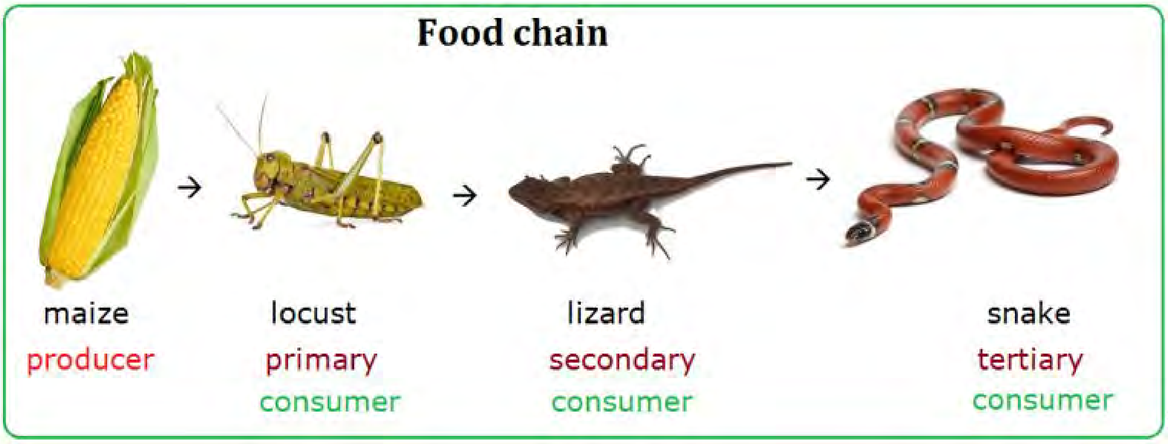
Food chains

Energy enters the pond from the sun. Through photosynthesis green plants trap the sunlight and use **chlorophyll** to make glucose. This food is stored as starch, which is also a carbohydrate. The green plants can also convert this into fats and proteins. We call green plants **producers** in a food chain.

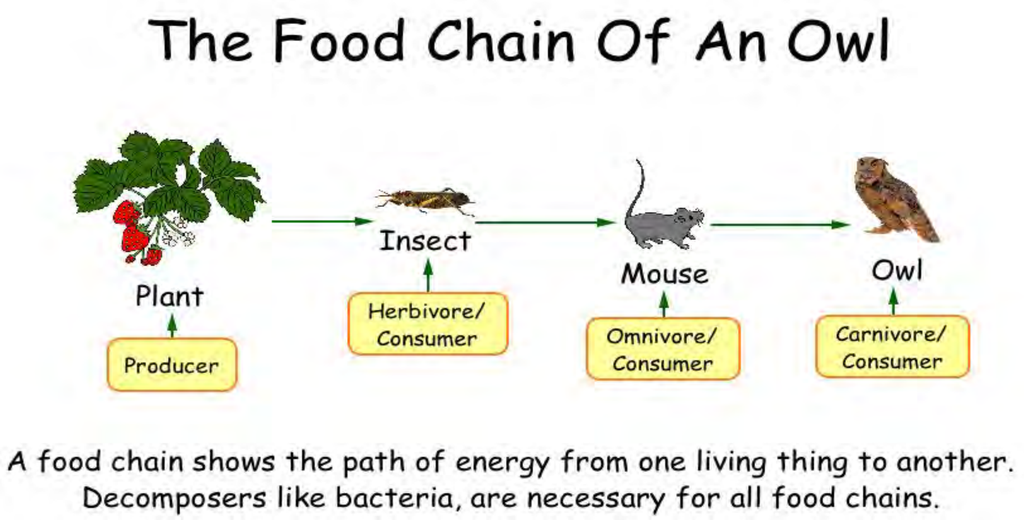
Animals eat the green plants. They use the energy locked up in the chemicals such as starch, protein and fat to enable their own bodies to respire and make new cells. These are called **consumers.**

A **food chain** can be used to show how this energy is passed from one organism to another.

The food chain below shows that the corn is the producer- it takes the energy from the sun and stores food as starch. The corn is eaten by the locust – it is the primary consumer – the first animal to consume or eat the plant. The next step up the food chain is the lizard. It is the secondary consumer because it eats the locust. The snake is the tertiary consumer- the top of the food chain as it eats the lizard but is not eaten by any animal.



An example of a food chain



This food chain starts with the strawberry plant. It is the producer as it used photosynthesis to produce carbohydrates. The insect is the primary consumer. It is labelled as a herbivore (plant eater) as it only eats plants. The mouse eats the insect so it is the secondary consumer. The final link in this chain is the owl. It is a carnivore (meat eater) and the top of the food chain. It is a tertiary consumer – it eats the mouse but isn't eaten by anything itself.

Food webs

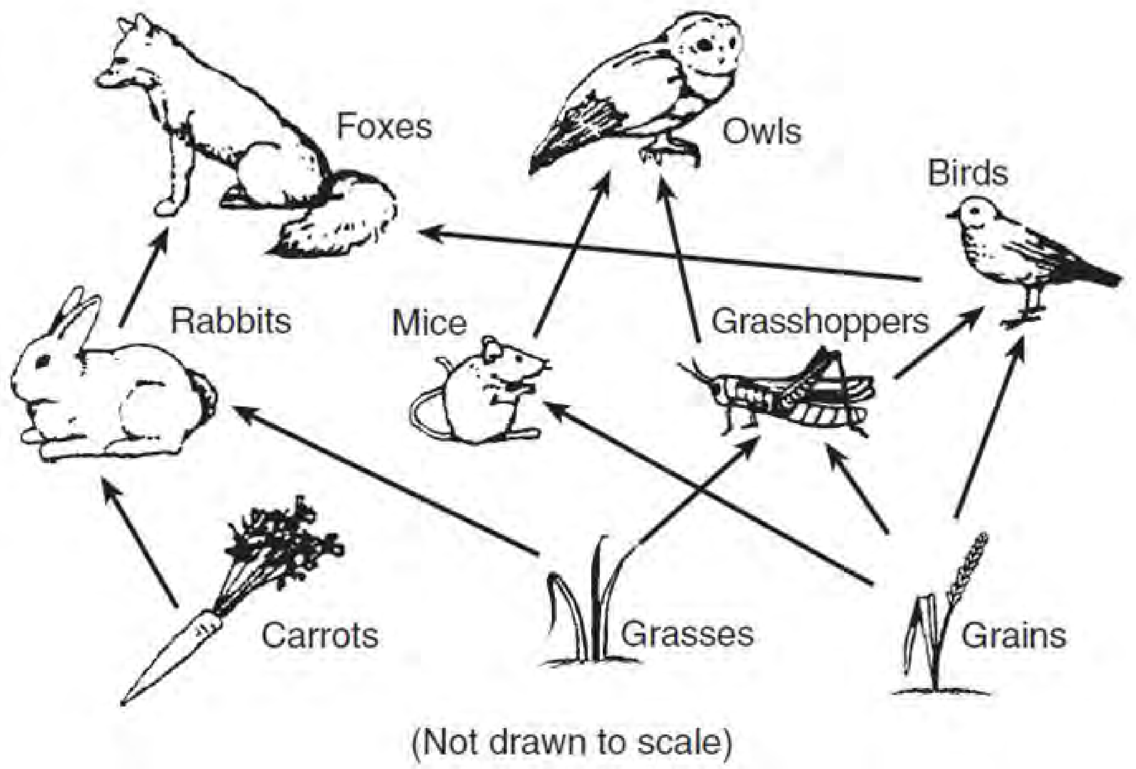
Food chains are simple they only show one pathway of the flow of energy between living things. **Often animals eat more than one type of food**, this can be different plants or different animals.

For example, a rabbit will eat grass and dandelions, a fox will eat rabbits and pheasants, a butterfly will get nectar from dandelions but a fox will not eat the butterfly. So food chains are not really as simple as a line of plant and animal names, because each of those living things can belong to more than one food chain. Living things live in a network of relation-ships.

Food chains can be linked together to make a food web. The plants and animals are linked together with arrows to show the directions the energy is flowing between them. The energy flows up the chain from the producer to the primary consumer then the secondary then the tertiary.

Remember it is not always a case of who eats whom, energy will still be found in the leaves that have fallen from the tree, otherwise how would the decomposers survive?

Hint: it is best to start with your top carnivores as you know nothing else will eat them, so they will only have arrows going towards them, then work your way downwards thinking about what animals they can eat.



An example of a food web

In this example you can follow different paths:

- Carrots are eaten by rabbits which are eaten by foxes
- Grasses are eaten by rabbits which are eaten by foxes but also grasses are eaten by grasshoppers which are eaten by both owls and birds.
- In this example the carrots, grasses and grains are producers.

- The rabbits, mice and grasshoppers are primary consumers, birds are secondary consumers and the top of the food chain, the owls and foxes are tertiary consumers.

Ask your child to make small cards of each of the organisms in the food web here. Write the name of the organism on the card. Mix them up and then try to make up different food chains and then a full food web using those cards. Check your answers using this example. Keep these cards for the next lesson.

Ask your child to complete this fun quiz:

Food chains - Quiz

1.
What is a food chain?
- A process that starts with ingredients and ends with cooked food
- A long chain made of food
- How animals depend on plants and animals for their food and survival

2.
Which part of a food chain is affected by one animal becoming extinct?
- The whole food chain is affected
- Only animals at the top of the food chain are affected
- Only plants and animals at the bottom of the food chain are affected

3.
What part do humans play in food chains?
- Producers
- Consumers
- Humans are not part of food chains

4.
Which is an example of a consumer eating another consumer?
- A rabbit eating grass

- A hedgehog eating a spider
- A squirrel eating nuts

5.
A producer uses energy from the Sun to make food. Which of these is NOT a producer?

- An oak tree
- A stinging nettle
- A caterpillar

6.
A consumer gets its food by eating other organisms. Which of these is NOT a consumer?

- A holly bush
- An earthworm
- A hedgehog

7.
What do you always find at the start of a food chain or web?

- An insect
- A bird of prey
- A green plant

8.
Why do food chains and food webs start with green plants?

- Because plants can absorb the Sun's energy to produce food
- Because most green plants are tasty
- Because most green plants eat other plants

9.
What do you call an animal that hunts and eats other animals?

- Predator
- Prey
- Producer

10.
A wood mouse eats leaves for food. A badger eats wood mice for food. Which animal is the prey in this food chain?

- Badger

- Wood mouse
- Neither animal

Answers:

Food chains - Quiz

1.
What is a food chain?
- A process that starts with ingredients and ends with cooked food
- A long chain made of food
- How animals depend on plants and animals for their food and survival

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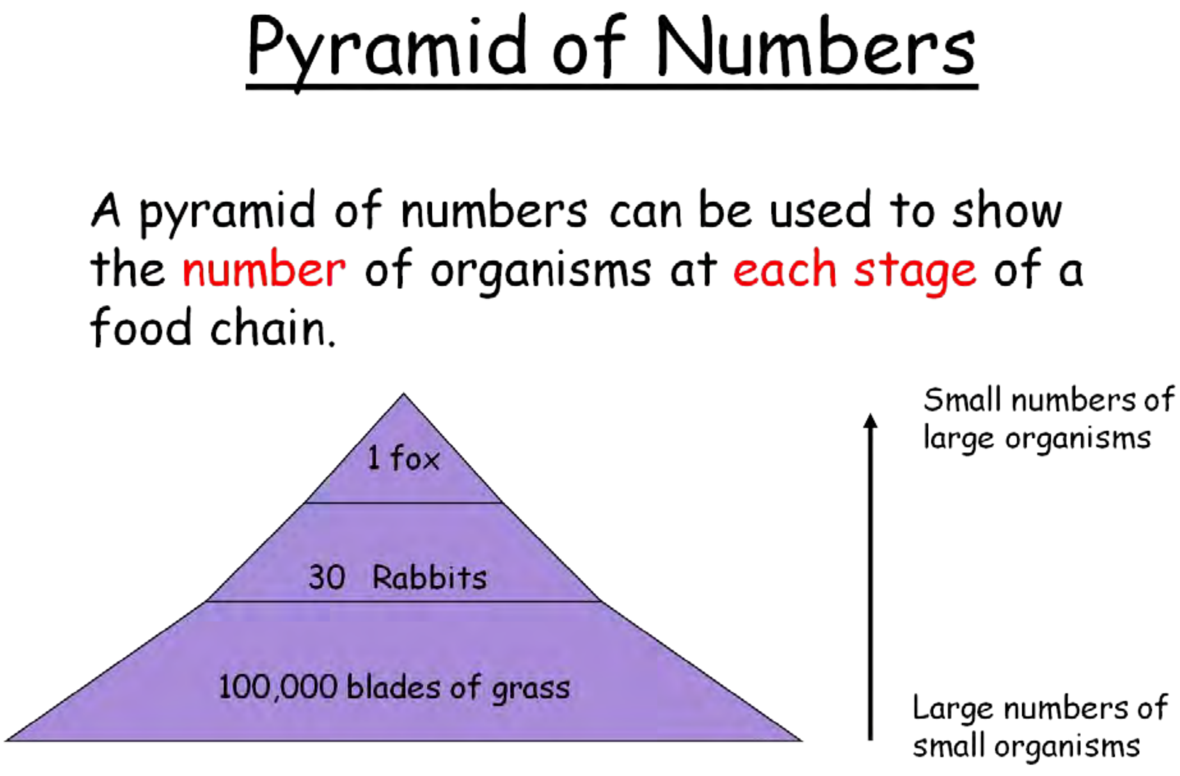
A wood mouse eats leaves for food. A badger eats wood mice for food. Which animal is the prey in this food chain?

