



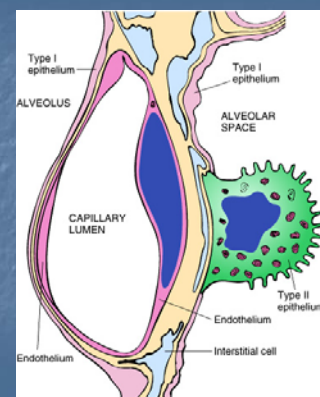
## Pulmonary Diseases

### We Move A Lot of Air

- Functions
  - Oxygenation
  - CO<sub>2</sub> & pH
- Basic defenses
  - Nose hairs
  - Cilia
  - Mucus
  - Cough reflex
  - Immune system



### Alveolar Level

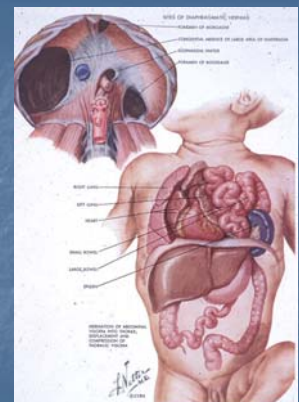


### Basic Categories

- Congenital
- Infectious
- Neoplastic
- Nutritional
- Trauma
- Immunologic
- Vascular

### Developmental

- Diaphragmatic defect
- Intestines in chest
- No room for lung to develop
- The newborn needs two.
- Depending on the degree of lung hypoplasia, may not be compatible with life.
- Today can surgical fix inutero.

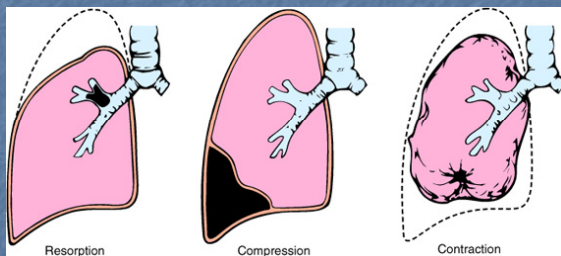


## Gene Defect Related

- Cystic fibrosis
  - Bronchial infections
  - Pancreatic destruction
  - Thick mucus
- Alpha-1 antitrypsin deficiency
  - Emphysema
  - Cirrhosis
  - Can't neutralized activated proteases
- Immune system failure



## Atelectasis (Collapse)



## Obstructive vs. Restrictive

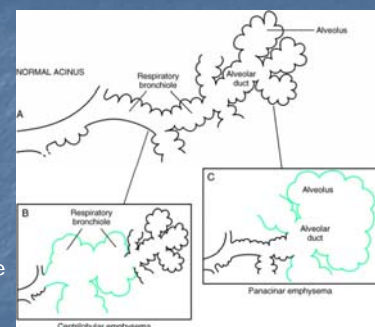
- Obstructive
  - Air passage patency
  - Increased resistance
  - Acute
    - asthma
  - Chronic
    - Chronic bronchitis
    - Emphysema
- Restrictive
  - Ability of lung to expand
  - Decreased total lung capacity

## Chronic Obstructive Pulmonary Disease

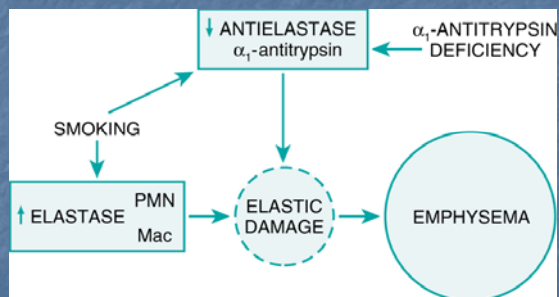
- COPD
- Lasting longer than 3 months
- Chronic cough with mucus production
- Restriction to air movement
- Two basic forms
  - Emphysema
  - Chronic bronchitis
- Actually most patients have a mix

## Emphysema

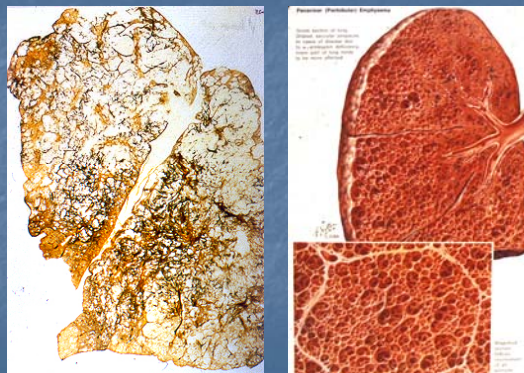
- Loss of pulmonary elastic tissue.
- Inflammatory
- Smoking
- Can't keep small airways open.
- Reduced surface area
- Reduced air volume exchange
- COPD



