

# Micro-Organisms



# Welcome to Micro-organisms

Hello, I'm Dr David Moore and I am a mycologist at the University of Manchester.

So, what is a mycologist?

Well, let me explain, a mycologist is someone who has studied, and therefore knows quite a lot about fungus. The fungus Kingdom includes mushrooms and yeast and much, much more. As a mycologist, I know the common (Penny Bun) and Latin (*Boletus edulis*) names of many species of fungi, but more than 100,000 species exist, so I learn more every day! I know how they are classified; what they look like; how they reproduce, feed and grow; how they are used to make medicines (like penicillin and statins) and food (beer, wine, cheese, edible mushrooms, Quorn) and also their dangers such as poisoning and infection. As you can see, mycology is an extremely fascinating and important subject.



Why do we need fungi?

We depend on fungi every day of our lives. From breakfast to supper we rely on fungi to provide our food, our treats, our consumer products and our medicines. Fungi are not just mushrooms and moulds. Fungi digest the grass eaten by cows (and all other herbivores) and by doing so indirectly provide the milk for our breakfast and the steak for dinner. Fungi make plant roots work and by doing so provide the corn for our cornflakes, oats for our porridge, potatoes, lettuce, cabbages, cotton, paper, timber, and every other plant product we find so essential.

How do fungi relate to micro-organisms?

Fungi can be classified as micro-organisms along with Bacteria, Viruses, Algae and Protozoa and we will be looking at these in more detail in this section of the Children's University.

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# What are Micro-organisms?

Many living organisms such as plants, animals and humans are large enough to be seen with the naked eye.

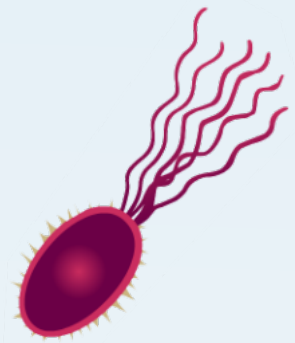


Other living organisms are so small that we need a powerful microscope to see them; these are called micro-organisms or microbes.

The five types of living micro-organisms are bacteria, viruses, fungi, protozoa and algae.

## Bacteria

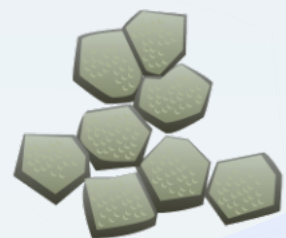
Bacteria are single-celled spherical, spiral or rod-shaped organisms. Examples include *Salmonella enteritidis* which causes food poisoning and *Streptococcus pyogenes* which causes sore throats.



## Viruses

Viruses are parasites, which means that they can only survive inside the cells of other living things!

They cause very infectious diseases such as chicken pox, measles and conjunctivitis. Viruses are the smallest of the micro-organisms and can only be seen with a very powerful microscope.



# Fungi

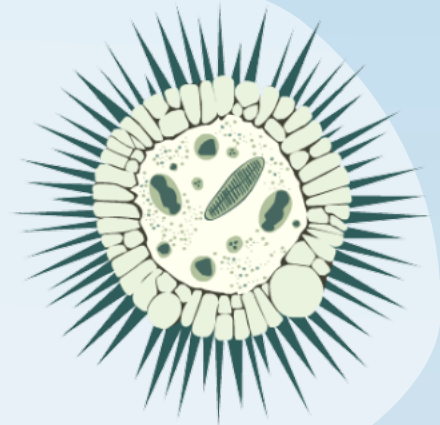
Fungi can be many different sizes ranging from microscopic single celled yeasts used in bread and beer making to the macroscopic fungi which contain many cells such as moulds, mushrooms and toadstools.



# Protozoa

Protozoa are single celled organisms which can cause diseases such as malaria and sleeping sickness.

They can also be useful, for example in the treatment of sewage where they eat the harmful bacteria making it safe for disposal.



# Algae

Algae can be many different sizes from the microscopic single celled diatoms used in toothpastes to the macroscopic algae which contain many cells like seaweed.





# 30 Micro-organisms Indoors and Out.

The Ocean

The Study

Bathroom

Bedroom

The Garden

Living Room

The Kitchen

## The Ocean



### Algal blooms

This happens naturally at certain times of the year or because of human activities such as excess fertiliser or untreated sewage being released into lakes or the sea. These activities cause a huge increase in the amount of nutrients available to certain algae, this causes rapid growth and reproduction. Algal blooms can limit the amount of light available to other plants and oxygen needed by fish, disrupting the whole life cycle of lakes and seas.

## The Garden



### 1. Compost

Compost is made when decomposing micro-organisms (mainly bacteria) break down the teabags, vegetable peelings, fruit and grass cuttings in your compost heap.

The useful nutrients which are released can be used again in your garden.



## The Garden



### 2. Stomachs of sheep, Cows and goats

Some herbivores, like cows, sheep and goats, get their nutrients by eating grass which is a brilliant source of fibre. The problem is that the chemicals in the animals stomach can not break down the cellulose fibre to release the nutrients on their own. They depend on special fungi called CHYTRIDS which live in the animal's stomach and which break the cellulose down for them.

The relationship between these animals and the chytrids is SYMBIOTIC because the animal benefits from the presence of the fungi and the fungi benefit by living off a small amount of the nutrients released from food in the animal's stomach.

The chytrids are spread from animal to animal via their pool Fungi in the dung attaches to nearby grass, which is then eaten by other cows!



### 3. Peas and Beans

The bacteria Rhizobium live inside the roots of plants in little lumps called root nodules. These bacteria are extremely important to plants because they change the nitrogen gas in the air to a type of nitrogen that the plant can use for growth. In return, the plants give the bacteria food such as sugars and amino acids. This is called a symbiotic relationship because both organisms benefit.

# The Garden



## 4. Potato Blight

*Phytophthora infestans* is a type of fungus that causes disease in potatoes and has the nick name "The Infesting Plant Destroyer". In 1845 in Ireland the fungus killed all the potato crops and because the Irish were poor and always ate potatoes, they were left with no food. Sadly, many people died of starvation, and others had to emigrate to England, America or Australia to survive.



## 5. Oxygen Producers

Algae, which provide 75% of the world's oxygen, are found in the sea, rivers, lakes, streams and ponds. Like plants, algae produce oxygen by a process called photosynthesis. In this process the algae take in carbon dioxide and water to make oxygen and sugar.

The oxygen is released into the atmosphere for us to breathe! So don't forget, if we kill the algae by polluting the water we will reduce our own vital supply of oxygen!



## 6. Environmental cleaners

Most types of fungi are great environmental cleaners, or decomposers - they clear away dead animals, plants and logs by eating them or breaking them down into very small particles!

Although bacteria can also degrade or "eat away" dead animals and plants only fungi can grow on and degrade dead trees or fallen branches.



# Indoors



## The Study



### 1. Plant Roots

Certain fungi that are associated with the roots of plants have a strange name, they are called MYCORRHIZAS. Plants get their nutrients (or food) by absorbing minerals and water from the soil using their roots. Mycorrhizas help the plant by greatly increasing the surface area of the roots. This means that the plants will receive many more minerals and much more water, so they can grow stronger and taller. Both the plant and the fungus receive nutrients so their relationship is mutualistic, like being friends!

### 2. Measles

The measles virus, or scientifically the Morbillivirus, causes a red rash all over the body. The virus also causes a very high temperature of about  $40^{\circ}\text{C}$ , a cough and a cold! People catch the measles virus by breathing in infected droplets from the air. These droplets can come from other infected people that have coughed or sneezed. Finally, did you know that the measles is one of the most highly infectious viruses known? You do now!!





## The Bedroom

### 1. Malaria



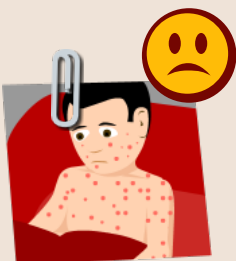
Malaria is a tropical disease caused by protazoa. Mosquitoes infected with the protist, Plasmodium infect humans by biting them, causing Malaria. The protist travels to and infects liver cells and then red blood cells. This makes the person feel very ill; they will suffer from sickness, high temperature and headaches.

### 2. Sleeping sickness

Sleeping Sickness is a very serious and life threatening disease of East Africa. It is caused by Trypanosoma brucei which is a protozoan parasite. The protozoa are carried by the Tsetse Fly and when it bites an unsuspecting person it transfers the parasite into that person. The disease, which occurs in two stages, can kill the person if they are not treated with medicine. During the first stage the person will feel very sick, have a very high temperature and feel very tired. During the second stage the brain is affected and damaged affecting how well and when the person sleeps. Their concentration will also decrease.



### 3. Chickenpox



The Varicella-Zoster Virus infects only people and causes chickenpox, which are very itchy spots. If you have had the chickenpox it is very unlikely that you will ever get them again.



## The Bathroom

### 1. Dental plaque



Dental plaque is often described as a 'community of bacteria' because within it there are many different types of bacteria each present in their millions! When we eat sugary foods, these bacteria produce acid causing tooth decay. So, protect your teeth and brush twice a day, to keep the dentist at bay!!

### 2. Penicillin

Penicillin is produced by the fungal mould *Penicillium notatum* and was discovered in 1928 by Alexander Fleming. Penicillin is an antibiotic that kills certain bacteria. It is used to treat people who are suffering from bacterial infections such as pneumonia and meningitis.



### 3. Sore throat



The bacteria called streptococcus affects people by making them feel very sick and tired. It causes sore throats and makes your tonsils bigger!

### 4. Antibiotics

The bacteria called *Bacillus* is very useful to humans as it produces antibiotics. These are drugs that your doctor will give you when you have a bad bacterial infection, such as a sore throat caused by *Streptococcus*.



# The Bathroom

## 5. Toothpaste



Diatoms are extremely small single-celled algae which are enclosed in very hard silica shells. Over thousands of years huge numbers of these shells have accumulated under the ground in areas near a current, or former, lake, sea or river. These fossil deposits, known as diatomaceous earth, are now mined and used as the abrasive substance in toothpastes.

## 6. Sewage treatment

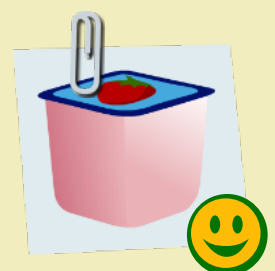
A protozoa called Paramecium is present in sewage treatment systems. It removes harmful bacteria from sewage by eating them! The treated sewage is now safe to release into the sea, on farmers land or it is burnt or buried.



# The Kitchen

## 1. Yogurt

The bacteria *Lactobacillus* is important in yogurt production. The bacteria use the sugars in milk as food and produce lactic acid as its waste product. Lactic acid causes the milk to become more solid or gel-like. Flavours such as strawberry or peach are then added to make the yogurt taste good.



## 2. Yeast in brewing and baking

Bread and beer are both produced using yeast which is a very tiny fungus with just one cell! Yeast is a living organism which means it can breathe or respire. It is very clever because it can respire with or without oxygen. When there is no oxygen, the process is called FERMENTATION. In this process, the yeast eats the sugar and gives off alcohol, carbon dioxide and water. In the brewing industry, the Brewer's Yeast, *Saccharomyces cerevisiae* is used to produce the alcohol in beer.



In the baking industry, Baker's Yeast, also called *Saccharomyces cerevisiae*, eats sugar in the flour of the dough mixture to produce carbon dioxide gas. The carbon dioxide makes bubbles in the dough and causes the bread to rise. The alcohol evaporates during the baking process!

## 3. Mushrooms



You can buy a large variety of mushrooms, which are a type of fungus, at the supermarket. When you next go shopping with your parents see if you can spot these types of mushrooms:

1. Shiitake
2. Button mushroom

Look at the difference in size, shape and colour.

## 4. Bread mould

One type of bread mould is the fungus *Penicillium notatum*. Its blue-green spores can appear on bread when it is stored in air in warm, dark, moist, conditions.



## 5. Food poisoning

Bacteria called *Salmonella* can contaminate uncooked foods such as chicken, and can cause people to be sick. This is called food poisoning. To help prevent it you must cook meats properly before eating, keep uncooked meats away from ready-to-eat foods, and always wash your hands after going to the toilet.





## The Kitchen

### 6. Soy Sauce

Some people like to add flavour to their food by adding soy sauce. Did you know that during the production of soy sauce two moulds (a type of fungus remember) are used. These also have strange names: *Aspergillus oryzae* and *Aspergillus sojae*. Try and say that ten times without getting tongue-tied! These moulds together with soybeans and a long complex process eventually produce soy sauce.

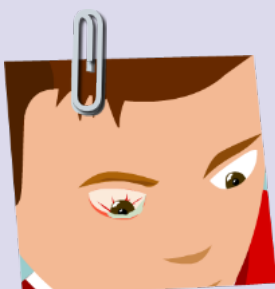


### 7. Jam and Jelly

Jam, jelly and iced-cream are thickened using the alginates extracted from the algae seaweed. Alginates are very nutritious, low in fat and help to stop food going bad.



## Living Room



### 1. Conjunctivitis

The Adenovirus can cause different illnesses in humans such as a sore throat, conjunctivitis (sticky eyes) and stomach aches in little children. To prevent getting the virus you must wash your hands after going to the toilet.