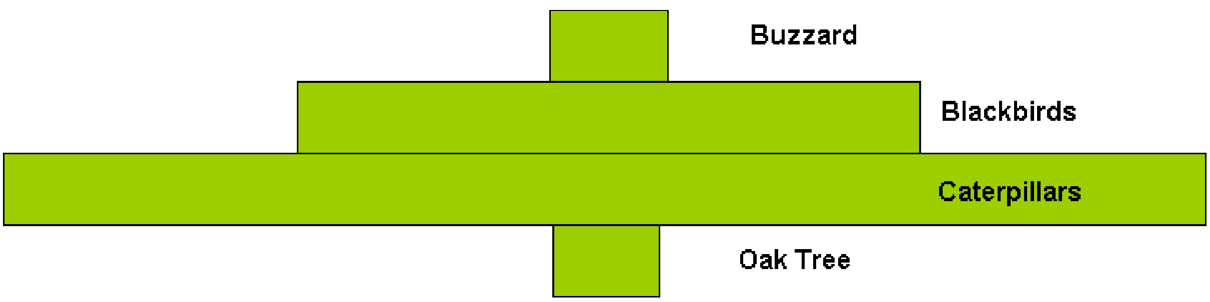
- Badger
- Wood mouse
- Neither animal

Pyramid of numbers

In a food chain there is energy lost between each link. Animals respire, keep warm, excrete and move. All the time, energy is being lost to the surroundings as heat. This means that the number of organisms at each level gets less.

The number of organisms in each level can be represented using a **pyramid of numbers**





An example of a pyramid of numbers

In this green pyramid there is only one oak tree but it is huge and supports many, many caterpillars. These caterpillars are eaten by a fewer number of blackbirds which in turn are preyed upon by only a few buzzards.

Watch this YouTube clip to consolidate learning

http://www.echo.education/url/foodchainsandwebs

Important point to know:

The only ecosystems in the world that **don't start with plants** are found on the bottom of the oceans beside **hot volcanic hydrothermal vents**. **Here bacteria feed directly** on the chemicals released from the vents and the bacteria are eaten in turn by other organisms. Life exists here in complete darkness.

Lesson 2: Ecosystems and Interdependency

Today's Important Spellings:	
Habitat Biotic factors Abiotic factors	Interdependency Pesticide Bioaccumulation Ecosystems

Suggested resources:

- Cards from food web in last lesson

Lesson Content

An **ecosystem** is a natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the non-living physical (abiotic) factors of the environment.

It can be made up of a number of different **habitats**. In an ecosystem the organisms interact with one another and their environment. If the numbers of one organism change, this can have complex effects throughout the ecosystem.

E.g. if shrimps are all killed by pollution, the seagulls which would have eaten the shrimp, now have to eat more fish instead therefore reducing the numbers of fish. This affects any animal that would eat those fish. An **ecosystem** is comprised of all the **non-living elements and living** species in a specific local environment.

Components of most ecosystems include

- Water
- Air
- Sunlight
- Soil
- Plants
- Microorganisms
- Insects
- animals.

Ecosystems may on land (terrestrial) or in water – ponds, lakes, rivers, sea etc. Sizes of ecosystems vary; they could be just a small puddle or an enormous area of desert so ecosystems can look quite different from one another.

Tropical Rainforest Ecosystems

Located in tropical regions, rainforests have a greater diversity of plant and animal life than any other type of ecosystem. Due to the huge amount of rainfall there is dense, green vegetation. Trees grow very tall as they compete for sunlight, and animals live in their canopy.

Temperate Forest Ecosystems

Forest ecosystems are common across temperate climates. These are areas where winters are cold and summers are warm. They usually consist of deciduous trees, which shed their leaves each autumn, and coniferous trees, which stay green throughout the year.

Grassland Ecosystems

Grasslands are located in semi-arid zones and contain wide, treeless expanses often inhabited by grazing animals. Sub-categories of grassland ecosystems include savannas, which are found in the tropics and prairies, situated in temperate regions.

Desert Ecosystems

Desert ecosystems have an even drier climate than grasslands and are characterized by relatively sparse vegetation, and the number of insects and animals is also relatively limited. Deserts aren't necessarily hot; they can lie in temperate zones as well. They don't have to be sandy; many deserts have rock floors.

Tundra Ecosystems

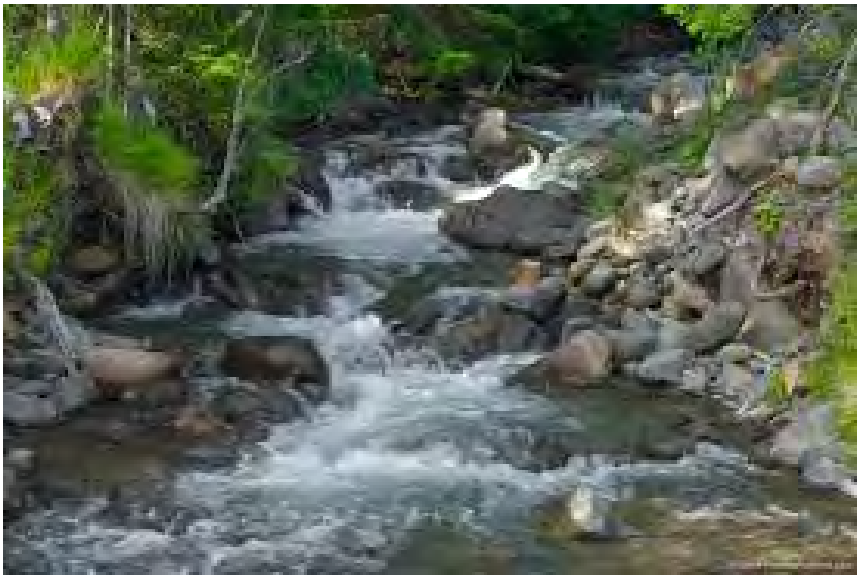
Tundra ecosystems are located in polar regions or on the tops of high mountains and are frozen and snow-covered most of the year. Life is hard in these white treeless areas but during the brief summer, snows may melt enough to expose lichens or small wildflowers and attract migrating birds.

Stillwater Ecosystems

Various aquatic ecosystems can be found in stagnant or very slowly flowing waters. Lakes, ponds, bogs, freshwater and saltwater marshes, swamps and lagoons are examples of ecosystems found in stationary or nearly-stationary waters. Algae, plankton, underwater and floating plants, such as lily pads, may inhabit the calm waters.

River and Stream Ecosystems

These consist of flowing freshwater. They support a variety of underwater life. Their relatively fast-moving waters have a higher oxygen content than that of stationary waters which gives greater biodiversity among plant and animal species.



Ask your child to arrange the cards from the last lesson in a food web. Now remove one organism from the web (assume something has happened to kill that organism) Can they explain what effects this will have on all the other organisms in your web.

How many of these ecosystems can they remember – can they give you a few characteristics of each?

Pesticides

Bioaccumulation

Bioaccumulation is when ***toxins*** build up in a food chain. The animals at the top of the food chain are affected most severely.

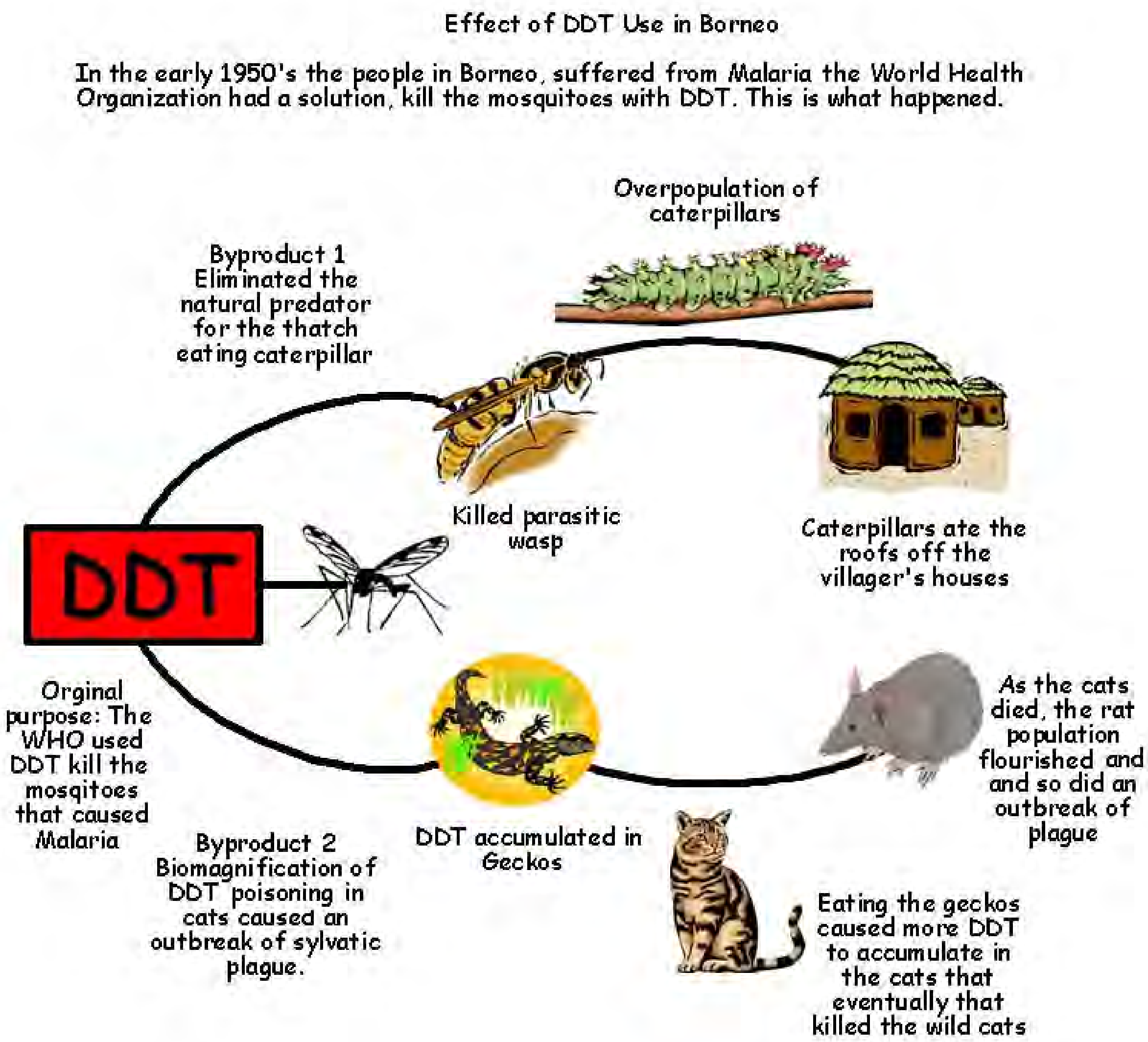
This is what happens:

1. Small amounts of toxic substances - often from human activity - are taken up by plants.
2. These plants are eaten by primary consumers and the toxins move into their bodies.
3. The primary consumers are eaten by secondary consumers, and the secondary consumers are eaten by higher level consumers. Each time the toxins move up the food chain.
4. At each stage (trophic level) of the food chain, harmless substances are excreted but the toxins remain in the tissues of the ***organisms*** - so the concentration of toxin becomes most concentrated in the body tissues of the animals at the top of the food chain.

