MUSHROOM MOUNTAIN

Oyster Mushroom Growing Kit for Students & Young Mycologists

Thank you for purchasing an Oyster Mushroom Growing Kit For Students from Mushroom Mountain. We've included everything you will need to create miniature mushroom gardens in your home or classroom in just a few weeks.

The kit can be fruited for simple mushroom life cycle observation but also includes further interesting science experiments for teaching about the importance of mushrooms. If used sparingly there is enough mushroom spawn to do more than one experiment. The experiments are labeled by grade level and difficulty. It is best to start with the initial experiments and work your way up to the more advanced ones.

IMPORTANT OYSTER MUSHROOM FACTS BEFORE YOU BEGIN

- This kit contains a living organism.
- The spawn bag is sealed shut to prevent contaminants from entering and to prevent the mixture from drying out. Keep the bag sealed and only open the bag when you are ready to prepare for the experiment.
- Once you receive your kit, immediately store the spawn bag in the fridge. Failing to refrigerate it will force the mushrooms to fruit from the spawn bag and you will no longer be able to use it in your experiment. Do not freeze the bag as this will kill the living organism. If stored properly the mushroom spawn can last in the fridge for up to 6 months.
- Oyster Mushrooms colonize the substrate and fruit in temperature ranges of 60-85 °F
- ***Pleurotus Ostreatus*** (Latin name) are a choice edible mushroom and can be cooked and consumed once they have fruited from your experiment. Be sure that the water you use to pasteurize the growing substrate and water the mushrooms when they are growing is clean, potable water that is safe for consumption.
- If you are considering eating the mushrooms do not eat them raw, they need to be cooked to break down the chitin cell wall structure and make them bio available for human digestive uptake.

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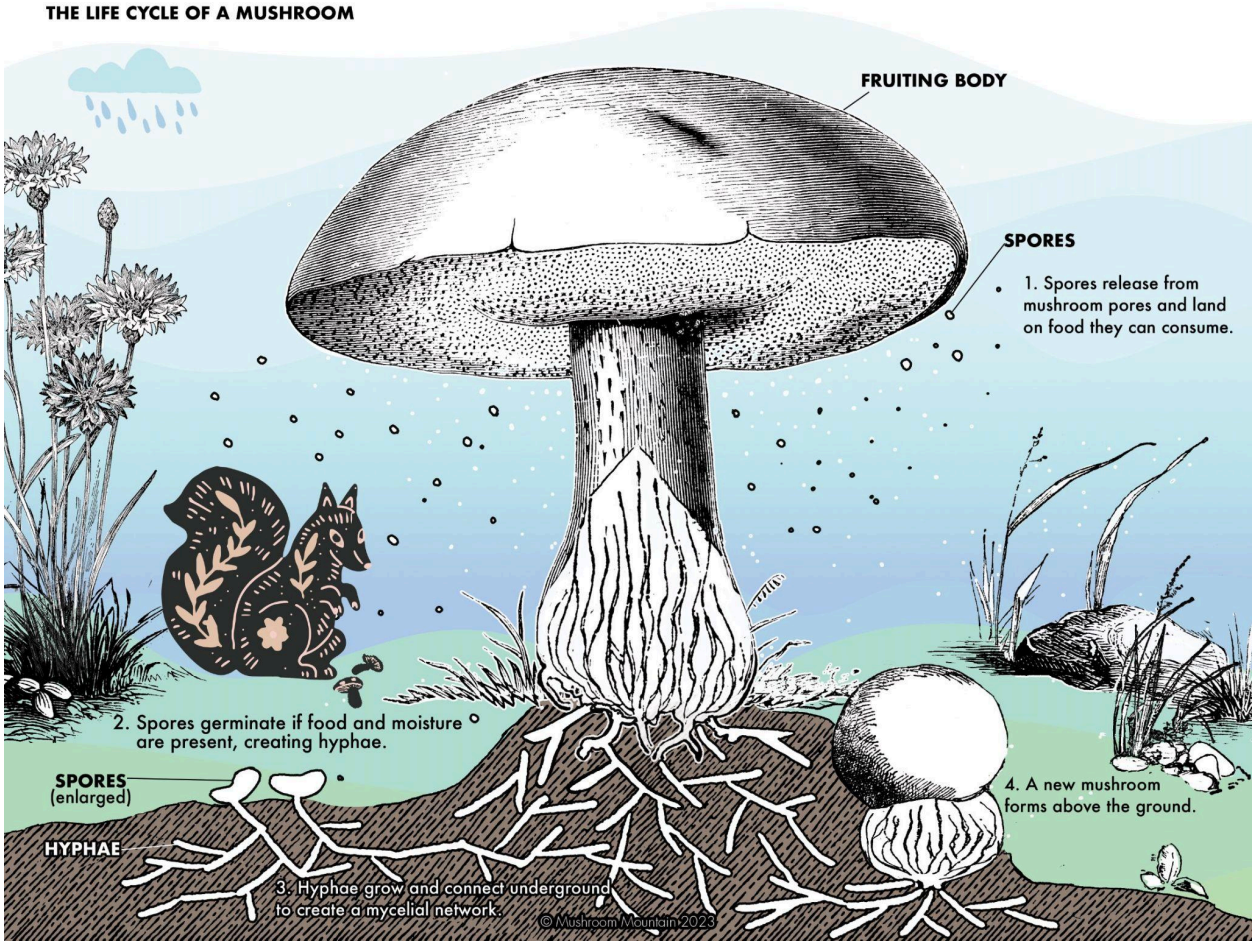
1. KIT CONTENTS