## Emphysema



## Emphysema



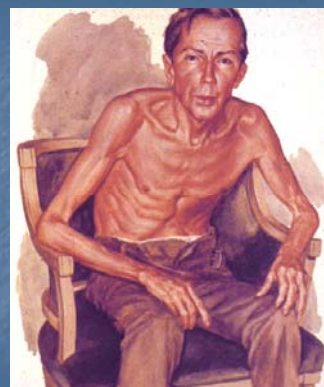
## Emphysema

- Large airspaces
- Trapped in air the dilated alveoli
  - causes compression of smaller airways
  - Hyperinflation
- Changes are irreversible



## Emphysema

- Pink puffer
- Barrel chest
  - Hyperinflation
  - Trapped air
- Thin
  - Lots of calories just to breath
- Rapid respirations
- Pursed lips
- COPD



## Chronic Bronchitis

- Also a chronic obstructive disease
- Chronic cough with mucus production for 3 months.
- May lead to emphysema (especially in smokers).
- COPD
- Larger airway narrowing
- Increased secretions
  - Goblet cell hyperplasia
- Blue bloater
  - Cyanotic



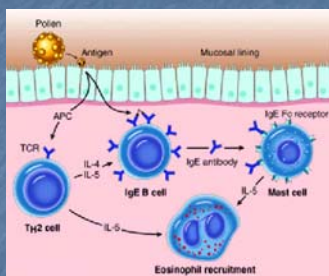
## Asthma

- Bronchoconstriction
  - Episodic
  - Reversible
  - Various stimuli
- Extrinsic Asthma
  - Type I hypersensitivity
  - IgE
  - Atopic most frequent
    - Other manifestations
- Intrinsic
  - Triggers are nonimmune
    - Aspirin
    - Viral infections
    - Cold
    - Stress

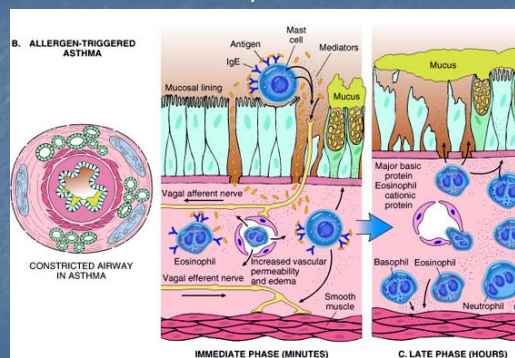


## Asthma, Sensitization

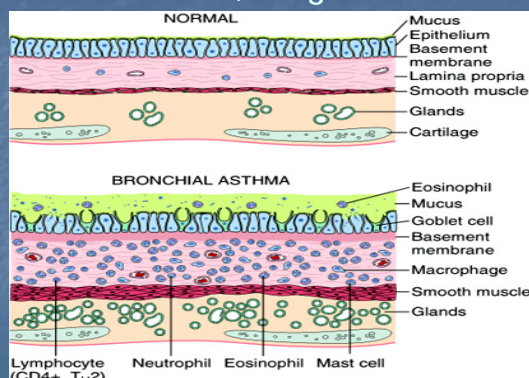
- Sensitization of CD4 cells
  - The  $T_H2$  class
- $T_H2$  cells release cytokines
  - IL-4, IL-5 & IL-13
  - Cause production IgE
  - Growth of mast cells
    - Histamine producers
  - Activation of eosinophils
- Typically see 2 phases to an attack
  - Early, 30-60 minutes
  - Late, 4-8 hours



## Asthma, Reaction



## Asthma, Long-term



## Bronchiectasis

- Dilated and inflamed bronchi
- Repeat infections
- Lots of mucus
- Foul smelling breath
- Unbelievable, productive morning cough

