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Mushrooms of the Athabasca region

Edition 1.0, May 2022

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MUSHROOMS OF THE ATHABASCA REGION

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About this booklet

This booklet was written for naturalists, teachers, outdoors people, foresters, and the public interested in the mushrooms of the Athabasca region of Alberta. It may also be useful for some adjacent parts of the Canadian boreal region.

Walking in the boreal forest, enjoying nature and soaking in the sights, smells and sounds of the woodlands is a powerful antidote to the gloom of our perpetual and growing environmental crisis. Mushrooms and other fungi have a lot to contribute to solve many of the human-made problems in our world. Antibiotics from fungi have saved and continue to save millions of human lives around the world. Essential items, such as bread, wine and beer would not exist without the action of fungal yeasts. Fungi biodegrade many environmental toxins. You are invited to learn about the mushrooms in the boreal forest and find out how fungi relate to nature and to humans.

Fungi are organisms that nourish trees and other plants, create soils, recycle waste products and form, together with plants and bacteria, the foundation of any ecosystem. When you see a mushroom, remember that it is only the reproductive part of an organism that is otherwise hidden in the soil or in a piece of wood in the form of a mycelium.

Since ancient times mushrooms have been connected to human history. There are reports of puffballs used by First Nations in North America, while other fungi are still an important part of native smudging ceremonies. It is rumoured that Roman Emperor Claudius' death in the year 54 was the result of a mushroom poisoning with a death cap.

Mushrooms can be important sources of income in some parts of the world. For example, the price for a kilogram of white truffles in Europe may range from CAN $ 2000 - 9000. A few years ago, the medicinal Chinese caterpillar fungus peaked at $ 58,000 per kg.

Most people become interested in mushrooms because of their culinary and gourmet value. In recent decades mushrooms have been discovered as a health

food. Eating mushrooms that you collected from the woods can be highly rewarding and provide you with a source of healthy food and a sense of connectedness with nature, but it could also lead to a trip to the hospital emergency room if you lack mushroom identification skills. As in other parts of the world, a number of mushrooms are poisonous and toxic to humans. Only collect those mushrooms for meals that you can identify with confidence.

Disclaimer: The author assumes no responsibility for misidentifications of mushrooms, nor for any poisoning cases that may result from eating wild fungi. Do not experiment if you have no experience in mushroom identification. Consult an expert or a local mushroom group before you eat mushrooms collected in the wild. The golden rule is to eat only mushrooms that you can safely identify. If you have any doubts, do not eat the mushrooms.

Part A: General Part

Overview and biology of mushrooms and their role in nature. Edible and poisonous mushrooms.

What are mushrooms?

Mushrooms are organisms that belong to the kingdom of Fungi. Most fungi exist in the form of a mycelium, a network of microscopic interconnected threads (hyphae) that lives in a substrate, for example in soil, completely invisible to the human eye. Only when the mycelium forms condensed, larger structures, the mushrooms, we become aware of their existence.

We still know very little about the factors that play a role in triggering mushroom formation (temperature, moisture, CO_2 levels, light). Unlike plants, mushrooms may not occur on a site for several years, despite the presence of a mycelium, but re-emerge unexpectedly during a bumper year. There is no doubt that this erratic behaviour contributes to the perceived and real mystery of the fungus world.

In the past, mushrooms were studied by botanists because they were considered to be a part of the plant kingdom. We now know that fungi are in fact closer related to animals, and therefore to humans, than they are to plants. Therefore the kingdom of Fungi has a separate standing from the kingdoms of animals and plants.

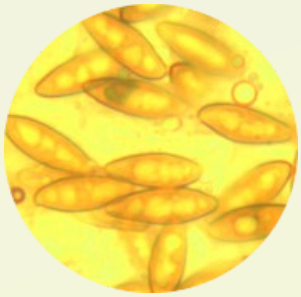
Mushrooms are formed for the purpose of propagation and reproduction. Each fruitbody produces millions of spores which are released from the gills or from the pores. Most mushrooms other than the bracket fungi are short-lived and disappear after a few days, however their mycelium in the soil will remain.

While all mushrooms are fungi, the reverse is not true: many fungi do not form mushrooms. Moulds, yeasts, rust and smut fungi as well as some animal and human pathogens belong into this category.

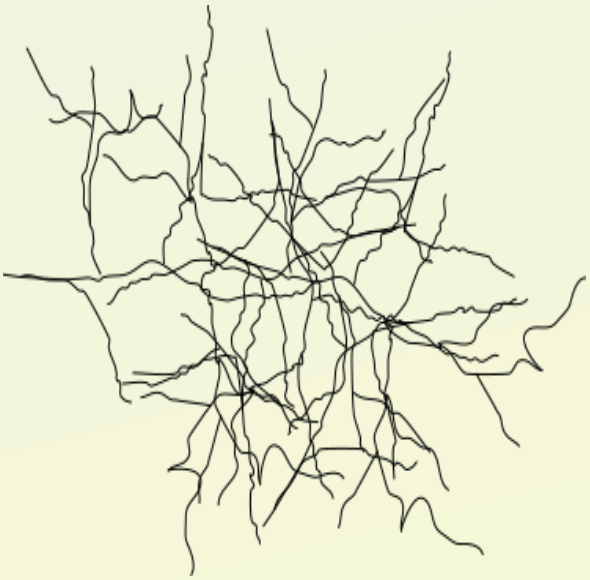
The lifecycle of a mushroom

If conditions are right, the mycelium may form a short-lived fruitbody = mushroom.

Mushrooms produce numerous spores.



Spores that land on a suitable substrate will germinate to form a mycelium. This is the normally invisible fungus that persists and grows for a considerable time.



Glossary

Decomposer fungus (= saprotrophic fungus): A fungus that obtains its nutrition from dead organic matter.

Ectomycorrhiza: A type of mycrrhiza where the fungus covers the fine roots of trees. Unlike other mycorrhizas, ectomycorrhizas can be seen without a microscope.

Fruitbodies (= fruiting bodies): The reproductive structure of a Not all fungi form fruiting bodies.

Fungal toxins: Poisonous substances produced by mushrooms

Fungus (pl. fungi): A kingdom of organisms. (Examples of other kingdoms are animals and plants). Fungi include the macrofungi (mushrooms), but also microfungi, such as moulds and yeasts.

Gleba: Inner part of the puffballs where the spores are produced.

Hymenium: The layer of a mushroom where the spores are produced. Most mushrooms have gills, others have pores and a few have spines. In the puffballs the hymenium is enclosed inside the mushrooms in the form of a gleba.

Hypha (pl. hyphae): The thread-like microscopic part of a fungus.

Macrofungi: Fungi that can be observed without a microscope because they form large fruitbodies (mushrooms).

Microfungi: Small fungi which require a microscope for observation. At least 50% of fungal species are microfungi. Moulds and yeasts are examples of microfungi. Rust and smut fungi are parasitic on plants. Other microfungi are parasites on animals, including humans (athlete's foot, etc.)

Mushrooms: The fruiting bodies of macrofungi. The term is not well defined but here we use the term for all macrofungi.

Mycelium (pl. mycelia): Interconnected network of hyphae in a substrate, e.g. in wood or soil

Mycorrhiza: Association of a fungus with the root of a plant.

Mycotoxins: Highly toxic substances produced by moulds.

Peridium: The outer layer of puffballs. It consists of further sublayers, an outer exoperidium and an inner endoperidium. Occasionally a mesoperidium is in the middle.

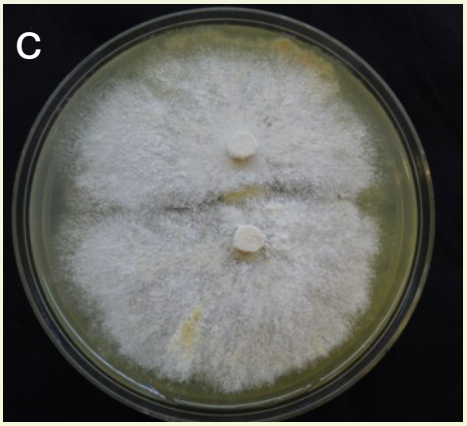
Spores: Reproductive cells of a mushroom or fungus.

Toadstool: In traditional British English the term is used for all wild mushrooms (as opposed to cultivated ones). In a more narrow sense it refers to poisonous mushrooms.

Umbo: Nipple-shaped central part on the caps of some mushrooms, e.g. in many fibre caps.

It is all about the mycelium

The sudden appearance of mushrooms, especially after a heavy rainfall, contributes to their reputation as mysterious beings. However, when seeing a mushroom, you are only looking at the reproductive structure of a fungus that has been present in its substrate for a long time. It is the invisible mycelium that constitutes a fungus and only when the conditions are right (moisture, oxygen, light, carbon dioxide, temperature), the mycelium will condense into small buttons from which the fruitbodies are formed. Most of the dry mass is already condensed in the button stage and the growth of a mushroom mainly consists of water uptake.



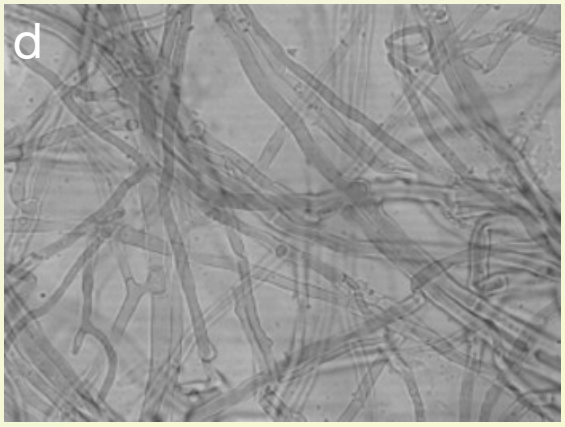
Fungal mycelium

a) covering a branch

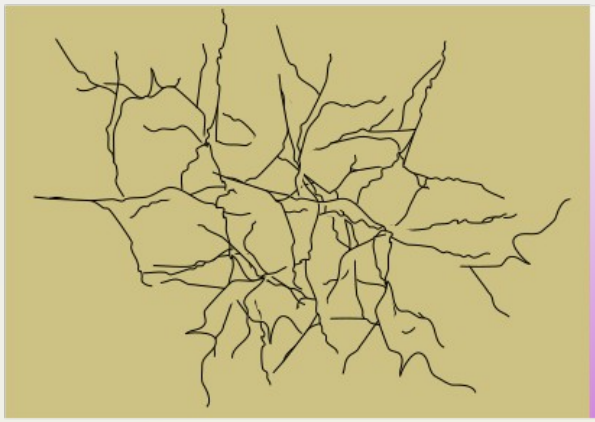
b) in a mushroom cultivation box

c) in a petri dish

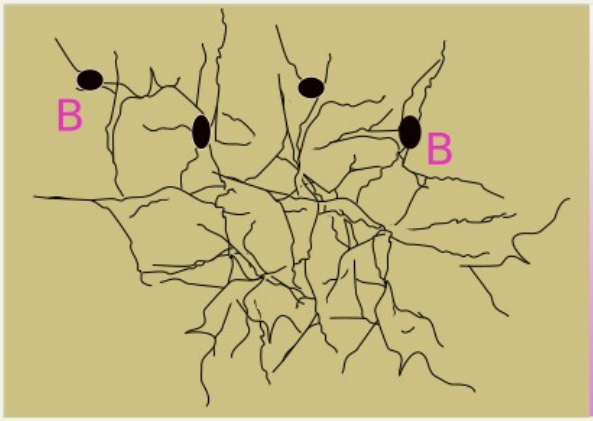
d) in microscopic view.
Note the numerous hyphae forming a network.



