

4-H Guide J-11-5

Fun with Fungi



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Acknowledgments

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Note to Leaders

This project offers an opportunity to gain knowledge and skill in an area of biology in which few are proficient. Urban and rural youth, both preteens and teenagers, can learn something new and interesting about this life science. Although the main focus of this project is on making a collection of mushrooms and mushroomlike fungi, there is much room for individuality in how the subject matter is offered. See the section "Other Activities with Mushrooms and Fleshy Fungi" for ideas. Public library books and extension bulletins are free and useful resources. The initial dollar cost is modest—a small price for surprising learning possibilities.

Most good keys to identifying mushrooms rely on spore color as a characteristic for positive identification. To identify gilled mushrooms correctly, a spore print must be made. Spore prints are easy to make; an explanation is included in this guide.

The mushrooms you collect should not be eaten until you have considerable experience in identifying them accurately. Though some people consider a few types of mushrooms or related fungi as gourmet items, most mushrooms, bracket fungi, tooth fungi, pore fungi, coral fungi, and puffballs are as tasty as cardboard and have little nutritive value. *Some mushrooms are deadly poisonous when eaten.*

Why Study Fungi?

Fungi (fun'-ji or fun'-gi; the plural of fungus) are a mysterious, diverse, and sometimes poorly understood group of organisms. Those who strive to learn more about them are rewarded with an awesome appreciation for the tremendous variety in this division of organisms and for their impact on our daily lives.

Without fungi, we would suffocate in piles of dead and dying biological matter that would not decay. Mushrooms, toadstools, bracket fungi, bird's-nest fungi, puffballs, and other fungi reduce literally tons of wood, leaves, roots, animal carcasses, and other dead biological matter into soil nutrients that living organisms use again.

Antibiotics such as penicillin and griseofulvin, which have saved many lives and cured many illnesses, are products of certain fungi. Riboflavin and other B vitamins are produced from fungi for medical use and as nutritional supplements. L-ephedrine, which is used to treat asthma, and certain other drugs are manufactured from fungal organisms.

Industries use fungi to manufacture numerous acids, alcohols, pigments, and enzymes necessary for processing food, fiber, and other products that we take for granted today. Without fungi, we could not enjoy many breads and cheeses. We even eat fungi themselves when we have mushrooms on our steak or pizza.

Though we depend upon many types of fungi to provide useful products for us and to keep us healthy, other types destroy many of the products we make and are responsible for certain diseases of humans, animals, and plants. Athlete's foot, ringworm, aspergillosis, candidiasis, and San Joaquin Valley fever (coccidioidomycosis) are a few examples of human and animal diseases caused by fungi. Certain fungal molds that grow on damp corn produce toxins. Farmers using this corn as feed may inadver-

tently harm their livestock. Chestnut blight and Dutch elm disease are examples of how a single fungus disease can threaten an entire plant species with extinction. We pay higher prices for groceries because fungal plant diseases continually plague our crops. Even the lumber in our houses is threatened by various kinds of fungi that cause wood decay.

Mycologists (mi'-kaul'-o-jists) are scientists who study fungi. Mycologists call mushrooms and associated mushroomlike fungi *macrofungi*. Macrofungi can be seen with the naked eye. *Microfungi* are very small, only seen clearly through a hand lens, magnifying glass, or microscope. Most plant diseases are caused by microfungi. Some 4-H projects in plant pathology deal with the fungi that cause disease in plants. Learning how to identify macrofungi and understanding their biology will help you understand the more subtle, less visible disease-causing microfungi.

Mushroom Form and Function

Mushrooms, which are the reproductive portions of fungi, produce spores that spread the fungus to other areas. The main part of the mushroom lives in the food supply that it grows upon (substrate), such as a tree stump or soil in a forest. This out-of-sight portion of the fungus exists as tiny threadlike strands called *hyphae* (hi'-fee). If all the fungus strands in one ounce (28 g) of rich forest soil were laid end to end, they would cover 2 miles (3.2 km)! Hyphae become visible when many grow together to form what is called a *mycelium* (mi-see'-lee-um). Mushrooms develop from a full-grown mycelium.