## 2. Athlete's Foot

This is caused by the fungus *Trichophyton rubrum* which infects the moist, warm skin between your toes and sometimes the sole of your foot. The fungus causes the skin to turn very dry and very itchy. It is called Athlete's Foot because athlete's feet get very hot and sweaty in their trainers when they run, creating the perfect conditions for the survival of this fungus.



## 3. Quorn

The product called Quorn is a mycoprotein. It is NOT a yeast or a mushroom, but a filamentous fungus called *Fusarium venenatum*. Myco-protein is used as an alternative to meat in health and vegetarian products.



| Protein Dietary Fibre Fat |     |     |     |
|---------------------------|-----|-----|-----|
| Mycoprotein               | 44% | 18% | 13% |
| Beef Steak                | 68% | 0%  | 30% |

This table compares the percentages of protein, fibre and fat content in both myco-protein and beef. Which do you think is healthier?

## 4. Fizzy Drinks

Citric acid is made by feeding sugar to the fungus *Aspergillus niger*. The citric acid is added to fizzy drinks to give them a sour taste, help to keep them fizzy and preserve them - that means stop them going bad!



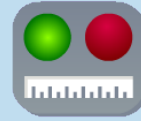
## 5. Amoebic dysentery

Another protozoan parasite, called *Entamoeba histolytica* causes the amoebic dysentery disease. The person will suffer from severe diarrhoea. People get this disease by drinking or eating infected food or drink, this type of protozoa travels through the digestive system and stays in the intestine where it causes infection. This disease is uncommon in developed countries, but is sometimes caught by travellers in more exotic parts of the world!



# Did You Know?

Scientists at The University of Manchester have invented a test which can spot harmful bacteria in meat in seconds. This new test, which uses infra-red beams, may prevent thousands of cases of food poisoning each year!



## Quiztime!

1. What is a micro-organism?

- A) A living organism which can only be seen under a microscope
- B) A living organism which can be seen by the naked eye
- C) A living organism which lives in the microwave

2. What are the five types of micro-organism?

- A) Plants, virus, animals, minerals, fungi
- B) Fungi, bacteria, protozoa, virus, algae
- C) Trees, bacteria, protozoa, plants, fungi

3. Which of the following are caused by bacteria?

- A) Chicken pox, conjunctivitis and measles
- B) Food poisoning, tooth decay, sore throats
- C) Chicken pox, dental plaque and food poisoning

4. Which of the following are made using fungi?

- A) Soy sauce, Quorn, bread, beer, penicillin
- B) Toothpaste, mint sauce, crisps, oxygen
- C) Mushrooms, jam, tomato sauce, potatoes

5. Which of the following produce 75% of the world's oxygen?

- A) Bacteria
- B) Fungi
- C) Algae

6. Which of the following cause malaria, sleeping sickness and amoebic dysentery?

- A) Fungi
- B) Protozoa
- C) Bacteria

7. Which of the following are caused by a virus

- A) Conjunctivitis, measles, chicken pox
- B) Salmonella, algal bloom, measles
- C) Athlete's foot, sleeping sickness, tooth decay

See the answers at the end of the module



# What are Fungi?

Fungi are all about us...



Quorn



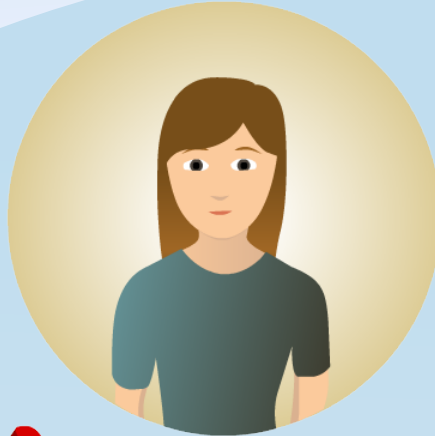
Athlete's Foot



Yeast in  
bread & beer



Soy sauce



Bread mould



Potato blight



Mushrooms

Fungi are not plants or animals, in fact they are so important they have their own kingdom...

## The five kingdoms of organisms

Plant Kingdom



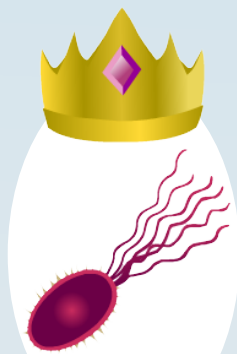
Animal Kingdom



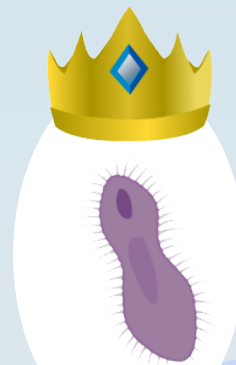
Kingdom Fungi



Kingdom Monera  
(bacteria)

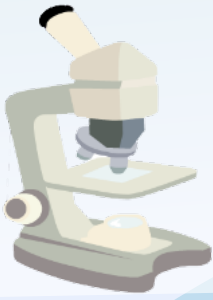


Kingdom Protista  
(algae and protozoa)





## Big & Small



Some fungi such as yeasts, which are used to make bread and beer, are micro-organisms and can only be seen under the microscope. Other fungi start from microscopic filaments which grow bigger and bigger until we can see them with our eye...

## Fungi & Mushrooms

Mushrooms and toadstools are the reproductive part of the fungus, or fruiting body. They produce millions of microscopic spores which, when dispersed, grow to make a new fungus, a bit like the seeds in an apple.



## Fungi as Food?

Some people think...

"Mushroom?  
That's an edible fungus,  
I can eat that one"

"Toadstool? That's a  
poisonous fungus, I'll avoid  
that one"



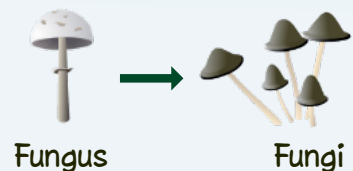
**BEWARE:** This has no scientific basis - just remember:

- Some fungi are edible but some are very **POISONOUS!**
- **NEVER** eat a fungus unless you are absolutely sure it is safe - ask an **EXPERT!**
- **ALWAYS** wash your hands after touching fungi

## Fungi Names

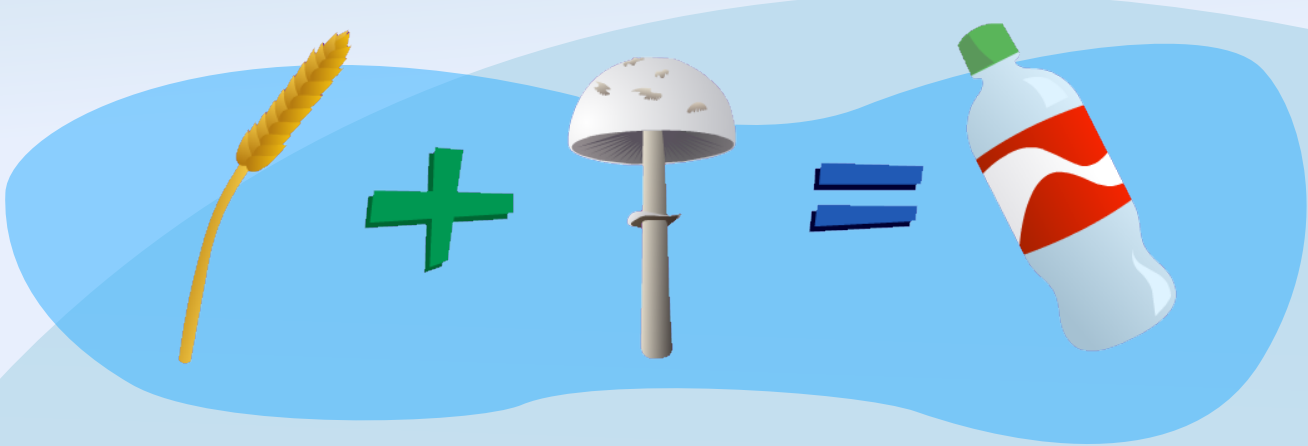
Fungi is the name given to more than one fungus. Each type of fungus usually has two names:

- A common name which can tell you something about how the fungus looks for example orange peel fungus.
- A scientific name for example *Aleuria aurantia*, which is written in Latin and is a unique identifier for scientists worldwide!



# Did You Know?

Scientists at the University of Manchester are investigating ways to make biodegradable plastics from wheat and other cereals using fungus



## Quiztime!

1. Which of these are fungi?

- A) Bread mould, mushrooms, yeast
- B) Turnips, pumpkins, potatoes
- C) Algae, protozoa, monera

2. What are the five kingdoms of organisms?

- A) Animals, plants, fungi, monera, protista
- B) Fungi, lions, flowers, bacteria, virus
- C) Animals, vegetable, minerals, plants, insects

The five kingdoms of organisms are:

Plant Kingdom, Animal Kingdom, Kingdom Fungi, Kingdom Monera (bacteria), Kingdom Protista (algae and protozoa).

3. What is more than one fungus called?

- A) Funguses
- B) Fungi
- C) Mushroom

4. Are fungi micro-organisms?

- A) Yes fungi are micro-organisms
- B) No fungi are not micro-organisms
- C) Some fungi are micro-organisms

5. What is a mushroom?

- A) The reproductive part of the fungus
- B) A poisonous fungus
- C) An untidy room

6. Which name tells you about the appearance of the fungus?

- A) Surname
- B) Scientific name
- C) Common name

See the answers at the  
end of the module



# The Structure of a Mushroom

## The Gills

Seen on the underside of the cap. Spores are produced and released from the gills. Other types of mushrooms may have teeth-like structures or pores that produce the spores.



Pores



Teeth

## The Cap

Forms the umbrella shaped part of the mushroom and is covered with a skin called the pellicle. The cap can sometimes have small remains of the universal veil that appear to be stuck on its surface.

## The Volva

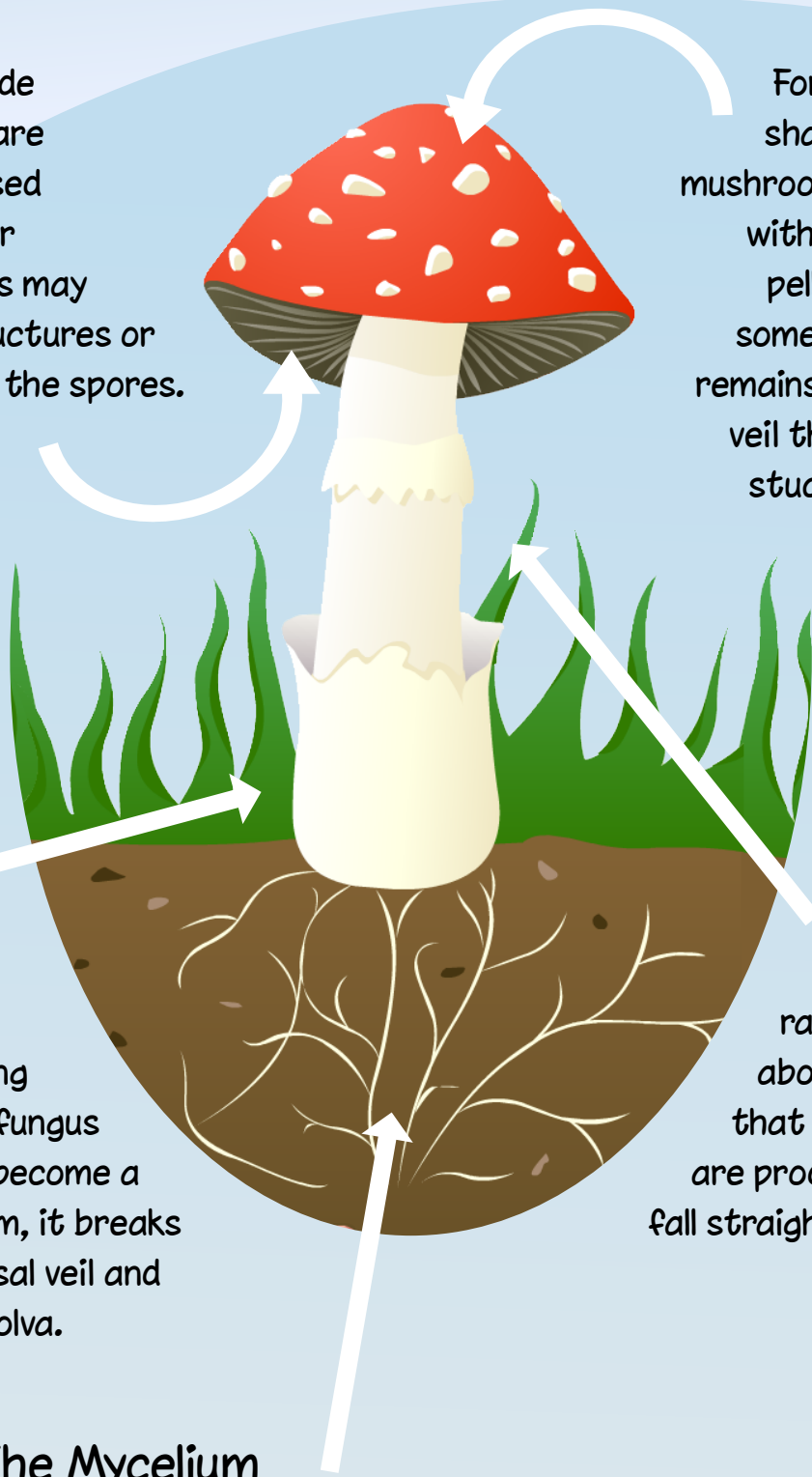
Is the remains of the universal veil which covered and protected the young mushroom. As the fungus grows upwards to become a fully formed shroom, it breaks through the universal veil and leaves behind the volva.

