

*"Nothing more than mushroom identification develops the powers of observation." --  
John Cage, INDETERMINACY*

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## How to Look at Fungi

### Introduction

There exists an estimated 3 million species of fungi, with more being discovered every day! The number of Agarics alone exceeds 10,000! These numbers are huge when compared to, say the 700 or so species of birds in North America and they provide the first clues that identifying mushrooms is more challenging than bird watching. In addition to their vast numbers, the facts that most fungi only fruit for a very short time and are often separated into different species based largely on microscopic differences also indicates some of the difficulties encountered. Yet, in spite of these difficulties (or perhaps because of them) mushroom identification is one of the most enjoyable, satisfying and rewarding pastimes.

So how does one get started in identifying mushrooms? Perhaps first by admitting that you are not going to identify every mushroom you find. You are not even going to identify half of the mushrooms you find without hours and hours of work. Second, with many mushrooms you will have to lower your identification standards and be content to identify the specimen as a poisonous Amanita or a Russula or a member of some other large group or genus of mushrooms. Many of these groups contain hundreds or thousands of species, and even the experts have trouble sorting them out.

But while mushroom identification is not easy, it is possible. Many mushrooms have distinguishing features that set them apart and it is possible to learn most of the common mushrooms that you run into regularly. The key is knowing what to look for.

Keep in mind that the mushroom is nothing more than a fruit, like an apple; the main part of the fungus lies beneath the soil or in the wood. The purpose of the mushroom is to give off spores (microscopic seeds) and it is entirely built around this purpose.

First you need to take the mushroom that you are looking at and put it into the broadest category that you can. Here are seven general categories. Not everything fits neatly into one of these categories but most do. It would be prudent to look through this list and either say to yourself "Sure, I've seen those" or else look for these in a mushroom identification book so that you will know them when you see them. [Note that no one group is edible or poisonous.]

**Gilled Mushrooms.** These are the traditional "mushrooms" that one often finds. They have a stem and a cap and if you turn them over you'll see blades, or gills, radiating away from the stem. In some the gill structure is actually only folds and not true gills or nearly absent altogether. In all these case they provide a surface area for the spores to grow on and be released.

**Boletes.** These look almost the same as gilled mushrooms, except that when you turn them over there is only a spongy looking surface. When you look closer, this surface is full of holes called pores that are the openings for tubes where the spores develop.

**Toothed Fungi.** In some cases these have the same basic shape as the gilled mushrooms and boletes (a cap sitting on a stem). The only difference is that they produce their spores on spikes pointing down under the cap.

**Polypores.** These are primarily fungi that grow out from wood to form shelves or large fleshy clusters which drop their spores through pores (like boletes). There are often tough and some last for many years but also can be soft and fleshy and do not last beyond a limited season.

**Puffballs and Earthstars.** As the names imply these are ball-shaped fungi or ball-shaped sitting on a star-like base. They produce their spores inside the ball and puff them out when disturbed. You can find these in small sizes all the way up to a couple feet in diameter.

**Coral Fungi.** These look somewhat like ocean coral. They are usually a few inches tall and grow either on ground or wood with many branches growing upward. The spores are produced on these branches.

**Cup Fungi.** These are small (up to a few inches in diameter) flat saucer-shaped mushrooms that aren't much interest to the mushroom eater, but can be a fun challenge to the identifier.

**Morels and similar.** Both true and false morels are related to the cup fungi, true morels appear briefly once a year in the spring but some false morels appear throughout the year. True morels have pits and ridges while false morels often are smooth or have folds and can be brain or saddle shaped with hollow or chambered stems.

**Now let's concentrate on the gilled mushrooms as an example of the characters of fungi and techniques of identification. Most of what is said will also apply to the boletes.**

### **Spore Color**

The first question you will want to answer is difficult to quickly answer in most cases: what color are the spores? Since the spores are microscopic you just can't look at one and see what color it is...you need to get a spore print. To do this you must get a white sheet of paper (some folks prefer halfwhite and halfblack paper), cut the stem off the mushroom and place the cap with the gills down on the paper. Cover it with a cup or bowl. This works best with a more mature specimen. Hopefully within a few hours thousands of spores will drop from the gills and leave a deposit. Note the color of the deposit and this is the color you will check against the book or identification key you are using. The problem with this is that it takes at least a few hours and if the mushroom is too dry, too mature or too immature you may not get any deposit at all. Many experienced mushroom foragers will make an educated guess based on the color of gills, but this often gives a false answer as gill color can change as the mushroom matures. If you are really fortunate and find multiple mushrooms the ones above will often drop a spore deposit on the lower ones or on the leaf litter below and this is your answer. Spore deposits fall into only a few color ranges so this also helps, but some of these can be pretty close...salmon looks like light brown, dark purple looks like black, etc., so you have to look closely and in good light.