How mushrooms develop from a mycelium



1. The mycelium is a three-dimensional network and consists of thousands of interconnected microscopic hyphae. This is the actual fungus that lives invisibly inside a substrate (soil, wood, etc.).



2. Under appropriate conditions, some areas of the mycelium will condense into small buttons (B).

3. When moisture levels are high, for example after a heavy rain, the buttons will absorb water and expand into full mushrooms. This process occurs within a day or two.

The role of mushrooms and fungi in our forests

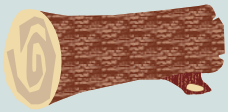
Mushrooms and other fungi, have two major roles in nature: they are either

- decomposer fungi or
- mycorrhizal fungi.

In addition, some fungi are

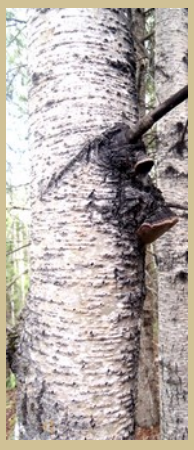
- parasites on plants or animals.

Decomposer fungi
degrade dead organic matter such as leaves, branches, fallen trees, roots.



Mycorrhizal fungi
have a mutualistic symbiosis with plants and both partners depend on each other. They exchange minerals, nutrients and water.

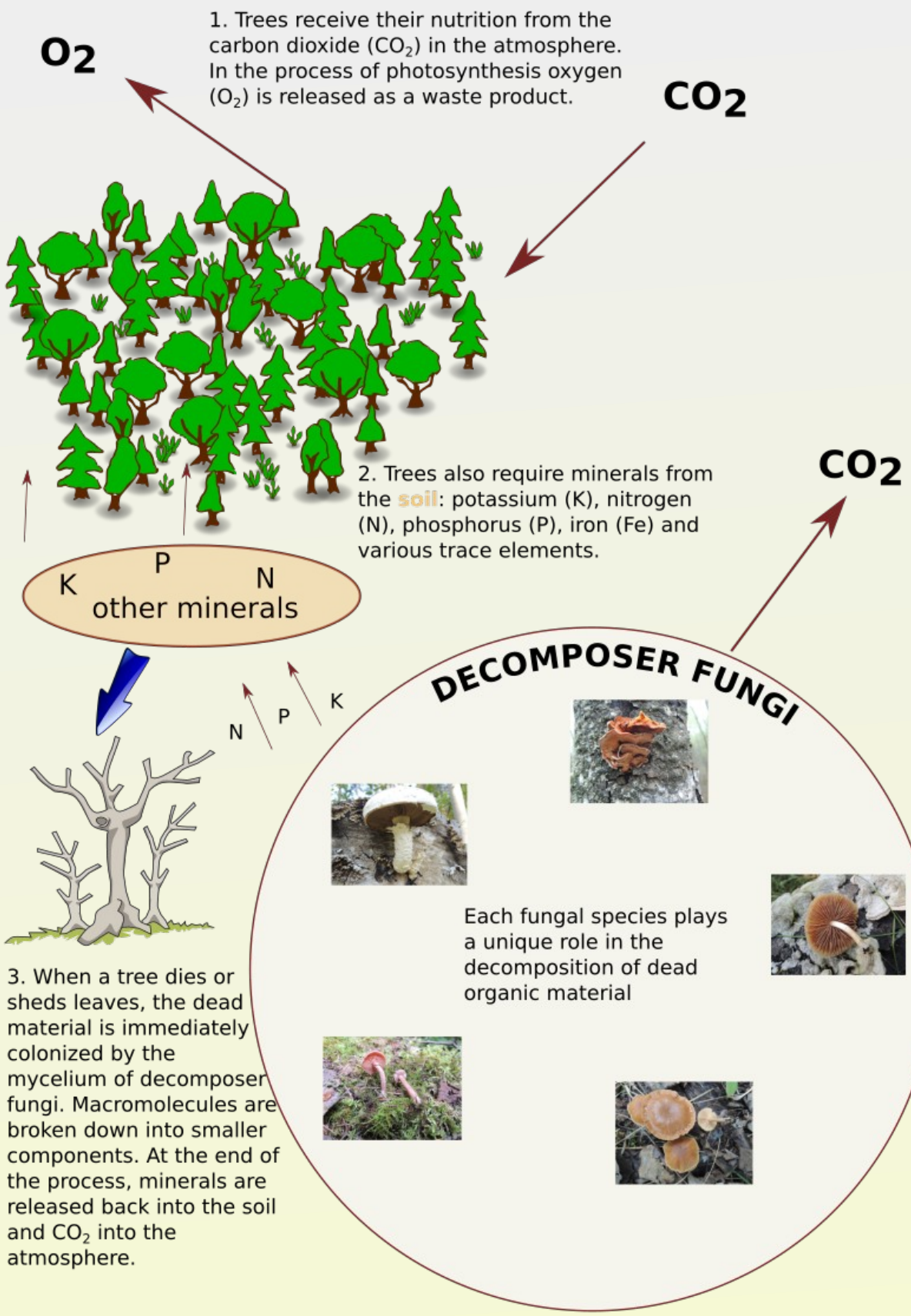
Parasitic fungi
take away nutrients from their living hosts causing damage or even death.



Albatrellus is a mycorrhizal mushroom

Decomposer fungi

Decomposition of dead organic material is a key function in any ecosystem. Decomposer fungi are the major recyclers of nature: in several steps they break down dead organic material (leaves, roots, twigs, wood logs, dead animals) which is eventually released as minerals back into the soil. Without this important function, our ecosystems would collapse within months, because dead organic material would accumulate on our forest floors without any decay; soils would become nutrient deficient and plant growth would come to a standstill. All nutrient flows in nature are based on the recycling of existing elements within the same system and soil fungi play a central role in this process. Carbon, in the form of carbon dioxide (CO_2), is supplied from the air to plants and processed via photosynthesis to sugars, cellulose, starch and other carbohydrates. When a plant dies or when a tree sheds its leaves, these carbohydrates are recycled by fungi as a crucial source of carbon to produce fruitbodies (mushrooms) which are eaten by animals, including humans. Eventually, that carbon is released again as carbon dioxide through the process of respiration by fungi, animals and plants into the atmosphere where it becomes available once again for photosynthesis.


1. Trees receive their nutrition from the carbon dioxide (CO_2) in the atmosphere. In the process of photosynthesis oxygen (O_2) is released as a waste product.
O_2
CO_2
2. Trees also require minerals from the soil: potassium (K), nitrogen (N), phosphorus (P), iron (Fe) and various trace elements.
CO_2
K
P
N
other minerals
N
P
K
DECOMPOSER FUNGI
Each fungal species plays a unique role in the decomposition of dead organic material
3. When a tree dies or sheds leaves, the dead material is immediately colonized by the mycelium of decomposer fungi. Macromolecules are broken down into smaller components. At the end of the process, minerals are released back into the soil and CO_2 into the atmosphere.