To identify mushrooms, the collector must be familiar with the parts of a mushroom. The illustrations of a gilled mushroom

1. Agarics—gilled mushrooms
2. Chanterelles—mushrooms with ridges or wrinkles instead of gills
3. Boletes—pore mushrooms that are soft and grow on the ground
4. Polypores—pore brackets and mushrooms that are tough or rubbery and grow on wood
5. Teeth fungi—fungi with teeth instead of gills
6. Puffballs, earthstars, and bird's nests—fungi whose spores are contained in round balls
7. Stinkhorns—fungi that stink, look like horns, and whose spores are in a slime at the top of the horn
8. Coral fungi—soft, fleshy fungi that look like coral
9. Jelly fungi—soft fungi that when wet look like blobs of jelly
10. True morels—brittle, soft fungi with stalks and cone-shaped tops that have pits and ridges
11. False morels—fungi resembling true morels but with wrinkled or saddle-shaped tops
12. Cup fungi—fleshy fungi that look like tiny shallow cups or bowls

13. Earth tongues and allies—fungi that are tough to woody and fingerlike to marblelike

Where and When to Hunt for Mushrooms and Other Fleshy Fungi

Generally, mushroom hunting is excellent in natural woods and grassy areas. Mushrooms can also be found on backyard trees, in city parks, and along streams, lakes, or drainage ditches. Indeed, you can find mushrooms and other fleshy fungi in a variety of outdoor settings. The best places to look are on moldering logs, tree stumps, and dead trees and in areas where a considerable amount of organic matter is in the soil, such as the forest floor. Manure and compost sometimes yield a few types of mushrooms. Soon you will have a natural "feel" for the type of environment in which mushrooms flourish.

A general rule for hunting is to avoid places that are very dry or wet, especially sandy areas or areas mostly submerged in water. Other fungi, invisible to the eye,

inhabit these areas, but rarely mushrooms.

Though you will find some bracket or shelf fungi in the winter on trees and stumps, the peak seasons for mushroom collecting are mid- to late spring and early to midautumn. The summer is also a good time to find many types of mushrooms, but fleshy fungi will be seen only in the spring or fall because the summer is too hot and dry for them.

For example, *Coriolus versicolor*, the ubiquitous leathery stump decayer, can be found all year long. *Armillaria mellea*, the honey mushroom, can be found from late spring to midautumn (see photograph on inside back cover). The reddish lined cups of the colorful little *Sarcoscypha coccinea* can be found in the spring but only rarely in the fall; they usually appear huddled together in groups of two or three on fallen branches and twigs, like cereal bowls for chipmunks. The sought-after morels are also spring mushrooms. In late summer to early autumn, the large, rapidly growing species of the giant puffballs (*Calvatia* spp.) are likely to be found on the ground, resembling small spherical loaves of bread.

Fleshy mushrooms are usually freshest in the morning, having emerged from the soil or been bathed with dew overnight. The short-lived types may be gone by the heat of the day. Some inky caps, for example, last only 6 to 10 hours from the time they emerge from the ground.

What to Take Along on Field Trips

Always dress appropriately for the weather. This means packing rain gear for that unpredictable shower. An adequate supply of plastic bags for storing collected fungi is essential to a successful mushroom-hunting field trip. To avoid both confusion when you

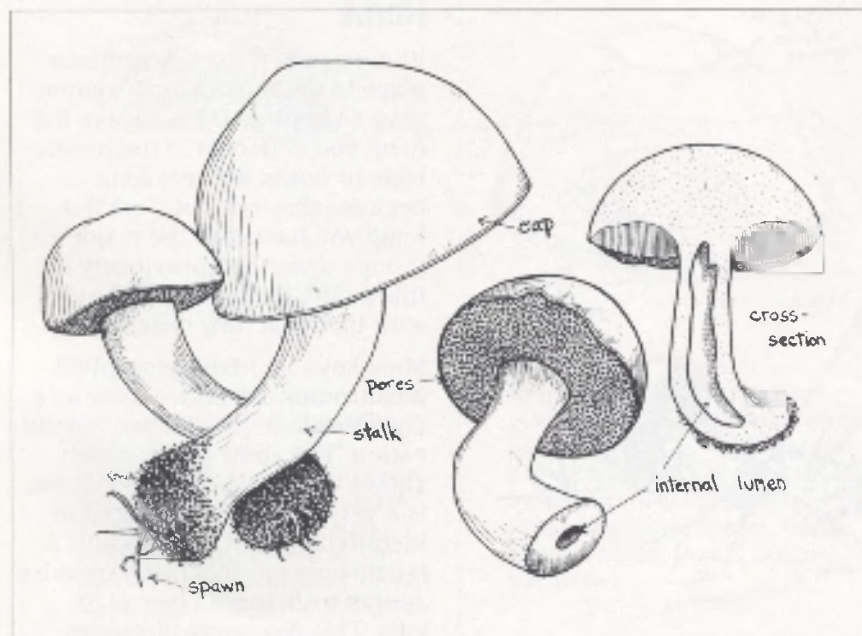


Fig. 2. *Boletus* sp.—a pore-type mushroom. Spores are produced on the inside of tubelike pores instead of on the surface of gills.

get home and damage to your collection, put only one kind of fungus in each bag and only one to three delicate fungi together. Make a few notes about the mushroom on a piece of paper or card for reference when you get home.

