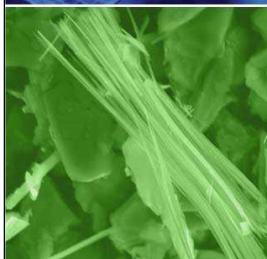




CENTER FOR
ENVIRONMENTAL
TRAINING



Allergens and Allergic Disease

Will begin at 9:00 a.m. (Pacific)
Participants will be in listen-only mode.

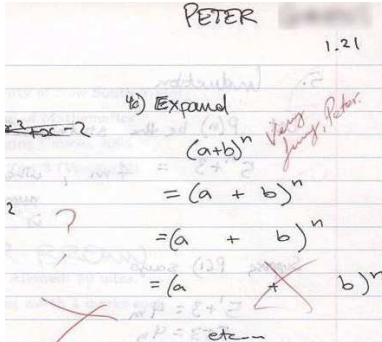
Download the PDF of this presentation (case sensitive):
<http://www.emlab.com/m/media/allergens-webinar.pdf>

Presented by:
Harriet A. Burge, Ph.D.



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To receive a certificate of attendance, you must complete the survey after the webinar:

- Click on the survey link in the "Thank you" email (sent 1 hour after this webinar).
- Complete survey by this Friday, July 15, 2016.
- You will receive an email in 2-3 weeks with instructions when your certificate is ready.



Introduction: Immune-mediated Hypersensitivity

- Type 1: Immediate hypersensitivity (allergy)
- Type 2: Cytotoxic
- Type 3: Immune complex disease
- Type 4: Delayed hypersensitivity
- Type 5: Autoimmune disease
- * Caused by environmental antigens



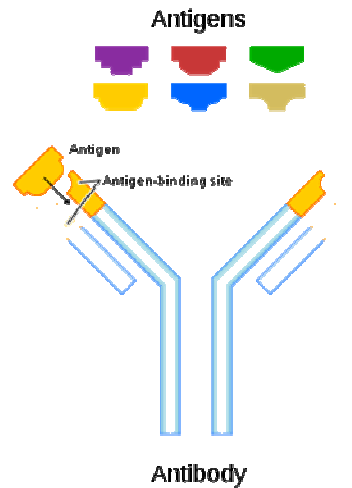
Type I Hypersensitivity

- Caused by allergens, which are antigens capable of stimulating a type I hypersensitivity response (i.e., an allergy via an IgE antibody response.
- Most humans mount significant Immunoglobulin E responses only as a defense against parasitic infections.
- Atopic individuals may respond to many common environmental antigens
- Sensitivities vary widely from one person (or other animal) to another. A very broad range of substances can be allergens to sensitive individuals.



A Few Terms

- **Antigen:** A substance that stimulates an immune response, esp. production of antibodies.
- **Antibody:** One of a variety of proteins called immunoglobulins
 - Normally present in the body or produced in response to an antigen
 - IgA, IgD, IgE, IgG, IgM



Source: <http://en.wikipedia.org/wiki/Antigen>



Antigen: An antigen is a substance or molecule that when introduced into the body triggers the production of an antibody by the immune system which will then kill or neutralize the antigen that is recognized as a foreign and potentially harmful invader. These invaders can be molecules such as pollen or cells such as bacteria. Can have Exogenous antigens, entered the body from the outside. Endogenous antigens, generated inside due to things like infections, or autoantigens where the immune system is attacking the body due to an autoimmune disease.

Antibodies (also known as immunoglobulins[1], abbreviated Ig) are gamma globulin proteins that are found in blood or other bodily, and are used by the immune system to identify and neutralize foreign objects, such as bacteria and viruses.

Antibodies can come in different varieties known as isotypes or classes. In placental mammals there are five antibody isotypes known as IgA, IgD, IgE, IgG and IgM. They are each named with an "Ig" prefix that stands for immunoglobulin, another name for antibody, and differ in their biological properties, functional locations and ability to deal with different antigens, as depicted in the table.[14]

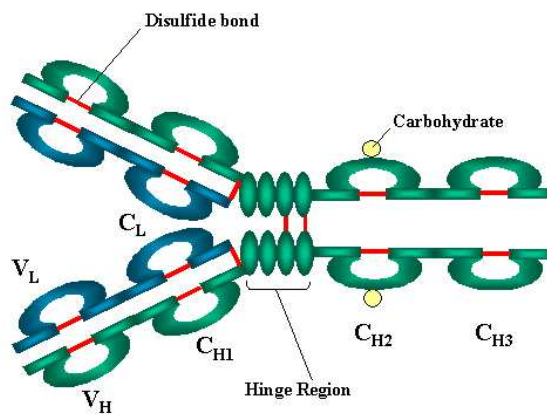
Definitions: Allergens/Antigens

- Antigen (an' tī-jen) any substance capable of inducing a specific immune response and of reacting with the products of that response, i.e., with specific antibody or specifically sensitized T lymphocytes (blood cells), or both.
- An allergen is a usually harmless antigen capable of triggering a response that starts in the immune system and results in an allergic reaction. (AAAAI)