An **example of bioaccumulation** is the use of ***DDT*** as an ***insecticide*** in the 1950s and 1960s. The apex predators (those at the top of the food chain) – the birds of prey were badly affected because the DDT in their bodies made the shells of their eggs very thin, causing them to break easily when the birds tried to incubate them.

Spraying crops with DDT

Another example of the effects of DDT across the world is from Borneo. DDT was used to kill the mosquitoes in a bid to rid the country of the disease, Malaria. Unfortunately the DDT affected many more species than just the mosquitoes.



Lesson 3: Air Pollution

Today's Important Spellings:	
Pollution Pollutant Carbon dioxide Carbon monoxide	Sulfur Dioxide Global Warming Greenhouse effect CFCs Nitrogen oxides

Lesson Content

What is Air Pollution & how is it Made?

Air pollution is the term used to describe **any harmful gases in the air we breathe.**

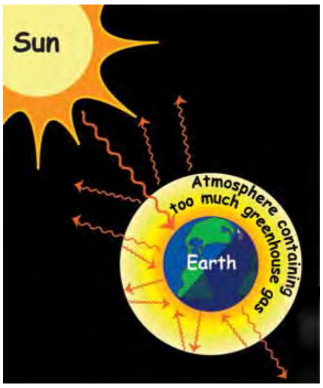
Humans pollute (put harmful gases into) the air in many ways:

- Car engines burn fuel (petrol or diesel) and fumes come out of the exhaust pipe and pollute the air.
- Electricity is made in power stations by the burning of fossil fuels (coal, oil and gas). As this takes place gases go up tall chimneys and out into the air.
- Houses may have coal or gas fires which produce pollution as they burn.
- The pollution sources above are all man made. But, pollution can also come from **natural sources**, for example volcanoes.

The Most Common Air Pollutants

- **Carbon monoxide** is a pollutant that is mainly produced by road transport. It has no colour or smell. It is a **poisonous** gas.

- **Carbon dioxide** is produced the burning of fossil fuels. This increases the **greenhouse effect** leading to **global warming.**

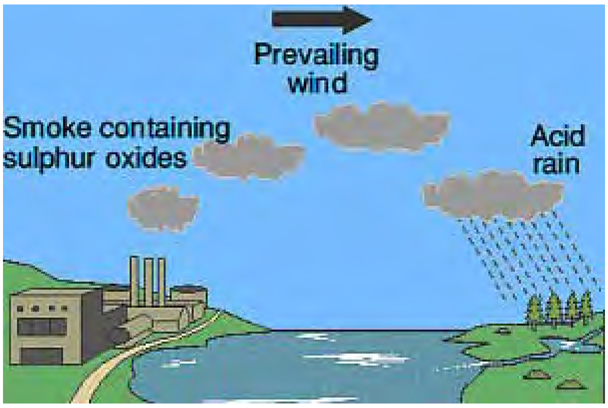


- **Hydrocarbons** are produced when petrol is not fully burnt. They contribute to the formation of **smog.**

Nitrogen oxides are emitted from vehicles and power stations. Very high amounts can be recorded in cities during rush-hour traffic. They add to **acid rain**, **smog** and breathing difficulties.

- **CFCs** are used as coolant liquids in fridges and freezers. They thin the ozone layer which is important because it protects us from the Sun's ultraviolet rays.

- **Sulfur Dioxide** Sulfur dioxide is formed by the combustion of fossil fuels. It helps cause acid rain.



Air pollution leads to global warming, acid rain and the breakdown of the ozone layer

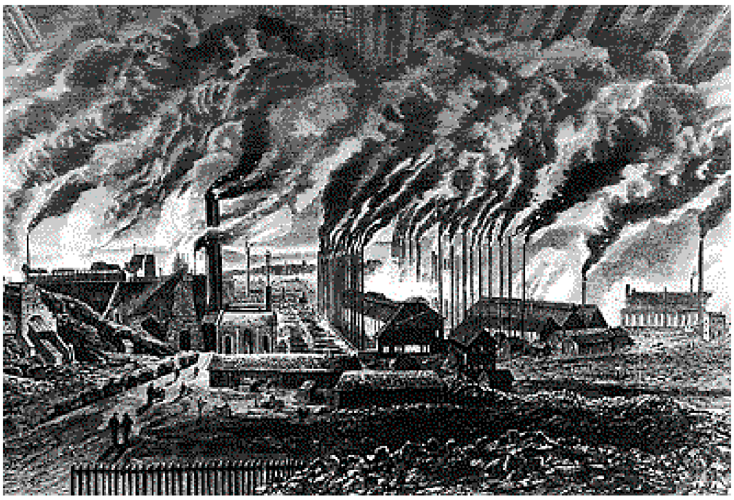
Ask your child to complete this activity.
The 20 words printed below can be matched up to make 10 new phrases. Match a word from the left hand column with one from the right hand column (left hand first).

SULFUR	**FUELS**
FOSSIL	**SMOG**
CARBON	**TRANSPORT**
NITROGEN	**REVOLUTION**
INDUSTRIAL	**RAIN**
CARBON	**MONOXIDE**
POWER	**CONVERTER**
ACID	**OXIDES**
CATALYTIC	**STATION**
PUBLIC	**DIOXIDE**

Answers (sulfur dioxide, fossil fuels, carbon dioxide/monoxide, industrial revolution, carbon dioxide/monoxide, power station, acid rain, catalytic converter, public transport)

The History of Air Pollution

Problems of air pollution were recognised about 500 years ago. At this time, the burning of coal was rising in cities like London. About 200 years ago, the **Industrial Revolution** began in Britain. The Industrial Revolution was based on the use of coal in both industries and the home.



The coal produced a lot of smoke when it was burnt and made the air very dirty. When the weather was foggy and winds were low, the pollution became trapped over the cities. The smoke and fog mixed to produce smog.

smoke + fog = smog

Smog was a big problem in the winter as the weather was cold and so more coal was burnt to produce heat. When smog lay over a city it became hard for people to breathe and see.

In 1952 the Great London Smog killed more than 4000 people. Something had to be done to prevent future deaths

The Clean Air Acts of 1956 and 1968 were passed to achieve this.

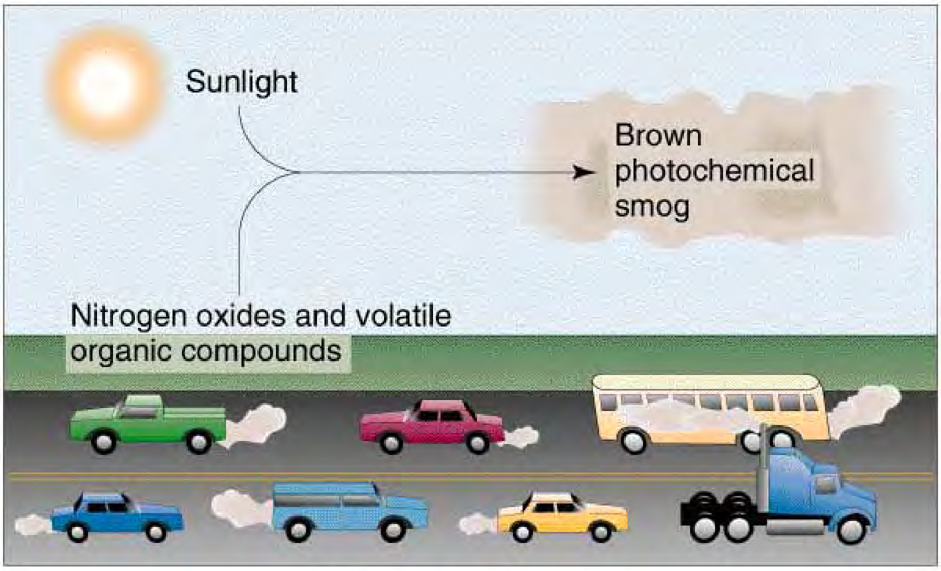
- They reduced the amount of coal burnt in houses and encouraged people to use gas instead of coal.
- They introduced the use of tall chimneys at power stations to try and make the pollutants disappear into the sky. (This has had limited success since the pollutants just come down somewhere else).

- Factories had always been built in towns, but now new ones were built in the countryside away from where most people live.
- As the problems of smoke and sulfur dioxide reduced, new pollutants became a problem. **Since the 1980s pollution from traffic, including ozone and carbon monoxide have become a major issue.**

Present Day Air Pollution

In the past, smog was the term used to describe a mixture of smoke and fog. Following the Clean Air Acts, this type of smog died out and the word now has a new meaning.

Pollutants from cars, power stations, factories and homes are released into the air. In the presence of sunlight, hydrocarbons and nitrogen oxides react to form **photochemical smog**.



(b) Photochemical smog

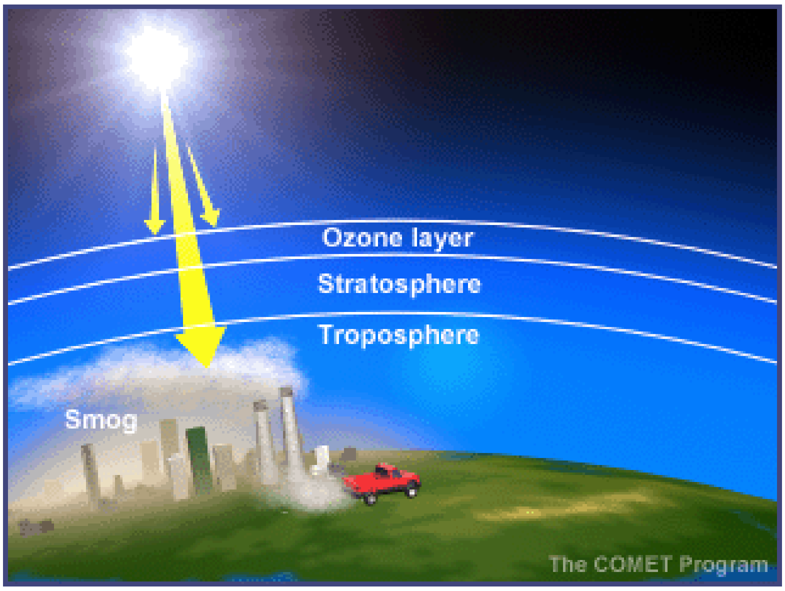
The main pollutant found in the smog is **ozone**. This is a harmful form of oxygen that causes health problems including:

1. chest pain
2. headaches
3. eye irritations
4. breathing problems

Smog can cause **damage to buildings** as it cracks rubber, peels and fades paint and eats away at plaster.

The Ozone Layer

Ozone in the air we breathe should not be confused with the Ozone Layer. High above the Earth, ozone forms naturally. It is not a problem there as we are not breathing it in. In fact, it is helpful as **it filters out harmful rays from the sun**. Today the Ozone Layer is being damaged by all the pollution man puts into the air.



Air Pollution and Transport

Today, the largest source of air pollution in Britain is transport. Between 1980 and 2000, the number of vehicles on Britain's roads increased by about a third to give a total of 29 million. This is expected to increase even more. With the growing number of cars, it is important that something is done to reduce the pollution they make. Some of the efforts being made are:

1. **Catalytic Converters** Since 1993 all new cars sold in Europe have been fitted with a catalytic converter. A catalytic converter takes harmful pollutants and turns them into less harmful ones.
2. **Cleaner Fuels**

New fuels are being made that are cleaner than petrol and diesel. These include natural gas, liquid petroleum gas, hydrogen, alcohol and battery power.

How can we reduce pollution?

• walking or cycling for short journeys instead of taking the car;

• using public transport like trains, buses and trams, (as one bus holds a lot more people than a car);

• stopping people taking cars into city centres as pollution is greatest here;

• building shopping centres and places of work closer to where people live to prevent the need to travel every day.

Air Pollution & Industry

Although pollution from industry has reduced by a large amount following the Clean Air Acts, it is still a major pollutant source. The major pollutants produced by industry are:

• **sulfur dioxide** in Britain about 90% of sulfur dioxide that is put into the air by humans comes from **power stations and other industry**. Sulfur dioxide is the main pollutant associated with **acid rain**. It combines with water in the atmosphere to produce sulfuric acid. This then falls back to earth as rain.