### **Gill Attachment**

The second most important feature of a gilled mushroom is one that you may not think of with most mushrooms: gill attachment. How are the gills attached to the stem, if at all? There are two main categories for gill attachment: free and attached. When we say a mushroom has free gills we mean that the gills never reach over to touch the stem. This is quite noticeable in older mushrooms as there is a small area around the stem where there are no gills. It's sometimes harder to see in younger mushrooms but still noticeable. The second category, attached gills, is further divided into degrees of attachment: Are the gills just barely attached (adnexed)? Do the gills run straight into the stem (adnate)? Or do the gills run down the stem for a little ways (decurrent)? If this weren't complicated enough, there is one other common possibility where the gills get short like they want to be free, but near the stem are decurrent. These are called notched gills.

So how do you keep all of these attachments straight? Most people just divide gill attachment into four possibilities: **Free, Attached, Decurrent or Notched** (where it's understood that attached does not mean decurrent or notched).

## The Veil

The next group of features that you want to look for comes about as the mushroom is developing. When a mushroom starts growing it tries not to dry out, which is hard for the gills not to do because there is so much surface area. A lot of mushrooms deal with this problem by forming a veil. (This is a thin layer of tissue.) Sometimes this veil covers the entire mushroom (the universal veil) -- sometimes just the cap (a partial veil), and sometimes there are several veils (or layers) that may cover both. When we find the mushroom often it is older and in many cases the veil has broken or vanished. Some of the characters that it leaves behind are:

A **volva**, cup or bulb at the base of the stipe. This is where the veil that covered the entire mushroom was attached. It can have several shapes and often these shapes are important in identifying the mushroom to species.

**Patches** on the top of the cap are remnants of the veil that covered the cap. These can vanish quickly for some kinds of mushrooms and are not

A **ring** on the stem is an important piece of evidence. Like the patches, the weather can take these away rather quickly for some mushrooms, but a ring is very important, because it means that the mushroom developed with a veil around its cap attached to its stem. Sometimes the ring can be thick and sometimes it is just a few darkened threads on the stem.

The veil itself or **veil remnants** can often be found in many mushrooms at least partially attached to the edge of the cap. Like the ring, sometimes it is thick and sometimes very thin like a spider's web.

All four of these items are important when found. The most common found of these is a ring. But if you see a cup at the base of the stem and free gills, you can immediately place the mushroom into just a few groups: *Amanita* or *Volvariella*. Likewise, if you see a spiderweb-like veil, you can say (with a few exceptions) that the mushroom you have is a *Cortinarius*.

Another comment about rings and veils is that they are good places for spores to get trapped. So by looking closely at the ring or veil, you can often see a dusting of spores and save the trouble of making a spore print. The same is true about leaves under the caps as well as other mushrooms growing up beneath their older siblings.

## Stem Characters

Most mushrooms have what we call a fleshy stem. In a few cases, however, it is a thinner, tougher stem. This is usually called a cartilaginous stem. Other mushrooms go the other direction with a big brittle stem that crumbles like damp chalk.

Another very important character of the stem, when it occurs, is the lateral stem, i.e., the stem coming out from the side of the cap. This is usually seen in mushrooms growing on trees.

## Other Characters

There are many other characters that are used in mushroom identification -- too many to mention here. A few of the more common things to look for are:

**Bleeding:** many mushrooms exude a juice when cut or broken. In particular, one genera, *Lactarius*, is identified primarily by this feature.

**Bruising:** Color changes can be important keys to identifying species.

**Liquefying:** One group of mushrooms, the inky caps, have the property that the cap and gills turn to liquid (ink) or exhibit deliquescence as part of their spore releasing mechanism....hence the name inky caps.

