CHARLESTON PARKS CONSERVANCY™

Your place, your space.

MUSHROOM LEARNING STATIONS

- What are Fungi?
- Mushroom Life Cycle
- Mushroom ID Basics
- Uses of Fungi
- Cooking with Mushrooms
- Grow Your Own Mushrooms

Scroll to explore our 6 different learning stations!

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Table of Contents

The following learning stations provide additional information and learning materials relevant to the fungi, and more specifically, mushrooms, that inspired the art installation at Hampton Park.

Topics Include:

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What are Fungi?

1

Fungi are a kingdom of living organisms that include an estimated 1.5 - 5 million species, though only about 5% have been named. Mushrooms are a subset of this group and are the fruiting bodies of some types of fungi that grow on a wide range of materials. All mushrooms are fungi, but not all fungi are mushrooms. For example, in addition to mushrooms, yeast and mold are also fungi.

All fungi digest foods in their environment with enzymes (like we do with our stomachs!). The main body of the organism is known as mycelium, which grows in multiple directions as it seeks food to digest in wood and soil. When the conditions are right, mycelium will form mushrooms and fruit, producing spores that are similar to seeds, in that they are the reproductive elements of the organism.

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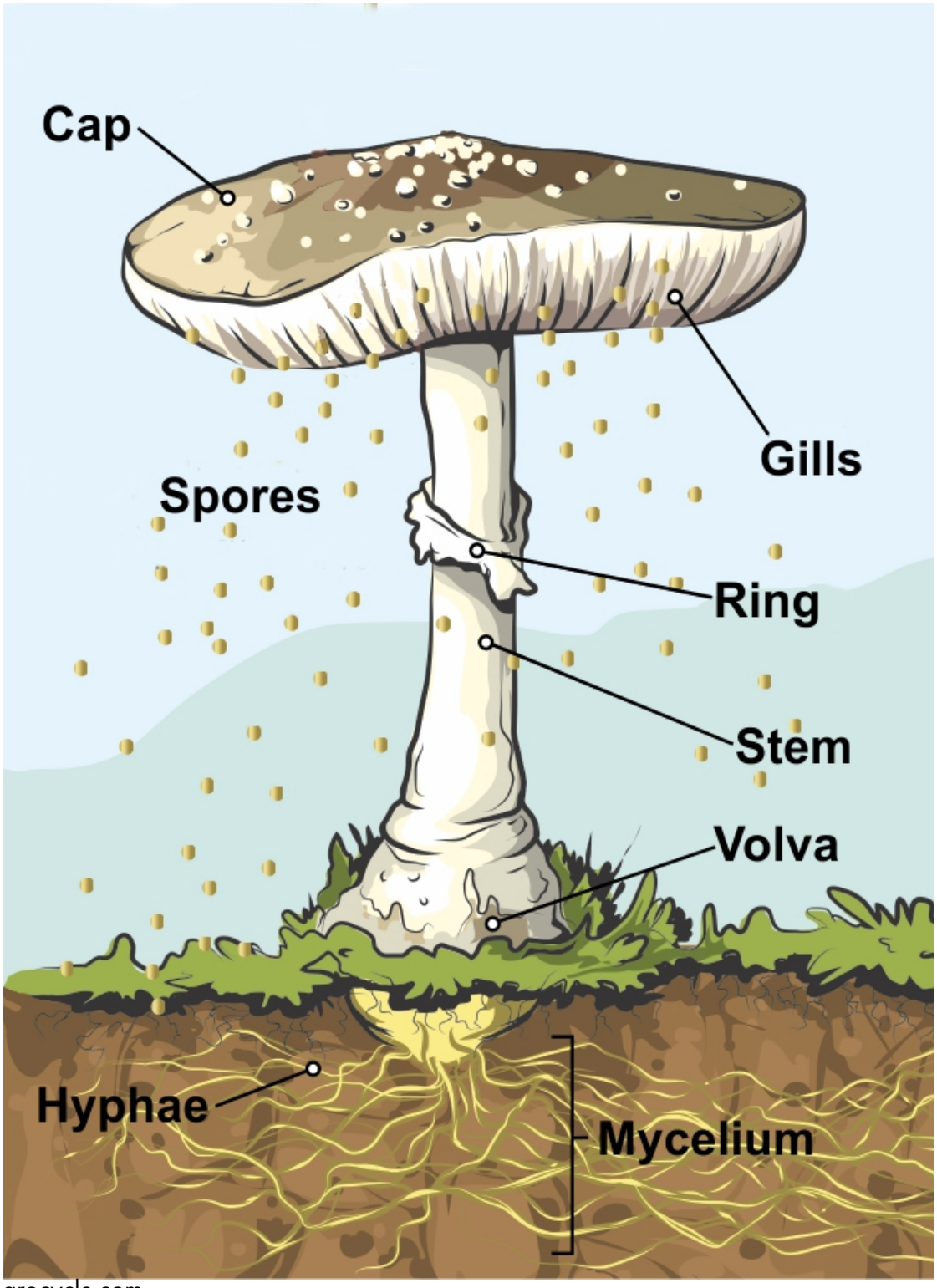
Anatomy of a Mushroom

1



grocycle.com

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Anatomy of a Mushroom

1

Cap: The topmost part of the mushroom that contains and protects the spore-producing surface of the mushroom (the gills, pores, or teeth).