Carry the plastic bags and other gear in a sturdy basket to protect the fungi from being crushed. A fishing tackle box is an excellent collecting tool. Clear and sturdy tackle boxes with many small to large compartments are perfect for collecting different types of fragile fungi and keeping them separate. If moist sphagnum moss is available where you are collecting, pack it gently around your specimens to keep them fresh and prevent breaking.

In the basket with your tackle boxes and plastic bags, take along a hunting knife in a sheath to help you take fungi off trees or out of the ground. A small trowel is useful if you are hunting mushrooms that grow on the ground. If you cannot take either, a pocket

knife serves the same purpose. A cloth to wipe off your hands and tools is also useful.

If possible, take along a good field guide to mushrooms for making preliminary identifications. You can make more careful identifications when you get home. A camera is useful for taking pictures of a specimen you can't reach or the habitat of a mushroom you collect. Also, attractive photographs of fungi can be displayed at county or state fairs.

If you intend to be out collecting for a long time, take along the things you would use on any extended excursion into natural areas, for example, a canteen, a compass, food, and matches.

When collecting, dig out the mushrooms and knock off the excess soil to collect the base of the stalk, which is important for identification (fig. 3). A number of animals feed on mushrooms. When you find a mushroom you like, check it over first to be sure you are not taking home maggots, beetles, or slugs.

The novice mushroom collector who plans to identify the mushrooms gathered should collect only two to four different kinds on each field trip. This way the task of identifying them will be easier, quicker, and more rewarding. If you intend to identify and preserve the specimens you collect, take home two or more of each kind you find. Use one mushroom to make spore prints and examine for identification. Preserve and display the other in your collection.

Checklist

1. Appropriate clothing
2. Basket
3. Plastic bags
4. Clear fishing tackle box(es)
5. Small notebook or index cards
6. Pencils
7. Hunting knife in sheath (or pocket knife or trowel)
8. Clean cloth or rag
9. Mushroom field guide
10. Camera (optional)
11. Other gear needed for long trips or rough terrain

What to Do When You Get Home

When you first get home, find a place to spread out and examine your collection. Do not leave the fungi you collected in the plastic bags or boxes for very long because they will rot. Sort the fungi you have into the major groups described previously in this guide. Keep your field notes with the fungi they describe.

Most keys for identifying gilled mushrooms use spore color as a characteristic for positive identification. The spore print, which shows what color the spores are, is a very important first step in identifying gilled mushrooms. A mushroom forcibly discharges its spores from the surface of its gills. This discharge of spores "prints" the paper. Figure 4 shows how to set up a spore print. Even



Fig. 3. Collecting a mushroom. Always get the base of the mushroom stalk.

if you do not "key out" your fungi, set up a few spore prints to see the beautiful patterns cast by the spores. Most macrofungi will cast a spore print; try it with different types.

At home, consult references to identify the fungi you have collected. A list of references is given at the end of this guide. An exact identification is not always possible since some species cannot be distinguished from others except by an experienced mushroom collector. If you plan to prepare a mushroom collection, the more accurate identifications you make, the better your collection will be.

For beginners, a collection identifying the major group to which a fungus belongs is sufficient. Advanced beginners should identify mushrooms for their collection at least by genus. As interest and experience increase, collectors should be able to identify a fungus by its complete scientific name (genus and species).

Some mushrooms and similar fungi (for example, puffballs, bird's-nest fungi, and bracket fungi) dry out quite nicely on their own without using any special techniques to preserve them. *Marasmius* dries out in nature, but when wetted, it swells up again and releases more spores.

Most fleshy fungi, especially the fleshier mushrooms and other delicate fungi, disintegrate or decay if they are not preserved quickly with rapid drying techniques. Silica gel is excellent for preserving the form and color of specimens and dries them thoroughly for collections. This process is illustrated in figure 5.

Your Fun with Fungi Collection

For display and judging purposes, include in your collection a minimum of twelve distinctly different kinds of fungi. Of the twelve, there should be at least

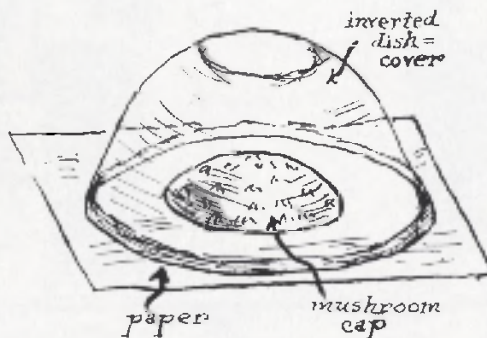
one gilled mushroom (agaric), one pore mushroom (bolete), and one bracket (shelf) fungus (polypore). For a more complete collection, include spring, summer, and autumn specimens as well. Your collection should also contain one or more spore prints. Figure 6 shows a display collection of fungi. Collections that include twelve different fungi identified only to their major group should be titled "Beginner's Collection."

