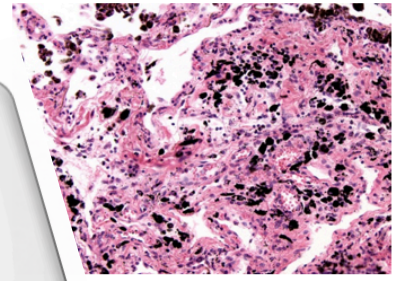
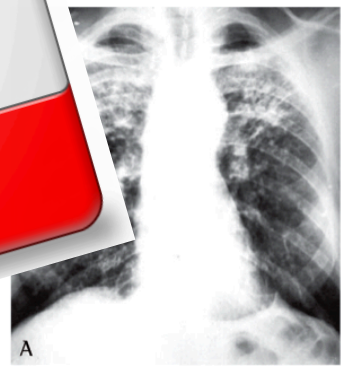
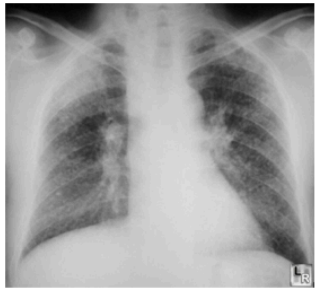
Pneumoconioses for the USMLE Step One Exam

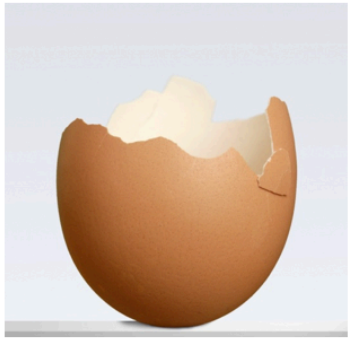
Coal



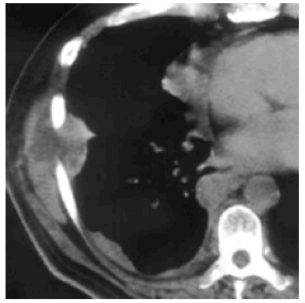


Silicosis





Asbestos



Howard J. Sachs, MD

Associate Professor of Medicine

University of Massachusetts Medical School

www.12DaysinMarch.com; Season III

E-mail: Howard@12daysinmarch.com