• **nitrogen oxides** are also produced by industry. Nitrogen oxides combine with water to form nitric acid, another component of **acid rain**.

Acid Rain

When the acid rain falls to Earth it causes harm to the environment in a number of ways:

- buildings erode faster than usual
- lakes and streams become acidic and many fish and other creature slowly die
- vegetation can become damaged or even die
- humans and wildlife can experience discomfort and death

The Effects of Air Pollution

1. Health. Humans depend on air to live and breathe. Polluted air can cause damage to our health and affect us in a negative way. The very young and very old are most affected by high pollutant levels. Different pollutants can harm the body in different ways. People who have **asthma** find it difficult to breathe at times and it is believed that pollution can make their problem worse.
2. Vegetation is generally negatively affected by pollution. Poor growth rates in city centres reflect this.
3. Buildings In large amounts, some pollutants damage buildings:
4. Smog cracks rubber, peels and fades paint and eats away at plaster;
5. Acid rain reacts with some building materials and causes them to break down.

Conclusion

- Air pollution has clearly been a problem for hundreds of years. There have been a number of changes in the major types of pollutants, and today pollution from cars is the biggest issue. To make sure we leave the world fit for future people we need to reduce the amount of pollution we produce by:

- educating people about the damage they are causing to the environment and their health;
- developing alternative fuels at a price everyone can afford;
- using public transport, bicycles or our feet to get around, wherever possible;
- conserving energy used in the home, for example by using energy-efficient lighting, insulating hot water tanks, and turning the thermostat down 1 or 2 degrees Celsius.

Ask your child to write their own glossary of term to do with air pollution. e.g.

Glossary

Asthma: a health problem that affects breathing.
Acid Rain: Rain water with a pH of less than 7.
Catalytic Converter: A device fitted to the exhaust system of a vehicle, which converts harmful gases into less harmful ones.
Fossil Fuels: Coal, oil and natural gas. Formed deep in the Earth from the remains of dead plants and animals.
Industrial Revolution: A fast growth in industry that began in the late 18th century (200 years ago). It was made possible by extracting energy from fossil fuels.
Ozone: A form of oxygen, harmful if breathed in, but protects life from damaging UV sunlight when found high up in the atmosphere.
Particulate: A tiny amount of solid or liquid carried in the air, for example soot, dust, fumes.
Pollutant: A harmful substance emitted into the air, water or soil.
Smog: Originally a mixture of smoke and fog. Now, air pollution produced by the mixing of hydrocarbons and nitrogen oxides in the presence of sunlight. It is mainly made up of ozone.

Lesson 4: Water Pollution

Today's Important Spellings:	
Pollution Pollutant	Sewage Pesticides Fertilisers

Lesson Content

Water is polluted in many different ways:

- rubbish
- waste from factories e.g. metals such as mercury leads to bioaccumulation (when toxins build up in a food chain)
- chemicals from farms – pesticides and fertilisers which lead to bioaccumulation - poisonous chemicals used by farmers wash off the land into oceans and rivers
- rubbish and plastic bags thrown into the sea kill over one million sea creatures every year
- oil spills from ships or oil rings kill birds and sea life
- in some places, untreated sewage goes into the sea which makes the sea and beaches dirty and spreads disease

Human activity is a big problem in polluting water- both fresh and marine water. This affects animals and plants that live in the water as well as animals and humans that drink it.

Water pollution occurs for a number of reasons.

1. Sometimes waste from factories pollutes rivers, and fertilisers and weed killers **wash off farm land.**

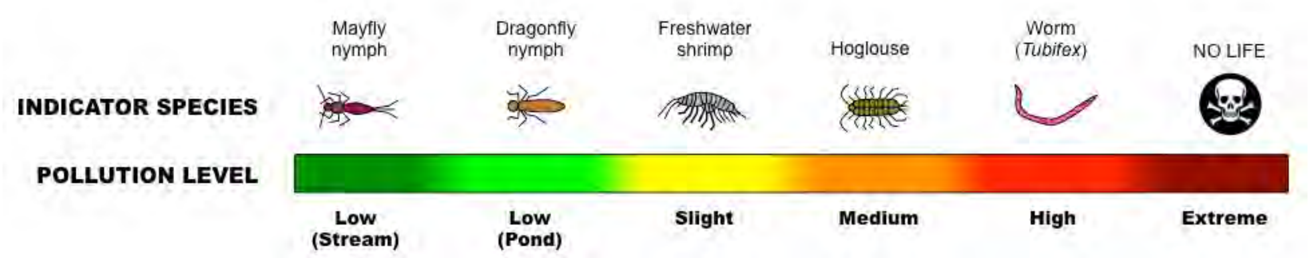
2. Pollution can also occur when the waste water treatment does not work properly.

3. Drainage from the roads in rural areas can also cause pollution in burns and rivers as it often carries high levels of petrol and oil. This can cause oxygen loss in the water which kills plants and animals. In cities, the drainage from roads usually joins the main waste water network and is treated.

4. Some people illegally throw weed killer or paint stripper down drains which can pollute rivers and upset the waste water treatment process.

Testing for pollution in water

- A very reliable method of testing pollution levels in ponds and burns is through recording animal life, known as **indicator species**, found there. **Different kinds of animals need different levels of oxygen to survive.**



- Beaches also show signs of pollution. Litter is often left by careless visitors but a lot of litter on our beaches comes from ships and includes: broken glass plastic

- People also flush things they shouldn't down the toilet. These can block and break screens and end up on the beach. Items include: : drinks cans, paper, wood, cotton buds, baby wipes and razors Instead you should put these items in bags and then put them in the bin. Don't flush them!

Ask your child to design a poster about water pollution or to write a report or a newspaper article about an area which has suffered from water pollution. This could be general or focus in on one aspect of the issue.

Lesson 5: Bio indicator Species

Today's Important Spellings: Bio indicators Organisms Ecosystem	Pollution

Suggested resources for practical pond testing:

- a plastic container
- a plastic tray
- a magnifying glass
- a long handled net
- a pond-life book
- pH paper

Lesson Introduction

A **bio indicator** is a living organism that gives us an idea of the health of an ecosystem. Some organisms are very sensitive to pollution in their environment, so if pollutants are present, the organism may change its morphology, physiology or behaviour, or it could even die. One example of a **bio indicator for air purity** is lichens.

A **lichen** is a composite organism that arises from algae or cyanobacteria (or both) living among filaments of a fungus in a mutually beneficial relationship. The whole combined life form has properties that are very different from properties of its component organisms. **Lichens** come in many colours, sizes, and forms. Lichens are bio indicators of clean air. Their presence tells us that air quality is high

Usefulness of lichens as bio-indicators

- They are found almost everywhere and at all seasons
- They absorb nutrients and pollutants from the air, often to high concentrations
- Different species show different sensitivities and accumulation abilities
- They are symbiotic organisms. The fungus cannot survive if the algae is killed by pollution

Bio indicators are useful because

1. some are only present in **polluted places**
2. some only survive where it is **clean.**

Some examples of bio indicator species:

1. ***Bloodworms*** and ***sludge worms*** are found in **polluted water**

Bloodworms

A Sludge worm

Sludge Worms

Sludge worms live in clusters on the bottom of ponds and streams. They burrow themselves into the mud and live upside down. They wave their bodies in the water to collect oxygen. They are so good at this that they can live in polluted ponds where the oxygen levels are low.

2. ***Stonefly nymphs*** are only found in very **clean water**

Stonefly nymph

Stonefly nymphs breathe using external gills. They have no haemoglobin like blood and sludge worms, so the oxygen circulates in their bodies in simple solution. This means they need a higher concentration of oxygen to survive. In unpolluted water, with a high concentration of oxygen, nymphs are more mobile than worms and compete more successfully for food than the worms.

A Practical Experiment to Test how Clean your Local Pond or Stream is.

You will need: - a plastic container - a plastic tray - a magnifying glass - a long handled net - a pond-life book - pH paper

One very reliable test is to find out what minibeasts live in the water. Different kinds of creatures need different levels of oxygen to survive. The pollution detector showing different species of minibeasts is very good in helping you to identify what is living in the water. We call these indicator species as they indicate how polluted a river is.

Poor water quality: blood worms and sludge worms

Good water quality: stonefly nymphs and freshwater shrimp

1. With an adult, visit a pond, river or stream in your area.
2. Find a safe place to go pond-dipping.
3. Sweep the net slowly through the water against the current.
4. Put your catch in the tray and use the pond-life book to record what you have found.
5. Return the catch alive to the water.
6. Do the same at another part of the pond, river or stream.
7. Take a sample of the water and test it to see if it is acid or alkali.

Try to answer these questions:

1. Is there any rubbish on the edges?
2. What colour is the water?
3. Can you see the bottom?
4. Are there other birds and other creatures on or near the water? List them.

5. How could the area be improved?

Ask your child Write up a report of your findings including which indicator species they found as well as other visible signs of pollution.

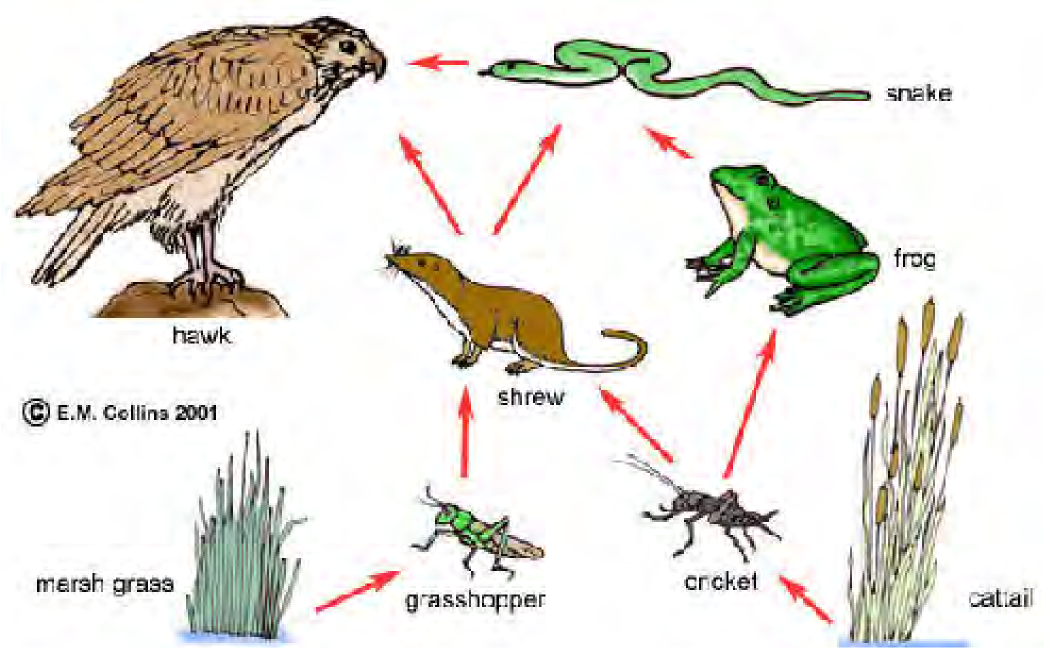
Environmental Interactions End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions

1) What type of organism is present at the bottom of almost every food chain?

2) What process do these organisms complete which means they start food chains?

3) This is a food web. What do the arrows mean in the food web?



4) Give one example of a food chain from this a food web

5) Explain what would happen to the numbers of shrew and hawk and the amount of marsh grass if all the grasshoppers get killed by pesticides

   The marsh grass-

   The shrew numbers would-

   The number of hawks would therefore-

6) Which organisms are the producers in this food web?

7) Name the primary consumers in this web?

8) What is the tertiary consumer, the apex predator at the top this web?

9) How does the concentration of pesticides like DDT build up in organisms in the food chain?

10) Where would you find the only food chains in the world that don't start with plants?

11) Explain how pond dipping could give you an indication of how polluted your local stream is

12) Name 3 sources of water pollution

a)

b)

c)

13) Name one bio indicator species that you might find in polluted water

14) Why are pesticides used on farms?

15) How do these pesticides end up in rivers?

16) Name three gases that are released when we burn fossil fuels

a)

b)

c)

17) Carbon dioxide in the air increases the greenhouse effect which is turn leads to……………………………………….

18) Name a gas that leads to acid rain

19) Which pollutants are released into the air by fridge and freezer coolants?