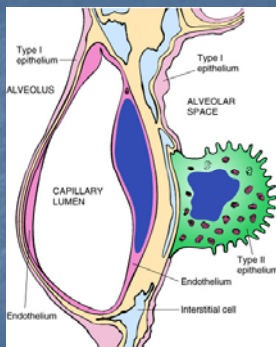


## Restrictive Lung Disease

- Reduced compliance
  - Acute, surfactant problem
  - Chronic, fibrosis

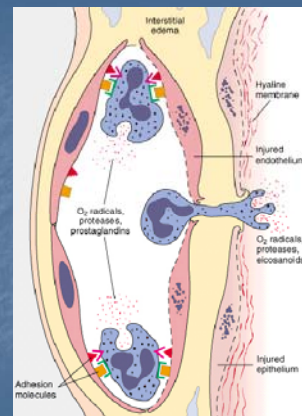
### Acute Respiratory Distress

- Endothelial injury
  - Loss of fluid and proteins
- Injury to Type II epi
  - Lack of surfactant
- Accumulation of protein in the form of hyaline membranes within alveoli.

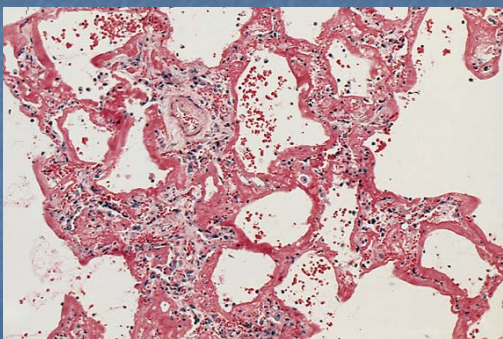


### Hyaline Membrane Formation

- Initiation of inflammatory response
- Neutrophils play significant role
- Oxidant injury
- Leakage of proteins
- Formation of hyaline membrane
  - Reduces  $O_2$  diffusion
- Reduced surfactant
- Alveolar wall becomes rigid.



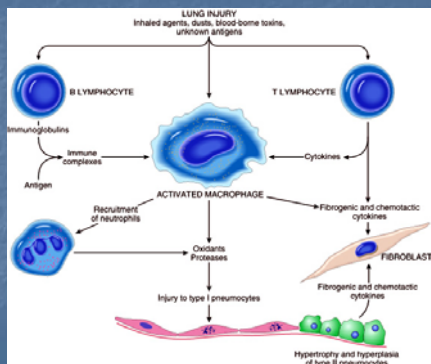
### Hyaline Membranes



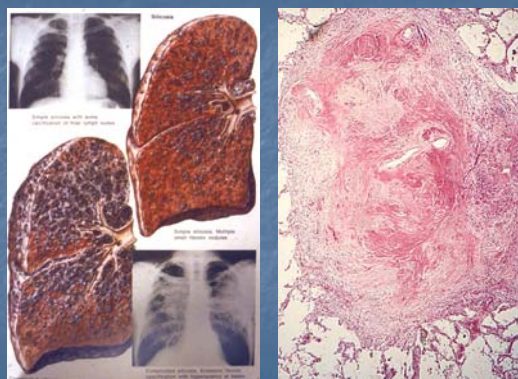
### Chronic Restrictive Lung Disease

- Occupational
  - Asbestos
  - Silicosis
  - Coal miner's lung
- Chemotherapy
  - Busulfan
- Immunological
  - Rheumatoid arthritis
  - Sarcoid
  - Scleroderma and other collagen vascular diseases
- Idiopathic

### Pulmonary Fibrosis



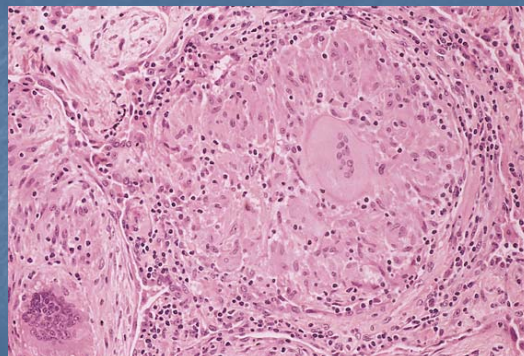
### Silicosis



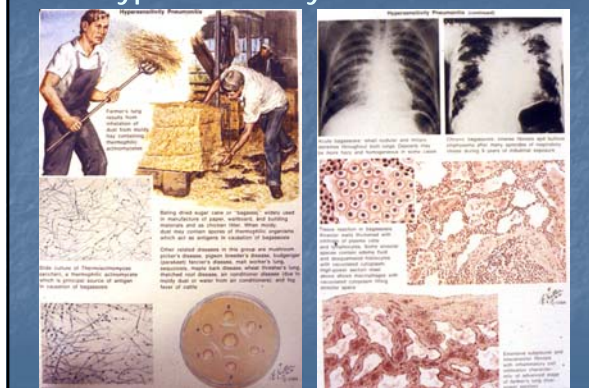
### Sarcoidosis



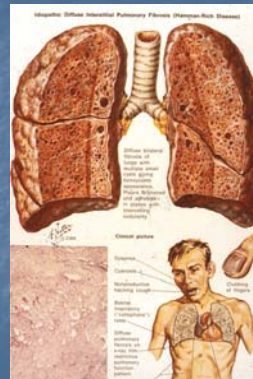
### Sarcoidosis



### Hypersensitivity Pneumonitis



### Idiopathic Pulmonary Fibrosis



### Vascular Related Pulmonary Disease

- Acute alterations in blood flow.
  - Congestion and edema
  - PE
- Chronic congestion
  - Eisenmenger reaction
- Primary Pulmonary hypertension
- Inflammatory
  - Autoimmune vasculitis

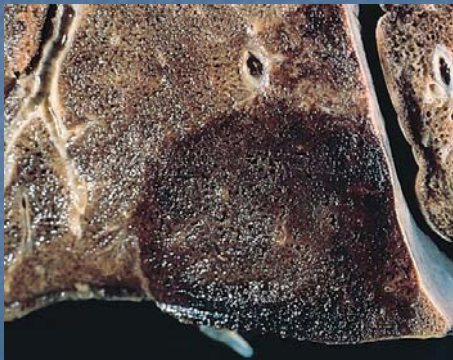
Pulmonary Edema



Pulmonary Embolus

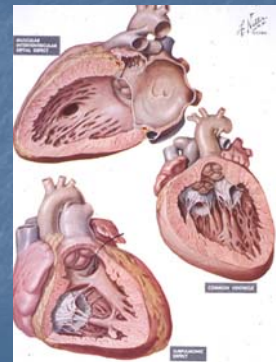


Pulmonary Infarct

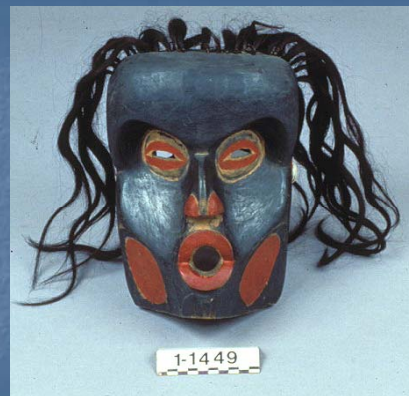
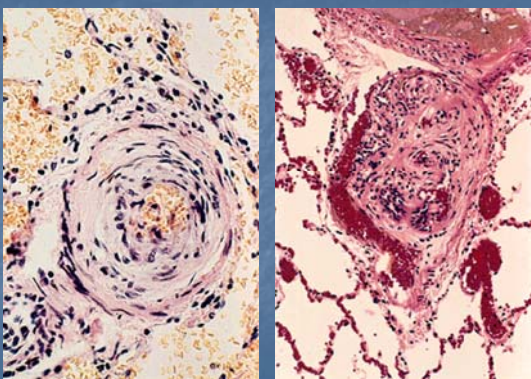


Ventricular Septal Defect

- Left to right shunt
- Depending on size will lead to Eisenminger reaction.
- Later becomes right to left shunt.
- Possible infections.



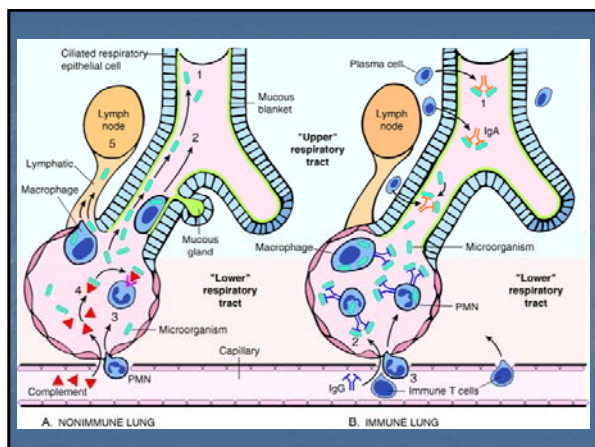
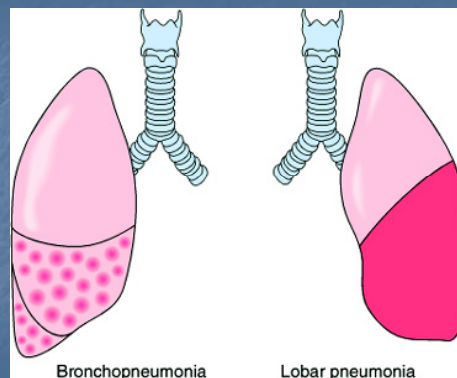
Pulmonary Hypertension