# Getting Started

## Keys

So now you know some of the things to look for. But who's going to tell you what they mean? So what if it has attached gills, a ring, and a white spore print. What is it and is it edible? This is where the books come in.

Gary Lincoff. *National Audubon Society Field Guide to North American Mushrooms*.

Michael Kuo and Andrew Methven. *Mushrooms of the Midwest* (does a great job covering our area and has many of the newer names)

Teresa Marrone and Kathy Yerich. *Mushrooms of the Upper Midwest* (pocket sized for the field, great pictures and written for the citizen scientist)

Roger Phillips. *Mushrooms of North America* (large book with many pictures and comprehensive text for a large number of species)

Kent and Vera McKnight. *A Field Guide to Mushrooms: North America*.

David Arora. *Mushrooms Demystified* (has good keys, but focused on the west coast)

**KEY TO GILLED MUSHROOMS FOR BEGINNERS, by Gary Lincoff**

Gilled mushrooms have spore prints that can be placed in four basic color groups: white to yellowish (called "white"), pinkish to salmon (called "pink"), yellow-brown to rusty-brown (called "brown"), and purple-brown to purple:Black to black (called "black"). There is also one mushroom with a distinctly greenish spore print (Chlorophyllum molybdites, the Green-spored Lepiota), and one with a distinctly lilac-gray spore print (Pleurotus ostreatus, the oyster Mushroom).

**WHITE-SPORED GILLED MUSHROOMS**

1. Stem central		2
1. Stem absent, lateral, or eccentric		13
2. Ring (skirt-like or band of tissue) on stem OR saclike cup at base of stem or removable patches of tissue on cap		3
2. NO ring on stem or cup at base of stem		5
3. Ring on stem OR cup at base of stem	<b>AMANITA</b>	
Cap margin striate (pleated)		
Cup present and ring present	sect. Vaginatae	
Cup present but ring absent		
Cup membranous	sect. Vaginatae	
Cup leathery, persistent	sect. Volvatae	
Cup absent but ring present	sect. Amanita	
Cap margin smooth		
Cup present, membranous	sect. Phalloideae	
Cup present, leathery	sect. Volvatae	
Cup absent but cap & stem showing remnants of universal veil, as tissue fragments, powder, or warts		
Stem bulbous, swollen	sect. Validae	
Stem rooting	sect. Lepidella	
3. Ring on stem but NO cup at base of stem		4
4. Gills free	<b>LEPIOTA</b>	
Mushrooms large, fleshy		
Mushrooms white-spored	Macrolepiota	
Mushroom green-spored	Chlorophyllum	
Mushrooms medium to small		
Mushroom Agaricus-like	Leucoagaricus	
Mushroom Coprinus-like	Leucocoprinus	
Mushroom with scaly cap	Lepiota	
4. Gills attached to somewhat decurrent	<b>ARMILLARIA</b>	
5. Gills brittle, crumbly or gills oozing milk-like latex on breaking		6
5. Gills not as above		7

6. Gills brittle or crumbly on breaking	RUSSULA	
Mushroom hard-fleshed, white or staining on bruising or aging.	sect. Compacta	
Mushroom not hard-fleshed		
Cap yellowish, smelling like marzipan when young, fetid when mature	sect. Ingratae	
Cap variously colored, matte	sect. Rigidae	
Cap mostly red, slimy, shiny	sect. Russula	
6. Gills oozing milk-like latex on breaking	LACTARIUS	
Gills oozing orange, red or blue when broken; mushrooms turning greenish on bruising	sect. Dapetes	
Gills oozing mild, white latex; mushrooms orange to brownish orange or darker	sect. Dulces	
Gills oozing peppery or acrid white latex; mushrooms white to whitish, hard-fleshed	sect. Albati	
Gills oozing white latex, turning pinkish; mushrooms with velvet like brown to beige caps	sect. Plinthogali	
Gills oozing mild to acrid white latex; mushrooms often fragrant, caps dry, matte	sect. Russulares	
Gills oozing mild to acrid white latex, sometimes changing to yellow or purple; mushroom caps either slimy to shiny or dry and fringed	sect. Lactarius	
7. Gills waxy or wax-like on rubbing	HYGROPHORUS	
7 Gills not waxy		8
8. Cap and stem fleshy; medium to large		9
8. Cap fleshy but stem cartilaginous or rubbery		10
9. Gills decurrent (even slightly)	CLITOCYBE	
Gills forked	see Cantharellus	
Gills straight, not forked		
Gills deeply decurrent		
Mushrooms whitish	Clitocybe	
Mushrooms bright orange, clustered on wood	Omphalotus	
Mushrooms honey-brown, clustered on the ground on buried wood	Armillaria tabescens	
Gills barely decurrent		
Mushrooms blue to tan; spore print pinkish tan, on the ground	Clitocybe nuda	
Mushrooms pinkish brown to tan; gills pinkish to lilac; spore print white; on ground	Laccaria	
9. Gills notched at stem	TRICHOLOMA	
10. Cap fleshy, stem cartilaginous, small to large		11

