# Mushroom Classification

**What is a mushroom?**

*Mushrooms* are not plants! Recently it has been discovered that they are more closely related to animals. But at one time, Fungi, including mushrooms, were believed to be close relatives of plants so much of their *nomenclature*(names for parts of the mushroom) are close to the names used for plant parts. It is the *fruit* (like an apple) of the mushroom "body" and contain mushroom "seeds" called spores. The body of the mushroom in called mycelium and its individual parts are microscopic. Since the body of the mushroom is usually dispersed over a relatively large area it is rarely noticed. In nature some species of mushrooms may have a body that spreads over hundreds of square miles!

***Mushrooms are fungi***, and are usually placed in a Kingdom of their own apart from plants and animals. Mushrooms contain no chlorophyll and most are considered saprophytes. That is, they obtain their nutrition from metabolizing non living organic matter. This means they break down and "eat" dead plants, like your compost pile does.

The body of the mushroom stores nutrients and other essential compounds, and when enough material is stored and the conditions are right they start to *fruit* - produce mushrooms. It is a hidden kingdom. The part of the fungus that we see is only the “fruit” of the organism. The living body of the fungus is a mycelium made out of a web of tiny filaments called hyphae. The mycelium is usually hidden in the soil, in wood, or another food source. A mycelium may fill a single ant, or cover many acres. The branching hyphae can add over a half mile (1 km) of total length to the mycelium each day. These webs live unseen until they develop mushrooms, puffballs, truffles, brackets, cups, “birds nests,” “corals” or other fruiting bodies. If the mycelium produces microscopic fruiting bodies, people may never notice the fungus.

Most fungi build their cell walls out of chitin. This is the same material as the hard outer shells of insects and other arthropods. Plants do not make chitin.

**Source :** <https://www.gmushrooms.com/info.htm>

#### Mushroom can be classified in following two types:

1. **Edible Mushroom**
2. **Poisonous Mushroom**
3. **Edible Mushroom:**

***Edible mushrooms***are the fleshy and **edible** fruit bodies of several species of macrofungi (**fungi** which bear fruiting structures that are large enough to be seen with the naked eye). They can appear either below ground (hypogeous) or above ground (epigeous) where they may be picked by hand. Edibility may be defined by criteria that include absence of [poisonous](https://en.wikipedia.org/wiki/Mushroom_poisoning" \o "Mushroom poisoning) effects on humans and desirable [taste](https://en.wikipedia.org/wiki/Taste" \o "Taste) and [aroma](https://en.wikipedia.org/wiki/Aroma" \o "Aroma).

Edible mushrooms are consumed for their [nutritional](https://en.wikipedia.org/wiki/Nutrition" \o "Nutrition) and [culinary](https://en.wikipedia.org/wiki/Cuisine" \o "Cuisine) value. Mushrooms, especially dried [shiitake](https://en.wikipedia.org/wiki/Shiitake" \o "Shiitake), are sources of [umami](https://en.wikipedia.org/wiki/Umami" \o "Umami) flavor from guanylate. Mushrooms consumed by those practicing [folk medicine](https://en.wikipedia.org/wiki/Folk_medicine" \o "Folk medicine) are known as [medicinal mushrooms](https://en.wikipedia.org/wiki/Medicinal_fungi" \o "Medicinal fungi). While [psychedelic mushrooms](https://en.wikipedia.org/wiki/Psychedelic_mushrooms" \o "Psychedelic mushrooms) are occasionally consumed for [recreational](https://en.wikipedia.org/wiki/Recreational_drug_use" \o "Recreational drug use) or [entheogenic](https://en.wikipedia.org/wiki/Entheogen" \o "Entheogen) purposes, they can produce psychological effects, and are therefore not commonly used as food. There is no evidence from high-quality [clinical research](https://en.wikipedia.org/wiki/Clinical_research" \o "Clinical research) that 'medicinal' mushrooms have any effect on human diseases.

* **Edible Mushrooms available in India** :
* **Oyster mushrooms:** This common edible wild mushroom, now grown commercially across the world, was first cultivated in Germany during World War I as a means of subsistence. It got its name because of its broad fan or oyster shaped cap. It also has a bittersweet aroma, which some believe, has a faint resemblance to the flavour of oysters. The colour of this gilled mushroom varies from white, grey, tan and reddish brown. This variety — known for its tender flesh, velvety texture and mild flavour — is used for salads, soups, sautés, grills and toasts. This mushroom is one of the few known carnivorous mushroom. Yes, it kills and digests parasites to obtain nitrogen! Also, the health benefits are numerous. They are very high in protein, fiber, vitamins B1 and B2, iron and anti-oxidants, and low on fat. They are also known to prevent cancer, high cholesterol and inflammation and high blood pressure. They are also known as tree oyster, straw mushroom, hiratake and tamogitake. **Price:**500 gm for Rs125
* **Shiitake mushrooms:** This edible mushroom is mostly consumed in East Asia, as it grows in warm and moist climate. It is typically cultivated on dead and decaying logs of deciduous trees such as chestnut, oak, maple, beech, ironwood, mulberry and is also known as sawtooth oak mushroom, black forest mushroom, black mushroom, golden oak mushroom and oakwood mushroom. This variety has 10 times the flavour of common white button mushrooms. Known for its pungent, woodsy flavour and meaty texture, shiitake is used in East Asian cuisines. In Japan it is used in soups, steamed and simmered dishes, while in China they are sautéed in vegetarian dishes. In Thailand, they are fried or steamed. In Russia, it is mostly picked. This variety of mushroom is generally dried (to get rid of the umami flavour) and sold as preserved food. Shiitake is high protein, potassium, vitamin B, calcium, magnesium and phosphorus. They also have anti-viral and immunity boosting properties. It is prescribed to fight virus, lower cholesterol and regulate blood pressure. **Price**: 500 gm for Rs1000
* **Shimeji mushrooms:** This variety is native to East Asia, but is also found in Northern Europe. They are often called beech mushrooms as they grown on dead beech trees. They have a white base and cracked, speckled brown caps. It has a rich Umami flavour. This variety is always cooked as it is bitter when raw and also lacks the nutritional value that it has when cooked. Once cooked, it has a pleasant, firm, spongy, slightly crunchy and nutty flavour. It is mostly used in stir-fried food and soups, stews and sauces. It can also be sautéed as a whole, including stem and stalk. They are also the perfect accompaniment to noodles. But yes, it is so difficult to grow that its cultivation method has been patented. Because of its petit size and delicate nature, they are harvested in bouquets to protect their vulnerable structure. **Price**: 500 gm for Rs850
* **Portobello mushrooms:** Native to grasslands in Europe and North America, these mushrooms are one of the most widely consumed mushrooms in the world. When immature and white, is known as common mushroom, button mushroom, white mushroom, table mushroom and champignon mushroom. When immature and brown, it is known as Swiss brown mushroom, Roman brown mushroom, Italian mushroom and Cremini mushroom. When fully grown, Portobellos are fairly big in size and have a tender meaty texture and earthy flavour. It has a large, light tan cap. Cooking helps unlock the more subtle flavours of this variety. This variety of mushrooms cooks very quickly in high heat. Hence, it is turned, moved and stirred constantly. Portobellos pair well with most food. Also, these rot quickly when wet. So if you are using water to clean it, cook immediately to minimize wastage. These are an excellent source of copper, phosphorous, vitamin B, potassium, zinc and manganese. Can be refrigerated in paper bag for a week. **Price:**500 gm for Rs1,900
* **Enoki mushrooms:** Unlike most mushrooms, Enoki has a mild and delicate — almost fruity flavour — with a slight, crunchy texture. They can be eaten both raw and cooked and are used for salads, soups, sandwiches and pasta sauces. Heat makes them tough, hence, when cooked, they are added at last. They are also known as golden needle or lily mushroom. Enoki mushrooms come in two distinct varieties — wild and cultivated. While the wild variety, grown on mulberry and similar trees, are dark brown in colour and has a shorter and thicker stem, cultivated mushrooms have long, slender white stems with tiny, firm caps. This variety of mushrooms have significant amount of anti-oxidants and protein, apart from vitamin D and B-complex. They can be refrigerated for eight days in a paper bag. **Price:** 500 gm for Rs875

***Source:*** <https://timesofindia.indiatimes.com/Know-all-about-mushrooms/articleshow/47514152.cms>

**Common Characteristics of Edible Mushrooms:**

***1. When you cut the mushroom it does not stain green or purple.***

***2. When you taste a piece of the mushroom, it does not burn or sting the tongue.***

***3. Edible mushrooms have pleasant odour.***

***4. It has sweet taste.***

***5. There is presence of worms.***

***6. There is no scale on the cap.***

**2 . Poisonous Mushroom:**

Mushroom [poisoning](https://medical-dictionary.thefreedictionary.com/poisoning) refers to the severe and often deadly

effects of various toxins that are found in certain types of mushrooms. One type known as *Amanita phalloides*, appropriately called "death cap," accounts for the majority of cases. The toxins initially cause severe abdominal cramping, vomiting, and watery [diarrhea](https://medical-dictionary.thefreedictionary.com/diarrhea), and then lead to liver and kidney failure.

### Causes and symptoms

Poisonous mushrooms contain at least two different types of toxins, each of which can cause death if taken in large enough quantities. Some of the toxins found in poisonous mushrooms are among the most potent ever discovered. One group of poisons, known as amatoxins, blocks the production of DNA, the basis of cell reproduction. This leads to the death of many cells, especially those that reproduce frequently such as in the liver, intestines, and kidney. Other mushroom poisons affect the proteins needed for muscle contraction, and therefore reduce the ability of certain muscle groups to perform.

Symptoms of *Amanita* poisoning occur in different stages or phases. These include:

* First phase. Abdominal cramping, nausea, vomiting, and severe watery diarrhea occur anywhere from 6-24 hours after eating the mushroom and last for about 24 hours. These intestinal symptoms can lead to [dehydration](https://medical-dictionary.thefreedictionary.com/dehydration) and low blood pressure (hypotension).
* Second phase. A period of remission of symptoms that lasts 1-2 days. During this time, the patient feels better, but blood tests begin to show evidence of liver and kidney damage.
* Third phase. Liver and kidney failure develop at this point and either lead to death within about a week or recovery within 2-3 weeks.

Other symptoms are due to either a decrease in blood clotting factors that leads to internal bleeding or reduced muscle function, with the development of weakness and [paralysis](https://medical-dictionary.thefreedictionary.com/paralysis).

## Poisonous Mushrooms in India:

* **Omphalotus olivascens:**

Omphalotus olivascens, commonly known as the western jack-o'-lantern mushroom, is an orange to brown-colored gilled [mushroom](https://en.wikipedia.org/wiki/Mushroom" \o "Mushroom) native to [California](https://en.wikipedia.org/wiki/California" \o "California) and [Mexico](https://en.wikipedia.org/wiki/Mexico" \o "Mexico).

To an untrained eye, O. olivascens appears similar to some [chanterelles](https://en.wikipedia.org/wiki/Cantharellus" \o "Cantharellus), but unlike the chanterelle, the jack-o'-lantern mushroom has true, blade-like [gills](https://en.wikipedia.org/wiki/Lamella_(mycology)" \o "Lamella (mycology)) (rather than ridges) and it can have olive coloration that chanterelles lack; also, Omphalotus species are [saprotrophic](https://en.wikipedia.org/wiki/Saprotrophic_nutrition" \o "Saprotrophic nutrition), grow directly on wood, and are [bioluminescent](https://en.wikipedia.org/wiki/Bioluminescence" \o "Bioluminescence).

A [saprobe](https://en.wikipedia.org/wiki/Saprotroph" \o "Saprotroph) or [parasite](https://en.wikipedia.org/wiki/Parasitism" \o "Parasitism), O. nidiformis is nonspecific in its needs and is compatible with a wide variety of [hosts](https://en.wikipedia.org/wiki/Host_(biology)" \o "Host (biology)).

Omphalotus species cause a [white rot](https://en.wikipedia.org/wiki/Wood-decay_fungus" \l "White_rot" \o "Wood-decay fungus) by breaking down [lignin](https://en.wikipedia.org/wiki/Lignin" \o "Lignin) in their tree hosts

The jack o'lantern mushroom is [poisonous](https://en.wikipedia.org/wiki/Poisonous_mushroom" \o "Poisonous mushroom); while not lethal, consuming this mushroom leads to very severe [cramps](https://en.wikipedia.org/wiki/Cramp" \o "Cramp), [vomiting](https://en.wikipedia.org/wiki/Vomiting" \o "Vomiting), and [diarrhea](https://en.wikipedia.org/wiki/Diarrhea" \o "Diarrhea).