Dry all specimens in silica gel or a similar chemical. Silica gel, which is used for drying flowers, is sometimes available from florist and hobby shops. If not, you can order it from Ward's Natural Science Establishment, P.O. Box 1712, Rochester, NY 14602, or Fisher Scientific Company, 15 Jet View Drive, Rochester, NY 14624. A five-pound can will last a long time.

Silica gel can be recycled by pouring it through a fine sieve to remove dirt particles and heating it for about 1 hour in an oven at



1. Find and collect a capped mushroom. Make a label, recording type of mushroom, place collected, date, town, and state. Keep it with the specimen. Try to collect three or four specimens of the same kind so you can dry one. Mushrooms should be young or the cap only half to two-thirds expanded.



2. At home, cut off the stem and place the cap on a sheet of white paper, gill side down. Cover the cap with a dish to prevent drafts from disturbing the pattern formed by falling spores. Leave 12 to 24 hours. Do not discard the stem.



3. The resulting spore print shows the gill pattern. Label and keep the spore print with a dried specimen of the same mushroom. Spray it with several thin coats of clear lacquer or acrylic to keep the print from smudging.

Fig. 4. How to make a spore print

350°F. Immediately seal the container upon removing it from the oven.

Mount your specimens in a display container suitable for twelve specimens and spore print(s). Display boxes made of styrofoam are available as B-R-D collection boxes from the Biological Research Development Company, 1750 Wooten Road, Beaumont, TX 77707. You also can make your own display boxes out of cardboard, styrofoam, or wood with a glass top. Insect pins, size no. 4 (100 per package) are available from Ward's Natural Science Establishment at the same address.

Label Records

Next to each fungus place a label printed neatly with your name, the date of collection, the county and state in which you collected the specimen, and special information such as the city or township of collection. You can use the labels on the label card supplied with this guide or make

your own. Additional label cards for display collections are available from the 4-H specialist, Department of Plant Pathology, 334 Plant Science Building, Cornell University, Ithaca, NY 14853. These are presently free on request.

Print the following data on each label (see the sample record on the label card and the examples in fig. 6.):

Locality (state, county, township, or city; road or street)
Date collected
Habitat (optional)
Name of collector

Example:

Tompkins Co., N.Y.
Dryden Road
June 20, 1988
Apple orchard
Jennie Smith

Identify the fungus by printing its name neatly on a small piece of paper and placing it near your specimen. A common name will do, but give a scientific name (at

least a genus name) if the mushroom has no common name. When possible, give the common and scientific names of the fungus together.

Other Activities with Mushrooms and Fleshy Fungi

Fungi can be used to make artistic creations. Spore prints arranged in a myriad of patterns and designs create interesting wall hangings, greeting cards, or post cards. See the article "Artistic Spore Prints" by Samuel J. Ristich in *Mushroom, the Journal of Wild Mushrooming*, fall 1983, pp. 7-8.

Collect the artist's conk (*Ganoderma applanatum*), a bracket polypore, in mid- to late summer from dead or dying trees or stumps. The pore-bearing under-surface is white and smooth, but when etched it turns brown, making it a wonderful surface to draw on.