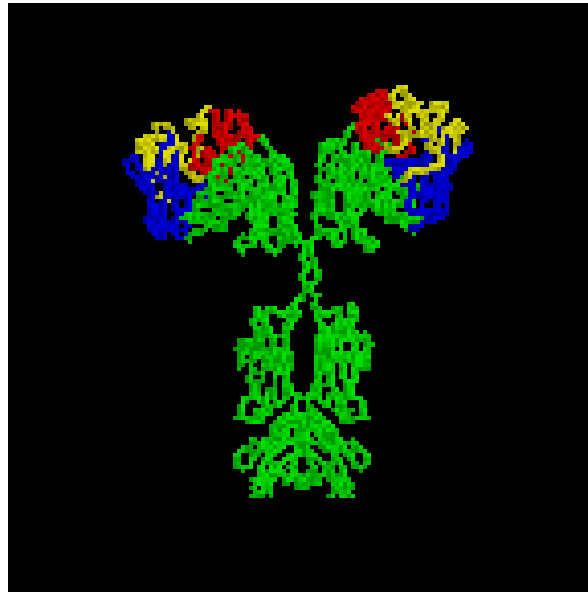


Definitions: Antibodies

- Immunoglobulins are glycoprotein molecules that are produced by plasma cells in response to an immunogen (antigen) and which function as antibodies.



Immunoglobulin



Immunoglobulin Classes

Immunoglobulins can be divided into five different classes, based on differences in the amino acid sequences in the constant region of the heavy chains. All immunoglobulins within a given class will have very similar heavy chain constant regions.

1. *IgG - Gamma heavy chains*
2. *IgM - Mu heavy chains*
3. *IgA - Alpha heavy chains*
4. *IgD - Delta heavy chains*
5. *IgE - Epsilon heavy chains*



IgG

IgG is the most versatile immunoglobulin because it is capable of carrying out all of the functions of immunoglobulin molecules

a) IgG is the major Immunoglobulin in serum - 75% of serum Immunoglobulin is IgG

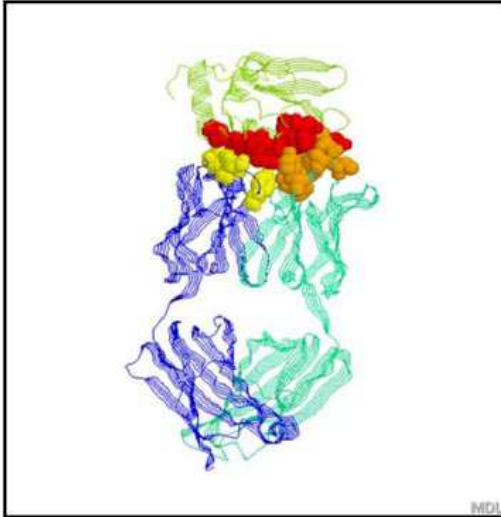


IgE

- a) IgE is the least common serum Ig since it binds very tightly to basophils and mast cells even before interacting with antigen
- b) Involved in allergic reactions - As a consequence of its binding to basophils and mast cells, IgE is involved in allergic reactions. Binding of the allergen to the IgE on the cells results in the release of various pharmacological mediators that result in allergic symptoms
- c) IgE also plays a role in parasitic helminth diseases



Antigen-Antibody Reactions



Lock and Key Concept

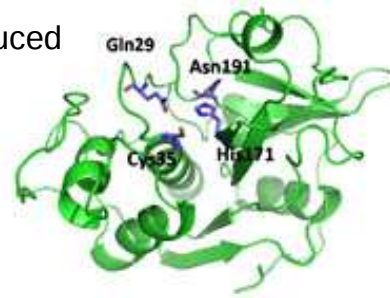
- The antigen (the key) fits into a lock (i.e. the antibody).

Source: Li, Y., Li, H., Smith-Gill, S. J.,
Mariuzza, R. A., Biochemistry 39, 6296, 2000



Allergy

- Genetically controlled
- Sensitization thought to require repeated low-level exposures to allergens
- Allergens are complex proteins produced by many different organisms
 - Dust mites, cockroaches
 - Cats, dogs, other pets
 - Rats, mice
 - Fungi
 - Plants
- Symptoms include upper respiratory (hay fever), lower respiratory (asthma), systemic (anaphylaxis), and skin (hives).



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Once sensitization has been accomplished, the next exposure may cause symptoms.

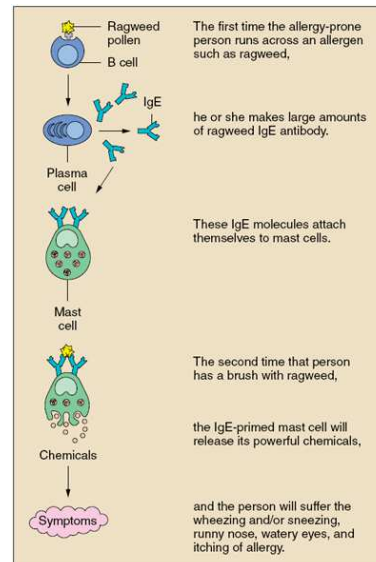
Symptoms may be present simultaneously.

IgG helps with antibody based protection against pathogens. Infrequently, inappropriate sensitization can lead to hypersensitivity pneumonitis.

Other factors may play a role in sensitization. For example, ADJUVANTS (immunostimulants) may stimulate a stronger response than the allergen alone. For example, the fungus *Alternaria* has adjuvant-like properties that stimulate sensitization in the lower airways. (Kobayashi et al., 2009). Holt et al., 2009 postulate that early failure of the innate mucosal immune system predisposes some infants and young children to respiratory infections and the development of allergies. This predisposition is probably genetically controlled.

Allergy

- Allergy is an inappropriate over-reaction of our immune system.
- IgE antibodies are produced by B cells in response to allergen exposure
- IgE molecules attach to Mast cells.
- Mast cells release Histamine and other chemicals



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Food allergies are included in this.

A family history is the strongest risk factor for the development of allergies or asthma.