Gills: Thin, paper-like structures layered side by side that often hang from the underside of the cap. The gills produce and disperse billions of spores. (*Note: not all mushrooms have gills. Some have pores or teeth that serve the same role).

Spores: Microscopic reproductive cells produced in the gills. The spores are like seeds that contain the genetic material needed to grow new mushrooms. Mushrooms release their spores at the end of their lifecycles.

Stem: The stem supports the cap and elevates it above the ground, which allows for the successful dispersal of spores.

Mycelium: A web-like structure, similar to roots, made up of long hyphae fibers found in or on soil and other substrates.

Hyphae: The individual threads that make up the mycelium of the fungus. They absorb nutrients from the environment and transport them to other parts of the fungus.

Ring: The swath of tissue that covers and protects the gills of the fruiting body while it is developing.

Volva: A cup-like structure at the base of a mushroom that encloses the immature body of a mushroom prior to fruiting.

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What are Fungi?

1

There are four main types of mushrooms:

(1) Mycorrhizal fungi form beneficial partnerships with plants and trees, trading water and nutrients for carbohydrates and sugars. (Examples: truffles, porcini, chanterelle, morels)

(2) Saprophytes decompose dead organic matter (logs, woodchips, straw, sawdust, grain hulls, etc.) as a food source. (Examples: Oyster, Shiitake, Chicken of the Woods)

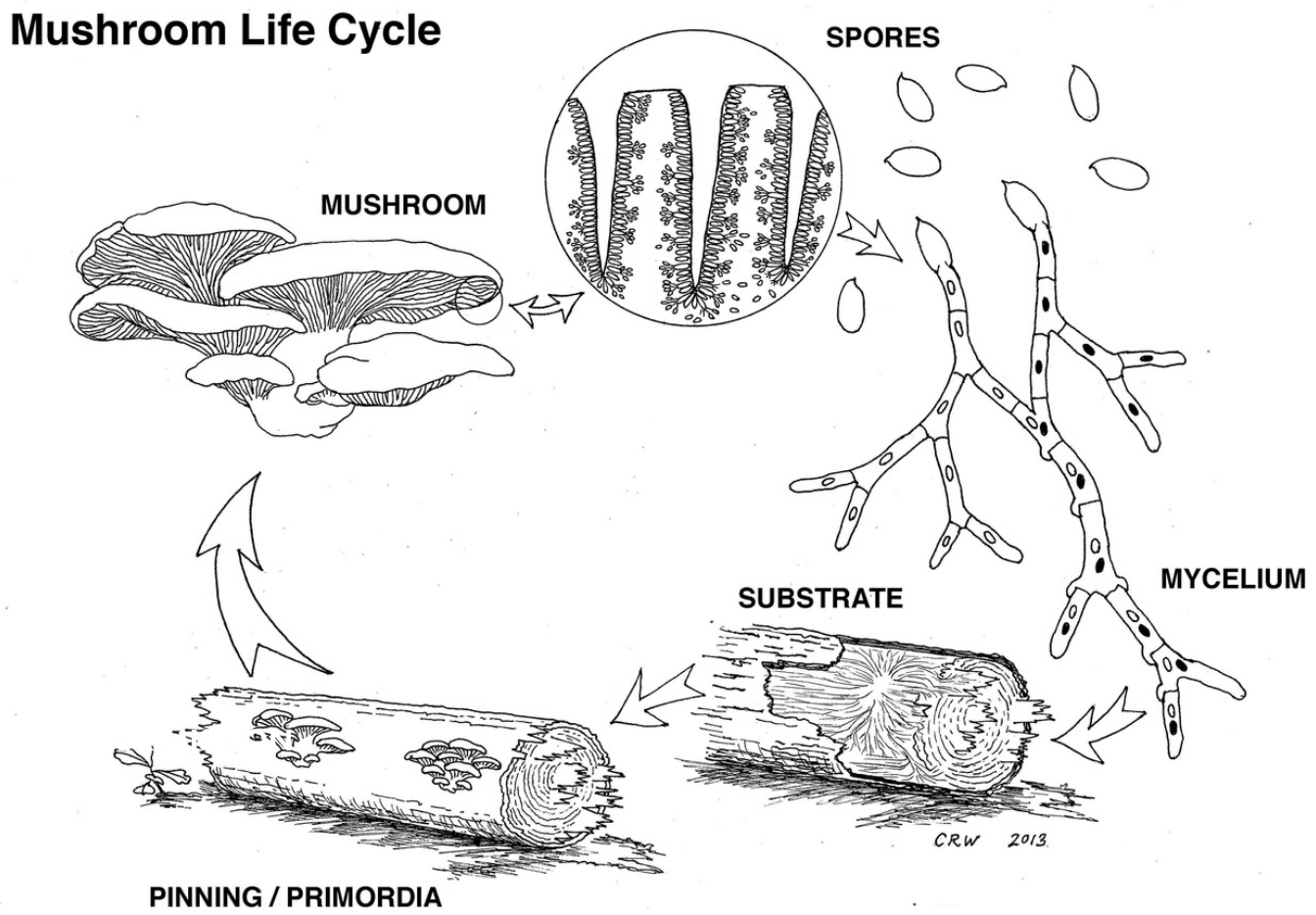
(3/4) Parasites and Pathogens feed off living plants and trees and can range in their impacts; these are the disease fungi often focused on in forestry and agriculture. (Examples: cordyceps, chaga, apple scab, fire blight)