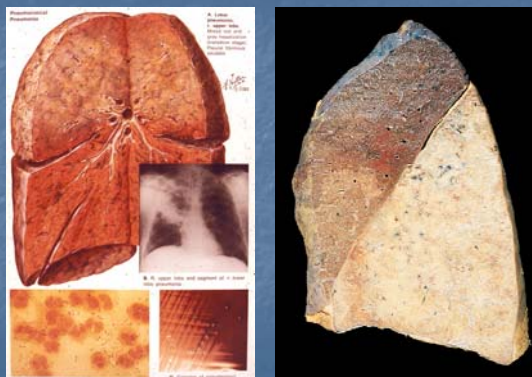
## Pulmonary Infections

- Pneumonia
  - Infection in the alveolar spaces
    - Bacteria
    - TB
  - Interstitial tissue
    - Virus
    - Mycoplasma
- Abscess
- Bronchitis
- Bronchiolitis
- Pleuritis

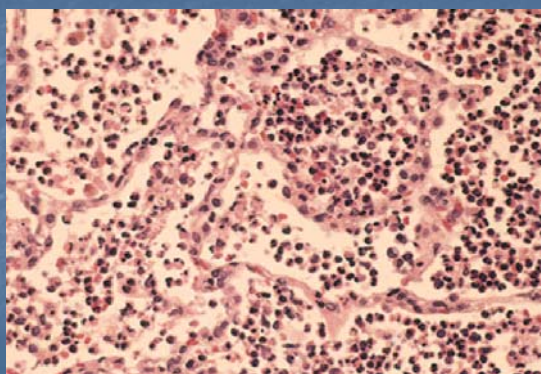
## Bacterial Pneumonia



## Streptococcal pneumoniae



## Acute Bacterial Pneumonia

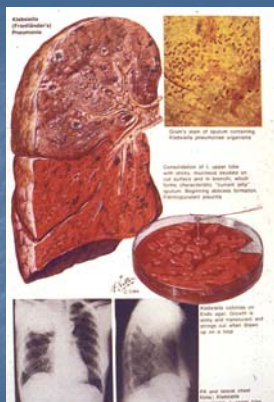


## Gram Negative Bugs

- Typically from body flora
  - 'Opportunistic' infections
- Compromised host
  - Alcoholic
    - Aspiration
  - Chemotherapy
  - Tracheostomy
  - Broad spectrum antibiotics that change host flora

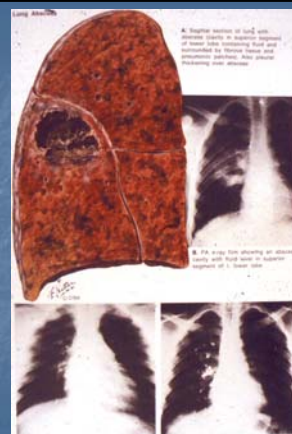
### Klebsiella Pneumonia

- Gram negative rod
  - Very mucoid capsule
- Aspiration
  - Head down in the gutter
- Rusty sputum
- High fever



### Pulmonary Abscess

- Staphylococcus
- Aspiration of gastric material
- Hole with
- Air-fluid level

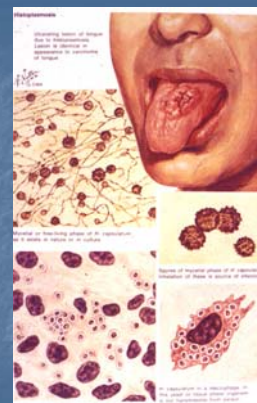


### Fungal Pneumonias

- Typically means something wrong with immune system
- Histoplasmosis is very common
  - Ohio River valley
  - Virtually all of us beat the bug
- HIV has changed things a lot

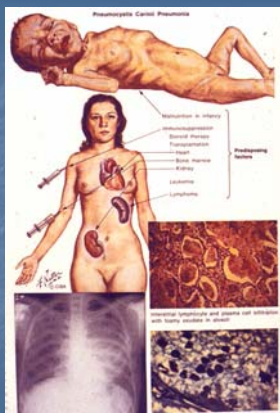
### Histoplasmosis

- Dimorphic yeast
- Fungal growth phase
- Oral or pulmonary infection
- Granulomas
- Most people lock it down.
- Forms of the disease
  - Pulmonary
  - Systemic