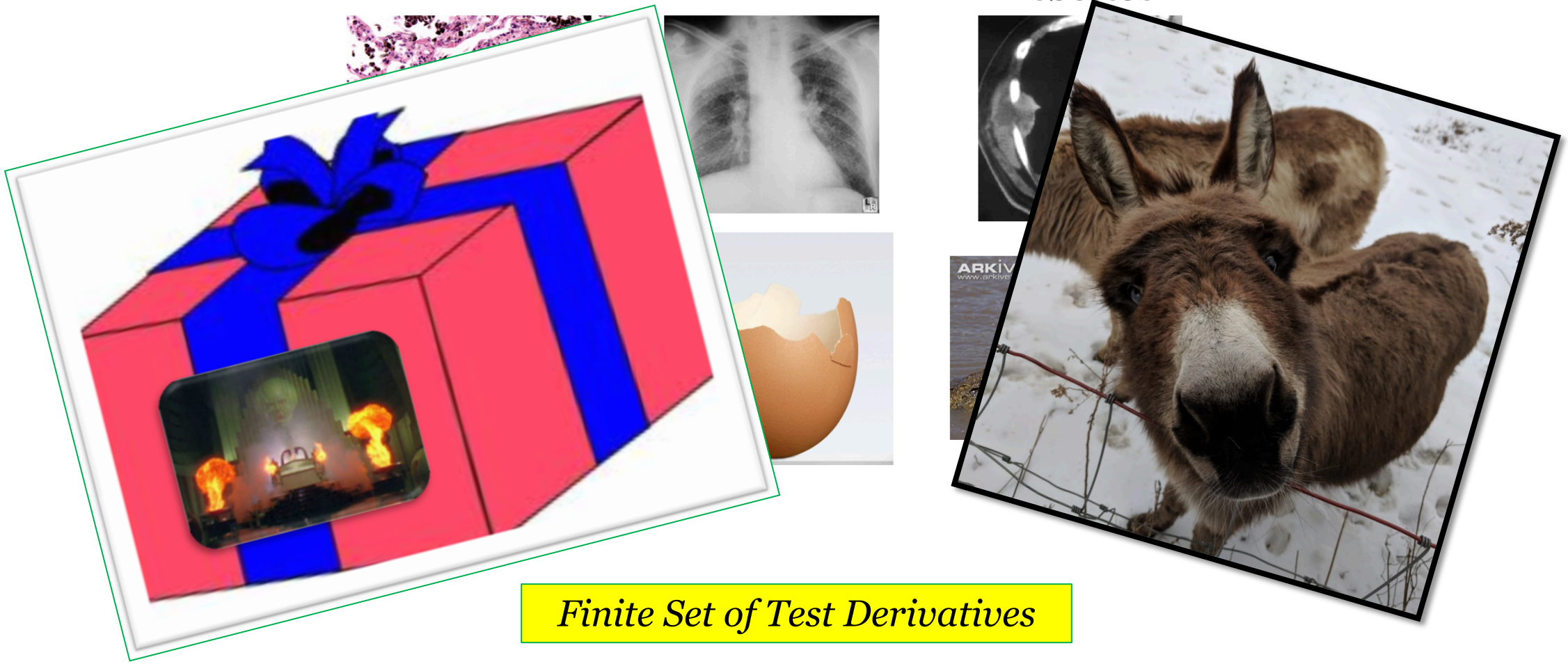
Tutorial Services

Pneumoconioses: inhaled inorganic dusts

Coal

Silicosis

Asbestos



Finite Set of Test Derivatives

Pneumo**conioses**: inhaled inorganic dusts

Coal

Silicosis

Asbestos

Konis (Gk): dust

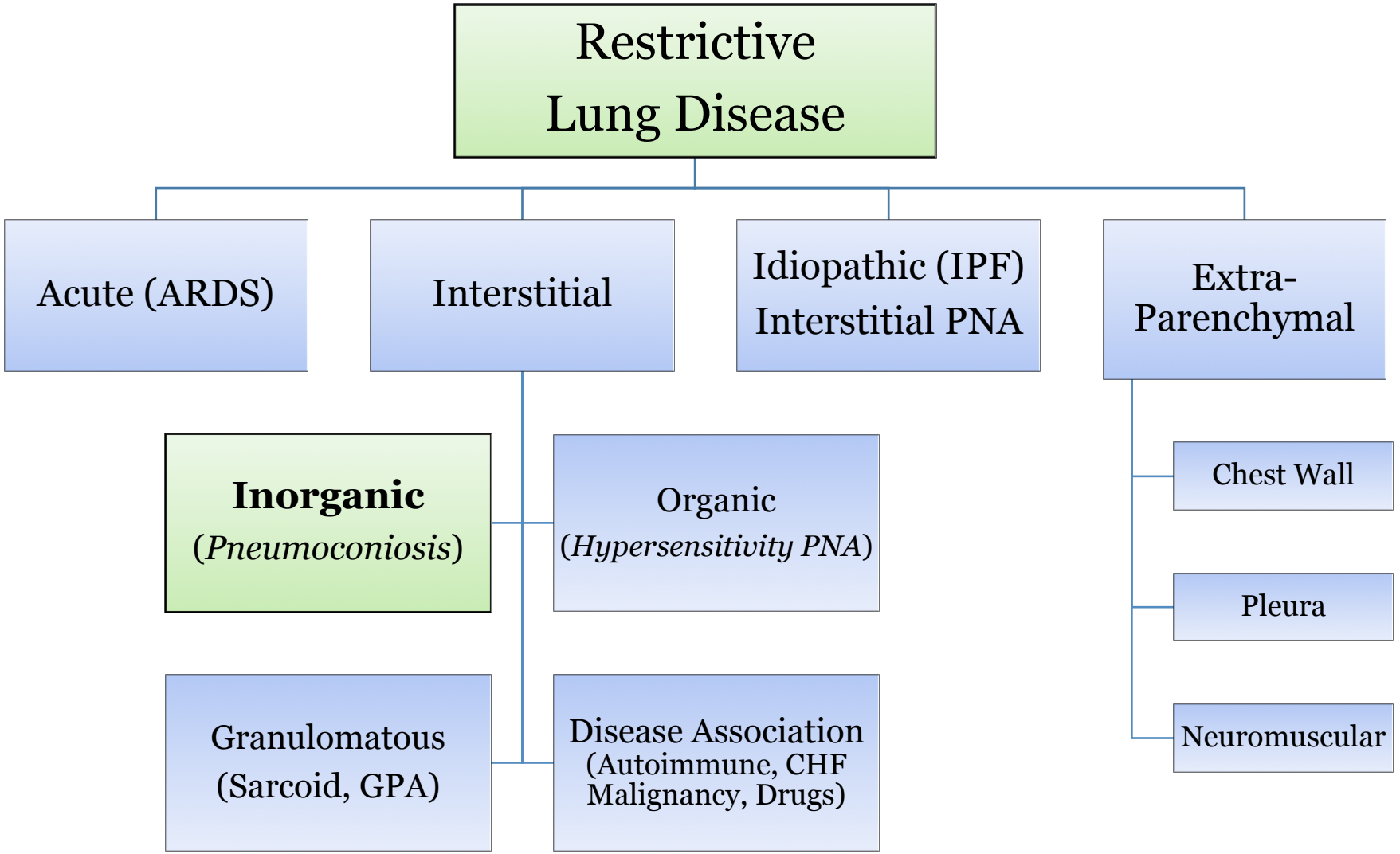
Pneumoconioses Index

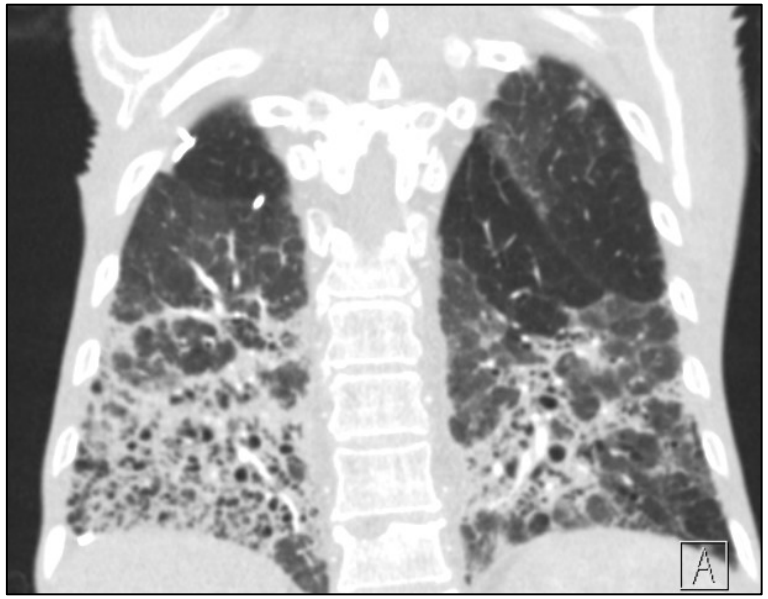
Part I

- Background
  - Intersititial Lung Disease
  - PFT: Restrictive pattern
