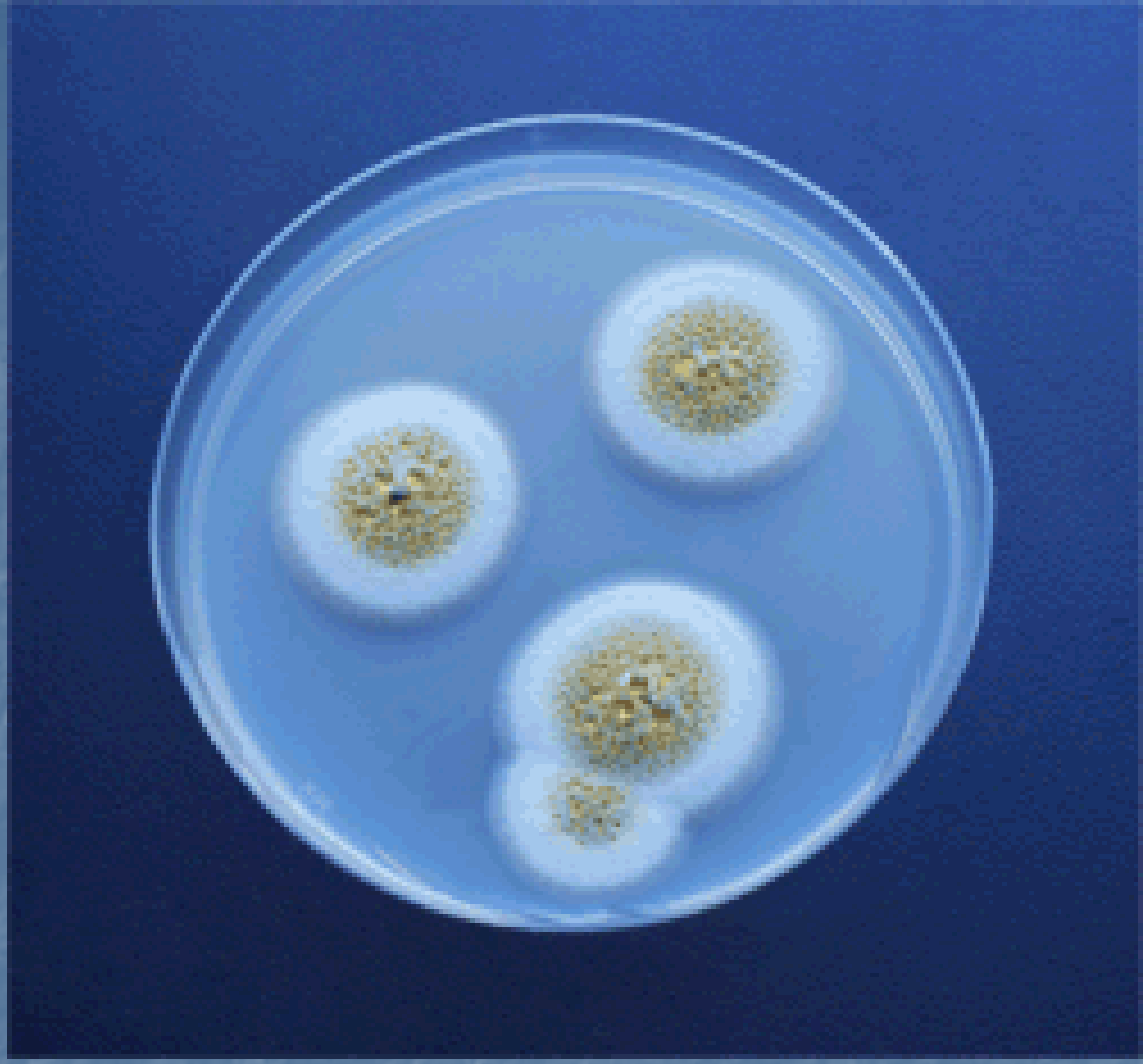
# Mold Madness



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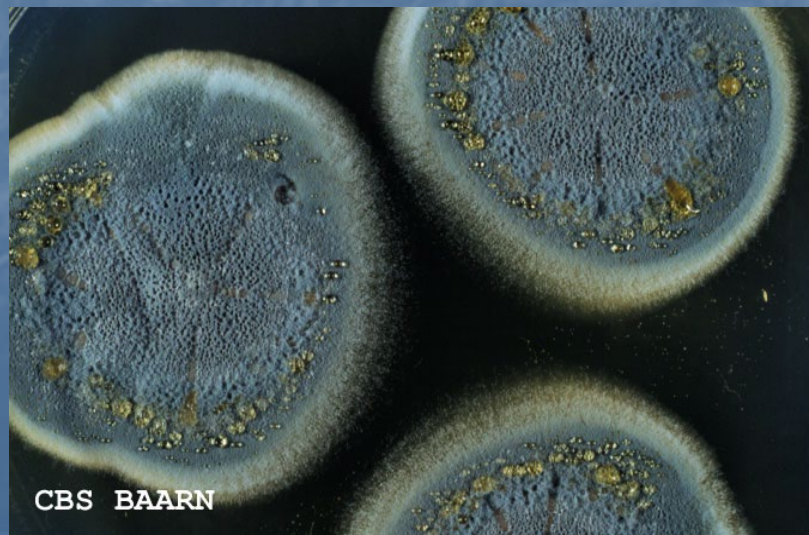
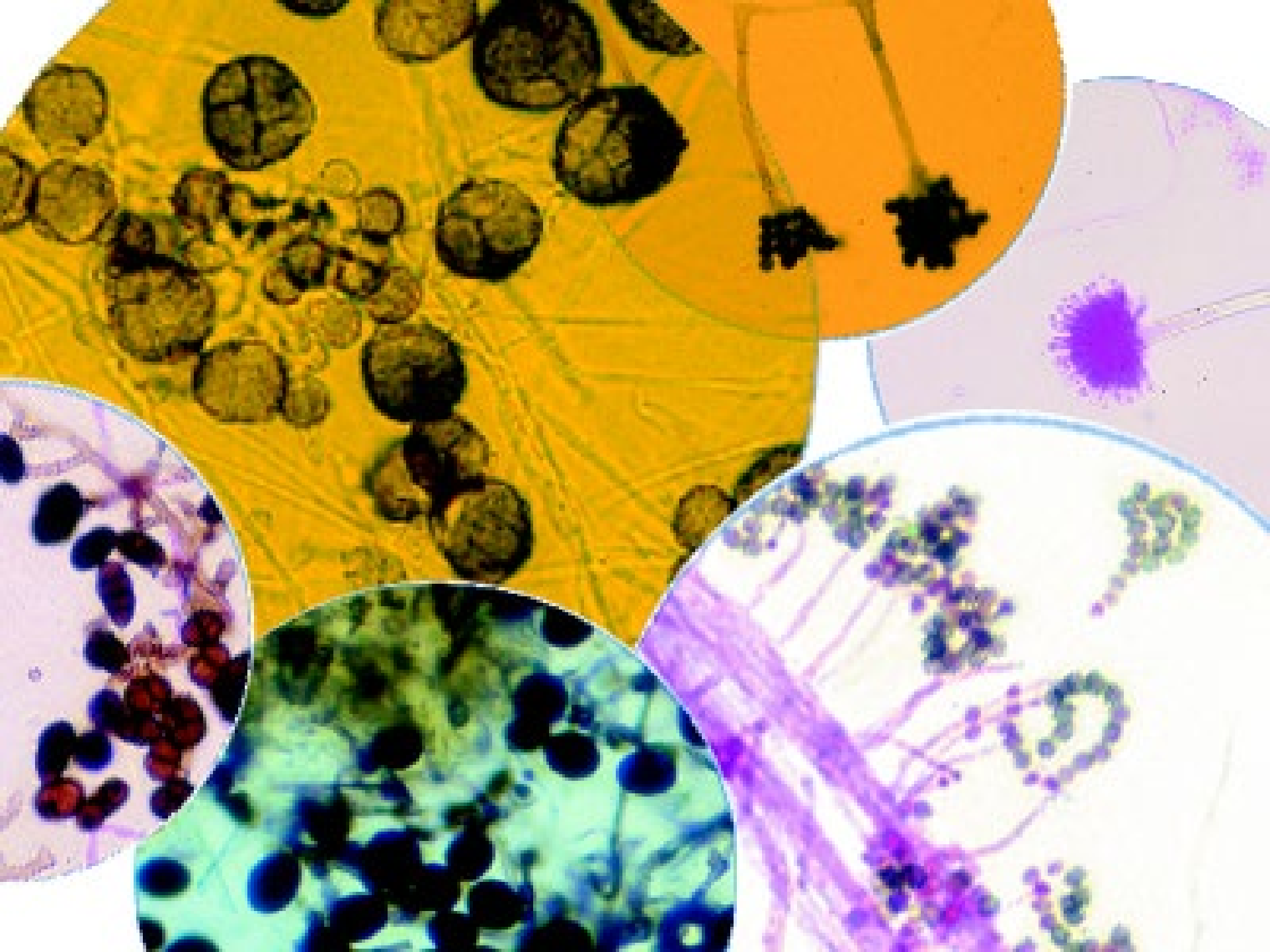
# What is Mold?

Living and dead environmental microorganisms (fungi), and