M O L D S

Molds are the common name for a group of fungi often characterized by the presence of threadlike filaments, called hyphae, that mass together to form mycelia, vegetative bodies that resemble cotton. Some molds, however, such as the SLIME MOLDS, are more amoeba-like and form multinucleate masses of protoplasm called plasmodia. Molds grow over many surfaces, such as wood and food, and thrive best in warm and moist condition. Many, however, do well at freezing temperatures, presenting problems for refrigerated foods.

Perhaps the most widely studies mold is the familiar bread molds, Rhizopus nigricans, which appears on bread that has been moistened, exposed to air, and placed in a warm, dark place. Bread molds have different types of hyphae. Those that spread along the surface are called stolons. At intervals along the stolons, clusters of shorter hyphae, called rhizoids, extend down into the food supply and secrete enzymes that break down sugar and starch into digestible food. The rhizoids absorb the food, and water as well.

Molds can reproduce both asexually and sexually. To produce asexually, some molds develop special reproductive hyphae (sporangiophores), which extend into the air. Black knobs, or spore cases (sporangia), appear at the ends of these hyphae after a few days. When mature, the sporanzia break open and release their spores, which will germinate if they reach a suitable environment. Sexual reproduction is accomplished through a form of conjugation. Two different mating types of hyphae, termed plus and minus, form short, specialized side branches. If the tip of a plus branch meets the tip of a minus branch, conjugation occurs. Each tip becomes a gamete cell, with two fusing to for a zygote. The zygote matures into a zygospore, which may germinate after one to several months if conditions are favorable.

Some molds, like water molds, live on the bodies of dead insects and other animals in the water. Others are parasites, invading the tissue of living animals. Molds of the genera Aspergillus and Penicillium often referred to as MILDEW, appear on food and form characteristic growths. Several species of Penicillium have economic value. Some are used in cheesemaking, in which enzymes secreted by the mold give the cheese its flavor. Another species produces the antibiotic PENCILLIN.

Mold is growing on bread that was left in a warm, dark, damp place. Molds are the common name for a group of fungi which often have threadlike filaments, called hyphae.

Bibliography: Christensen, Clyde M., Molds and Men: An Introduction to the Fungi, 3d ed. (1965), and Molds, Mushrooms and Mycotoxins (1975); Dube, H. C., An Introduction to Fungi (1983); Moore-Landecker, Elizabeth, Fundamental of the Fungi, 3d ed. (1990).

Name: _____ Date: _____

BREAD MOLD PROJECT INTRODUCTION

You can learn more about bread mold (a type of fungi), more about the scientific method, and get some hands-on experience designing, conducting, and analyzing a *controlled* experiment all at the same time. Here's how: by growing mold on two slices of bread over the next two weeks and then writing up the results of this experiment as a scientific lab report.

You will need two slices of bread, some water, another substance of your choice (this is the "variable" of this experiment), two zip-lock baggies, a safe room temperature environment in which to store your molding bread slices as this experiment unfolds, your lab booklet, and enough personal responsibility to keep yourself checking and recording data on the experiment **each day** for the next **15 days**.

Set-up Procedure:

- Put both slices of bread onto a counter and leave them exposed to the air for an hour or two. This should allow enough time for microscopic spores present in the air inside your house to land on the bread.
- Next, sprinkle or spray each slice with enough water to thoroughly dampen the bread's surface. That will enable the spores to grow and reproduce.
- Slip one slice into a zip-lock bag (this is the "control" of your experiment).
- Now saturate the other slice with your chosen substance (the "variable").
- Slide it into the other zip-lock bag. Be sure you've labeled each bag "control" or "variable".
- Store both the control and the variable in a safe, room-temperature location.
- Observe both slices every day for the next 15 days, recording any changes you note. **Be specific** when recording your observations in the data table you've set up in your lab booklet. Note changes in the % of mold, its smell, color, and the bread's texture. When mold (usually visible as a color change) grows, you will need to develop a system for estimating the % of bread it covers. Think about that now! How will you get an accurate estimate? Remember, when you are recording your data, **be specific**!