20) Name three things we can do to help reduce human causes of air pollution

a)
b)
c)

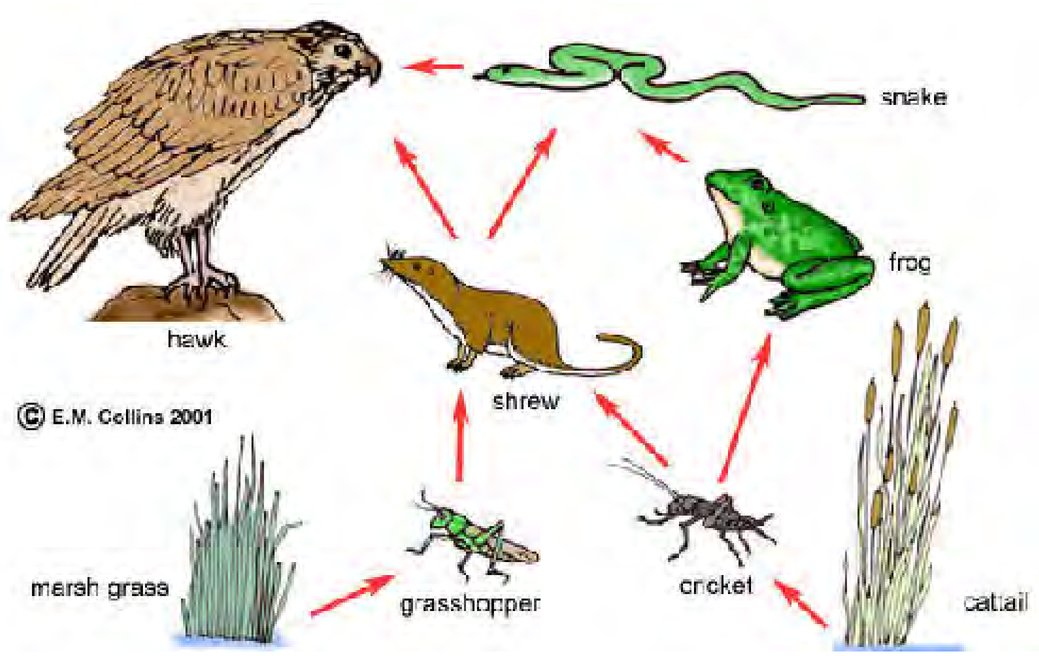
Environmental Interactions End of Topic Practise Questions

ANSWERS

1) What type of organism is present at the bottom of almost every food chain?
   Plant

2) What process do these organisms complete which means they start food chains?
   Photosynthesis

3) This is a food web. What do the arrows mean in the food web?
   They show the direction of the energy transfer. The organism at the start of the arrow is eaten by the organism at the end of the arrow.



4) Give one example of a food chain from this a food web

Marsh grass -> grasshopper->shrew ->snake ->hawk

(other examples are possible)

5) Explain what would happen to the numbers of shrew and hawk and the amount of marsh grass if all the grasshoppers get killed by pesticides

   The marsh grass- would increase in numbers as it isn't being eaten by grasshoppers

   The shrew numbers would- decrease as they have less grasshoppers to eat but they would have to reply on crickets for food

   The number of hawks would therefore- decrease as they would have less shrews to eat

6) Which organisms are the producers in this food web?

Marsh grass and cattail

7) Name the primary consumers in this web?
   Crickets and grasshoppers

8) What is the tertiary consumer, the apex predator at the top this web?
   Hawk

9) How does the concentration of pesticides like DDT build up in organisms in the food chain?

They increase as you move up the food chain and they stay in the food as it is passed up the chain.

10) Where would you find the only food chains in the world that don't start with plants?
At the bottom of the ocean next to hot volcanic vents

11) Explain how pond dipping could give you an indication of how polluted your local stream is
You would look at the diversity of species and whether there are biodiversity species present

12) Name 3 sources of water pollution
Any three of these :- rubbish, waste from factories, chemicals from farms , untreated sewage, rubbish and plastic bags, oil spills,

13) Name one bioindicator species that you might find in polluted water
Bloodworms or sludge worms

14) Why are pesticides used on farms?
To kill pests that are eating their crops

15) How do these pesticides end up in rivers?

They wash off the land in rainwater

16) Name three gases that are released when we burn fossil fuels
3 of Carbon dioxide, carbon monoxide, nitrogen oxides or sulphur dioxide

17) Carbon dioxide in the air increases the greenhouse effect which is turn leads to global warming

18) Name a gas that leads to acid rain
Nitrogen oxide or sulphur dioxide

19) Which pollutants are released into the air by fridge and freezer coolants?

CFCs

20) Name three things we can do to help reduce human causes of air pollution

a) walk instead of drive

b) turn down our heating

c) use buses and trains

other answers are possible

Lesson 1: Heredity and Genetic Diversity

Today's Important Spellings: Heredity Clones	Asexual reproduction Binary fission

Suggested resources:

- Playdough

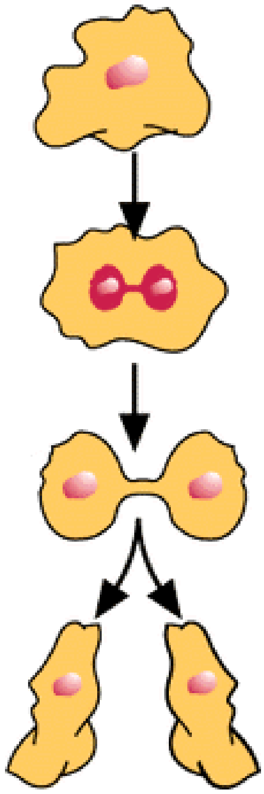
Lesson Content

Genetic information is passed from one generation to the next. This is called ***heredity*** and why we resemble our parents. The genetic information itself is contained in a complex molecule called ***DNA*** .

You inherited some genetic information from both your mother and your father when your father's sperm fertilised your mother's ovum. As you grow up you have developed a personality and skills and have learnt a lot but your genetic information has not changed. It is unique to you (unless you are an identical twin)

Humans are born as a result of ***sexual reproduction***- they are formed from the combination of two sets of genetic information – one from each parent. Many other animals reproduce sexually too.

Some animals, most microorganisms and many plants duce ***asexually.*** In these cases there is only one parent and the offspring are genetically identical to one another and to their parent. We call them ***clones.***

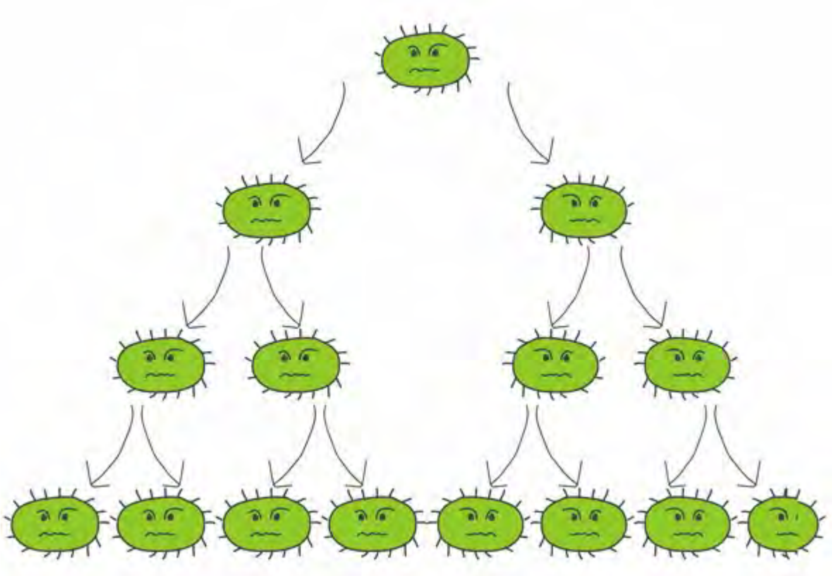


Example of asexual reproduction – one cell splitting in two

The passing on of genetic information from one generation to the next is called ***heredity.***

Asexual reproduction can be very quick and produce large number of identical organisms. This is the case with bacteria for example.

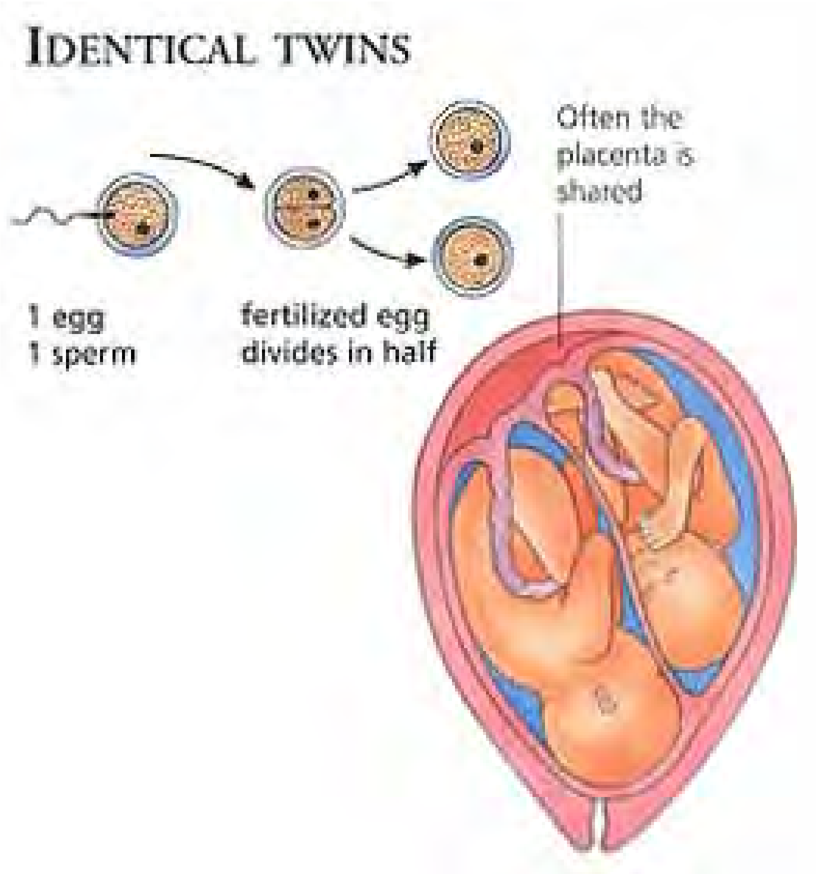
Many microorganisms reproduce asexually by copying their genetic information before splitting into two in a process called ***binary fission.***



Bacteria reproducing by asexual reproduction

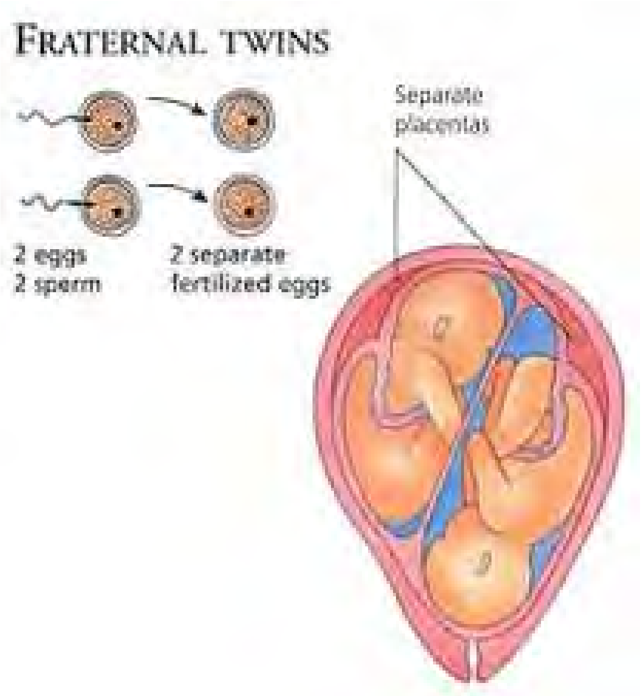
Twins

Identical twins result from sexual reproduction and **are genetically identical to one another** but NOT to their parents. They occur when one fertilised egg splits into two and grows into two identical twins. Because they are identical, these twins have to be the same sex!



