The Effect of Environmental Factors on Mold Growth

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Topic

Growth of bread mold

Time

30 to 45 minutes preparation, 2 weeks of observation 15 minutes daily

Safety

Please click on the safety icon to view the safety precautions.
The experiment should not be performed by students with severe mold allergies. Bags containing moldy bread should not be opened, except for optional procedure 2. Be careful when cutting bread. Do not eat bread mold, and wash your hands thoroughly if you touch it.

Materials

- nutrient source for mold (bread, at least one type, depending on variables chosen)
- small notebook
- ruler
- scissors or knife
- zip-lock sandwich bags
- camera (optional)
- spray bottle
- microscope (optional)
- water

Procedure

1. On the first page of your notebook, make a list of the types of environmental conditions you think might affect mold growth. Your list might include temperature, moisture, bread type, or any other factor you think will have an effect.
2. Choose two or more of these factors. These will be your manipulated variables. Remember, when you are testing a variable, all other factors must be kept constant in your experiment. For example, an experiment to test the effect of moisture could be done using one wet and one dry sample, or using different measured amounts of moisture from a dry to a soaked condition. Figure 1 is a table of possible setups with a control. It's your choice how detailed you want your exploration of a factor to be.
3. Develop hypotheses based on your chosen variables. List these on page 2 of your notebook. For example, hypothesis 1: Mold will grow better in the dark than in sunlight.
4. You will need one half-slice of bread for each variable, as well as one half-slice of bread as your control. Be careful not to cut yourself when cutting the bread. Remember, all conditions must be kept constant with the exception of the

Figure 1

Table of Possible Variables					
Control	Moisture	Temperature	Source of mold	Bread type	Light
No light	No light	No light	No light	No light	Exposed to sunlight
Damp	Dry	Damp	Damp	Damp	Damp
Warm	Warm	Hot or cold	Warm	Warm	Warm
Airborne dust	Airborne dust	Airborne dust	Dust from room surface	Airborne dust	Airborne dust
Homemade bread	Homemade bread	Homemade bread	Homemade bread	Commercial bread	Homemade bread

Variables appear in bold boxes ▭.

variable being tested. If the type of bread is a variable, you will need two kinds: one for the test and one for all the other types tested.

5. Expose all the bread halves to a source of mold. You can do this by exposing the bread to the air for a few hours or by using the bread to lightly dust a surface in the room. If the source of mold is one of your variables, make sure that all other samples, including the control, use a different source: for instance, dust from another locator.
6. Using the spray bottle, moisten all of your samples with clean water. Make sure the bread doesn't get too wet and that you moisten all samples equally. If moisture is a variable, only those samples testing this condition vary—being dry, or wetter than all the others.
7. Place each sample in a separate zip-lock bag and seal it. Label each sample bag with the date and the variable being tested. Label the control as such.
8. Label the top of a separate page of your notebook for each sample. Choose relevant factors to observe, and list these in your notebook before you begin the experiment. Leave a few pages empty between each description for further records. This is your experimental journal. Make an initial observation about the appearance of each sample, and record this as shown in figure 2.
9. Place all your experimental samples in the same locations, unless a variable is location specific—-for example, in the dark or in the refrigerator. Remember, all conditions must be kept constant with the exception of the variable being tested.
10. Observe your samples daily, and record all observations in your journal under the proper sample heading. Always include the date and time you record your observations. When the mold begins to grow, measure the diameter of the affected areas. Be sure to check both sides. Record all visible data such as color, texture, layering, and any other factors you might find important.

