Some Types of Mold are:
(source: AEROTECH P & K)

**Actinomycetes**
**Phonetic:** Ack-tin-oh-my-seats

A distinct group of microorganisms defined by morphological criteria, basically their ability to grow as branching, filamentous cells that form spores or reproduce by fragmentation of hyphae. Because of their resemblance to fungi, the actinomycetes were once considered members of the Fungi Imperfecti. However, these organisms are not eukaryotic fungi, but prokaryotic bacteria (they do not have organelles). Most aerobic actinomycetes represent part of the indigenous microflora found in soil, mud, and dust; on the surfaces of vegetation, within decaying vegetation, in both fresh and marine water, and in decaying animal feces. This group is very tolerant of low moisture and high temperatures, and has the ability to survive without a food source for extended periods of time by becoming dormant. All of the medically important actinomycetes have been isolated from environmental reservoirs worldwide. Most actinomycetes are mesophilic, however thermophilic groups abound in manure and compost piles (causing the earthy smell).

**Mesophilic Actinomycetes:** The most clinically significant actinomycetes belong to the genus *Nocardia*, of which there are currently 12 accepted species. All of the infections in humans can be divided into the following six categories:

1. Pulmonary nocardiosis
2. Systemic nocardiosis
3. Central nervous system nocardiosis
4. Cutaneous, subcutaneous, & lymphocutaneous nocardiosis
5. Extrapulmonary localized nocardiosis
6. Nocardial mycetoma

In the U.S. the most common form of disease is pulmonary nocardiosis caused by *Nocardia asteroides*. In tropical regions, mycetoma caused by *N. brasiliensis* is most frequently diagnosed. A mycetoma is a chronic granulomatous disease that begins as a painless nodule at the site of a localized injury, such as a puncture wound from a thorn. With time the nodule increases in size and becomes purulent and necrotic, producing drainage tracts, which expand into surrounding tissue ultimately invading muscle and adjacent bones causing osteomyelitis. The incidence of nocardial infections in humans is not known, as few attempts to determine the prevalence of nocardiosis have been made. Several reports indicate that infections by these bacteria are not rare, are frequently misdiagnosed, or are under diagnosed, and that the incidence of infection is increasing.
The spectrum of disease caused by nocardia is broad and varies from a self limited, asymptomatic infection to an aggressive, destructive disease resulting in death. Every category of nocardial infection described above has been diagnosed in previously healthy adults. However, the nocardiae are frequently being recognized as emerging opportunistic pathogens; the most common underlying predispositions include organ transplantation, malignancies, the use of corticosteriods, alcohol abuse, diabetes, or other debilitating factors.

Thermophilic Actinomycetes: Allergic respiratory disease caused by the actinomycetes is referred to as farmer’s lung, a hypersensitivity reaction from repeated exposure to antigens produced by the actinomycetes, particularly the thermophiles. The most common actinomycetous agents of farmer’s lung are Micropolyspora faeni and Thermoactinomyces vulgaris. These organisms do not represent all of the possible etiological agents of the syndrome however; they represent a majority of the cases reported. Thermophilic actinomycetes are usually found in closed barns, silos, grain mills, bagasse (sugar cane waste), and poorly maintained air conditioning ducts.

Actinomycetes may also cause other diseases such as ocular infections, periodontal disease, and abscess formations, which can infect humans and animals. Most infections are slowly developed and tend to be chronic.

**Alternaria**

**Phonetic:** All-tur-nair-ee-uh

Alternaria is a large and widespread genus, the conidia of which are easily carried by the wind, with peak concentrations in the summer and early fall. Alternaria is commonly found in house dust, carpets, textiles, on horizontal surfaces in building interiors, and window frames. It is one of the main fungal causes of allergy, being a common type I & III allergen. Outdoors, it may be isolated from samples of soil, seeds and plants, and is frequently reported in air. The large spore size suggests that this fungus will deposit in the nose, mouth and upper respiratory tract causing nasal septum infections. It has also been associated with hypersensitivity pneumonitis. It is a common cause of extrinsic asthma. Acute symptoms include edema and bronchiospasms; chronic cases may develop pulmonary emphysema. Baker’s asthma is associated with inhalation of Alternaria conidia present in flour. Other diseases caused by Alternaria include: Farmer’s lung, mycotic keratitis, skin infections, and osteomyelitis. Also, the species A. alternata is capable of producing tenuazonic acid and other toxic metabolites that may be associated with disease in humans or animals. Several species are pathogenic to plants and contribute to the spoilage of agricultural products. Alternaria has been isolated from substrates such as sewage, leather, stone monuments, optical instruments, cosmetics, computer disks, and jet fuel. Morphological characteristics include abundant production of conidia that are large (18-83 x 7-18 microns) and multicellular with both transverse and longitudinal septa; conidiophores are dark, mostly simple. Colonies grow fast, are suede-like to floccose, and black to olivaceous-black or grayish in color. (Aw–0.85-0.89)
**Ascospore**
**Phonetic:** Ask-oh-spore

