



Mushroom Cultivation Mini-Book

An extract from
Milkwood: Real Skills for Down-to-Earth Living

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PINK OYSTER



PEARL OYSTER



LION'S MANE



GOLDEN OYSTER



KING OYSTER



PEARL OYSTER



SHIITAKE



MAY THE MYCELIUM BE WITH YOU

Mushrooms are meaty soul food, in fungal form. They're not even in the same kingdom as plants or animals, and yet they taste like both, at once.

Learning how to grow mushrooms from scratch is a little bit like learning a magic trick. And yet, once you have the basic skills and principles sorted out, it's really very doable. Fungi are both complex and simple. They need certain things to grow well, and if you don't provide these they will sulk and produce no mushrooms. But the kingdom of fungi is also hugely generous and capable of producing incredible amounts of nutrient-rich mushrooms from simple waste substances – again, and again, and again. You just need to get to know them.

Blue oysters, garden giants, enokitake, pink oysters, turkey tail, shiitake, reishi, pioppini. A whole world of mushrooms can be grown down the side of your house. It's crazy but true.

Cultivating mushrooms is an excellent way to vastly increase both the diversity and the nutrition of your home-grown produce. And conveniently, mushrooms can be grown in disused areas with little light, so they slot into a home-grown food system without competing for the same space as your other growing projects. Down the shady, paved side of your house where not much else grows, in buckets in the empty space under the porch, under your stairs, or even under your couch can all be great places to cultivate mushrooms. Don't have much light? Mushrooms don't mind. If they have a stable temperature to grow in and can be moved to a humid environment to fruit in, they're happy.

As a bonus, home mushroom cultivation can be run mainly, or exclusively if you like, on common waste products – woodchips, coffee grounds, straw, cardboard, tree prunings, and so on. The cost for setting up home cultivation can be very small, and once you get right into it, you can harvest all year round, and each month can be packed with nutrient-dense mushroom goodness.

Don't be put off by the technical 'mushroom speak'. Generally, mushrooms are not well understood, but once you've got the fundamentals straight, the processes are straightforward. And then you'll have a potential lifetime of mushroom harvests ahead of you to nourish and heal your family, to swap and share, and you'll be able to teach others how to grow them as well. Bring on the mushrooms.

Types of fungi

Fungi are divided into two main categories, mycorrhizal fungi and saprotrophic fungi. Mycorrhizal fungi form a partnership with some plants, mostly with living trees. You can read more about these in the Wild Food chapter on page 276. Saprotrophic fungi prefer dead and decaying material. This group contains the largest number of species. If you're new to mushroom cultivation, we suggest working with a few different species of saprotrophic fungi – specifically, delicious edible ones that grow mushrooms on wood or on straw.

OPPOSITE: Some of the many edible mushrooms you can cultivate at home.



THE BIOLOGY AND HISTORY OF MUSHROOMS

FUNGI AND MUSHROOMS

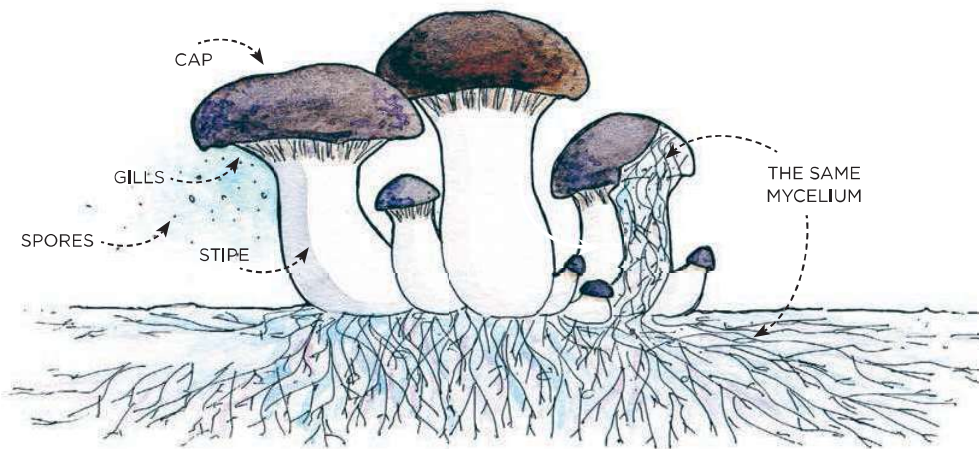
Fungi are an entirely separate kingdom of life – they’re not a plant, nor an animal. They’re weird and amazing. Without them, life on earth might not exist.