Overwhelming evidence that sensitization to indoor allergens is a major risk factor for the development of clinical atopic (allergic reaction) disease in genetically susceptible individuals.

Some non-intuitive evidence exists that early exposure to cats, or dogs; or living on a farm or being exposed to endotoxins reduces the risk of developing certain allergies or asthma.

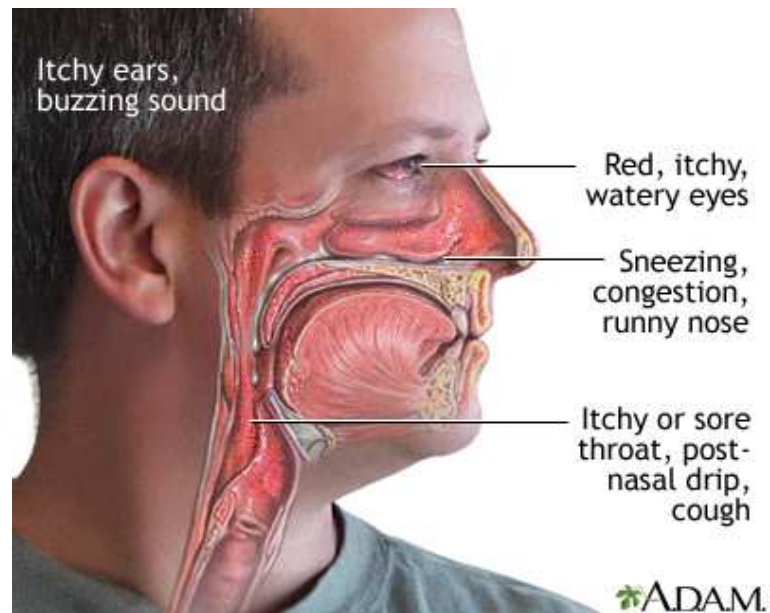
Current theories for causes of the increase in asthma include: better diagnosis, urban living, higher exposure to dust mites, atmospheric pollution, nutrition, lifestyle changes, maternal smoking, diesel fumes, geography, the hygiene hypothesis, and others.

IgE-mediated Symptoms

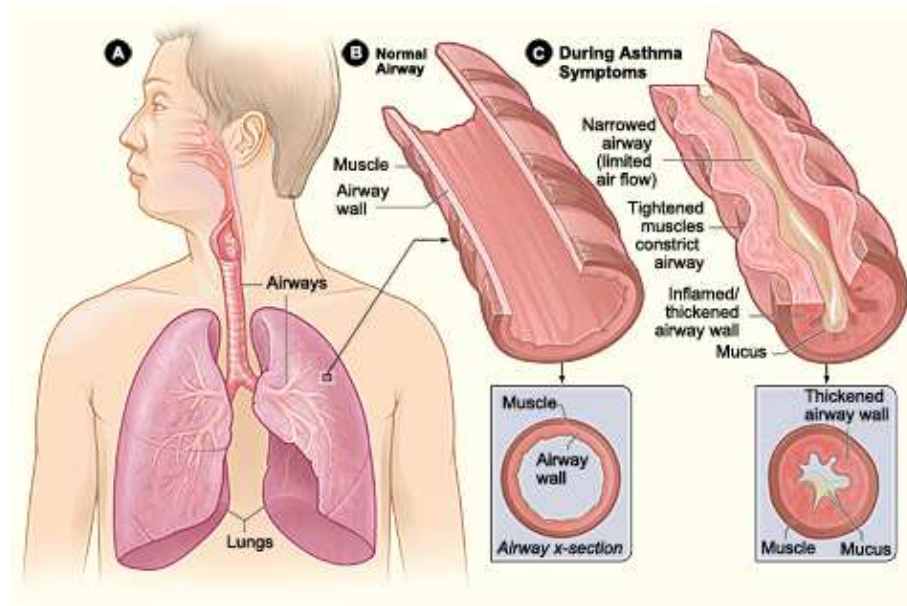
- Hay fever
- Asthma
- Allergic bronchopulmonary mycoses
- Atopic dermatitis (eczema)
- Anaphylaxis