- Occupations (demographics)
- Pathology
- Radiography
- **Complications**

Part II

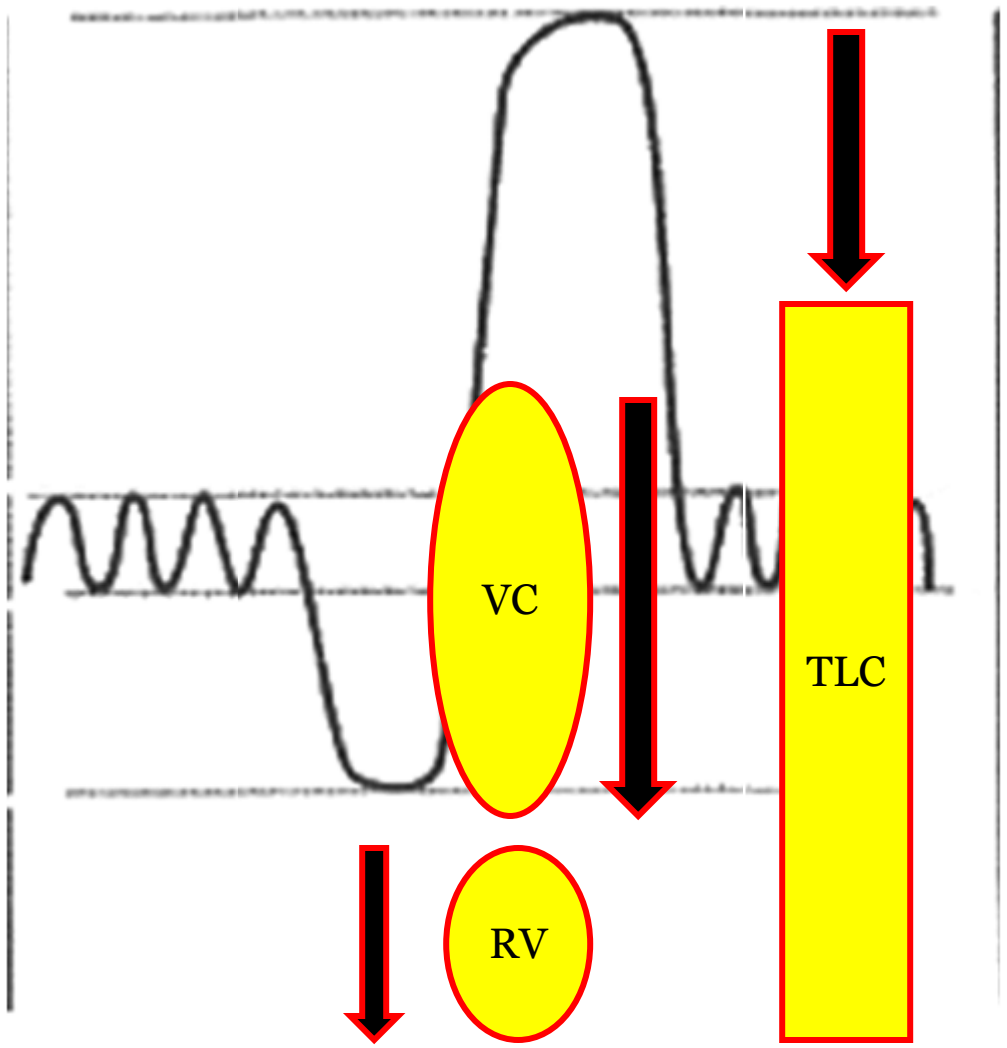
- Sample Questions


Restrictive Lung Disease
Acute (ARDS)
Interstitial
Idiopathic (IPF) Interstitial PNA
Extra-Parenchymal
Inorganic (*Pneumoconiosis*)
Organic (*Hypersensitivity PNA*)
Granulomatous (Sarcoid, GPA)
Disease Association (Autoimmune, CHF Malignancy, Drugs)
Chest Wall
Pleura
Neuromuscular