The kingdom of fungi (Eumycota) encompasses yeasts, tinea, penicillium, moulds, blights and mushrooms, to name just a few. Compared to animals and plants, very little is known about this kingdom of life. It’s estimated that there may be up to 6 million species of fungi, although only about 1.5 per cent of those have been formally classified – compare that with the total of 300,000 species of plants on earth!

Mushrooms are the fruiting bodies of some types of fungi. A mushroom-producing fungi spends the majority of its life cycle hidden under, or inside, other substances – substances like wood, soil or straw – in the form of mycelium, which slowly colonises and eats that substance, before fruiting into mushrooms.

It’s thought that there are about 10,000 species of mushroom-producing fungi worldwide. Of these, about 30 species are grown commercially or on a home scale. There are only a handful of deadly species, and about 25 seriously poisonous species in total. Of course, these are very good to know if you’re a mushroom forager. Mushroom cultivation is different to foraging, though – it’s the process of growing just one species of mushroom at a time, in a controlled environment.

The parts of a mushroom, rising from its mycelial network.



LIFE CYCLE OF A MUSHROOM

Mushrooms start off as spores, emitted from a mushroom much like seeds from a seed pod. When a spore lands on a suitable substance, it grows into a hypha – a little thread composed mainly of mycochitin, a similar substance to that which crustaceans use to make their shells.

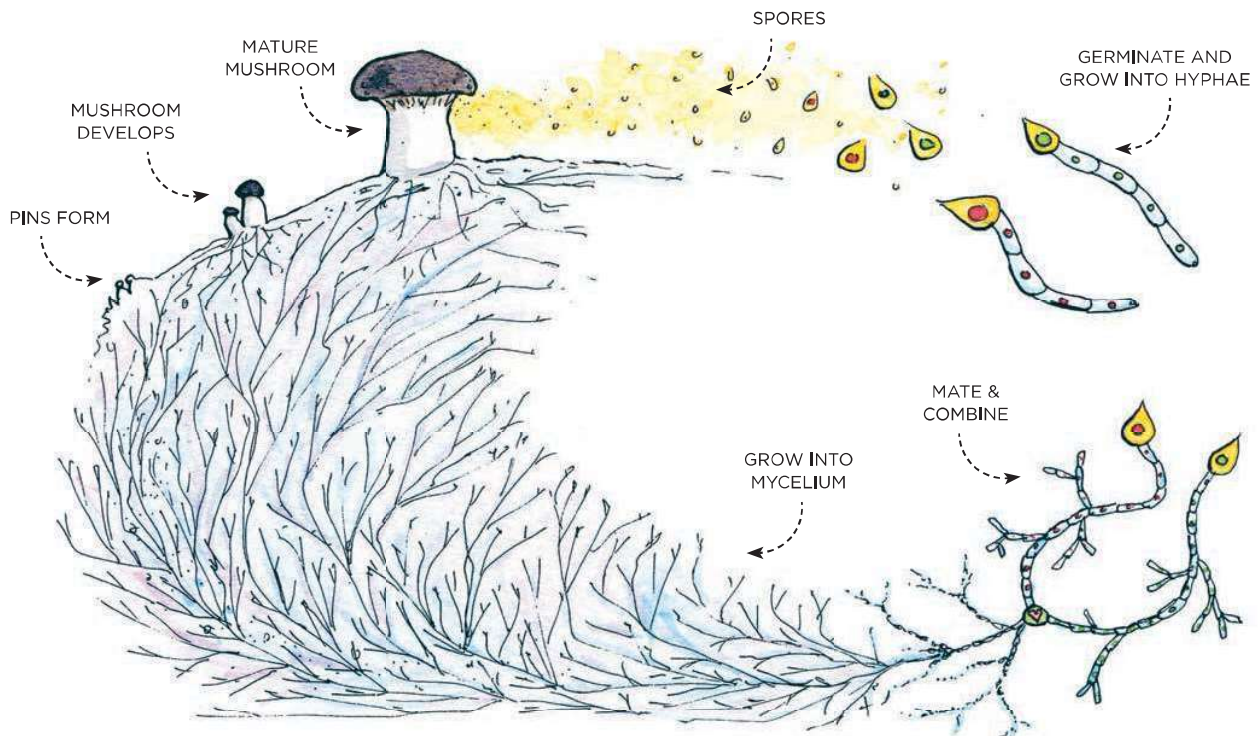
When two or more hypha grow near each other, they bond together and share their genes to produce mycelium, a large network of hyphae, looking a little like a branching web of delicate white threads or roots.

