Learning Objectives:

- Identify common trees whose pollens trigger allergies, asthma, and other respiratory problems
- Describe the concept of microclimates and allergic disease
- Recognize newly described severe inflammatory responses to important aeroallergens.
- Specify the observed effects of climate change on allergic disease

Which type of tree is currently (June) the most active source of pollen in the Bay Area?

A. A. Cypress
B. B. Elm
C. C. Oak
D. D. Olive
Which type of tree is currently (June) the most active source of pollen in the Bay Area?

A. Cypress (Early spring)
B. Elm (Early fall)
C. Oak (Mid spring)
D. Olive (Early summer)

Practical tip to access pollen counts:
American Academy of Allergy, Asthma and Immunology web site: "AAAAI.org"

✓ Pollen counts
✓ Your nearest location

Partial list of trees that can trigger pollen allergies:
Cedar
Cypress
Juniper
Birch
Oak
Ash
Bottlebrush
Maple
Sycamore
Elm

Olive
Cottonwood
Mulberry
Walnut
Sweet gum
Black locust
Mesquite
Acacia
Alder
Pepper
“Cross-reactivity”

Partial list of trees that can trigger pollen allergies:

- Cedar
- Cypress
- Juniper
- Birch
- Oak
- Ash
- Bottlebrush
- Maple
- Sycamore
- Elm

- Olive
- Privet
- Mulberry
- Walnut
- Sweet gum
- Black locust
- Mesquite
- Acacia
- Alder
- Pepper

Squeezeweasel
Pepper Tray
But then there are multiple kinds of.

Weeds  (some cross-reactive and some distinct)
Grasses  (LOTS of cross-reactivity)
Molds   (mostly distinct)

Not to mention a closer look at our indoor environments! Cat, dog, dust mites, cockroaches, etc.

Definitions

**Antigen**
A molecule that is capable of triggering an immunologic response in the host.

**Allergen**
An antigen that induces an allergic response (usually involving a “Th2” immune response). A major allergen is “an antigen that binds to the IgE sera from 50% or more of a clinically allergic group of patients.”

**Aeroallergen**
An airborne allergen that triggers allergic inflammation of mucosa

What is “sensitization?”
Definitions

*Sensitization*

A term used to indicate evidence of IgE recognition of an antigen. For example, *positive aeroallergen skin testing determines sensitization*, not necessarily allergy, which requires *clinical correlation*.

Approaches to Management of Respiratory Allergies

Maximal preventive measures

- Remediation of indoor and outdoor environments, saline irrigation

Treatment of symptoms

- Nasal sprays, antihistamines, antileukotrienes, inhalers, medicated irrigation, otc products, allergy eye drops, biologics agents, etc.

Retrain the immune system

- Allergen immunotherapy
  - Subcutaneous injections
  - Sublingual tablet

When it comes to pollen, in northern California it’s all about the

*MICROCLIMATE*

*On which side of the hill do you live?*
*Near the water or inland?*
*What trees are in your neighborhood?*

What’s new in 2016?

*What new data do we have about microclimates in northern California?*
We asked....

How can we modify our skin testing panel to optimize quality of care?
How many antigens are needed to identify potential allergens with the greatest accuracy?

- Improve the precision of our testing
- Minimize patient time, expense, and discomfort
- Improve clinic efficiency by reducing need for space and staff

Analysis of 12 years of data from allergy skin testing at UCSF

At least 200,000 discrete pieces of data.
Only partial analysis thus far...

There are many unique sensitizations!

• Sensitization to cedar but not cypress
• Sensitization to oak but not birch
• Sensitization to one species of oak but not another

What does this mean???

Nanoclimates!

“Please take some pictures of the trees, bushes and grasses in your neighborhood...”
• Can we adjust testing panels by zip code?

• Are there trends in the past 10 years that can inform the updated importance of each antigen?

• Are there unexpected associations between antigens?