Figure 2: Sample Journal Pages

Control: Date 3/12/90

a) mold source: dust from window sill

b) nutrient: white bread

c) moisture: yes

d) variable: none

Sample 1: (variable) Moisture Date 3/12/90

a) mold source: dust from window sill

b) nutrient: white bread

c) moisture: none

d) variable: see c above

Sample 2: Temperature Date 3/12/90

a) mold source: dust from window sill

b) nutrient: white bread

c) moisture: yes

d) variable: placed in refrigerator

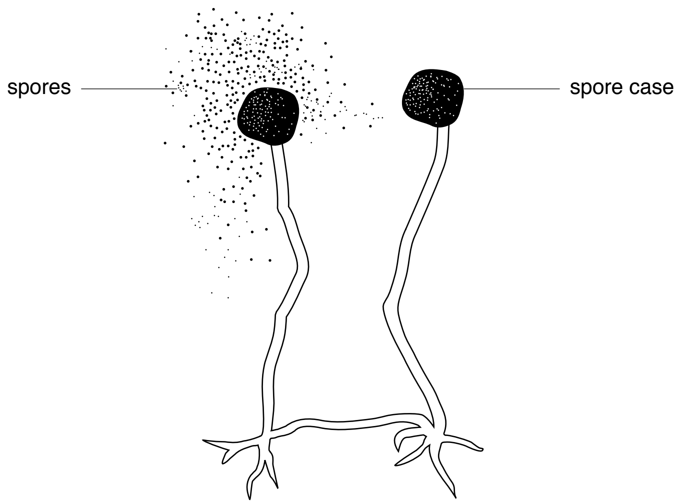
11. As the experiment progresses, compare your experimental samples with your control sample, always keeping in mind your hypotheses. Record any pertinent points along the way. At the midway point in the experiment (end of the first week), check your hypotheses and see whether they're holding true, but remember that results can change in a few days, so don't make any decisions yet.
12. At the end of the 2-week period, gather together all of your samples and notes and make your final observations. Now go back to your hypotheses and find out from your data which match your findings and which need to be changed based on your current data. Make a chart that lists the experimental variables, your hypotheses, and the final results of your experimentation. Dispose of the samples in their plastic bags.

Optional Procedures

1. In order to provide documentation of your results and enhance your journal, you can keep a photographic record of this experiment. Every few days, starting when mold first appears, take photographs of your samples. Be sure to record the dates when you photograph and the number of each photo under the proper listing in your journal, so that you know which photograph corresponds to which mold sample and at what point in its growth.
2. If you have access to a microscope, when the experiment is finished take a small sample of each mold and place it on a microscope slide, add a drop of water, and cover this with a cover slip. Observe this specimen under the microscope. Draw

in your journal what you see, and write descriptions to go with your drawings. Compare the structure of different colors and types of molds, comparing samples grown with different variables. Try to identify the spores and spore cases, as well as the part of the mold responsible for decomposition (see figure 3).

Figure 3



3. Based on your results:
   a. Which combination of conditions will allow optimal mold growth?
   b. Which combination of conditions will prevent or slow mold growth?
4. How many different varieties of mold did you grow, and how can you identify them?
5. Why do you think it was possible for you to grow your mold without any special seed or spore kits?

What's Going On

The answers to both questions 3a and 3b will depend on the variables chosen for your experimental samples; however, some general statements can be made. Optimal growth will take place in an environment that is dark, moist, and warm. In order to prevent mold, it is best to have an environment with extremes of hot or cold, plenty of light, and a lack of moisture. Refrigeration is one way of preventing mold, as is heating a substance. Heat kills fungi, and cold either slows molds down to a state of dormancy or kills them. Preservatives are another way of preventing mold growth. A preservative is a substance that will not allow mold to grow.

You may have noticed over time that some of your results became more similar. This is because as molds grew in your samples, conditions that started as very different are now stabilized. This is why it is so important to keep records on a daily basis. The amount of varieties present will vary with different environments and variables. You can identify the different varieties by counting how many different colors of mold there are. This will tell you how many different varieties you've grown. Spores travel through the air. When you dusted an area of your lab, the dust contained a high concentration of spores. If you left a sample out in the air for a few hours, you collected spores floating through the air. The concentration of spores in the air at any given moment is not as great as that in a pile of dust. This is why the sample had to sit out so long, and also why that sample probably did not grow as much mold as a dusted sample.

Connections

Yeast, mold, and mushrooms are all types of a life-form called a *fungus*. These plantlike organisms cannot manufacture their own food and must therefore live within or on other organisms. A fungus breaks down the body of the plant or animal it lives on, turning it into starch or sugar that the fungus can absorb. This process, called *decomposition*, provides the fungus with the energy necessary to survive and reproduce. A fungus reproduces by forming reproductive cells called *spores*. When the spores settle on a proper medium for their nutrition, they begin to grow and to decompose it. Some types of fungus are very useful, providing foods and medicines, such as blue cheese and penicillin. Others can cause diseases—for example, ringworm and athlete's foot—or are poisonous, like certain types of mushroom. In this experiment, you determined what conditions optimize growth in bread mold and what conditions slow or prevent growth.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES