**Moldy Bread**

**DESCRIPTION & OBJECTIVES:**

Microbiota in our living environment can be cultured as they grow on bread slices. By observing microbial growth on bread over time, the activity will help reveal the effect of moisture and temperature on mold growth.

**GRADE LEVELS:**

Elementary School, Middle School, and High School

**NEXT GENERATION SCIENCE STANDARDS:**

Disciplinary Core Idea:

2/5-PS1.A Structure and Properties of Matter, MS/HS-PS1 Matter and Its Interactions

Performance Expectations:

5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.

[To be furnished]

Practices: Developing / using models, Planning / carrying out investigations

Crosscutting Concepts: Cause and effect: Mechanism / explanation

**OUTCOMES:**

To gain a general understanding of:

* The presence of microbiota in our living environment
* Effect of moisture on mold growth.
* Effect of temperature on mold growth.

**CONTACT:**

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**Moldy Bread**

**MATERIALS:**

* Bread slices (white bread is recommended for better mold growth and notable visual changes)
* Water
* Zip-lock bags (ideally freezer bags for better moisture retention)
* Labeling tape
* Marker
* Camera (e.g. on a phone)

**DIRECTIONS:**

**Inoculating bread slices:**

1. Divide 12 slices of bread into 3 groups: Dry, Moist, and Wet. Each group will have 4 slices
2. Swab slices of bread on 3 different surfaces, with each surface swabbed by one slice from each group. Each group should also have a “control” slice which is not swabbed on any surface. Examples of surface include hands, cellphones, kitchen sink, toilet cover
3. For the Wet Group, submerge slices of bread under water for 3 seconds, then recover the slice
4. Sprinkle ~1 tablespoon of water on each slice of bread for the Moist Group, while keep some slices of bread dry for the Dry Group
5. Put each slice of bread inside a zip-lock bag, and label the bag with moisture level, surface swabbed, and starting date. Seal the zip-lock bags and tape the opening for improved seal.
6. Instruct class to keep the samples under refrigeration (40 °F) or warm conditions (80 °F, e.g. behind a fridge)

**Observations:**

1. Take a picture of the sample each day, over 10 days
2. Discard sealed zip-lock bags at the end of the experiment. **DO NOT OPEN THE BAGS**.

**HELPFUL HINTS:**

* Try not to use bread slices at the ends of a loaf
* Mold spores can be hazardous, and thus zip-lock bags should remain sealed throughout the experiment

**EXPECTED RESULTS:**

* Higher moisture and temperature facilitate mold growth
* Inoculating bread with environment microbiota accelerates mold growth
* Microbiota vary depending on the surface swabbed

**EXPERIMENT QUESTIONS**

**Basic Level**

Which sample has the most pronounced mold growth?

Teacher’s notes: High moisture level and warm temperature favors mold growth. Mold growth can be retarded by low temperature and low moisture.

How do mold affect human health?

Teacher’s notes: People with allergies may be more sensitive to molds. People with immune suppression or underlying lung disease are more susceptible to fungal infections. Individuals with chronic respiratory disease (e.g., chronic obstructive pulmonary disorder (COPD), asthma) may experience difficulty breathing. Individuals with immune suppression are at increased risk for infection from molds. If you or your family members have these conditions, a qualified medical clinician should be consulted for diagnosis and treatment.

**Advanced Level**

How do molds reproduce and grow? Why didn’t see these colonies on surfaces I swabbed on?

Teacher’s notes: Mold spores produced by a mold colony can be attached to a surface while not germinating unless favorable conditions are met. Bread slices are rich in biodegradable carbohydrates (e.g. starch) and proteins that can be readily metabolized by mold colonies.

What are those molds?

Teacher’s notes: Microbiota in our living environment is highly complex and can contain thousands of different microorganisms. Common mold organisms include Aspergillus, Penicillium and Stachybotrys.

**REFERENCES**

“Basic Facts about Mold and Dampness” by US CDC, <https://www.cdc.gov/mold/faqs.htm>