10. Cap fleshy, stem fleshy to cartilaginous, small		12
11. Cap fleshy, stem cartilaginous	COLLYBIA	
Mushrooms tiny, attached to tubers	Collybia tuberosa	
Mushrooms large, rooting	Oudemansiella radicata	
Mushrooms large, at base of trees; stem with white, 'root'	Tricholomopsis platyphylla	
Mushrooms medium sized, orange	Collybia dryophila	
11. Cap fleshy, stem rubbery, bendable	MARASMIUS	
12. Cap & stem fleshy, small, typically on wood	MYCENA	
12. Cap fleshy, stem cartilaginous	XEROMPHALINA	
13. Mushrooms fleshy, putrescent	PLEUROTUS	
Stem absent		
Spore print lilac-gray	Pleurotus ostreatus	
Spore print pink	Phyllotopsis nidulans	
Spore print white		
Cap smooth	Pleurotus spp.	
Cap hairy	Lentinellus ursinus	
Stem lateral or eccentric		
Stem short, stublike, mostly lateral.		
Mushrooms smooth	Panellus	
Mushrooms hairy	Panus rudis	
Stem long, eccentric		
Singly, high in trees	Hypsizygus	
Clustered on wood	Pleurotus	
13. Mushrooms tough, leathery to woody		14
14. Mushroom tough, woody	see LENZITES (under polypores)	
14. Mushroom leathery	see SCHIZOPHYLLUM (under chanterelles)	

PINK-SPORED GILLED MUSHROOMS

1. Gills free		2
2. Gills attached		3
2. Cup present about base of stem	VOLVARIELLA	
2. Cup absent; on wood.	PLUTEUS	
3. Gills long decurrent or short decurrent		4
3. Gills attached but not decurrent	ENTOLOMA	
4. Gills long decurrent	CLITOPILUS	

4. Gills short decurrent; mushrooms often in association with numbers of small, whitish, balllike spheres Entoloma abortivum

#### BROWN-SPORED GILLED MUSHROOMS

- |   |                        |
|---|------------------------|
| 1. Stem absent, lateral or eccentric  | 2                      |
| 1. Stem central   | 3                      |
| 2. Stem absent; mushrooms small   | <b>CREPIDOTUS</b>      |
| 2. Stem lateral to eccentric, large   | Paxillus atromentarius |
| 3. Membranous ring present  | 4                      |
| 3. Membranous ring absent   | 5                      |
| 4. Gills free   | <b>AGARICUS</b>        |
| Mushrooms of parks, grasslands  | sect. Agaricus         |
| Mushrooms of parks or woods   |                        |
| Staining yellow on bruising   |                        |
| Smells of anise or almond extract   | sect. Arvenses         |
| Smells of creosote or medicine cabinet  | sect. Xanthodermei     |
| Staining red on peeling or bruising   | sect. Sanguinolenta    |
| 4. Gills attached   | <b>PHOLIOTA</b>        |
| Mushrooms on wood   |                        |
| Clustered; cap usually scaly  | Pholiota               |
| Clustered, cap & stem orange, smooth to innately scaly  | Gymnopilus             |
| Single to scattered on wood; cap smooth and hygrophanous (drying from brown to yellow)                      | Galerina               |
| Mushrooms on ground   |                        |
| Ring at middle of stem  | Rozites                |
| On wood chips; ring high on stem  | Agrocybe praecox       |
| 5. Partial veil present or absent but no ring on stem; at most only a band of colored fibrils on upper stem | 6                      |
| 5. Not as above   | 8                      |
| 6. Gills colored becoming rusty brown   | <b>CORTINARIUS</b>     |
| Mushrooms dry, violet; cap scaly  | sect. Cortinarius      |
| Cap & stem slimy to shiny   | sect. Myxacium         |
| Cap slimy; stem dry, often bulbous  | sect. Phlegmacium      |
| Cap & stem dry; silvery-blue  | sect. Sericeocybe      |
| Cap & stem dry; brownish  | sect. Telamonia        |
| Cap & stem dry; gills red or orange   | sect. Dennocybe        |
| Cap & stem dry; gills greenish yellow   | sect. Leprocybe        |
| 6. Gills gray-brown to brown  | 7                      |