BREAD MOLD EXPERIMENT

Over the next two weeks you will be conducting a bread mold experiment at home. It will involve daily homework of about 5 minutes for the entire two weeks. Keep this sheet in a safe place. It will help you with the rough draft of your lab report. The following pieces need to be part of your lab report.

Testable Question: What question are you going to try and answer with this experiment? Make sure you have only one variable to test! Some examples might include: Does mold grow better in the dark? Will mold grow better on white or wheat bread? Will wheat bread soaked in lemon juice grow mold better than wheat bread that has just been sprinkled with water?

Hypothesis: What do you think the answer to your question will be prior to beginning the experiment? You'll need to do some research to help you figure this out. Mr. B's mold research packet and web site, along with your own "key word" Internet searches, should help you out with that. Questions to answer during your research should include: What does mold need in order to grow well? What ingredients are in your variable (read the label)? Would any of these ingredients help/hurt mold growth? Develop some logical reasoning *based on research* to back up your hypothesis!

Materials: Make a list of the type and amount of each ingredient or item that you use to set up, observe, and record data for your experiment over the entire two weeks (yes, even the room temperature environment where you store your bread slices and the lab booklet and pencil you use to record your data!).

Procedure: Write an introductory paragraph that explains when, where, and why you are conducting this experiment. List each step you took to prepare the experiment. Be specific and include the types and amounts of ingredients that were used. Also, write down how often you made observations and what factors you checked and recorded during a typical observation. Be detailed enough so anyone could repeat both your set-up and a typical observation.

Observations (data): Observe your experiment for 15 days and record what you see, smell, and notice. Be specific by estimating and describing the **size** (in % of the bread that's covered by mold), **color**, **smell**, and **texture** of your control and variable bread slices each day (even over the weekend). ***To record your data in the lab booklet, I'd suggest a table with each of these characteristics as table headings.***

Conclusion: What answer can you give to the testable question you developed at the beginning of the experiment? What data do you have to back up that answer? Does it agree or disagree with your hypothesis you wrote? Write down any logical thoughts or reasoning that might explain the results (data) you obtained. Did anything you *didn't plan on* occur during the course of your experiment that causes you to doubt the reliability of your results? Explain what happened and why this may have altered your results. If the experiment ran smoothly and you trust your data, state that! Beyond the answer to your original question, what have you learned about mold and its growth during this experiment? What further questions about mold growth or mold in general do you still have lingering in your mind now that the experiment is over? ***All seven of these questions*** must be addressed for your conclusion to be complete!

Table of Bread Mold Observations Something vs. Something								
Date	Control % of Bread	Experimental % of Bread	Control	Experimental	Control Smell	Experimental Smell	Control Mold Color	Experimental Mold Color

Bread Mold Lab Report Conference Sheet

*** Double check to be sure you have all of the following components included in your lab report. Then have a peer or a parent read your lab report to offer you any advice on how to improve the style, content, and grammar of each area.**

Question: 1. clearly worded 2. answerable by conducting an experiment 3. control & variable specifics are stated 4. only one variable is used	
Hypothesis: 1. clearly worded 2. makes logical sense 3. multiple pieces of reasoning given shows research/thought	
Materials: 1. used to set up experiment 2. used during observations 3. Types & amounts stated	
Procedure: 1. intro tells when, where, why experiment was done 2. set-up steps listed 3. includes types & amounts of materials used 4. data collection steps explained 5. enough detail so reader could repeat the set-up & data collection	
Observations: 1. all 15 days present (dated) 2. each date has specific details: %	

of mold, smell, color, bread texture for control-variable 3. data table is accurately titled & labeled 4. line graph is accurately titled, labeled, & plotted	
Conclusion 1. answer to testable question is provided 2. data evidence is given to back up answer 3. agreement or disagreement with hypothesis is given 4. logical reasoning given to explain results of mold's growth 5. discussion about reliability of data is given 6. explains what was learned (beyond answer to testable question) 7. raises further questions about mold	

Have you used complete sentences where needed? Have you used numbered or bulleted lists where needed? Have you double-checked your spelling? Have you said everything you need to say in a clear manner? Is your final copy neat? Have you labeled each section with a bold heading? Are the sections in the proper order? Do your data table and graph each have an accurate title and are the categories and the X & Y axis labeled? Did you proofread to make sure this is your "best" work?

