Mushroom Structure: Teacher's notes

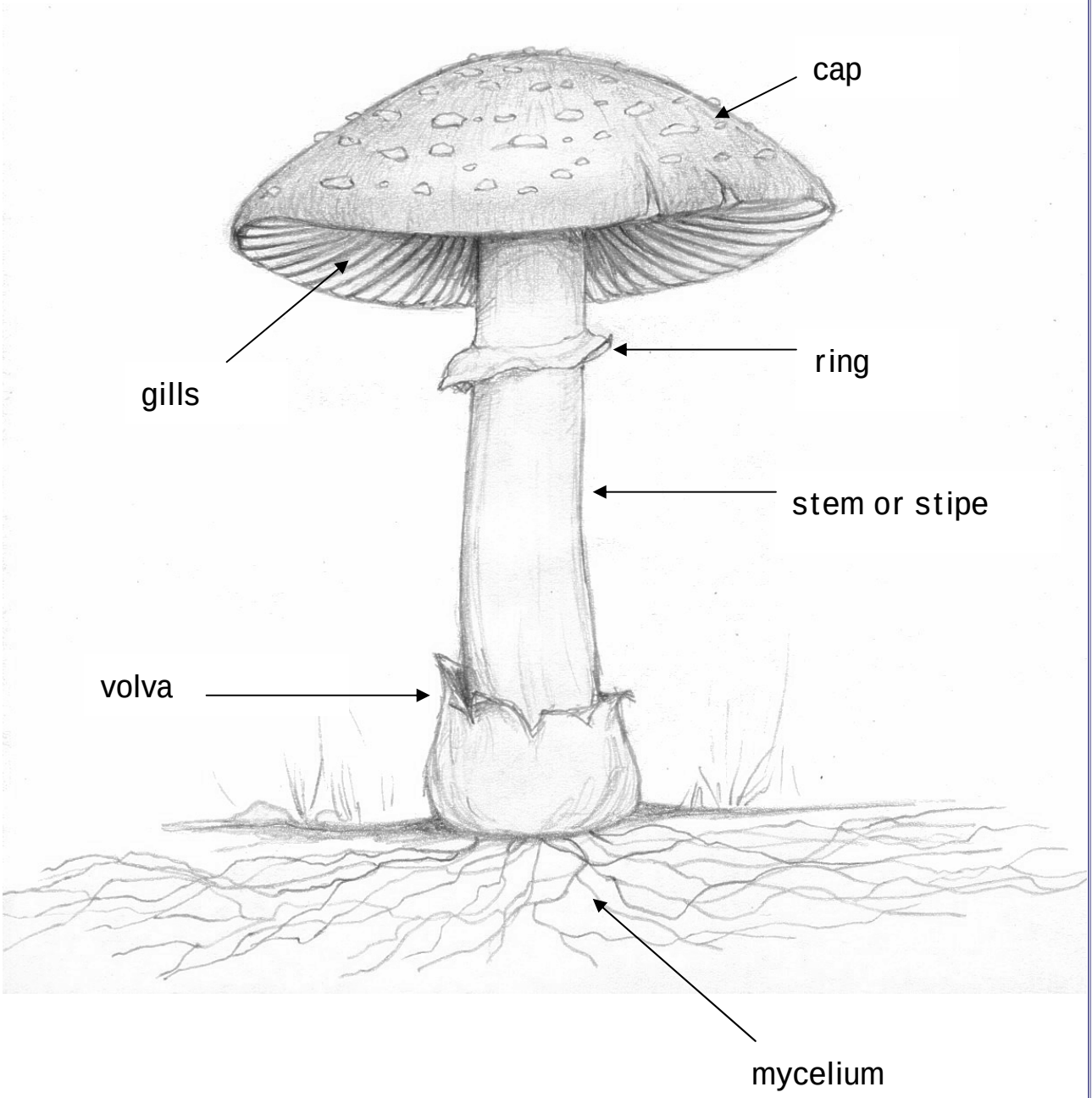
After learning about fungi in lessons; this exercise is a fun way for pupils to get their hands on real mushrooms and have a proper look at them. Something many may never have done. The exercise can lead into discussions of biological development and morphogenesis (even the lowly mushroom has tissues that carry out different functions and a genetically-defined developmental process that ensures that each species produces mushrooms that look the same each time it fruits); biodiversity (there are thousands of different mushroom species – compare oyster mushrooms and *Agaricus* mushrooms and have a field guide or two on display to illustrate the wider diversity in wild species); and evolution (why is a mushroom shaped like a mushroom? Why are some mushrooms tall and thin, others short and stout? Why do mushrooms have gills? Why do some have pores instead of gills?). **Additional sheets attached to these notes can help you with this wider discussion and might be used as class-sheets.**

