An Introduction to Fungi

Forest of Dean Fungus Group
Cover photo: *Geastrum triplex*, the Common Earthstar
An Introduction to the Mysterious World of Fungi

Mushrooms and toadstools have always been a mystery to man. So many myths have been attached to them in the past that even today they still carry with them a hint of the occult. It is hoped that this brief presentation will dispel some of those myths and show fungi for what they are: a vital component of the natural world and nature's most efficient recycling machine.

Most of us are familiar with the notion of three Kingdoms under which all the things found on earth are categorised as animal, vegetable or mineral. For a long time fungi were classed with vegetables, but over the past 200 years the scientific study of fungi has shown that although there are similarities between fungi and vegetables, the differences between them are so numerous that fungi should be placed in a Kingdom of their own.
The most important difference is that fungi do not rely on chlorophyll (the green substance which gives leaves their characteristic colour) to help them produce their food. With the aid of chlorophyll and sunlight plants convert carbon dioxide in the atmosphere into starch and sugar, major items in a plant's diet. Sunlight is therefore essential to the growth of plants. Fungi, on the other hand, need neither chlorophyll nor sunlight, but like animals, obtain their food by absorption of nutrients, and need a ready supply of pre-existing organic matter. Fungi can therefore grow quite happily in the dark, providing an organic food source is available.

It is probably this last fact which has made fungi appear so mysterious to man. When a pasture suddenly sprouted a crop of mushrooms (or toadstools, if you like, because there is no real difference between them) it is no wonder that our forebears believed that some sort of magic was involved. They did not understand that the main activity of the mushroom "plant" had been going on under the soil for years. Fungi grow from spores, tiny microscopic capsules of genes invisible to the naked eye. It has been estimated that a single mushroom cap can produce 70,000,000 spores an hour for several hours. The spores are so small that a single cubic millimetre could contain well over 4,000,000. Different species produce spores of different shapes and colours, and even tiny as they are, there are spores which are ornamented with ridges, hollows, pimples and spines.

In some senses the spores have been likened to the seeds of a plant. They can germinate and send out microscopic “roots”; known as hyphae, which penetrate substances (the substrate) around them and absorb the necessary chemicals required for further growth. However, the hyphae from a single spore cannot, by themselves, produce a mushroom, unlike an apple seed which can grow into a tree and produce apples.

In fact fungal spores are more like the gametes (egg cells and sperm/pollen) of plants and animals in that in order to reproduce themselves the hyphae of one spore must meet and fuse with the hyphae of another spore of the same species. The two groups of hyphae (of different mating strains – the fungal equivalent of sexes) combine and eventually produce what we all recognise as a mushroom.

This system is fundamentally different from the reproductive processes of plants. Plants require pollination, effected usually by an external agency, such as wind, flies, bees or other insects. Fungi really can only sit back and wait for another spore to land...
sufficiently near for their hyphae to meet. As no equivalent to the mechanism of pollination exists, fungi have to produce vast numbers of spores to increase the chance of two spores germinating within reach of each other.

Of course, in order to flourish the spores of fungi have to land on a suitable substrate and it is here that fungi earn the title of the world's most efficient recycling organisms. There is a fungus which will thrive on virtually every naturally occurring organic material. Some favour dead trees, dead plants, horse manure, rabbit droppings, or old timber. Others prefer the bodies of insects, caterpillars, spiders and one, as most of the world knows, flourished on the contents of the Petri dish which Sir Alexander Fleming had left uncovered. That fungus was *Penicillium*.

Fungi have several different ways of spreading their spores around the world. Spores are so small and light that the slightest breath of wind will carry them for miles. No building is safe from them. An average house will contain millions of fungal spores and the only reason that the house is not full of mushrooms or toadstools is because the spores have not landed on material suitable for their growth. Damp wood in the floorboards of a house provides the ideal site for the growth of the dry-rot fungus *Serpula lachrymans* and sooner or later a spore of that fungus will find it. And if you
think that modern invention MDF (resin-bonded Medium Density Fibreboard) would be immune, it is not. Given a sufficiently high moisture level it provides ideal food for *Auricularia auricula-judae* - the Jelly-ear fungus - so called because its fruit body quite often looks like a human ear.