7. Cap slimy; shiny and sticky when dry	HEBELOMA	
7. Cap mostly dry with radial fibrils	INOCYBE	
8. Mushroom large, gills decurrent		9
8. Mushrooms small, fragile, gills not decurrent		10
9. Cap margin inrolled; cap yellowish	Paxillus involutus	
9. Cap margin straight; cap reddish, gills yellow	PHYLLOPORUS	
10. Cap flat, hemispherical, yellow	Agrocybe pediades	
10. Cap dunce-shaped, white to tan	Conocybe lactea	

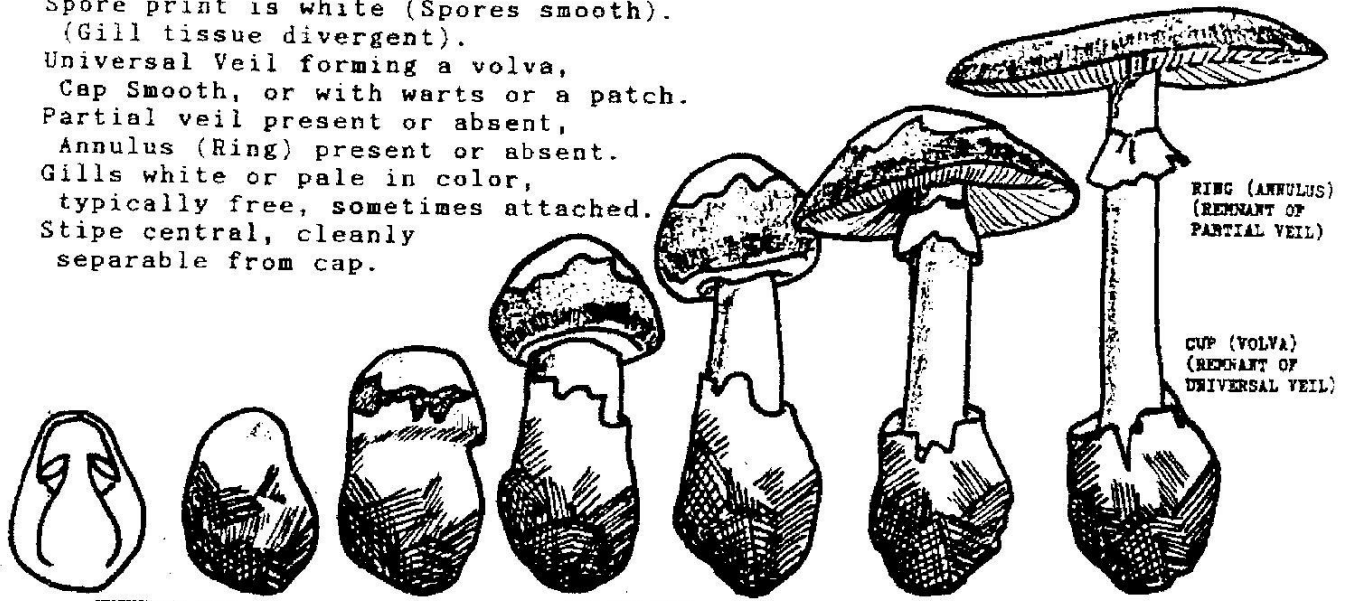
#### PURPLE-BROWN TO BLACK-SPORED GILLED MUSHROOMS

1. Spore print purple brown to purple black		2
1. Spore print mostly blackish		4
2. Ring present on stem; white cordlike 'root' at base of stem	STROPHARIA	
2. Partial veil present but ring absent		3
3. Big clusters on wood	NAEMATOLOMA	
3. Single or small clusters on wood or soil	PSILOCYBE	
4. Cap deliquescing (dissolving into black ink)	COPRINUS	
4. Cap not deliquescing		5
5. Mushrooms on dung; stem generally stiff	PANAEOLUS	
5. Mushrooms usually on wood	PSATHYRELLA	