From a cultivation perspective, the most delicious mushrooms are in the first two groups, but because of the challenge of orchestrating an ecological relationship between fungi and plants, very little success is achieved in mycorrhizal cultivation. Saprophytes or decomposing fungi are the overwhelming favorites for successful growing. The most common among these include shiitake, oyster, lion's mane, and chestnut.

End of Station 1

Mushroom Lifecycle

2



Decomposing mushrooms produce spores that carry genetic information and germinate, growing single strands of hyphae and if a mate is found form patches of mycelium that grow through a substrate as a food source, and when conditions are right initiate pinning or primordia formation, which turns back into mushrooms!

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Mushroom ID Basics

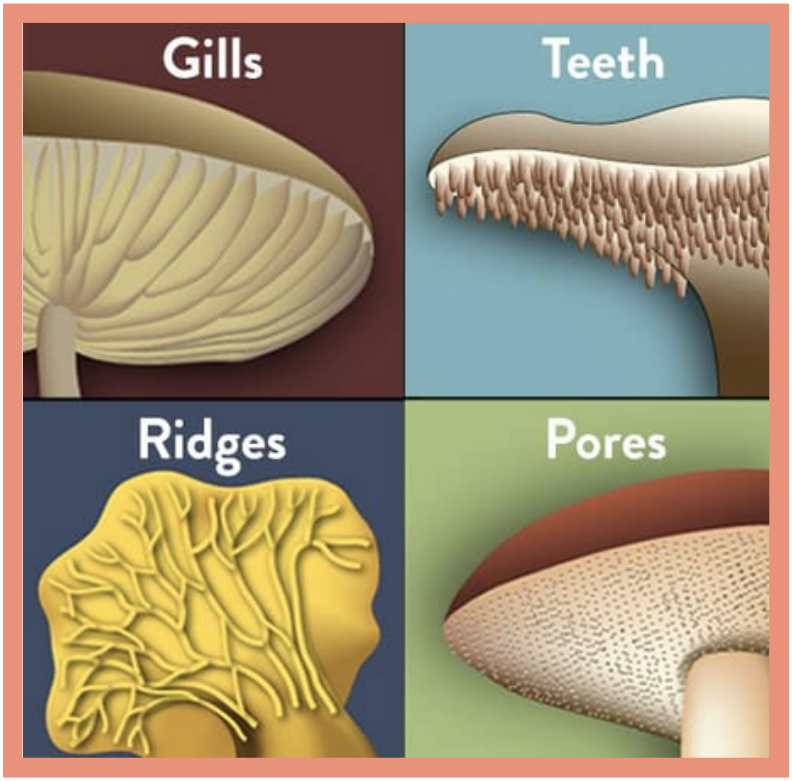
3

Accurate identification is essential to safely foraging and consuming both wild and cultivated mushrooms. The following information provides a brief introduction to mushroom identification, but it is important to always positively identify homegrown or foraged mushrooms to ensure they are safe to enjoy.

A few of the diagnostic features used to identify mushrooms include:

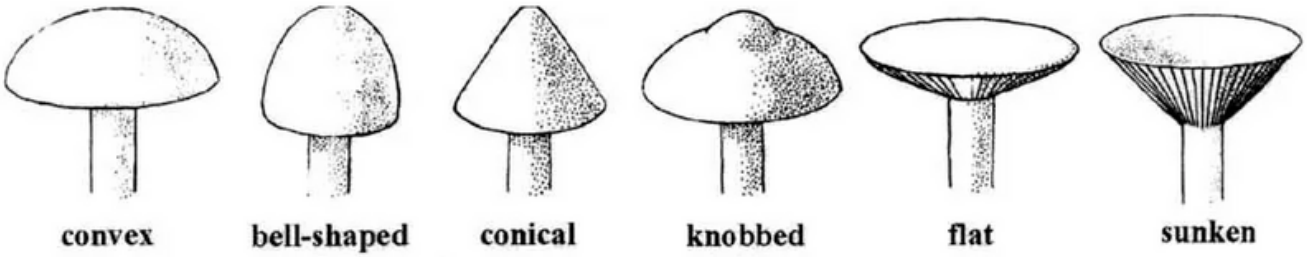
- Size
- Color
- Shape of the cap and stem
- Whether the underside of the cap has pores, gills, or teeth
- The absence or presence of a veil