Fungi are very particular about their nutritional needs and will take from their host only those chemicals they require. Imagine a dead tree falling to the ground in a forest. Sooner or later it will be invaded by a fungus which will extract chemicals from the wood. Eventually the fungus will have consumed all those nutrients available to it. The fungus will itself then die. The subtle change in the chemical composition of the dead tree will, however, make it an ideal food source for another species of fungus which then follows the first. A single tree can be colonised by a succession of different fungi, each species removing from the tree the particular chemicals it needs for its growth. Ultimately the entire tree will have disappeared. And what of the last fungus in the tree? Fortunately there are fungi which live on other fungi so the process of decomposition can continue.

So how many different species of fungus are there? Well it's difficult to say because it is only recently that efforts have been made to record all the fungi in the world. It has been estimated that there are some 140,000 species worldwide, but this is simply an estimate. In the Forest of Dean, the Dean Fungus Group, a group of amateur mycologists, have collected and identified over 39,000 fungi over the years and on their forays they are still regularly finding new species.

**Is it safe to eat?**

It is not the business of the Dean Fungus Group to advise on edibility, but one question which always arises in any discussion on fungi is "How can you tell which one is safe to eat?"

That knowledge comes in the same way that knowledge of safe foodstuffs has been handed down generation after generation. We distinguish between edible and poisonous fungi in the same way we distinguish between blackberries and deadly nightshade – by learning to identify them. We know that apples are safe to eat because our predecessors ate them and usually suffered no ill effects, but we have to learn the difference between a Cox’s Orange and a crab. Similarly we know that the field mushroom *Agaricus campestris* and its commercial relative *Agaricus bisporus* are also usually safe because
millions of people around the world eat them in vast quantities every day, but we have to learn the difference between these and *Agaricus xanthodermus*, for example.

Other fungi which are known to be edible, and distinctive enough not to create problems of identification, include the Penny-bun (*Boletus edulis*), the Chanterelle (*Cantherellus cibarius*), the Field Blewit (*Lepista saeva*) and the Wood Cauliflower fungus (*Sparassis crispa*). The edible St. George's mushroom (*Calocybe gambosa*) physically resembles several other mushrooms but because it appears early in the year (usually around April 23rd, St. George's Day) it can be easily recognised. Those species with which it might be confused usually occur in the autumn.

There are, of course, a large number of mushrooms which are edible in the sense that they are not injurious to health, but the majority of these are not pleasant to eat, and certainly for those people who do not wish to delve into the realms of microscopic identification it is best to stick to tried and tested species. Finally there are mushrooms which are deadly poisonous. The Death Cap (*Amanita phalloides*) - an almost all-white fungus when young - is very similar in

![Figure 3 Amanita muscaria - the Fly Agaric](image-url)
shape to commercial mushrooms, and has been the cause of many deaths. There are many others which can cause violent digestive problems, so it is therefore worth repeating the advice "eat only what you know to be safe."

Colours help recognition

Although fungi do not contain chlorophyll they are by no means without colour. One, _Amanita muscaria_, the Fly Agaric (a member of the same family as _Amanita phalloides_ and another one not to be eaten) is probably the best known because its vivid red cap dotted with white spots is a favourite illustration in children's books. Many members of the _Russula_ family have coloured caps varying from yellow and brown to red, purple and grey. There are even green fungi although the pigments which colour _Clitocybe odora_ and _Chlorociboria aeruginascens_ are not produced by chlorophyll but by quite different substances. In the latter case the pigment, xylindine, permeates the timber in which the fungus is growing and produces the green wood used in the manufacture of Tunbridge ware. In the tropics vivid colours are far more common and New Zealand boasts a beautiful blue fungus.