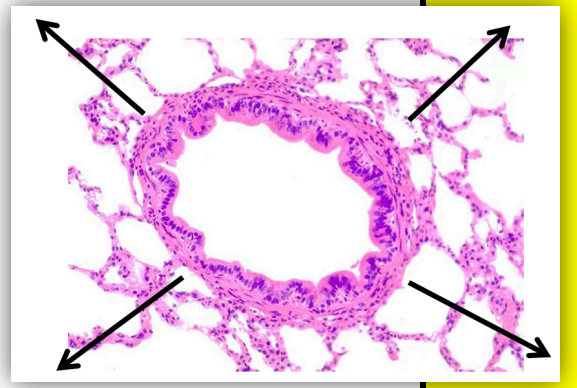
Fibrotic lung disease

Restrictive Disease



Decreased Volumes and Capacities

Restrictive Disease



Features shared by all ***restrictive disorders*:**

Radial traction
prevents airway collapse

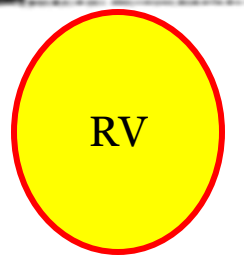
↓ FEV1
↓ FVC
FEV1:FVC ← Normal **Ratio**

RV

Restrictive Disease

Features shared by all ***restrictive disorders*:**

↓ FEV1
↓ FVC
FEV1:FVC
↓ RV
↓ TLC
↓ Compliance
↑ **Elasticity**



Restrictive Disease

Features shared by all ***restrictive disorders*:**

↓ *Distensibility*

↓ FEV1
↓ FVC
FEV1:FVC
↓ RV
↓ TLC
↓ Compliance
↑ **Elasticity**

RV

Restrictive Disease

Features shared by all ***restrictive disorders*:**

↓ *Distensibility*

↓ FEV1
↓ FVC
FEV1:FVC
↓ RV
↓ TLC
↓ Compliance
↑ **Elasticity**

↑ Elastic Recoil

RV

Restrictive Disease

Features shared by all ***restrictive disorders*:**

↓ *Distensibility*

↓ FEV1
↓ FVC
FEV1:FVC
↓ RV
↓ TLC
↓ Compliance
↑ **Elasticity**

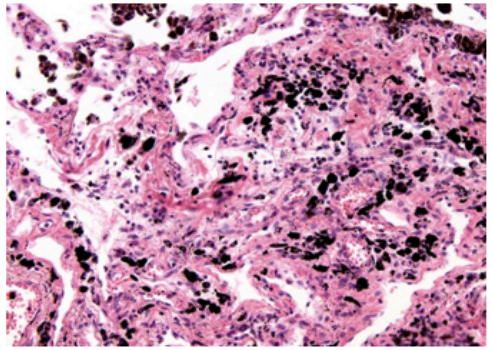
↑ Elastic Recoil

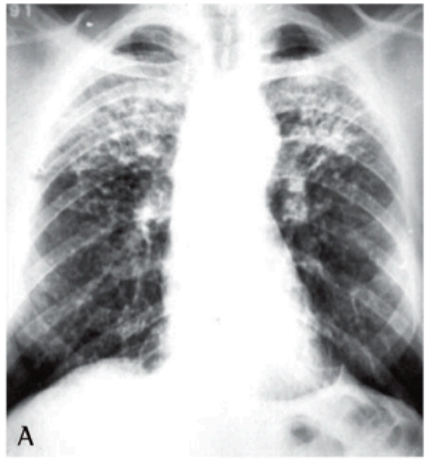
All parameters are decreased except the ratio and elastic recoil

Pneumoconioses: inhaled **in**organic dusts

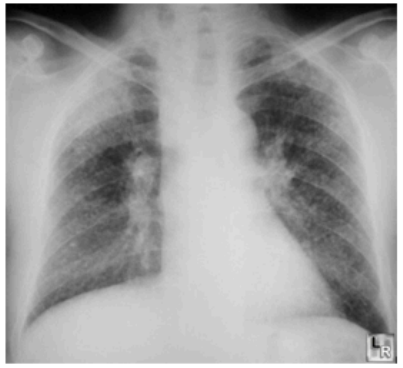
ILD = Restriction = Fibrosis

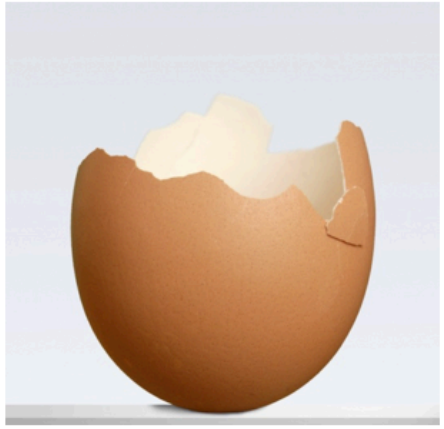
Coal



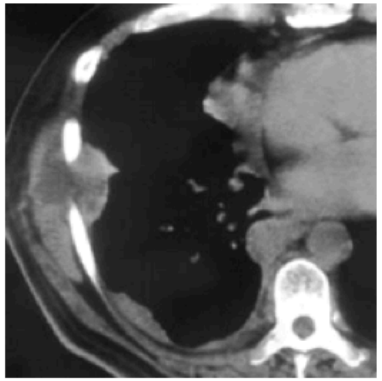


Silicosis





Asbestos



Occupations: Recognizing Pneumoconiosis
Which occupation would be a/w Coal Worker's Disease?

Occupations: Recognizing Pneumoconiosis
Which occupation would be a/w Coal Worker's Disease?