# Amanita

## DEVELOPMENT OF A GILLED MUSHROOM

Terrestrial fungi, mostly in woods  
 (most mycorrhizal with trees).  
 Spore print is white (Spores smooth).  
 (Gill tissue divergent).  
 Universal Veil forming a volva,  
 Cap Smooth, or with warts or a patch.  
 Partial veil present or absent,  
 Annulus (Ring) present or absent.  
 Gills white or pale in color,  
 typically free, sometimes attached.  
 Stipe central, cleanly  
 separable from cap.

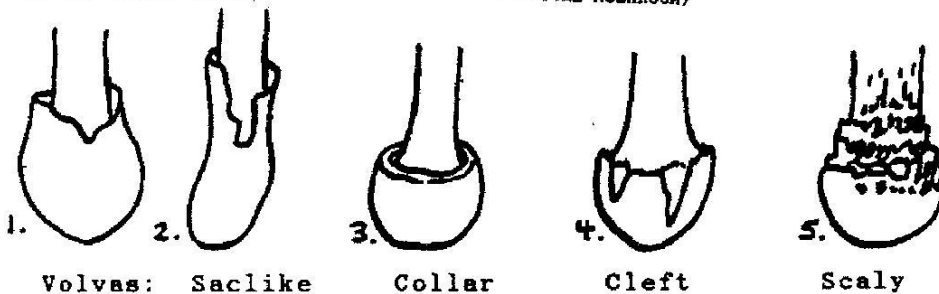


UNIVERSAL VEIL  
 (COVERS ENTIRE  
 IMMATURE MUSHROOM  
 IN THE "BUTTON" STAGE)

PARTIAL VEIL  
 (EXTENDS FROM CAP EDGE  
 TO STALK, COVERING GILLS OF  
 IMMATURE MUSHROOM)

RING (ANNULUS)  
 (REMNANT OF  
 PARTIAL VEIL)

CUP (VOLVA)  
 (REMNANT OF  
 UNIVERSAL VEIL)



1. Volvas: Saclike

3. Collar

4. Cleft

5. Scaly

WARTS (IF PRESENT,  
 ARE REMNANTS OF  
 UNIVERSAL VEIL).



### Amanita species in Minnesota

- 4. *A. brunnescens*  
     variety *brunnescens*  
     variety *pallida*
- 3. *A. citrina*
- 5. 7. *A. flavoconia*
- 2. *A. fulva*
- A. gemmata*
- 2. *A. inaurata*
- 5. *A. muscaria*  
     variety *formosa*  
     variety *alba*
- 6. *A. rubescens*
- 2. *A. vaginata*
- 1. *A. verna*
- 1. *A. virosa*
- 6. *A. wellsi*



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*Limacella illinita* - has glutinous universal veil.

# AMANITAS

## BIG FLESHY DEADLY BEAUTIFUL OVER 100 SPECIES

Medium to large terrestrial fungi found mostly in woods. CAP *smooth or with warts or a cottony patch or other remains of the volva*. GILLS *typically white, creamy, or yellow; close, attached or free*. STALK *central, usually hollow or stuffed, cleanly separable from cap*. VEIL (inner) *usually present, forming a membranous ring on stalk*. VOLVA *usually present as a sack, rim, collar, or series of concentric rings at base of stalk*. SPORE PRINT *white*. Spores *smooth, amyloid or not amyloid*. Gill hyphae *divergent (at least when young)*.

### FRUITING BODY

- Stipe and cap cleanly separate (like ball and socket)
- Cap may have patches or warts (Remnants of universal veil)  
Membranous to cottony to powdery  
Patches or warts may wash off leaving a smooth surface

### GILLS (LAMELLAE)

- Free—usually, but may be finely attached in some
- Truncate to attenuate
- Lamellar tissue divergent—a unique feature of amanitas

### ANNULUS (RING)

- Present—Skirt-like veil to evanescent ring
- Absent— species were included in former genus *amanitopsis*

### SPORES

- Pale colored spore print--White to slightly gray
- Amyloid or inamyloid in Meltzers--basis for subgenera
- Globose to elongate-ellipsoid. smooth