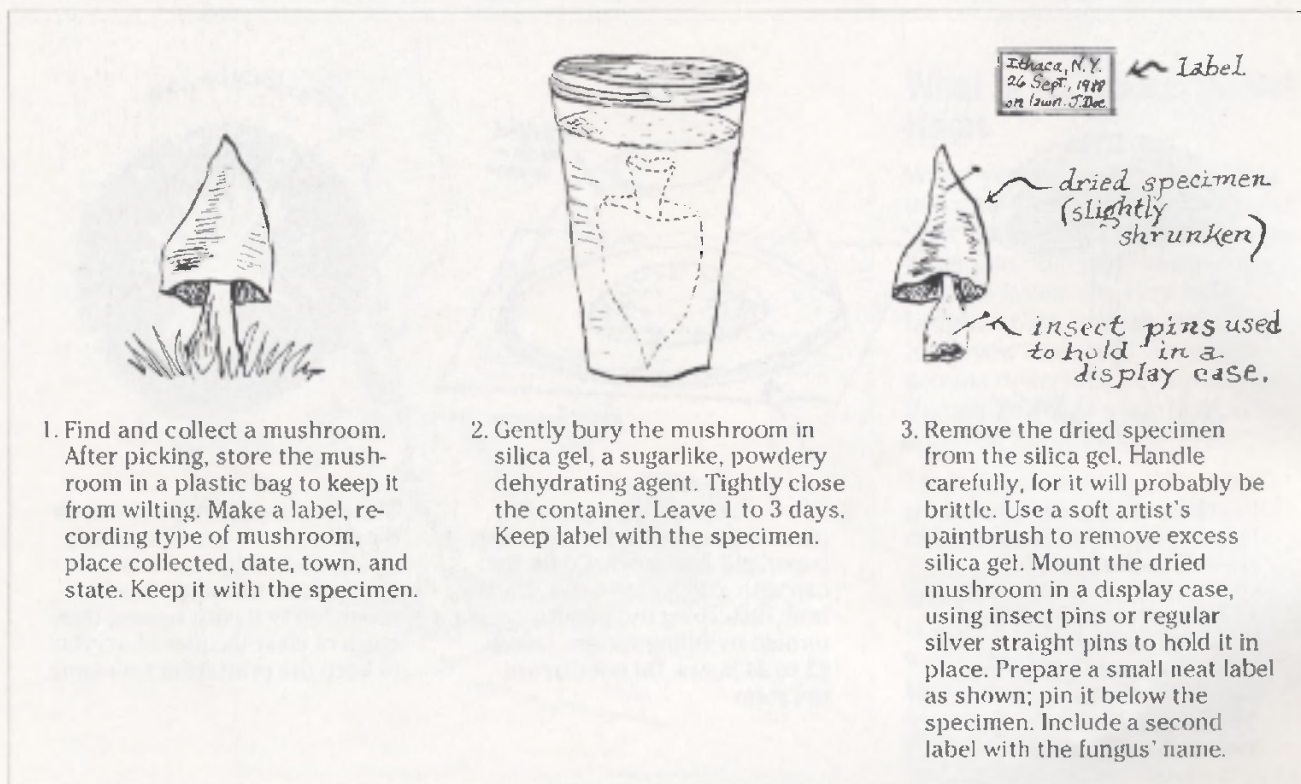


Fig. 5. A technique for drying fleshy fungi

After using silica gel to dry specimens, collectors interested in home crafts can arrange dried fungi into miniature scenes for home decorations, use them in dried floral arrangements, imbed them in a heavy material for paperweights, or use them in other crafts.

Collectors interested in growing mushrooms should refer to the bulletin *Growing Button Mushrooms* listed in the references. Mushroom-growing kits teach the concept of growing mushrooms from mushroom spawn (mycelium) and show how the mushroom structure emerges from the spawn. Some garden catalogs and commercial growers sell spawn for do-it-yourself mushroom-growing kits. The mushrooms grown are the same kind found commonly in grocery stores.

Your club may want to invite an experienced mushroom collector, commercial mushroom grower, naturalist, science teacher, or other local resource person to broaden the group's knowledge of mushrooms and other fungi. Some hobbyists are very knowledgeable and can add considerable background and subject matter information.

A slide show of various personal or group discoveries presented by someone in the group can be an enjoyable activity. Use the slides to demonstrate mushroom collecting or present facts about mushrooms and other fungi.

References

Field Guides

These books are handy to have on collecting trips. They also are very useful in identifying fungi when you get home with your collection. Most are available at local bookstores or can be ordered there. It is often helpful to have two guides so you can compare the descriptions in each.

- Bigelow, Howard E. 1979. *Mushroom pocket field guide*. New York: Macmillan. 115 pp. (Common mushrooms with 64 color photos.)
- Christensen, Clyde M. 1981. *Edible mushrooms*. 2d ed. rev. University of Minnesota Press. 136 pp. (Guidebook for identification of edible wild mushrooms, with information on poisonous varieties and a section on mushroom cooking.)