Occupations: Recognizing Pneumoconiosis

Silica:
Foundries, Sandblasters, Mines, Stone Cutters, Ceramic Pottery, Granite

Are you cutting, grinding, or polishing granite?
Granite contains up to 70% crystalline silica. Protect your lungs!

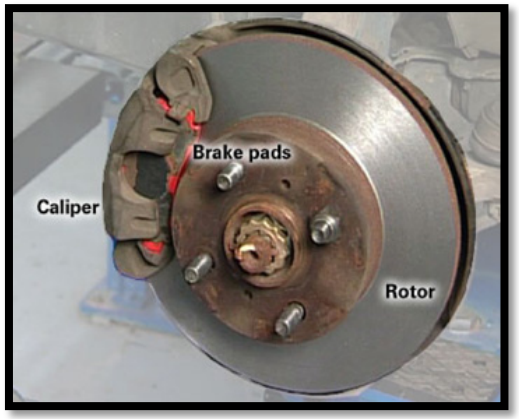
If It's Silica... It's Not Just Dust!

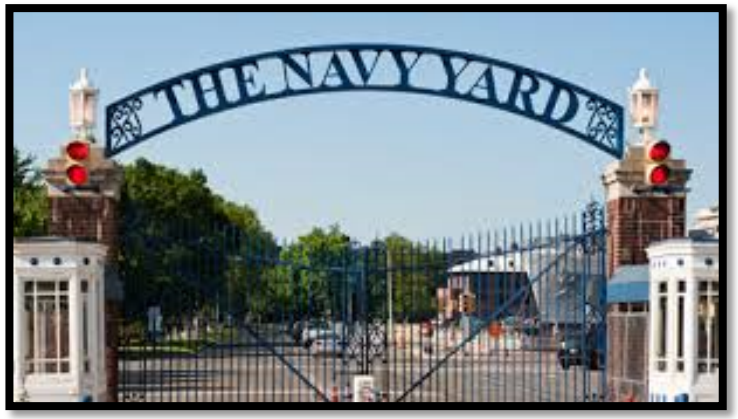
Examples of Silica-Dust Producing Tasks

- Mining
- Construction
- Stone cutting
- Glass manufacturing
- Granite counter top installation
- Ceramics
- Clay and pottery manufacturing
- Sandblasting
- Excavation work
- Demolition work
- Tool cleaning using abrasives

Occupations: Recognizing Pneumoconiosis

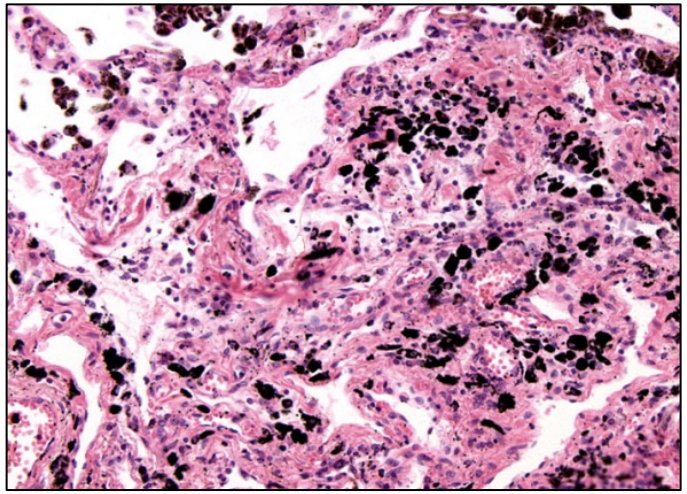
Asbestos:
Navy yard/shipbuilder, insulation, roofing/tiles, building demolition, auto mechanics/car brakes