To ensure that all mushrooms are safe to handle and are edible, buy the mushrooms from a supermarket. Most large supermarkets offer a variety of mushrooms that come in different shapes and sizes. The large mushrooms called 'open flats' are good for this exercise as the cap is fully open so that the gills are easy to look at. Because these are usually displayed 'upside down', the gills will probably look flattened. This is a natural gravitropism and is explained in the accompanying sheets. You can reverse the process by storing the mushrooms the right way up for 24-36 hours before they are to be used in the workshop. Indeed, the pupils can be involved in this preparation process and can learn a bit of fungal biology at the same time!

3-4 different species should be enough for the pupils to study, and most supermarkets will be able to supply fresh oyster mushrooms (maybe in two or three different colour varieties) and shiitake mushrooms as well as brown and white varieties of the normal *Agaricus* mushroom. For successful dissection of the mushrooms buy some 'picnic style' plastic knives and forks, paper plates and napkins from the supermarket when you get the mushrooms.

And don't forget a supply of plastic bin bags for the after-session clear-up. NOTE that the chopped up mushrooms can be discarded into an ordinary (external) bin providing they are double-wrapped (one bin bag inside another).

Parts of a Fungus correctly labelled



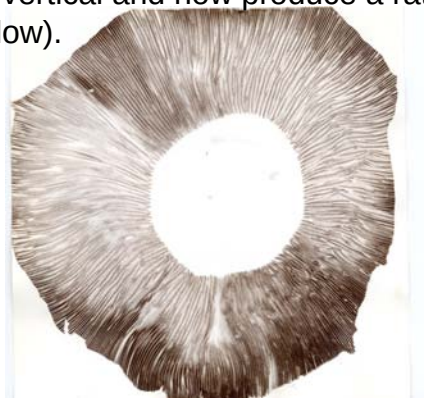
Shop-bought mushrooms

If you want to make spore prints but don't want to collect wild mushrooms, there's nothing wrong with shop-bought (cultivated) mushrooms, BUT you must understand their biology sufficiently to make sure you get suitable material. Button mushrooms are ***young mushrooms*** and have not usually developed enough to produce spores – they often still have a protective membrane completely covering the gills. You need to buy 'open-cap' or 'large flat' mushrooms.

HOWEVER, these mushrooms are often displayed (and stored and distributed) upside down so the customers can see the gills. But the gills are gravitropic - they can sense they are away from the vertical and try to grow back to the vertical (now there's an interesting discussion point about growth and development!).

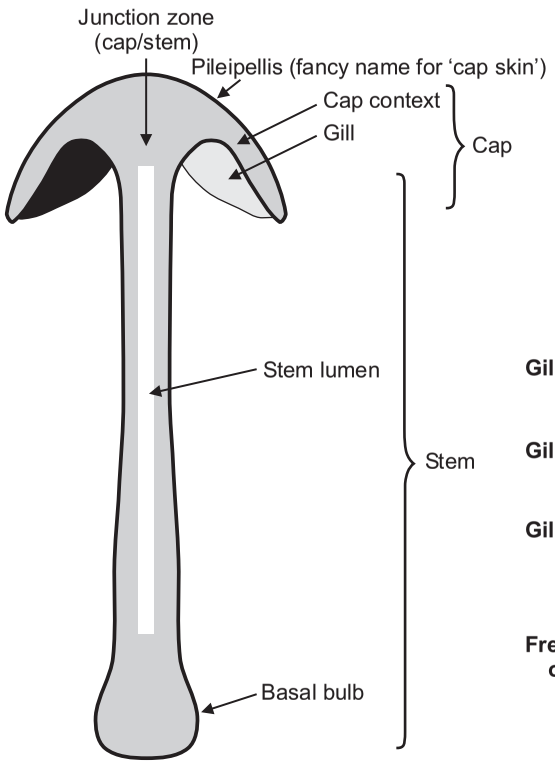
Here's an example in the packet shown above; note the flattened gills – particularly evident at top and bottom of the picture. These are not damaged, they're just trying to adjust themselves back to the vertical. The true vertical in the original transport tray was in the approximately "two o'clock" position, so the gills from about "9 o'clock to 2 o'clock" have flattened onto their right hand side, and gills from "2 o'clock to 7 o'clock" have flattened onto their left hand side, leaving those at about 2 o'clock (and at 8 o'clock under the label) still vertical.