Different mycelium eat different things. Some break down whatever woody substances they can get close to. Some mycelium have special relationships with certain tree species, sharing sugars and other nutrients with plant roots. Some mycelium eat insects, or live within them. They're truly embedded into every aspect of life on earth, in a range of symbiotic roles.

Once the mycelium has colonised and eaten as much of its chosen food as it can, and when conditions are right, the mycelium will start to form fruiting bodies in the form of mushrooms, to reproduce and extend its territory.

Mushrooms are incredible little pieces of life. They're 'anti-gravity', meaning they'll push upwards with uncanny force, through wood or soil or sometimes even asphalt in a bid to get up into the fresh air and the light, to spread their spores. Just a few days later, they're rotted and gone. Like peaches, mushrooms are a tasty, unprotected food – their mission is to be eaten. In the process of being knocked about, picked up or generally taken apart, their tiny spores spread near and far, in their millions, with some spores landing in just the right spot to begin the process of life all over again.

The life cycle of fungi, which results in mushrooms as the fruiting bodies.





ABOVE: Shiitake mushrooms fruiting on a scribbly gum (*Eucalyptus haemastoma*) log in our shade house.

OPPOSITE: A gorgeous flush of pearl oyster mushrooms, ready to become dinner.

MUSHROOMS AND HUMANS

Mushrooms and humans have, in many ways, co-evolved ever since there were homo sapiens to forage, taste, eat and distribute edible and useful mushrooms across the earth. Ötzi the Iceman, preserved since around 3300 BC, was found to be carrying two mushrooms – a tinder fungus in his fire-starting kit, and a medicinal birch polypore.

There's evidence that the Romans and the Egyptians had mushrooms on their menus, and the Aztecs and Mayans used mushrooms for ceremony. Asian rulers commanded envoys to go out and seek the medicinal *Ganoderma* (reishi) growing out of certain plum trees up to 4000 years ago. And so it follows that every culture that has lived where wild mushrooms grow had all kinds of uses for them, from Australia all the way to Russia.

All these ancient mushrooms were foraged – gathered from the wild – as opposed to cultivated. Cultivating mushrooms isn't hard once you know what you're doing, but figuring out how to cultivate specific mycelium was an enormous leap forward in our relationship with fungi. The first record of edible mushrooms being specifically cultivated as opposed to foraged is in about 1000 AD, with *Lentinula* (shiitake / xiang gu) being cultivated in Qingyuan county in China.