Characteristic of Underside:



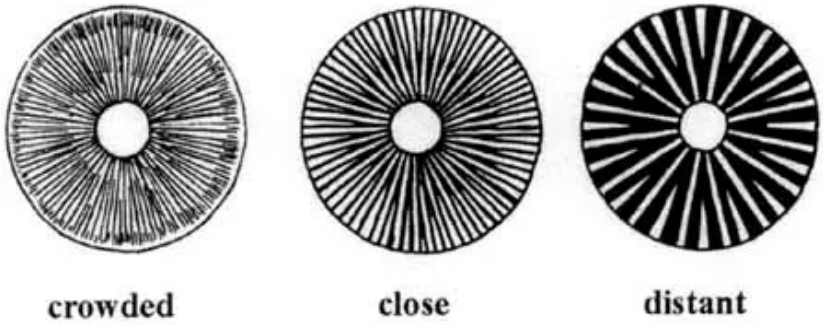
Real Mushrooms

Shape of Cap:

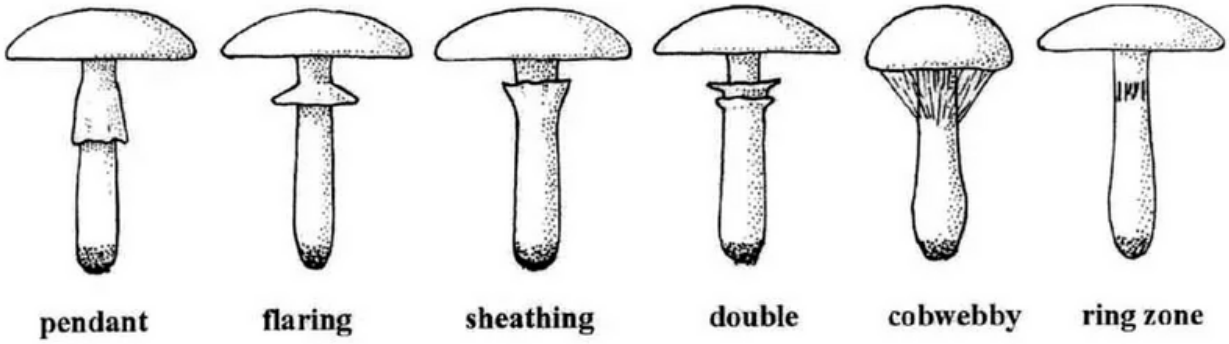


Midwest Mycology

Spacing of Gills:



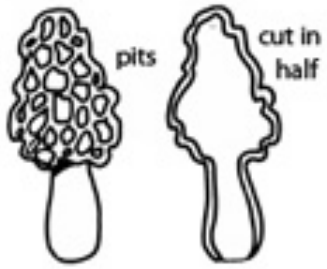
Presence / Type of Veil:



Common Mushrooms:

Cup fungi

False Morels

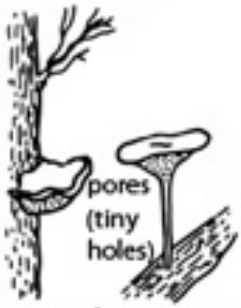


True Morels

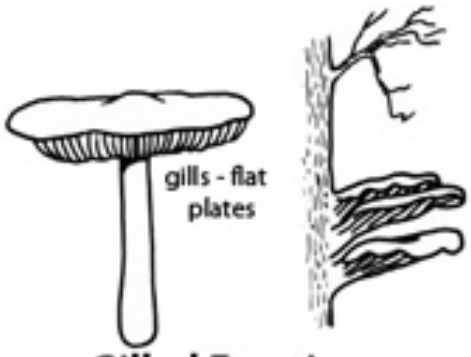
Teeth Fungi

Chanterelles

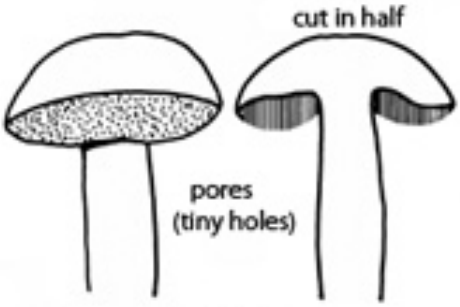
Coral Fungi



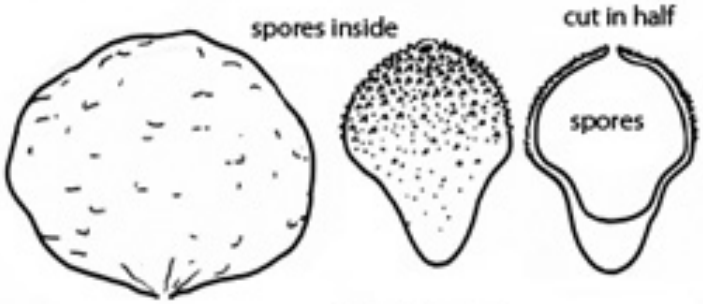
Polypores



Gilled Fungi

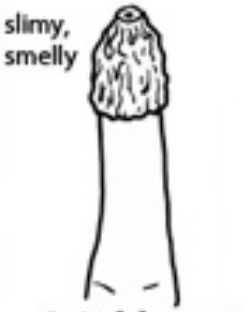


Boletes



Puffballs

Earthstars



Stinkhorns

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Uses of Fungi

4

Fungi, including mushrooms, have many unique and diverse uses. In addition to providing the essential function of nutrient cycling in our ecosystems in their role as decomposers, fungi are also used as sources of food, medicine, art, and in mycoremediation.