How identical twins split from one fertilised egg

Non-identical twins are also a result of sexual reproduction BUT are not genetically identical as they are not from ONE sperm and ONE egg. Two separate ova are fertilised by two separate sperm and they grow at the same time in the same womb but are genetically DIFFERENT people born at the same time. They are no more alike than any other two brothers and sisters. They may be the same sex or one boy and one girl.



☆ To illustrate this ask your child to use playdough.

Firstly to represent asexual reproduction ask your child to roll a piece of playdough in to a ball. Now break it in two and roll each to look identical to one another and to their parent.

Now to represent sexual reproduction you child needs to roll a ball for an ovum and a sperm. These two need to meet and mould together to make one individual. (you may choose to make a second to represent non identical twins and a split a second fertilised embryo in two to represent identical twins.)

	Fraternal Twins	Identical Twins
Develop from	Two different eggs fertilized by two different sperm cells	The splitting of the same fertilized egg into two
Genetic code	Like any other sibling; not identical	Nearly identical
Gender	Usually different	Always the same
Likelihood	Varies by country. About 6 in 1,000 in Japan, up to over 20 per 1,000 in some parts of Africa. Two-thirds of all twins in the world are fraternal.	Uniform around the world; about 3 in 1,000. Only one-third of all twins in the world are identical.
Blood type	May be different	Always the same
Causes	Hereditary predisposition, certain fertility drugs, IVF	Not known
Fingerprints	Different	Different
Appearance	As similar as any other sibling	Extremely similar, although may not be exactly identical due to environmental factors
In utero	Develop separate sacs in utero.	May be contained in one sac in utero.
Risk for TTTS (twin-to-twin transfusion syndrome)	Low risk	Higher risk compared with fraternal twins

Lesson 2: Genetic Diversity

Today's Important Spellings: Organisms Population Natural selection	Genetic diversity Inbreeding

Lesson Content

The range of genetic differences between organisms within a species is called **genetic diversity**. It is important for the survival of individual populations that genetic diversity of all organisms is maintained. If the organisms are not genetically different enough a change in the environment, a new predator or even a disease could kill all the organisms and wipe out a species leading to extinction.

Most higher organisms (both plants and animals) reproduce sexually—that is, they produce offspring through the union of reproductive cells from two different parents. The resulting offspring are genetically similar, though not identical, to the parent.

We've talked about maintaining genetic diversity genetic diversity but why is it important?

Sexual reproduction is critical for maintaining **genetic diversity** within a species because it combines the parents' genetic material, resulting in offspring with unique genetic blueprints—different from either parent.

Genetic diversity is important for two reasons.

1) When a population of an organism contains a large gene pool—that is, if the genetic blueprints of individuals in the population vary significantly—the group has a greater chance of surviving and flourishing than a population with limited genetic variability. This is because some of the individuals may have inherited traits making them particularly resistant to disease or tolerant of cold, for exam-

ple. Or they may possess other traits that increase their chance for survival. In nature, the "fittest" individuals succeed and go on to reproduce—Charles Darwin termed this process **"natural selection."** Suppose there's an outbreak of a disease that threatens to wipe out an entire species. The more genetic variability there is within that species, the higher the likelihood that at least some of the individuals will be resistant, and will survive.

In the lab, plant breeders take advantage of these genetic variants to improve existing plants and create new varieties. Through cross breeding they strive to breed in disease resistance, superior fruit production, increased cold tolerance, or other desirable traits.

2) Genetic diversity also reduces the incidence of unfavourable inherited traits. In a small, isolated population of organisms, individuals may be forced to breed with close relatives. When this happens, the genetic makeup of the individuals becomes more and more uniform, and genetic flaws become increasingly more common. This phenomenon is called **inbreeding.**

When closely related organisms (siblings or cousins, for example) interbreed, any genetic weaknesses that are hidden in the parents can be multiplied in the offspring. For example, animals can be carriers of a gene for an inherited disease, but not show any symptoms. If they mate with a partner who is also a carrier, then the offspring may exhibit symptoms of the disease. In an inbred population, chances are greater that carriers will interbreed. Over time, the entire population is weakened.

In summary, genetic diversity strengthens a population by increasing the likelihood that at least some individuals will be able to survive major disturbances, and by making the group less susceptible to inherited disorders.

Scientists are worried that at the rate that we are destroying habitats like the rainforests we are making it much harder for organisms to survive in the first place but also we are reducing genetic diversity. Scientists keep genetic information in gene banks to help maintain genetic diversity. These gene banks store seeds for plants or cryogenically freeze sperm and ova of animals. We will look at two examples – one for plants – the Kew Millennium Seed Bank and the other for animals – ZSL London Zoo.

Kew Gardens Millennium Seed Bank

They say: "Today, 60,000 to 100,000 species of plant are faced with the threat of extinction. Together with our partners in 80 countries worldwide, we have already successfully saved seeds from over 13% of the world's wild plant species.

By 2020, our aim is to secure the safe storage of seed from 25% of the world's bankable plants. We target plants and regions most at risk from climate change and the ever-increasing impact of human activities. We also save the seeds of the world's plant life faced with the threat of extinction, and those that could be of most use in the future.

The seeds we save are banked at Kew's Millennium Seed Bank at Wakehurst, and in our partner seed banks around the world.

Latest seed count: 34,088 wild plant species and 1,980,405,036 seeds in storage

Inside the Millennium Seed Bank

Why Kew saves seeds

Today, between 60,000 and 100,000 species of plant are faced with the threat of extinction – roughly a quarter of all plant species.

Plants are dying out largely due to the activities of people. Clearing of primary vegetation, over-exploitation and climate change are all causing species losses.

We need plants, because plants are useful. Plants provide the air we breathe, they provide clean water, fuel, building materials, fibres, resins and we all rely on plants for food.

Plants also play a vital role in combating climate change. Plants maintain the atmosphere and counteract climate change by absorbing carbon dioxide, turning it into plant material. Kew's projects are supporting plants in mitigating and adapting to our changing climate."

ZSL London Zoo

ZSL London Zoo's Mission statement aims,

• **To achieve and promote the worldwide conservation of animals and their habitats**

• **A world where animals are valued and their conservation assured**.

They say:

"Where some animals are unable to breed naturally, other management tools are employed. For example:

A) Male and female live together but refuse to mate.

B) Zoos are unable to transfer animals.

C) Zoos are unable to house a breeding pair of animals.

D) There is risk of aggressive behaviour between mates.

E) A genetically valuable individual can be used to inseminate a number of females.

Techniques include:

- *Artificial insemination (AI)*
- *In vitro fertilization (IVF)*
- *Embryo transfer. AI (Artificial insemination)*

In some cases a genetically valuable male may be able to provide sperm that can be used to artificially inseminate a number of captive females. IVF (In vitro fertilisation) If a male animal has a low sperm count or low sperm motility, IVF can be used to produce a 'test-tube' embryo which can then be implanted into the female. Embryo transfer Embryos are produced and are then carried by a surrogate female.

Very rare species embryos can be carried by domestic equivalents e.g. domestic cattle carry embryos for the Gaur. Transferring sperm and embryos is cheaper, easier and safer then moving live animals and has welfare benefits, in avoiding the need for sedation, capture, and transport of live animals."

ZSL

LIVING CONSERVATION

Lesson 3: DNA

Today's Important Spellings:	
Heredity Double helix Genome	Nucleus Genes Chromosomes Deoxyribonucleic acid

Suggested resources for practical:

- 50ml Rubbing alcohol or isopropyl or denatured alcohol (ethanol) or vodka
- Washing up liquid
- Salt
- Water
- Plastic food bag (zip lock is best)
- Beaker or test tube (or clear glass jar)
- Measuring cups/spoons
- Tweezers
- Safety glasses
- Sieve
- 3 strawberries

Lesson Content

Genetic information is passed from one generation to the next. This is called ***heredity*** and why we resemble our parents. The genetic information itself is contained in a complex molecule called ***DNA*.**

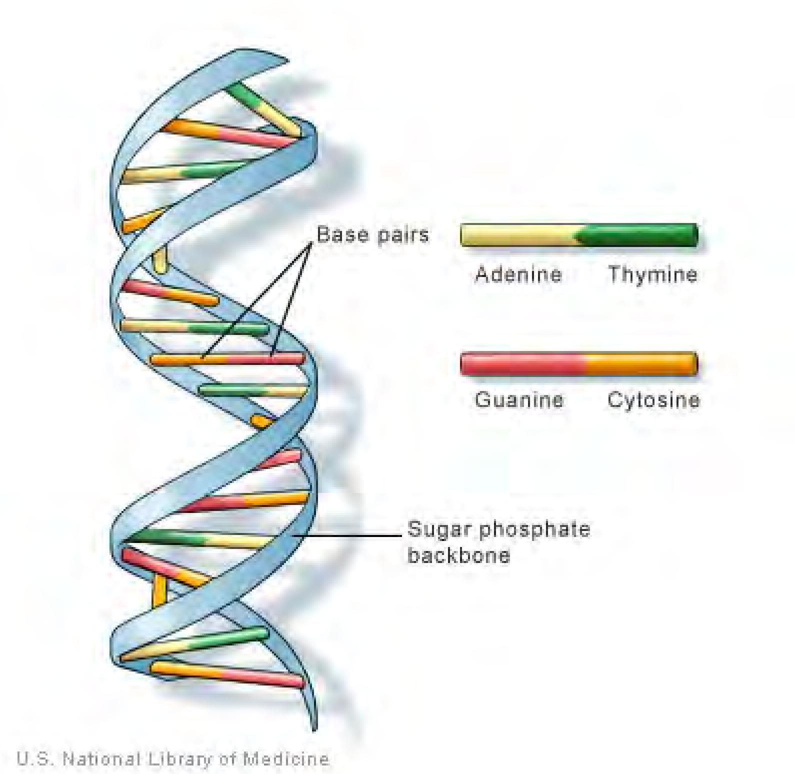
Scientists worked out the structure of DNA in the 1950s. Rosalind Franklin made 'X-ray diffraction' images of DNA.

The x-ray diffraction image of DNA

James Watson and Francis Crick used information from one of her images to work out a model for the structure of DNA. Work by Maurice Wilkins, a colleague of Franklin, supported their model.

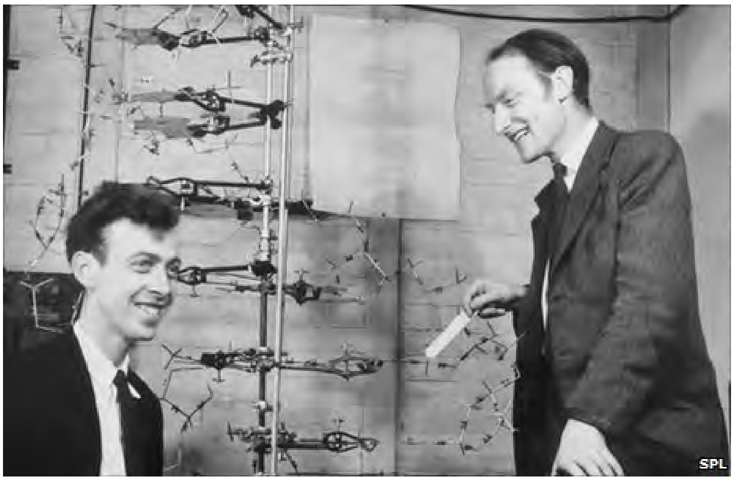
Watson and Crick were able to work out how DNA was arranged and the tiny distances between its different features. They worked out that in a DNA molecule:

- there are two strands
- the strands are twisted around each other to form a **double helix**
- the strands are held together by **bonds** between **base pairs**



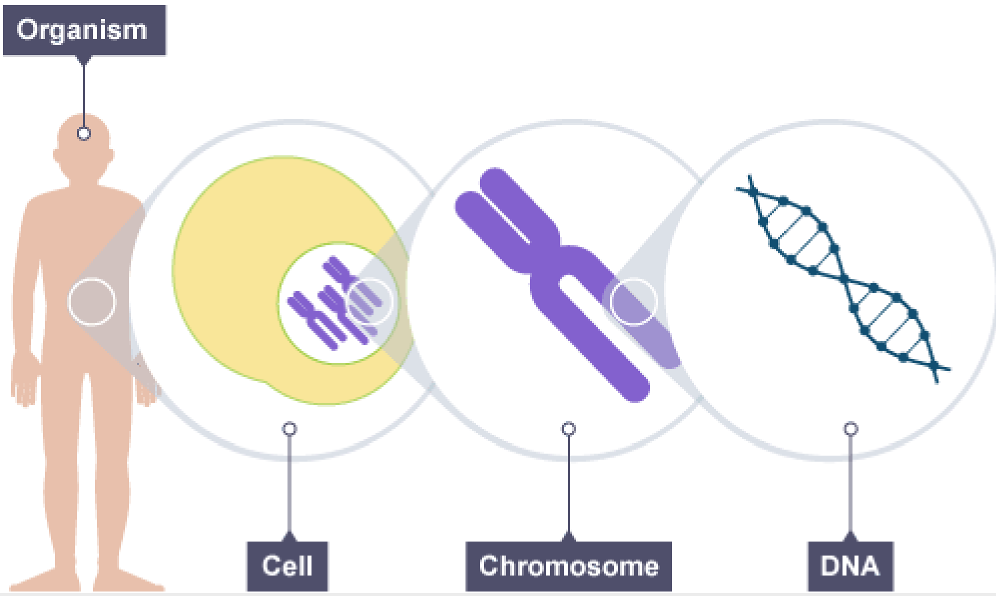
The Structure of DNA showing its pair bases G-C and A-T

Watson, Crick and Wilkins were awarded the 1962 **Nobel Prize** in Physiology or Medicine for their discovery. (Franklin had died before then and so could not be awarded it with them.)