Ascospores are a general category of spores that have been produced by means of sexual reproduction (in a sack-like structure called an ascus). These are ubiquitous saprobes and plant pathogens, many of which are easily identifiable (i.e. Chaetomium). This group contains potential opportunistic pathogens, toxin producers, and allergens depending on the genus and species. A rupture in the top portion of the ascus disperses the spores during rain or in times of high humidity. Some asexual fungi, such as Aspergillus and Penicillium can become sexual under specific conditions, these are then considered ascomycetes and are given distinct names.

**Aspergillus**
**Phonetic:** Ass-purr-jill-us

Aspergillus is a common type I & III allergen. They are frequently isolated from forest products, soils, grains, nuts, cotton, organic debris, and water damaged building materials. Spores can also be found in moist ventilation systems and house dust. There are more than 160 different species of Aspergillus, sixteen of which have been documented as etiological agents of human disease but rarely occur in individuals with normally functioning immune systems. However, due to the substantial increase in populations of individuals with HIV, chemotherapy patients and those on corticosteroid treatment, contamination of building substrates with fungi, particularly Aspergillus is of concern. Aspergillosis is now the second most common fungal infection requiring hospitalization in the United States. Many Aspergillus species produce mycotoxins that may be associated with diseases in humans and other animals. Toxin production is dependent on the species or strain within the species and on the food source for the fungus. Some of these toxins, such as aflatoxins and ochratoxin are carcinogenic. Aspergillus is a common cause of extrinsic asthma with symptoms including edema and bronchospasms, and chronic cases may develop pulmonary emphysema. These fungi are frequently secondary opportunistic pathogens in patients with bronchiectasis, carcinoma, other mycoses, sarcoid, and tuberculosis. Some species can also cause onychomycosis (infection of the nail). (A_m = 0.71 – 0.94).

**Aspergillus fumigatus**
**Phonetic:** Ass-pur-jill-us fume-uh-got-us

Aspergillus fumigatus is a saprobe with worldwide distribution. It is common in house dust, both outdoor and indoor air, in different types of soil, on decaying plant material, compost, wood chips, bird feathers and droppings, and also on hay and crops. It is also an important
causal agent of systemic mycosis in domestic animals and in humans, especially the immunocompromised. Aspergillus fumigatus has also been reported to cause allergies, asthma, and rhinitis. This fungus produces a large number of mycotoxins and tremorgenic metabolites. It is an important human pathogen, being the most common cause of aspergillosis. A. fumigatus is a thermotolerant fungi and can grow at temperatures up to 50°C. This species is typically fast growing and is blue-green in color. (Aw-0.82 - >0.97)

**Aspergillus versicolor**  
*Phonetic: Ass-purr-jill-us ver-see-color*

Aspergillus versicolor can be found mostly in temperate areas in air, house dust, foods, soils, hay, cotton, and dairy products. Its presence in indoor air often indicates moisture problems in buildings, as it is readily found in water damaged building materials. This species produces the mycotoxin sterigmatocystin, which is reported to be carcinogenic to the liver and kidney, and it can cause such symptoms as diarrhea and upset stomach. It also produces the volatile organic compound (VOC) geosmin, which causes irritation of the mucus membranes of humans and pets, and also causes the characteristic musty, earthy odor often connected with moldy houses. A. versicolor may be in various colors, as the name implies, and displays great variety in colony pattern and size. (Aw-0.78)

**Basidiospore**  
*Phonetic: Buh-cyd-ee-oh-spore*

Basidiospores are a general category of sexual spores that have been released from the basidium of a fungus. A ubiquitous type I & III allergen, saprobe and plant pathogen, mainly found in gardens, forests, and woodlands. Spores disseminate during rain or in times of high humidity. Rarely opportunistic pathogens, Basidiospores may produce toxins, including amanitins, monomethyl-hydrazine, muscarine, ibotenic acid, and psilocybin. Basidiospores are an agent of dry wood rot, which may destroy the structure wood of buildings.