Food

Mushrooms are highly nutritious and medicinal foods, with twice the protein of most vegetables and a rich array of all the essential amino acids we need in our diet. Along with being an excellent source of protein, dietary fiber, and minerals, they have zero saturated fats.

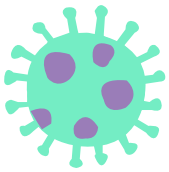
Medicine

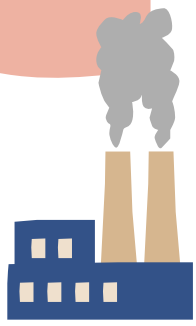
Mushrooms also offer an impressive array of medicinal compounds that offer antiviral, antimicrobial, anti-inflammatory, and immune-modulating benefits. Some medicines derived from fungi include the antibiotic penicillin, cyclosporine which enables organ transplants, and lovastatin which lowers cholesterol. Certain types of fungal treatments are also being explored for their cancer-fighter properties.

Art

In addition to providing inspiration for art, like the illuminated installation in Hampton Park, mushrooms can also be used to create natural dyes and inks. Additionally, some artists use mushrooms to create paper and as natural stamps. In this way, mushrooms act as both subject and medium.

Mycoremediation





Because fungi are effective at breaking down a wide range of organic molecules, they have the potential to be used for cleaning contaminated land and water. This decontamination of our environment through fungi is called mycoremediation. Through this process, fungi can be used to break down biological pathogens such as E. coli and Salmonella, chemical contaminants including PCBs and Dioxins, and Industrial Pollutants such as heavy metals and carcinogens. Acting as natural filters, fungi ultimately convert these harmful contaminants into non-toxic carbon dioxide and air!

Cooking with Mushrooms

5

Mushrooms are highly nutritious and medicinal foods, with twice the protein of most vegetables and rich in all the essential amino acids we need in our diet. Along with being an excellent source of protein, dietary fiber, and minerals, they have zero saturated fats.

Not sure how to prepare mushrooms or which varieties to cook with? Click on the recipes below for instruction and inspiration!

1) Mushroom Veggie Pot Pie

2) Wild* Mushroom Risotto

*Feel free to substitute store-bought mushrooms of any variety in place of wild mushrooms. Wild mushrooms should only be foraged and consumed if you are confident in your mushroom ID!

3) Spinach & Mushroom Quiche

4) Braised Mushroom Tacos

5) Slow Cooker Mushroom Mac n' Cheese

6) Lion's Mane Mushroom Crab Cakes

When in doubt, sautéing with butter and spices will usually do the trick!

End of Station 5

How to Grow Your Own Mushrooms

6

Information and instructions courtesy of Cornell Small Farms

Cultivation of mushrooms has been a traditional cultural practice in many parts of the world, along with wild foraging. In North America, button mushrooms (Agaricus bisporus) are the most commonly cultivated, making up 97% of production and grown on a large, industrial scale. The opportunities that exist for small and medium-sized growers are mainly to offer specialty mushrooms to local markets, most notably with shiitake and oyster mushrooms.

This guide describes four mushroom cultivation methods. Each method offers a different set of materials, context, and requirements. Depending on your personal interests and goals, there are many possibilities for incorporating mushrooms into your life.

While mushroom poisoning is actually a very rare occurrence, many people are afraid of this possibility. It's important to learn to properly identify any mushrooms you are growing, in order to ensure you don't consume a toxic species by mistake. Identification guides for the species offered in this guidebook can be found at www.CornellMushrooms.org.

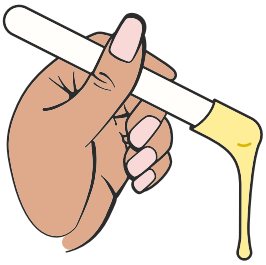
Shiitake on Hardwood Logs

Shiitake (Lentinula edodes) are native to various parts of Asia including Japan, China, and Korea. They have been cultivated on logs for thousands of years and have a rich history as part of traditional agricultural practices dating back centuries.

They are grown indoors and outdoors on hardwood logs. Traditional growers utilize the natural environment of the forest to create the perfect conditions for growth and fruiting.