their spores, fragments, and metabolic products.



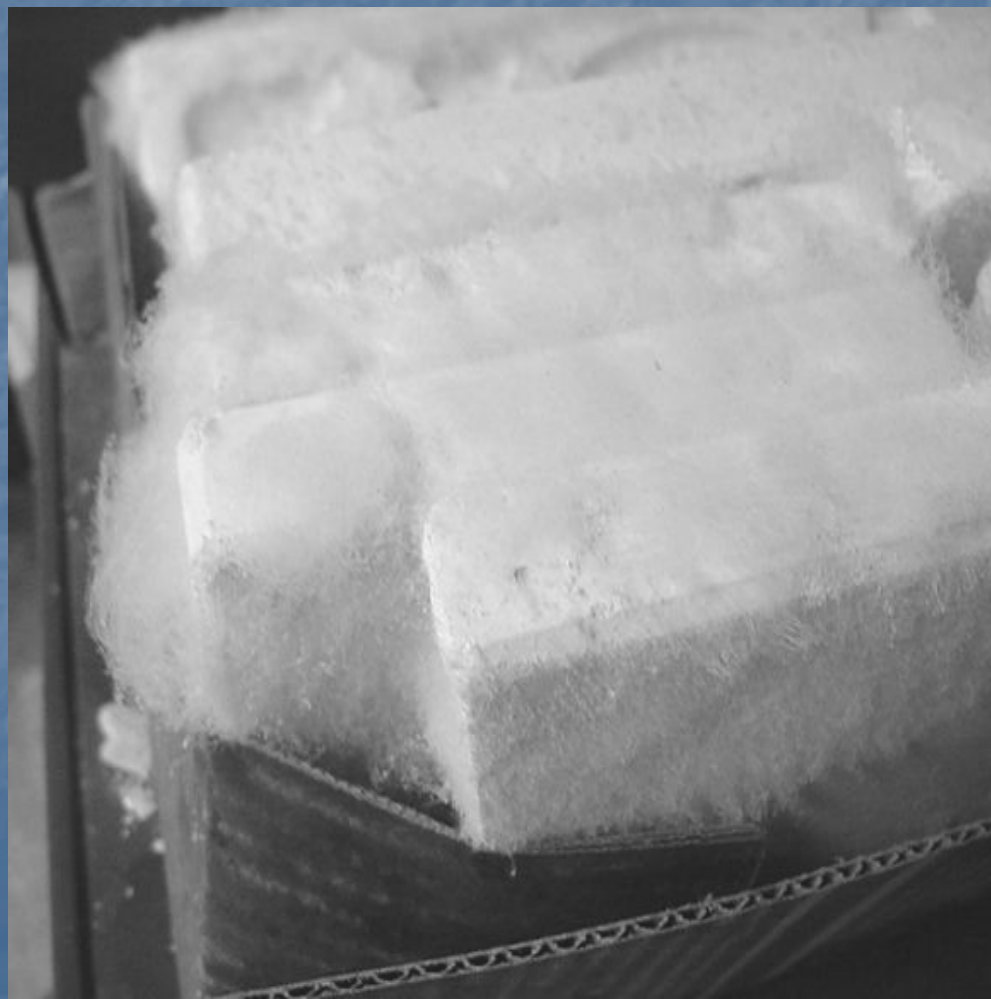


# The Kingdom of Fungi

- Digest organic material—Saprophytes
- Molds, yeast, mushrooms
- 25% of earth's biomass
- Reproduce via spores
- More than 100,000 species