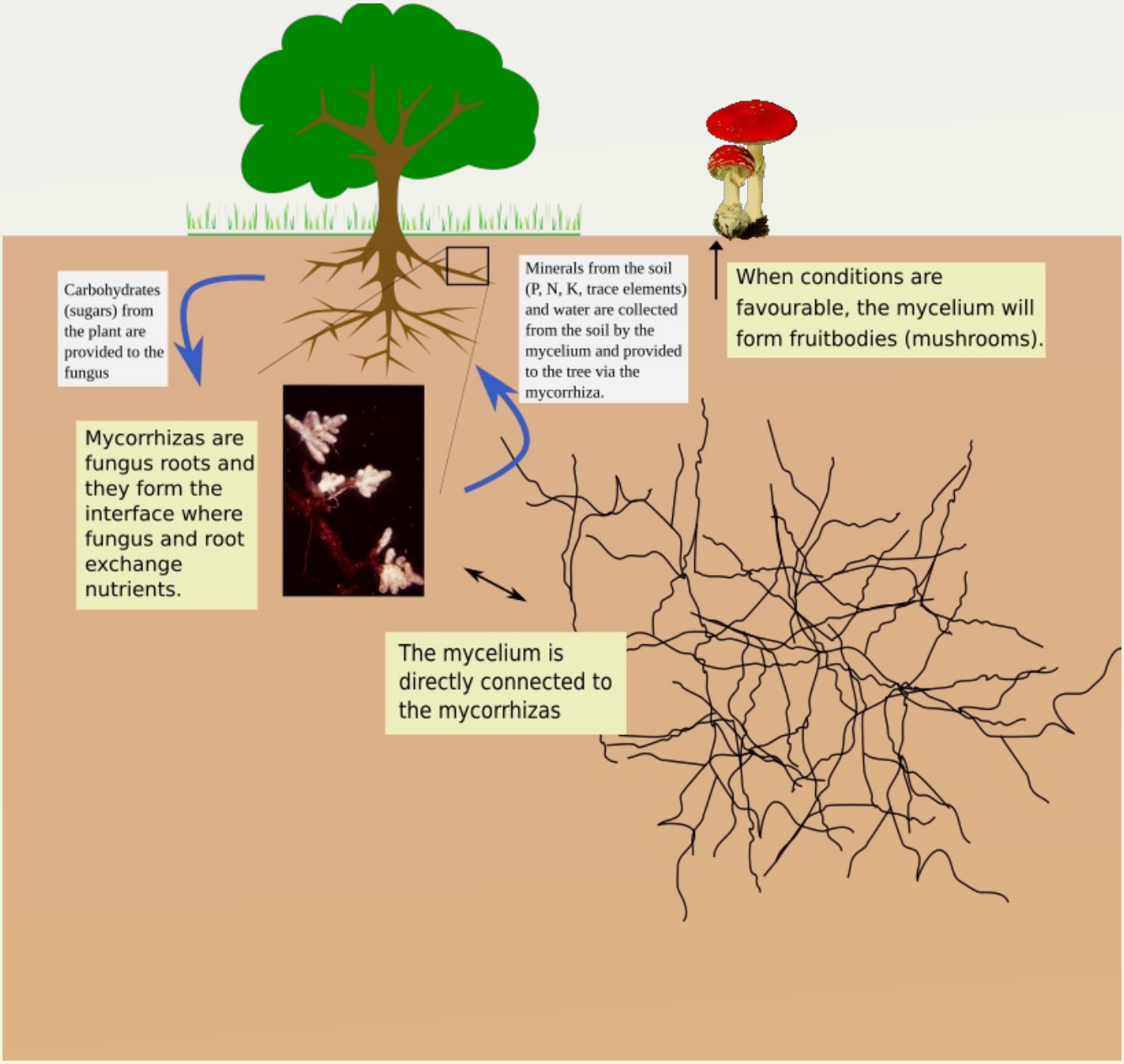
Mycorrhizal fungi

Many of our mushrooms are mycorrhiza forming and associated with trees where they form mycorrhizas with the plant roots. Mycorrhizas have a crucial role in providing minerals and water directly to the plant roots. They are structures that are formed jointly by fungal hyphae and plant roots. Fungal hyphae spread out from mycorrhizas, forming extensions of plant roots that make them much more efficient in acquiring both minerals and water. In addition, fungi mobilize soil nutrients that would otherwise not be accessible to plants. Some forms of soil phosphorus, for example, cannot be utilized by plant roots alone; they need the aid of a mycorrhizal system where the fungal hyphae provide crucial access to normally unavailable phosphorus. In exchange, the fungus obtains carbohydrates (sugars) from the plant and these carbohydrates are used to form mycelium and, in many cases, mushrooms. Some mycorrhizal fungi were shown to prevent root diseases in plants.

These illustrations show a variety of mycorrhizas formed by different fungi. Mushrooms only form ectomycorrhizas, with the fungus completely covering the final ramifications of the root system. Ectomycorrhizas are the only type of mycorrhizas that are visible without a microscope.

Mycorrhizas in forest ecosystems

How mushrooms are associated with trees



Since tree health depends on the services of mycorrhizal fungi, inoculation of trees with mycorrhizal inoculum at the nursery stage is becoming an established practice in many countries. Frequently, trees only survive and become established if they have suitable ectomycorrhizas. Many mushrooms described in this guide are mycorrhiza forming.

Parasitic fungi

Some fungi are parasites and they damage their hosts, sometimes considerably. Most of the parasitic fungi belong to the microfungi and they do not form mushrooms. Two examples are shown below:

The western gall rust (*Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka) infects pines.

A very common parasitic fungus in our forests, *Phellinus tremulae*, frequently attacks aspen trees.

Western gall rust forming cankers on pines

Phellinus tremulae, a frequent parasite on aspen trees

Syzygospora mycetophila (brain-shaped) is a parasite on the mushroom *Gymnopus dryophilus*

Our boreal forests

The Athabasca region, located in the province of Alberta, Canada, is a part of the boreal forest zone which extends over 550 million hectares across the North American continent from the Alaskan panhandle all the way to Newfoundland and Labrador.

According to Environment Canada, Athabasca has an annual mean temperature of 2.3 ^{0}C and an annual precipitation of 479 mm. The climate is continental with cold winters and most of the precipitation is falling in the summer months.

The map above shows the extent of the boreal forest zone in Canada.

Source: Canadian Forest Service: https://www.nrcan.gc.ca/our-natural-resources/forests/sustainable-forest-management/boreal-forest/13071

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Boreal forests are usually associated with conifer trees and in our area include black spruce (*Picea mariana*) and white spruce (*P. glauca*), tamarack or larch (*Larix laricina*), balsam fir (*Abies balsamea*), jack pine (*Pinus banksiana*) and lodgepole pine (*P. contorta*). However, many of our forests are dominated by the deciduous aspen tree (*Populus tremuloides*).

White spruce (*Picea glauca*) is the dominant conifer in our boreal forests.

Balsam fir (*Abies balsamea*) requires more precipitation and is found in moister conditions.

In bogs and fens black spruce (*Picea mariana*) with its characteristic narrow crowns dominates.

Tamarack (*Larix laricina*) is often found associated with black spruce in bogs and fens.

Aspen (*Populus tremuloides*) dominates many of the boreal forests in the Athabasca region.

When identifying mushrooms it is important to know the surrounding trees, because mycorrhizal mushrooms often associate with specific tree partners.
Many species of *Suillus* (right) are only found in association with pines.

Fungal diversity in North America

It is estimated that between 1 and 5 million species of Fungi inhabit our planet, but only around 120,000 species have been described so far.

In North America, there are more than 45,000 described species of fungi, with about 20,000 species of macrofungi (loosely, macrofungi can be called mushrooms, however, some macrofungi are tiny and would hardly be considered as mushrooms).

The remaining fungi are microfungi that require a microscope for viewing. These numbers exclude the lichens which are fungi associated with other organisms (cyanobacteria, algae).

The mushrooms shown in this guide depict common fungi of the Athabasca region. On this page are some more rare fungi that should not be collected.
Left: *Gymnopilus luteofolius;* this mushroom contains psilocybin, but the extremely bitter taste is a deterrent.
Top right: *Boletus suglabripes*.
Bottom right: *Rhodotus palmatus*

Nutritional value of mushrooms

Mushrooms are an excellent source of proteins and contain many vitamins and minerals while their fat content and their caloric value are very low. Therefore, in addition to their culinary value as a gourmet food, mushrooms are considered as a health food. Some nutritional data about mushrooms are below:

- Water content: 90% Dry matter: 10%
- Protein content: 20-35% of dry matter
- Mushroom protein contains all nine essential amino acids.
- Fat content less than 3% of dry weight (< 0.3% of fresh weight)
- Mushrooms are a good source of dietary fibres.
- Mushrooms contain many antioxidants.

Vitamins:

- B vitamins: mushrooms are a good source of riboflavin, niacin and folic acids as well as vitamin B12.
- Some species of mushrooms (but not all) have a considerable amount of vitamin D or ergosterol (pro-Vitamin D). This is the only known source of vitamin D of non-animal origin.
- Mushrooms have moderate amounts of vitamin C and E.

Minerals:

- Mushrooms contain potassium, magnesium, phosphorus, zinc and copper; their sodium content is very low.

Mushrooms contain considerable amounts of all nine essential amino acids, often vitamin D and vitamin B_{12}, all of which are in short supply in a vegetarian diet. Therefore, vegetarians are well advised to add mushrooms to their diet on a regular base.

A selection of edible mushrooms collected by the author (for scientific studies).

Medicinal mushrooms

Medicinal fungi have been used in Eurasia, particularly in China, Russia, Korea, and Japan for many centuries.

More recently, researchers have discovered several classes of glucans and polysaccharides from species of medicinal mushrooms that inhibit a variety of human cancer cell lines.

A different line of research targets mushrooms as potential sources of antibiotics because resistant strains of bacteria (so-called “super bugs”) which are no longer treatable with conventional antibiotics are becoming a major public health concern around the world. Some of the classical antibiotics, such as penicillin, are derived from fungi (moulds) and have saved many millions of lives since their discovery. In recent years, numerous species of mushrooms were also tested against bacterial cultures, and it was shown that some mushroom mycelia display a high activity against pathogenic bacteria. This research activity may lead to the development of urgently needed new antibiotics.

At the interface of medical science and nutrition, numerous types of antioxidants have been detected in mushrooms (e.g., phenolic acids, polysaccharides). Antioxidants play a role in eliminating the effects of so-called free radicals; the latter are harmful by-products of the human metabolism and they are neutralized by these antioxidants.

Most of the research activity on medicinal mushrooms is carried out in East Asia (China, Korea, Japan).

This illustration shows the Ling-zhi fungus, *Ganoderma lucidum* in cultivation. It does not grow in the harsh Alberta climate but occurs further south in North America. Ling-Zhi is the most widely used medicinal fungus in the world and is cultivated in Asia on an industrial scale.

Chaga (*Inonotus obliquus*) is a medicinal fungus found in our Athabasca forests on birch.

It is especially popular in Russia and in Korea where it has been used against stomach ailments and as a cancer remedy. First Nations in Canada have used Chaga as well. The black pieces of Chaga resemble charcoal and represent a sterile form of the fungus. It is very difficult to ever find the fertile polypore stage.

Due to its popularity, over-harvesting this fungus may become a problem. It should only be collected in a sustainable manner.

Birch polypore (*Piptoporus betulinus*) has antihelminthic properties, which means that it is effective against intestinal worms. Its name implies that the fungus only inhabits birch trees.

In the early nineties, a well mummified human from the late Stone Age, dating back more than 5000 years, called “Ötzi” was found in the Alps along a retreating glacier. Ötzi had carried many different items on his final journey, including the fruitbodies of two mushrooms species. One of these species was birch polypore. Scientists also detected the ulcer-causing bacterium *Helicobacter* in the man’s stomach which gave rise to the speculation that the birch polypore was used as a medicinal fungus against stomach ailments.

The **artist's conk** (*Ganoderma applanatum*) appears to have some medicinal properties but it is overshadowed by a related species, the well-known Ling-zhi fungus (*G. lucidum)* which is not found in Alberta.

Some species of *Phellinus* were shown to be active against various types of cancer cell lines.

Phellinus igniarius from the Athabasca area

First Nations and Mushrooms

Compared to plants, the use of mushrooms and other fungi (ethnomycology) by indigenous people is not widely documented in the Canadian literature. However, the examples of the diamond willow fungus, Chaga and puffballs hint at a wide range of traditional applications of mushrooms by First Nations across North America.

Diamond willow fungus (*Haploporus odorus*)

This fungus is held in highest esteem by First Nations and Metis people in Canada. It is an increasingly rare shelf fungus (polypore) and grows exclusively on diamond willows. Its pleasant aromatic smell intensifies after burning and it is widely used in smudging ceremonies by First Nations across Canada. The species is also found in parts of Eurasia and it is listed as “near threatened” on the IUCN (International Union for the Conservation of Nature) Red List. Therefore it should only be collected for its traditional indigenous uses.

Chaga (*Inonotus obliquus*) is a sterile part of a fungus that grows exclusively on birch trees all over the northern hemisphere. Its widespread use by several First Nations has been mentioned.

Puffballs (various species of *Calvatia*). The use of (giant) puffballs by indigenous people of the North American plains has been documented widely.