Supplies you will need:

- Fresh cut hardwood logs 4 - 8" in diameter and 18 - 36" long
- Drill or Angle Grinder and drill bit
- Shiitake sawdust or dowel spawn
- Inoculation tool (sawdust) or hammer (dowels)
- Hot plate and an old pot to melt wax
- Food-grade cheese wax
- Brushes



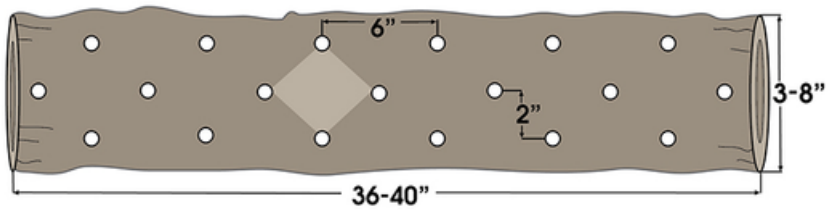
The steps to growing Shiitake mushrooms on Logs

1. Acquire Logs

Hardwood logs are harvested by the farmer or purchased from a supplier. Traditionally, Oak (Quercus spp.) is used, but many other hardwood species can work. We have had success on Sugar Maple (Acer saccharum) and members of the Beech (Fagus spp.) and Birch (Betula and Alnus spp.) families. Logs are best from small-diameter trees cut to 4 – 8″ in diameter and 3 feet in length. Fresh-cut logs, less than three months old, are best to ensure they are free from competing fungi.

2. Drill Holes

Approximately 50 holes are drilled into each log, using a corded drill or angle grinder. The holes are spaced 4 inches apart within each row, and 2 inches between rows, which are offset to form a diamond pattern. A drill bit made specifically for this task with a stop to drilling about 1″ deep is ideal and is often available from mushroom suppliers.



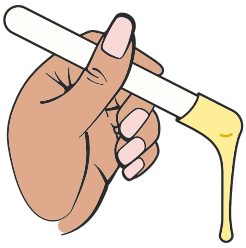
Shiitakes on Hardwood Logs

3. Fill Holes with Spawn

Each hole is filled with the shiitake mycelium, known as "spawn," from a supplier. Spawn can be purchased in several forms, most commonly as sawdust or dowels. The spawn is inserted and packed tightly into each hole, leaving no gaps

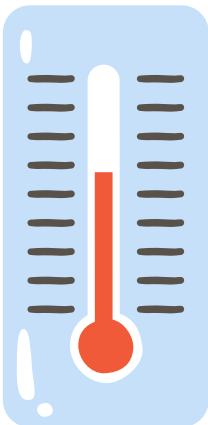
4. Wax over the Holes

Wax, most often a food grade "cheese" wax, is applied to each hole to keep the spawn from coming out and to prevent issues with moisture and pests as the fungus grows into the wood. Be sure to heat the wax to a high enough temperature so it sizzles a bit when applied to the log. This ensures it will stay in place for many years as the mushrooms grow into the wood.



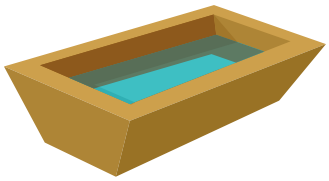
5. Spawn Run

After inoculation, logs need 6 to 8 months of temperatures averaging 60 degrees F or above before they are ready to fruit. Most often, they are stacked in the shade of a tree, as this environment provides proper moisture, humidity, and shade for the mushrooms to produce. During winter months logs can be left outside. Any growth is dormant during this time.



6. Soaking

After the spawn runs through the log (because of winter, typically 12 months from inoculation in colder climates), it can be soaked during those months when the ambient air temperature exceeds 50 degrees F during daytime and nighttime. Logs are soaked for 24 hours in a stock tank or natural body of water. It is recommended that fresh water is used for each soaking. This activity stimulates fruiting.



7. Fruiting & Harvest

Once removed from the water, logs are stacked upright to make harvesting easier. Mushrooms will usually begin to appear within 3 days and will be ready for harvest within 7 – 10 days from soaking. They are typically harvested with a sanitized knife or scissors and placed in stainless steel or food grade plastic containers. They should be picked when the cap is still curled under to ensure a long shelf life.

8. Storage and Use

After harvest, mushrooms can be stored in a fridge for up to one week without losing flavor or texture. Fresh mushrooms are commonly used in soups, stir fry, and other dishes. Shiitake mushrooms also dehydrate well for longer term storage. It is recommended that mushrooms are always cooked prior to consumption, at a minimum for 1 – 3 minutes on high heat with oil or butter.

Oysters on Straw

6

Oysters (Plueterous spp.) are a family of many species that exist on almost every continent in the world. They are the most adaptable mushroom, able to be grown on almost any organic material including logs, paper, sawdust, straw, and more. For reliable production and commercial operations, they are most commonly grown on straw or on sawdust blocks supplemented with grain hulls. These methods rely on indoor "grow rooms," which are clean spaces free of contaminants and with regulated air flow, temperature, humidity, and light to offer the best results.