### Pneumocystis carinii

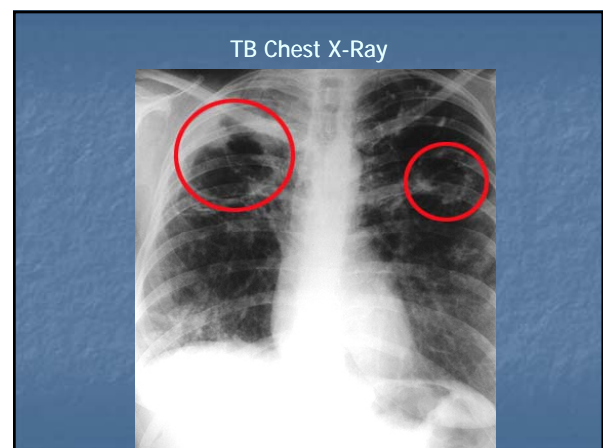
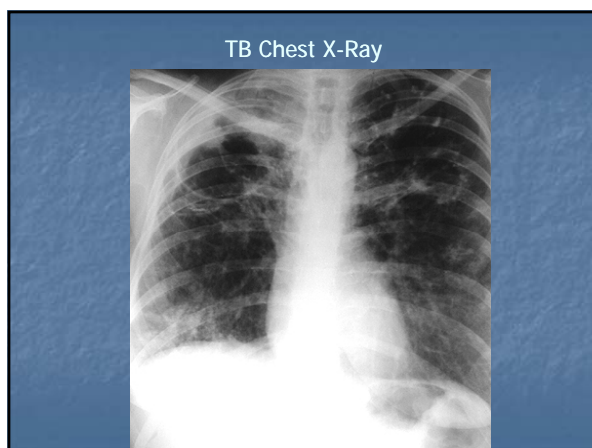
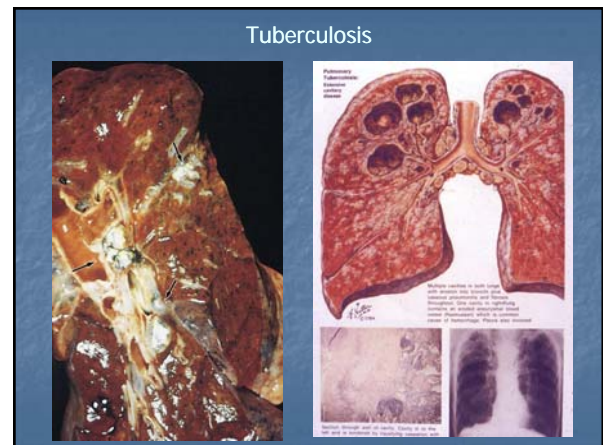
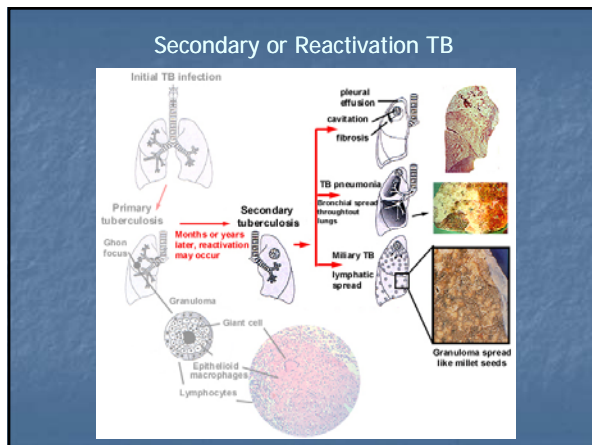
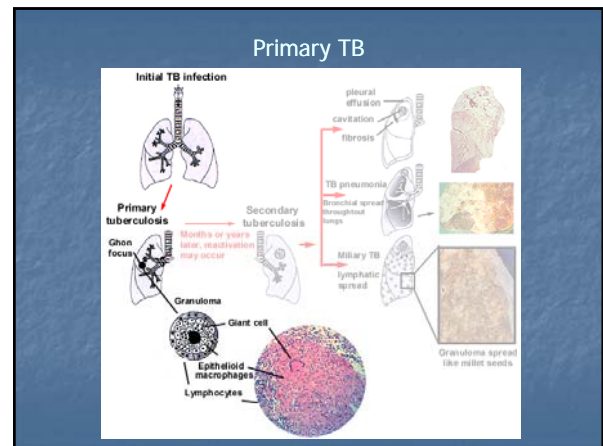
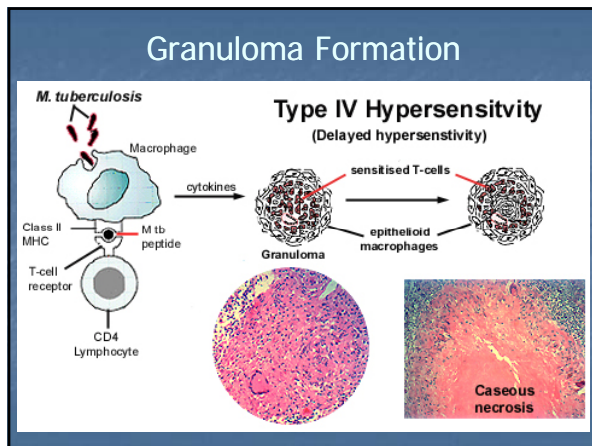
- Immune failure
- Organism is very common
- Immunosuppression
  - Starvation
  - HIV
  - Chemotherapy
- Can't culture
- [Bronchial wash](#)
- Stain for the bug