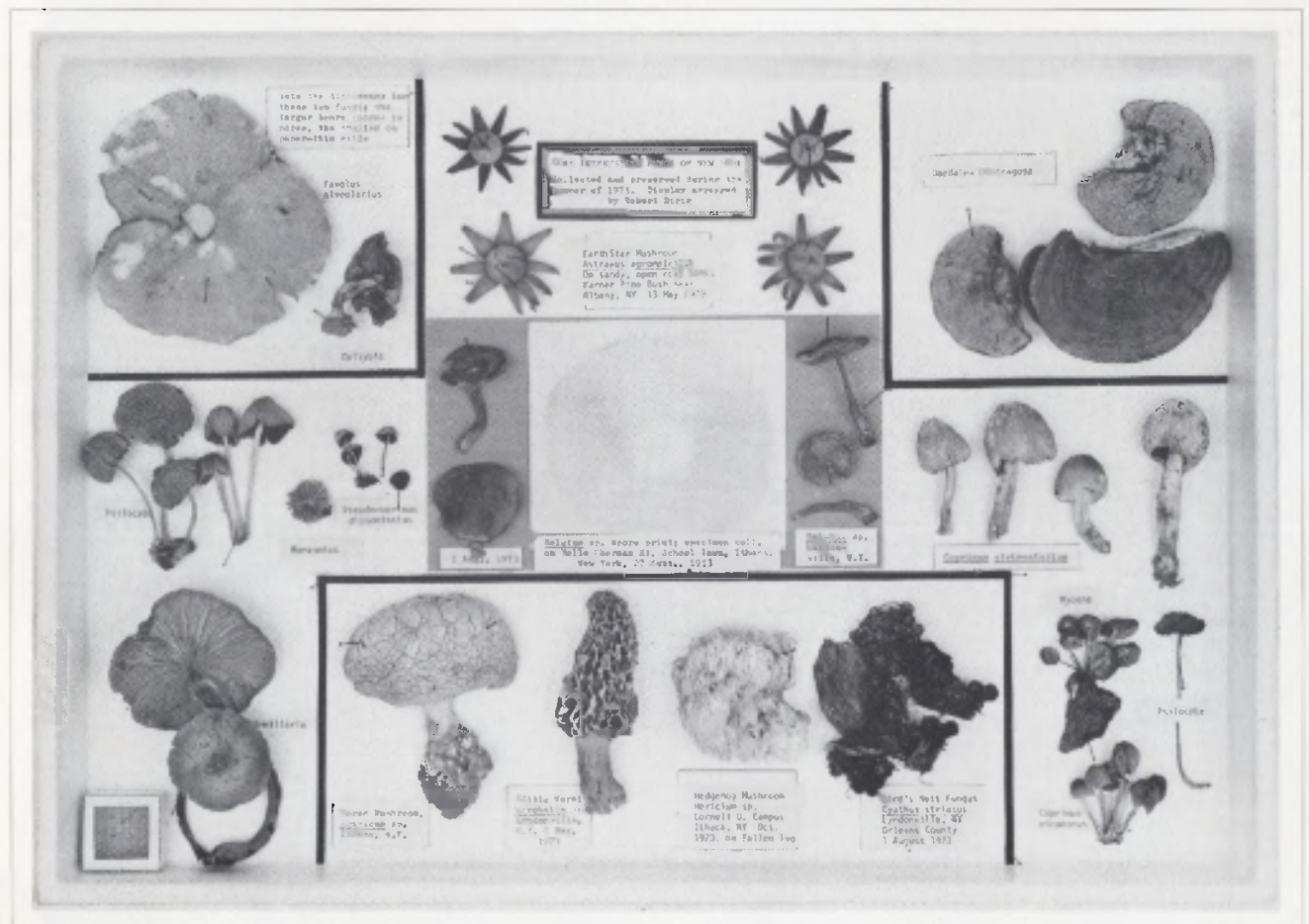


Fig. 6. A collection of fungi suitable for display. Fungi are identified by their Latin name when they have no common name.

- Lincoff, Gary H. 1981. *The Audubon Society field guide to North American mushrooms*. New York: Chanticleer Press. 928 pp. (A photographic guide for identifying mushrooms based on their shape and color; detailed descriptions given.)
- Lincoff, Gary H., ed. 1981. *Simon and Schuster's guide to mushrooms*. New York: Simon and Schuster. 512 pp. (More than 400 color illustrations and photographs; keys for identification broken down into ten groups based on fungus shape.)
- McKnight, Kent H., and Vera B. McKnight. 1987. *A field guide to mushrooms of North America*. Boston: Houghton Mifflin. 429 pp. (A Peterson field guide; 48 color plates; covers all major groups of macrofungi.)
- Miller, Orson K. Jr. 1979. *Mushrooms of North America*. Rev. ed. New York: E. P. Dutton. 359 pp. (A comprehensive guide to finding, identifying, and collecting many different fungi; 422 species described; contains 292 color photographs.)
- Smith, Alexander H., Helen V. Smith, and Nancy S. Weber. 1979. *How to know the gilled mushrooms*. Dubuque, Iowa: William C. Brown. 334 pp. (Keys to and drawings of many gilled fungi; spiral bound.)
- Smith, Alexander H., Helen V. Smith, and Nancy S. Weber. 1981. *How to know the nongilled mushrooms*. Dubuque, Iowa: William C. Brown. 324 pp. (Keys to and drawings of many nongilled fleshy fungi; spiral bound.)