### HABITAT

- Most mycorrhizal
- Some with conifers: some with oak/deciduous

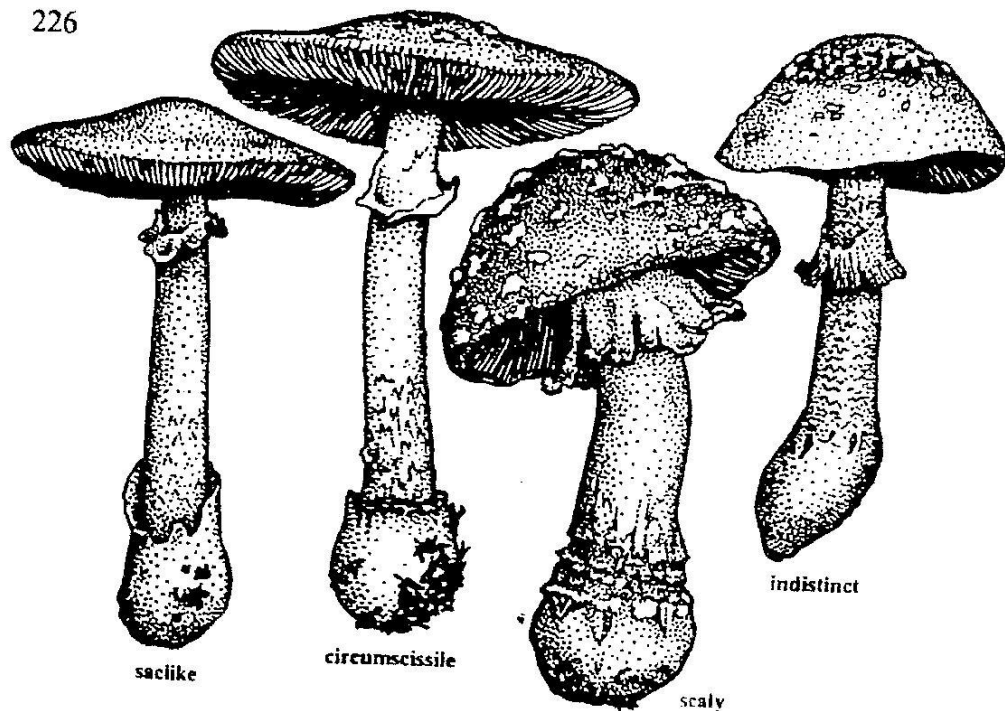
### VOLVA

- Membranous saclike—forming a sheath around the base of the stem
- Friable-interwoven—forming scales, concentric rings or collar at top of volva

Bulb - Absent to small to large, shape, "root", cleft

## Key to Sections of Amanita

1. Membranous saccate volva around base of stalk; cap margin striate; lamellulae truncate; spores inamyloid → 4 (*Section Vaginatae*).
1. Membranous saccate volva around base of stalk; cap margin usually nonstriate; lamellulae attenuate in most species, spores amyloid; warts or patches (if present) also membranous → 6 (*Section Phalloidae*).
1. Membranous saccate volva around base of stalk; spores amyloid; warts usually more powdery/mealy than membranous; cap margin usually appendiculate; ring usually absent → 9 (*Section Amidella*).
1. No membranous saccate volva around base of stalk → 2.
  2. Cap margin striate; lamellulae usually truncate; spores inamyloid; ring and basal bulb both absent → 4 (*Section Vaginatae*).
  2. Cap margin striate; lamellulae truncate; spores inamyloid; ring or partial veil usually but not always present; basal bulb present → 10 (*Section Amanita*).
  2. Cap margin nonstriate; lamellulae usually attenuate; spores amyloid; basal bulb present → 3.
3. Marginate or submarginate bulb present → 6 (*Section Phalloidae*).
3. Warts or powdery patches usually visible on cap and/or on stalk base; cap usually white, cream, or gray; basal bulb usually large → 15 (*Section Lepidella*).
3. Small warts or powdery patches usually visible on cap or on stalk base; cap usually distinctly colored; basal bulb usually small → 14 (*Section Validae*).



Different types of volvas in *Amanita*. Left to right: *A. phalloides*, *A. pantherina*, *A. muscaria*, *A. rubescens*.