

# Is This Building Making Me Sick?

## **Curriculum Design By:**

Cynthia Kaye Cook  
Murrah High School  
1400 Murrah Drive  
Jackson, MS 39202  
[ccooksped@aol.com](mailto:ccooksped@aol.com)

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Dr. Larry McDaniel, Department of Microbiology  
University of Mississippi Medical Center  
Jackson, MS

## Is This Building Making Me Sick?

### Table of Contents:

<b>Page Number:</b>	<b>Contents:</b>
4	Introduction/Background
5	Overview/Student Objectives
6	Student Outcomes/Time Requirements
7	Preparations (Materials and Procedures)
8	Implementation of Research (Day 2-5)
9	Sample Complaint Letter
10	Sample Complaint/Symptoms 1-2
11	Sample Complaint/Symptoms 3-4
12	Sample Complaint/ Symptoms 5-6
13	Sick School Sample Survey 1
14	Sick School Sample Survey 2
15	Cont.
16	Sample Results
17	Inoculation of Plates
18	Identification of Fungi
19	Cont./Optional Yeast Study
20	Identification Key
21	Colony Description
22	Observation Sheet
23	Student Expectations/Results/Assessment
24	Rubric
25	<b>Student Section</b> /Background Info
26	Materials
27	Procedures
28	Inoculation/Identification
29	Making Stained Slides
30	Observation Sheet

**Teacher guide:***I. Introduction:*

According to educational research literature, learning is enhanced in the science classroom with “hands-on” activities linked to real-life situations. The purpose of this activity is to demonstrate one method of enhancing traditional teaching methodology with “hands-on” examples. Immunology and/or Microbiology units for grades 7-12 will be targeted. However, this unit can easily be adapted to accommodate lower grades. Students will benefit from these methodological approaches by analyzing, synthesizing, and evaluating, which are essential to understanding and appreciating the content information presented and how it relates to real-life situations.

*II. Background:*

An **immune response** activates a number of molecules that attempts to remove **antigen** by inducing a localized **inflammatory response** without causing extensive tissue damage. However, this inflammatory response can cause significant tissue damage or even death. These reactions are termed **hypersensitive or allergic reactions**. Hypersensitive reactions can develop in the course of either a **humoral or cell mediated response**. Reactions within the humoral branch are initiated by **antibody or antigen-antibody complexes** and are termed immediate hypersensitivity reactions because the symptoms manifest within minutes or hours following exposure with antigen by a sensitive recipient. The humoral branch involves the interaction of **B lymphocytes** or **B cells** with antigen which subsequently leads to proliferation and differentiation of B cells into antibody-secreting cells called **plasma cells**. The secreted antibody binds to antigen produced by a foreign agent (viruses, bacteria, parasites, fungi, etc.) either neutralizing it or facilitating its elimination. Reactions within the cell-mediated branch are initiated by **T lymphocytes** or **T cells** and are referred to as delayed-type hypersensitivity reactions in reference to the delay of symptoms for days following exposure. **T helper cells** and **cytotoxic lymphocytes** are the effector cells within the cell-mediated response. Low molecular weight proteins, **cytokines**, secreted by the T helper cells activate various phagocytic cells thus facilitating the destruction of foreign agents (viruses, bacteria, parasites, fungi, ect.).

Several types of hypersensitive reactions can be distinguished. **Type I reactions** produce conditions ranging from serious life-threatening reactions, such as asthma, to hay fever, which is merely annoying. Common antigen associated with Type I hypersensitivity includes plant pollen, drugs, foods, insect venoms, mold spores, and animal hair. These antigens, capable of stimulating Type I hypersensitivity responses in allergic individuals, are termed **allergens**. Most allergic responses occur on mucous membrane surfaces and in response to allergens that enter the body through inhalation or ingestion. An example of a common allergen, ragweed pollen, a major pollen allergen in the United States, has been found to contain a variety of allergic substances that mount a Type I response in 95% of ragweed sensitive individuals. This condition is also prevalent in the allergens associated with other biological contaminants. **Type II reactions** involve antibody mediated destruction of cells. This type of reaction is characterized by blood transfusion reactions, hemolytic disease, and various autoimmune reactions. **Type III reactions** involve the reaction of the antibody with antigen that generates immune complexes

and facilitates the clearance of antigen by phagocytic cells. This type of hypersensitivity can lead to tissue damage and include autoimmune disorders such as systemic lupus and Rheumatoid arthritis. **Type IV reactions** involve the cell-mediated branch of the immune system in which antigen activated T cells induce the release of cytokines. The release of these proteins could cause the accumulation of toxins and result in tissue damage possibly in the form of skin lesions.

The term “**sick building syndrome**” is used to describe situations in which building occupants experience acute health problems that appear to be linked to time spent in a building. The complaints may be localized in a particular room or area, or may be widespread throughout the building. According to current investigations, these conditions are not only found in older buildings, but also exist in new or remodeled buildings. These building conditions most often are subject to complaints related to indoor air quality. Often, the quality of air in buildings becomes restricted due to inappropriate building design.

Indicators of Sick Building Syndrome include headache, eye, nose, throat irritation, dry cough, dry-itchy skin, dizziness and nausea, difficulty in concentrating, fatigue, and sensitivity to odors. Most of the complainants report relief after leaving the building. One major contributor of Sick Building Syndrome is inadequate ventilation. Inadequate ventilation can occur if heating, ventilating, and air conditioning systems do not effectively distribute air to occupants in the building. Other contributors to Sick Building Syndrome include biological contaminants. **Bacteria, mold spores, pollen, and viruses** are a few of these contaminants. They may breed in stagnant water that accumulates in ducts, drain pans, or other places capable of collecting water. Physical symptoms associated with biological contamination include cough, chest tightness, fever, chills, muscle aches, and allergic responses such as mucous membrane irritation and upper respiratory congestion.