## The Stem

Is the tall structure that raises the cap high above the ground so that when the spores are produced they won't fall straight to the ground.

## The Mycelium

Is the hidden part of the fungus that is always present underneath the ground in the soil. It grows upwards and outwards in search of food. When enough food has been found the mycelium grows towards the soil surface and produces the mushroom.



# Did You Know?

A monster fungus found in Michigan, America and called *Armillaria bulbosa* covers an area of fifteen hectares, weighs around one hundred metric tonnes and is at least fifteen hundred years old. This makes it amongst the largest, heaviest and oldest living things known on this planet!

## Quiztime!

1. Which part of the mushroom searches for food?

- A) The mycelium
- B) The cap
- C) The stem

2. What is the volva?

- A) The remains of the universal veil
- B) The fruiting body
- C) The transport system

3. Why does a mushroom need a stem?

- A) To lift the cap off the ground
- B) To stop ants crawling over it
- C) So it can see over the grass

4. What is the fleshy head at the top of the mushroom called?

- A) Bob
- B) Nut
- C) Cap

5. What can you see under the cap?

- A) Eyes
- B) Hair
- C) Gills



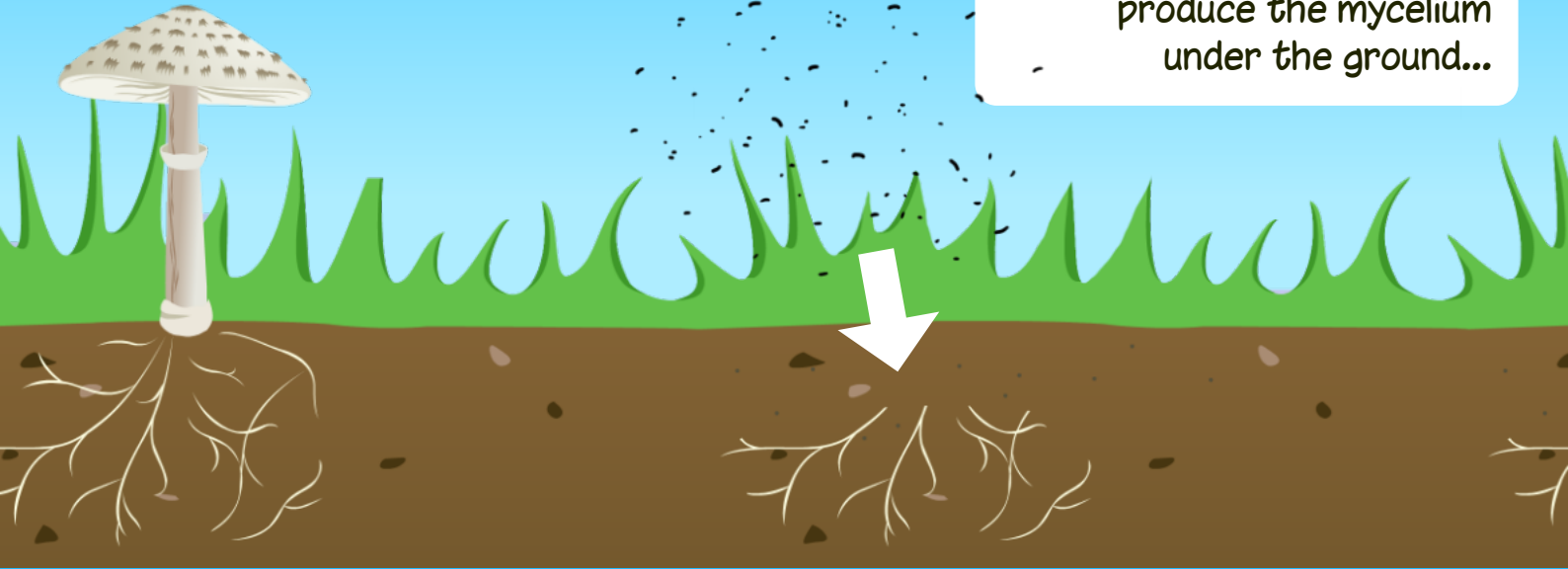
See the answers at the end of the module



# The Life-cycle of a Mushroom

1. The reproductive part of the fungus – releases spores, in a process known as sporulation...

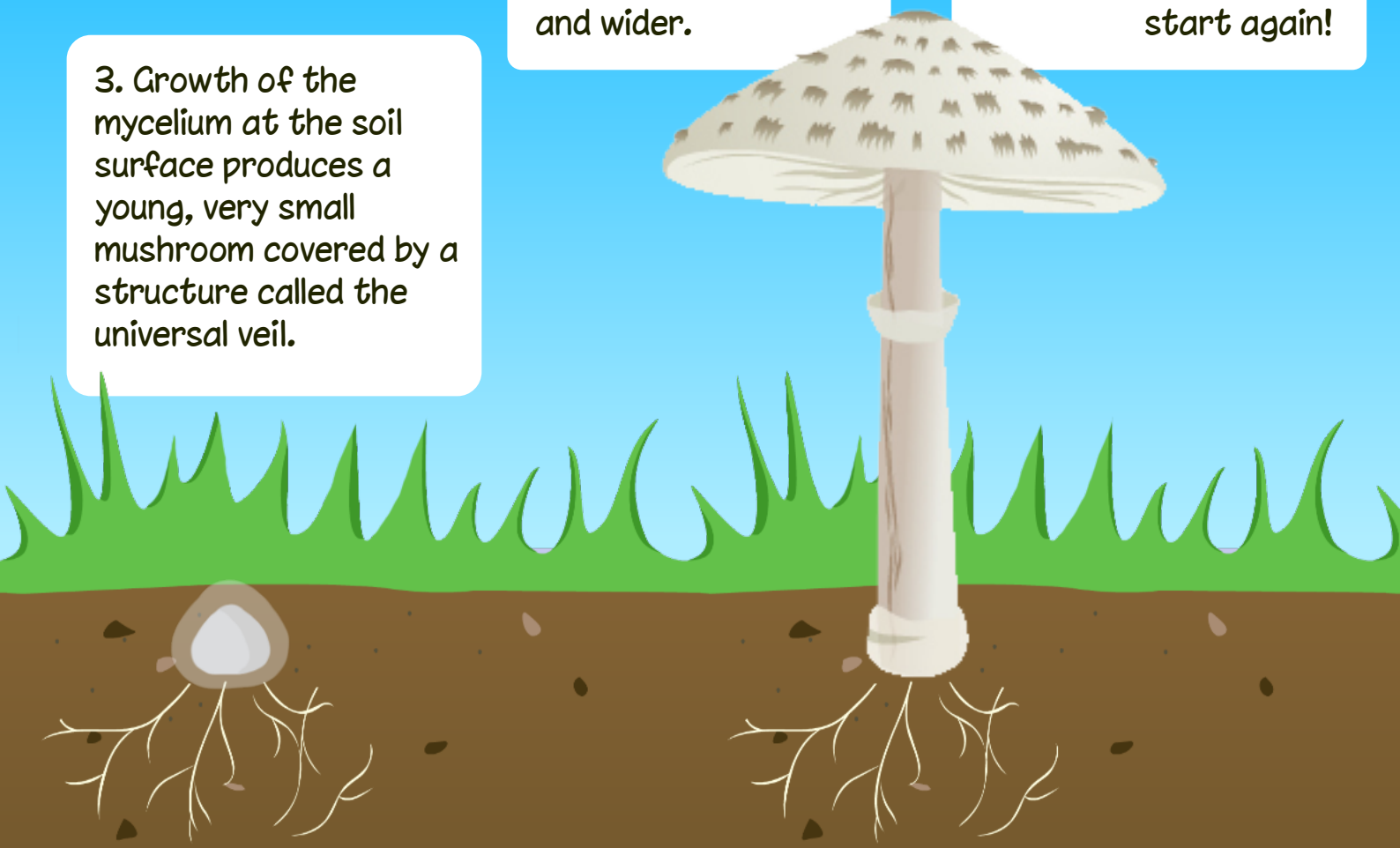
2. The spores that land on their ideal environment (this could be soil, dung, or plant litter) begin to produce the mycelium under the ground...



3. Growth of the mycelium at the soil surface produces a young, very small mushroom covered by a structure called the universal veil.

4. The mushroom breaks through this veil and grows taller and wider.

5. The adult mushroom produces spores and the process can start again!



# Did You Know?

Many industries use fungi like yeast to make materials such as alcohol and vinegar and this has been an active area of research at The University of Manchester for over 10 years. Currently, researchers are working out how to make fungus produce animal and human proteins which could be used to treat disease and help people to get well again.



## Quiztime!

1. What is a mushroom?

- A) The reproductive part of a fungus
- B) The reproductive part of a virus
- C) The reproductive part of a bacteria

2. What are the seeds of a mushroom called?

- A) Mycelium
- B) Pips
- C) Spores

3. Where do mushrooms like to grow?

- A) Soil, Dung, Plant litter, Trees
- B) Gravel, Water, Disinfectant
- C) Plastic, Paper, Metal

4. What protects the young mushroom?

- A) A Cap
- B) A Universal Veil
- C) A Tent

See the answers at the end of the module

# How Are A Mushroom's Spores Dispersed?

To ensure survival of its species, a fungus must produce and release spores as quickly as possible. Different types of fungi use different methods to disperse their spores over a wide area.

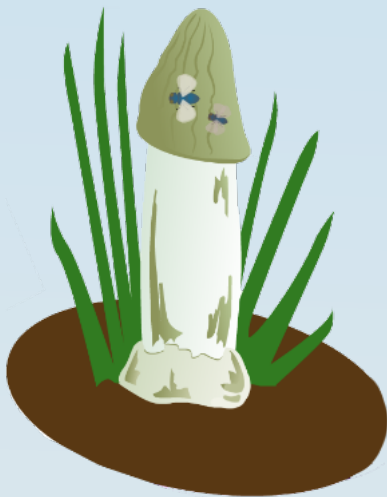


## Wind

Some types of mushroom, such as *Amanita muscaria*, release spores from the gills. The spores are then carried away over large distances by the wind.

## Rain

The cup fungus or Bird's Nest Fungus has its spores dispersed by rain fall. Raindrops fall into the fungus fruit body and force the spores out.



## Insects

The spores of the Stinkhorn fungus, *Phallus impudicus* are found in a foul smelling, slimy secretion on the bell shaped tip of the fruiting body. Flies are attracted to the strong smell and spores are transferred onto their legs.

## Mechanical Processes

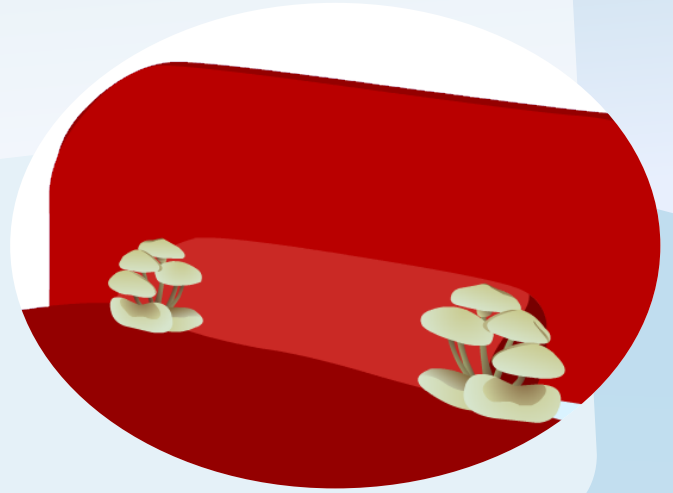
When the ball shaped fruit body of the Earthstar (*Geastrum*) is disturbed (by an animal or by twigs, leaves or rain drops falling on it) the pressure inside increases so much that the millions of spores are forced out at high speeds.



# Did You Know?

Researchers at The University of Manchester have discovered millions of fungal spores right under our noses - in our pillows!

Pillows are also inhabited by the house dust mite which eat the fungi, and the fungi in turn survive by eating the house dust mites' poos!