Watson and Crick

The DNA in all of your cells is approximately **two metres long**, except red blood cells which have none and sperm or eggs which only have about one metre. Because it is so long it is very thin and coiled into structures called **chromosomes**. The chromosomes are found in the **nucleus** of each cell.



Each cell with a nucleus contains chromosomes, which are made from DNA

Human body cells each contain **23 pairs of chromosomes**, half of which are from each parent. So, human gametes (eggs and sperm) each contain 23 chromosomes. When an egg is fertilised by a sperm, it becomes a cell with **23 pairs of chromosomes**. This is why children resemble both their parents – half of their chromosomes and DNA comes from their mother, and half from their father.

Other organisms have different numbers of chromosomes e.g. chimpanzees have 24 pairs and grape vines have 19 pairs.

A collection of human chromosomes

A **gene** is a section of DNA that is responsible for a characteristic like eye colour or blood group. Humans have around 20,000 genes. DNA makes up genes, which makes up chromosomes. One copy of all your chromosomes is called your **genome.**

Experiment time!

You and your child can extract DNA from strawberries! If you don't want to actually do the experiment – you can watch it here

http://www.echo.education/url/dnafromastrawberry

In order to study DNA, scientists have to extract it from cells. There are many DNA extraction kits available for scientists to use in the lab, but they all work in roughly the same way. This experiment lets you make your own DNA extraction kit from common household materials. You will extract DNA from strawberries and see the clumps of DNA strands. Strawberries are easy to use in this experiment because they are easy to mash and they contain a lot of DNA in each cell. However, you can do this experiment on most any living (or formerly living) thing. Try this experiment using other fruits and vegetables or soft meats (like chicken liver).

You will need:

50ml Rubbing alcohol **or isopropyl or denatured alcohol (ethanol) or vodka**
Washing up liquid
Salt
Water
Plastic food bag (zip lock is best)
Beaker or test tube (or clear glass jar)
Measuring cups/spoons
Tweezers
Safety glasses
Sieve
3 strawberries

Method:

1) Put 50ml of rubbing alcohol into the freezer to chill
2) To 100ml of water add 10ml of washing up liquid and 0.5 teaspoon of salt and mix well. This is your extraction liquid.
3) Put a strawberry into a plastic food bag (zip lock is best) and add about 4 tablespoons of the extraction liquid.
4) Remove as much air as possible and seal the bag. Mash the strawberry with your hands for 2 minutes until there are no big lumps left.
5) Sieve the strawberry solution to remove the bits and push through with a spoon to get as much through as you can.
6) Transfer the liquid to small beaker or small glass jar
7) Add 50ml of iced rubbing alcohol pouring it very gently down the side of the beaker and wait for a few minutes. The alcohol will form a layer on top of the strawberry solution.

8) Now you should see stringy white solid collecting between the two layers. This is DNA. You can gently remove it with the tweezers.
9) If you have one why not look at the DNA under a microscope? The round 'doughnut' like things you will see are bubbles and the DNA will look like long spirally strings.

How does this work?

The washing up liquid causes the cells to pop open and release their DNA. The alcohol causes the DNA to come out of the solution.

You can do this experiment on lots of other living things – here are some YouTube clips to watch and/or copy!

Extracting DNA from a banana
http://www.echo.education/url/dnabanana

Extracting DNA from peas
http://www.echo.education/url/dnapeas

Extracting DNA from onion
http://www.echo.education/url/dnaonion

Lesson 4: Variation

Today's Important Spellings:	
Variation Genetic variation	Environmental variation Breeds

Lesson Content

There are differences within a species and between different species. For example all dogs are the same species- dogs- but they look very different.

Differences within a species like this are called **variation**. Smaller groups within the species that have less variation within them are called **breeds** e.g. these three dogs are all Labradors

Some variation within a species is inherited, and some variation is due to the environment.

Inherited Variation

Variation in a characteristic that is a result of genetic inheritance from the parents is called inherited variation.

Children usually look a little like their father, and a little like their mother, but they will not be identical to either of their parents. This is because they get half of their inherited features from each parent.

Each egg cell and each sperm cell contains half of the genetic information needed for an individual. When these join at fertilisation a new cell is formed with all the genetic information needed for an individual.

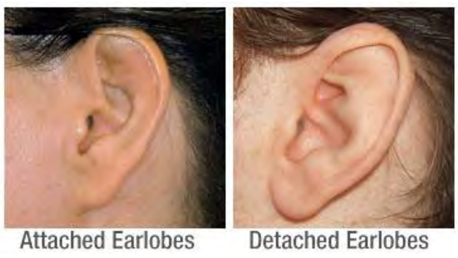
Here are some examples of inherited variation in humans:

- eye colour

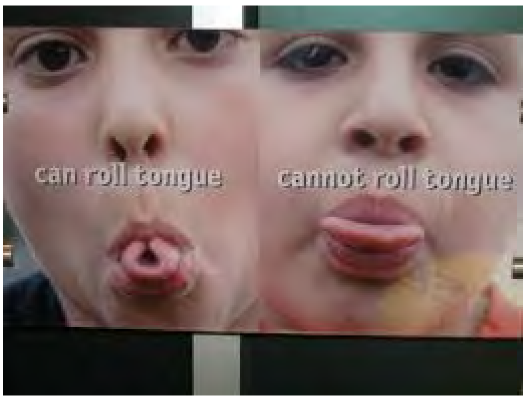
- hair colour

- skin colour

- lobed or lobe less ears.



- if you are able to roll your tongue



- Gender- whether you are male or female is a result of the genes you inherited from your parents.

Environmental causes of variation

Characteristics of animal and plant species can be affected by factors such as

- climate,
- diet,
- accidents,
- Culture and lifestyle.

For example, if you eat too much you will become heavier, and if you eat too little you will become lighter. A plant in the shade of a big tree will grow taller as it tries to reach more light.

Variation caused by the surroundings is called **environmental variation.**

Here are some other examples of features that show environmental variation:

- your language and religion
- flower colour in hydrangeas - these plants produce blue flowers in acidic soil and pink flowers in alkaline soil.

Hydrangeas

Both types together

Some features vary because of a mixture of inherited causes and environmental causes.

For example, identical twins inherit exactly the same features from their parents. But if you take a pair of twins, and twin 'A' is given more to eat than twin 'B', twin 'A' is likely to end up heavier.

Genetic and environmental variation can be further catergorised into

1) **Continuous-** the data collected comes in a range e.g. height, weight etc
2) **Discontinuous** – the data collected come in discrete groups e.g. eye colour, shoe size or blood group

Ask your child to create a chart with 2 columns – in one column list the factors of genetic variation and in the second, the environment variation factors.

Lesson 5: Natural Selection and the Theory of Evolution

Today's Important Spellings: Evolution Natural selection Survival of the Fittest Speciation	Extinct Charles Darwin Galapagos Islands Mutations Artificial selection

Lesson Content

The ***theory of evolution by natural selection*** is an idea that explains how species *evolve*, or change through time — sometimes changing so much that new species are created. It says that the variety you see in the living things all around you is a result of each organism's unique genes.

The theory of evolution by natural selection **doesn't attempt to explain *how* life first began or *why* living things are on earth.** Rather, the theory of evolution by natural selection explains the scientifically observable processes that change the physical characteristics of living things through time.

When two organisms reproduce sexually, their offspring have some characteristics from one parent and some from the other.

Each generation of offspring is the result of a novel combination of genes from each parent. However, sometimes random changes, called ***mutations***, can occur by accident, or they may be caused by an outside influence.

When a mutation occurs in a gene, it changes the gene and may change the physical trait determined by that gene. Sometimes change is good, sometimes it's bad, but most of the time it's neither good nor bad. There are three ways that these changes can affect the organism:

1) A new physical trait can help an organism survive more easily – e.g. eating, growing, and reproducing making living less difficult and, ultimately, reproduction more successful.

2) A new physical trait that disrupts an organism's life or decreases its chances for survival leading to decreased reproductive success.

3) Some mutations sometimes lead to traits that don't affect the organism's ability to survive and reproduce in either a positive or negative way

When the process of selecting for or choosing an adaptive trait occurs in nature, it's called ***natural selection***. When humans manage this process, it's called ***artificial selection***. Animal breeders, farmers, and gardeners play a role in species evolution by selecting one trait over another. Unlike natural selection, artificial selection reduces the genetic diversity of the organism being worked with.

If an organism is able to reproduce with a genetic change, it will pass on that change. Eventually, all the changes may add up, creating a new species. The development of new species from an existing population is called ***speciation.***

The theory of evolution by natural selection explains that living things change through time as a result of genetic mutations and natural selection for the most adaptive traits

The steps in this theory of evolution are:

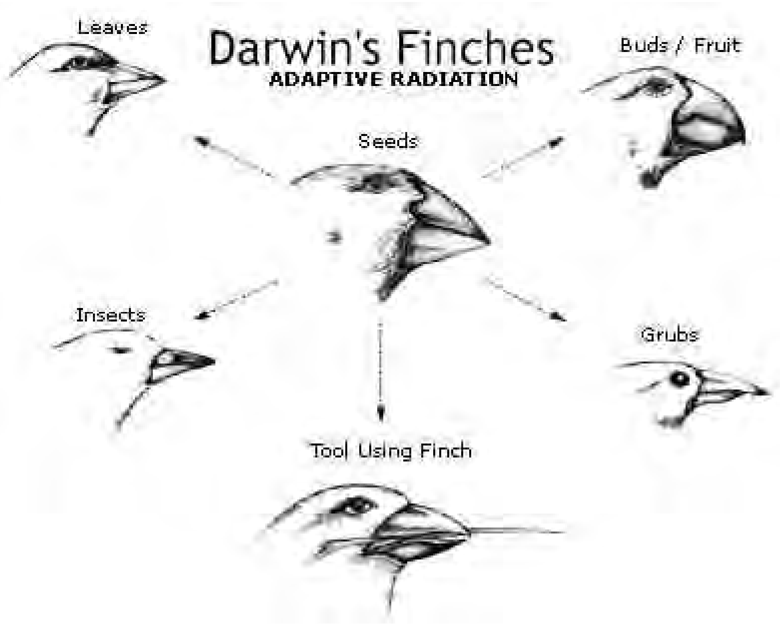
1) Variation exists in the population of all living creatures
2) Individuals within a population will compete with each other to survive
3) Variation results in some individuals possessing characteristics which mean they are better adapted to survive and reproduce (this is called **survival of the fittest** or **natural selection**).
4) Heredity means that this advantageous characteristics get passed on to their offspring
5) Over many, many generations small changes in characteristics can add up and a new species of life can be formed.

6) Those individuals or whole species that are poorly adapted to survive may die out completely or become **extinct.**

Charles Darwin

The theory of natural selection was first developed and written up by **Charles Darwin**. Charles Darwin was born in England in 1809, he died in 1882.