**Candida**  
*Phonetic: Can-deed’-uh*

Candida is a yeast that includes about 154 species, six of which are frequently isolated in human infections. It is a part of the normal flora of skin and other mucous membranes in the body. This fungus is naturally found on leaves, flowers, water, organic debris and in
soils. The infections caused by this genus are referred to as candidiasis, and almost any organ or system in the body can be affected. It is the cause of infections such as thrush (mouth infection), esophagitis (esophagus infection), cutaneous candidiasis (skin infection), vaginal yeast infections, and deep candidiasis (blood infection). Overgrowth of this fungus is prevented by the presence of “good” bacteria and by the body’s immune system; if antibiotics decrease the number of bacteria, or if the person’s immune system is weakened because of illness, malnutrition or medications, Candida can multiply and cause symptoms. These species account for more than 85% of all hospitalizations from fungal infections. Mucocutaneous candidiasis is one of the most common manifestations of HIV infection. The environment is not a likely source of exposure for this fungus, and cells from this organism are not usually airborne. Candida albicans is the organism isolated most from patients. Most species of yeast reproduce asexually through a process called budding. The daughter cell is at first much smaller and tends to cling to the parent cell; clumps or chains of cells are often formed. (A_w-062-0.92)

Cladosporium
Phonetic: Clad-oh-spore’-ee-um

Cladosporium is widely distributed in air and rotten organic material. C. herbarum is the most frequently found species in outdoor air in temperate climates. It is often found indoors, usually in lesser numbers than outdoors. The dry conidia become easily airborne and are transported over long distances. This fungus is often encountered in dirty refrigerators, especially in reservoirs where condensation is collected. It can easily be seen on moist window frames covering the whole painted area with a velvety olive-green layer. Cladosporium often discolors interior paint, paper, or textiles stored under humid conditions. Houses with poor ventilation, houses with thatched straw roofs and houses situated in damp environments may have heavy concentrations of Cladosporium, which will be easily expressed when domestic mold is analyzed. It is commonly found on the surface of fiberglass duct liners in the interior of supply ducts. It is also found naturally on dead & woody plants, food, straw, soils, paint, and textiles. The ability to sporulate heavily, ease of dispersal, and buoyant spores makes this fungus the most important fungal airway allergen; and together with Alternaria, it commonly causes asthma and hay fever in the Western hemisphere. A few species of this genus cause disease, which range from phaeohyphomycosis, a group of mycotic infections characterized by the presence of demataceous septate hyphae. Infections of the eyes and skin by black fungi (also classified as phaeohyphomycosis), and chromoblastomycosis, chronic localized infection of the skin and subcutaneous tissue that follows the traumatic implantation of the etiologic agent are also caused by this fungus. Chromoblastomycosis lesions are verrucoid, ulcerated, and crusted. Skin abscesses, mycotic keratitis and pulmonary fungus ball have been recorded in immunocompromised patients. It may also cause corneal infections and mycetoma, characterized by localized infections that involve cutaneous and subcutaneous tissue, fascia, and bone consisting of abscesses, granulomata, and draining sinuses, usually in immunocompromised hosts.
Cladosporium produces the toxins cladosporin and emodin, but neither of these is very toxic. Fungal colonies are powdery or velvety olive-green to olive-brown. Other characteristics include dark conidia that are 1- or 2-celled and are variable in shape and size, typically ovoid to cylindrical in shape. (A_w = 0.84 – 0.88)

**Fusarium**

**Phonetic:** Few-sarh-ee-um

Fusarium is a type I allergen and is an opportunistic pathogen commonly found in soil, plants, grains, and often in humidifiers. While most of the species are found in tropical and subtropical areas, some are found in the soil of cold climates. Some species are plant pathogens causing root and stem rot, vascular wilt or fruit rot, and all require extremely wet conditions for growth. This fungus is the most common cause of mycotic keratitis. It has been isolated from skin lesions of burn patients, nail infections, ear infections, varicose ulcer, mycetoma, osteomyelitis following trauma, and disseminated infections. Infections due to Fusarium are commonly referred to as fusariosis. This fungus produces very harmful toxins, especially in storage of infected crops. These toxins, known as trichothecenes (scierpene) target the circulatory, alimentary, skin, and nervous systems. Fusarium can also produce Vomitoxin, T-2 toxin, Fumonisin, and Zearalenone. Vomitoxin is produced on grains, which has been associated with outbreaks of acute gastrointestinal illness in humans. T-2 Toxin and related trichothecenes are some of the deadliest known toxins. If ingested in sufficient quantity, T-2 toxin can severely damage the entire digestive tract and cause rapid death due to internal hemorrhage. Fumonisin, commonly found in corn and corn based products, has recently been associated with outbreaks of veterinary mycotoxicosis causing "crazy horse disease". Zearalenone toxin is similar in chemical structure to the female sex hormone estrogen and targets the reproductive organs. *Fusarium* is one of the most drug resistant fungi. Morphological characteristics of this fungus include extensive cotton-like mycelium in culture, often with some tinge of pink, purple or yellow. (A_w = 0.86 - 0.91)