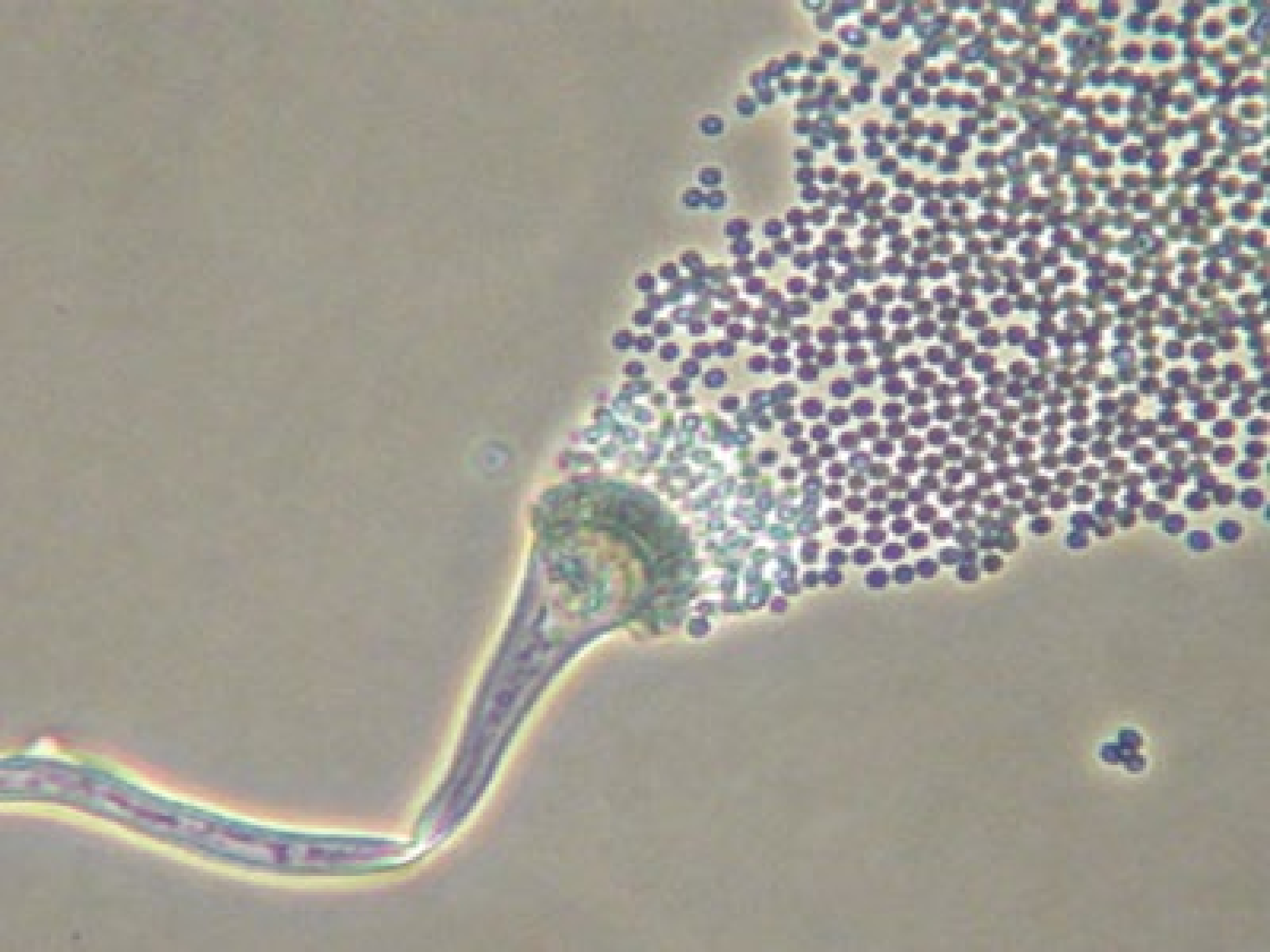
Molds consist of long, branching filaments of cells called hyphae.

- A mass of hyphae visible to the unaided eye is a mycelium.



# Mold Needs Four Things To Grow

- Spores
- Nutrients
- Moisture
- Time



# Nutrients

- Unlike plants, fungi need external sources of complex sugars and starches.
- Wood, fabric, wallpaper, carpet, padding, paper-faced gypsum, -- any product or material containing sugars and starches.
- Soap scum, dead skin cells, fats, oils, bio-films.

# Di-Hydrogen Monoxide

- **Moisture** - Required to begin the decaying process of the cellulose material by the mold.

- **Time** - Growth begins between 24 hours and 10 days once the conditions are favorable.

# Conditions for Growth

- **Moisture**
  - Hydrophillic; wet substrate
  - Mesophillic; damp substrate
  - Xerophillic; relatively dry substrate

# Toxic Molds (Mycotoxins)

- Mycotoxins are produced by some molds to kill others competing for food / water.
- >220 Mycotoxins from Common Molds
  - Aflatoxins-( Aspergillus)
  - Stachybotrys (trichothecenes)
  - Penicillium produces >100 classes of mycotoxins.
- Do not always produce mycotoxins.
- Dose

# “Black Mold”

- **CDC Update**
  - Pulmonary hemorrhage / hemosiderosis among infants
    - MWR March 10, 2000
- A review of the 1993- 1996 investigation of pulmonary hemorrhage/hemosiderosis among infants in Cleveland, Ohio concluded that earlier association between exposure to Stachybotrys atra and this condition was <u>not</u> proven.

# Health Impacts

- Irritant effects
- Asthma and allergy
- Opportunistic infections -- immune compromised individuals
- Toxic effects from inhaling mold?

# Common Health Effects From Inhalation Exposure to Mold

- **Everyone is exposed to airborne mold**
  - Inflammation and irritation of eyes, mucus membranes and respiratory tract (MVOCs)
  - Allergic rhinitis, sinusitis
  - Trigger or aggravate asthma episodes

# Allergic Reaction

## 6 - 10% General Population

- Allergic rhinitis
- A Mayo Clinic study found 93% of patients with chronic sinusitis were caused by mold.
- Sensitization
- Asthma Trigger - Up to 32% of asthmatics are sensitive to molds.

# Less Common Health Effects

- Hypersensitivity Pneumonia (Farmer's Lung) Organic Toxic Dust Syndrome
- Allergic Bronchopulmonary Aspergillosis
- Opportunistic infections-- Usually occur in people with compromised immune systems

# Who is at Greater Risk?

- Children and the elderly
- People with allergies or pulmonary disease
- People with compromised immune systems
  - Preexisting disease
  - Medications
  - Post operative patients
  - HIV/AIDS

# Sources of Moisture

- Leaks, flooding, drainage problems
- Negative pressure ↔ air movement
- Uncontrolled humidity
  - > 60% rh for > 24 - 48 hours
  - Unvented heating operations
  - Humidifiers

# Moisture in Buildings

Water as a liquid

- Plumbing leaks
- Roof leaks
- Flooding
- Direct penetration

Water as a vapor

- High relative humidity (over 60% for extended periods)
- Condensation: Cool surface + warm moist air

# Air Movement

Wet  Dry

High press.  Low press.