## Quiztime!

1. Why does a mushroom scatter its spores?

- A) To make sure they all get enough food
- B) To avoid being poisoned
- C) So they can find new friends

2. Which four processes are used to disperse spores?

- A) Wind, rain, nuclear, tidal
- B) Wind, rain, insects, mechanical
- C) Wind, rain, thermal, nuclear

3. Which process is used by *Amanita muscaria* to disperse its spores?

- A) Wind
- B) Rain
- C) Insects

4. Which process is used by the Birds Nest fungus to disperse its spores?

- A) Wind
- B) Rain
- C) Insects

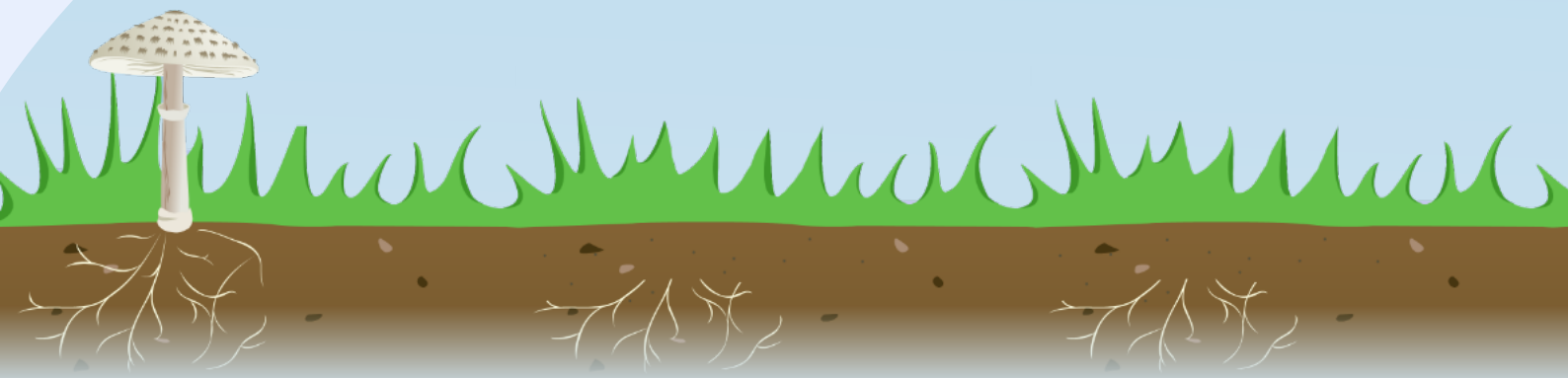
5. Which process is used by the Stinkhorn to disperse its spores?

- A) Wind
- B) Rain
- C) Insects

6. Which process is used by the Earthstar to disperse its spores?

- A) Wind
- B) Mechanical
- C) Insects

See the answers at the end of the module



## Match the Mushrooms

Fungi can be identified by looking at their size, shape, colour and habitat. A simple way to classify fungi is to divide them into simple groups based on their shape. See if you can classify all the fungi by its correct group.

### HINTS

- Look carefully at the outline shape.
- Is the fungus growing on a tree?
- Has the fungus got gills?





## Mushroom types:



PUFFBALLS



BOLETES



BRACKETS



GILL FUNGI



TRUMPETS



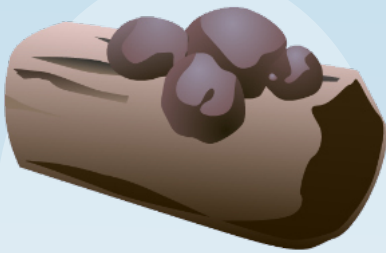
CUPS & EARS



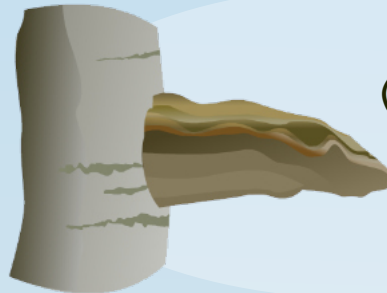
BLOBS ON WOOD



CLUB FUNGI

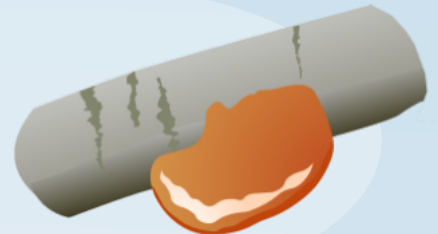


King Alfred's Cakes  
(*Daldinia concentrica*)  
Found on dead wood



Artist's Fungus  
(*Ganoderma applanatum*)  
Found on trees,  
especially beech

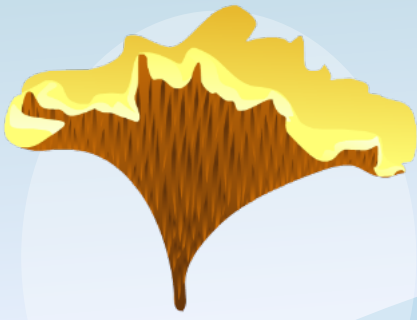
Beefsteak fungus  
(*Fistulina hepatica*)  
Found on trees, oak  
and sweet chestnut



Birch Bracket  
(*Piptoporus betulinus*)  
Found on birch trees

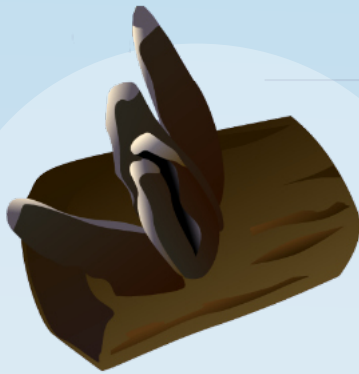


Butter Cap  
(*Collybia butyracea*)  
Found in leaf litter in woodlands,  
especially under broad leaved trees.



Chanterelle  
(*Cantharellus cibarius*)  
Found in woodland

Common Inkcap  
(*Coprinus atramentarius*)  
Found on the soil,  
associated with  
buried wood



Dead Man's Fingers  
(*Xylaria polymorpha*)  
Found on stumps of trees,  
often beech



Common Puffball  
(*Lycoperdon perlatum*)  
Found on dead wood,  
woodland



Dryad's Saddle  
(*Polyporus squamosus*)  
Found on trees, beech and sycamore



Earthball  
(*Scleroderma citrinum*)  
Found on rich woodland,  
sandy soil

Earthstar  
(*Geastrum triplex*)  
Found on the ground in woods.



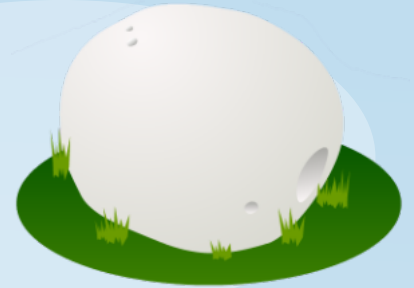


Field Mushroom  
(*Agaricus campestris*)  
Found in pastures



Fly Agaric  
(*Amanita muscaria*)  
Found in open  
Woodland

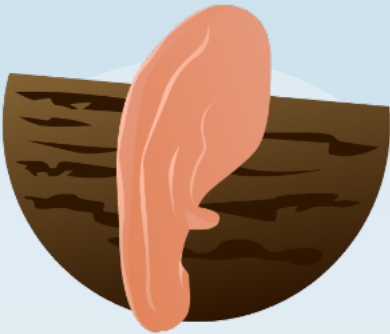
Giant Puffball  
(*Calvatia gigantea*)  
Found in pasture,  
light woodland



Glistening Inkcap  
(*Coprinus micaceus*)  
Found on or around  
stumps or buried wood



Horn of Plenty  
(*Craterellus cornucopoides*)  
Found on woodland leaf litter



Jelly Ear  
(*Auricularia auricula-judae*)  
Found on living or dead wood



Milk Caps  
(*Lactarius vietus*)  
Found under birch trees

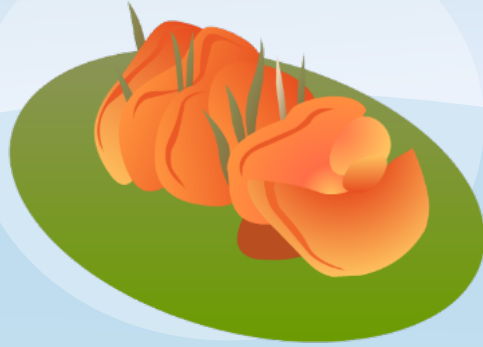


Mottled Bolete  
(*Leccinum varicolor*)  
Found in birch  
woodlands



Orange Birch Bolete  
(*Leccinum versipelle*)  
Found in birch  
woodlands

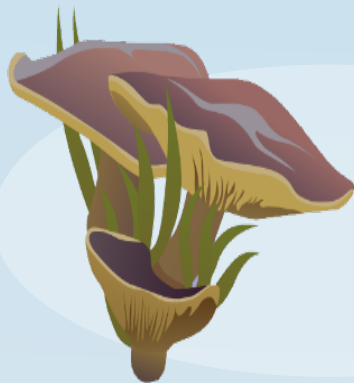
Orange Peel Fungus  
(*Aleuria aurantia*)  
Found on grass, soil



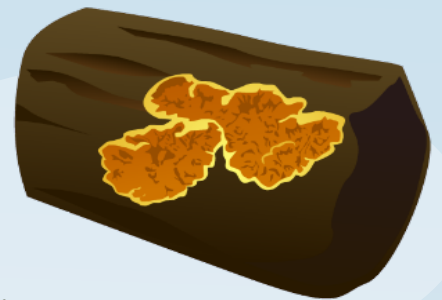
Parasol  
Mushroom  
(*Macrolepiota  
procera*)  
Found in fields  
and parks



Penny Bun  
(*Boletus edulis*)  
Found under pine trees  
and woodland



Plums and Custard  
(*Tricholomopsis  
rutilans*)  
Found on conifer  
stumps



*Pseudomerulius aureus*  
Found on surface of dead  
coniferous wood



Shaggy Inkcap  
(*Coprinus comatus*)  
Found in grass at  
roadsides, in lawns



Spluttered Candle  
(*Helvella crispa*)  
Found in woodlands



**Verdigris Toadstool**  
(*Stropharia aeruginosa*)  
Found in gardens, parks and  
hedgerows, also woods.

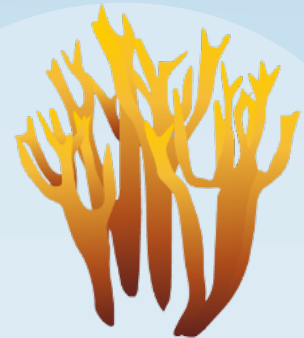


**Velvet Shank**  
(*Flammulina velutipes*)  
Found on dead broad-leaved  
trees, especially elm and  
shrubs, notably gorse.

**Witches' Butter**  
(*Exidia glandulosa*)  
Found on dead wood

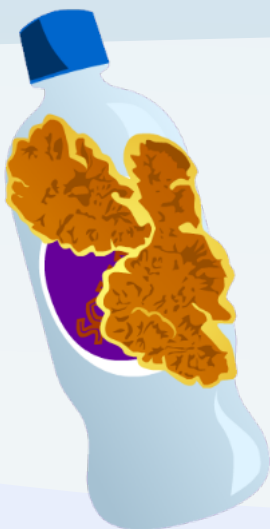


**Wrinkled Club**  
(*Clavulina cinerea*)  
Found on the ground  
in woods



**Yellow Stagshorn**  
(*Calocera viscosa*)  
Found on rotting pine  
stumps

## Did You Know?



We already know that Fungi are good at breaking down dead wood but now researchers at The University of Manchester are finding out which fungi are the best at breaking down plastics - so that they can reduce waste and help the environment.



# Quiztime!

1. Which features can you use to identify a mushroom?

- A) Shape, size, colour, habitat
- B) Shape, size, colour, sound
- C) Shape, size, colour, movement

2. Which fungi only grow on wood?

- A) Gill Fungi
- B) Bracket Fungi
- C) Boletes

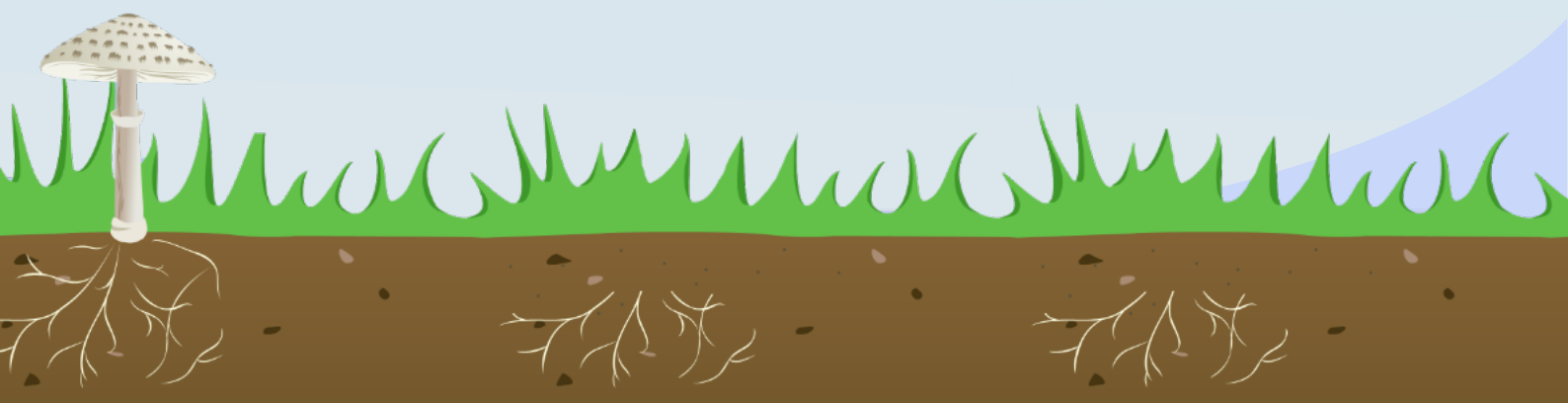
3. Which fungi have gills?