You can get the gills to re-orient themselves by putting the fruit body the right way up (i.e. gills downwards!) in a moist chamber overnight. No grand apparatus is required. The moist chamber can be a dinner plate covered with a mixing basin and a layer of moist kitchen tissue. If the stem or fruit body margin get in the way and prevent the cap sitting horizontally, then spear the stem onto a cocktail stick (or toothpick) supported in a piece of potato. Leave for 24-36 hours. On the right is the same fruit body after 36 hours in a moist chamber; note that many of the gills have returned to the vertical and now produce a rather nice spore print (below).

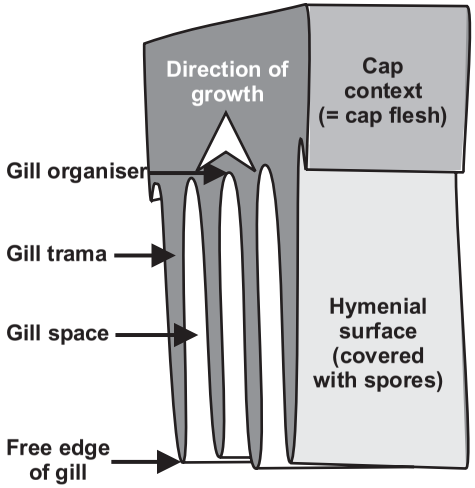


You can do this preparation in your kitchen before the activity. Alternatively, set up the moist chamber in the classroom with the children and use the exercise to discuss growth and development in these organisms. The next page explains the biology in outline.

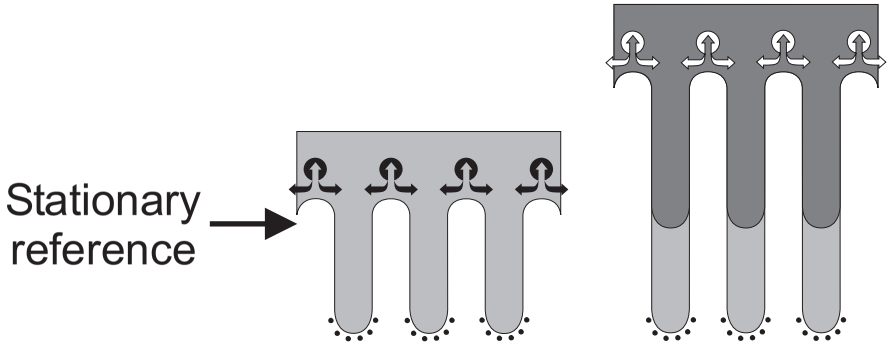
Understanding how mushrooms work



This is a segment of the cap showing a few gills to orient your point of view. The diagrams below show the front face of this.



To understand mushroom development properly you must recognise the (counter-intuitive) fact that gills DO NOT GROW AT THEIR FREE EDGE. Rather, they extend where they are joined to the cap flesh. Effectively, the spaces between gills extend into the cap flesh and leave differentiated gills behind them (rather like the way that fingers were produced on your hand when you were an embryo).

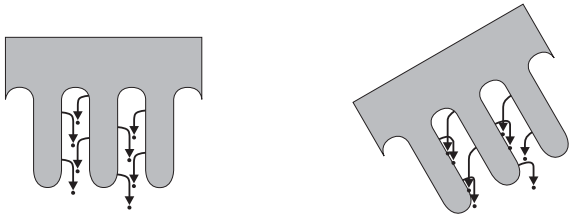


This can be demonstrated by painting drawing ink on the free edges of very young (primordial) gills.