1. Oyster mushroom **SPAWN (**mushroom roots - 5 lbs)
2. Growing **SUBSTRATE** (cotton seed hulls - 3.5 lbs)
3. Clear cups (growing container - 25 count)
4. Domed lids with holes (humidity control and contaminant shield - 25 count)
5. Cotton balls (air exchange filter - 25 count)
6. Mixing bag for spawn and substrate - 1 count
7. Journal for experiment tracking - page 11 - make copies for each student.

2. INTRODUCTION - The Mushroom Life Cycle



Mushrooms can be grown from seeds also known as **SPORES,** that are released from the gills of a mushroom when it is ripe or mature. Mushrooms can also be grown from living mushroom roots called **SPAWN**. Much like the root system of a plant, **MYCELIUM** is the vegetative form of mushrooms. They can later grow “fruit” with a stem and a cap above the ground. The Oyster mushroom spawn in this kit contains a mixture of hardwood sawdust and some grain which was **INOCULATED** with mushroom spores. The mushroom spores feed on the grain and then on the sawdust. As they feed more and more, they start to create white strands of mycelium, which take over the entire bag of sawdust mixture. It becomes solid white if left alone for too long and will eventually fruit even in the sealed bag.

The sawdust spawn that you receive in this kit should have visible mycelium strands in it, however if it gets bumped around during shipment you might not notice them right away. In case you don’t see any white patches of mycelium, leave the bag out on your kitchen counter at room temperature - (60-85 °F) - for a couple of days and you will start to see the mycelium taking over again. Do not let it go too far and refrigerate again to slow down its process so that you can do multiple experiments.

The white strands of the mycelium are called **HYPHAE**. We usually do not see the hyphae or mycelium in nature. They are concealed under leaves, inside decaying trees and within mulch.

The mycelium is feeding on dead plant matter until it uses it up. When there is no food left, the mycelium begins to form a **FRUITING BODY** that produces spores (like seeds). The spores are then carried away by wind, animals and people to another location that hopefully has some decaying plant matter for it to feed on and start the cycle again.

In nature, the lifecycle of a mushroom can take up to several months. Cultivating mushrooms takes less time when one uses mushroom spawn. Mushroom spawn is the easiest way to grow mushrooms because half of the mushroom cycle has already happened. The mushroom spawn in this kit is a concentrate. If used sparingly it will take more time for the experiment to unfold. If you use more than the recommended amount, the mycelium will **COLONIZE** the growing substrate faster. If you do not use enough spawn other organisms such as mold or bacteria can outcompete the mycelium and prevent it from fruiting. If you use the recommended amount, the experiment will take between two to three weeks, provided there is enough light and moisture.