The toxic ingredient of many species of Omphalotus is a [sesquiterpene](https://en.wikipedia.org/wiki/Sesquiterpene" \o "Sesquiterpene) compound known as [illudin](https://en.wikipedia.org/wiki/Illudin" \o "Illudin) S. This, along with illudin M, have been identified in O. nidiformis. The two illudins are common to the genus Omphalotus and not found in any other basidiomycete mushroom.

* **Mycena pura:**

***Mycena pura***, commonly known as the **lilac bonnet**, is a species of [mushroom](https://en.wikipedia.org/wiki/Mushroom" \o "Mushroom) in the family [Mycenaceae](https://en.wikipedia.org/wiki/Mycenaceae" \o "Mycenaceae). First called *Agaricus prunus* in 1794 by [Christian Hendrik Persoon](https://en.wikipedia.org/wiki/Christian_Hendrik_Persoon" \o "Christian Hendrik Persoon), it was assigned its current name in 1871 by German [Paul Kummer](https://en.wikipedia.org/wiki/Paul_Kummer" \o "Paul Kummer).

*Mycena pura* is known to [bioaccumulate](https://en.wikipedia.org/wiki/Bioaccumulation" \o "Bioaccumulation) the element [boron](https://en.wikipedia.org/wiki/Boron" \o "Boron).

*Mycena pura* contains the chemical puraquinonic acid, a [sesquiterpene](https://en.wikipedia.org/wiki/Sesquiterpene" \o "Sesquiterpene). This compound induces mammalian cells (specifically, the [cell line](https://en.wikipedia.org/wiki/Cell_line" \o "Cell line) [HL60](https://en.wikipedia.org/wiki/HL60" \o "HL60)) to differentiate into [granulocyte](https://en.wikipedia.org/wiki/Granulocyte" \o "Granulocyte)- or [macrophage](https://en.wikipedia.org/wiki/Macrophage" \o "Macrophage)-like cells. The fungus also contains the [mycotoxin](https://en.wikipedia.org/wiki/Mycotoxin" \o "Mycotoxin) [muscarine](https://en.wikipedia.org/wiki/Muscarine" \o "Muscarine), and the [antifungal](https://en.wikipedia.org/wiki/Fungicide" \o "Fungicide) metabolite [strobilurin](https://en.wikipedia.org/wiki/Strobilurin" \o "Strobilurin) D, the latter previously found in *[Cyphellopsis anomala](https://en.wikipedia.org/w/index.php?title=Cyphellopsis_anomala&action=edit&redlink=1" \o "Cyphellopsis anomala (page does not exist))*.[[4]](https://en.wikipedia.org/wiki/Mycena_pura" \l "cite_note-4) Despite this, some guides list *M. pura* as [edible](https://en.wikipedia.org/wiki/Edible_mushroom" \o "Edible mushroom).

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* **Chlorophyllum molybdites:**

***Chlorophyllum molybdites,*** which has the [common names](https://en.wikipedia.org/wiki/Common_name" \o "Common name) of **false parasol,** **green-spored Lepiota** and **vomiter,** is a widespread mushroom. Poisonous and producing severe gastrointestinal symptoms of vomiting and diarrhea, it is commonly confused with the [shaggy parasol](https://en.wikipedia.org/wiki/Shaggy_parasol" \o "Shaggy parasol) or [shaggy mane](https://en.wikipedia.org/wiki/Shaggy_mane" \o "Shaggy mane), and is the most commonly consumed poisonous mushroom in [North America](https://en.wikipedia.org/wiki/North_America" \o "North America). Its large size and similarity to the edible [parasol mushroom](https://en.wikipedia.org/wiki/Macrolepiota_procera" \o "Macrolepiota procera), as well as its habit of growing in areas near human habitation, are reasons cited for this. The nature of the poisoning is predominantly gastrointestinal.