**One goal of a building investigation is to identify and solve indoor air quality complaints in a manner that prevents reoccurrence and avoids the creation of future problems. To achieve this goal, it is imperative that the investigator discover whether a complaint is actually related to indoor air quality, identify the cause, and determine the most appropriate corrective measure.**

### *III. Overview:*

The purpose of this unit is to incorporate a “hands-on” inquiry based approach into traditional teaching methodology. An emphasis will be placed on Immunology and Microbiology. The concepts covered in this unit will include a survey of allergens associated with sick building syndrome. The laboratory investigation will consist of techniques commonly used to isolate and identify one particular biological contaminant, mold spores. Students will be expected to conduct background research in the relevant areas of immunology and microbiology. With information collected from numerous sources, the student will analyze the problem, construct and propose a method of researching the problem, and select an appropriate resolution if a problem is found to exist.

*Even though the information in this curriculum exists from another location, a hypothetical situation should be designed to incorporate the content into any location. For example, teachers within a given school are experiencing symptoms that are consistent with sick building syndrome. The initial investigation might involve the incorporation of the information included (complaint letters, surveys, ect.) or a creative design with the investigators own personal touch.*

*IV. Student Objectives:***The student will:**

1. **Read** hypothetical complaint letters from teachers of the school and discuss the possible causes for the symptoms exhibited.
2. **Define** the following terms: Immune response, humoral response, cell mediated response, antigen, antibody, antigen-antibody complex, hypersensitivity, allergen, biological contaminant, sick building syndrome, B cells, T cells, plasma cells, T helper cells, cytotoxic lymphocytes and cytokines.
3. **Conduct** background research utilizing Internet sources:  
*<http://www.pta.org/programs/envlibr>*  
*<http://www.a-o.com/aegis>*  
*<http://www.epa.gov/iaq>*
4. **Determine** factors that contribute to sick building syndrome from the Internet research
5. **Construct** a method for researching the problem based on information gathered from Internet sources of current methods or from microbiology laboratory texts.
6. After careful investigation and discussion, **select** an appropriate resolution if a problem is found to occur.

*V. Student Outcomes:***After completion of this unit, the student will:**

1. **Recall** information associated with the immune response and relate it to not only sick building syndrome, but also other similar situations.  
*Example: Legionaries, Tuberculosis, Ebola, etc.*
2. **Examine** other situations and make proposals for specific types of research conducted.  
*Example: Symptoms surveys, Environmental situations, etc.*
3. **Select** an appropriate approach to the resolution of similar problems based on standards or criteria.  
*Example: Order of operations from problem detection to resolution.*

VI. *Time Requirements:*

**Schedule:**

1. Regular schedule, 55 minutes, 10 days.
2. Block Schedule, 90 minutes, 6 days.

VII. *Preparation:*

**Materials and Procedures for Implementation**

A. Suggested Number of students:

This investigation can be adapted to accommodate 1-25 students working individually or in small groups. If cooperative learning groups are chosen, it is imperative to make sure all students are assigned specific tasks that will lead to the successful completion of the investigation.

B. Materials:

*Information Research:*

Internet-capable computer  
printer  
periodicals  
complaint letters

*Experiment:*

petri dishes  
Sabouraud growth media  
hot plate  
electronic balance  
weighing paper  
spatula  
microscope  
microscope slides  
cover slips  
sharp pointed scalpels  
cotton blue stain or similar stain  
cotton swabs  
zip-lock bags (sandwich)

C. Procedures:

*Day 1:* **Discuss** the immune response as it pertains to the hypersensitive reaction Type I. Describe conditions associated with Type I hypersensitivity, especially as it relates to sick building syndrome.

**Define** the following terms: Immune response, humoral response, cell mediated response, antigen, antibody, antigen-antibody complex, hypersensitivity, allergen, biological contaminant, sick building syndrome.

**List** possible contributors to sick building syndrome.

**Evaluate** the teacher complaint letters.

**Identify** the possible causes the complaint/symptoms.

**Review** standard procedures for collecting background information utilizing the Internet and library.

**Collect** information from the Internet and the library.

*Day 2:* **Assign** students to cooperative learning groups. Each student in the group should have a specific contribution. *Examples might include Researcher, Recorder, and Presenter.* Each group will **produce** a proposal for further study based on the results of the library search. The students will **present** their proposal to the class and **submit** a copy in writing.

**Establish** a class research proposal based on student findings.

**Generate** a letter requesting permission to conduct research in the school and submit it to the school administrator for approval. (*See sample letter*)

### *Day 3:* **Implementation of Research**

**Design** teacher survey based on symptoms related to sick building syndrome, make copies and distribute to teachers. (*See sample surveys*)

*Day 4:* **Collect** surveys from teachers.

**Analyze** the surveys for patterns consistent with sick building syndrome.

**Develop** a data table reflecting the patterns. (*See Sample Data Table*)

**Isolate** possible “hot-spots” or areas of the building displaying the greatest frequency of patterns associated with sick building syndrome.

*Day 5:* **Draw** a map of the school indicating possible “hot spots”. (*Bulletin Board Paper can be used*)

**Discuss** the possible causes for these areas. (*Examples: inadequate air ventilation, mold, mildew, other*)

## Sample Teacher Complaint Letters

Memo to: Dr. Mott

From: Faculty group at Murrah High School

Date: September 21, 1998

Re: Air conditioning system, old wing

As faculty teaching in the old wing of Murrah High School, we are very concerned about the air conditioning system and the hazards it is bringing to our health. Ms. Wilson has been very responsive to our needs, reporting our complaints to JPS since last year. JPS has changed the filters on air conditioners in individual rooms. This has not helped.

It is our belief that the system (air ducts, vents, etc.) needs to be cleaned of mold and any other irritants. Collectively we have had numerous sore throats, laryngitis, sinus infections and breathing difficulties. In order to try to cope, we have taken antibiotics, used nasal sprays, placed cheesecloth over vents to try to catch the irritants, and sprayed disinfectant over the vents. The problem still exists. There is enough of a track record for us to know that it is indeed the air conditioning system which is causing the problem. We are not sick when we are at home for extended times, and we are not sick when individual room units are turned off for a time. One of us taught in the new wing for two years and did not experience any problems until moving to the old wing.

To assist us in teaching in good health and good attendance, we are asking for your assistance as soon as possible. Our individual reports are attached. Thank you for your concern.

T. Moore *T. Moore*  
B. P. Williams *B. P. Williams*  
D. Cain *DeLange Cain*  
K. Redhead *K. Redhead*  
S. Dickson *A. Dickson*  
L. Hardy *L. Hardy*  
C. Ellington *C. Ellington*

## Complaint/Symptoms #1

Since teaching in the old wing beginning in the fall of '97, I have been plagued with sinus infections and extreme laryngitis. I have been on numerous antibiotics and steroid nasal spray. I got my first infection after school begin in '97, along with complete laryngitis, which I do not usually get. I suspected the air conditioner as the problem, and turned it off (individual unit). When cold weather came in December, I turned on the heat. I got the sinus infection and complete laryngitis again, requiring antibiotics again. I turned the unit off until the heat became unbearable in April. After turning the unit on, I got another sinus infection and complete laryngitis. I brought a large fan from home and kept the unit off until the end of the school year. At the beginning of this school year, the same thing happened. At my request, I have been moved to another room, still in the old wing. I was hoping the situation would be better, but it is not. Every day my throat burns and I have congestion. In this room, I cannot turn the unit off. I previously taught in the new wing for two years and never had this problem. I am requesting that the matter be looked into right away. If it is not solved soon, I must request that the air be turned off in my room, which will be very uncomfortable for me and my students. Thank you for your assistance.

*J. Moore*

## Complaint/Symptoms #2

TO WHOM IT MAY CONCERN:

Having suffered from a chronic sore throat since March of 1996, I would like to join in a plea for a thorough investigation of the air conditioning system at Murrah. I have taught in rooms 114 and 207 during this period and both are in the old section of the building. Students are constantly sneezing and experiencing runny noses.

I have sought the professional help of an ENT physician, Dr. Michael Osborne, in trying to get rid of the sore throat. The medication that I am taking helps some but the problem remains.

Thanks for your help.

*BP Williams*

### Complaint/Symptoms #3

I am a lung patient. I have Chronic Obstruction of the airways. These symptoms are similar to asthma. I am highly allergic to mold. My vent is covered in mold, even on the outside of the unit. This mold makes a horrible odor in the room.

I have been in the room since Aug. 11, 1998. Since being in the room, my lungs have become infected. I've had asthma attacks frequently, and I've had to increase my medication for breathing, since my breathing has become more laborer.

I would appreciate your quickest response to this problem so my health can improve.

*Herbauge Cain*

### Complaint/Symptoms #4

Each year since my location in Room 212, I have missed school due to sinus drainage/respiratory related illness which begins with a sore throat, moves into my sinuses and then my chest. Each time antibiotics were necessary. These episodes resulted in my missing several days of school at a time. I have to take aspirin and other over-the-counter drugs throughout the year due to these illnesses. I do not have these problems during the summer. The time missed from school, in addition to the expense from visits to the doctor and prescription medicine, is problematic.

*Karen Redhead*

### Complaint/Symptoms #5

Sinus infections -- year before last--from February to May  
Upper respiratory infections, headaches, constant cough, sore throat

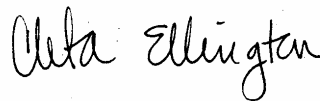
Remedies:

- cheese cloth over vents
- Do not turn air off so moisture can build up, grow mold.  
When school turns off the system, mold can grow.
- Put curved plastic vent so mold spores are thrown to the wall and not out in classroom
- nasal sprays to block allergens
- antihistamines
- yearly cortisone shots approximately every six months to loosen and alleviate symptoms
- cortisone pack to help with symptoms



### Complaint/Symptoms #6

Concerning the problems with the air ventilation, Room 120 has had a terrible odor since the beginning of this school year. Students complain of the offensive odor daily, and some even claim to have headaches because of the smell, especially in the afternoons when the air conditioning has difficulty cooling off the classroom. I have already used two full-size cans of Lysol Deodorizer in trying to eliminate the problem. I also have suffered headaches in the afternoons due to the strong odor. I believe the problem is connected to the dirty air conditioning ducts or in the pipes.



### Sick School Teacher Sample Survey 1

**Name:** \_\_\_\_\_ **Grade:** \_\_\_\_\_

How many years have you attended Murrah? \_\_\_\_\_

Please give a brief medical history prior to your attendance at Murrah. (e.g. sinus problems, allergies, etc.):

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Have you suffered from any of the following symptoms while attending Murrah? (Please Check)

- |   |  |
|---|--|
| <input type="checkbox"/> Flu-like symptoms                | <input type="checkbox"/> Persistent coughing or wheezing |
| <input type="checkbox"/> Stuffy or runny nose             | <input type="checkbox"/> Fatigue                         |
| <input type="checkbox"/> Nausea                           | <input type="checkbox"/> Dry or itchy skin               |
| <input type="checkbox"/> Eye, nose, and throat irritation | <input type="checkbox"/> Dizziness                       |
| <input type="checkbox"/> Difficulty in concentration      | <input type="checkbox"/> Sensitivity to odors            |
| <input type="checkbox"/> Dark circles under eyes          | <input type="checkbox"/> Reddened outer ears             |
| <input type="checkbox"/> Chronic skin rashes              | <input type="checkbox"/> Back acne                       |

Do you suffer from these symptoms during the summer or during breaks from school?

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Have you experienced any weird smells in any of your classes? If so, please list the room numbers of the classes.

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Please list your schedule.

**Sick School Teacher Sample Survey 2**

Name \_\_\_\_\_

Date \_\_\_\_\_

Room Number \_\_\_\_\_

What type of air conditioning do you have?

How would you describe the air ventilation in your room?

Poor\_\_\_\_\_

Good\_\_\_\_\_

Excellent\_\_\_\_\_

What is your reason for this rating?

Do you have a history of respiratory problems?

If so, have they gotten worse during your time at Murrah?

If you did not previously suffer from respiratory problems, do you now suffer from them?

Have you experienced any of these? (Please check off the symptoms that afflict you.)

Hyperactivity \_\_\_\_\_

Aggression \_\_\_\_\_

Mood and personality changes \_\_\_\_\_

Memory loss \_\_\_\_\_

Exhaustion and drowsiness \_\_\_\_\_

- Central nervous system disorders \_\_\_\_\_
- Irritated eyed \_\_\_\_\_
- Migraines \_\_\_\_\_
- Stuffy or runny nose \_\_\_\_\_
- Coughing \_\_\_\_\_
- Wheezing and asthma \_\_\_\_\_
- Diarrhea \_\_\_\_\_
- Skin rashes \_\_\_\_\_
- Seizures \_\_\_\_\_
- Dizziness \_\_\_\_\_
- Light sensitivity \_\_\_\_\_
- Backache \_\_\_\_\_
- Sore throat \_\_\_\_\_
- Sensory changes involving tastes or odors \_\_\_\_\_
- Dry or itchy skin \_\_\_\_\_
- Difficulty in concentrating \_\_\_\_\_
- Poor coordination and balance \_\_\_\_\_
- Chronic headaches \_\_\_\_\_
- Flu-like symptoms \_\_\_\_\_

Do your students exhibit or complain of any of these behaviors?

If so, list them.

### Sick School Teacher Survey Results Sample

Teacher Name	Room #	Ventilation	Exhaustion and Drowsiness	Irritated Eyes	Headaches	Stuffy or Runny Nose	Coughing
Slater	Office	P			Y		Y
Allen, M.	104	G		Y			
Aseeri	201	P	Y	Y	Y	Y	Y
Rogers	113	P					
Lamb	120			Y	Y		Y
Jones	114	P	Y	Y	Y	Y	Y
Stokes	206	P					
Hardy	214	P		Y	Y		Y
Dickson	215	P	Y	Y	Y	Y	Y
Tharp	211	G		Y		Y	

#### Day 6: Collection of samples for investigation

**Record** room numbers of possible “hot spots” and begin collections. Survey each room for possible sites of mold or mildew. Also, find the ventilation system and swab the outer area. Place the swab into a zip-lock bag and label it according to the room number. Also, date the each bag.

*Optional: Prepared petri dishes of Sabouraud could easily be left open in each room for at least 1 hour.*

#### **Prepare** growth media:

**Sabouraud Dextrose Agar** is the growth media that has been selected for the growth and isolation of fungi. It can be obtained as dehydrated or prepared. When dissolving this growth media, either a hot plate or a microwave could be used. However, make sure to closely observe the media if using a microwave. It will go into solution faster and pressure will increase in the bottle if the top is not loosened or removed.

**Dehydrated: 65 grams per liter of distilled water** (sufficient to pour 50-60 standard petri dishes)  
Heat slowly to the boiling point to dissolve. Stir or swirl frequently and avoid prolonged boiling. Cool down to about 50 degrees Celsius and pour plates. Let the plates cool to room temperature.

**Prepared: Bottled in 100 ml or 500 ml**

(100 ml bottles are sufficient for 5-6 standard petri dishes and 500 ml for 25-30 petri dishes)

Loosen or remove the top of the bottle and heat slowly to the boiling point to dissolve. Stir or swirl frequently and avoid prolonged boiling. Cool down to about 50 degrees Celsius and pour plates. Let the plates cool to room temperature.

**Inoculation** of Sabouraud plates:

1. Place the “hot spot” swab bag on a table.
2. Place the prepared plates next to the bags.
3. Label the plates with the information from the bags including the room number.
4. Make sure each bag has it’s own corresponding prepared plates.
5. Remove the swab from the bag. **Do not** allow it to touch any surface other than the media in the plates.
6. Lift the top of the petri dish at a slant. Roll the swab across the surface of the media and close the plate.
7. Place the swab back in the bag and move to the side.
8. Repeat this process until all samples have been used.
9. Allow growth at room temperature for 2-4 days. Observe the colonies--color top and bottom surfaces and make notes.  
(*See: Sample Observation Sheet*)

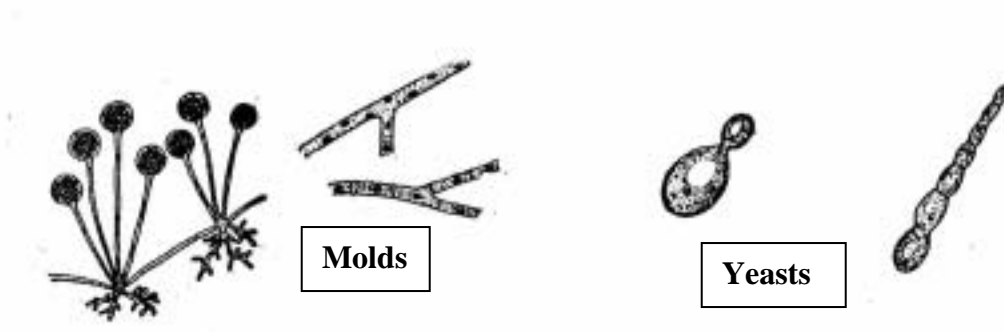
*Day 7-9: Identification of fungi on growth media***Background Information on Fungi:**

Fungi are plant-like organisms that lack chlorophyll. They belong to the phylum **Mycophyta**. The study of fungi is called **mycology**. Examples of fungi include molds, yeasts, puffballs, bracket fungi, and other related types. These organisms are not only characterized by the absence of chlorophyll, but also the absence of tissue differentiation within the roots, stems, and leaves which has been proposed as the evolutionary link between fungi and algae.

Molds and yeasts comprise the two major groups of fungi. The basic difference between

the two is essentially yeasts are unicellular and molds are multicellular. The characteristics of molds can easily be observed. The **hyphae** are the individual filaments. If these filaments have cross-walls, it is said to be **septate**. If no cross-walls exist, the hyphae is **non-septate**. Most often, a mass of intermeshed hyphae, **mycelium**, can be observed with the naked eye. Yeasts are characterized by the formation of a bud or blastospore which may separate from the original cell or remain attached.

The phylum Mycophyta is subdivided into classes on the basis of sexual spores produced. Zygosporangia, ascospores, and basidiospores are the three spore types. **Phycomycetes** are non-septate and produce **zygosporangia**, which are formed from the union of nuclear material from the hyphae of two strains. (*Example: Rhizopus*) **Ascomycetes** have septate hyphae and produce ascospores in oval sacs called asci. (*Example: yeasts*) **Basidiomycetes** have septate hyphae and produce **basidiospores** on club-shaped bodies called **basidia**. (*Examples: Mushrooms and Bracket Fungi*)



## Identification Procedures

### Fungi Study

1. **Examine** the exposed Petri dishes after a 2-4 day incubation period. A good plate will maintain many different colored colonies.
2. **Note** the characteristic nature of the colonies. Look at the colony from the underside of the Petri dish and observe how the colonies differ in color. (*Note: The identification of molds is based on surface color, backside color, or hyphal structure and spore type*)
3. **Make a stained slide directly from the colonies.**

### **Materials**

Mold cultures  
Microscope slides and cover slips  
Scapel  
Cotton blue stain or similar stain  
Identification Key

### **Procedures**

1. Place an uncovered Petri dish on the stage of the microscope. **View** the outer edges of the colonies with a low power objective lens.
2. **Consult** the identification key for possible identification.
3. **Make a wet mount** slide by transferring a small piece of the culture with the aid of a scapel to a slide. Place a drop of stain on the sample and cover with glass cover slip.
4. **Examine** under low power and high power objective lenses.
5. **Consult** the identification key for possible identification.
6. **Record results** on the observation sheet. **Repeat** until all samples have been completed.

### **Optional Yeast Study**

*(Prepare wet mount samples of suspected yeasts. Oil immersion will reveal the greatest detail. Look for the nucleus and vacuole)*