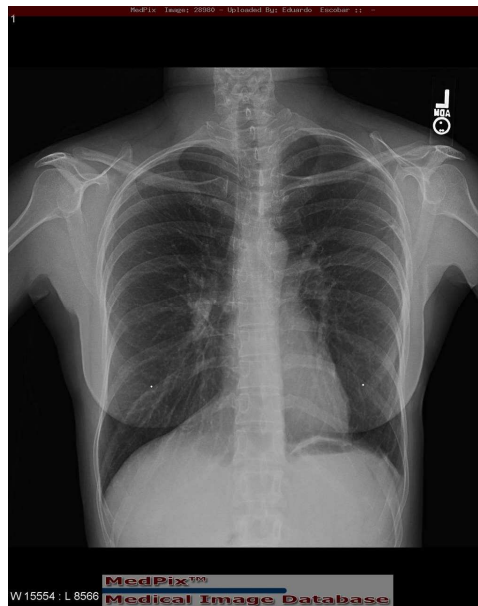
Hay Fever



Asthma



Allergic Bronchopulmonary Mycoses



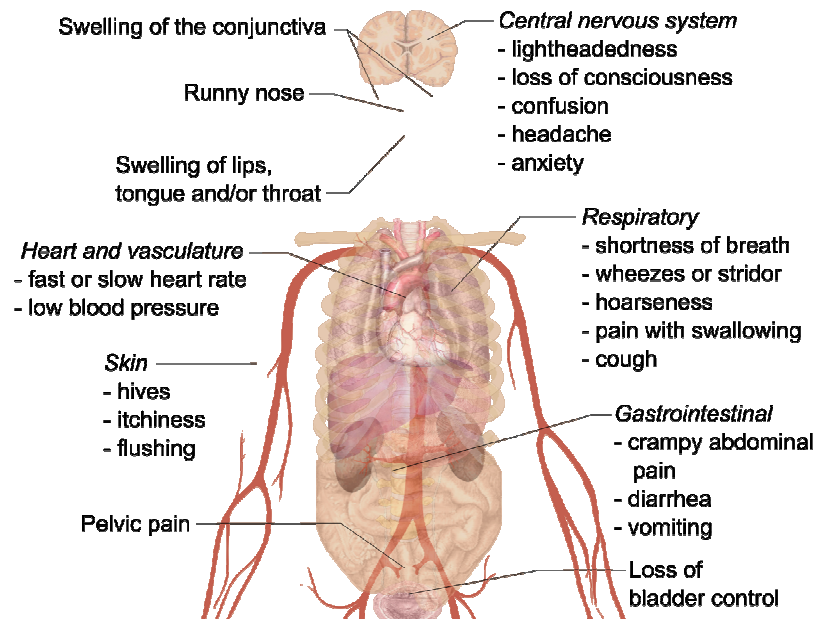
Atopic Dermatitis (Eczema)



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Signs and Symptoms of Anaphylaxis



What Are Allergens?

Allergens are proteins derived from:

- Airborne particles: pollen, fungal spores, dust mite fecal particles, cat and dog skin secretions, rat and mouse urine, and others
- Food
- Stinging insect venom
- Pharmaceuticals



The Allergens

- Allergens are named according to the species from which they are derived and the order in which they are identified:
 - Ragweed: *Ambrosia artemesiifolia* = Amb a 1
 - Alternaria: *Alternaria alternata* = Alt a 1
 - Dust mite: *Dermatophagoides farinae* = Der f 1



Some Indoor Sources of Allergens

Organism	Some allergens	Some sources within organism	Some exposure sources
Dust mites	Der f1, Der p1, Blo t1, etc.	Fecal material	Dust, especially bedding
Cockroaches	Bla g1, Bla a1	Skin secretions	Dust, especially, kitchens
Cats	Fel d1, etc.	Skin secretions	Airborne, accumulates in dust
Dogs	Can f1	Skin secretions	Airborne, accumulates in dust
Rodents	Rat r1, Mus m1	Urine	Airborne, accumulates in dust
Fungi	Alt a1, Pen c1, Asp v1, etc.	Digestive enzymes	Airborne with spores, accumulates in dust



Most bacteria do not produce IgE stimulating allergens. However, some Gram positive bacteria can stimulate IgG and can sensitize cells in the lung leading to hypersensitivity pneumonitis.

In domestic environments, source control and removal is by far the most effective approach to reducing allergen exposure.

Remember

- The organism isn't the allergen. A good example:
 - Cat (*Felis domesticus*) allergy is an inhalant disease, but one does not inhale a cat. One inhales tiny particles shed from the cat that contain a group of proteins called Fel d 1, Fel d 2, etc.



Inhalant Allergen Sources

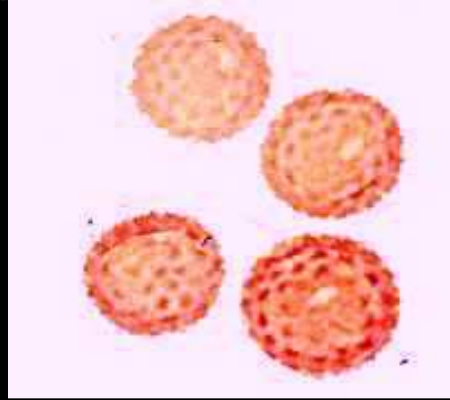
Pollen: The male reproductive structure of vascular plants

- The allergens are recognition proteins that trigger germination when the grain lands at an appropriate site for fertilization of an egg.
- The allergens are soluble and are released quickly in respiratory tract secretions
- Exposure is mostly outdoors.
- Plants with showy flowers release little pollen





© Patrick J. Alexander





Pollen Allergy Research

- Darrow, LA. Hess, J; Rogers, CA.; et al. 2012. Ambient pollen concentrations and emergency department visits for asthma and wheeze JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY 130(3): 630-
- Asthma ER visits increase up to 15% when Oak and grass pollen concentrations peak in Atlanta, GA



Inhalant Allergens

Fungal spores: sexual or asexual reproductive units of fungi

- The allergens are digestive proteins that are released into the environment to digest food.
- These proteins are released as the spore absorbs water, and release is often delayed until sufficient water has been absorbed.
- Exposure is mostly outdoors
- Indoor fungal growth can occur when liquid water is consistently present



Mold



- Most molds produce potential allergens
- Mold allergens are proteins. Two commonly identified mold allergens are *Alt a1* and *Asp f1*
- Well documented evidence exists for mold as a cause of allergic disease (asthma, hay fever, upper respiratory allergies, hypersensitivity pneumonitis)
- 30 to 35% of the population can have allergic response to the environment. 1/3 of these (10% of the population) may have fungal allergies



We don't do these assays anymore.