Hot  Cold

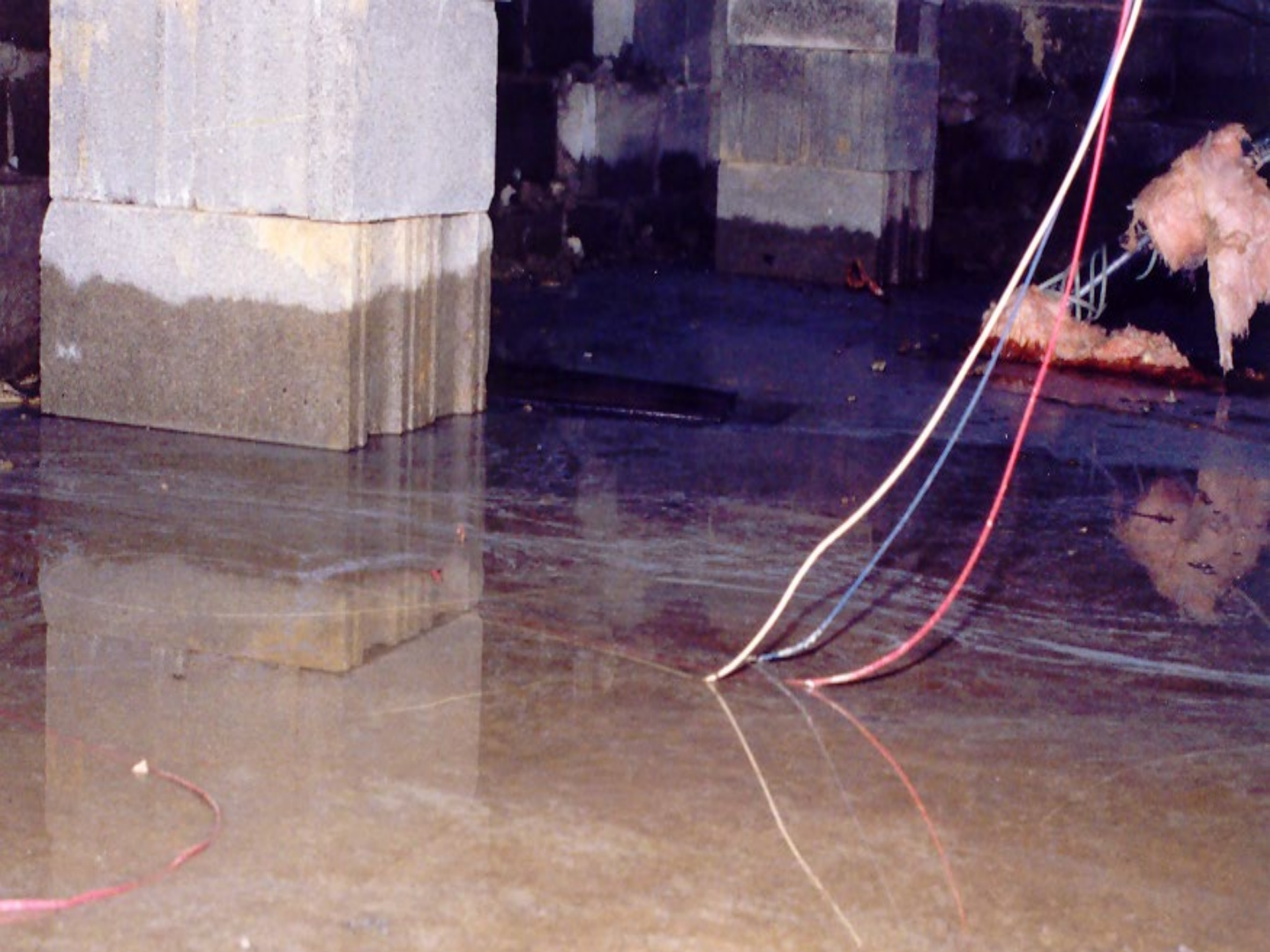
Source + Driving Force + Pathway

=

Excessive Moisture in Buildings

# Water Movement + Accumulation

- Liquid water flow, gravity
- Capillary action
- Air movement
- Vapor diffusion
- Condensation surfaces
- Drainage Planes