Edible mushrooms

For millennia the Athabasca woodlands provided abundant resources, among them mushrooms, to the First Nations of this area. As they were used sustainably, we can still enjoy them today.

If you are familiar with some mushroom species and if you follow the rule to never eat any mushrooms that you cannot identify confidently, here are some simple recommendations for gathering mushrooms:

1. Use only fresh mushrooms. Similar to other foods, spoilt mushrooms can make you sick, even if they were edible when fresh.

2. Avoid any areas where pesticides were sprayed, or where other forms of pollution may occur, in particular roadsides. While fungi are able to biodegrade many toxins, they initially accumulate them in their fruitbodies. It is likely that many reported “mushroom poisonings” were indeed caused by mushrooms exposed to pesticides.

3. Use collection containers that provide ample aeration. Remember that mushrooms still breathe after being collected. Cloth bags and baskets are perfect. Never use plastic bags for collecting mushrooms. At home, immediately remove the mushrooms from their container.

4. Cleaning mushrooms in the field, at least superficially, will save you ample work when you prepare them for cooking.

5. Do not eat raw mushrooms. Some of the best edible mushrooms, such as the morels, are poisonous when eaten raw.

Only collect mushrooms that you can safely identify!

Left: *Kuehneromyces mutabilis*, growing on wood, excellent edible.
Right: *Galerina autumnalis*, growing on wood, contains amatoxins, deadly poisonous.

When you collect mushrooms, remember that you walk on the traditional lands of the Indigenous Peoples. Respect their natural and cultural heritage.

Poisonous fungi and fungal toxins

Some of the mushroom species in northern Alberta are poisonous and their toxins may result in sickness, hospitalization or even death.

Many different fungal toxins have been described and occasionally new ones are discovered in various parts of the world. Here we only mention a small selection of the most important toxins relevant for mushrooms of the Athabasca region.

As a general rule, the time span between eating poisonous mushrooms and the occurrence of first poisoning symptoms (incubation time) is indicative of the severity of the poisoning. Mushrooms with a long incubation time (5 hours to several days) produce severe symptoms and poisonings may occasionally end fatal. If incubation times are short, in some cases occurring within 30 minutes, symptoms tend to be less severe and rarely fatal but may still require hospitalization.

- Most fatal poisonings are caused by amatoxins which occur in death caps (some species of *Amanita*) and in some *Galerina* species.
- Orellanines are the most toxic among all mushroom poisons and are found in some species of web caps (*Cortinarius* sp.).
- Gyromitrin occurs in false morels (*Gyromitra esculenta*). In humans it is quickly metabolized to hydrazin which is otherwise known as a rocket fuel.
- The mind altering ibotenic acid and muscimol are the principal toxins of the fly agaric (*Amanita muscaria*).
- Muscarine poisonings are frequent and cause a variety of gastrointestinal symptoms. Most fibre caps (*Inocybe* sp.) contain this toxin which is also found in some species of funnel caps (*Clitocybe* sp.) as well as in other groups.

Ibotenic acid, muscimol; 30-60 minutes;

Hallucinations, delirium, nausea and vomiting

Amatoxins; 8-24 hours

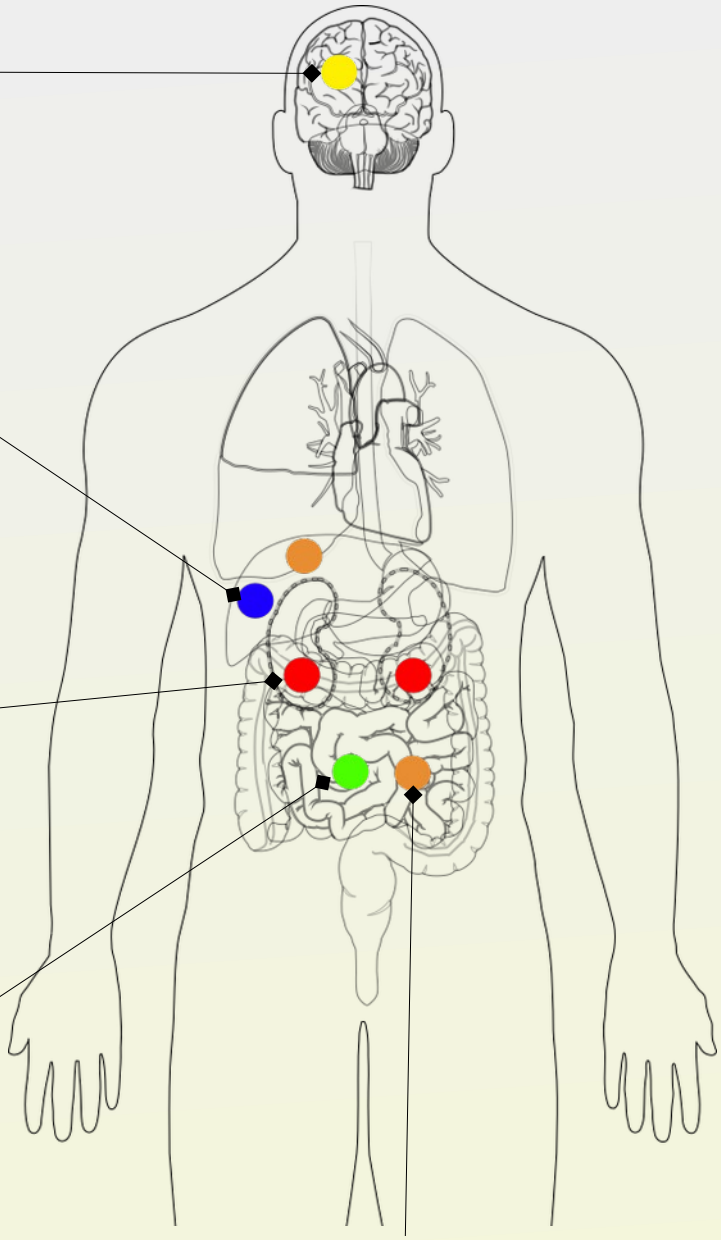
Diarrhea, vomiting, abdominal pain, liver damage

Orellanine; 2 days to 3 weeks;

Vomiting, diarrhea, headache, kidney damage

Muscarine; 20-30 minutes;

Perspiration, lacrimation, salivation, vomiting, diarrhea



Gyromitrin; 6 -10 hours

Severe gastrointestinal symptoms, nausea, vomiting.
In some cases liver damage

Part B: Special Part

Showing major groups of fungi, some important characters for the identification of mushrooms as well as selected mushrooms of the Athabasca region.

Panaeolus

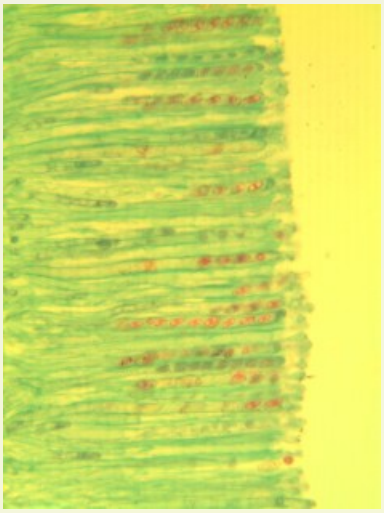
The two major groups of mushrooms are the

Ascomycetes and the Basidiomycetes

ASCOMYCETES

Ascomycetes form their spores inside a microscopic structure called the ascus and each ascus produces eight ascospores. Thousands of asci are arranged on the hymenium of a fruitbody.

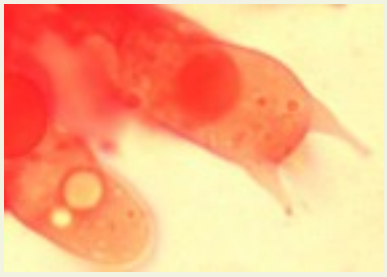
Cup fungi, morels, false morels and truffles are ascomycetes. However, this group also includes fungi that don't produce mushrooms: baker's and brewer's yeast, as well as many plant pathogenic fungi such as mildews, the ergot fungus, black knot disease on cherries and numerous others.



Asci in the hymenium of an ascomycete. Each ascus includes 8 spores.

BASIDIOMYCETES

Basidiomycetes form their spores on the outside of a microscopic structure called the basidium and each basidium produces 4 basidiospores.



Basidium in the hymenium of a basidiomycete. The four spores are formed externally

Thousands of basidia are arranged on the hymenium of a fruitbody. The hymenium comes in the form of gills or pores, more rarely as spines or completely smooth.

Some basidiomycetes form a hymenium inside the fruitbody in a gleba (e.g. puffballs).

Most typical mushrooms are included in the basidiomycetes which include all mushrooms with gills, pores and spines as well as the puffballs and earth stars.

ASCOMYCETES

Apiosporina morbosa, a common parasite, is an ascomycete causing black knot disease on various species of cherry (*Prunus*). It is common in woodlands; a few years ago a massive outbreak of the disease occurred on planted cherries in the town of Athabasca and in surrounding areas.