3. TOOLS AND MATERIALS FOR THE EXPERIMENT

- Sink and water
- Large pot and hot plate or stove
- Oven mitts or kitchen towels for handling hot objects
- Kitchen food thermometer
- Kitchen scale for measuring
- Fine mesh strainer / colander
- Misting bottle with potable water
- Measuring cup or measuring spoons
- Soap or hand sanitizer
- Aluminum foil sheets for spore prints

4. Grades K - 12 • Basic Experiment - Growing Oyster Mushrooms from Cups

Experiment overview

- Prep: pasteurize growing substrate
- Mix growing substrate and mushroom spawn together and add to cups.
- Fill out initial experiment journal
- Set cups in space accessible for observation
- Observe daily and fill out journal
- Do advanced experiments if applicable to student age group

PREPARATION FOR SIMPLE MUSHROOM GROWING EXPERIMENT

- For grades K - 8 we recommend an adult to prepare the growing media, which requires boiling and straining hot mushroom substrate / cotton seed hulls.
- To help avoid contamination, set up and start your experiment in a clean space and with clean hands.
- In order to give the mushroom mycelium a good chance for outcompeting contaminants and colonizing all of the growing media you supply, you will need to boil the growing

media to kill off any contaminants like bacteria and mold. This process is called **PASTEURIZATION**.

- Each plastic cup you plan on filling needs to have about 1 cup worth of growing substrate. For 20 - 25 students you will need to use all of the growing substrate (3.5 lbs)
- *Tip: Use 70% Isopropyl alcohol to clean your surfaces. Wait until the alcohol has dried before proceeding.
- Soak the growing substrate in hot water for 1 - 2 hours. The water temperature needs to be maintained between 160 - 180 °F.
- Using oven mitts or a kitchen towel, remove and drain the growing substrate into a clean fine mesh colander or strainer in the sink. Wait for it to stop dripping and until it's cooled down. Once it has cooled off, transfer it with CLEAN hands into the mixing bag provided with the kit. Close up the mixing bag with a twist tie to prevent contamination.

- Take the mushroom spawn bag out of the fridge and without opening, massage it until it is separated into small enough clumps that it will mix easily with your growing substrate. The smaller and more evenly distributed the spawn is, the faster and more evenly it will colonize the growing substrate.
- With clean hands and a clean measuring cup, measure out 1.5 cups of spawn, if you are doing multiple experiments and you are trying to use the spawn sparingly. If you are only doing one experiment you are free to use the entire bag of spawn. If spawn is left over, close off your spawn bag and return to the fridge.
- Open up the mixing bag and add the spawn. Twist the top of the bag and close it firmly with the twist tie. Gently but thoroughly mix the contents by massaging the bag back and forth until well combined.

STUDENTS COMMENCE EXPERIMENT

- At this stage you will be able to let the students work on the experiment.
    - With clean hands, have the students write their names on their lid and cup with a permanent marker.
    - With clean hands, measure out 1/2 cup of growing media and put it in the plastic cups. The mixture needs to be pressed down firmly to the bottom of the cup. If you end up with a bunch of growing medium still left over, create spare cups in case contamination occurs and someone needs a replacement cup.
    - Attach your lid to the top. Be sure to keep the cups upright so the mixture does not become loose.
    - Place a cotton ball into the hole of the lid, half way in so it sticks out. This will keep contamination out and still let the mushroom culture breathe.

- Using the worksheet, have the students fill out the initial experiment notes.
    i. Have students fill out their name and start the calendar as instructed on the journal sheet.
    ii. Draw and color the mushroom growing medium on the first diagram
    iii. Label the diagram with these words: FILTER, SUBSTRATE, CONTAMINATION SHIELD
- Gently place your cup in a safe place where it will not be disturbed. They should be in a well lit area or under fluorescent light, but not in direct sunlight.
- Each following day, with clean hands, observe your mushroom kit and **MIST** each cup **ONCE** by removing the cotton ball, bringing the sprayer to the hole and misting. Replace the cotton ball. **DO NOT OVERWATER**. If you notice water condensation in the lid, do not water any more. If you notice water build up in the bottom of the cup, remove the lid and drain the water. Replace the lid and cotton ball.
- Each day the students use the worksheet to mark the day that has passed with a blue **X** if they watered it, and with a black **X** if they didn't water it.
- The students should notice the change in color of the substrate as the mycelium starts to take over. Once all the substrate has turned mostly white, have the students mark the calendar with a yellow **X** and illustrate the change in the second image under the calendar.