# Exterior Building Issues

- Gutters, downspouts and drainage
- Landscaping
- Roofs
- Air intakes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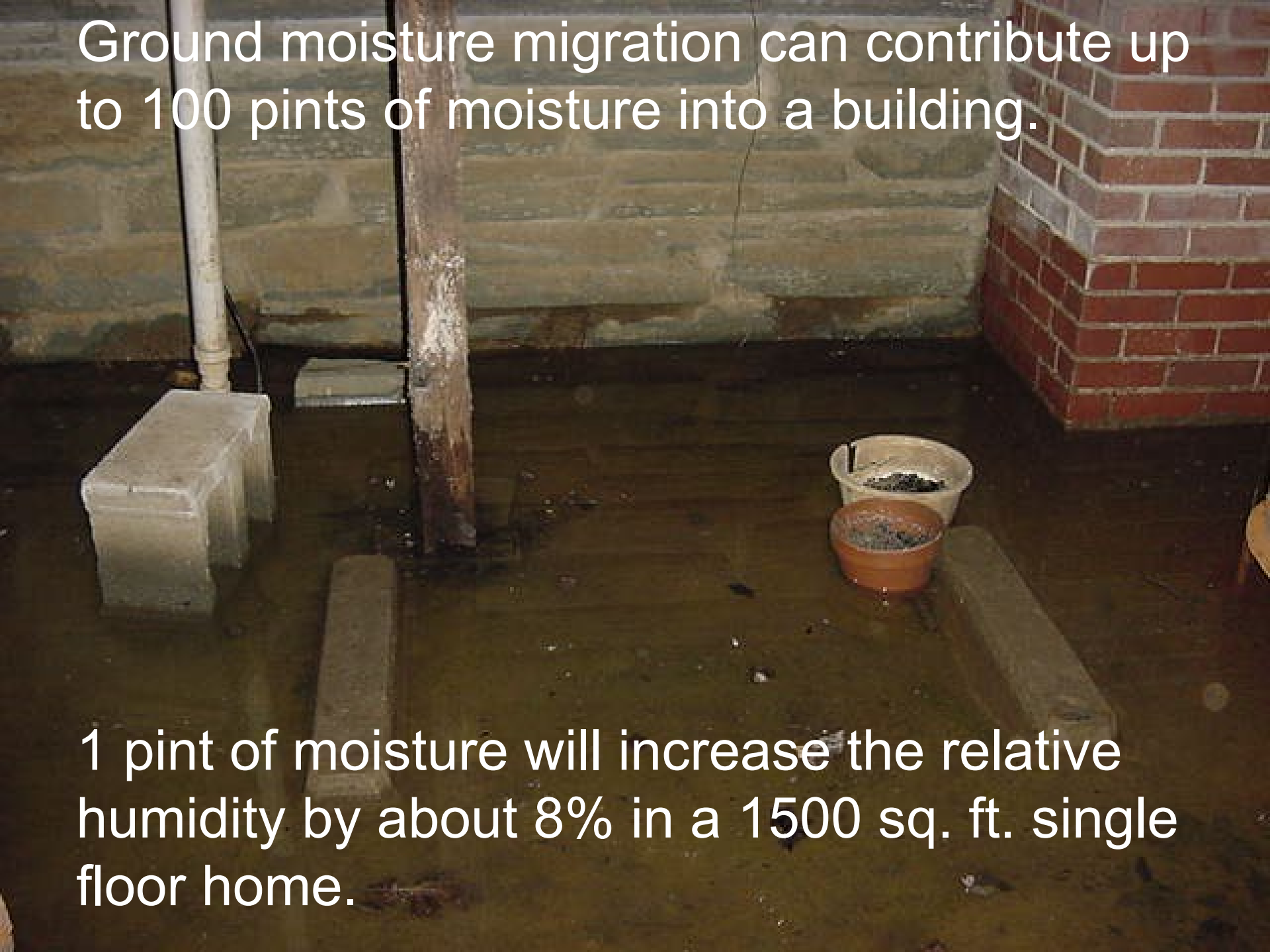
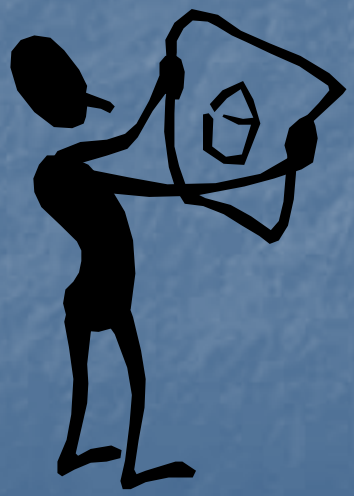
For long lasting, reliable performance nothing beats a Whisper Filter...
Compare our features!
The Whisper Guarantee


Ground moisture migration can contribute up to 100 pints of moisture into a building.
1 pint of moisture will increase the relative humidity by about 8% in a 1500 sq. ft. single floor home.


Pocket Rules
Phonics Flip Chart

# Exhaust Ventilation

- Dryers
- Kilns
- Furnaces
- Combustion operations
- Shower rooms



# Exhaust Ventilation

Clothes dryers 5 pints $H_2O$ / load

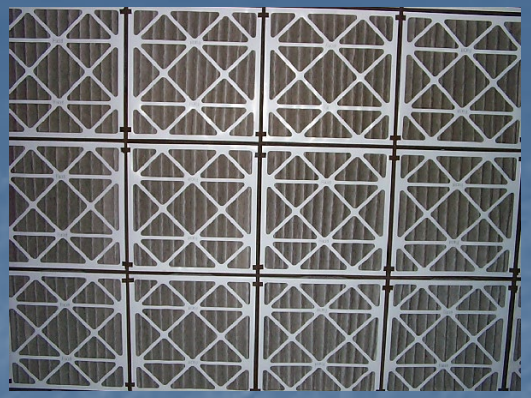
Ranges and ovens 1.2 pints $H_2O$ / dinner for 4,
1.6 pints $H_2O$ / dinner for 4 (gas)

Bathrooms 1 pint $H_2O$ /10 min. shower

Combustion appliances unvented space heater
7.6 pints $H_2O$ / gallon kerosene

- Provide adequate make up air.
- 1 pint of moisture will increase the relative humidity by about 8% in a 1500 $ft^2$. single floor home.

# HVAC Systems



Function

- Temperature control
- Humidity control
- Distribution
- Filtration

To function properly

- Design
- Maintenance

# HVAC Issues

- Location of outdoor air intake
- HVAC design -- short cycle
- HVAC operation – setbacks
- Mold growth on insulation downstream from coils
- Maintenance and condensate drainage

# HVAC Humidity Control

- Heat load
- HVAC system sizing
- Are humidistats needed?


Carrier


10

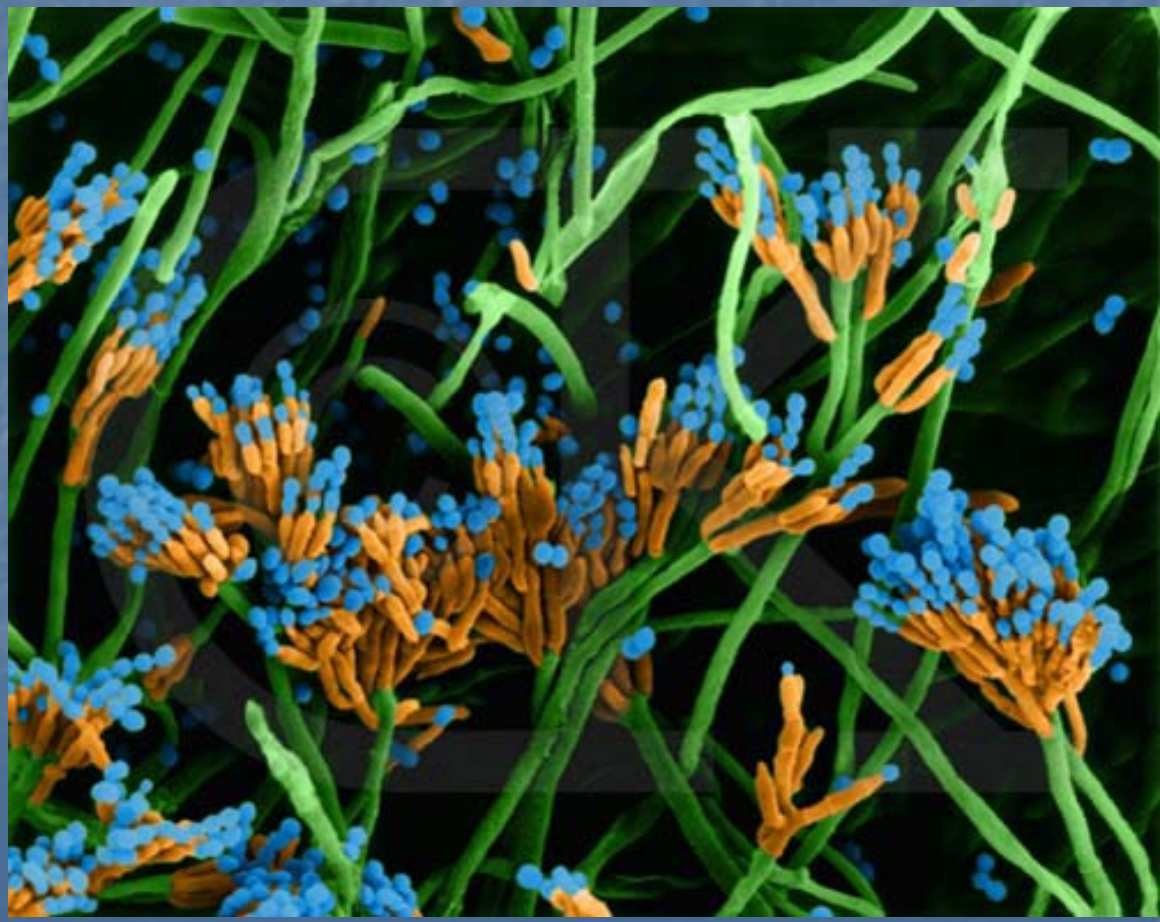
# Fungal Contamination Environmental Assessment