Name of Scientist:_____ Date: _____

Bread Mold Lab Report Evaluation

Question: (Related to growth of mold, Clearly stated/worded, Can be answered by conducting an experiment over time, Provides specific control & variable info., Contains only one variable,)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

Hypothesis: (Prediction is clearly stated/worded, Two pieces of logical reasoning are provided to back up the prediction.)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

Materials: (Complete list: including *types and amounts* of materials used to set up experiment, Materials used to make observations during experiment also provided.)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

Procedure: (Intro paragraph) establishes context/purpose. Complete directions, step-by-step, including *types and amounts* of materials used to set up the experiment. Specific description of what you did during an observation, including the factors checked & recorded. Written in enough detail to enable reader to repeat the set-up procedure and the daily observation procedure on his/her own)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

Observations: (Contains all 14-15 days of data in a neat table. Each day is dated and labeled "control" & "variable". Specific details (% of mold, color, smell, bread texture) recorded each day on the table. Graph of mold growth (% for control vs. variable) is neat, complete, accurate, and has an informative title. The X & Y axis are correctly labeled and numbered.)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

Conclusion: (Includes the answer to your testable question, evidence/data to back up answer is provided, a statement about agreement or disagreement with your hypothesis is given. The explanation behind your mold growth results shows logical reasoning. You evaluate the reliability of your data. You reflect upon what you've learned through this experiment *beyond the answer to your testable question.* You raise further questions to consider concerning the experiment or mold growth in general.)

	All Criteria Met			Totally Missing
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

G.U.M.S. (Word-processed, Each section labeled, Sections appear in the proper order, Everything is spell-checked, Written in complete sentences or numbered/bulleted lists where appropriate, Few errors in grammar, word use, and mechanics, Table of data is neat and properly titled & labeled, Line graph is neat and properly titled and labeled)

	All Criteria Met			Rough draft only
Extends mastery 4	**3 Proficient**	**2 Somewhat**	**1 Well below proficient**	**0**

I. Literacy Standard 4b, 4c, 4d, 5a, 5b: Writing a Scientific Report/Writing a Procedure

4b (Focus/Purpose)

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

4c (Organization)

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

4d (Details/Elaborations)

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

5a, b (Grammar, Usage, Mechanics, Spelling)

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

II. Science Standard: Nature of Science 1 – Formulating Questions & Hypothesizing

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

III. Standard: Nature of Science 2 – Planning & Critiquing Investigations

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

IV. Standard: Nature of Science 3 - Conducting Investigations

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

***V.* Standard: Nature of Science 4 – Developing & Evaluating Explanations**

Extends mastery 4 *3 Proficient* *2 Somewhat* *1 Well below proficient*

Dear Parents,

For the next two weeks your child will be conducting a mold experiment at home. This will involve placing two pieces of bread into plastic bags (zip-lock would be best) and allowing the bread to mold. Your child will be expected to set up the experiment and record daily observations on its progress for a period of 15 days. We will then be working on analyzing and writing up the results of the experiment here at school. Your knowledge and supervision of this endeavor is crucial to its success. Please do not accidentally throw away the experiment while it is in progress. Please do remind your child to make her/his daily observations on the worksheet, which should accompany this letter. Help him/her to keep the assignment and these directions in a safe place. Sign the attached slip to let me know your child has discussed the experiment with you and have her/him return it to me at school. Thanks for your cooperation!

Ms Crumby
& Ms. Harris

My child_____has shown me this letter, and I agree to help them out as needed to complete the two-week experiment outlined above.

PARENT SIGNATURE: _____