### **For More Information on Identification:**

<http://www.botany.utoronto.ca>

### Identification Key for Commonly Found Fungi

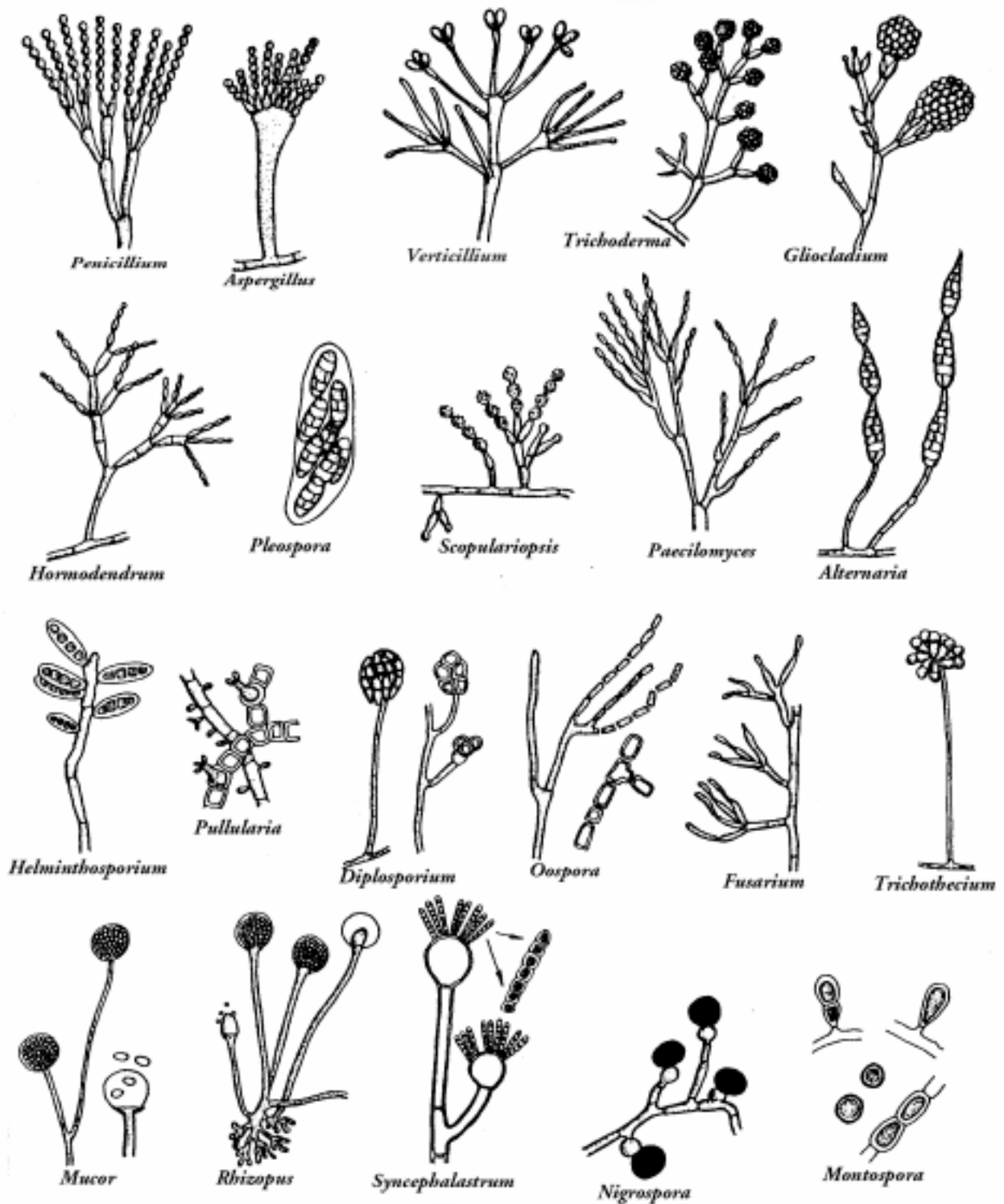


Illustration Modified from the second edition *Manual of Clinical Mycology*, Conant, et. Al., Philadelphia: W. B. Saunders Co., 1954.

## Colony Description

<b>Fungi Type</b>	<b>Colony Surface Color</b>	<b>Colony Back Color</b>	<b>Spore Formation or Description</b>	<b>Other Characteristics</b>
<i>Penicillium</i>	Bluish green		Brush arrangement of conidia	
<i>Aspergillus</i>	Bluish green with yellow areas on surface			
<i>Verticillium</i>	Pinkish-brown		Elliptical conidia	
<i>Trichoderma</i>	Green			Resembles <i>Penicillium</i>
<i>Gliocladium</i>	Dark green			Grows fast
<i>Hormodendrum</i>	Light green	Gray to black		
<i>Pleospora</i>	Tan to green	Brown to Black	Ascospores	
<i>Scopulariopsis</i>	Light brown		Rough walled conidia	
<i>Paecilomyces</i>	Yellowish brown		Elliptical conidia	
<i>Alternaria</i>	Black with gray surround	Black		
<i>Helminthosporium</i>	Black with gray surround			
<i>Pullularia</i>	Black, shiny		Budding	Thick walled
<i>Diplosporium</i>	Buff, wooly	Red with brown surround		
<i>Oospora</i>	Buff			Hyphae break into thin rectangular cells
<i>Fusarium</i>	Deep red with pink surround		Sickle-shaped conidia	
<i>Trichothecium</i>	White to pink		Two-celled conidia	
<i>Mucor</i>	White to gray		Sporangia and Sporangiospores	Non-septate hyphae
<i>Rhizopus</i>	White to gray		Sporangiospores	Non-septate hyphae Root-like rhyzoids
<i>Syncephalastrum</i>	White to dark gray			
<i>Nigrospora</i>	White to gray	Black		
<i>Montospora</i>	Dark gray with Light gray surround		Yellow-brown conidia	

### Sick School Fungi Observation Sheet

Room Number: \_\_\_\_\_

<b>Surface Color</b>	<b>Backside Color</b>	<b>Hyphal Structure</b>	<b>Spore Structure</b>

*VIII. Student Expectations:***The student will:**

1. **Analyze** and **Discuss** the results of the research
2. **Generate** and **Write** a Laboratory Report
3. **Design** a Power Point Presentation of findings
4. **Present** findings in a 10-12 minute PowerPoint Presentation

*IX. Anticipated Results:*

The results of this research will reveal some fungi that are considered to be allergens. These fungi are found in almost all locations, especially if the buildings are not recently constructed. The fungi appearing most frequently should be *Penicillium* and *Aspergillus*. With these identification procedures, students will find true identifications somewhat difficult because of the similarity between fungi. This laboratory will not identify allergens with great accuracy. More advanced technological methodology would produce more dependable results. However, it gives the students experience in problem-based learning and provides them with the thought they are actually involved in identifying and finding a resolution to a real-life problem.

*X. Assessments:***Rubric For Presentation and Laboratory Report:**

A suggested rubric for grading the Presentation and Lab Report is included. This rubric is flexible enough for the instructor to make changes. (*See: Rubric for Presentation and Lab Report*)