The first European cultivation of mushrooms is not precisely known, but there's a famous story about a Parisian market gardener in the 17th century pouring wash water from wild mushrooms (which would have contained the mushrooms' spores) over some melon offcuts, and inadvertently producing a mushroom harvest of *Agaricus bisporus* (button mushrooms) soon after. The canny gardener repeated and refined the process, and was soon selling the mushrooms commercially.

Then there's another story that Parisian market gardeners noticed there were always good crops of field mushrooms found in horse manure (their main fertiliser of the era, hauled in by the tonne), and so started cultivating them that way. Then it was discovered that caves provided a stable, moist climate for reliable cultivation, and soon there was a cultivated mushroom industry for *Agaricus bisporus* across Europe.

The amazing extent of mushroom cultivation as we know it now is very recent, however. Up until the 1970s it was pretty impossible to get any cultivated mushrooms in Europe other than button mushrooms and truffles. All other mushrooms were wild-sourced, and limited to seasonal eating. As the world shrank and mycology advanced, however, the mushrooms spread (maybe this was all part of their plan) and now it's possible to get spawn for dozens of edible species on nearly every continent.





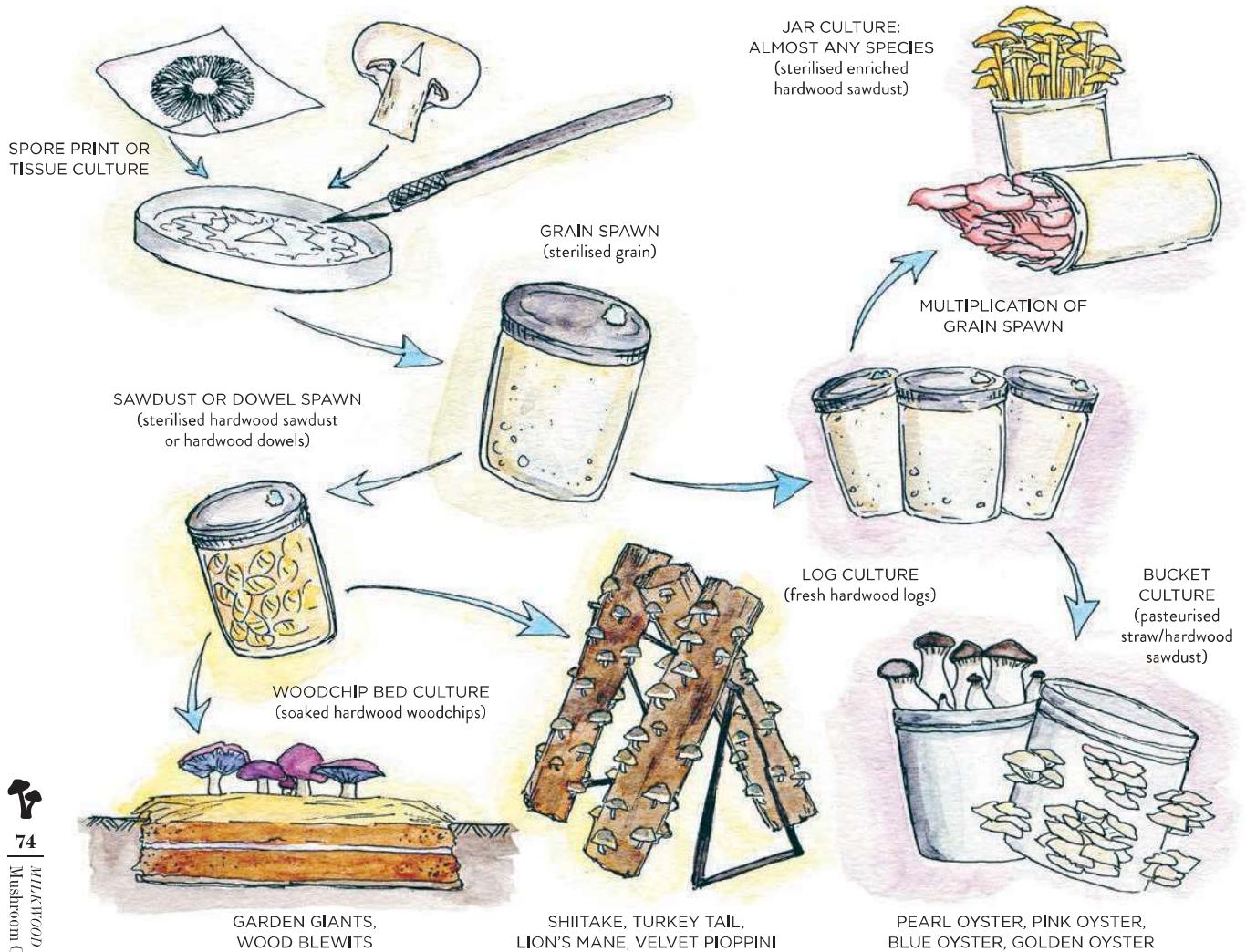
CULTIVATING MUSHROOMS AT HOME

Once you demystify the mushroom cultivation process, it's not unlike growing plants in many ways. You're just dealing with a different kingdom of life, which has different life cycles, needs and outputs. When you understand the basics, you can get creative. And if you get hooked, no garden or home of yours will ever be without edible mushrooms again.

Over the years we've learned different cultivation techniques from different experts, hobbyists and mad mushroom folk (there are quite a few of those). Cultivation can be done inside, outside or wherever you have some space, and requires zero specialised equipment to get started.

We've slowly developed a cultivation process that works well for us on a home scale.

Waste-free mushroom cultivation, with no single-use plastic.