- A) Beefsteak, Dryads Saddle
- B) Fly Agaric, Butter Cap
- C) Inkcap, Spluttered Candle

4. Which fungi are shaped like a trumpet?

- A) Chanterelle, Horn of Plenty
- B) Puffball, Earthstar, Earthball
- C) Dead Mans Fingers, Witches butter

See the answers at the end of the module





# What are Bacteria?

Bacteria are single celled micro-organisms. They first appeared on Earth about 3.5-4 BILLION years ago and were the very first form of life to exist on Earth.

Bacteria live everywhere! They are on your skin right now, in your nose and all over your teeth. Others can be found in the soil, on surfaces in the kitchen, the toilet and over raw meat like chicken.

Certain tough bacteria are able to live in the Earth's most extreme environments.

Bacteria have been found deep inside ice above Lake Vostok in the Antarctic.



Scientists have discovered bacteria growing in the hot springs of Yellowstone National Park, America, where the water reaches near boiling temperatures!



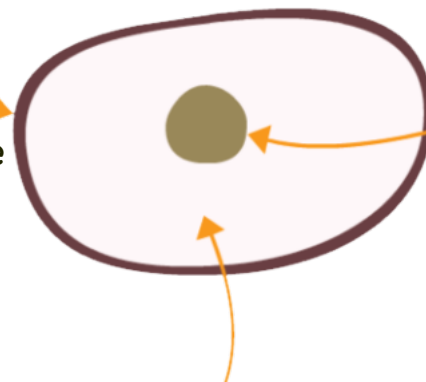
What do bacteria look like?

The cells that make up animals, like people, cats, dogs, fish etc, are quite simple structures...

## An Animal cell

Cell Membrane

This gives the cell its shape and controls what enters and leaves the cell, for example waste products.



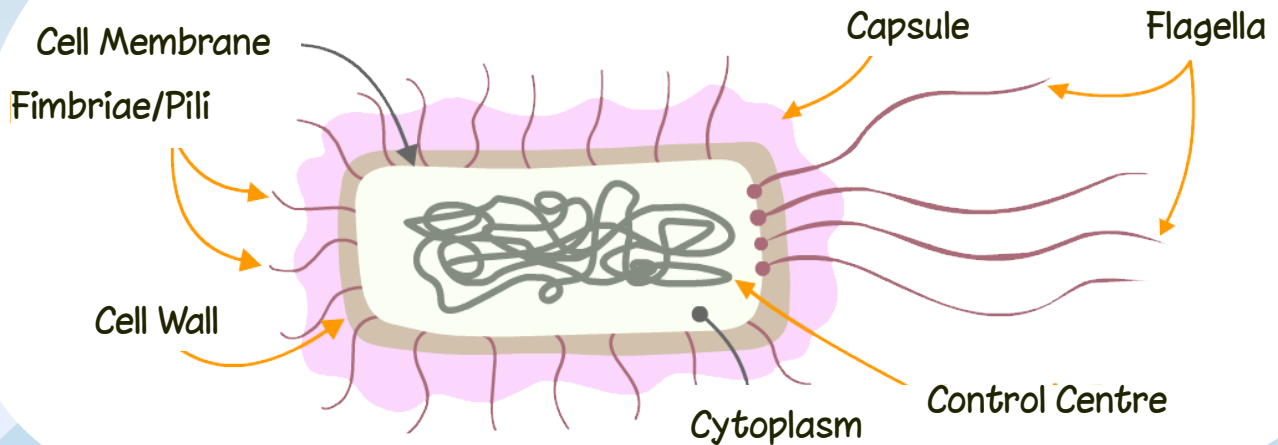
Nucleus

Contains DNA. Is known as the 'brain' control centre of the cell as it controls what the cell does.

Cytoplasm

this is a jelly-like material where the cell's chemical reactions occur.

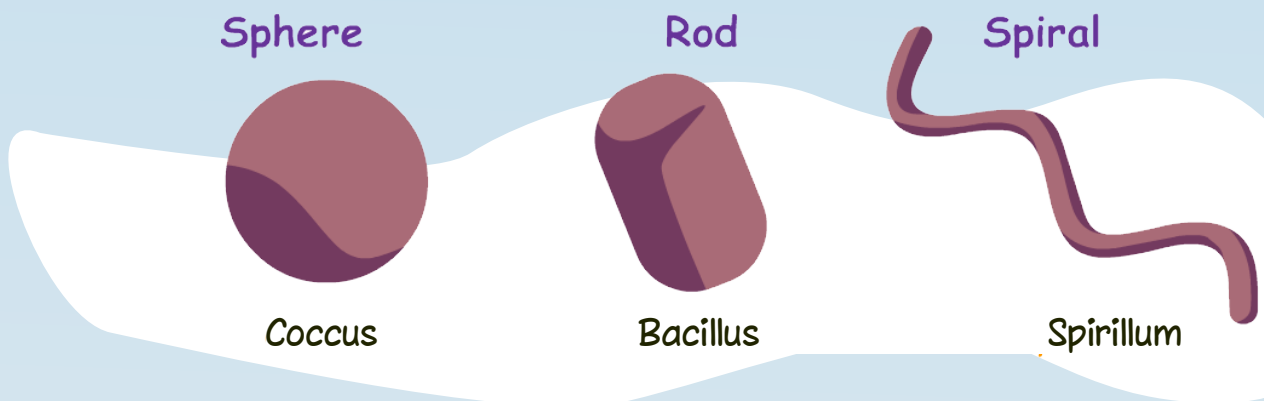
# A Bacterial cell



Bacterial cells are very different to animal cells; they have a more complex structure.

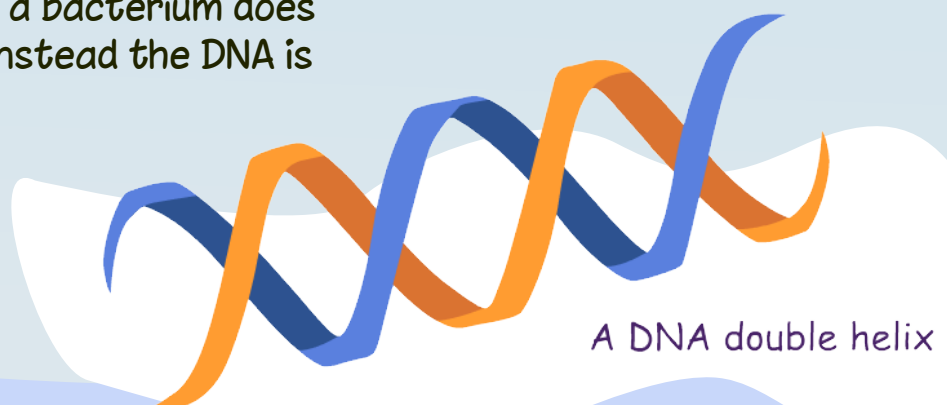
## Cell wall

The Cell Wall gives the bacterium its shape. There are three main shapes that bacteria can have:



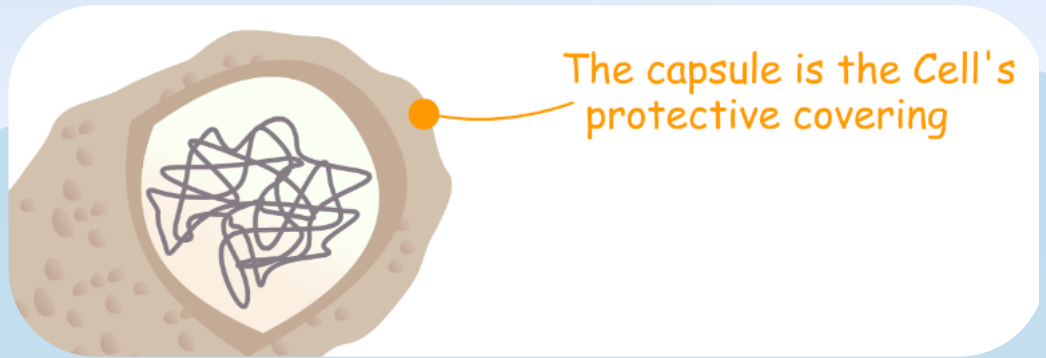
## Control centre

Unlike an animal cell, a bacterium does not have a nucleus. Instead the DNA is spread out inside the cell. It still controls the cells activity though!



# Capsule

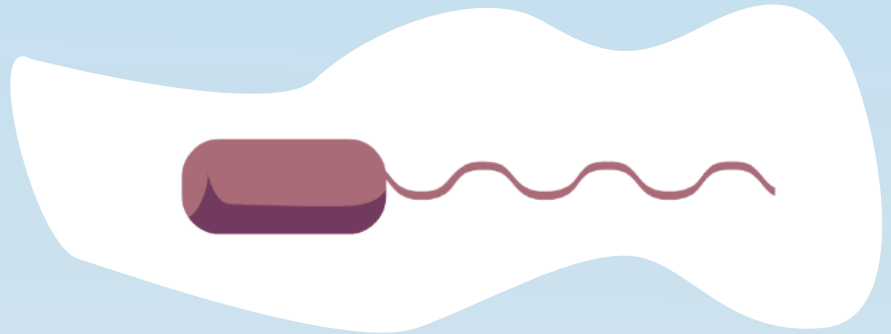
The capsule is the cell's protective layer. It stops white blood cells of the human body attacking and killing it. If it isn't killed the bacterium will go on to cause illness.



# Flagella

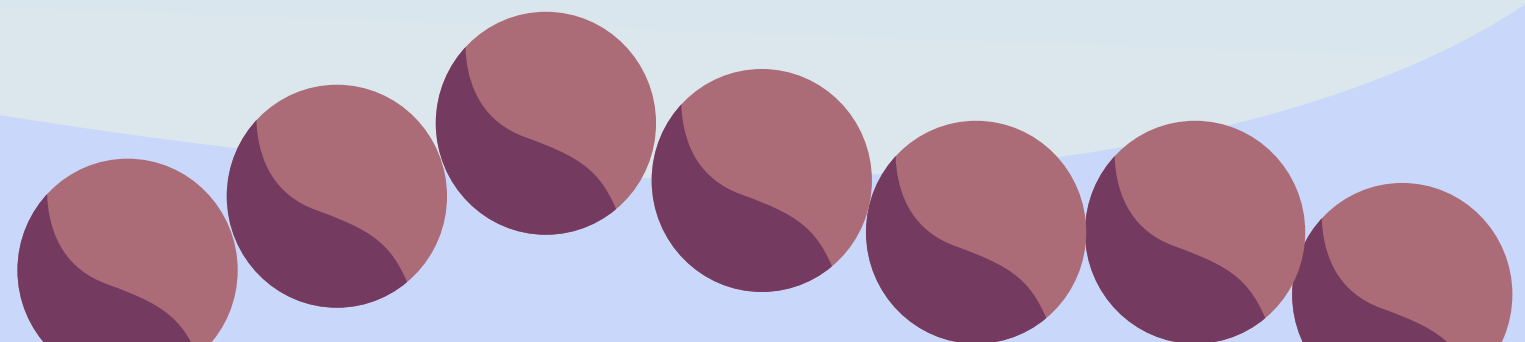
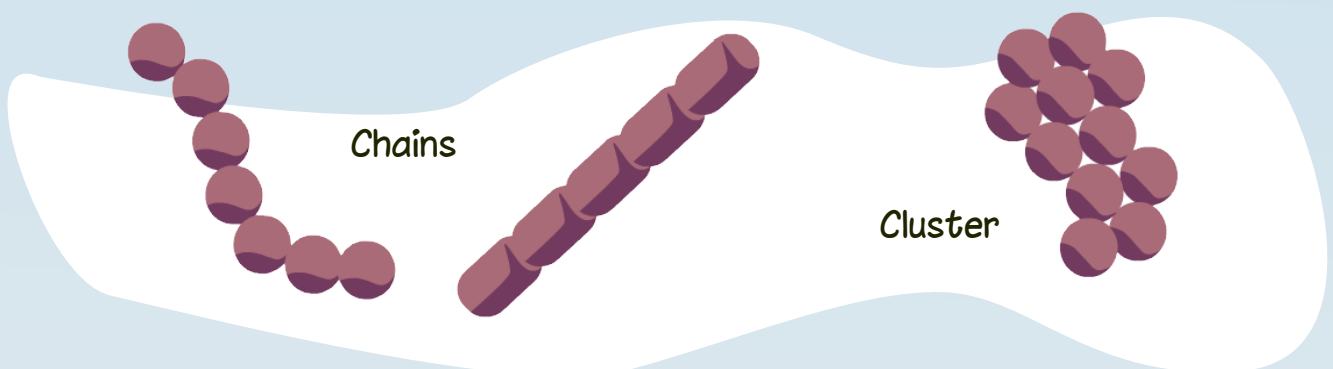
The flagella is a long tail like structure that allows the bacterium to move or swim around. Think of it as the propeller. The flagella can rotate clockwise or anti-clockwise depending on what it wants to do.

A bacterium can have one, two or many flagella



# Fimbriae

Fimbriae, or Pili, are short hair like structures that allow bacteria to stick to each other, human cells or surfaces like kitchen surfaces! Think of them as the bacterium's glue stick!



# Did You Know?

Gastroenteritis - that's abdominal pain, vomiting and diarrhoea!  
- is caused by bacteria called *Campylobacter jejuni*.