While colour attracts the eye to fungi growing in the wild and can often be a ready aid to recognition, many fungi also emit characteristic smells. The Chanterelle, which has already been mentioned, is said to emit the odour of peaches or apricots, a fact which no doubt enhances its culinary popularity. Other fungi, such as _Clitocybe odora_, _Lentinus cochleatus_, and _Trametes suaveolans_ smell of anise. It is said of the last-mentioned that the young men of Lapland used, in days long gone, to carry a piece of this fungus in their clothing so that they would smell sweet and thus encourage the attention of young ladies. No doubt it made a change from the smell of reindeer.

Not all fungi smell sweetly. The majority simply smell mushroomy, but among the less attractive smells encountered are ammonia, rancid oil, acetylene, gas tar and chlorine. One cannot leave this list without mentioning the Stinkhorn _Phallus impudicus_ The smell from this fungus, like rotting flesh, is so distinct that it is not necessary to see it in order to record its presence. The smell is sufficient proof of its existence!

There are many "lookalikes" among fungi and in order to identify these precisely it is necessary to take note of every attribute. The exact size of the cap and the
stem, the colour, the smell, does the stem have a loose ring around it, and what is the colour and size of the spores - all these are vitally important for identification.

As has been mentioned earlier fungus spores are microscopic so in order to determine the colour a few million must be lumped together and only then can it be seen whether the spores are white, cream, light brown, dark brown, or black the usual range of colours for spores. Spores vary in size, the average being of the order of six thousandths of a millimetre (6µm) so obviously they cannot be measured without the aid of a powerful microscope. In the Russula family some species can only be determined by the pattern of the ornamentation on their spores.

Those fungi which are substrate-specific offer a little more help to the amateur seeking to identify a fungus. Piptoporus betulinus the Birch Polypore grows only on birch trees; Daldinia concentrica King Alfred's Cakes - grows mainly on ash trees and does indeed look like burnt teacakes; Wax Caps of the genus Hygrocybe grow mainly on undisturbed grassland and Fistulina hepatica the Beefsteak Fungus is confined almost exclusively to oak trees.

![Figure 4 Fomitopsis pinicola](image-url)
The official names of all fungi conform to the Linnean binomial system of nomenclature, i.e. a generic name followed by a specific name in either botanic Latin or Latinised Greek, but don't be put off by this. The Swedish botanist Carl Linnaeus introduced this system so that every species of plant, animal or fungus would have a unique name by which it could be identified anywhere in the world, whereas local vernacular names vary from place to place and of course from country to country. Most people who go walking in the woods or spend their leisure time in the garden use such names as a matter of course. After all, the names *Delphinium* and *Antirrhinum* are familiar to the gardener, as are *Lumbago* and *Rheumatism* to the rambler, and *Tyrannosaurus* and *Diplodocus* to every three-year-old. The names of fungi are no more difficult. It's just a matter of getting used to them!

**Fungus Conservation**

As with other forms of wildlife, many fungi are under threat from trampling, habitat destruction, climate change, agricultural intensification (particularly the use of fertilisers and fungicides), and indiscriminate collecting for the restaurant trade.

In general, fungi receive the same legal protection as wild plants, and should never be gathered without the landowner’s permission. Red Data listed species should never be picked.

The Dean Fungus Group, and other local and national groups record the distribution of fungi, providing information to land managers, planners, and local and national biological record centres to inform planning and management decisions to ensure the best possible outcomes for fungi and other wildlife.

You wouldn’t dig up bluebells from a wood or take home a blackbird’s eggs for dinner, so please treat fungi with the same respect, and leave them to carry out their lives, and for others to enjoy.
The Dean Fungus Group is the local fungus recording group for the Forest of Dean and the surrounding area. It is affiliated with the British Mycological Society and the Fungus Conservation Trust.
It is hoped that the information given in this booklet will have whetted your appetite so that the next time you go for a walk in the fields or woods and find a fungus growing in the grass or on the trunk of a tree you will have a closer look. You will be impressed by its structure and will certainly want to know its name. This little booklet cannot tell you how to identify it, but if it has aroused your interest then there are plenty of books available to help you. If you live in the Forest of Dean area, the Dean Fungus Group will be happy to take you along on a foray with them.

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