## US DOL - OSHA

"Is it necessary to sample for mold? In most cases, if visible mold growth is present, sampling is unnecessary. Air sampling for mold may not be a part of a routine assessment because decisions about appropriate remediation strategies often can be made on the basis of a visual inspection."

# Assessment & Evaluation

- Should not grow indoors
- Visual ID
- Odors
- Moisture
- Sampling
  - Bulk
  - Air



# Mold Environmental Assessment

- Visual inspection - most important initial step
- Determine extent of mold growth
- Substrates-what is mold growing on?
- Water damage
- Inspected & evaluate HVAC systems

# Who Regulates Indoor Mold?

- No one directly
- No recognized airborne exposure limits
- Some states did regulate inspectors and abatement contractors – not anymore

# Regulation of Mold Contamination?

- Airborne limits?
- Size of mold affected area ?
- Occupant generated moisture problems ?

# Governmental Guidance

- EPA -- *Mold remediation in Schools and Commercial Buildings*
- NY City Department of Health and Mental Hygiene --*Guidelines on Assessment and Remediation of Fungi in Indoor Environments*
- Centers for Disease Control and Prevention -- *Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods*

# OSHA

## A Brief Guide to Mold in the Workplace

Safety & Health Information Bulletin
SHIB 03-10-10

## Preventing Mold-Related Problems in the Indoor Workplace

## A Guide for Building Owners, Managers and Occupants

OSHA 3304-04N

# OSHA

SECTION III: CHAPTER 2
**INDOOR AIR QUALITY INVESTIGATION**

SECTION III: CHAPTER 3
**VENTILATION INVESTIGATION**

OSHA Tech. Manual

# Air Monitoring, Why Not?

- What will it prove?
- No standards or guidelines
- Only to prove a specific hypothesis
- Variable over time and space

# Air Monitoring, Why Not?

- Large number of samples needed for statistical confidence
- Sampling techniques and media
- False negative and false positive results
- Divert attention and resources from solving moisture problem

# We Want Tests To:

**Determine if mold is present.**

- *Molds are present in every environment, the presence of  a few mold spores does not mean mold is growing in the building*

**Determine types of mold or presence of toxic mold.**

- *Mold growth is unacceptable and undesirable independent of type or species*

# We Want Tests To:

**Find cause of health complaints.**

- *Other pollutants in the building may be the cause health complaints*

**Determine if environment is safe.**

- *Safe or unsafe levels of mold are not established. Interpreting results is subjective and based on professional judgment. Health effects vary due to individual sensitivity.*

# We Want Tests To:

**Determine how to correct the problem.**

- *General strategy for mold remediation is always to control the water and clean or remove and replace moldy materials.*

**Get someone to respond.**

- *No legal requirements for parties to respond*

# Results

Total Fungi

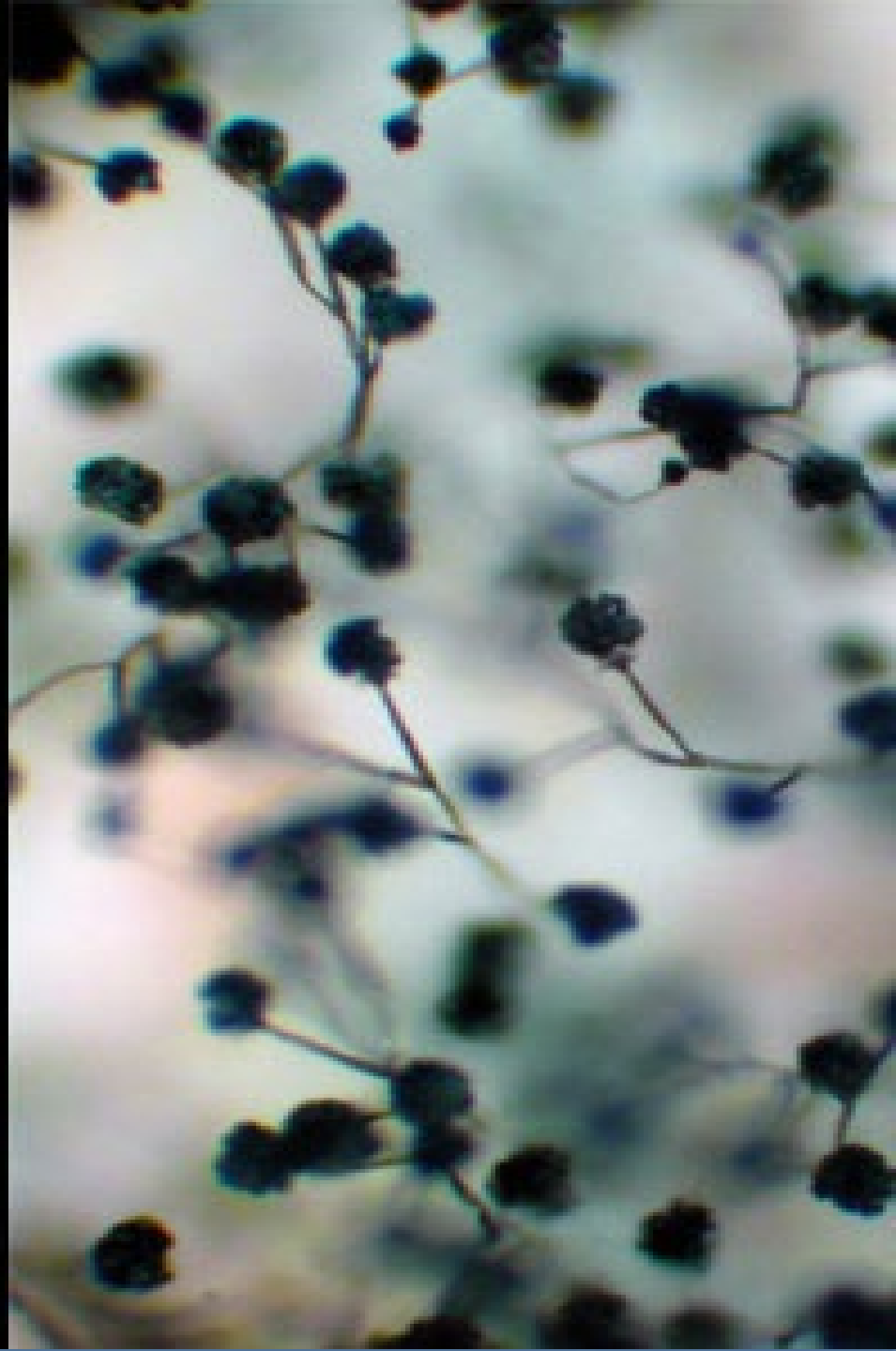
| | Count | Count/$m^3$ |
|---|---|---|
| A | 4 | 169 |
| B | 137 | 5780 |
| C | 59 | 2460 |
| D | 1430 | 60400 |