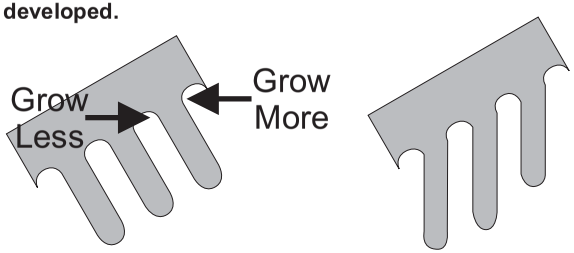
Allow the gills to continue to develop and although they will get much deeper, the ink will remain at the free edge

Understanding how mushrooms work - dependence on gravity

Mushroom spores are distributed on air currents. They are shot into about the middle of the space between adjacent gills and then drop vertically downwards to escape from the cap and into the turbulent air below.
The gills must be absolutely vertical for this to happen. If the gills lean only slightly away from the vertical, many of the spores will drop onto the opposing gill surface.

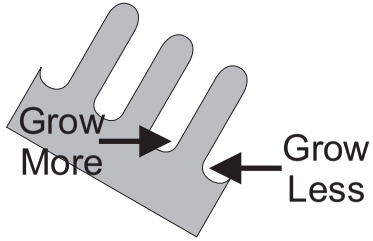


Mushrooms are exquisitely sensitive to gravity. Those with thin stems tend to rely on stem bending to adjust the orientation of the cap.
But most species have a 'fine adjustment' at the growing point where the gill is joined to the cap, and in species with thick stems (like the cultivated mushroom) gravitropism at this site is especially highly developed.

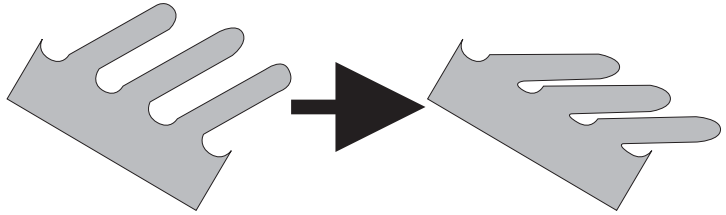


This growing point of the gill acts like a hinge, when the high side grows more and the low side grows less. When the gill is back to the vertical there is no high/low difference and The two sides of the gill grow equally.

Now imagine what happens when a mushroom is turned upside down. If a gill is truly vertical it will continue to grow vertically (even though upside down). But gills off the vertical will react gravitropically, and again the high side grows more and the low side grows less.



Now, though, the gill can't get back to the vertical. The best it can do is lie flat against its fellows.