Beginners' Guides to Fungi

These booklets introduce the world of fungi to young audiences.

- Charles, Vera K. 1974. *Introduction to mushroom hunting*. New York: Dover. 60 pp. (49 photographs; describes some major mushroom families; paperback.)
- Kendrick, Bryce. 1986. *A young person's guide to the fungi*. Waterloo, Ontario, Canada: Mycologue Publications. 52 pp. (A full-sized, delightful book with beautiful line drawings, each accompanied by a description of a fascinating aspect of the world of fungi.)
- Shuttleworth, Floyd S., and Herbert S. Zim. 1967. *Nonflowering plants*. New York: Golden. 160 pp. (A pocket-sized book with a section describing the various kinds of fungi; a Golden guide.)

Books on Different Groups of Fungi

- Coker, William C. 1975. *The club and coral mushrooms (Clavarias) of the United States and Canada*. Mineola, N.Y.: Dover. 320 pp.
- Coker, William C., and Alma Beers. 1974. *The Boleti of North Carolina*. Mineola, N.Y.: Dover. 163 pp.
- Coker, William C., and John N. Couch. 1974. *The Gasteromycetes of the eastern United States and Canada*. Mineola, N.Y.: Dover. 447 pp. (Describes puffballs, bird's-nest fungi, stinkhorns, and related fungi.)

Bulletins

- Bartelli, Ingrid. N.d. *Best of the boletes*. Michigan State University Cooperative Extension Service, East Lansing. E-926.
- Bartelli, Ingrid. N.d. *May is morel month in Michigan*. Michigan State University Cooperative Extension Service, East Lansing. E-614.
- Bartelli, Ingrid. N.d. *Mushrooms grow on stumps*. Michigan State University Cooperative Extension Service, East Lansing. E-924.
- Bartelli, Ingrid. N.d. *Wood waste makes wonderful mushrooms*. Michigan State University Cooperative Extension Service, East Lansing. E-925.
- Bessette, Alan. 1985. *Guide to some edible and poisonous mushrooms of New York*. Utica College of Syracuse University, Utica, N.Y. 24 pp.
- Carroll, Juliet E. 1986. *Artists' conks*. Discover 4-H, New York State 4-H Program, Ithaca. 2 pp.
- Carroll, Juliet E. 1989. *Growing button mushrooms*. 4-H Member's Guide M-11-6. New York State College of Agriculture and Life Sciences, Cornell University, Ithaca.
- Carroll, Juliet E. 1986. *Make spore prints from mushrooms*. Discover 4-H, New York State 4-H Program, Ithaca. 2 pp.
- Mushroom collecting for beginners*. Canadian Agricultural Publication Information Division, Canada Department of Agriculture, Ottawa, K1A 0C7. No. 861.
- Tiffany, Lois H., George Knaphus, and Robert F. Nyvall. 1981. *Mushrooms and other related fungi*. Cooperative Extension Service, Iowa State University, Ames. Extension Publication 129. 12 pp.

References for General Reading on Mushrooms and Fungi

The following books may be available in public, high school, college, or university libraries.

- Christensen, Clyde M. 1975. *Molds, mushrooms, and mycotoxins*. Minneapolis: University of Minnesota Press. 292 pp. (Describes fungi that are potentially harmful to people, plants, or animals in different ways; includes poisonous and wood-decaying mushrooms as well as toxic molds, pathogens, and allergy-causing fungi.)
- Dobbs, Elizabeth. 1962. *Fungi for fun*. San Francisco: Lew Heymann Books. 62 pp. (Basic description of the biology and morphology of mushrooms, molds, and yeasts in language easy for grade-school children to understand.)
- Kavaler, Lucy. 1965. *Mushrooms, molds, and miracles*. San Francisco: Lew Heymann Books. 318 pp. (The importance of fungi to people and the role of fungi in world economics and ecology; for junior and senior high school readers.)
- Large, E. C. 1940. *The advance of the fungi*. New York: Henry Holt. 480 pp. (A historical account of the discovery of fungi and the findings that led to our understanding of these organisms; an entertaining book for high school readers.)
- Marshall, Nina L. 1920. *The mushroom book*. New York: Doubleday, Page & Co. 170 pp. (An old popular guide to the more common fungi, with color and black-and-white illustrations.)
- Rinaldi, Augusto, and Vassili Tyndalo. 1974. *The complete book of mushrooms*. New York: Crown. 330 pp. (1,000 species of American, European, and Asian mushrooms with 460 photographs and illustrations; topics include mushroom identification, crop culture, and cooking.)