It is an imposing mushroom with a [pileus](https://en.wikipedia.org/wiki/Pileus_(mycology)" \o "Pileus (mycology)) (cap) up to 40 cm in diameter, hemispherical and with a flattened top. The cap is whitish in colour with coarse brownish scales. The [gills](https://en.wikipedia.org/wiki/Lamella_(mycology)" \o "Lamella (mycology)) are free and white, usually turning dark and green with maturity. It has a rare green [spore print](https://en.wikipedia.org/wiki/Spore_print" \o "Spore print). The tall [stipe](https://en.wikipedia.org/wiki/Stipe_(mycology)" \o "Stipe (mycology)) may be up to 25 cm tall and bears a ring. This mushroom lacks the snakeskin pattern that is generally present on the [parasol mushroom](https://en.wikipedia.org/wiki/Parasol_mushroom" \o "Parasol mushroom).

*Chlorophyllum molybdites* is the poisonous mushroom most frequently eaten in North America.[[1]](https://en.wikipedia.org/wiki/Chlorophyllum_molybdites" \l "cite_note-poisonoverview-1) The symptoms are predominantly gastrointestinal in nature, with vomiting, diarrhea and colic, often severe, occurring 1–3 hours after consumption.[[3]](https://en.wikipedia.org/wiki/Chlorophyllum_molybdites" \l "cite_note-benjamin95-3) Although these poisonings can be severe, none has yet resulted in death.[[5]](https://en.wikipedia.org/wiki/Chlorophyllum_molybdites" \l "cite_note-5)

Professor James Kimbrough writes on page 325 of his book, *Common Florida Mushrooms*:

* *Chlorophyllum molybdites*, the green-spored Morgan's Lepiota, is responsible for the greatest number of cases of mushroom poisonings in North America, and in Florida. This is probably due to the fact that it is easily confused with choice edible species such as *Lepiota procera* and *L. rhacodes*, and it is one of the most common mushrooms found on lawns and pastures throughout the country, with the exception of the Pacific Northwest. When eaten raw *C. molybdites* produce severe symptoms, including bloody stools, within a couple of hours. When cooked well, or parboiled and decanting the liquid before cooking, others eat and enjoy it. Eilers and Nelso (1974) found a heat-labile, high molecular weight protein which showed an adverse effect when given by intraperitoneal injection into laboratory animals.

### Common Characteristics of poisonous Mushrooms:

* ***When you cut the mushroom it turns either green or purple.***
* ***When you taste a piece of the mushroom, it burns or stings the tongue.***
* ***Poisonous mushrooms have bad odour.***
* ***It tastes bitter.***
* ***There is no presence of worms.***
* ***There is presence of scales on the cap****.*

*Although Mushrooms which are edible can be used as a healthy diet because it’s full of nutrients (* Low in calories and fat and cholesterol-free, mushrooms contain a modest amount of fiber and over a dozen minerals and **vitamins**, including copper, potassium, magnesium, zinc and a number of **B vitamins** such as folate ). *But due to improper identification of mushroom many people loses their live* *around the globe. So it has became a responsibility of every human being to make it easier to distinguish between* ***Edible*** *and* ***Poisonous***

*Mushrooms.*

*From above details, we can see the clear differences between physical characteristics of* ***Edible*** *and* ***Poisonous*** *Mushrooms. So it would be easier to distinguish between them just by observing their Physical characteristics.*

*So, being an Computer Engineer student I would like give this task to my Computer.*

*We collected a data from:*

**Source:**

[https://datahub.io/machine-learning/mushroom#resource-mushroom](https://datahub.io/machine-learning/mushroom" \l "resource-mushroom)

*It contains 16 physical features of mushrooms :*

1. *gill-attachment*
2. *gill-size*
3. *gill-color*
4. *stalk-shape*
5. *stalk-root*
6. *stalk-surface-above-ring*
7. *stalk-surface-below-ring*
8. *stalk-color-above-ring*
9. *stalk-color-below-ring*
10. *veil-type*
11. *veil-color*
12. *ring-number*
13. *ring-type*
14. *spore-print-color*
15. *Population*
16. *Habitat*

*From above features, a final column represent the if the mushroom is* ***edible*** *or* ***Poisonous.***

***Using all this Data we can build a Machine Learning model which will accurately predict if the if the given Mushroom is edible or Poisonous by just observing its physical features***

***By:***

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