It is possible to cultivate mushrooms from scratch using the tissue culture of an existing mushroom. This is extremely cool but it is also extremely fiddly, with no guarantee of success when you're a beginner and you don't have all the right equipment. So we'll show you how to start at the spawn stage and work forward from there.

There are multiple paths you can take to grow your mushrooms from the spawn stage. Container cultivation (see page 81) covers growing mushrooms in buckets, jars and bags, in a semi-controlled environment. Outdoor cultivation (see page 99) covers growing mushrooms on logs, stumps and in gardens, letting the seasons do most of the work for you. Choose your own mycelial adventure. Or do both.

GROWING FROM SPAWN

Your first bag, jar or bucket of spawn will look like a white lump of mysterious goodness. It can be purchased from a mushroom supplier or, if you're lucky, a friendly mushroom grower. Spawn is simply substrate – the food that mycelium likes to eat – that has been fully colonised by said mycelium, that is, the white stuff (or possibly brown, depending on the species).

Importantly, healthy spawn is substrate that has been colonised by a single species of mycelium – the species that you want to grow. Whether it's oyster, shiitake or pioppini, that spawn will contain just the mycelium for that species, growing on a high-nutrient substrate (often grain) that makes the mycelium grow fast.

A bag of spawn can be used a bit like a bag of seeds, in the sense that you can inoculate lots more substrate (known as your fruiting substrate) with this spawn. Once that mycelium has eaten up its new substrate, the mycelium will fruit into mushrooms.

Depending on the species of mushroom you want to grow, your fruiting substrate might be logs or stumps in your backyard, or straw laid down in a garden bed. It might be coffee grounds and sawdust packed into a bucket or a jar. All these materials can be food for mycelium, although different species prefer different materials.



BELOW LEFT: Grain spawn, about to be mixed with pasteurised substrate.

BELOW: King oyster mushrooms growing on a block of well-colonised substrate/spawn mix.



BEST TYPES OF MUSHROOMS FOR BEGINNERS

Mushroom cultivation is quite different from going for a walk in a pine forest at the right time of year to gather a basket of wild mushrooms. Although, if you set up your mushroom gardens well, it can feel a lot like that experience.