- When the students observe small growth of white arm-like structures poking out of the top of the substrate they mark the calendar with a green **X**.

- Baby mushrooms will start to reach toward the cotton ball looking for more oxygen.
- When the mushrooms are close to reaching the cotton, remove the cotton ball completely. Once the cotton has been removed the mushroom can dry out pretty fast so be sure to mist the caps several times a day until they are fully grown. Mushrooms are fully grown when they stop doubling in size daily.
- Using the worksheet, have the students illustrate the mushroom. Label the parts, STIPE, CAP, GILLS
- Once the mushrooms are fully grown, the students can mark their calendar with a red **X** and pick their mushrooms by grasping the stem at the very bottom and twisting upwards away from the cup.

- The professor can collect the picked mushrooms and cook them with some oil or butter and salt for about 10 minutes on medium heat. Then the students can taste the mushrooms.
- This experiment can be repeated up to three times by replacing the lid and a new cotton ball filter and letting the cup sit and rest without watering for two weeks. After two weeks open the cup and completely fill the cup with water. Let it sit for one hour and then drain by tilting the cup. After two weeks, repeat the experiment by misting every day until new mushrooms grow.
- You can expect to repeat the experiment up to three times.

ADVANCED EXPERIMENT - Grades 4 and up: SPORE PRINT

- Spore prints can be made by cutting off the cap and placing its gills down, on a piece of aluminum foil. Cover up the cap by gently folding the foil over it leaving an air pocket inside, not pressing down. Leave this undisturbed overnight and open the next day. Gently remove the cap upwards (do not drag or smear it). Underneath you will find that the spores have dropped and created a mirror image of the gills.
- Spore prints can also be made from mushrooms collected in nature. Spore prints are often used as one of the markers to identify if mushrooms are safe for consumption. DO NOT CONSUME MUSHROOMS HARVESTED FROM THE WILD IF YOU DO NOT KNOW WHAT SPECIES THEY ARE, AS THEY CAN BE DEADLY.

ADVANCED EXPERIMENT - Grades 6 and up: BOTANICAL ILLUSTRATION

- Once the mushroom has been harvested the students can on a separate sheet do a botanical drawing of the whole mushroom, the underside of the mushroom and the cross-section of the mushroom.

ADVANCED EXPERIMENT - Grades 8 and up: RESPONSE TO LIGHT

- Mushrooms do not make their own food from the sunlight like plants do; a process called photosynthesis. They do react to light, bending towards it so they can use the light to make products such as pigments (cap colors) which are used to make their protein, natural antibiotics, and other molecules. Mushrooms grown in the dark will look different from mushrooms grown in light. Mushrooms have different properties depending on the environmental conditions such as light, air and nutrients. Mushrooms like bright, indirect light, like next to a window, but DO NOT like direct sunlight, so make sure the cups are not exposed too long to the sun. Fluorescent light is also good for mushrooms if no natural light is available. Once you notice the first baby mushrooms form, try growing a few mushroom cups in bright light and a few in total darkness. Measure what happens to the size of the mushrooms by using a small ruler. Draw and color the two groups and compare how each group is different. Only check the mushrooms growing in the dark once or twice a day to prevent them from extra light exposure or you will not see the differences between the groups.
- QUESTION: Why does a mushroom change color with available light.

