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Home Mycology Lab



From MAKE Magazine

This project first appeared on the pages of MAKE magazine.

Use an off-the-shelf home air purifier to culture and grow mushrooms.

Author: [Philip Ross](#) Difficulty: **Moderate**

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Agriculturalists have long considered mushroom growing a challenge, largely because you need a space that's as hygienic as a hospital or a chip-fab clean room. Laboratories create these spaces with a piece of benchtop equipment known as a laminar flow hood, but these are prohibitively expensive. This project explains how you can make your own "hood" out of a household air purifier and use basic kitchen techniques to culture and grow mushrooms.

The crucial component in the purifier is its High Efficiency Particulate Air (HEPA) filter. Originally developed for the Manhattan Project during World War II, these filters later became standard in



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hospital and computer manufacturing facilities. Now, cheap HEPA filters are built into vacuum cleaners and other mass-market consumer appliances, and their trickle-down availability lets amateur biologists run procedures that were previously reserved for large corporations, universities, and research institutions.

Mushroom Growing Tips

Clean the room and all of your equipment so that you could literally eat off of any surface.

» If there are cobwebs in the room, there are probably microorganism-carrying spiders and insects. Get rid of them or try another location.

» Choose a work area that's isolated from open windows, drafts, plants, pets, and other people.

» Use dedicated equipment — things you're not also using for cooking or other activities.

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Tools

Drill , with drill bits

 Hobby knife

Journal

Keyhole saw *or jigsaw*

Latex gloves

Mason jar , 1-quart, with lid

Pen

Spray bottle

Stockpot

Stove

Relevant Parts

Relevant Parts (continued)

Isopropyl alcohol

Cotton balls *or cut-up sponge pieces*

Plastic container , with lid; small, transparent, dishwasher-safe *Like the kind fresh salsa comes in, or use lab-standard petri dishes*

Growing substrate , Cellulose-based *Such as sawdust. You can also use paper- or pine-based cat litter, wood shavings, newspaper, rye grain, or birdseed; look in pet supply and animal feed stores. Some animal bedding is heat-treated to kill microorganisms, which is a plus. If you plan to eat the mushrooms, make sure that there is nothing in the substrate that you wouldn't want to ingest yourself.*

Mushroom , fresh *I recommend oyster mushroom for first timers, available at upscale food markets, natural food stores, Asian groceries, farmers markets, or in the wild. It should smell fresh, like a forest. A fishy or sour smell means the mushroom probably has too much bacteria for good culturing.*

Plastic file box , translucent, with lid *Bottom must*

Air purifier , Small countertop model, with HEPA filter and flat boxy shape such as the Sunpentown AC-3000 Magic Clean (available at home, hardware, and large drugstores)
Silicone caulk , White, sealant
Agar seaweed gelatin, aka agar. Available at many health food stores and Asian groceries.
Calcium carbonate , Tums tablet
Labels

be bigger than output side of air purifier; available at office, home, or hardware stores.

Aluminum foil
Soapy water , warm
Bleach-and-water solution

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Step 1 — Cut the hole.

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Find the output side of the air purifier, and trace it on the bottom of the plastic box.

Drill pilot holes at the corners of the traced outline.

Use a keyhole saw or jigsaw at the highest speed to cut out the entire hole.

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Step 2 — Install the purifier.

[Edit](#) 

Fit the air purifier into the hole, with the intake side facing out and the output side blowing into the box. You might want to prop it up on some books to keep it in place.

Use silicone sealer to generously caulk around the air filter, securing it in place. Let it sit overnight so that the caulk can dry. That's it — now you have your hood! Move it onto a good work surface with its opening facing you, and let's start using it.

Step 3 — Clean the hood.

[Edit](#) 

This isn't just Step 3; it's something you'll need to do every time you work inside your laminar flow hood. The hood is crucial for mushroom growing, but it's only one part of the larger regimen of cleanliness required for successful lab work.

Clean all of the hood's surfaces with warm, soapy

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water.

Disinfect all surfaces of the hood with a bleach-and-water solution.

Finally, turn the fan on and disinfect the hood with isopropyl alcohol. You can never be too clean!

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Step 4 — Make the agar plate. [Edit](#)

We'll begin growing our mushroom tissue in agar (seaweed gelatin), a standard laboratory growth medium. Petri dishes are traditionally used, but you can use any shallow, washable container with a lid. As long as you're cooking a batch of agar, you'll find it handy to make several of these plates at once and store them in airtight bags for later use.

Drill or cut a 1/2" hole in the lid of a washable plastic container.