He is most famous for his work on natural selection, the idea that all species of life have evolved over time from common ancestors. This process involves favourable characteristics becoming more common in successive generations of living things while at the same time unfavourable characteristics become less common. Not only did Darwin develop the idea of natural selection, he also presented compelling evidence from his detailed research which included a five year voyage on the HMS Beagle. On this voyage, Darwin visited ecologically diverse regions such as Brazil, Chile, Australia, the Falkland Islands and the Galapagos Islands. Here, Darwin observed similar looking finches on different islands which had a range of beak shapes and sizes. Darwin thought that the birds were all descended from one species that was blown from the South American mainland during a storm. He thought that the the small changes that would have existed naturally in the original population, allowed them to feed successfully on specific islands with different food sources.



His 1859 book '**The Origin of Species by Means of Natural Selection'**, detailed much of his research on natural selection, it contained a large amount of evidence to back up his ideas and became a landmark work in the field of evolutionary biology. Darwin's ideas created a lot of discussion regarding the impact on various scientific, religious and philosophical viewpoints. Although most of those in educated society accepted the theory of evolution, many still challenge its existence.

Ask your child to imagine they are on the HMS Beagle and they are Charles Darwin himself. They should write a letter home to explain what they have observed in the beaks of the finches and what that has led them to believe about the natural selection of species. You could age the letter by rubbing the paper with an old tea bag and burning the edges (this is easiest if you roll the paper up first)

Genetics End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions.

1) Does sexual and asexual reproduction produce clones?

2) What does heredity mean?

3) Do identical or non-identical twins come from 2 ova?

4) What did Watson and Crick discover?

5) One copy of your entire DNA is called a …………..?

6) How many pairs of chromosome do humans have?

7) Which letters are the DNA bases labelled as?

8) What do we call differences within a species?

9) Name two traits you inherit from your parents

a)

b)

10) Give two traits affected by environmental variation

a)

b)

11) Name one example of continuous variation

12) Give one example of discontinuous variation

13) Who wrote the book, ‘The Origin of species by Means of Natural Selection’?

14) Which birds had he observed on the Galapagos Islands?

15) Why have some species become extinct according to this theory?

16) State the two reproductive cells in plants

a)

b)

17) Describe how microorganisms reproduce

18) Explain why reproductive cells have half the genetic information of a normal cell

19) Why are you similar to your brothers and sisters but not exactly the same?

20) Why must identical twins be the same sex?

Genetics End of Topic Practise Questions

ANSWERS

1) Does sexual and asexual reproduction produce clones?
   Asexual

2) What does heredity mean?
   It is the passing on of genetic information from one generation to the next

3) Do identical or non-identical twins come from 2 ova?

Non-identical

4) What did Watson and Crick discover?
   DNA
5) One copy of your entire DNA is called a genome

6) How many pairs of chromosome do humans have?
   23

7) Which letters are DNA bases labelled as?

A -T and G-C

8) What do we call differences within a species?
   Variation

9) Name two traits you inherit from your parents

   a) eye colour
   b) hair colour
   other answers are possible including ear lobes or tongue rolling

10) Give two traits affected by environmental variation
a) scars
b) flower colour in hydrangeas

11) Name one example of continuous variation
Height or weight

12) Give one example of discontinuous variation
Eye colour, shoe size or blood group

13) Who wrote the book, ‘The Origin of species by Means of Natural Selection’?
Charles Darwin

14) Which birds had he observed on the Galapagos Islands?
Finches

15) Why have some species become extinct according to his theory?
If they are poorly adapted to their environment they will eventually die out

16) State the two reproductive cells in plants

a) pollen
b) ova

17) Describe how microorganisms reproduce
Asexual reproduction – they split in two and make 2 identical copies of themselves

18) Explain why reproductive cells have half the genetic information of a normal cell

Because they will join with a second sex cell and combine genetic information to make the full set of 23 chromosomes.

19) Why are you similar to your brothers and sisters but not exactly the same?

Our genetic information isn't identical as we came from 2 separate sperm and eggs. These sex cells were not identical. Also we have environmental variation too e.g scars

20) Why must identical twins be the same sex?

They are identical because they come from the splitting of one fertilised egg.

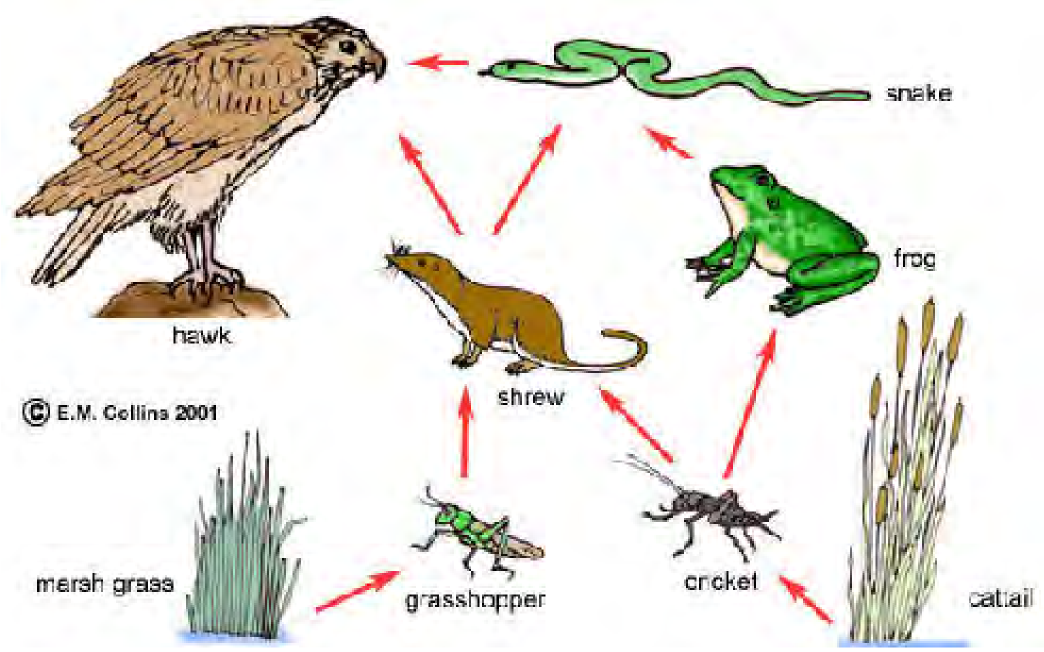
Environmental Interactions End of Topic Practise Questions

These practise questions can be presented to your child in any way that is appropriate – you could do a fun quiz style, a 'pick a question from a box type quiz, an oral 'let's have a go at these together' style or as a test of what they have understood by setting as a 'test'. It is entirely up to you. You can use all of the questions or pick and choose. The answers follow the questions

1) What type of organism is present at the bottom of almost every food chain?

2) What process do these organisms complete which means they start food chains?

3) This is a food web. What do the arrows mean in the food web?



4) Give one example of a food chain from this a food web

5) Explain what would happen to the numbers of shrew and hawk and the amount of marsh grass if all the grasshoppers get killed by pesticides

   The marsh grass-

   The shrew numbers would-

   The number of hawks would therefore-

6) Which organisms are the producers in this food web?

7) Name the primary consumers in this web?

8) What is the tertiary consumer, the apex predator at the top this web?

9) How does the concentration of pesticides like DDT build up in organisms in the food chain?

10) Where would you find the only food chains in the world that don't start with plants?

11) Explain how pond dipping could give you an indication of how polluted your local stream is

12) Name 3 sources of water pollution

a)

b)

c)

13) Name one bio indicator species that you might find in polluted water

14) Why are pesticides used on farms?

15) How do these pesticides end up in rivers?

16) Name three gases that are released when we burn fossil fuels

a)
b)
c)

17) Carbon dioxide in the air increases the greenhouse effect which is turn leads to…………………………………….

18) Name a gas that leads to acid rain

19) Which pollutants are released into the air by fridge and freezer coolants?

20) Name three things we can do to help reduce human causes of air pollution

a)
b)
c)

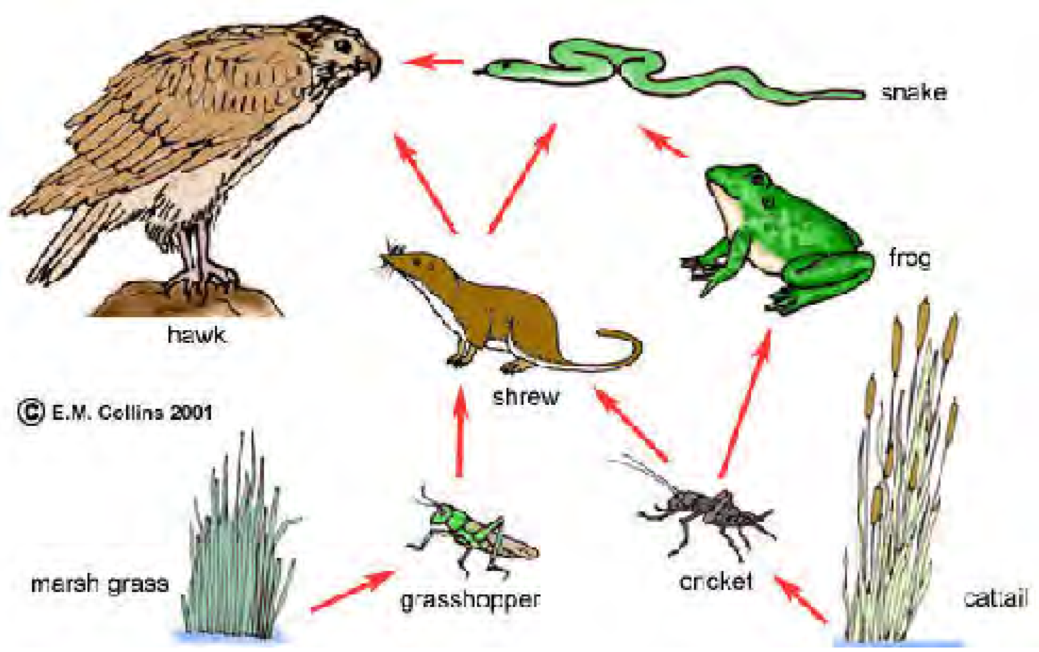
Environmental Interactions End of Topic Practise Questions

ANSWERS

1) What type of organism is present at the bottom of almost every food chain?
Plant

2) What process do these organisms complete which means they start food chains?
Photosynthesis

3) This is a food web. What do the arrows mean in the food web?
They show the direction of the energy transfer. The organism at the start of the arrow is eaten by the organism at the end of the arrow.



4) Give one example of a food chain from this a food web

Marsh grass -> grasshopper->shrew ->snake ->hawk

(other examples are possible)

5) Explain what would happen to the numbers of shrew and hawk and the amount of marsh grass if all the grasshoppers get killed by pesticides

   The marsh grass- would increase in numbers as it isn't being eaten by grasshoppers

   The shrew numbers would- decrease as they have less grasshoppers to eat but they would have to reply on crickets for food

   The number of hawks would therefore- decrease as they would have less shrews to eat

6) Which organisms are the producers in this food web?

Marsh grass and cattail

7) Name the primary consumers in this web?
   Crickets and grasshoppers

8) What is the tertiary consumer, the apex predator at the top this web?
   Hawk

9) How does the concentration of pesticides like DDT build up in organisms in the food chain?

They increase as you move up the food chain and they stay in the food as it is passed up the chain.

10) Where would you find the only food chains in the world that don't start with plants?
At the bottom of the ocean next to hot volcanic vents

11) Explain how pond dipping could give you an indication of how polluted your local stream is
You would look at the diversity of species and whether there are biodiversity species present

12) Name 3 sources of water pollution
Any three of these :- rubbish, waste from factories, chemicals from farms , untreated sewage, rubbish and plastic bags, oil spills,

13) Name one bioindicator species that you might find in polluted water
Bloodworms or sludge worms

14) Why are pesticides used on farms?
To kill pests that are eating their crops

15) How do these pesticides end up in rivers?

They wash off the land in rainwater

16) Name three gases that are released when we burn fossil fuels
3 of Carbon dioxide, carbon monoxide, nitrogen oxides or sulphur dioxide

17) Carbon dioxide in the air increases the greenhouse effect which is turn leads to global warming

18) Name a gas that leads to acid rain
Nitrogen oxide or sulphur dioxide

19) Which pollutants are released into the air by fridge and freezer coolants?
CFCs

20) Name three things we can do to help reduce human causes of air pollution

a) walk instead of drive
b) turn down our heating
c) use buses and trains
other answers are possible