Researchers at the University of Manchester are finding out how the bacteria that live in the food we eat can make us so poorly. If their research is successful, they may be able to prevent the illness from happening.

## Quiztime!

1. How long ago did bacteria first appear on the Earth?

- A) 3.5 to 4 billion years ago
- B) 1.5 to 2 billion years ago
- C) 65 Million years ago

2. Where are bacteria found?

- A) In the soil
- B) In dirty places
- C) Everywhere!

3. Why do bacteria have a cell wall?

- A) To protect it from the enemy
- B) To keep its shape
- C) To keep animals off its garden!

4. What is DNA?

- A) The Brain, or control centre
- B) The skin
- C) The stomach

5. How do bacteria move about?

- A) Use their legs
- B) Rotate their flagella
- C) The stomach

6. Which part of the bacteria protects it from human fighting cells?

- A) DNA
- B) Fimbriae
- C) Capsule

See the answers at the end of the module

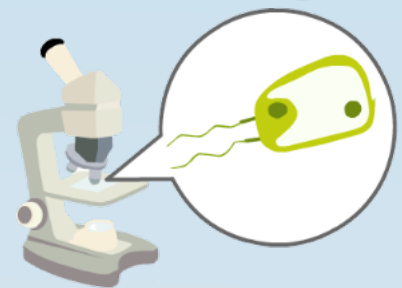
## What are Algae?



Algae belong to Kingdom Protista along with protozoa. Algae are extremely diverse in **STRUCTURE** and **SIZE** as they range from single-celled *Chlamydomonas* found in lakes and other fresh water habitats to 60m long multicellular kelps found in the sea!

Unlike bacteria and viruses, algal cells have a nucleus and unlike ALL the other micro-organisms they are able to **PHOTOSYNTHESISE**.

Algae are close relatives to plants as they both have **CHLOROPLASTS** in their cells. Chloroplasts are small green structures that contain the green pigment **CHLOROPHYLL**. It is the chlorophyll that absorbs sunlight which provides energy for the process of photosynthesis.



*Chlamydomonas*



**Water +  
carbon dioxide**

**sugar + oxygen**

During photosynthesis, water and carbon dioxide gas are used to make sugar and oxygen. The algae will use the sugar as food and the oxygen is released and used by fish to breathe.

Algae display great Structural Diversity. This means different types of algae look very different from each other.

They can be...

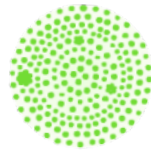


**Filamentous**  
very long thin  
strands of algae

**Single-celled**  
small unicellular algae

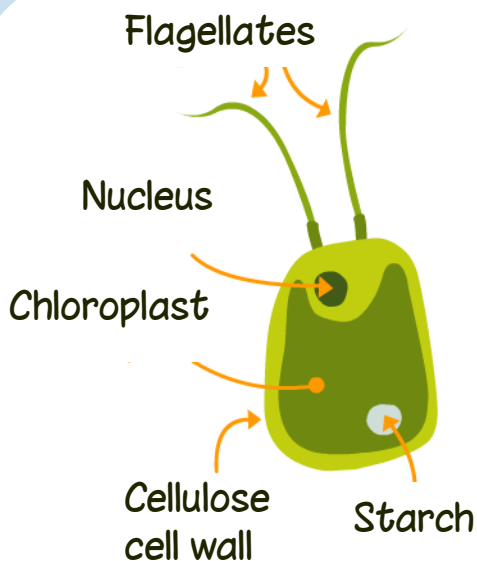


**Large Multicellular**  
the algae you find in the  
sea and washed up onto  
beaches



**Colonial**  
many algal cells  
arranged like a circle

## Single-celled



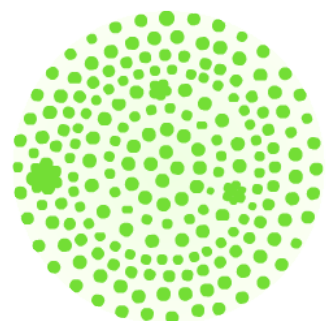
Chlamydomonas is a single celled green alga of group Chlorophyta, which can be found in fresh water habitats such as lakes and rivers. It has two flagella (known as biflagellate) at one end of its body which uses for movement.

Chlamydomonas is similar to plants in two ways:

1. They both have cell walls made from CELLULOSE.
2. The sugar made from photosynthesis is stored as STARCH.

## Colonial

Volvox is also a green alga of group Chlorophyta. It is made up of many flagellated algal cells that are attached to each other by very thin strands of cytoplasm, to form a spherical colony.





## Filamentous

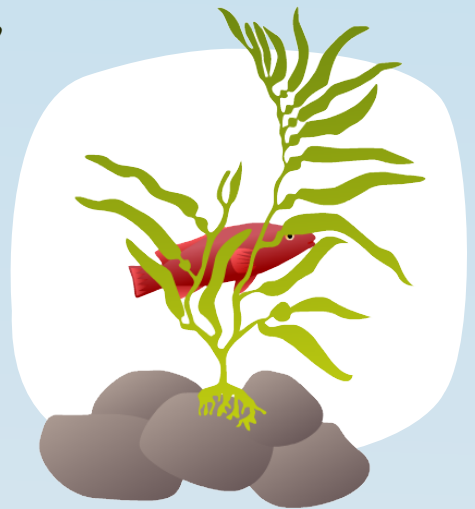
Spirogyra is another green algae whose cells are positioned end-to-end to form long thin filaments. It can be found all over the world in fresh water habitats such as ponds, lakes and slow flowing streams. It can even survive in Antarctica! The whole filament is covered by a thin, sticky layer of mucilage (think of it as glue) which causes many filaments to stick together forming a huge Spirogyra mass. Oxygen released during photosynthesis becomes trapped in the huge filamentous mass causing it to float.



## Large multicellular

Have you ever seen seaweed washed up on a beach? If you have then you've seen a type of alga. Red and brown algae are large multicellular organisms (NOT micro-organisms), although brown algae is A LOT bigger than red algae.

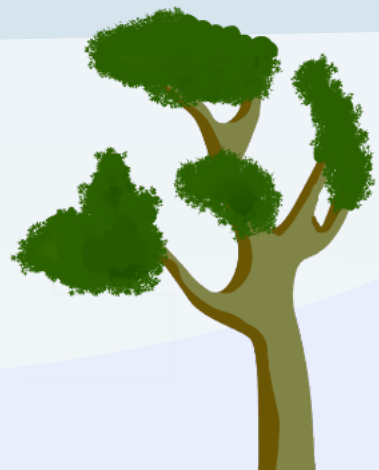
Amongst the biggest brown algae is *Macrocystis*, a type of kelp that can grow to over 60m in length! Kelps grow very rapidly, close together and in huge numbers forming 'kelp forests' which provides food and shelter for all sorts of marine organisms.



*Macrocystis*

## Did You Know?

The green coating you can often see on the bark of trees is an alga. The single cells of algae are usually found floating in the sea and fresh water, but they also grow on the surfaces of damp walls, rocks, the bark of trees and on soil.



# Quiztime!

1. Are algae micro-organisms?

- A) Yes, all algae are micro-organisms
- B) No, algae are not micro-organisms
- C) Some algae are micro-organisms

2. Which is the only micro-organism that can photosynthesise?

- A) Virus
- B) Bacteria
- C) Algae

3. What shape are algae?

- A) Lots of shapes
- B) Spherical
- C) Rod like

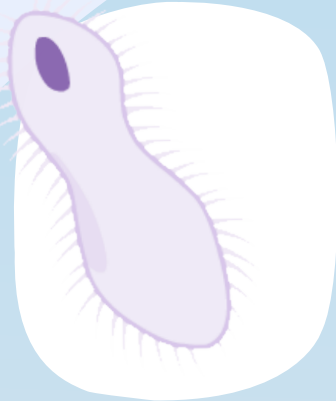
4. Which of these are algae?

- A) Seaweed and Kelp
- B) Sunflower and Tulip
- C) Dandelion and Burdock

See the answers at the  
end of the module

# What are Protozoa?

Protozoa are single-celled micro-organisms that get their food from the surrounding environment, or as scientists would say they are heterotrophs'. They can be found in a variety of habitats such as freshwater (including ponds & rivers), marine (the sea) and even in the soil.



Protozoa are extremely DIVERSE, which means that the different types of protozoa that exist differ in size, shape, by how they feed and how they move. It is these differences that enable scientists to classify them into FOUR groups;

## The Amoebas

The scientific name for the protozoan shown is *Amoeba proteus*! During feeding the amoeba produces long extensions of its body known as PSEUDOPODS around the food until it is completely surrounded. This creates a food parcel inside the amoeba. The food is then digested by special molecules called ENZYMES that break down the food into much smaller particles that the amoeba can use as energy for movement.

*Amoeba proteus*



*Entamoeba histolytica* is another type of amoeba that causes an illness in humans called Amoebic Dysentery disease. The disease causes severe diarrhoea and is caught by drinking or eating infected food or drink. This type of protozoa travels through the digestive system and stays in the intestine where it causes infection

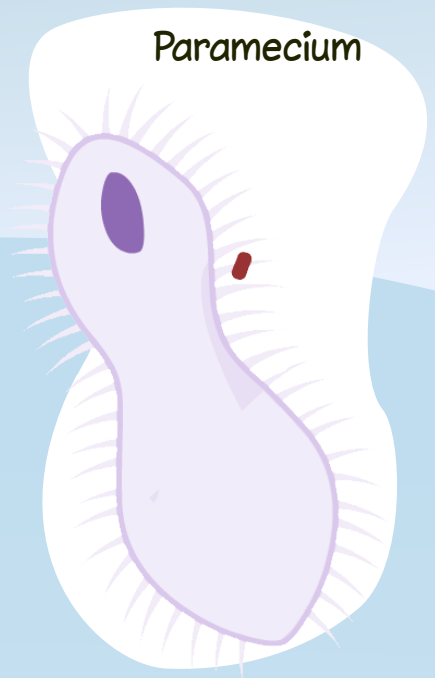
This demonstrates the diversity between different types of amoebas, some live in lakes and ponds whilst *Entamoeba histolytica* can survive in the human body!

## The Cilites

This group of protozoa are called the ciliates because they are lined with tiny hair like projections called cilia which are used for movement. The cilia move backwards and forward rapidly causing the micro-organism to move forwards whilst spinning. The example shown here is called Paramecium.

Paramecium has a different feeding mechanism than The Amoebas. This time the rapidly moving cilia help to capture the bacteria (this is what Paramecium eat) near the 'mouth' region on the side of the Paramecium. The bacterium is then passed down this opening and then into the cytoplasm as a food parcel. Enzymes then break down the bacterium into useful products for the Paramecium.

Since Paramecium eat bacteria they are extremely useful in the treatment of sewage! It removes the harmful bacteria from raw sewage, which is everything that gets flushed down the toilet after we have used it. Our poo is full of different types of bacteria that must be removed before it reaches the sea, if it isn't treated and we come into contact with it then we can become very ill. The treated sewage is safe to release into the sea, on farmers' land or it is burnt or buried.



Paramecium

## The Flagellates

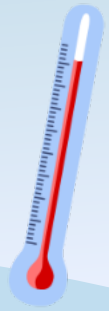
This group of protozoa are called The Flagellates because they have one or more flagella on their cell body. Flagella are used for movement; they are much longer than cilia and also move rapidly but in a whip like motion. An example of a protozoan flagellate is Trypanosoma brucei.

Sleeping Sickness is a very serious and life threatening disease of East Africa. It is caused by Trypanosoma brucei which is a protozoan PARASITE. The protozoa are carried by the Tsetse Fly and when it bites an unsuspecting person it transfers the parasite into that person.

Trypanosoma brucei.



The disease, which occurs in two stages, can kill the person if they are not treated with medicine. During the first stage the person will feel very sick, have a very high temperature and feel very tired. During the second stage the brain is affected and damaged, affecting how well and when the person sleeps. Their concentration will also decrease.



## The Sporozoans



Think of the Sporozoans as the odd one out because they are not motile. They do not have flagella or cilia so can not move on their own. To survive they must live inside a host such as an animal or a human where they act as a parasite. This means that the sporozoan is in NO way beneficial or good for the host and in most cases will cause serious disease!

An example of a parasitic sporozoan is Plasmodium which causes Malaria. Mosquito's infected with the protist Plasmodium infect humans by biting them, causing Malaria. The protist travels to and infects liver cells and then red blood cells. This makes the person feel very ill; they will suffer from sickness, high temperature and headaches.



## The life-cycle of Plasmodium:

1. Mosquito Bites a human and passes on Plasmodium



2. Plasmodium enters liver cells and reproduces... these then enter red blood cells and reproduce again...



3. Some red blood cells burst, destroying them, this causes the symptoms of Malaria - fever and the chills



4. Another mosquito feeds on infected blood, and the plasmodium is passed into the mosquito!





# Did You Know?

There are more Protozoa in the world than any other sort of animal. Some of the ones that live in the sea make chalky shells to live in, and these settle to the bottom of the sea when the protozoan dies. That's been happening for 600 million years and although the shells are so tiny, there have been so many of them that present-day chalk and limestone rocks are mainly made up of those shells.