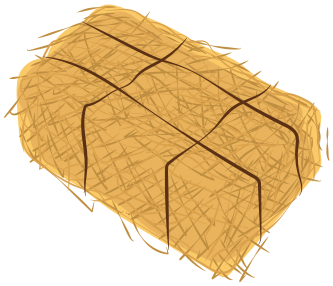
Supplies you will need:

- Oyster grain spawn
- Straw or similar brittle, dry, and carbon-rich materials
- Large pot to boil water in
- Tongs
- A cooling pan with holes to drain liquid, or a sheet
- Plastic filter bag from supplier, or 1-gallon zip lock bag per roll

The Steps to Growing Oyster Mushrooms on Straw

1. Gather Materials

Straw (not hay) or any similar material that is dry, brown, and rich in carbon can be used for this method - many plant materials can be harvested and dried for this purpose. You can sometimes purchase or order pre-shredded straw online. Just make sure it isn't treated with anything.



2. Shred It!

It's best to shred your material before inoculating so that the mycelium can easily grow through it. Increasing the surface area through shredding increases yields by two times or more. You can cut or shred by hand, use a barrel and a weed whacker, or most efficient is a wood chipper or bale shredder.

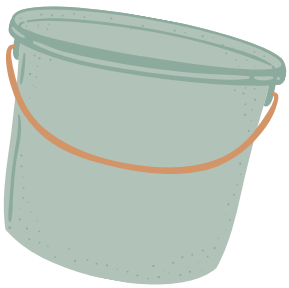
3. Treat it!

The material needs to be treated in order to "clean" it of potential contaminants before inoculation. You can do one of several methods.

- Cold Water Fermentation: Soak in cold water for 5 - 10 days, this goes anaerobic and “stinky” when ready for inoculation.
- Hot Water Pasteurization: cook for 2 hours at a minimum temperature of 140 - 160 degrees F, drain and cool before inoculating. With hot water, the straw needs to be quickly cooled on a rack or using a sheet before inoculation.
- Hydrated lime: raise the pH using hydrated mason’s lime with less than 10% magnesium content. This can be found at masonry suppliers. Add .35 lbs per gallon of water, and soak the straw for 16 hours before inoculating. This raises the pH, and it’s best to test and ensure it gets to at least 12 - 13pH. After soaking, the wastewater should be balanced before disposal.

4. Inoculate and pack into containers

Once the straw is treated, it can be packed into containers and compressed as much as possible. Wear gloves and spray any tools and surfaces with 70% isopropyl alcohol to reduce contamination. Bags, buckets, jars, or other clean containers can be used. Make sure there are holes for oxygen to get in.



Oysters on Straw

5. Spawn Run

This takes about 3 - 4 weeks. Keep the inoculated straw in a cool space (60 - 70 degrees F) without sealing off access to some fresh air, and keep the space dark. Mycelium will move through the straw and become full and firm when close to fruiting time.

6. Fruiting and resting

When spawn run is complete, bring material into contact with more fresh air by cutting or opening more of the container to air. Increase light exposure, though not too much. Increase humidity and moisture by spritzing the container with a spray bottle several times a day, or use a humidifier. After an initial flush and harvest, the material can and often will produce 2 - 3 times more after several weeks of rest.

Wine Cap in Woodchips

6

Stropharia (Stropharia rugosa-annulata) are native to North America and are often found fruiting in lawns, woodchip beds, and along forest edges. They are a wonderful garden or plant companion, as they grow very well alongside many fruits and vegetables, provided there is mulch (straw or woodchips) and good moisture. This is one of the easiest mushrooms to grow, though it is hard to produce a reliable or consistent crop. For most homes and community gardens, wood chips are affordable and easy to obtain. Inoculation can occur as early as April or as late as September, with spring being the preferred time as it often results in fruiting in the same season.

Supplies you will need:

- 2 - 5 buckets of (mostly) hardwood woodchips
- Stropharia sawdust spawn
- A bed, pot, or plastic bin
- 1 bucket of Soil or compost
- 1 bucket hardwood sawdust or shredded cardboard
- Shovel and Rake

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Wine Cap in Woodchips

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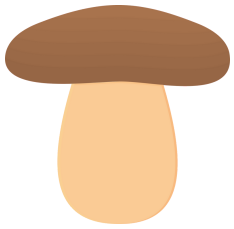


Steps to Growing Wine Cap in Woodchips

1. Measure out a spot to plant in a bed or lay out your pots or bins for planting. A 5lb bag will inoculate about 16 square feet of space; you can inoculate one continuous section, or multiple smaller areas.

2. Remove organic matter down to “bare soil” in a bed, or layer 1 - 2” of soil or compost in your bin. Add about 1/2” of hardwood sawdust or shredded cardboard and spread evenly - if available.

3. Layer the spawn on top, breaking it up into fine particles. On top of this, add 2 - 4” of woodchips or straw. Soak the bed thoroughly with water. You can also pre-soak the materials ahead of time if water is limited.

4. Wait 4 - 6 months as the mycelium moves through the substrate. Once mycelium is established, fruiting often occurs after heavy rainfalls or drops in temperature. It is important to properly identify Stropharia mushrooms before harvesting as there are many mushrooms that can emerge from mulched areas.