Fungal allergens are generally proteins, and are often enzymes released from the fungal spore during germination, although some may also be proteins located on the surface of spores. For surface allergens, the spore may not need to be living to cause sensitization. However, internally produced allergens must be released from the cell before they can be effective. Fungi with hydrophilic cell walls (e.g., *Fusarium*, *Acremonium*, *Stachybotrys*, and many others) may release internal allergens as soon as they contact a water source (e.g., the respiratory mucosa). Whether or not these spores need to be living has not been studied, although it is likely that long dead spores would not have retained the intact allergens. Hydrophobic fungal spores have an outer surface composed of rodlets called hydrophobins. A pathway must develop through these hydrophobins before internal allergens can be released. This pathway occurs during spore germination. Thus, for allergens to be released from hydrophobic spores, the spore must be alive. (Aimanianda et al., 2010; Dague et al., 2008).



Fungal Allergen Research

- O'Driscoll BR, Powell G, Chew F. 2009 Comparison of skin prick tests with specific serum immunoglobulin E in the diagnosis of fungal sensitization in patients with severe asthma CLINICAL AND EXPERIMENTAL ALLERGY 39(11): 1677-1683
- 65% of severe asthmatics are sensitized to fungal allergens



Inhalant Allergen Sources

Dust mites

- The allergens are digestive proteins excreted by the mites in membrane bound fecal balls
- Generally airborne only during active disturbance
- Exposure occurs indoors, mostly in bed
- High humidity required; mites absorb water directly from air.



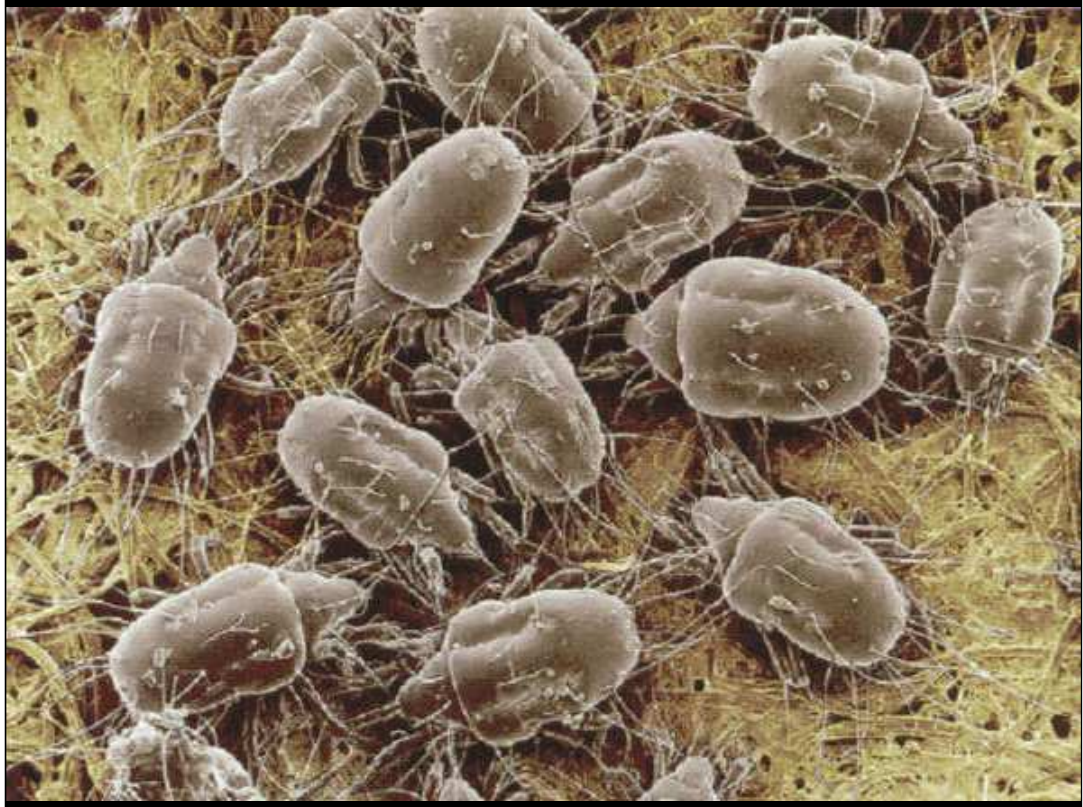
Dust Mites



- **Two most common house dust mites:**
 - American dust mite (*Dermatophagoides farinae*)
 - European dust mite (*Dermatophagoides pteronyssinus*)
- Very small, invisible to the unaided eye.
- Live for approximately 3-4 months.
- Prefer warm, moist areas (mattresses, pillows, carpeting and upholstery)
- **Cause of asthma and allergy:**
 - Approximately 85% of asthmatics are allergic to dust mite allergens
 - Evidence exists for a causal relationship between dust mite exposure and the development of asthma



Humans shed 1/5 oz dander/week. Could feed several thousand mites for 3 months.
Do not bite, not known to transmit disease.
2 micrograms of allergen/gram of dust felt to be enough for sensitization. 10 micrograms/gram for symptoms once sensitized.
ACGIH recommends sampling in multiple locations to obtain a reasonable determination of mite prevalence.



Dust Mite Allergen Research

- Naegele A, Reboux I, Scherer E, et al. 2013. Fungal food choices of *Dermatophagoides farinae* affect indoor fungi selection and dispersal INTERNATIONAL JOURNAL OF ENVIRONMENTAL HEALTH RESEARCH 23(2): 91-95
- Dust mites prefer some fungi to others, and may influence fungal prevalence and spread.