**Practical tip:**

*In the absence of extra training for allergy/immunology fellowship, how can one surmise which plants are allergenic?*

**Definitions**

**Entomophilous:**
Pollinated by insects (colorful, flowery)

**Anemophilous:**
Pollinated without insects (relying on the wind)

*Mystery pictures...*

Identify the foliage most like to emit aeroallergens:
Why are some aeroallergens more allergenic than others?
Which allergen is most associated with death due to severe asthma?

A. Alternaria  
B. Cat  
C. Dust mites  
D. Rye grass

Alternaria triggers a different pathway to inflammation

Intrinsic serine protease activity elicits the rapid release of IL-33 into the airways (mouse model)
- More rapid, augmented pulmonary inflammation compared to house dust mite
- Mucus release and loss of lung function

Underlies robust TH2 inflammation and exacerbation of allergic airway disease  
Snelgrove R, et al. JACI 2014

Another Alternaria mouse model

The presence of ovarian hormones was associated with increased Alternaria induced inflammatory response in the airways, involving TH2 cytokines, IL-33 and innate lymphoid cells. Also greater tissue infiltration of eosinophils and lymphocytes.

Is this a possible mechanism for increased asthma prevalence in women compared to men?  
Newcomb D, et al. JACI 2016
Implications?

We are beginning to understand the diversity of inflammatory reactions that constitute allergic asthma and allergic rhinitis.

This improved understanding will help lead to more targeted, allergen specific, inflammation specific treatments.

Clinical Pearl:
If you have a patient who develops fast, severe, bronchospasm, make certain he/she is evaluated for allergic disease.

Trends in Allergen Activity with the Change in Climate

Who cares?
There are 50 million people affected by aeroallergens in the US alone.

What do we know so far?
- On average, allergy season is arriving 2 weeks earlier compared to 10 years ago, and lasting an extra week at the end. This includes molds that can cause severe asthma.
- Higher levels of pollens are being measured, resulting in greater exposure. In the warmer climate, plants grow faster and produce more pollen; content of allergenic material is increased.
  Rhinitis, conjunctivitis, asthma more severe

Additional observations:

Warming temp = increased ground ozone, which worsens asthma and airway hyperreactivity.

Air pollution and increased pollen loads are a bad combination

Thunderstorms in spring and summer are related to hospital admissions for asthma.
Thunderstorm Asthma

Thunderstorm asthma can occur in people who don’t normally have asthma (most asthmatics don’t experience these symptoms).

Theory:
Heavy storm winds create updrafts that contain pollen and mold spores; hard rain saturates and causes the particles to burst into smaller pieces that can be inhaled more easily into the lungs.

How does one conduct a prospective study!? One doesn’t! However,

A subset of patients (27/271) undergoing allergen immunotherapy (allergy shots) in a Kentucky practice experienced adverse reactions only or predominantly in association with thunderstorms.

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Much will depend on the specifics of climate change in each area.

Drought vs excessive rain

We can use fossil pollen to understand changes in foliage due to climate/human activity

Pollen grains possess highly distinctive surface sculpture to permit identification

Pollens preserve well due to a highly resistant outer layer

Pollens that drop back to earth are preserved in the bottom sediment of ponds and bogs.

Blackrock.ccnmtl.columbia.edu/site; Paleoeclology
Warming of the climate 11,000 years ago was associated with:

- East coast of the US changed from predominance of spruce, fir and alder to more oaks and ash, as well as American beech, hickory and American chestnut.

- Increase in fossil pollens of grasses, ragweed and other weeds signaled land clearance associated with human activity.

Summary

Northern California is full of microclimates that lead to great diversity of allergic sensitization to pollens and molds (and fabulous habitat for the non-allergic!).

Alternaria is associated with severe asthma, and may elicit a different, more severe pattern of inflammation compared to other aeroallergens. Patients with rapid onset of severe asthma should be evaluated for allergic disease.

Anticipate worse allergic disease with a warmer climate, and changing patterns of allergic sensitization.