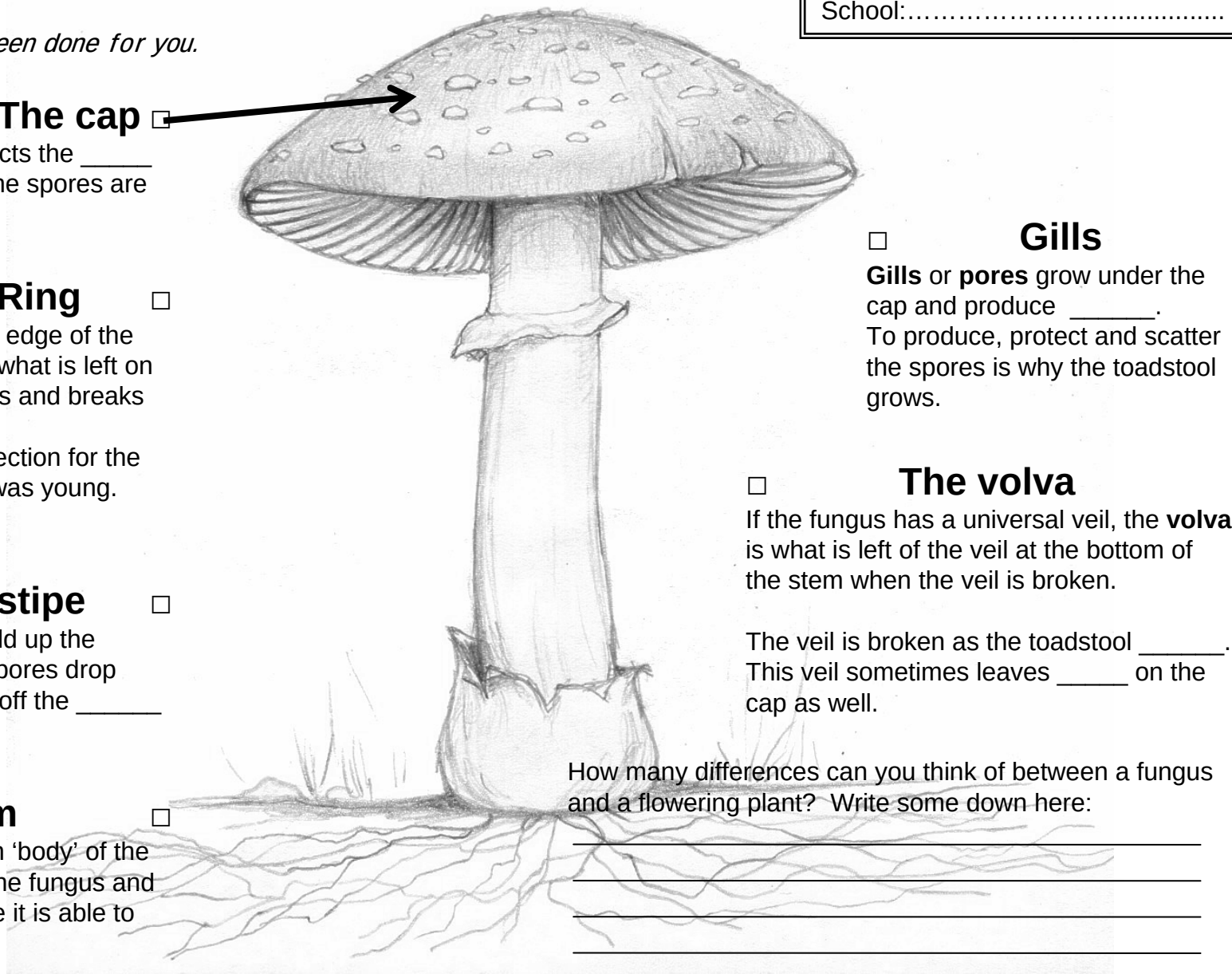
Understanding Fungi

Name:……

Class:……

School:……

Join the descriptions to the fungus by drawing a line between them.
The line for the cap has been done for you.
Complete the sentences.



The cap □

The **cap** supports and protects the _____ or _____ which are where the spores are produced.

Ring □

A partial veil grows from the edge of the cap to the stem, the **ring** is what is left on the _____ as the cap grows and breaks the _____.
The veil provided extra protection for the spores when the toadstool was young.

Stem or stipe □

The **stem** or stipe has to hold up the _____ So that when the spores drop down they are high enough off the _____ to drift away.

Mycelium □

The **mycelium** is the hidden 'body' of the fungus. It finds _____ for the fungus and when conditions are suitable it is able to produce a _____.

□ Gills

Gills or **pores** grow under the cap and produce _____.
To produce, protect and scatter the spores is why the toadstool grows.

□ The volva

If the fungus has a universal veil, the **volva** is what is left of the veil at the bottom of the stem when the veil is broken.