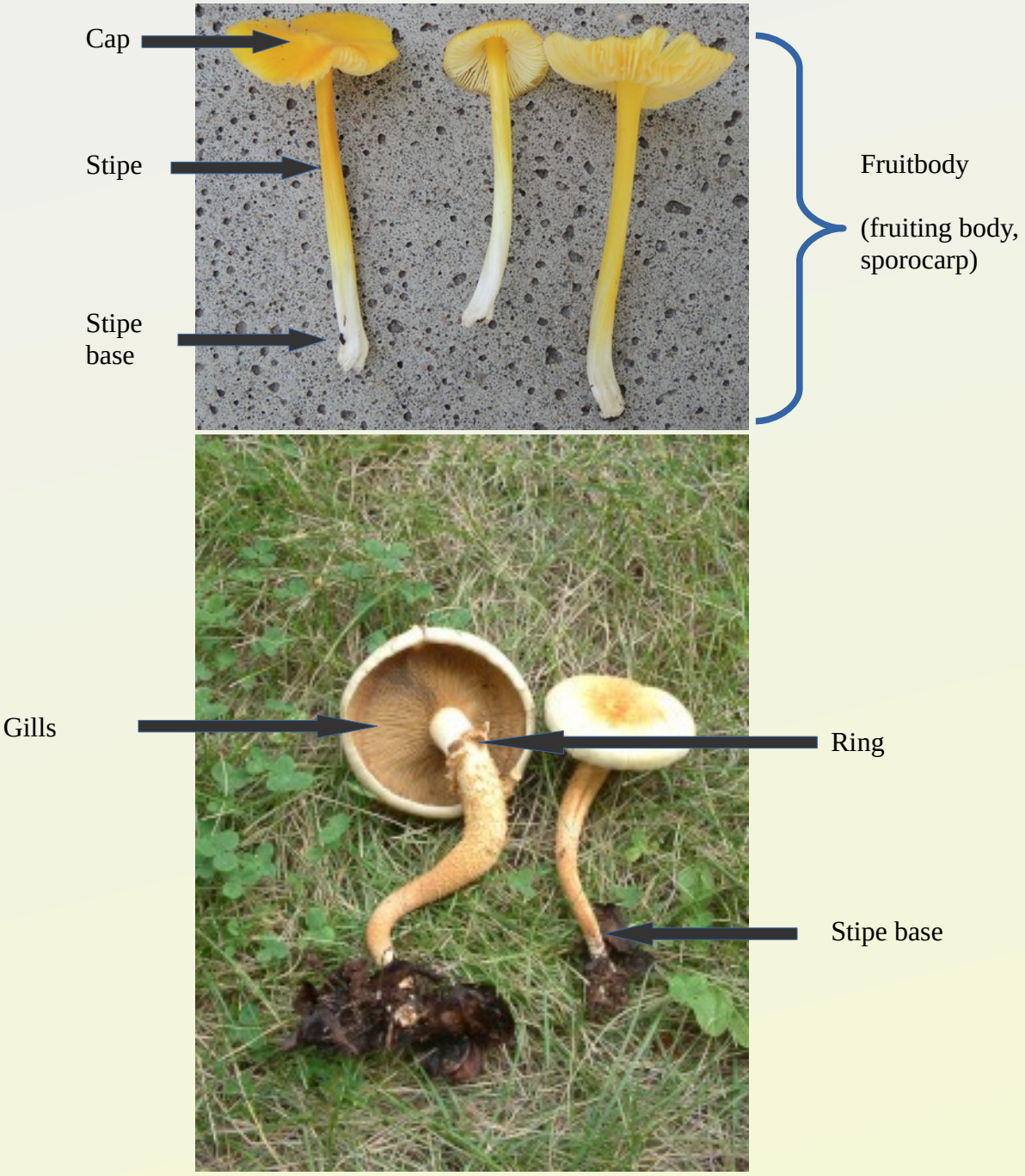
Many ascomycetes occur in spring, including this *Peziza* cup fungus.

BASIDIOMYCETES

The non-edible *Pholiota squarrosa* growing on aspen wood, with a distinct smell reminiscent of radish or garlic, is a basidiomycete.

Typical mushrooms with a cap and a stipe are basidiomycetes; shown here is a parasite on aspen trees, *Pholiota destruens*.

Parts of a typical mushroom with gills and a central stipe



The hymenium

Mushrooms produce spores, mostly on the underside, on the surface of a hymenium. Its structure is important to distinguish groups as the first step in mushroom identification. The hymenium can be in the form of gills, pores, spines (teeth), or it is smooth. Sometimes the hymenium is inside the fruitbody in the form of a gleba.

Above: *Xeromphalina* with gills as the hymenium. Note how the gills run down on the stipe

Some mushrooms have pores instead of gills as the hymenium. *Suillus* with pores.

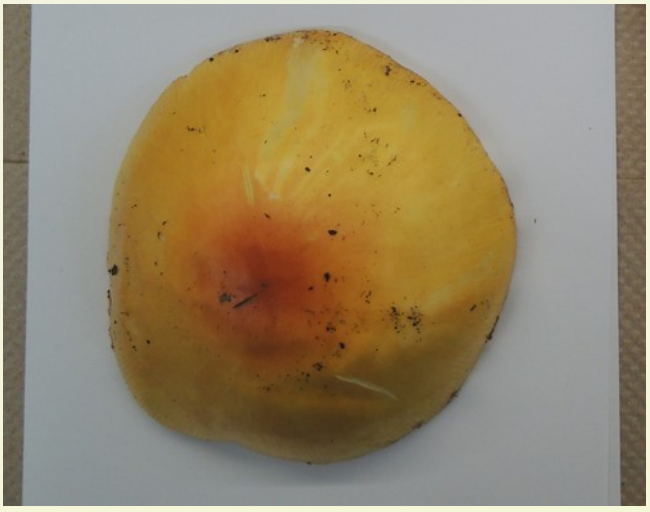
Fomitopsis, one fruitbody is turned upside down to show the hymenium with pores on the underside.

This *Hydnum* fruitbody has spines or teeth as a hymenium

Puffballs produce their spores inside the fruitbody in a gleba. The mature spores are then released from an opening upon mechanical disturbance (rain drops or animals)

Preparing a spore print

Identification of mushrooms involves the preparation of a spore print. It is obtained by cutting off the cap and placing it, gills down, on a white piece of paper. Under ideal conditions (no air circulation, 50-60% humidity), the falling spores will create a pattern of the hymenium (gills or pores) on the paper and the colour of that spore print will provide important clues for the identity of the mushrooms. The process takes between half an hour and several hours. An example of a spore print is shown in the milky cap section.
White paper is mandatory for identification purposes, but artists often use coloured paper to create visual effects.



Visual guide to the mushrooms of the Athabasca region

Mushrooms come in various shapes and with different types of hymenium. On this Visual Guide you can view and identify some of the main types that you might see around Athabasca.

Fleshy fungi with gills and a central stipe: pp. 48-65

Fleshy fungi with gills. Stipe short and excentric or absent: pp. 66-67

Boletes; fleshy fungi with pores and a central stipe: pp. 68-73

Leathery or corky bracket fungi with pores; stipe absent; on wood: pp. 74-79

Coral-shaped fungi without teeth or spines: pp. 80-81

Comb tooth, Coral Hedgehog fungi; Coral-shaped fungi with teeth (spines) as final ramifications: pp. 82-83

Puffballs with or without a stipe: pp. 84-85

Earth stars; star-shaped fungi with a central bulb: pp. 86-87

Jelly fungi with a gelatinous consistency, typically on wood: pp. 88-89

Cup-shaped fungi on wood or bare soil: pp. 90-93

Morels; fungi with cap and a central stipe; cap with a honey-comb surface; only in spring: pp. 94-97

False morels; fungi with a brain-shaped cap and a stipe; typically in spring, but some species occur in fall: pp. 98-99

Slime moulds with an irregular shape; fresh similar to a scrambled egg: pp. 100-101

MILKY CAPS (*Lactarius*)

Russulaceae

Milky caps are mid-sized to very large and they release a latex (milk) when injured. Their colour ranges from white or yellow to many shades of brown or orange, occasionally with blue or green tinges.

Main characters: Fruitbodies mid-sized to large, fresh mushrooms release a milky latex when broken, especially the gills.

The gills are white to yellowish, brittle and break easily.

Milky Caps and Russulas share a distinct character when their brittle fruitbodies are broken: their stipes break crosswise, unlike all other mushrooms with a stipe breaking lengthwise.

The spore print colour ranges from pure white to yellow.

When and where to find: July to early October, always associated with various trees (mycorrhiza forming).

Comments: A few species of milky caps are excellent edibles. Care must be taken to avoid the many sharp tasting species. If in doubt, it is recommended to chew a small piece of gill for at least a minute. This is enough to trigger a burning sensation on the tongue in the peppery tasting species. In Russia and some other countries of eastern Europe, milky caps are pickled which removes the acrid components and renders them mild. Milky caps form mycorrhizas with trees. More than 15 species are known from the Athabasca area.

MILKY CAPS

The milky cap on the left, *Lactarius resimus* has a white latex.

Latex colour and spore colour (yellow in this particular spore print from a different species) play an important role for species identification.

Lactarius deterrimus with orange latex, which makes it easy to identify, this is one of the recommended edible fungi.

Lactarius uvidus, due to its peppery taste it is not recommended for eating.

The large, extremely sharp-tasting *Lactarius vellereus* can easily reach 20 cm in diameter.

RUSSULAS (*Russula*)

Russulaceae

Russulas are frequently brightly coloured, mid-sized to very large mushrooms. Cap colours include shades of yellow, green, red, orange, purple, but a few are white, brown or almost black. As their gills split easily, they are sometimes called brittle gills. They are related to the milky caps but differ by the absence of a latex.

Stipes of Russulas and milky caps break crosswise, while the stipes of all other mushrooms break lengthwise.

Main characters: Fruitbodies mid-size to large, typically with bright colours, more rarely with shades of brown, black or white. No other group has these varieties of cap colours. Unfortunately some species change their colours depending on age and environment which makes identification of species a challenge.

The gills are white to yellowish, brittle and break easily.

Milky caps and Russulas share a distinct character when their brittle fruitbodies are broken: they can break crosswise, unlike all other mushrooms that break lengthwise.

The spore colour as seen in a spore print ranges from pure white to yellow.

When and where to find: June to September, only in woods as they are associated with trees.

Comments: Russulas share many characters with milky caps, especially the brittle structure of gills and fruitbodies. Unlike the milky caps, Russulas never have a latex and they have a wider range of colours. Some species are excellent edibles. Care must be taken to avoid the sharp tasting species. If in doubt, it is recommended to chew a small piece of gill for at least a minute. This is enough to trigger a burning sensation on the tongue in the peppery tasting species. Russulas are associated with trees (they form a mycorrhiza).

RUSSULAS

Russula foetens is one of the most frequent species in the aspen woods around Athabasca. Its Latin name means “Stinking Russula” and is well deserved.

The bright red *Russula borealis* is associated with aspen trees. While edible, it could be easily confused with extremely peppery, poisonous *Russula* species.

Russula flava with its bright yellow colour is small to mid sized, rather fragile and mild tasting edible. It is frequently found in summer around Athabasca. Older specimens develop a characteristic apricot smell.

Russula aeruginea is often much darker green than the collection shown here.

Fly Agaric, Fly Mushroom (*Amanita muscaria*)

Amanitaceae

The orange red, sometimes yellow colours with the white dots on the cap, the ring on the stipe and the swollen stipe base with several rows of scales make it easy to identify this poisonous mushroom.

Main characters: The bright orange red caps may reach up to 25 cm in diameter and are covered by white or whitish flakes. The gills are white and free. The stipe has a distinct ring. The base of the stipe is swollen and has several rows of white scales. The spore print is white.

When and where to find: July to September, associated with aspen, birch, spruce and other trees.

Comments: This mushroom has variable colours and is found in North America and Eurasia. Fly agarics in the Athabasca area are typically orange to yellow orange, but bright red in some other areas of North America. Fly agarics in Siberia have mind altering properties, but many poisoning cases have been reported from North America. In the past, fly mushrooms were used to poison flies. Fly agarics are also poisonous to humans. According to the ethnomycologist Gordon Wasson, fly agarics represent the mysterious Soma of the ancient Rig Veda.