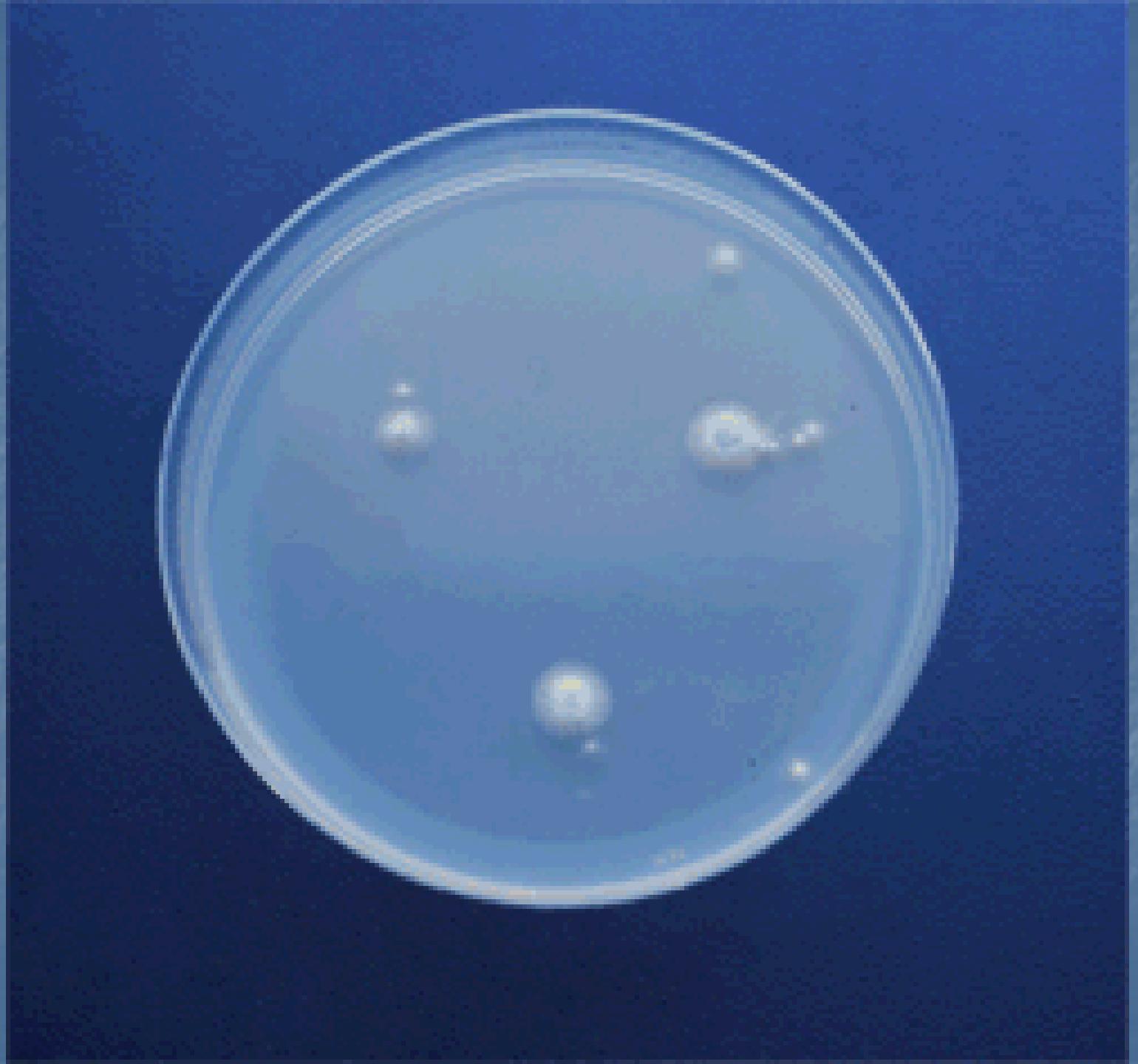
# Number of Samples

- “Grab” air samples for airborne mold have an inherent variability
  - Spores may be released in concentration bursts
  - Temperature, humidity, occupant activities affect release and distribution of spores
- Enough Indoor and outdoor samples for statistical confidence should be collected. (rarely done except in research $$$$)

# Types of Analysis

- **Analyses**
  - Microscopy- presumptive identification of spores
  - Culture-Identification of species
- Neither method addresses allergens in fungal structures
- Assays for fungal allergens, antigens, other fungal components, and DNA have been developed recently but the clinical relevance of some of these assays has not been validated or fully documented





# Bulk Identification and Sampling

- Visible fungal colonies
  - Mycelial mass
  - Unaided eye
  - Cellotape microscopy


Molded Mold

# Interpretation of sample results

- Dose-response relationships between exposure to fungi (or components) and symptoms lacking.
- No precise formula to distinguish “normal” or “typical” background levels or types of spores.
- Rank order analysis –relative abundance of mold types similar inside and outside, but overall levels inside should be lower.