Starting off with a species that will grow no matter what is a good idea. There's nothing like a feast of successfully home-grown mushrooms to spur you on to further cultivation. Of course, once you've mastered the process, you can branch out (like a mycelium!) to other mushrooms that have more specific needs. Here are the mushrooms we recommend when you're starting out on your mushroom cultivating journey.

***PLEUROTUS ERYNGII* (KING OYSTER)**

Considered by many to be the best tasting oyster mushroom, king oysters are a meaty, full feast that can be sliced and barbecued. They crisp up when stir-fried, yet stay wonderfully chewy and nutty. They can be grown in a similar way to pearl oysters, but their superior flavour makes them worth mentioning. Once you've mastered pearl oysters, give them a go.

Pleurotus ostreatus (pearl oyster)

The species we recommend starting with for bucket or jar cultivation is the pearl oyster. There are lots of *Pleurotus* (oyster) species, including *Pleurotus djamor* (pink oyster), *Pleurotus eryngii* (king oyster) and *Pleurotus citrinopileatus* (golden oyster). However, some of these other varieties are slightly more fiddly than *Pleurotus ostreatus*, so pearl oyster is a good starting point.

Preferred fruiting substrates: Oyster mushrooms prefer pasteurised straw or sawdust, but will fruit well on most farm waste products containing cellulose and lignin. They also like hardwood logs or stumps for outdoor cultivation. Waste coffee grounds are becoming popular among urban growers of oyster mushrooms, but note that they must be used while very fresh as they have a relatively high nutrient content and can be prone to contamination.

Climate: *Pleurotus ostreatus* are awesomely adaptable and will tolerate a range of growing conditions. They should fruit anywhere from 7–25°C (45–77°F).

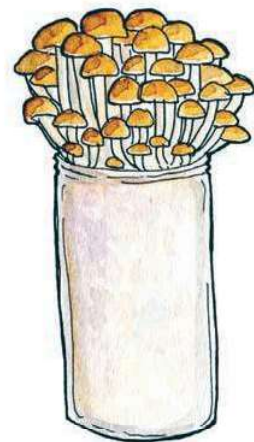
Time from inoculation to fruiting: Quick. From 2 to 3 weeks for indoor cultivation, depending on ambient temperature and the inoculation rates of substrate.



PEARL OYSTER



SHIITAKE



VELVET PLOPPINI

Lentinula edodes (shiitake)

Shiitake are a great species to use when you are starting outdoor cultivation. They will grow on logs in your garden. Although they're a lot slower to fruit than oyster mushrooms, if you inoculate a batch of logs every year (or even better, every season), you can soon have a regular supply of shiitakes.

Preferred fruiting substrates: Hardwood logs of almost every type, though yields will vary according to the log species. Eucalypts work well if you can't find oak, beech or alder. They can also be grown on sawdust.

Climate: There are different strains of shiitake, but the main strain that we use fruits between 14 and 20°C (57 and 68°F), which is a wide enough bracket for most temperate climates. There are both colder and warmer strains that fruit below, and above, that temperature envelope.

Time from inoculation to fruiting: Long. On logs: from 6 to 12 months (or longer), depending on climate and inoculation rates of the log. On sawdust blocks: 7 to 10 weeks. Worth the wait!



Shiitake mushrooms emerging from eucalyptus logs.

Agrocybe aegerita (velvet pioppini)

Native to poplar wood, this is a delicious mushroom with a nutty bite. It's great for stir-fries and other cooking methods.

Preferred fruiting substrates: Hardwood sawdust is best. This one is great for jar cultivation. It also does well on logs and stumps.

Climate: Keep it cool – pioppinos like to stay around 13–18°C (55–64°F), and tend to fruit in the spring, after the colder months.

Time from inoculation to fruiting: Long – 8 to 12 months for outdoor log cultivation or about 6 weeks for indoor cultivation.