Key to plate opposite

- A. "Honey mushroom"—*Armillaria mellea*
 B. "Jack-o-lantern mushroom"—*Clitocybe illudens* (poisonous)
 C. "Velvet-stemmed collybia"—*Collybia velutipes*
 D. "Shaggy mane mushroom"—*Coprinus comatus*
 E. "Fly agaric"—*Amanita muscaria* (poisonous)
 F. "Bitter bolete"—*Boletus felleus*
 G. *Panaeolus* sp. (poisonous)
 H. *Clavaria stricta*



A



B



C



D



E



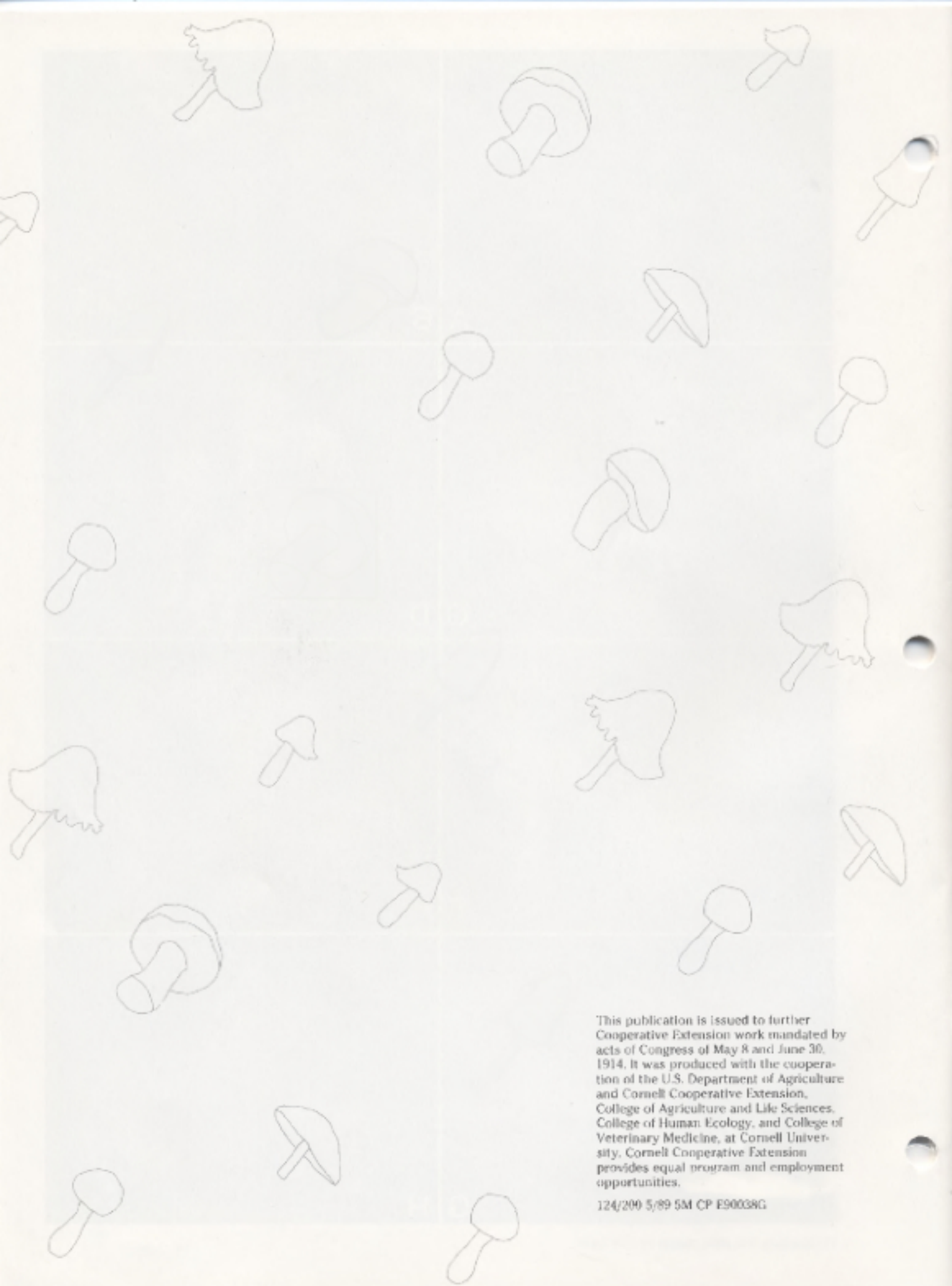
F



G



H



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