**Rubric For Presentation and Lab Report**  
Scoring Guide

Name of Student: \_\_\_\_\_ Score: \_\_\_\_\_

<b>I. The Student's Involvement with Science</b>	<b>Maximum Score</b>	<b>Actual Score</b>
<b>Introduction—Statement and identification of problem</b> <ul style="list-style-type: none"> <li>• Clarity in stating the problem under study</li> <li>• Creativity/originality—identification of problem; rationale for study</li> <li>• Background information evident</li> <li>• Hypothesis</li> </ul>	<b>20</b> 5 5 5 5	
<b>Acknowledgement of sources and major assistance received</b> <ul style="list-style-type: none"> <li>• Sources</li> <li>• Assistance</li> </ul>	<b>10</b> 5 5	
<b>Research design, procedures (materials &amp; methods), results</b> <ul style="list-style-type: none"> <li>• Student's involvement in designing the investigation</li> <li>• Originality and ingenuity in the research design or apparatus</li> <li>• Identification and control of variables; laboratory skills and techniques</li> <li>• Reproducibility</li> <li>• Quantity and quality of data generated (accuracy, organization, recognition of errors, statistical analysis)</li> </ul>	<b>20</b> 4 4 4 4 4	
<b>Discussion / Conclusions</b> <ul style="list-style-type: none"> <li>• Clarity in stating conclusions; discussion/conclusion relative to purpose of study</li> <li>• Interpretation of data; conclusions supported by data</li> <li>• Limitations in accuracy and significance of results acknowledged</li> <li>• Evidence of student's understanding of the scientific or technological principles employed in investigation</li> <li>• Theoretical or practical implications recognized or understood ( what was learned, new questions raised, future research)</li> </ul>	<b>20</b> 4 4 4 4 4	
<b>II. The Student's Effort and Performance</b>		
<b>Duration of research</b> <ul style="list-style-type: none"> <li>• Amount of work involved</li> <li>• Evidence of student's understanding</li> </ul>	<b>10</b> 5 5	
<b>Presentation</b> <ul style="list-style-type: none"> <li>• Clarity in stating the problem</li> <li>• Clarity in describing design, procedures, problems, and how they were handled</li> <li>• Clarity in presenting data, interpretations, and conclusions</li> <li>• Overall organization</li> <li>• Appropriate use of audio-visuals (PowerPoint)</li> <li>• Clarity of enunciation</li> <li>• Response to Questions</li> <li>• Time Frame (10-12 min discussion and 3-5 min questions)</li> </ul>	<b>8</b> 1 1 1 1 1 1 1	
<b>Paper</b> <ul style="list-style-type: none"> <li>• Abstract</li> <li>• Content, format, grammar, organization</li> </ul>	<b>12</b> 4 8	

## Is this building making me sick?

### Student Section:

#### Background Information:

An **immune response** activates a number of molecules that attempts to remove **antigen** by inducing a localized **inflammatory response** without causing extensive tissue damage. However, this inflammatory response can cause significant tissue damage or even death. These reactions are termed **hypersensitive or allergic reactions**. Hypersensitive reactions can develop in the course of either a **humoral or cell mediated response**. Reactions within the humoral branch are initiated by **antibody or antigen-antibody complexes** and are termed immediate hypersensitivity reactions because the symptoms manifest within minutes or hours following exposure with antigen by a sensitive recipient. The humoral branch involves the interaction of **B lymphocytes** or **B cells** with antigen which subsequently leads to proliferation and differentiation of B cells into antibody-secreting cells called **plasma cells**. The secreted antibody binds to antigen produced by a foreign agent (viruses, bacteria, parasites, fungi, etc.) either neutralizing it or facilitating its elimination. Reactions within the cell-mediated branch are initiated by **T-cells** and are referred to as delayed-type hypersensitivity reactions in reference to the delay of symptoms for days following exposure. **T helper cells** and **cytotoxic lymphocytes** are the effector cells within the cell-mediated response. Low molecular weight proteins, **cytokines**, secreted by the T helper cells activate various phagocytic cells thus facilitating the destruction of foreign agents (viruses, bacteria, parasites, fungi, etc.).

Several types of hypersensitive reactions can be distinguished. **Type I reactions** can produce conditions ranging from serious life-threatening reactions, such as asthma, to hay fever, which is merely annoying. Common antigen associated with Type I hypersensitivity includes plant pollen, drugs, foods, insect venoms, mold spores, and animal hair. These antigens, capable of stimulating Type I hypersensitivity responses in allergic individuals, are termed **allergens**. Most allergic responses occur on mucous membrane surfaces and in response to allergens that enter the body through inhalation or ingestion. An example of a common allergen, ragweed pollen, a major pollen allergen in the United States, has been found to contain a variety of allergic substances that mount a Type I response in 95% of ragweed sensitive individuals. This condition is also prevalent in the allergens associated with other biological contaminants.

The term “**sick building syndrome**” is used to describe situations in which building occupants experience acute health problems that appear to be linked to time spent in a building. The complaints may be localized in a particular room or area, or may be widespread throughout the building. According to current investigations, these conditions are not only found in older buildings, but also exist in new or remodeled buildings. These building conditions most often are subject to complaints related to indoor air quality. Often the quality of air in buildings become restricted due to inappropriate building design.

Indicators of Sick Building Syndrome include headache, eye, nose, throat irritation, dry cough, dry-itchy skin, dizziness and nausea, difficulty in concentrating, fatigue, and sensitivity to odors. Most of the complainants report relief after leaving the building. One major contributor of Sick Building Syndrome is inadequate ventilation. Inadequate ventilation can occur if heating, ventilating, and air conditioning systems do not effectively distribute air to occupants in

the building. Other contributors to Sick Building Syndrome include biological contaminants. **Bacteria, mold spores, pollen, and viruses** are a few of these contaminants. They may breed in stagnant water that accumulates in ducts, drain pans, or other places capable of collecting water. Physical symptoms associated with biological contamination include cough, chest tightness, fever, chills, muscle aches, and allergic responses such as mucous membrane irritation and upper respiratory congestion.

Fungi are plant-like organisms that lack chlorophyll. They belong to the phylum **Mycophyta**. The study of fungi is called **mycology**. Examples of fungi include molds, yeasts, puffballs, bracket fungi, and other related types. These organisms are not only characterized by the absence of chlorophyll, but also the absence of tissue differentiation within the roots, stems, and leaves which has been proposed as the evolutionary link between fungi and algae.