Wash the container and lid with soap and water, and then sterilize by immersing them in simmering water for 3 minutes. Switch on your hood's fan, and move



the container and lid inside for drying.

Make a filter by soaking a piece of cotton or sponge in isopropyl alcohol and then wringing it out. Place the filter in the hole in the container lid. It should fit snugly.

The sponge-piece filter keeps the mushroom tissue protected while letting it exchange gases with the surrounding air.

Mix 1 tablespoon of agar in 1 cup of water. Bring to a low boil and slowly simmer for about 15 minutes, stirring occasionally. Add a large pinch of the growing substrate you'll be using later (sawdust, cat litter, barley, etc.) to the simmering agar as a source of nutrition.

Inside your hood, pour the hot agar into the newly sterilized container until it is about as thick as a pencil. Let the gelatin cool and congeal.



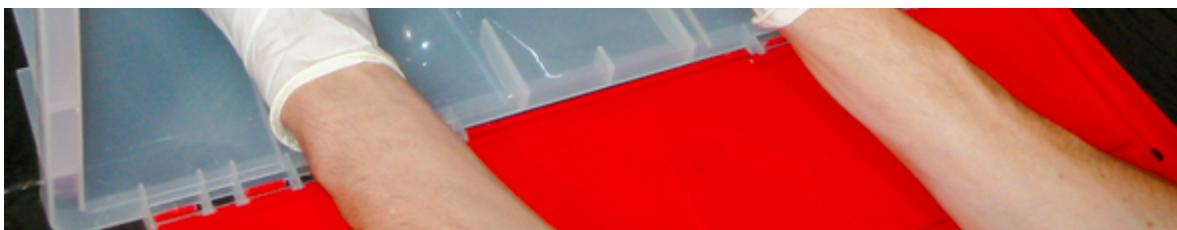
Step 5 — Start the culture.

Edit 

Sterilize a hobby knife by soaking it in isopropyl alcohol for a few minutes and letting it dry in the hood.

Inside the hood, break open the stem of a mushroom. Cut a clean, unbruised chunk of tissue from inside the stem and place it onto the agar in one of your plates. It is important to use only tissue that has never been exposed to air before.

Cover the container with the filter lid and leave it in the hood. Cells from the mushroom tissue will grow out across the agar and will look like a thready mold after a few days. When these growing cells have reached



the sides of the container, you're ready for the next step: moving them onto a larger food source.

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Step 6 — Transfer to the growth medium.

Edit 

Drill a ½" hole in the lid of the Mason jar, and make and fit a filter for it, as in Step 4.

Add 1 cup of growth medium into the jar, along with $\frac{2}{8}$ to $\frac{3}{4}$ cup water, and 1 teaspoon crushed Tums or other form of calcium carbonate. Mix the ingredients, seal the jar, and tightly wrap the lid with foil.

The calcium dissolves and helps keep the pH of the mix neutral; the foil keeps excess water from getting in during the next step, sterilization.

Stand the jar upright in the pot and steam for 1½ hours, covered. All the water in the jar should be absorbed into the substrate. If there is any standing water at the bottom of the jar, pour it out and steam for another 15 minutes. Pooled water increases the chance of bacteria growing in the jar.

Immediately after steaming, move the jar into your hood with the air stream on. Let it cool (1 to 1½ hours), then shake the jar to loosen the substrate material. Remove the foil.

Sterilize a knife as in Step 5, and use it to cut a wedge out of your agar plate, working inside the hood. Transfer the slice into the jar so that it sits on top of the substrate.



Step 7

Reseal the jar and move it out of your hood to a dedicated growing area. I like to use another wellcleaned, clear plastic box for this purpose because it adds an extra layer of protection. The growing area should have a comfortable temperature range (60-80°F) and a day/night light cycle, but direct sunlight is not so good. If there is no ambient daylight in your growing area, then a light with an on-off timer will do. Every 3 days it helps to gently shake the jar, mixing the growing mycelium through the substrate.

After about 6 days to 2 weeks, the mycelium will have fully grown through the material in the jar. Now you have a choice: use this material as spawn to grow more mushroom material, or encourage the fruiting bodies to form. If you use it as spawn, divide the material in the jar into 4 more jars of sterilized substrate, as prepared in the beginning of Step 6.

To encourage mushrooms/fruiting bodies to grow, expose the mycelium to more air, either by removing the air filter or by unsealing the lid and letting it sit askew on the jar's rim. You will also need to water your mushrooms daily using a spray bottle.