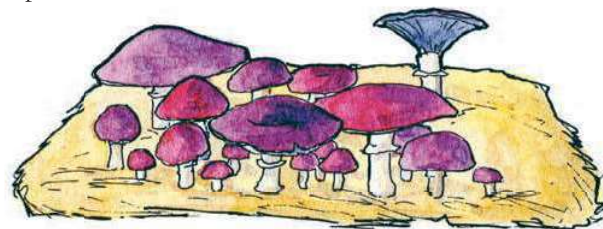
Stropharia rugosoannulata (king stropharia or garden giant)

This is our favourite mushroom to grow in woodchip gardens. It's easy to grow and delicious to eat.

Preferred fruiting substrates: Hardwood woodchips are preferred, but, like oyster mushrooms, king stropharia will grow in straw and many other farm waste products.

Climate: King stropharia grow in a very broad range of temperatures, from about 5–35°C (41–95°F), so they're great for both temperate and subtropical climates. They do need good moisture, however, so make sure this is supplied consistently.

Time from inoculation to fruiting: Long. About 4 to 6 months, depending on inoculation rates and which substrate you use.



KING STROPHARIA



KEEP IT CLEAN!

Mushroom cultivation is all about figuring out a way to get only the mycelium of your choice to grow on something. That's easier said than done, as our world involves all sorts of spores, bacteria and other microbiology constantly existing on absolutely everything. Everything wants to try and grow. And it will – no matter what you do.

The key to the mushroom cultivation game is figuring out low-energy, non-toxic ways of giving your chosen mycelium a head start on all the other microbiology. The best way to do this is to keep everything as clean as you possibly can, at every stage of cultivation. This is why we pasteurise or sterilise the substrate – to nullify most of the microbial competition and give our chosen mycelium an opportunity to eat first, so it can win the race and fruit into tasty mushrooms.

Contamination will still sometimes occur. Somewhere, somehow, an undesirable mould or bacteria will find its way in and establish itself, turning your carefully stewarded bucket of substrate unsettling shades of green, pink or grey. There's nothing to do but throw it on the compost pile and start again.

Curiously, though, successful home mushroom cultivation doesn't require going into total microbial lockdown or attempting to annihilate all life. Some of the microbiology out there will actually *help* your mycelium to thrive and protect it from invasion. Think of it as being similar to creating great gut health or growing a successful organic garden. The goal is to find ways to encourage the species you want to thrive, and ensure that the species you don't want aren't given a chance to establish.

The main point is this: keep your mushroom cultivation process as clean as possible and, when you're working in the open air with a just-prepared substrate, work quickly and don't break for lunch. That's all you need to do. Formaldehyde-soaked substrates or sterile suits and hair nets aren't necessary for successful home cultivation. Between your careful hands, good technique and the friendly microbes of the world, you'll soon be on your way to cultivating many mushrooms.

RIGHT: Enokitake in their 'wild' form, grown on sawdust in preserving jars.

OPPOSITE: A home harvest of lion's mane, tan oysters, pearl oysters, shiitake and king oyster mushrooms.





Home Mushroom Cultivation

online course

Loved our free Mushroom Cultivation Mini-Book?

You might like to join us to **learn everything you need to grow gourmet and medicinal mushrooms at home**, in ALL the ways... inside our complete Home Mushroom Cultivation online course.

Over 8 weeks, this comprehensive course will arm you with all the knowledge and skills you need - to create a thriving and resilient home mushroom cultivation system - **on cardboard, in buckets, in gardens and on logs**, too.

Using low-tech, low input and low-waste techniques, you will **join folks across the world** who have successfully integrated mushroom cultivation into their homes - and are harvesting all the edible and medicinal 'shrooms.

*"This course **gave me the confidence to grow mushrooms** easily and sustainably, it added to my sustainable lifestyle, allows me to take better care of my health and best of all it gives me so much joy. Seriously... just sign up - it's the best."*

~ Fiona Wall, student, Australia

Learn more about the course here: courses.milkwood.net/mushroomcultivation