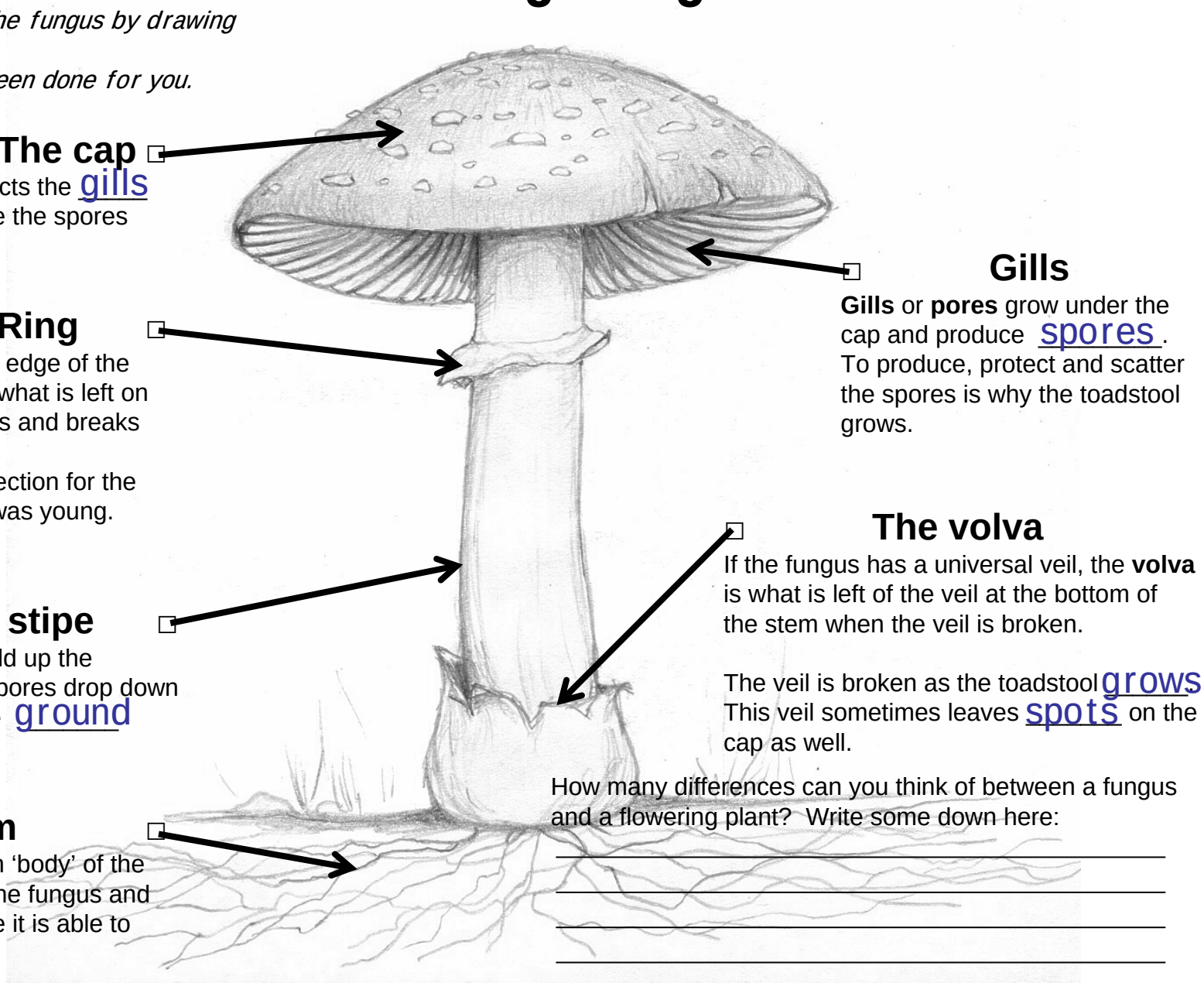
The veil is broken as the toadstool _____.
This veil sometimes leaves _____ on the cap as well.

How many differences can you think of between a fungus and a flowering plant? Write some down here:

_____
_____
_____
_____

Understanding Fungi

Join the descriptions to the fungus by drawing a line between them.
The line for the cap has been done for you.
Complete the sentences.



The cap

The **cap** supports and protects the gills or pores which are where the spores are produced.

Ring

A partial veil grows from the edge of the cap to the stem, the **ring** is what is left on the stem as the cap grows and breaks the veil.
The veil provided extra protection for the spores when the toadstool was young.

Stem or stipe

The **stem** or stipe has to hold up the cap So that when the spores drop down they are high enough off the ground to drift away.

Mycelium

The **mycelium** is the hidden 'body' of the fungus. It finds food for the fungus and when conditions are suitable it is able to produce a toadstool.

Gills

Gills or **pores** grow under the cap and produce spores.
To produce, protect and scatter the spores is why the toadstool grows.

The volva

If the fungus has a universal veil, the **volva** is what is left of the veil at the bottom of the stem when the veil is broken.

The veil is broken as the toadstool grows
This veil sometimes leaves spots on the cap as well.