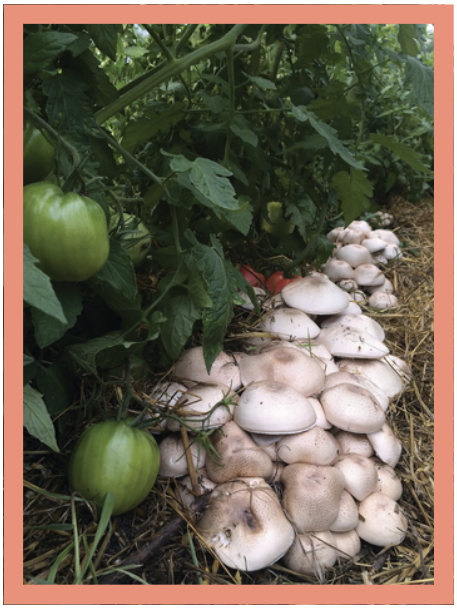
Wine Cap in Woodchips

5. Stropharia require little maintenance and can live and fruit for many years. In dry seasons water patches as you would plants in a garden. It is best to add 2 - 4" of fresh woodchips or straw in the fall to provide fresh food and protect the mycelium from damaging frosts. Once a patch has colonized an area for one full season, the mycelium can be divided into multiple handful-sized chunks and spread into other areas of the garden or into new containers with the same method above.

Almond Agaricus in Veggie Beds 6

Almond Agaricus (Agaricus subrufescens) are sweet, fragrant summer mushrooms that can be grown outdoors in the garden. A cousin to the white button mushroom, crimini, and portabella, it is much easier to grow. Just like button mushrooms, it grows in compost, but does not require pasteurization, caves, or grow houses.

Anyone who has a garden- flower, vegetable, shade, or container- can grow this mushroom. It can grow in shaded woods or a sunny garden (best alongside big, leafy plants because of the added shade). Or, it can be grown "small scale" in window boxes and large potted plants, indoors or out. It can be planted from May until early July in the north, earlier in the south, or whenever the last frost date is in your area. It is best to plant them so you can get at least 2-4 months of frost-free weather.



Supplies you will need

- Almond Agaricus Spawn
- Compost (bagged or homemade)
- Mulching material to retain moisture

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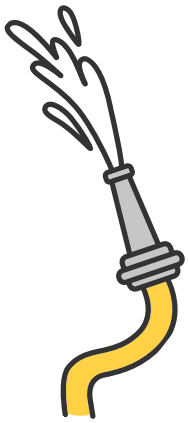
Almond Agaricus in Veggie Beds 6

The steps to growing Almond Mushrooms:



1. Choose a location

The shade requirement for Almond mushrooms is related to the ability to keep the bed moist during spawn run, and humidity to encourage large and succulent mushrooms when they fruit. This can be done outdoors in a fully sunny garden if you can provide lots of mulch and frequent, light watering from a sprinkler or soaker hose over the Almond bed for its spawn run phase, and big leafy plants nearby to capture humidity for its fruiting stage. Chard, lettuces, zucchini, tomatoes, and other large-leafed vegetables are all suitable companions for Almonds.

2. Build a bed

Beds 5 inches deep inoculated at a 5% rate (5 lbs. of spawn to 100 lbs. of compost) are optimal. Make attention to bed depth your priority. Deeper beds (but not too deep for the companion plants) are easier to maintain moisture, and shallower beds are prone to excessive drying, requiring more constant watering.

Almond Agaricus in Veggie Beds

3. Inoculate

Open the spawn bag and break off egg-sized pieces of spawn and bury each one 6-8 inches apart in a grid pattern, making sure spawn is covered with some compost after inoculation (take a moment to enjoy the signature almond-ish fragrance of the Almond spawn). Placing the spawn at different depths is also a helpful strategy.

4. Water and Monitor

Keeping the bed moist is perhaps the biggest challenge - you will want to keep it damp to the very top of the compost. We have used straw, paper grain sacks, shredded office paper, and cardboard to try to hold in moisture without excessive watering. Daily light sprinkling underneath dry cardboard or paper is almost daily work but is also quite effective.

After 2-3 weeks, watch the beds closely. The mycelium will start to knot just prior to fruiting, indicating that mushrooms are on the way. Now is the time, as an option, to apply a casing layer (preferably just before this stage, as the compost starts to show 60 percent myceliation).

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A casing layer is just a nutrient poor, thin layer of a water holding material that helps increase yields. Adding this layer is OPTIONAL. You will get plenty of mushrooms without it and it is an extra step.

To get the most out of your planting, the application of this layer is helpful for maintaining bed moisture and reducing the need for constant watering. We make our casing out of peat moss and adjust the pH with a little hydrated lime (found at garden/farm centers).

Casing recipe:

- 3 lb. peat moss
- 3 qt. water
- 1 1/2 T hydrated lime (look for types with less than 1% Mg (Magnesium) like Hi-Yield)
- Mix well

Before consuming any fresh mushroom, please make sure to positively identify it to ensure it is safe to enjoy.