# A Qualified Consultant Should:

- Understand moisture dynamics, building sciences, construction, sampling techniques, and how to interpret analytic results.
- Have the perspective / ability to recognize the boundary between the environmental assessment of a building and a medical diagnosis; … the discovery of mold growth does not always explain symptoms.

# Purpose of Remediation

- Restore area to clean and dry condition
- Physical removal of spores, fragments and bio-films

# Fungal Remediation

- Porous materials
  - Disposal
  - Extraction cleaning
- Non-porous
  - Surface cleaning
- Semi-porous
  - Clean
  - Dry

# Control of Fungal Contaminants

- Moisture control
- Source control
  - Cleaning
  - Removal
- Biocides??

# Biocides Antimicrobials

- Not a substitute for rapid and appropriate drying and removal of contaminated materials.
- Antimicrobial agents should not be used in place of moisture control, good cleaning practices and effective maintenance.

# Cleaning, Disinfecting or Sanitizing

Cleaning -- a physical process of removing soils, spores, hyphae and bio-films

Disinfecting or sanitizing -- killing or deactivation of microbial growth

- Cleaning is important because allergens are contained in spores hyphal fragments

# Verification of Remediation

How do you know the cleanup was effective?

- Inspect, verify, document critical control methods and work practices
- Verify moisture sources have been corrected
- No visible mold, damaged materials or odors
- Ultimately a judgment call

# Useful Instruments

- Nose
- Eyes
- Non destructive moisture meter
- Wood moisture meter
- Thermohygrometer
- Infrared thermometer
- Flashlight


TRAMEX
Moisture
Encounter
Scale 1. Wood, Timber.
Scale 2. Drywall, Roofing.
Scale 3. Plaster, Brick.
Non-Destructive Moisture Detection
Relative


LASER
MEASURE


MODEL DHM200


EXTECH
EXTECH

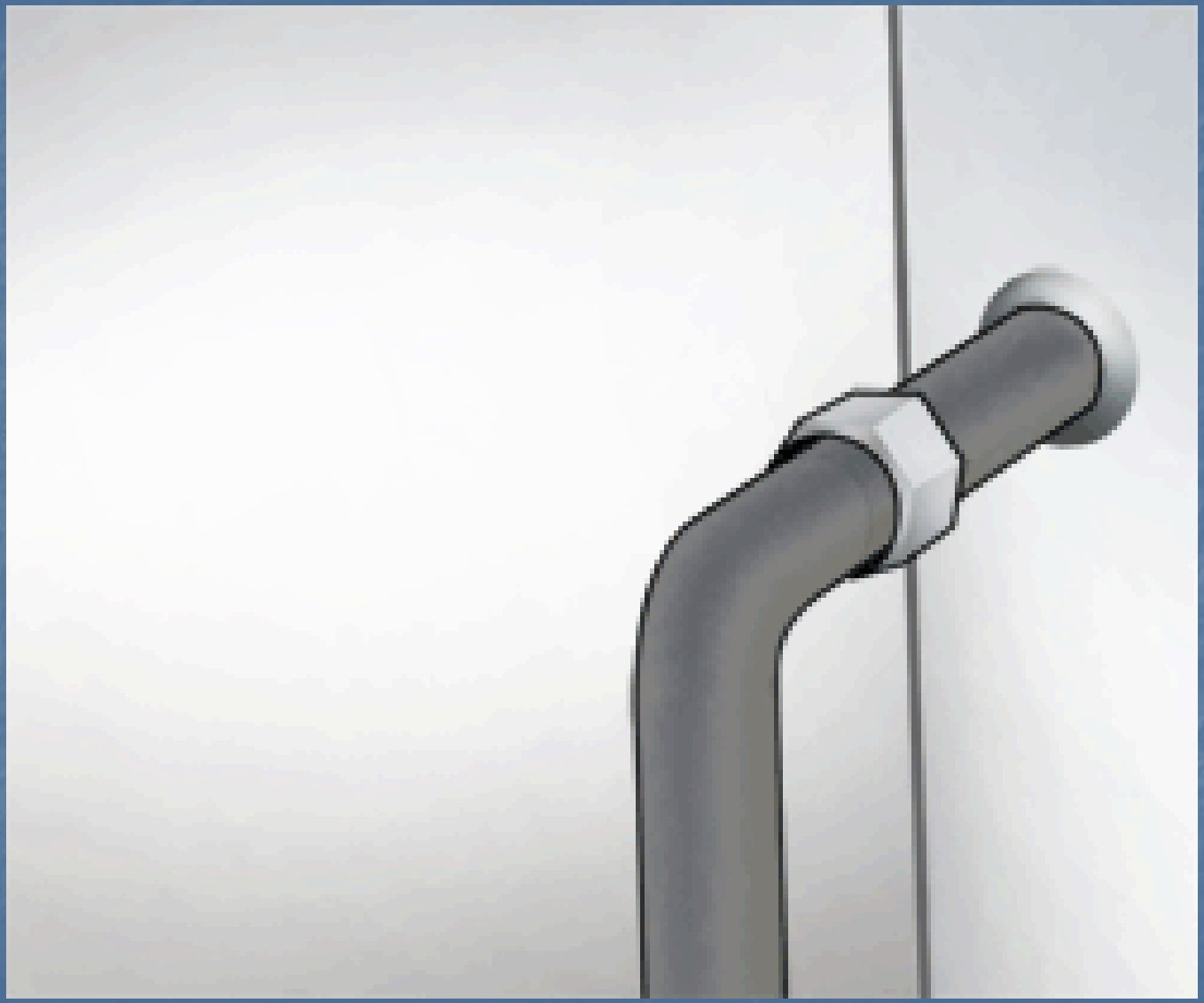
# Fungal Contamination Environmental Assessment

*Molds, Toxic Molds, and Indoor Air Quality*

- California Research Bureau, Pamela J. Davis, CRB Vol. 8, No. 1
- “Prudent public health practice might advise speedy clean-up or removal of heavily exposed populations from exposure as a first resort.”

# Prevent Mold Growth

- Time factor and microbial growth (exponential growth in favorable conditions)
  - Clean up spills, leaks, and water intrusions quickly
  - Remove water damaged materials
  - Remove flooded carpet and pad within 24 hours




EUREKA!