How many differences can you think of between a fungus and a flowering plant? Write some down here:

Understanding Fungi in the Forest

Name:……

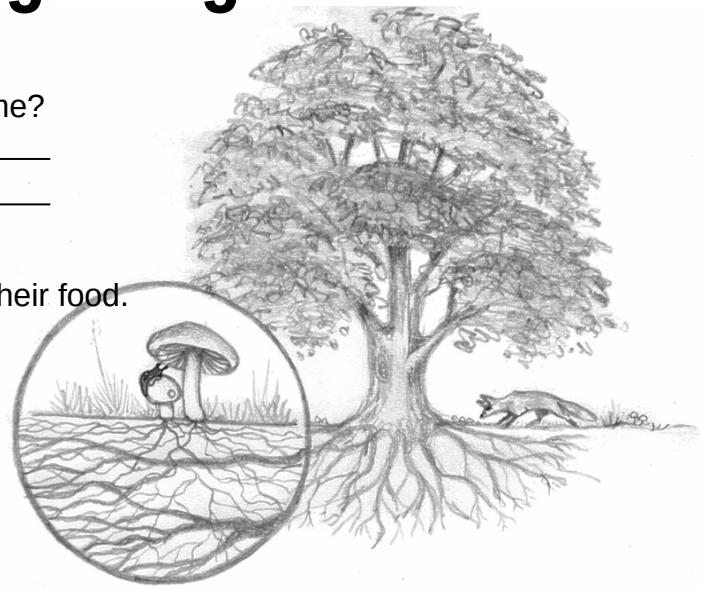
Class:……

School:……

Fungi are in the woodland all the time.
Why don't we see them most of the time?

_____

_____



There are three ways that woodland fungi get their food.
Can you name them?

_____

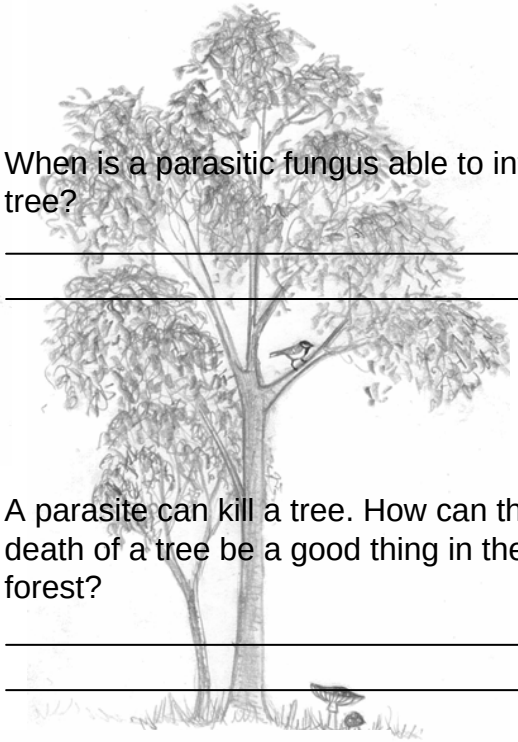
_____

_____

When is a parasitic fungus able to infect a tree?

_____

_____



How do exchanger fungi link up to their tree?

_____

_____

_____

A parasite can kill a tree. How can the death of a tree be a good thing in the forest?

_____

_____

How does the exchanger fungus help the tree?

_____

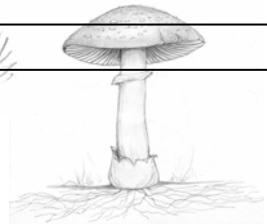
_____

_____

What did we use to help us try and identify some toadstools?

_____

_____



Can you think of two reasons why recycler fungi are important in the forest?

_____

_____

Autumn is a good time for recycler fungi; can you think why?

_____

_____

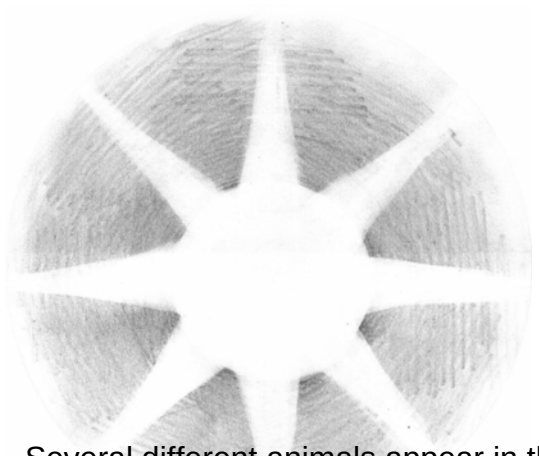
Use the pages that follow for colouring-in