ADVANCED EXPERIMENT - Grades 9 and up: GAS EXCHANGE

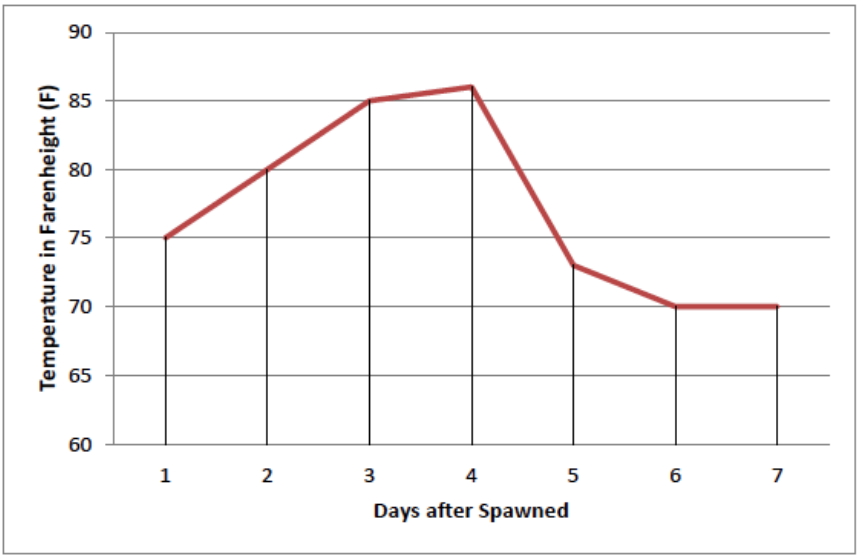
- Mushrooms need oxygen to breathe properly. This is why there must be a small air hole in the kit lid for them to grow properly. When mushrooms use oxygen, they exhale carbon dioxide, just like animals and people do. Placing mushroom cups in enclosed areas, such as aquariums or terrariums can also make the mushrooms look different.
- QUESTION: Are the stems longer or shorter in each group of cups? Why would a mushroom change its shape when the oxygen is different? Measure the length of the stem and the width of the cap. Compare the measurements to mushrooms grown with additional holes or when the cap is removed completely. Try growing a few cups in an empty aquarium and another group of cups in an aquarium that has a few small plants inside like a terrarium. The plants produce oxygen and need carbon dioxide, while the

mushrooms need oxygen and produce carbon dioxide. When the mushrooms fruit in these separate containers how do the mushrooms look different? Explain, draw or measure what you are seeing to describe the differences.

- QUESTION: Rate of stem elongation and growth. Measure the stem length or height of the mushrooms each day. Make a simple graph charting the growth of the mushrooms over one week once the mushrooms start fruiting.

ADVANCED EXPERIMENT - Grades 9 and up: TEMPERATURE GENERATION AND RATE OF GROWTH

- Questions and experiments: Temperature Generation (Thermogenesis)
  Measure the temperature of the growing media each day after you make the cups. Place the probe of a small digital cooking thermometer into the center of each cup at the same time each day. Keep track of the temperatures up until the mushrooms start to fruit so you can estimate how long it takes to grow mushrooms at specific temperatures. Placing cups at different temperatures or rooms can also change the rate of growth. Be sure to label the cups with numbers so you know which ones you are recording the temperatures for when making a graph. Take the measurements quickly through the breathing hole to avoid heat loss.



ADVANCED EXPERIMENT - Grades 9 and up: MUSHROOM ENZYME COLLECTION

- Once the growing media is colonized, make a shallow, smooth depression in the top by pressing in one finger and twisting it to a depth of about one inch. Allow the depression to heal over with mycelium so it makes a perfectly smooth cavity. Fill the hole halfway with a measured amount of distilled or purified water. This makes an observation pool where the mushroom's enzymes can accumulate and break down substances.
- Add small quantities of motor oil, household chemicals, herbicides, vegetable dyes, fertilizer, and any other substance that poses a risk for environmental concern. Measure the substances out equally for each module. Be sure to run a control of modules without the contaminant for comparison to eliminate any factors that could affect your results. Be sure not to tilt or spill the pool during the process.

- Observe any color changes or difference in appearance over several days to several weeks and record your observations. Fluid can be periodically removed in very small quantities and used for germinating bean seeds to act as a biological indicator species for toxicity. Do not consume any mushrooms produced from these experiments. Compost the contents of the kits outdoors when the experiments are complete.