## Quiztime!

1. Are protozoa microorganisms?

- A) Yes all protozoa are micro-organisms
- B) No, protozoa are not micro-organisms
- C) Some protozoa are micro-organisms

2. How do protozoa get their food?

- A) They make it themselves
- B) They eat other things
- C) They don't eat

3. Where do protozoa live?

- A) Ponds, rivers, sea and soil
- B) Deserts and dry places
- C) Both of the above



4. What are the four groups of protozoa?

- A) Amoebas, ciliates, flags, sporozoans
- B) Amoebas, ciliates, frogs, sporozoans
- C) Amoebas, ciliates, flagellates, sporozoans

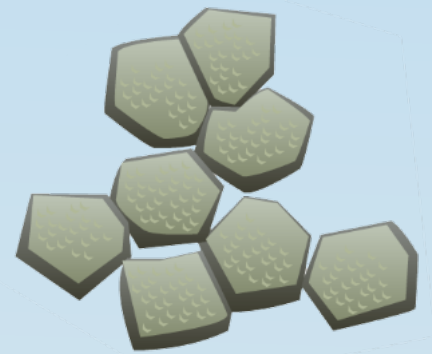
5. Can all four groups of protozoa move?

- A) Yes, they can move
- B) No, they can't move
- C) Some of them can move

## What are Viruses?

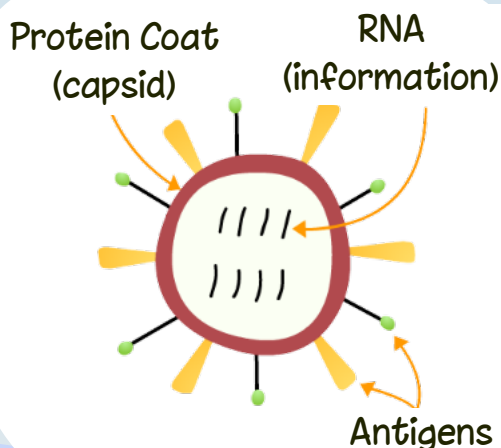
Viruses are so completely different to all the other micro-organisms that they are not included in the Five Kingdom classification system and some people don't consider them as being 'alive'!

So what are they? Viruses are the smallest type of microbe that causes a large number of diseases in plants, animals and humans. In order to LIVE and REPRODUCE it is essential that the virus enters a living cell; because of this scientists describe viruses as INTRACELLULAR PARASITES, It is best to think of a virus as INACTIVE when it isn't inside a living cell and ACTIVE when it is.



## Appearance

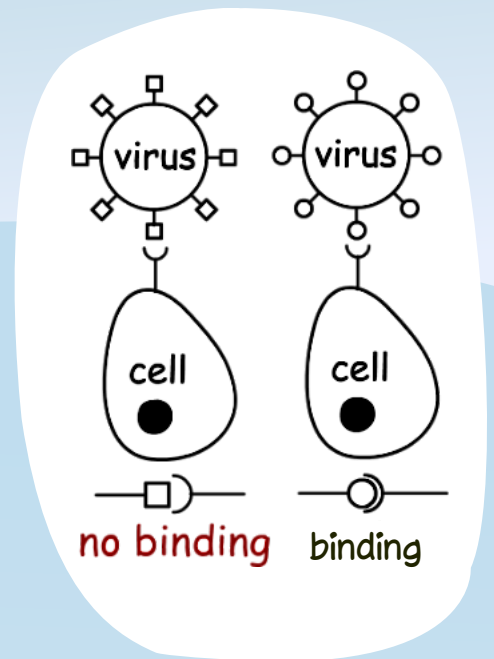
Viruses have simple structures that differ in size and shape. They do not have a nucleus (remember a nucleus contains DNA and controls what the cell does), instead viruses have one or two STRANDS of DNA or RNA (these are types of acid). A protein coat surrounds the DNA or RNA to protect it. This coat is called a CAPSID. Some viruses have another protective layer called an ENVELOPE.



# Infection

To infect a cell, a virus must first attach itself to the cell. Viruses have protein structures on their surfaces called ANTIGENS, these attach to protein receptors on the target cell surface. When an antigen connects with a specific receptor, they BIND very tightly.

If an antigen comes into contact with an incorrect receptor then NO binding will occur and the virus will not infect that cell. This is why different viruses affect different plants and animals.



Once firmly attached the virus 'injects' its DNA or RNA into the target cell. The target cell now acts like a virus factory making copies of the virus. When enough copies have been made the target cell bursts open and releases the viruses, which infect more cells and the whole process starts again!

# Influenza

Many people call this virus the Flu and you will probably know somebody who has suffered from it because it is very easy to catch. If somebody with the flu sneezes they will spread droplets containing the virus EVERYWHERE! If you breathe in some of these droplets or touch a surface where they have landed and then put your fingers in your mouth, it is very likely that you will become ill as well..

Flu symptoms:

- Shivering
- Headaches
- Tiredness
- Aching muscles
- High temperature (39°C)



# Chicken Pox

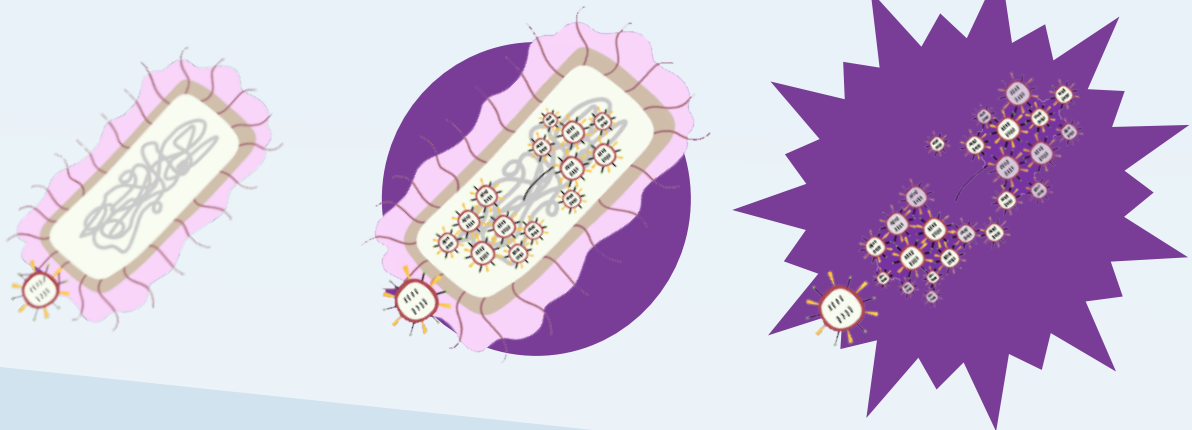
The chickenpox is caused by a virus called Varicella-Zoster; a characteristic of this illness is very itchy spots.

If you have had the chickenpox it is very unlikely that you will ever get them again. It is a common (happens quite a lot) illness in children. The itchy spots appear mostly on the body and face.



## Did You Know?

Bacteria catch virus diseases too. The virus is called a bacteriophage. It injects DNA into the bacterium that instructs the bacterium to produce lots of new viruses. So many are produced, that the bacterium bursts!



## Quiztime!

1. Which Kingdom do viruses belong to?

- A) Kingdom Protista
- B) Kingdom Monera
- C) They don't belong to a Kingdom

2. Which has the simplest cell structure?

- A) An Animal
- B) A Bacteria
- C) A Virus

3. Can one type of virus cause illness in all living things?

- A) Yes
- B) No
- C) Sometimes

4. Which illnesses are caused by a virus?

- A) Chicken Pox and Flu
- B) Food poisoning and Tooth Decay
- C) Amoebic dysentery and malaria



# Wordsearch

Can you find these words?

Orange peel  
Fly agaric  
Penny bun

Puffball  
Earthstar  
Stag horn

Waxcap  
Parasol  
Beef steak



# Answers



# What are micro-organisms (answers)

1. What is a micro-organism?

- A) A living organism which can only be seen under a microscope ✓
- B) A living organism which can be seen by the naked eye
- C) A living organism which lives in the microwave

A micro-organism is so small that we need a powerful microscope to see it.

2. What are the five types of micro-organism?

- A) Plants, virus, animals, minerals, fungi
- B) Fungi, bacteria, protozoa, virus, algae ✓
- C) Trees, bacteria, protozoa, plants, fungi

The five types of micro-organism are algae, bacteria, fungi, protozoa and virus. These can be separated into two groups, harmful and helpful micro-organisms.

3. Which of the following are caused by bacteria?

- A) Chicken pox, conjunctivitis and measles
- B) Food poisoning, tooth decay, sore throats ✓
- C) Chicken pox, dental plaque and food poisoning

Food poisoning, tooth decay and sore throats are all caused by bacteria. Remember though - bacteria aren't all bad, they can also be used to produce antibiotics!

4. Which of the following are made using fungi?

- A) Soy sauce, Quorn, bread, beer, penicillin ✓
- B) Toothpaste, mint sauce, crisps, oxygen
- C) Mushrooms, jam, tomato sauce, potatoes

Soy sauce, Quorn, bread, beer and penicillin are all made using fungi! Look out for these and other things that are made from fungi when you next go to the supermarket!

5. Which of the following produce 75% of the world's oxygen?

- A) Bacteria
- B) Fungi
- C) Algae ✓

Approximately 75% of the world's oxygen is produced by the algae which are found in the sea, lakes, rivers streams and ponds

6. Which of the following cause malaria, sleeping sickness and amoebic dysentery?

- A) Fungi
- B) Protozoa ✓
- C) Bacteria

Sleeping sickness and amoebic dysentery are both caused by protazoan parasites, which enter the body through bites from flies and mosquitoes.



7. Which of the following are caused by a virus

- A) Conjunctivitis, measles, chicken pox ✓
- B) Salmonella, algal bloom, measles
- C) Athlete's foot, sleeping sickness, tooth decay

Conjunctivitis, measles and chicken pox are all caused by a virus. Can you remember what causes the others?

# What are Fungi? (answers)

1. Which of these are fungi?

- A) Bread mould, mushrooms, yeast ✓
- B) Turnips, pumpkins, potatoes
- C) Algae, protozoa, monera

Fungi are all about us, they include bread mould, mushrooms, yeast, Quorn and penicillin. They are used to make marmite, soy sauce and beer and cause athletes foot and potato blight!

2. What are the five kingdoms of organisms?

- A) Animals, plants, fungi, monera, protista ✓
- B) Fungi, lions, flowers, bacteria, virus
- C) Animals, vegetable, minerals, plants, insects

The five kingdoms of organisms are:

Plant Kingdom, Animal Kingdom, Kingdom Fungi, Kingdom Monera (bacteria), Kingdom Protista (algae and protozoa).

3. What is more than one fungus called?

- A) Funguses
- B) Fungi ✓
- C) Mushroom

The plural, that's more than one fungus is fungi Remember, for virus the plural is viruses. That's tricky!

4. Are fungi micro-organisms?

- A) Yes fungi are micro-organisms
- B) No fungi are not micro-organisms
- C) Some fungi are micro-organisms ✓

Some fungi, like yeast and penicillin, are micro-organisms which we can only see using a microscope, Others like mushrooms start off as microscopic filaments which grow bigger and bigger to form mushrooms which we can see with our eye.

5. What is a mushroom?

- A) The reproductive part of the fungus ✓
- B) A poisonous fungus
- C) An untidy room

A mushroom is the reproductive part of the fungus. It is the part which produces the spores which are scattered and grow to make new fungi, They can be edible or very poisonous - SO DON'T eat one unless an expert says it is safe.

6. Which name tells you about the appearance of the fungus?


- A) Surname
- B) Scientific name
- C) Common name ✓

The common name of a fungus generally tells you something about its appearance in your own language eg orange peel fungus looks like orange peel. The scientific name is written in Latin eg *Aleuria aurantia* and is the name used by scientists all over the world to identify the fungus no matter what language they speak




# The structure of a Mushroom (answers)

1. Which part of the mushroom searches for food?

- A) The mycelium 
- B) The cap
- C) The stem

The mycelium, which is hidden under the ground, grows upwards and outwards in search of food.

2. What is the volva?

- A) The remains of the universal veil 
- B) The fruiting body
- C) The transport system


The volva, at the bottom of the stem, is the remains of the universal veil which covered and protected the young mushroom.

3. Why does a mushroom need a stem?

- A) To lift the cap off the ground
- B) To stop ants crawling over it
- C) So it can see over the grass


The stem raises the cap above the ground so that all of the spores don't land right under the mushroom and fail to grow due to lack of nutrients.

4. What is the fleshy head at the top of the mushroom called?

- A) Bob
- B) Nut
- C) Cap 

The cap is the fleshy head at the top of the mushroom. It can be many shapes but often looks like an umbrella with a detachable skin called the pellicle.


5. What can you see under the cap?

- A) Eyes
- B) Hair
- C) Gills 

The gills which produce the spores are found under the cap. Some mushrooms have teeth and some have pores which produce the spores instead.

## The Life-cycle of a Mushroom (answers)

1. What is a mushroom?

- A) The reproductive part of a fungus 
- B) The reproductive part of a virus
- C) The reproductive part of a bacteria

A mushroom is the reproductive part of the fungus which appears above the ground. It is also known as the fruiting body.