Inhalant Allergen Sources

Cockroaches

- Allergens are fecal material and other excretions
- Allergens become airborne with activity and when secretions dry and fragment
- Cockroaches require both food and water and are found frequently in kitchens
- Exposure occurs indoors



Cockroach



- **Two most common indoor species of cockroach in North America are:**
 - German cockroach (*Blattella germanica*)
 - American cockroach (*Periplaneta americana*)
- Widely distributed in homes and schools
- Found throughout homes, including beds, furniture, and carpets - highest levels are typically found in kitchen
- Exposure is more likely in the bedroom because the allergens are aerosolized when getting into bed
- ~20% of homes with no evidence of cockroach infestation have significant levels in settled dust



According to the ACGIH, Bioaerosols: assessment and control, any cockroach allergen detected (i.e. above the LDL) identifies an indoor area that places allergic persons at risk for symptoms and allergy-prone persons at some risk for sensitization and symptom development



Cockroach Allergen Research

- Perzanowski, Matthew S.; Chew, Ginger L.; Divjan, Adnan; et al. 2013 Early-life cockroach allergen and polycyclic aromatic hydrocarbon exposures predict cockroach sensitization among inner-city children
JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY 131(3):886
- Cockroach allergen exposures predict cockroach sensitization, especially in the presence of combustion products.



Inhalant Allergen Sources

Cats

- Cat allergens present in skin secretions that adhere to fur, then flake into tiny particles
- Allergens are constantly airborne, and are ubiquitous
- Exposure occurs indoors in homes with and without cats



Cat



- The household cat species is *Felis domestica*
- Cats are pets in 27% of U.S. households
- Cat allergens are very sticky and can remain airborne for long periods of time
- High levels are often found on walls and other surfaces within homes
- Cat allergens are easily carried from home to home, office, school, etc.
- The vast majority of homes contain cat allergen, even if a cat has not lived there
- Cat allergen is produced in cat sebaceous, salivary and anal glands



Room air cleaning is not an efficient method for removing exposure, nor is washing the pet, nor isolating the pet from the bedroom.

High efficiency filtration in a central forced air system was found to remove up to 55% of the airborne cat allergen.

Removal of the pet cat will eventually lead to allergen reduction after 4 to 6 months. Thorough cleaning will speed this up.

Allergens can be removed more easily from old carpets. Type of carpet, other than age, does not appear to affect the ease of removing cat allergen.



Cat Allergen Research

- Dharmage, Shyamali C.; Lodge, Caroline L.; Matheson, Melanie C.; et al. 2012 Exposure to Cats: Update on Risks for Sensitization and Allergic Diseases CURRENT ALLERGY AND ASTHMA REPORTS 12(5):413-423
- Exposure to cats during childhood may protect against future sensitization



Inhalant Allergen Sources

Dogs

- Allergens are present in urine and skin secretions
- Allergens are readily airborne and abundant in house dust where dogs are present
- Dog allergens are not as ubiquitous as those of cat



Dog

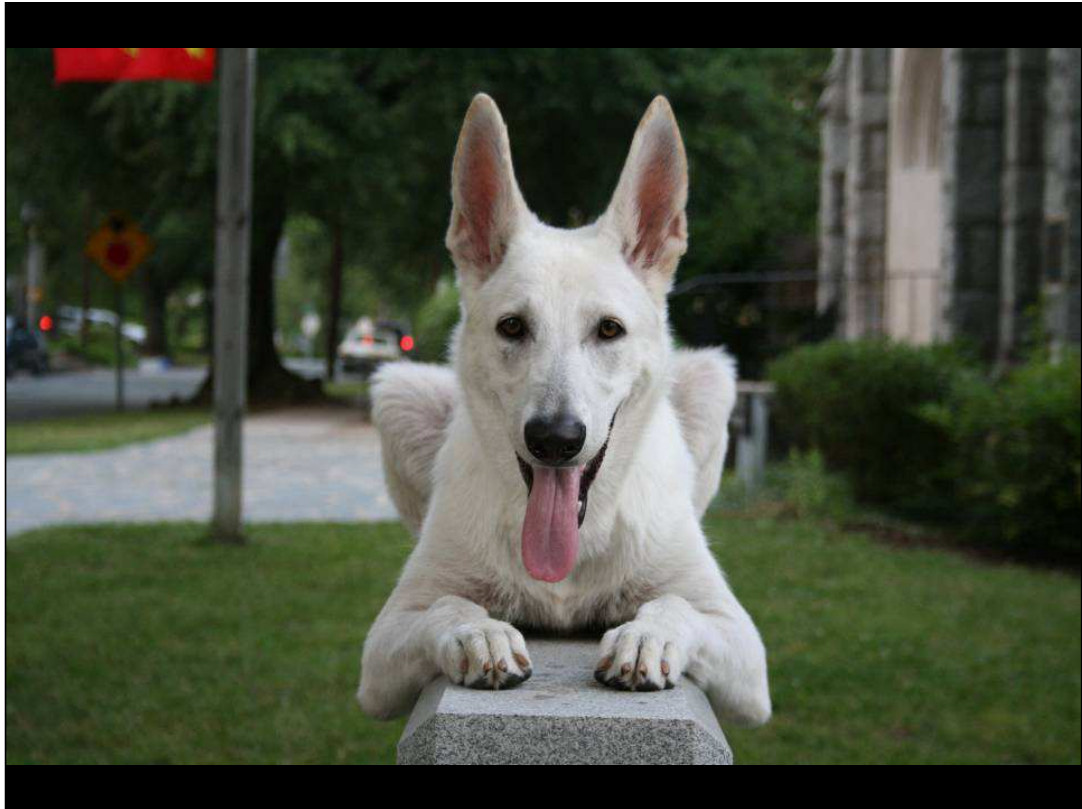


- The household dog species is *Canis familiaris*
- Dogs are pets in 31% of U.S. households
- Dog allergens are associated with particles smaller than 5 μ m, which are easily aerosolized and can remain airborne for long periods of time
- Carpeting, bedding, and upholstered furniture are typical reservoirs for deposited dog allergen
- Dog allergen is an important cause of asthma
- There are over 100 million dogs and cats in the U.S. and more than 15 million Americans have allergic reactions to dog allergen



Can f1 is found in dog dander, pelt, hair and saliva.