**Microsporum**

**Phonetic:** Micro-spore-um

Microsporum is a widespread cutaneous fungus, classified as a dermatophyte. This genus includes 17 species, 5 of which are isolated primarily from humans (anthropophilic), 7 from animals (zoophilic), and the rest primarily from soil (geophilic). It is the asexual state of the fungus. The telemorph phase is referred to as the genus Arthoderma. This fungus is one of the genera to cause dermatophytosis which is a general term used to define infections of the hair, skin, or nails due to a dermatophyte species. It has the ability to degrade keratin and can reside on skin and its appendages and remains noninvasive. The pathogenesis of the infection depends on the natural reservoir of the species. This genus is the cause of
A large number of organisms belong to this genus, and identification to species is difficult. Often found in aerosol samples, it is common in soil, food, cellulose, paint, grains, and compost piles. In the indoor environment it is in carpet, wallpaper, and in interior fiberglass duct insulation. Although this fungus causes fewer allergies than other molds, Penicillium is reported to be a type I & III allergen. It may cause hypersensitivity pneumonitis and allergic alveolitis in susceptible individuals. It can cause other infections such as keratitis, penicilliosis, and otomycosis. Some species can produce mycotoxins including Ochratoxin, which is damaging to the kidneys and liver and is also a suspected carcinogen; there is also evidence that impairs the immune system. It also produces Citrinin that can cause renal damage, vasodilatation, and bronchial constriction and Gliotoxin, which is immunosuppressive. Patulin is another of its mycotoxins that is believed to cause hemorrhaging in the brain and lungs and is usually associated with apple and grape spoilage. It can also cause extrinsic asthma. P. camemberti has been responsible for inducing occupational allergies among those who work with soft white cheeses on which the fungus grows (cheese washer’s lung). P. marneffei is the major pathogenic species causing infections of the lymphatic system, lungs, liver, skin, spleen, and bone, and is also the only species of the genus to have a yeast-like phase induced by temperature. Penicillium sp. are recognized by their dense brush-like spore-bearing structures. ($A_w$ -0.78-0.86).

**Stachybotrys**  
**Phonetic:** Stack-ee-bought-riss

Stachybotrys is commonly found in sub-tropical to tropical areas in soil and decaying plant materials, and is considered a type I & III allergen. Considerable recent media attention has been focused on the fungi Stachybotrys chartarum (atra) due to infant deaths in Cleveland from pulmonary hemosiderosis, which may be associated with contamination of residences with this fungus. Stachybotrys thrives on water damaged cellulose rich materials such as sheet rock, paper, ceiling tiles, cellulose containing insulation backing and wallpaper. The presence of this fungus in buildings is significant because of the mold’s ability to produce mycotoxins, such as Satratoxin H, Trichoverrol, and Cyclosporins that
possess cytotoxic, immunological, carcinogenic effects. Exposure to these toxins can occur through inhalation, ingestion or dermal exposure. Symptoms include dermatitis, cough, rhinitis, nose bleeds, a burning sensation in the mouth and nasal passage, cold and flu symptoms, headache, general malaise, and fever. Inhalation of conidia may also induce pathological changes (pneumomycotoxicoses). Satratoxin H has been reported to be abortogenic in animals and in high doses or chronic low doses it can be lethal. S. chartarum (atra) produces other macrocyclic and trichovertoid trichothecenes and, like Memnoniella echinata, produces phenylspirodrimanes, which are immunosuppressive. Stachybotrys typically appears as a sooty black fungus occasionally accompanied by a thick mass of white mycelia. Memnoniella differs from Stachybotrys by producing conidia in chains. As a general rule, air sampling for Stachybotrys yields unpredictable results mainly due to the fact that this fungus is usually accompanied by other fungi such as Aspergillus and Penicillium that normally are better aerosolized than Stachybotrys. Bulk or surface sampling of suspect materials can be analyzed in a laboratory for identification by light microscopy. This fungus is a slow grower on media, therefore does not compete well with other rapidly growing fungi. Colonies are powdery in texture, white, pink, orange or black in color. The species S. chartarum (atra) produces colonies black in color. (Aw-0.91 - >0.98)