Fairy Ring Mushroom (*Marasmius oreades*)

Marasmiaceae

Fairy rings, illustrated on the right, are frequently seen in farmers' fields and on lawns. They are caused by the Fairy Ring Mushroom mycelium. The circle indicates the current location of the mycelium and therefore the mushrooms are found along the circle.

Main characters: Mushrooms are small to medium-sized with a cap diameter of 1.5-5 cm, first honey-coloured but soon pale brown. The gills are whitish and characteristically distant and broad. The spore print is white. The stipe ranges from 3.5-6.5 cm and is pale yellow brown. Fresh mushrooms have a spicy smell.

When and where to find: June to September in fields and lawns.

Comments: The fairy ring mushroom, when fresh, is an excellent edible mushroom that is often used in soups. It can be preserved by drying. The rather tough stipes are usually discarded and only the caps are used. Care must be taken to use only fresh mushrooms and to avoid sites where pesticides are applied. This species and others in the *Marasmius* genus have the ability to dry out and revive again under moist conditions. Therefore their fruitbodies may persist for weeks rather than days as is the case for most other mushrooms. In this context it is not surprising that some powerful antibiotics were isolated from the fairy ring mushroom and from other *Marasmius* species.

The mysterious fairy rings were already mentioned in the literature several centuries ago and originally explained as the congregation sites of fairies, witches and other spirits.

Typically the circle consists of an inner zone where the grass is dying and an outer zone where the grass is growing more vigourously and with a darker colour, indicating a fertilizing effect. The exact nature of this interaction of the mycelium with grass species is still unclear. The circles (or semi-circles) grow in diameter each year as the mycelium grows steadily outwards from the centre of the circle. Fairy rings with a diameter exceeding 20 m have been reported.

Honey mushroom (*Armillaria*)

Physalacriaceae

Several species of honey mushrooms grow in the woods of the Athabasca region and some are serious parasites of trees with a devastating impact on forestry. Other species are wood degraders, with little or no impact on trees. Honey mushrooms often dominate our woods right before the onset of winter.

Main characters: This is one of the most variable mushrooms and several species have been described. The caps are 2-6.5 cm in diameter, convex with various shades of brown or honey colour, frequently with a darker centre. Typically the cap is covered by small, dark scales. The gills are whitish to pale brown. The stipe with a ring ranges from 4-10 cm, in many cases it has a bulbous stipe base. Occasionally a yellow veil is seen on the lower half of the stipe. The white spore print is crucial for identification, it can be seen in the photo on the right on some of the caps. Typically fruitbodies grow in clumps together.

When and where to find: Late July to early October in aspen and spruce woods. Always on wood but frequently the wood is buried and the mushrooms appear to grow on soil.

Comments: Honey mushrooms are frequently collected and often produce abundant crops in fall. Some people have experienced gastrointestinal problems after eating it. The mycelium produces a bioluminescence in the wood which can be seen in dark nights. Many species produce black strings (rhizomorphs).

Shaggy Parasol mushroom (*Chlorophyllum rhacodes*)

Agaricaceae

The Shaggy Parasol is one of the largest mushrooms that are found in the Athabasca region. Arguably, it is also one of the best edibles.

Main characters: Cap large, reaching up to 35 cm when expanded. Surface shaggy, with large brownish scales on a whitish background. Gills whitish, dense, free, spore print white. Stipe 10-25 cm long, with a distinct, movable ring. Stipe 1-2 cm thick, but the base is enlarged to a bulb. A very distinct character of this species is the orange to brick red stain that occurs when the fruitbody is bruised and especially in the flesh after cutting.

When and where to find: late July to September in grassland along the edge of woods, on nutrient rich soils.

Comments: The large fruitbodies with the shaggy cap, the ring on the stipe and the distinct reddish stain upon bruising make this species easy to recognize. Its taste is distinct and more reminiscent of meat than of mushrooms.

BUTTON MUSHROOMS (*Agaricus*)

Agaricaceae

Button mushrooms are large and fleshy, often white, occasionally with brown caps. Their gills are free, pink at first, turning dark brown when the spores mature. They have a ring around the stipe.

Main characters: Fruitbodies mid-sized to very large, fleshy. Many species are white, others have brown caps, occasionally with scales. The surface of caps and stipes may stain yellow in some species, occasionally also the flesh. Some species develop a red stain in the flesh.

The gills are free with a pink colour at first (never white) and turn dark brown when the spores mature.

Many species have a pleasant anise-like smell. Avoid species with a phenol smell.

The colour of the spore print is dark brown.

When and where to find: July to September; most species grow in grassy areas, fields, lawns, farm sites. A few species are found in woodlands.

Comments: This is the group of mushrooms that you can buy in your grocery store. They are cultivated on composted horse or chicken manure. Species collected from nature are usually tastier than the commercial ones. While many *Agaricus* species are edible and tasty, species with a phenol (pharmacy) smell and a yellow staining stipe base are poisonous and must be avoided.

BUTTON MUSHROOMS

The pictures above show our most frequent wood inhabiting species, *Agaricus silvicola.* Note the brown, free gills, a ring and frequently a bulb at the base. It has a distinct almond smell and the cap often develops a yellow tinge. This is one of our best *Agaricus* species.

Left *Agaricus bitorquis* with its double ring. Note the spores covering some of the caps. It is found in open areas, even in cities and towns. In some years it can be found in the town of Athabasca. The fruitbodies are unusually heavy and have the ability to push through asphalt. The species is cultivated in some countries.

FIBRE CAPS (*Inocybe*)

Inocybaceae

Small to mid-sized mushrooms, with a conical cap. Most species have various shades of brown to yellow-brown on caps while the stipes are paler. Their flesh has a characteristic spermatic smell. Most fibre caps contain muscarine and are therefore poisonous.

Main characters: Fruitbodies small to mid-size, cap often distinctly conical and with an umbo. The cap colour is mostly some shade of yellow-brown to brown, sometimes reddish or dark brown. The gills are yellow-brown to pale brown, rarely whitish.

The stipe is typically pale brown, sometimes whitish. Many fibre caps have a characteristic spermatic smell of the broken flesh. The spore colour as seen in a spore print ranges from brown to dark brown.

When and where to find: June to September, in woods.

Comments: Fibre caps are frequent in summer and should never be eaten as most species contain muscarine. Their spermatic smell is a good deterrent. Fibre caps form mycorrhizas with many different trees.

FIBRE CAPS

The two pictures on the left show the poisonous *Inocybe rimosa*. This is a frequent species in the aspen woods around Athabasca. Young specimens (above left) illustrate the typical conical shape of the cap. Elsewhere it has been confused with “magic mushrooms” *Psilocybe semilanceata* (not found in the Athabasca region). The resulting “trip” from such a confusion would inevitably end in a local hospital.

The picture below shows two important characters of many *Inocybe* species: a central umbo (nipple shaped structure) and radial cracks in the cap.

The picture above right of an unidentified *Inocybe* species (without the typical umbo) shows the brown gill colour of many species in this group.

Shaggy Mane (*Coprinus comatus*)

Coprinaceae

Fruitbodies large, with cone-shaped caps with a shaggy appearance, stipe whitish. Mature fruitbodies dissolve their gills, releasing their spores in the form of a black ink.

Main characters: The caps are cone-shaped and have a shaggy surface. The gills are white in young stages but soon turn pink and later black. The stipe is white.

When and where to find: August to September in open grassy areas, farm yards, on nutrient (nitrogen) rich soils.

Comments: The Shaggy Mane belongs to the group of inky caps (*Coprinus* and related genera). When mature, the inky caps release a protein digesting enzyme that turns the gills into a liquid stained black by the spores. This is different from most other mushrooms which release their spores through the air. The enzyme of the inky caps may have potential as a meat softener for the food processing industry. This mushroom is excellent to eat while young and still white inside. It needs to be processed shortly after collecting, long before its gills turn black.

WEB CAPS (Cortinarius)

Cortinariaceae

The web caps are the largest genus of mushrooms with many hundred species in North America. Young web caps have a characteristic veil between cap and stipe and range in size from small to large. Remnants of the veil are often found as ring zones on the stipes of mature fruitbodies. Cap colours are variable but brown and purple colours dominate. The gills are mostly brown in mature species, but some species have purple gills when young.

Main characters: Fruitbodies small to large, often fleshy. Frequently with brown and purple colours. The gills are first purple or brownish, on maturity almost always brown, due to the colour of the rusty brown mature spores. The colour of the spore print is rusty brown to brown.

When and where to find: July to September; in woodlands or around trees as they are mycorrhizal.

Comments: This is a group of mushrooms that must never be eaten. Although there are a few edible species, the group includes the most poisonous mushrooms known. A few species are known to have an incubation time of several days (up to 3 weeks) after eating without any symptoms, followed by a complete and irreparable breakdown of kidney function and death. Sometimes a kidney transplant may save the patient.

WEB CAPS

Cortinarius is the largest mushroom genus. It is fairly easy to recognize a mushroom as a *Cortinarius*, but identification of individual species is difficult. The most dangerous fungal toxins are found in this group, especially in the subgenus *Leprocybe*, with a representative species above right. Top left shows a representative of the subgenus *Phlegmacium*. The young fruitbody on the left shows the web-like cortina which gave the group its name. The two species on the bottom left show representatives of another subgenus, *Sericeocybe*. Note the remnants of the cortina as a ring zone on the stipe, stained rusty brown by the spores.

Oyster Mushroom (*Pleurotus populinus*)

Pleurotaceae

Oyster mushrooms are among the best edible mushrooms of the Athabasca region and are easy to identify. The illustrated species is the most common one around Athabasca and occurs every year on dead poplar wood. It is one of the early species that grows soon after the morel season. Its flavour is superior to the store bought oyster mushrooms.

Main characters: Cap whitish to very pale brownish, up to 15 cm broad, gills whitish, broad and fairly distant, flesh with an aromatic smell when fresh. The stipe is either absent or very short. If present, the stipe is attached laterally rather than centrally.

When and where to find: From June to early August, often abundant, only on dead poplar wood.

Comments: Similar to other species of oyster mushrooms, *P. populinus* can easily be cultivated on any waste products as substrates. Oyster mushrooms are cultivated around the world.

The mycelium of many oyster mushrooms is able to catch and eat nematodes.

Hypsizygus tessulatus

Lyophyllaceae

Superficially, *H. tessulatus* is similar to oyster mushrooms, however its distinct, often central stipes, the characteristic taste and smell and its occurrence in fall are easy clues to distinguish the two species.

Main characters: Caps 8-20 cm broad, whitish, very often with watery spots on the surface. Stipe distinct, up to 10 cm long, mostly central, occasionally eccentric. Smell and taste floury, often strong.

When and where to find: On dead poplar wood, September to early October.

Comments: This is often one of the last species to find at the end of the mushroom season in October when it fruits abundantly on poplar wood. The watery spots on the cap are characteristic. The strong taste of flour is not agreeable to everyone but a similar species, shimeji, is widely cultivated in Japan.

BOLETES (Boletaceae)

Boletaceae: *Boletus*, *Leccinum*, *Suillus*

Boletes are fleshy mushrooms with pores as a hymenium on the underside of the cap. Many species are collected for food.

Main characters: Fruitbodies large and fleshy. With brown, orange, red or yellow colours, rarely white or grey. Some species have a slimy cap surface. The spores are produced in pores rather than gills.

The stipe has a net like pattern or is white with black scales or sometimes yellowish. Only a few species have a ring on the stipe. The colour of the spore print is red brown to brown.

When and where to find: June to September; in woodlands because they are associated with trees.

Comments: This group includes many edible species. Since boletes form mycorrhizas, they are only found in the vicinity of trees whose roots are connected with the fungus.

SCABER STALKS (*Leccinum*)

Boletaceae

This group includes the red tops which are the most widely harvested edible fungi in the Athabasca area. Scaber stalks are easy to recognize by a combination of pores on the underside and a stipe that has black or brown scabers (scales). We can find several species of *Leccinum* around Athabasca, with the red tops being the most frequent ones. This is a northern hemisphere group that extends to the tundra zone.

Main characters: Fruitbodies large and fleshy. Cap with brown, orange, or red colours, rarely white or grey. The spores are produced in pores and the spore print is brown.

The stipe is white or pale, with black or brownish scales. Most species have a white flesh that stains pale pinkish to purple after a few minutes. Other species may turn green at the base of the stipe.

When and where to find: June to September; only in woodlands as they are associated with aspen or birch. Some species also occur in boggy areas around dwarf birch.

Comments: All scaber stalks in our area are edible. The most frequent species (red top) is associated with aspen, others are found under birch. Upon cooking these mushrooms develop a black colour. Red tops are found abundantly, with occasional bumper crops every few years.

SCABER STALKS

The illustrations on the left show the typical red tops, this is the most harvested mushroom in the Athabasca region. Note the orange colours of the cap, white to pale brownish pores and the distinct dark scales on the whitish stipe. The most common species around Athabasca are associated with aspen trees and are variously called *Leccinum insigne*, *L. boreale* and *L. aurantiacum*. *L. atrostipitatum*, another orange species grows only under birch.

Top right: *Leccinum holopus* is more rare and occurs under birch in boggy areas.

Suillus

Boletaceae

***Suillus* is another group of boletes with at least eight species in the Athabasca region. All species are mycorrhizal, often associated with pines, some also with tamarack. Many, but not all *Suillus* species have a slimy cap. Like all typical boletes, they have pores as a hymenium.**

Main characters: Fruitbodies large and fleshy. Cap with brown, or yellow colours. The spore print is various shades of brown. The stipe is yellow or brown, in some species with a ring. The pores are whitish, yellow or olive. Most species have a white to yellow flesh.

When and where to find: June to September; only in woodlands or bogs as they are associated with pines or tamarack.

Comments: *Suillus* species are edible, but of medium quality. It is recommended to remove the slimy cap skin if present.

SUILLUS

Top and centre: *Suillus granulatus* with a rather slimy cap. Note the small dots on the upper half of the stipe. Typical for boletes, the spores are produced in pores on the underside of the cap.

Below: *Suillus tomentosus* with overall yellow colours and dots on the stipe. A slight blue stain occurs when the pores are bruised. The yellow flesh likewise stains blueish when the fruitbody is cut.

Both species are associated with jack pine and with lodgepole pine.

BRACKET FUNGI (Aphyllophorales)

Bracket fungi or polypores (Aphyllophorales) form hard, shelf-like fruitbodies on trees. They consist of different groups that are not closely related to one another but are easy to recognize as a group when considering their hard, leathery or corky consistency, the pores on the underside and their growth on trees. Normally they lack a stipe. Unlike typical mushrooms they are persistent at least for a year, with some perennial species growing for several years. Therefore, many bracket fungi can also be observed in winter.

Main characters: Fruitbodies small to very large to large (up to 80 cm broad), forming shelf-like brackets on trees. Various colours, frequently brown or white, sometimes yellow or orange. Underside with pores. Spore prints various shades of white, yellow or brown, but very difficult to obtain in this group.

When and where to find: Perennial species can be found throughout the year; most bracket fungi grow directly on trees, both dead and alive.

Comments: The persistent fruitbodies of bracket fungi are composed of thick-walled skeletal hyphae which explains their mechanical hardness and stability. With few exceptions bracket fungi are not eaten, due to their consistency. These persistent fruitbodies also require chemical protection from decay and insect predation which likely contributes to the many medicinal properties that are found especially within the bracket fungi.

BRACKET FUNGI

Bjerkandera adusta is frequently found on decaying aspen wood.

Gloeophyllum sepiarium is often found on dead conifer wood. It is resistant to many wood preservatives and therefore can be found on wooden benches or railway ties.

Chicken of the wood (*Laetiporus sulphureus*) grows on aspen and balsam poplar in the Athabasca area. This is a bracket fungus that is soft enough to eat. It is tasty when fried but some people develop gastrointestinal problems, especially after over-consumption.

Fomitopsis pinicola

Fomitopsidaceae

F. pinicola is the most common polypore in the Athabasca region where it grows most frequently on aspen but can also occur on spruce. The orange or red brown colouration seen here is sometimes absent. The fruitbodies reach a width of up to 30 cm, the pores are white, narrow and may occasionally stain yellow. The fruitbodies have a peculiar, rather pungent smell.

In ecological terms, this fungus can be considered a keystone species because of its contribution to soil humus formation. As a brown rot fungus it degrades the wood cellulose but leaves the lignin intact which creates the typical crumb structure of humus in forest soils.

F. pinicola is also listed as a medicinal fungus and was used for various purposes by First Nations.

Tinder conk (*Fomes fomentarius*)

Polyporaceae

Tinder conk (*Fomes fomentarius*) from the Athabasca area where it frequently grows on birch.

Tinder conk has been used traditionally for fire making by First Nations and by early Europeans. It was one of the two species of fungus found in the possession of the stone-age man Ötzi from the Alps some 5,000 years ago. Tinder conk is perennial and its narrow pores on the underside are whitish to brownish. The gray to whitish conks may reach a with of 20 cm. Note the particular thickness of the tinder conk in contrast to the flat brackets of other species. In Romania, tinder conks are used for the production of hats.

Artist’s conk *(Ganoderma applanatum)*

Ganodermataceae

The artist’s conk (*Ganoderma applanatum*) is the biggest polypore in the Athabasca region and can easily reach a width of 50 cm or more. Unlike many other polypores it produces abundant masses of brown spores that can often be seen covering the upper side of the conks. The colour of the upper side is in various shades of brown or reddish brown. The pore surface below is whitish, the pores are dense, several per millimeter. It is a white rot fungus that degrades both cellulose and lignin. The name is derived from its use for artistic purposes: fresh conks can be used to make drawings on the pore surface below. Occasionally this art work sells in the range of several hundred dollars per conk.

Daedaleopsis confragosa

CORAL FUNGI

Amylostereaceae, Gomphaceae

As their name suggests, these fungi are shaped like corals, with many branches originating from a common base. Coral fungi are white, yellow, orange or brown.

Main characters: Fruitbodies mid-sized, forming mid-sized to large coral-shaped fruitbodies with white, orange, yellow or brown fruitbodies. The spores are formed at the tip of the coral branches.

When and where to find: June to September in woodlands. Many species are mycorrhizal and therefore associated with trees. Less frequently they grow on decaying wood.

Comments: The group includes both edible and poisonous species and species identification is difficult. Therefore, people not experienced in mushroom identification should refrain from eating coral fungi.

CORAL FUNGI

Top: Two species of *Ramaria* from around Athabasca. Note the coral shape of the fruitbodies.

Left: *Artomyces pyxidata* grows on decaying wood and is rather frequent. The crown shaped final ramifications are characteristic for this edible mushroom.

Hedgehog fungus (*Hericium americanum*)

Hericiaceae

This large white, somewhat coral-shaped fungus is characterized by its long spines (teeth) as the final ramifications on which the spores are formed. It is only found on decaying wood and its unique shape makes it easy to identify.

Main characters: White and coralloid. The spores are formed on long spines. It only grows on wood. Some large fruitbodies may exceed 25 cm in width.

When and where to find: July to September on decaying wood.

Comments: This is one of the most distinct edible mushrooms in the Athabasca area and on top one of the most tasty ones to eat. It is sometimes difficult to clean. You will only find it on decaying wood, typically on poplars. Remarkably, this is one of the few mushrooms that are not eaten by maggots. It may have some insecticidal properties.

PUFFBALLS (Lycoperdaceae)

Lycoperdaceae

Puffballs are spherical, with or without a stipe. Their spores develop inside the fruitbodies in a gleba and are released eventually when the upper part of the fruitbody forms a hole or disintegrates.

Main characters: Fruitbodies round, ball shaped, some with a stipe at the base, others without. Some species are small, 1-2 cm across, while giant puffballs may reach 30 cm or more in diameter. When cut in the middle, immature puff balls are white inside; as the spores mature they become successively yellow and then brown or purple brown.

When and where to find: July to August on grassland, lawns, fields, pastures. Some of the stiped species grow also in woodlands.

Comments: Large and small puff balls are edible and tasty as long as the spores have not matured. When cutting the fruitbodies in half, they should be completely white inside. Once they turn yellow, purple or brown, they should be rejected. Traditional use of puffballs by First Nations was reported from the plains.

PUFFBALLS

Lycoperdon pyriforme is a small, stiped puffball (up to 4 cm in diameter) that grows in forests on decaying wood.

Calvatia booniana with scales on the exoperidium, the fruitbody is almost mature and was found in the outskirts of Athabasca. The illustrated fruitbody was almost 30 cm in diameter. Note the olive brown gleba completely filling the inside of the fruitbody. This is where the spores are formed.

Calvatia craniiformis. The exoperidium (outer skin) is cracked in places and reveals the mature olive brown gleba on the inside.

In the Athabasca region, all puffballs are edible as long as they are immature and pure white inside (after cutting them in half lengthwise).
Obviously, the two illustrated *Calvatia* species are beyond the stage where they could be eaten safely.

EARTH STARS (*Geastrum*)

Geastraceae

Earth stars develop from an onion-shaped early stage; soon the lobes of the exo- and mesoperidium (outer skin) fold back to be arranged in a star-like pattern with the centre being occupied by a round endoperidium structure that holds the spores.