### Tuberculosis

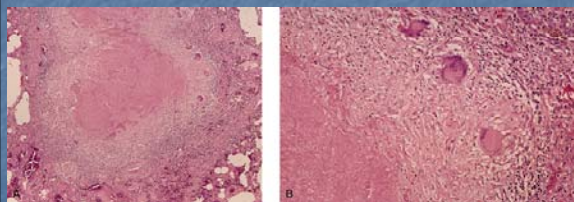
- Mycobacterium tuberculosis (most cases)
  - Type IV hypersensitivity
  - Granuloma
- Primary infection
  - Pulmonary
  - Perhaps goes lymphatics
  - Hopefully it stops here.
- Secondary TB
  - Internal reactivation
  - Perhaps years later
  - Not all patients





### Granulomas of TB

- Caseous granulomas
- Giant cells
- Inert bug



### Disseminated TB



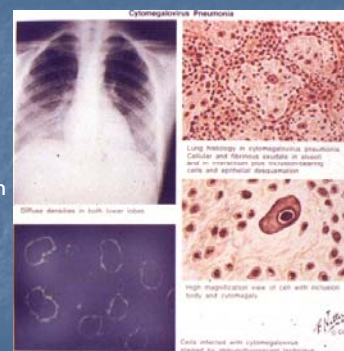
### Skin Test

- PPD
- Injected intradermally
- Read in 2 days
- Measure swelling
  - Not redness
- Positivity maybe life long



### CMV Pneumonia

- Common virus
- Infant and neonate
- Immune suppressed
  - HIV
  - Chemotherapy
- Characteristic inclusion



### Lung Tumors

- 'Mass' on X-Ray
  - Space occupying lesion
  - Granuloma
- Neoplasm
- Benign
- Malignant
  - Primary vs. Metastatic

## Benign

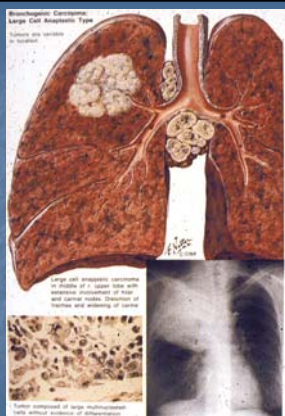
- Rare
- Hamartoma
  - A 'rest' of tissue from development
  - Cartilage most times

## Malignant

- Primary, so called 'bronchiogenic'.
  - Squamous cell
  - Small cell
  - Adenocarcinoma
- Metastatic, just about any source
  - Kidney
  - Breast
  - Colon
  - Reproductive
  - Even the other lung

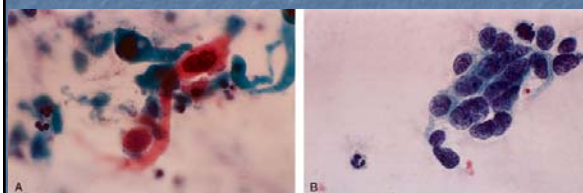
### Bronchiogenic Carcinoma

- Squamous in most cases
- Chronic irritant leads to squamous metaplasia.
- Continued exposure leads to dysplasia and eventually cancer.
- Very aggressive.
- Surgery is about it.
- Poor response to chemotherapy and radiation