Don't get too much water into the jars or spray too close or too hard. The mushrooms might start appearing after a few days or a few weeks, depending on various factors, so the best thing to do is be patient. Open the box they are growing in only when you are watering them, and resist the urge to touch any of the living material until you are ready to harvest the mushrooms.

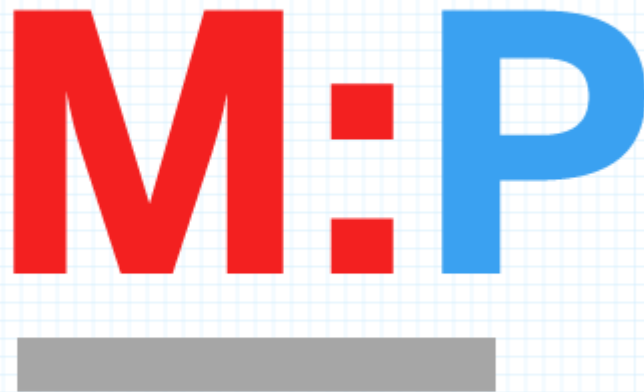
Another way to encourage mushroom growth is to temporarily change the temperature. Place the sealed jar in the fridge overnight (or outside if it's cold), and protect it from cooties by putting it in a sealed plastic

bag. The next morning, remove the jar from the bag and put it back into its grow box.

Step 8 — Explore equipment alternatives and keep a journal. Edit

The techniques described here are a good place to begin, and can be altered to fit your budget and space. Companies such as Fungi Perfecti (fungiperfecti.com) and Carolina Biological Supply (carolina.com) sell pre-poured agar plates, mycelium spawn, and plastic bags with pre-attached filters, which are common in the mushroom industry — or you can improvise your own with zip-lock bags and filter material. Drugstores have all sorts of supplies for protecting living materials. Experiment, keep track of what you've done, and be safe.

As you experiment, keep track of what you're doing. Write the date and type of mushroom you are culturing onto your agar plates and jars. In a journal, write down the recipes you followed or changed, the equipment and techniques you tried, measurements of ingredients, cleaning techniques, the number of times you cooked things, the smells of your cultures, the substrates you used, how things grew or got contaminated, and any other things you notice — even the weather and temperature outside. When something works, you can refer to your log to try to reproduce the results.



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This project first appeared in [MAKE Volume 07](#), page 102.

For more information, check out the [Science Projects category page](#).

I did it! Success!

Comments

Guide

This sounds like an awesome project! The HEPA filters in those air filtration units arnt true HEPA, are you having success keeping your contamination rates down? I worry that you may be passing bacteriologically contaminated air over your petris. I guess anything is better than open air.

Never cultivated myself, but I was thinking about joining a mycological society and trying my hand at some oysters.

adam west, Sep 20 2010

just as a follow up, i did try this improvised hood. I would not recommend it. As a test, prepared several petris by pouring them then sterilizing for 45min @ 15psi. I left five petris uncovered inside the box for 10 minutes. One was covered after only five. All but one petri were showing contamination after three days, the last eventually became contaminated. The two control dishes that I made never showed any contamination. Ive done lots of 'sterile' work in still air box with great success. Thanks for the idea, but I would pass on this design.

adam west, Dec 13 2010

good creative hood
but mushroom project it so hard.

Chanachok Srangeaim, Oct 14 2010

it is a good hood Mushroom projects really are not that hard using a pressure cooker to sterilize your sub instead of just steaming it (steaming works ok if your using PF style Brown Rice Flour cakes but is worthless for grains)if your just starting off you prolly would want to start with a good clean Liquid culture/spore syringe from a established supplier so you can skip the agar steps until you have a little more experience/confidence also finding a good forum like shroomotopia.net is invaluable to anyone trying to get started in this rewarding hobby

MycoFreak, Feb 5 2011

The last portion of third section in Step 7 needs to be amended, "...resist the urge to touch any of the living material until you are re"
Until I am.. what?

brent, Oct 28 2011

Ready to harvest the mushrooms! Fixed. Thanks!

Goli Mohammadi, Oct 28 2011

I'm on step 7. When it comes time to fruiting, can I just remove the lids from the jars? I'll have them in a temperature and humidity controlled environment. Fun stuff!

In addition to the cloning procedure outlined, I'm experimenting with making spore prints and transferring spores to an agar plate. Also, I'm playing with an agar recipe called Malt Extract Agar (MEA):

10 grams light malt extract (available in homebrewing supply stores)

9 grams agar agar (finally found on Amazon)

500 ml potable or distilled water

I mixed the ingredients and then steamed for an hour.

chazthebeerman, Dec 9 2011