Main characters: Fruitbodies star-shaped, the exoperidium forms the lobes of the star, and the endoperidium, i.e. the round structure in the centre, holds the spores. Similar to some of the puffballs, a small hole on top of the endoperidium serves to eventually release the spores upon disturbance.

When and where to find: July to October on soil in woods. Old fruitbodies often persist and may be found the following year.

Comments: Earth stars are not edible.

EARTH STARS

Earth stars (*Geastrum* sp.) often grow on nutrient rich soils. None of them are edible.

JELLY FUNGI

Tremellales, Auriculariales

This is a diverse group of various fungi with irregular shape and the consistency of jelly. Common species are white, bright yellow orange, black or brown.

Main characters: Fruitbodies irregular, ear-shaped, lobed or brain-like, always with the consistency of soft jelly when fresh. Colours are variable: black, brown, yellow, some are colourless.

When and where to find: June to October; on twigs, logs or pieces of wood.

Comments: Some species are eaten, but don’t expect a distinct taste. *Auricularia auricula-judae* is a mandatory ingredient of many Chinese meals as well as a medicinal fungus and is often cultivated for that purpose.

JELLY FUNGI

Tremella mesenterica, growing on wood, is the most common jelly fungus around Athabasca.

CUP FUNGI (Pezizales)

Pezizales

These cup-shaped fungi with brownish, red or yellow colours grow frequently on wood chips or on bare, exposed soil. They belong to the group of ascomycetes which also includes morels, false morels and truffles among other groups.

Main characters: Fruitbodies cup-shaped. They range in size from tiny cups of 1-2 mm to fairly large ones, up 10 cm in diameter. Some of the smaller cup fungi have brilliant yellow or red colours while the larger ones are often brown. Spores are formed on the surface inside the cup. Occasionally you may observe a simultaneous blast of spore dust when holding the cups in your hands.

When and where to find: From May to October on wood or bare soil.

Comments: Many cup fungi are some of the earliest fungi to fruit in spring. It is not recommended to eat cup fungi.

CUP FUNGI

Top: This large *Peziza* grows on well decayed wood and can reach 10 cm in diameter.

Microstoma protractum is a rare cup fungus occurring in spring on wood pieces.

Scutellinia scutellata (eyelash fungus) is a frequent cup fungus with small brown hairs along the margin of the cup. It is only 5-10 mm in diameter.

Woodstain Fungus (*Chlorociboria aeruginascens*)

Chlorociboriaceae, Helotiales

Where mycology meets art and history.

You may have never seen this tiny cup fungus (typically 5-7 mm in size) in the ascomycetes group. However, you can frequently see its action because the mycelium of this fungus stains wood to a beautiful dark green colour (xylindein). This is just one type of spalting, a term that is used for the colouration of wood caused by fungi.

Stained wood is sought after by woodworking artists who use it for the production of carvings or bowls.

Many pieces of church artwork in Europe have been produced from this stained wood dating back at least to the 15th century, because no other method was known to produce a lasting green wood stain. Some researchers speculate that woodworking guilds in Europe may have guarded the knowledge about this fungus as a trade secret.

WOODSTAIN FUNGUS

Decaying logs with green wood stain, a frequent sight in the Athabasca woodlands.

Chlorociboria aeruginascens fruitbodies are rarely seen after heavy autumn rains. This fruitbody was unusually large, almost 1 cm in diameter. The mycelium of this fungus produces the green wood stain.

TRUE MORELS (*Morchella*)

Morchellaceae

Morels occur exclusively in spring and they are among the best edibles. This group is easy to identify due to its cap with a honeycomb pattern, consisting of ridges and pits and a hollow stipe. Morel season in Athabasca starts in late May and lasts about four weeks.

Main characters: Fruitbodies with cap and stipe. Cap with ridges and pits or with a honeycomb pattern. Caps up to 12 cm high and up to 6 cm broad, but occasionally much larger. Stipes up to 10 cm long, whitish, occasionally pale yellow brown, soon hollow.

When and where to find: The true morel species appear in the last week of May in the Athabasca area. Each species can be found only for about one to two weeks, however there is a succession of different species which extends morel season as a whole. Morel habitat is very diverse. Burnt areas often provide bumper crops, with a maximum fruitbody production in the first year after the fire, while declining in the following years. Morels also appear along the edge of woods, in orchards, on waste sites or inside open woods. They prefer calcareous soils and require a large amount of nutrients, therefore river banks often produce large-sized fruitbodies.

Comments: True morels are among the best species of edible mushrooms but severe poisoning cases have been reported when morels were eaten raw or under-cooked. The general rule that mushrooms should never be eaten raw must be emphasized for the morels in particular.

There has never been much agreement on the naming and delimitation of morel species; many names persist in the literature and the group was recently revised again.

TRUE MORELS

The illustrations show different species of morels from the Athabasca area.

Top: *Morchella vulgaris* and *M. deliciosa*.
Centre: *M. esculenta*
Below left: *M. angusticeps.*

Both *M. angusticeps* and *M. deliciosa* are early species, occurring for a week at the end of May.

M. esculenta can be found most of June.

EARLY MORELS (*Verpa, Mitrophora*)

Morchellaceae

The early morels are found 3-4 weeks before the start of the true morel season in the Athabasca region. They have a cap with shallow ridges or with wrinkles and they lack the deep pits found in the true morels.

Main characters: Fruitbodies with cap and stipe. Cap with wrinkles or shallow ridges. Caps up to 5 cm high and up to 3 cm broad. Stipes up to 8 cm long, whitish, occasionally pale yellow brown, soon hollow.

When and where to find: The early morel species appear already in the first week of May in the Athabasca area in open woodlands. Compared to the true morels, their season is longer and they can be found until mid June.

Comments: Early morels are inferior in taste compared to the true morels. However, they can be found more reliably every spring, even in bad morel years. Some people have reported gastrointestinal issues after eating early morels. They must always be cooked well.

EARLY MORELS

Top left and right:

Verpa bohemica. This is the earliest species and it is reliably occurring every year in the first week of May. It needs moist to wet soils and grows abundantly around late snow melts.

Bottom right: *Mitrophora semilibera*, the half free morel, occurs about one week after the Verpas in open woods and persists for many weeks unlike most other species.

FALSE MORELS (*Gyromitra*)

Discinaceae

The false morels are spring fungi and occur in the same season as early morels and true morels. Their brain- or saddle-shaped cap sits on a white stipe and makes this group very easy to recognize.

Main characters: Fruitbodies with cap and stipe. Cap brain-shaped or saddle-shaped, light to dark brown. Stipes up to 2-8.5 cm long, whitish.

When and where to find: Some false morel species have a preference for sandy soils, while others are found in moist and loamy habitats, similar to the early morels. They occur from May to June in the Athabasca region.

Comments: Some false morel species, including *Gyromitra esculenta*, contain the toxin gyromitrin which is metabolized in the human body to methylhydrazine, a chemical that is used as a rocket fuel. Some people boil false morels in water before cooking as this may volatilize the toxin. However, due to severe poisoning cases in the past, false morels are not recommended for eating at all.

FALSE MORELS

Top: *Gyromitra esculenta*, the most frequent species in the Athabasca region occurs from May to June.

Another rare species of *Gyromitra* is shown on the left.

Due to the occurrence of gyromitrin, false morels should not be eaten.

SLIME MOULDS (Myxomycetes)

Slime moulds belong to the kingdom of Protista, they are not not Fungi, but there are some similarities. Slime moulds are distinguished by a slimy plasmodium that has the consistency of a raw scrambled egg. This plasmodium stage consists of a protoplasm without cell walls, is short-lived and within 1-2 days it forms fruitbodies in which the spores are produced. Plasmodia are white, reddish or yellow.

Main characters: Plasmodium irregular, forming a white, yellow or reddish protoplasm. Large slime molds may easily cover a 10 x 10 cm area (in warmer areas they can be much larger). This short-lasting stage is easy to observe, but is soon replaced by the fruitbody stage. Fruitbodies often small, with or without a stipe and in most cases with dark colours different from the plasmodium colour.

When and where to find: June to September; in woodlands on logs, trees, plants, soil, only under very moist or wet conditions.

Comments: Slime moulds are not related to fungi. The plasmodium is able of slow movement as demonstrated by time lapse photography (up to 1 mm/hour).

SLIME MOULDS

Fuligo septica at the late plasmodial stage. During this short-lived stage the plasmodium crawls slowly over its substrate feeding on bacteria. Note how the leaf on the left has been engulfed by the plasmodium. It is already turning into a fruitbody (aethelium) with numerous spores produced inside.

Wolf's milk (*Lycogala epidendrum*) is the most common slime mould in the Athabasca region.

Slime moulds are protists, not fungi and therefore have no mycelium.

Further reading and resources

If you wish to learn more about mushrooms and interact with others interested in mushrooms, check out the website of the Alberta Mycological Society:

https://www.albertamushrooms.ca/

If you are interested in medicinal mushrooms, consult the highly recommended book *The Fungal Pharmacy: The Complete Guide To Medicinal Mushrooms And Lichens Of North America* (2011) by Robert Rogers. North Atlantic Books.

If you are interested in the connection between mushrooms and the Indigenous Peoples of Canada, read the open access article by Nancy J. Turner and Alain Cuerrier: ‘Frog’s umbrella’ and ‘ghost’s face powder’: the cultural roles of mushrooms and other fungi for Canadian Indigenous Peoples.

https://cdnsciencepub.com/doi/full/10.1139/cjb-2021-0052

A recommended mushroom guide that covers Alberta in particular is *Mushrooms of Western Canada* (2021) by Helene Schalkwijk-Barendsen. Lone Pine.

Another field guide for Alberta Mushrooms is *Wild Edible Mushrooms of Alberta: A Field Guide* (2018) by Tom Cervenka. Northern Bushcraft Publishing.

Acknowledgements

This booklet was created exclusively with free, open source software: *LibreOffice*, *Inkscape* and *GIMP* developers and countless volunteers are acknowledged for their valuable contributions to create and improve freely available, high-standard software.

No corporations were enriched through the production of this document.

All photographs were taken by the author.

The map of the boreal zone was downloaded from the Canadian Forest Service: https://www.nrcan.gc.ca/our-natural-resources/forests/sustainable-forest-management/boreal-forest/13071

The graphic illustrations were created by the author, using some basic elements from the open source site Opencliparts (https://openclipart.org/).

This document is a work in progress and will be amended and updated when necessary. Constructive criticism and suggestions for additional content are welcome and will contribute to the improvement of this publication.

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