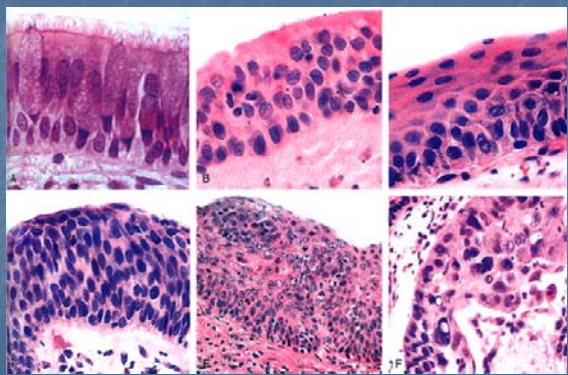


### Pulmonary Cytology

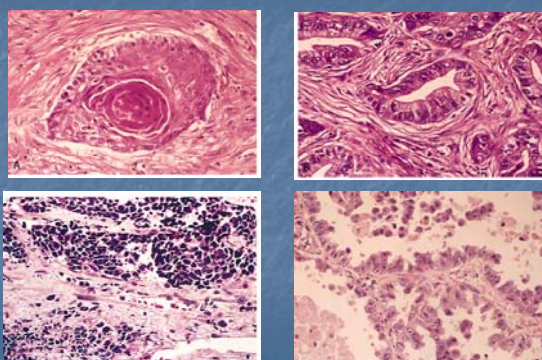
- Exfoliative cytology
  - Cough it up
  - Wash it out
- [Bronchoscopic biopsy](#)



### Metaplasia, Dysplasia, Cancer

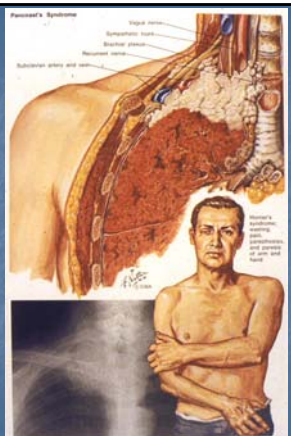


### Basic Patterns of Bronchiogenic Carcinoma



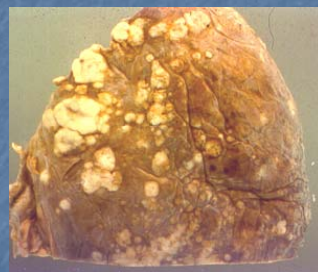
### What Lung Cancer Can Do

- Obstruct bronchus causing pneumonia
- Spread widely
- Odd hormonal activity
  - Small cell makes ADH and ACTH
  - Squamous cell makes PTH
- Multiple sclerosis like symptoms
  - Even without brain mets
- Pancoast's tumor ->
  - Horner's syndrome



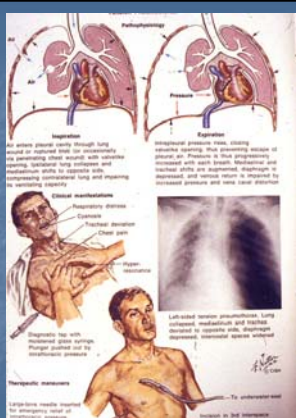
### Metastatic Cancer to Lung

- Can come from anywhere
- Microscopic looks like tumor of origin
- Spreads by blood
  - Isolated masses ->
- Spreads by lymphatics
  - Diffuse involvement



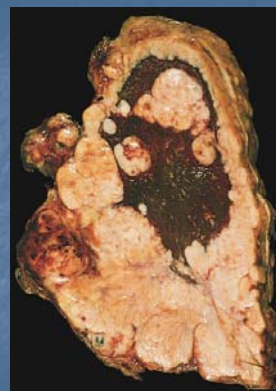
### Pleura

- Membranes surrounding lung and lining chest cavity
- Inflammation, Pleuritis
  - Sterile
    - Renal failure
  - Infectious
    - Bacteria, Lyme, Virus, TB
  - Either may lead to scarring and trapping of lung
- Hemothorax
- Pneumothorax ->



### Pleural Tumors

- Metastatic
  - About anywhere
- Primary, mesothelioma
  - Mesothelial cells
  - Asbestos workers
  - Slow growing
  - Traps & invades lung



### Upper Airway

- Allergic disease
- Sinusitis
- Larynx
  - Infections
  - Polyps
  - Squamous cancer