Identifying the occupations sets up the derivatives…

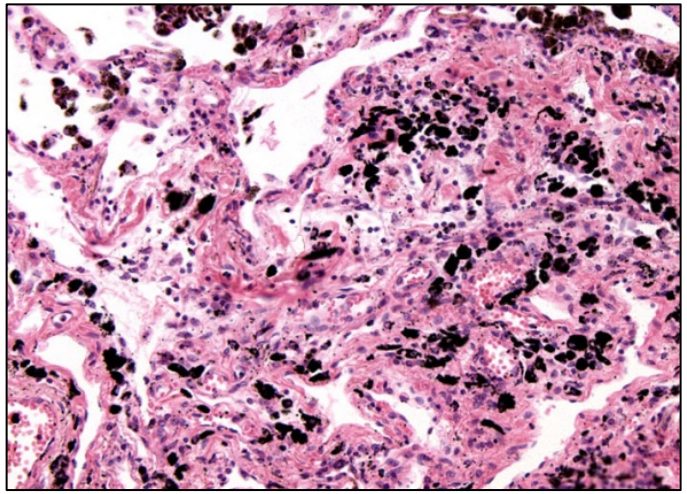
Pathology



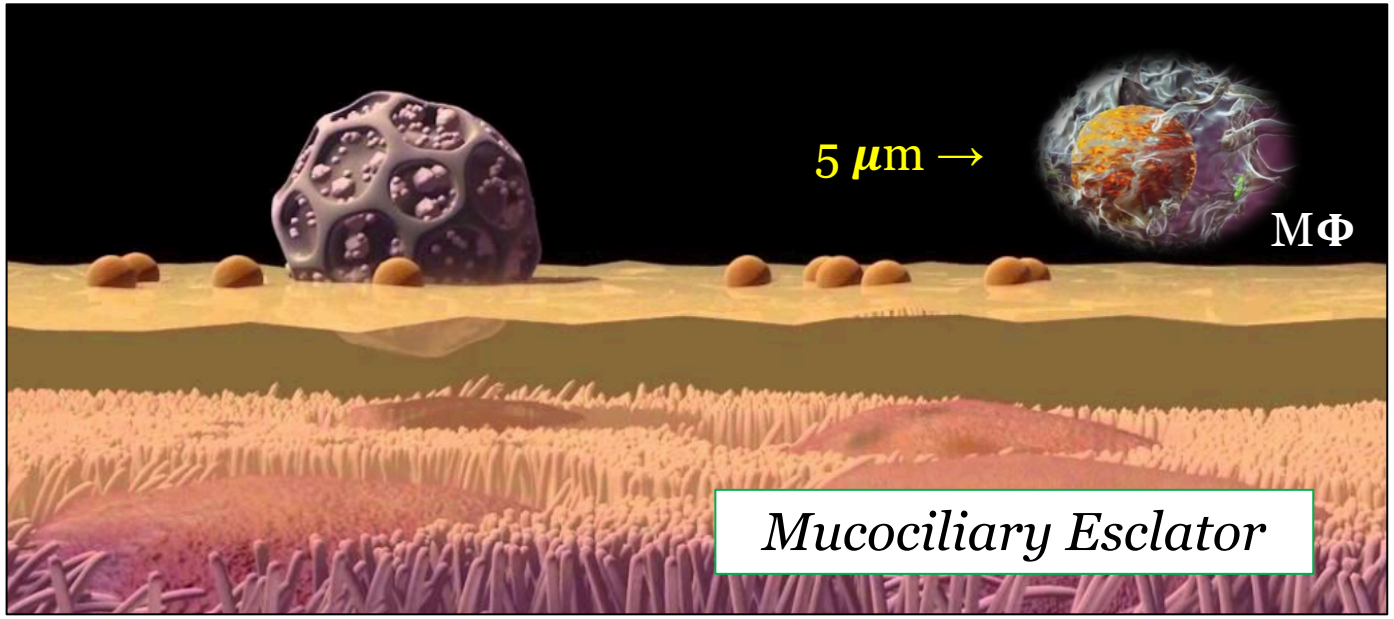
'Dust Cells'

<u>Coal</u>
Anthracotic pigment
Coal dust phagocytized by tissue MΦ
Alveolar MΦ: <5 microns

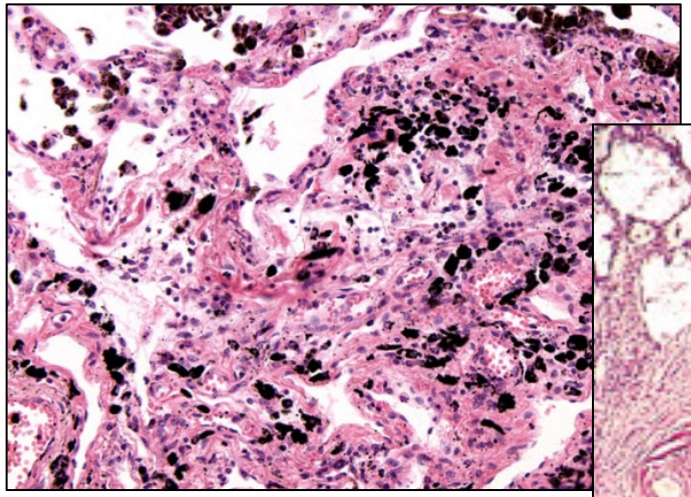
Pathology



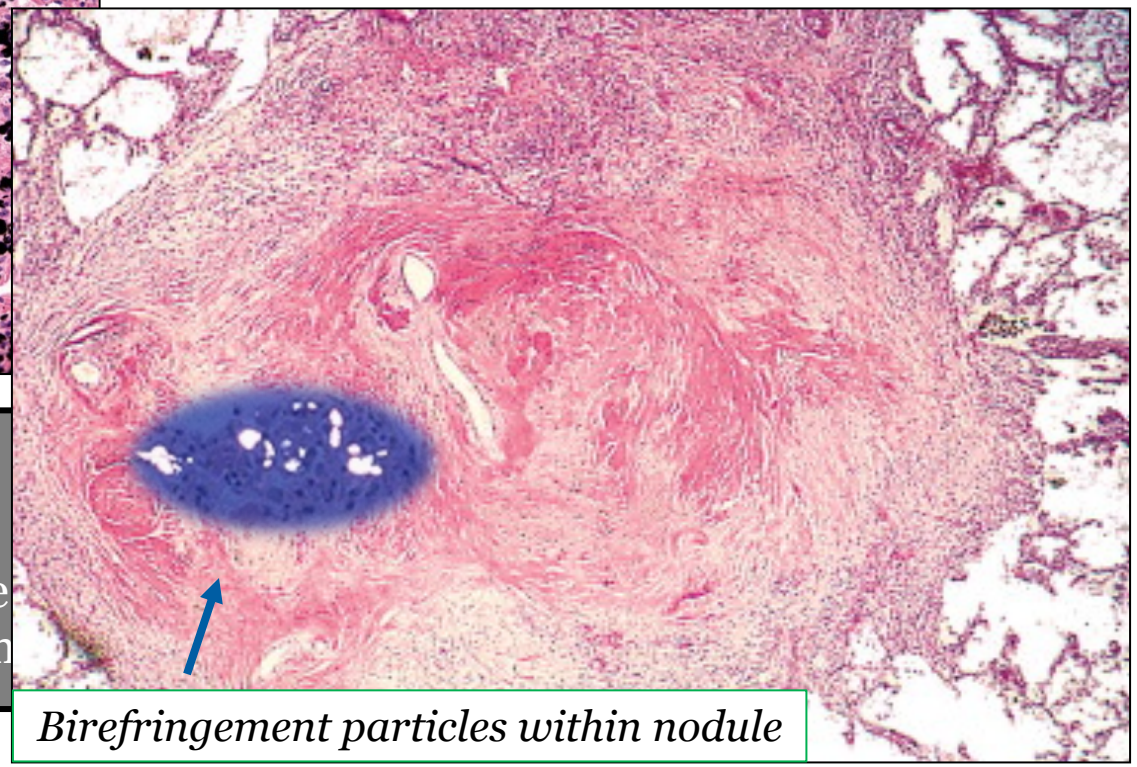
Coal
Anthracotic pigment
Coal dust phagocytized by tissue MΦ
Alveolar MΦ: <5 microns