Symptoms = runny noses, congestion, sneezing, skin rashes, itching and wheezing.



Dog Allergen Research

- Fu X, Lindgren T, Guo M, et al. 2013. Furry pet allergens, fungal DNA and microbial volatile organic compounds (MVOCs) in the commercial aircraft cabin environment ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS 15 (6): 1228-1234
- Allergen concentrations higher in fiber seats than in leather seats, and high compared to average house dust concentrations



Inhalant Allergen Sources

Rodent

- Rodent allergens are primarily urinary
- Rodents enter buildings in search of food and water, and remain to nest. Such colonization is especially common in inner city environments
- Urinary allergens are airborne as small particles
- Rat allergen exposure is a common occupational complaint among laboratory animal workers



Rodent (Mouse and Rat)



- Two known sources of rodent allergen are:
 - Rat (*Rattus norvegicus*)
 - Mouse (*Mus musculus*)
- High concentrations of these allergens are present in the rodent's urine.
- May be an important cause of asthma and allergic rhinitis.
- Exposure to rodent allergens have been linked to increased asthma symptoms among research animal lab workers.
- A major study on asthma among inner-city children found that nearly 20% of asthmatic children had been sensitized to rats and 15% were sensitized to mice.



50% of randomly selected homes had measurable mouse allergen.

Prevalence was higher in the inner city, especially in detached homes.

Rodent allergens considered to be a risk factor for having asthma.

Rodent allergens are common in classrooms.





Rodent Allergen Research

- Torjusen EN, Diette GB, Breysse PN, et al. 2013. Dose-response relationships between mouse allergen exposure and asthma morbidity among urban children and adolescents. *INDOOR AIR* 23(4):268-274
- Linear dose/response for asthma in response to mouse allergen exposure, especially in beds.



Inhalant Allergens

Latex

- Latex allergens are present in the sap of the rubber tree
- Human contact occurs when latex rubber is used in an enclosed environment or worn against the skin
- The allergens become airborne on power used on the surface of the rubber material





Latex Allergen Research

- Kelly KJ, Wang, Mei L, Klancnik M, et al. Prevention of IgE Sensitization to Latex in Health Care Workers After Reduction of Antigen Source: JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE 53(8):934-940



EMLab P&K's IAQ Pocket Guide



- Sampling and regulatory guidelines for: Fungi, Asbestos, Bacteria, Allergens, and Industrial Hygiene
- Updated MoldRange™ data from over 350,000 spore trap samples
- Data interpretation guidelines

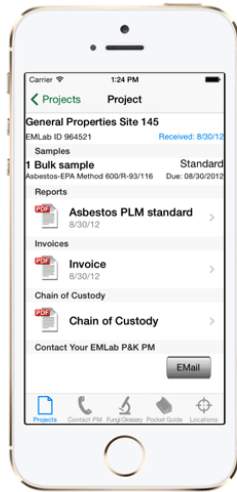
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Sampling For Environmental Allergens

Air Sampling

Allergen/Source	Spore Trap	Cultural Impactor	Filtration
Pollen	X		
Pollen allergens			X
Fungal spores	X	X	
Fungal allergens			X
Cat and rodent allergens			X
Latex allergens			X



Filtration

- Useful for specific airborne particulate allergens
- Analyzed by specific immunoassay when airborne concentrations are high
- Could be analyzed by quantitative PCR when concentrations are low



Dust Sampling for Allergens



- Sample using a dust cassette.
- Approximately 150mg or 1 teaspoon of dust is required for the analysis
- Dust mite allergen analysis is time sensitive and should be sent using a cold pack or a cooler to prevent the increase of allergens in transit

[illegible]

How Are Allergen Samples Analyzed?

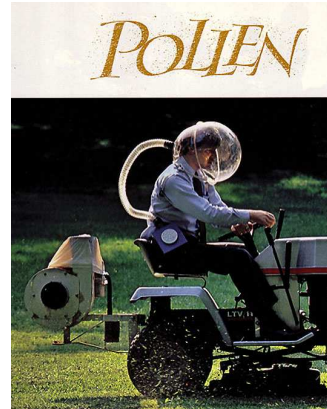
- Allergens are analyzed by ELISA (Enzyme-Linked ImmunoSorbent Assay)
- ELISA is a highly sensitive and specific test that uses monoclonal antibodies that latch on to the specific allergens
- Results are expressed as micrograms (μg) of allergen per gram (g) of dust



How Do I Interpret the Results?

Critical levels for sensitization

Dust mite	2.0µg/g of dust
Cockroach (<i>Bla g1</i>)	0.2 units/g of dust
Cat	1-8µg/g of dust
Dog	<i>Sufficient evidence is not yet available for establishing risk levels for these allergens.</i>
Mouse	
Rat	



Critical levels for exacerbation

Dust mite	10.0µg/g of dust
Cat	>8µg/g of dust
Cockroach (<i>Bla g1</i>)	1 to 2 units/g of dust



Cockroach - we've switched from *Bla g2* to *Bla g1*, which reports in units/gram vs. micrograms/gram.