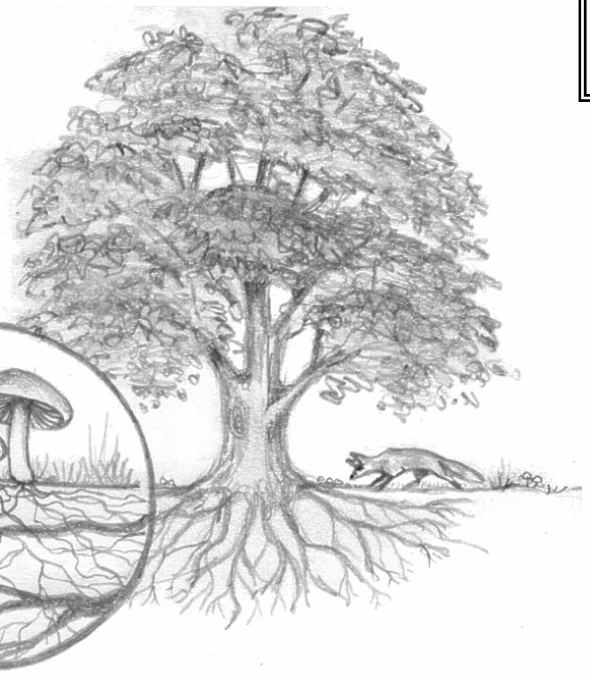
Fungi and Food Chains

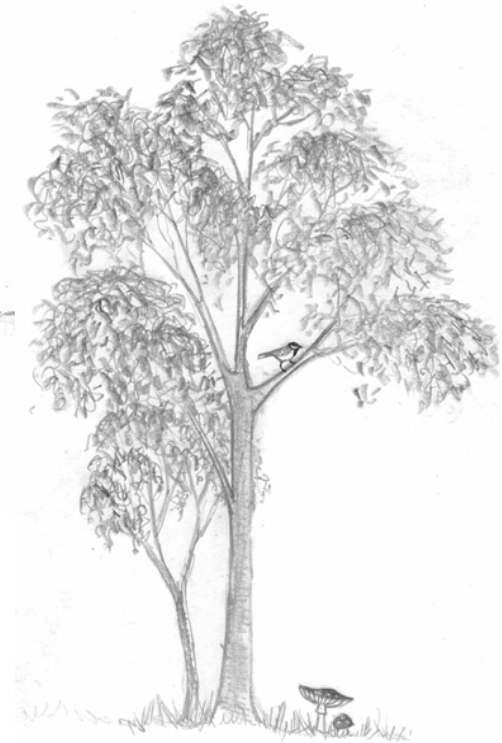
Name:……

Class:……

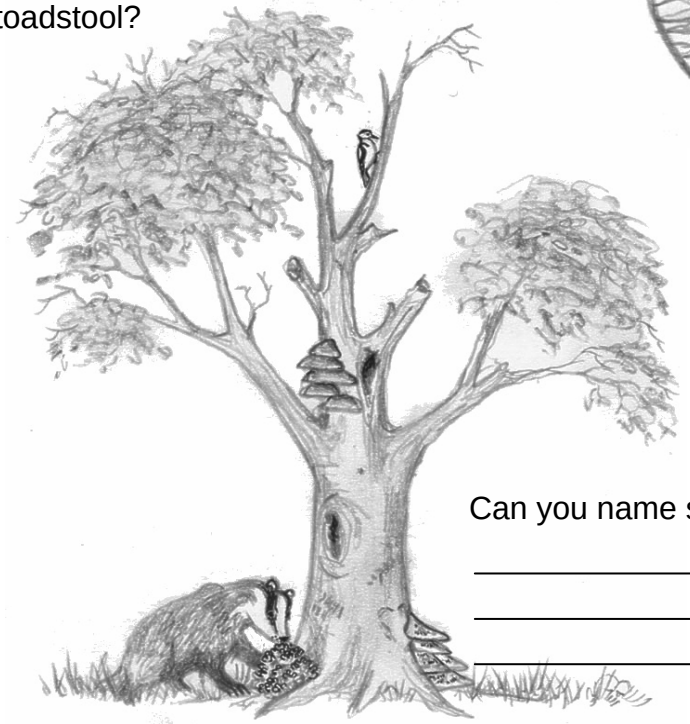
School:……







Several different animals appear in these diagrams. Can you find them?
Can you make at least TWO different food chains, starting with the sun and including a toadstool?



Can you name some woodland creatures that either eat or live in fungi?

_____ _____

_____ _____

_____ _____