Pathology



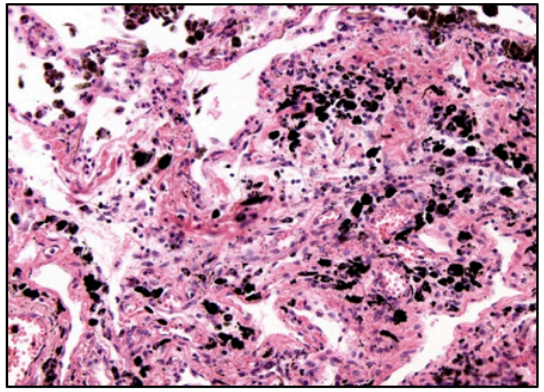
Coal
Anthracotic pigment
Coal dust ingested by tissue
Alveolar MΦ: <5 micron



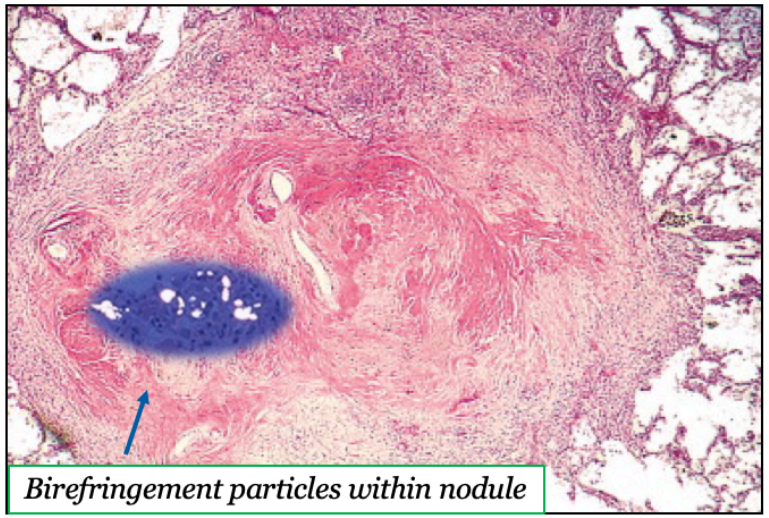
Birefringement particles within nodule

Silica
Dense collagenous nodules
Very fibrotic (*acellular fibrosis*)