Switched to *g1* because it's more commonly applied and there is more literature. It also has more

Cross reactivity between the two cockroaches; so, you're really looking for both types of cockroaches

Or at least more so than *g2*.

Dust Mite Control

- Keep humidity below 50%
- Vacuum regularly and discard bags immediately; Replace carpet with hard flooring if possible
- Wash bedding every week in hot water (54° C); Use allergen free mattress and pillow covers
- Minimize upholstered furniture and curtains or drapes
- Minimize dust and dust catchers



Few myths. Sometimes people say dust mites add considerable weight to pillows & mattresses. This is not true.

Sometimes told not to use feather pillows but they should use them. A 1996 study from the British Medical Journal has shown that polyester fibre pillows contained more than 8 times the total weight of Der p I and 3.57 times more micrograms of Der p I per gram of fine dust than feather pillows

Pest Control

- Keep kitchens clean and dry
- Use cockroach traps; if you see cockroaches, call an exterminator
- Seal up openings for mouse/rat entry
- If you see mice or rats, call an exterminator



Other IgE-mediated Allergy Sources

- Food
- Drugs such as antibiotics
- Insect venoms



Ingestion Allergen Sources

- Peanut
 - Tree Nuts: walnut, almond, hazelnut, cashew, pistachio, and Brazil nuts
 - Milk
 - Egg
 - Wheat
 - Soy
 - Fish
 - Shellfish
 - Other
- Anaphylaxis is a frequent result of food allergen ingestion
 - Reaction is very rapid, and must be treated quickly
 - Chest tightness, wheeze, swelling of mucous membranes, and other symptoms may precede a full anaphylactic reactions



Type 3 Hypersensitivity

- Antigen-antibody complexes that are not adequately cleared by innate immune cells accumulate, giving rise to an inflammatory response and attraction of leucocytes
- Hypersensitivity pneumonitis (in part)
- Serum sickness
- Others



Type 4 Hypersensitivity

- Often called delayed type hypersensitivity as the reaction takes two to three days to develop. it is not antibody mediated but rather is a type of cell-mediated response.
- Contact dermatitis (e.g., poison ivy)
- Hypersensitivity pneumonitis (in part)
- Rheumatoid arthritis
- Multiple sclerosis
- Others



Hypersensitivity Pneumonitis

- Hypersensitivity pneumonitis is a disease in which your lungs become inflamed when you breathe in certain antigens to which you are allergic.
- When you inhale this dust the first time, you won't notice any problem. After repeated or intense exposure the tiny air sacs in the lung become inflamed, their walls fill with white blood cells, and sometimes the sacs fill with fluid.
- The disease may flare up again because of more exposure to the dusts. Parts of the lung may develop scar tissue and can no longer function normally in breathing.



Hypersensitivity Pneumonitis (cont'd)

- Antigen exposure leads to sensitized IgG antibodies
- Following subsequent exposure, IgG antibodies combine with the inhaled allergen to form immune complexes in the walls of the alveoli in the lungs.
- This causes fluid, protein, and cells to accumulate in the alveolar wall which slows blood-gas interchange and compromises the function of the lung.



Hypersensitivity Pneumonitis (Extrinsic Allergic Alveolitis)

- Bird fancier's lung
- Farmer's lung
- Hot tub lung
- Humidifier lung
- Mushroom picker's disease
- Machinist's lung



Bird Fancier's Lung

- Exposure to bird proteins present in the dry dust of the droppings and sometimes in the feathers of a variety of birds.
- Pigeons, parakeets, cockatiels, shell parakeets (budgerigars), parrots, turtle doves, turkeys and chickens have been implicated.
- People who work with birds or own many birds are at risk. Bird hobbyists and pet store workers may also be at risk.



Farmer's Lung

- Inhalation of thermophilic actinomycetes spores (a type of bacteria) or fungal spores, especially *Aspergillus fumigatus*.
- Farmers and compost workers are most often at risk.



Hot Tub Lung

- Inhalation of Mycobacterium avium antigens while occupying a hot tub
- The hot tub bubbles cause the cells to become airborne



Humidifier Lung

- Humidifiers, especially cool mist and ultrasonic vaporizers
- Many organisms grow in the reservoirs and the antigens are sprayed into the air during humidifier operation



Machinist's Lung

- Metal grinding operations require sprayed on coolants which are generally water based
- *Mycobacterium immunogenum* grows in the coolants and are inhaled by the workers



Summary and Conclusions

- Almost any foreign protein can elicit an immune response
- IgE antibody responses are termed allergies and can be caused by inhalant, food, pharmaceutical and venom allergens
- IgG and cellular responses to foreign proteins are often also called allergies and are typified by hypersensitivity pneumonitis

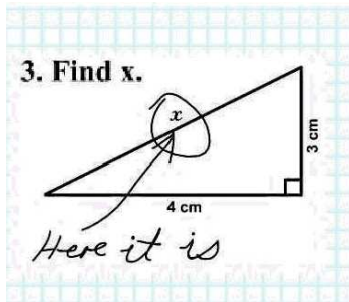


Summary and Conclusions (cont'd)

- Sampling plans for these environmental agents depend on the type of agent involved, but most often involve dust or bulk sampling
- Analysis is generally by immunoassay
- The visible presence of pets, cockroaches, birds, some types of humidifiers, molds, and other organic materials should be considered evidence that allergens are present



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Pleasanton, CA 94566
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202 E. Airport Road
Suite 140
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