Molds and yeasts comprise the two major groups of fungi. The basic difference between the two is essentially yeasts are unicellular and molds are multicellular. The characteristics of molds can easily be observed. The **hyphae** are the individual filaments. If these filaments have cross-walls, it is said to be **septate**. If no cross-walls exist, the hyphae is **non-septate**. Most often, a mass of intermeshed hyphae, **mycelium**, can be observed with the naked eye. Yeasts are characterized by the formation of a bud or blastospore which may separate from the original cell or remain attached.

The phylum Mycophyta is subdivided into classes on the basis of sexual spores produced. Zygosporangia, ascospores, and basidiospores are the three spore types. **Phycomycetes** are non-septate and produce **zygosporangia**, which are formed from the union of nuclear material from the hyphae of two strains. (*Example: Rhizopus*) **Ascomycetes** have septate hyphae and produce ascospores in oval sacs called asci. (*Example: yeasts*) **Basidiomycetes** have septate hyphae and produce **basidiospores** on club-shaped bodies called **basidia**. (*Examples: Mushrooms and Bracket Fungi*)

**One goal of a building investigation is to identify and solve indoor air quality complaints in a manner that prevents reoccurrence and avoids the creation of future problems. To achieve this goal, it is imperative that the investigator discover whether a complaint is actually related to indoor air quality, identify the cause, and determine the most appropriate corrective measure.**

### Materials:

#### *Information Research:*

- Internet-capable computer
- printer
- periodicals
- complaint letters

#### *Experiment:*

- petri dishes
- Sabouraud growth media
- hot plate
- electronic balance
- weighing paper
- spatula
- microscope

microscope slides  
cover slips  
sharp pointed scalpels  
cotton blue stain or similar stain  
cotton swabs  
zip-lock bags (sandwich)

**Procedures:**

1. **Discuss** the immune response as it pertains to the hypersensitive reaction Type I. Describe conditions associated with Type I hypersensitivity, especially as it relates to sick building syndrome.
2. **Define** the following terms: Immune response, humoral response, cell mediated response, antigen, antibody, antigen-antibody complex, hypersensitivity, allergen, biological contaminant, sick building syndrome, B cells, T cells, plasma cells, T helper cells, cytotoxic lymphocytes, and cytokines.
3. **List** possible contributors to sick building syndrome.
4. **Evaluate** the teacher complaint letters.
5. **Identify** the possible causes the complaint/symptoms.
6. **Review** standard procedures for collecting background information utilizing the Internet and library.
7. **Record** room numbers of possible “hot spots” and begin collections. Survey each room for possible sites of mold or mildew. Also, find the ventilation system and swab the outer area. Place the swab into a zip-lock bag and label it according to the room number. Also, date the each bag.

*Optional: Prepared petri dishes of Sabouraud could easily be left open in each room for at least 1 hour.*

8. **Prepare** growth media:

**Sabouraud Dextrose Agar** is the growth media that has been selected for the growth and isolation of fungi. It can be obtained as dehydrated or prepared. When dissolving this growth media, either a hot plate or a microwave could be used. However, make sure to closely observe the media if using a microwave. It will go into solution faster and pressure will increase in the bottle if the top is not loosened or removed.

**Dehydrated: 65 grams per liter of distilled water**  
(sufficient to pour 50-60 standard petri dishes)

Heat slowly to the boiling point to dissolve. Stir or swirl frequently and avoid prolonged boiling. Cool down to about 50 degrees Celsius and pour plates. Let the plates cool to room temperature.

**Prepared: Bottled in 100 ml or 500 ml**

(100 ml bottles are sufficient for 5-6 standard petri dishes and 500 ml for 25-30 petri dishes)

Loosen or remove the top of the bottle and heat slowly to the boiling point to dissolve. Stir or swirl frequently and avoid prolonged boiling. Cool down to about 50 degrees Celsius and pour plates. Let the plates cool to room temperature.

9. **Inoculation** of Sabouraud plates:

1. Place the “hot spot” swab bag on a table.
2. Place the prepared plates next to the bags.
3. Label the plates with the information from the bags including the room number.
4. Make sure each bag has it's own corresponding prepared plates.
5. Remove the swab from the bag. **Do not** allow it to touch any surface other than the media in the plates.
6. Lift the top of the petri dish at a slant. Roll the swab across the surface of the media and close the plate.
7. Place the swab back in the bag and move to the side.
8. Repeat this process until all samples have been used.
9. Allow growth at room temperature for 2-4 days. Observe the colonies--color top and bottom surfaces and make notes.  
(See: *Sample Observation Sheet*)

10. **Identification Procedures:**

**Fungi Study**

1. Examine the exposed Petri dishes after a 2-4 day incubation period. A good plate will maintain many different colored colonies.

2. **Note** the characteristic nature of the colonies. Look at the colony from the underside of the Petri dish and observe how the colonies differ in color. (*Note: The identification of molds is based on surface color, backside color, or hyphal structure and spore type*)
3. **Make a stained slide directly from the colonies.**

### Materials

Mold cultures  
Microscope slides and cover slips  
Scapel  
Cotton blue stain or similar stain  
Identification Key

### Procedures

1. Place an uncovered Petri dish on the stage of the microscope. **View** the outer edges of the colonies with a low power objective lens.
2. **Consult** the identification key for possible identification.
3. **Make a wet mount** slide by transferring a small piece of the culture with the aid of a scapel to a slide. Place a drop of stain on the sample and cover with glass cover slip.
4. **Examine** under low power and high power objective lenses.
5. **Consult** the identification key for possible identification.
6. **Record results** on the observation sheet. **Repeat** until all samples have been completed.

### Sick School Fungi Observation Sheet

Room Number: \_\_\_\_\_

Surface Color	Backside Color	Hyphal Structure	Spore Structure