Trichoderma
Phonetic: Trick-oh-derm-uh

Trichoderma is a widespread saprobe in temperate to tropical areas commonly found in soil and wood. Trichoderma is often found in polluted waters, dung, sewage plants and driftwood. It can be found on paper, and in wood construction and mineral fiber panels. This fungus is highly cellulolytic, and some species are considered to be parasitic on other fungi. Trichoderma is reported as a type I & III allergen. Inhalation of the conidia or the microbial volatile organic compounds (mVOC) may cause symptoms similar to those of Stachybotrys reactions. The species T. viridae is often isolated from indoor air samples and house dust. This species is used in commercial beer, wine and food processing. T. viridae has also been reported from a case of infection of a lungs (fungus ball), and cases of peritonitis (an infection or inflammation of the membrane that covers the surfaces of the organs in the abdomen). Conidia are 1-celled, oblong, smooth, green, and occur in balls or small wet masses at the tips of the phialides (bottle shaped cells that produce conidia). The colonies are fast growing, flat to cottony, white to green-yellow in color.
Ulocladium
Phonetic: You-low-clad-ee-um

Ulocladium is reported to be a major type I allergen. This saprobe (weak parasite) is widespread and commonly found on plant materials, soils, dung, grass, compost, and textiles. Some species are cellulolytic and can grow on water-damaged building materials. Ulocladium is also found in dust and air samples; and indoors on carpets and painted surfaces. This mitosporic (lacks a sexual state) fungus has been reported from cases of phaeohyphomycosis (cutaneous and subcutaneous infections caused by dematiaceous (dark-walled) fungi). Infection sites for susceptible hosts vary widely. Conidia are dark brown to black, egg-shaped to cylindrical, solitary, smooth or rough, divided into several cells by transverse, longitudinal walls. The colonies are moderately fast growing, wooly to cottony or velvety, olive-brown to black or grayish in color. ($A_w$ - 0.89).

Yeast

Yeasts are found worldwide in a variety of natural habitats or organic substrates such as plant leaves, flowers, soil, and salt water and are often able to grow at reduced oxygen levels. They can also be found on the skin surfaces and in the intestinal tracts of warm-blooded animals, where they might be considered parasites, but can live symbiotically. Some yeast is reported to be allergenic, and may cause problems in individuals with previous exposure and developed hypersensitivities.

Yeasts are unicellular fungi, spherical to oval, 2.5 to 6 μm in diameter that reproduce asexually through a process called budding. This daughter cell is at first much smaller and tends to cling to the parent and often clumps, or chains of cells, are formed. Yeasts are separated into three groups: 1) Blastomycetes, with no known sexual stage (Fungi Imperfecti); 2) Ascomycota (Hemiascomycetes), which produce ascospores as a result of sexual reproduction; and 3) Blastomycota (Heterobasidiomycetes), which form basidiospores as a result of sexual reproduction. Yeast colonies grow rapidly and appear smooth & glabrous, or pasty, moist or dry, white to cream in color, but some may be tan, pinkish or orange.

Yeasts most commonly isolated from human sources include Candida (candidiasis), Cryptococcus (cryptococcosis), Torulopsis (torulopsosis), Trichosporon (trichosporonosis), Geotrichum and many others causing miscellaneous infections. Yeast infections are among the most common fungal infections in humans. Their form ranges from localized cutaneous or mucocutaneous lesions, to fungemia or disseminated systemic mycoses. Candida albicans is the most frequent yeast pathogen isolated because of their part in the normal flora of the gastrointestinal tract and female urogenital area.
The most well-known commercially significant yeast are the species of Saccharomyces cerevisiae, which is used in the production of several types of beers, or known as Brewer’s yeast. It is also known as Baker’s yeast and is used for other types of fermentation. Yeast is often taken as a vitamin supplement because it is 50% protein and is also a good source of B vitamins, niacin, and folic acid. ($A_w$-0.61-0.95)

**Zygosporium**

**Phonetic:** Zigh-go-spore-ee-um

Zygosporium is a widespread mitosporic (lacks a sexual state) fungus commonly found in subtropical to tropical areas on dead leaves and wood, and occasionally from soil. This saprobe (weak parasite) has been found growing indoors on damp walls, and also on cheese. The species Z. mansonii can produce Cytochalasin D, which is used mainly in fermentation processes. The conidial size ranges from 4 μm – 7.2 mm and may be minutely roughened depending on the species.

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