ADVANCED EXPERIMENT - Grades 9 and up: VARIOUS SUBSTRATES AND MYCOREMEDIATION

- The sawdust spawn can also be expanded on different waste byproducts such as spent coffee grounds, cardboard, cotton clothing, and many other by-products of agricultural and industrial businesses.
- Try soaking any waste of interest in hot water for a few hours and then spawning it into a larger vessel such as a 5 gallon bucket or plastic storage bins.
- Interview and identify the waste streams at your home, school, or a local business to see what they are throwing away that can be composted using mushrooms. Write up a report and share the results.
- Discuss products that can be eliminated or changed to compostable products, such as asking principals, business owners to consider paper products instead of plastics. Coffee shops can be encouraged to save the spent grinds for you in a large bucket, making it easy to set up a composting system that produces mushrooms all in one!
- Weigh how much waste and see how much debris you can divert from entering your local landfill. Start a contest within the school or with other schools to see who can compost the most trash into soil that can be used at the school for landscaping or gardening projects.

OYSTER MUSHROOM FRUITING EXPERIMENT JOURNAL

STUDENT NAME: **DATE:**

1. On the calendar below, in the **MONTH** column, fill in the name of the month you started the experiment.
2. Mark the date you started the experiment with a red X.
- Every day when you check your experiment, fill in the calendar with the date in the small box, a blue X if you watered your kit, and a black X if you didn't need to water.
- Mark the calendar with a yellow X when the substrate turns white.
- Mark the calendar with a green X when a mushroom starts growing.
- Mark the calendar with a red X when the mushroom stops growing and you pick the mushroom.
- Wait for two weeks without watering.
- After two weeks soak, drain, and mark the calendar with a red X. Repeat the steps again.

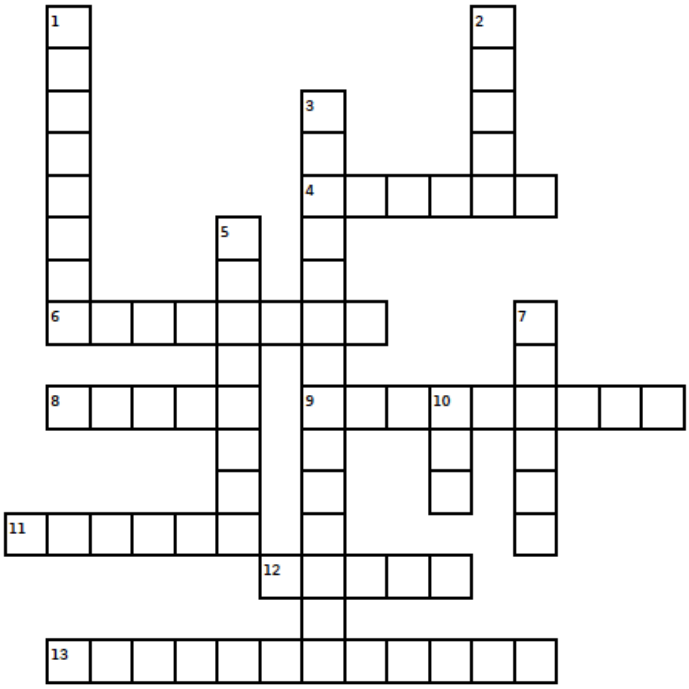
MONTH	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

Draw and color the substrate.

Draw and color colonized substrate.

Draw and color the mushrooms.

All About Mushrooms



Down:

1. Fungal growth with cap, stipe and gills
2. Stem of mushroom
3. Removing bacteria with hot water
5. Mushroom roots consuming plant
7. Air cleaning membrane
10. Dome of mushroom body

Across:

4. Mushroom seeds
6. A mass of mushroom roots
8. Prepared roots for growing mushrooms
9. Introduce a mushroom species to sterile growing media
11. Individual mushroom root sections
12. Where the spores are stored on mushrooms
13. Part of plant that grows and carries seeds

Crossword puzzle key - Down

1. Mushrooms
2. Stipe
3. Pasteurization
5. Colonize
7. Filter
10. Cap

Crossword puzzle key - Across

4. Spores
6. Mycelium
8. Spawn
9. Inoculate
11. Hyphae
12. Gills
13. Fruiting Body