2. What are the seeds of a mushroom called?

- A) Mycelium
- B) Pips
- C) Spores 

The seeds of a mushroom are called spores. When they are scattered by the mushroom, it is known as sporulation.



3. Where do mushrooms like to grow?

- A) Soil, Dung, Plant litter, Trees ✓
- B) Gravel, Water, Disinfectant
- C) Plastic, Paper, Metal

Mushrooms like to grow in many places including soil, dung, plant litter and on trees. See if you can spot any when you are next out in the park - they are particularly common in autumn.

4. What protects the young mushroom?

- A) A Cap
- B) A Universal Veil ✓
- C) A Tent

The young mushroom is protected by the universal veil. As the mushroom grows taller it breaks through the Universal Veil leaving the volva at the base of the mushroom's stem.

## How Are A Mushroom's Spores Dispersed? (answers)

1. Why does a mushroom scatter its spores?

- A) To make sure they all get enough food ✓
- B) To avoid being poisoned
- C) So they can find new friends


If the spores are scattered over a large area, they have a better chance of finding enough food and water to survive and grow.

2. Which four processes are used to disperse spores?

- A) Wind, rain, nuclear, tidal
- B) Wind, rain, insects, mechanical ✓
- C) Wind, rain, thermal, nuclear


Spores can be dispersed by the wind, rain, insects and by mechanical processes such as a twig hitting the fruiting body

3. Which process is used by *Amanita muscaria* to disperse its spores?

- A) Wind 
- B) Rain
- C) Insects


*Amanita muscaria* releases spores from its gills and these are dispersed over large areas by the wind.

4. Which process is used by the Birds Nest fungus to disperse its spores?

- A) Wind
- B) Rain 
- C) Insects


Rain falls into the fungus fruit body forcing the spores out of the nest and onto new ground where they grow to make new fungi.

5. Which process is used by the Stinkhorn to disperse its spores?

- A) Wind
- B) Rain
- C) Insects 

Insects are attracted to the foul smelling slime on the St fungus. The insects carry away the spores which stick to their legs.


6. Which process is used by the Earthstar to disperse its spores?

- A) Wind
- B) Mechanical 
- C) Insects

The Geastrum fungus has a ball shaped fruiting body which releases millions of spores when it is disturbed by a mechanical process - such as a falling twig or a passing animal.

## Match the Mushroom Quiz (answers)

1. Which features can you use to identify a mushroom?

- A) Shape, size, colour, habitat 
- B) Shape, size, colour, sound
- C) Shape, size, colour, movement


A mushroom can be identified by looking at its shape, size, colour and habitat, Why not have a go? If you can't find any outside, take a look at some of the mushrooms that you can buy in the supermarket.

2. Which fungi only grow on wood?

- A) Gill Fungi
- B) Bracket Fungi 
- C) Boletes

Bracket fungi such as Dryads Saddle, Artist's fungus and Birch bracket look like shelves and are all found growing on wood.

3. Which fungi have gills?

- A) Beefsteak, Dryads Saddle
- B) Fly Agaric, Butter Cap. Inkcap 
- C) Stagshorn, Spluttered Candle

Lots of fungi have gills including the Fly. Agaric, Butter Cap. Inkcap, Velvet Shank, Field mushroom, Milkcap, Parasol mushroom, Verdigris Toadstool and Plums and Custard

4. Which fungi are shaped like a trumpet?

- A) Chanterelle, Horn of Plenty ✓
- B) Puffball, Earthstar, Earthball
- C) Dead Mans Fingers, Witches butter

Chanterelle and Horn of Plenty are two of the trumpet shaped mushrooms, Dead Mans fingers and Witches butter are from the Blobs on Wood group.

## What are Bacteria? (answers)

1. How long ago did bacteria first appear on the Earth?

- A) 3.5 to 4 billion years ago ✓
- B) 1.5 to 2 billion years ago
- C) 65 Million years ago

Bacteria first appeared on the Earth about 3,5 to 4 billion years ago and are the oldest known fossils. One type, called cyanobacteria, are able to use sunlight to produce oxygen and it is this oxygen which then allowed other life forms to evolve.

2. Where are bacteria found?

- A) In the soil
- B) In dirty places
- C) Everywhere! ✓

Bacteria are found almost everywhere - on your teeth and skin in your nose, under your nails, on kitchen surfaces, in food, in the soil.... Don't forget to wash your hands before you eat or prepare food!

### 3. Why do bacteria have a cell wall?

- A) To protect it from the enemy
- B) To keep its shape ✓
- C) To keep animals off its garden!

Bacteria, like plants, have a cell wall to help them keep their shape – usually spherical, spiral or rod shaped, Animal cells don't need a cell wall – they have a skeleton to support them and give them shape!

### 4. What is DNA?

- A) The Brain, or control centre ✓
- B) The skin
- C) The stomach

DNA is the brain or control centre of the bacteria and it is spread throughout the cell – unlike plant and animal cells which have a nucleus to hold the DNA.

### 5. How do bacteria move about?

- A) Use their legs
- B) Rotate their flagella ✓
- C) The stomach

Bacteria have a long tail like structure called a flagella which can rotate clockwise or anticlockwise. Think of it like a propeller on a boat!

### 6. Which part of the bacteria protects it from human fighting cells?

- A) DNA
- B) Fimbriae
- C) Capsule ✓

The capsule is the bacteria's protective covering – it tries to stop our white blood cells attacking and killing it so that it can go on to cause illness.

# What are Algae? (answers)

1. Are algae micro-organisms?

- A) Yes, all algae are micro-organisms
- B) No, algae are not micro-organisms
- C) Some algae are micro-organisms ✓

Some algae such as the single-celled *Chlamydomonas* are micro-organisms. Others such as the 60m long sea kelps which can be seen without a microscope are massive organisms!

2. Which is the only micro-organism that can photosynthesise?

- A) Virus
- B) Bacteria
- C) Algae ✓

Algae are the only micro-organisms that can photosynthesise - like plants, they contain chlorophyll, a pigment which uses the energy from sunlight to convert water and carbon dioxide into sugar and oxygen.


3. What shape are algae?

- A) Lots of shapes ✓
- B) Spherical
- C) Rod like

Algae come in many different shapes and sizes, *Chlamydomonas* is a roughly spherical single cell, *Volvox* is a spherical colony containing many single cells, *Spirogyra* contains many cells which form a long filament.




4 Which of these are algae?

- A) Seaweed and Kelp 
- B) Sunflower and Tulip
- C) Dandelion and Burdock

Seaweed and kelp are both algae - next time you see seaweed washed up on the seashore, you'll know you are looking at a type of algae!


## What are Protozoa? (answers)

1. Are protozoa microorganisms?

- A) Yes all protozoa are micro-organisms 
- B) No, protozoa are not micro-organisms
- C) Some protozoa are micro-organisms


Protozoa are micro-organisms – they are made up of a single cell which can only be seen using a microscope.

2. How do protozoa get their food?

- A) They make it themselves
- B) They eat other things 
- C) They don't eat

Protozoa, like animals, fungi and most bacteria are heterotrophs, they get their food from other organisms. In contrast, algae and plants are autotrophs, which means they make their own food from carbon dioxide using photosynthesis.

3. Where do protozoa live?

- A) Ponds, rivers, sea and soil 
- B) Deserts and dry places
- C) Both of the above

Protozoa live in moist environments such as ponds, rivers, the sea and even in soil.

4. What are the four groups of protozoa?

- A) Amoebas, ciliates, flags, sporozoans
- B) Amoebas, ciliates, frogs, sporozoans
- C) Amoebas, ciliates, flagellates, sporozoans ✓

The four groups of protozoa are Amoebas, ciliates, flagella and sporozoans. They differ in their size and shape and the way they move and feed.

5. Can all four groups of protozoa move?

- A) Yes, they can move
- B) No, they can't move
- C) Some of them can move ✓

Amoebas move by producing long extensions of their body called pseudopods, ciliates move using tiny hairs called cilia, flagellates move using by whipping their tail like flagella, Sporozoans cannot move.

## What are Viruses? (answers)

1. Which Kingdom do viruses belong to?

- A) Kingdom Protista
- B) Kingdom Monera
- C) They don't belong to a Kingdom ✓

Viruses do not belong to any of the 5 Kingdoms of organisms, they are the smallest of the micro-organisms and are parasites - they can only live if they are inside the cell of another living organism.

2. Which has the simplest cell structure?

- A) An Animal
- B) A Bacteria
- C) A Virus ✓

A virus has the simplest cell structure of all - it consists of just one or two strands of DNA or RNA (that's the genetic information) inside a protective protein coat or capsid.

3. Can one type of virus cause illness in all living things?

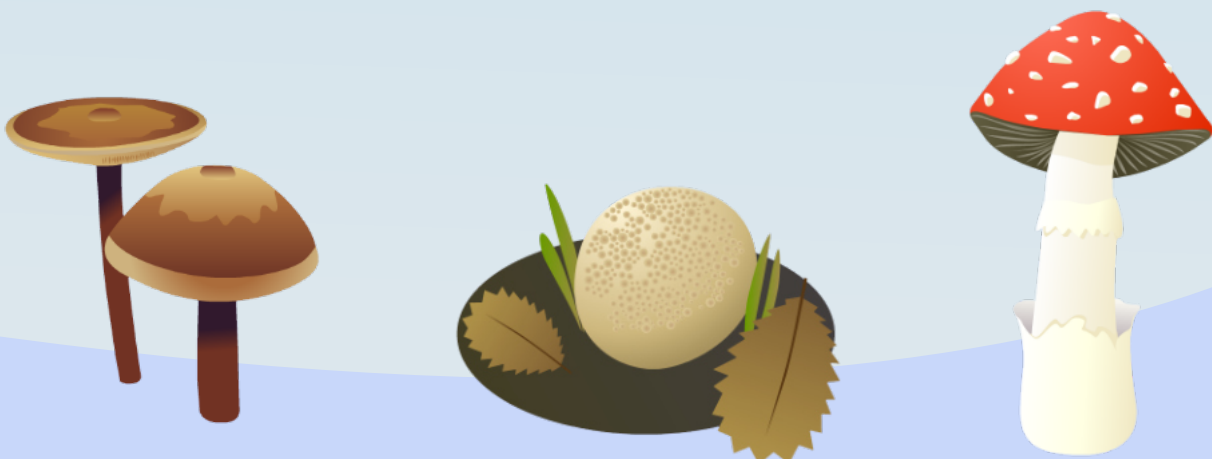
- A) Yes
- B) No ✓
- C) Sometimes

Each virus can only attach itself to a specific surface eg a plant cell, a bird cell, a human cell. Only if the surface is the one it is looking for can the virus attach firmly to it, inject its DNA or RNA and cause an infection.

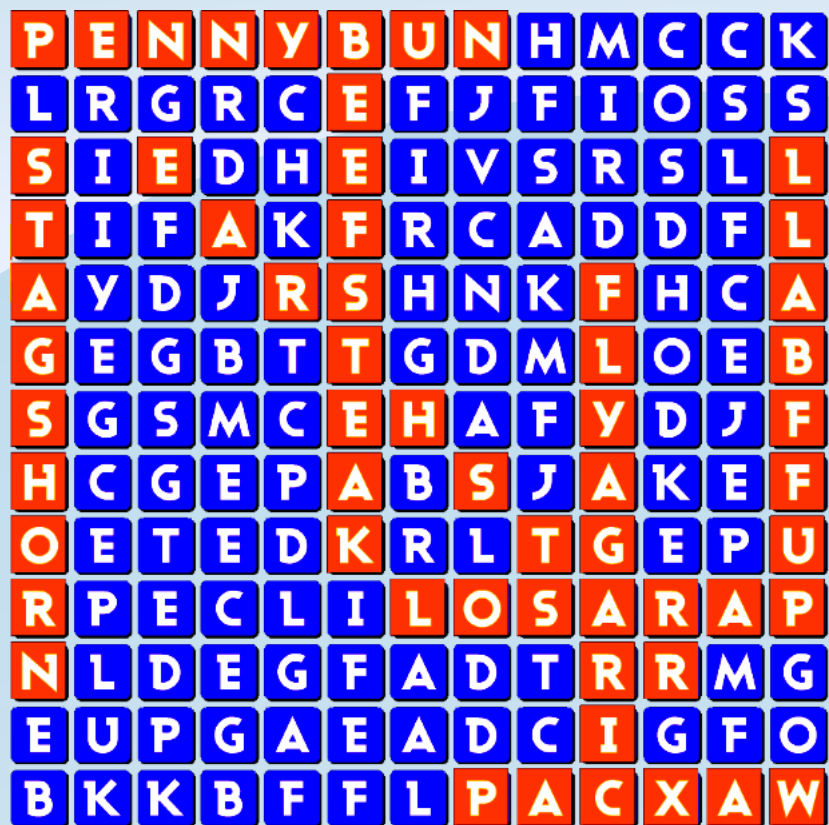
4. Which illnesses are caused by a virus?

- A) Chicken Pox and Flu ✓
- B) Food poisoning and Tooth Decay
- C) Amoebic dysentery and malaria

Chicken pox and flu are caused by viruses. If a person with flu sneezes, they will spread droplets containing the virus - if you breathe one of these in, the chances are you will catch flu too!



# Wordsearch (answers)



**Thanks for  
completing  
this module!**