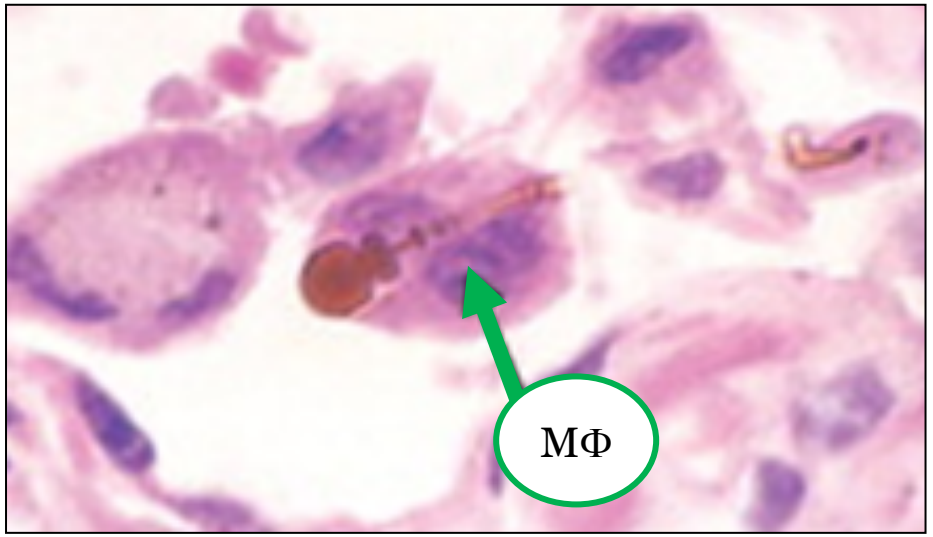
Pathology



Coal
Anthracotic pigment
Coal dust ingested by tissue MΦ
Alveolar MΦ: <5 microns



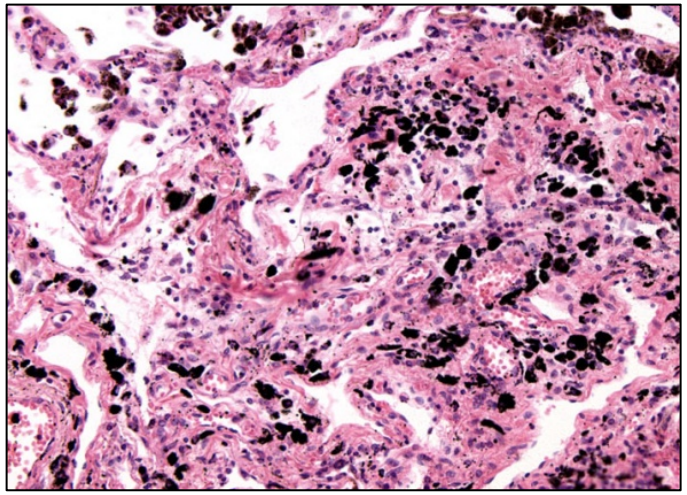
Silica
Dense collagenous nodules
Very fibrotic (acellular fibrosis)

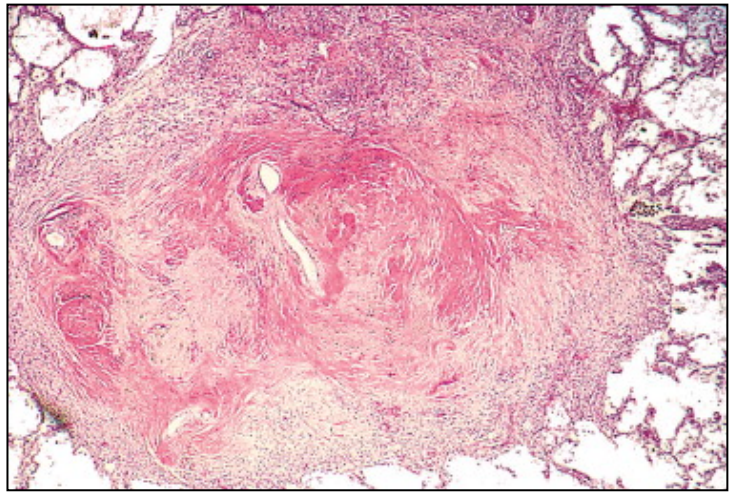


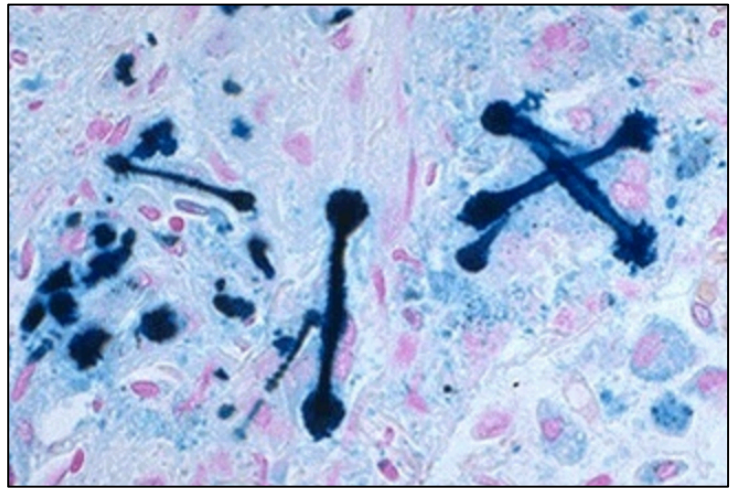
Asbestos bodies: **crocidolite** (*amphobile*) fibers contained within macrophage and coated with iron-containing proteinaceous material (*derived from phagocyte* ***ferritin***)

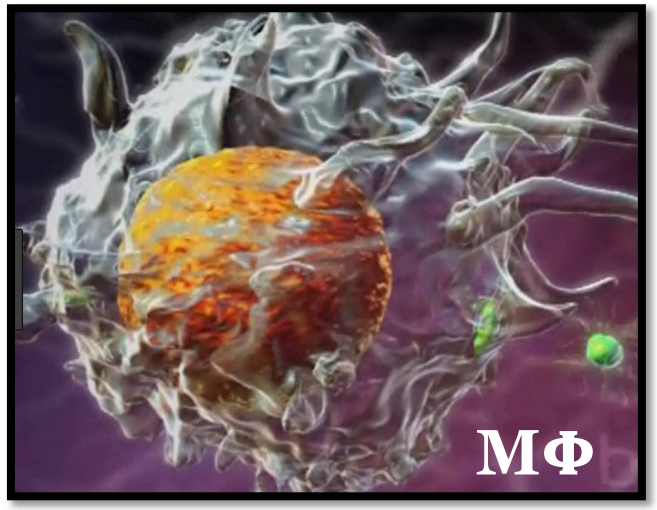
Ferruginous bodies similar but *different mineral fiber*

Pathology



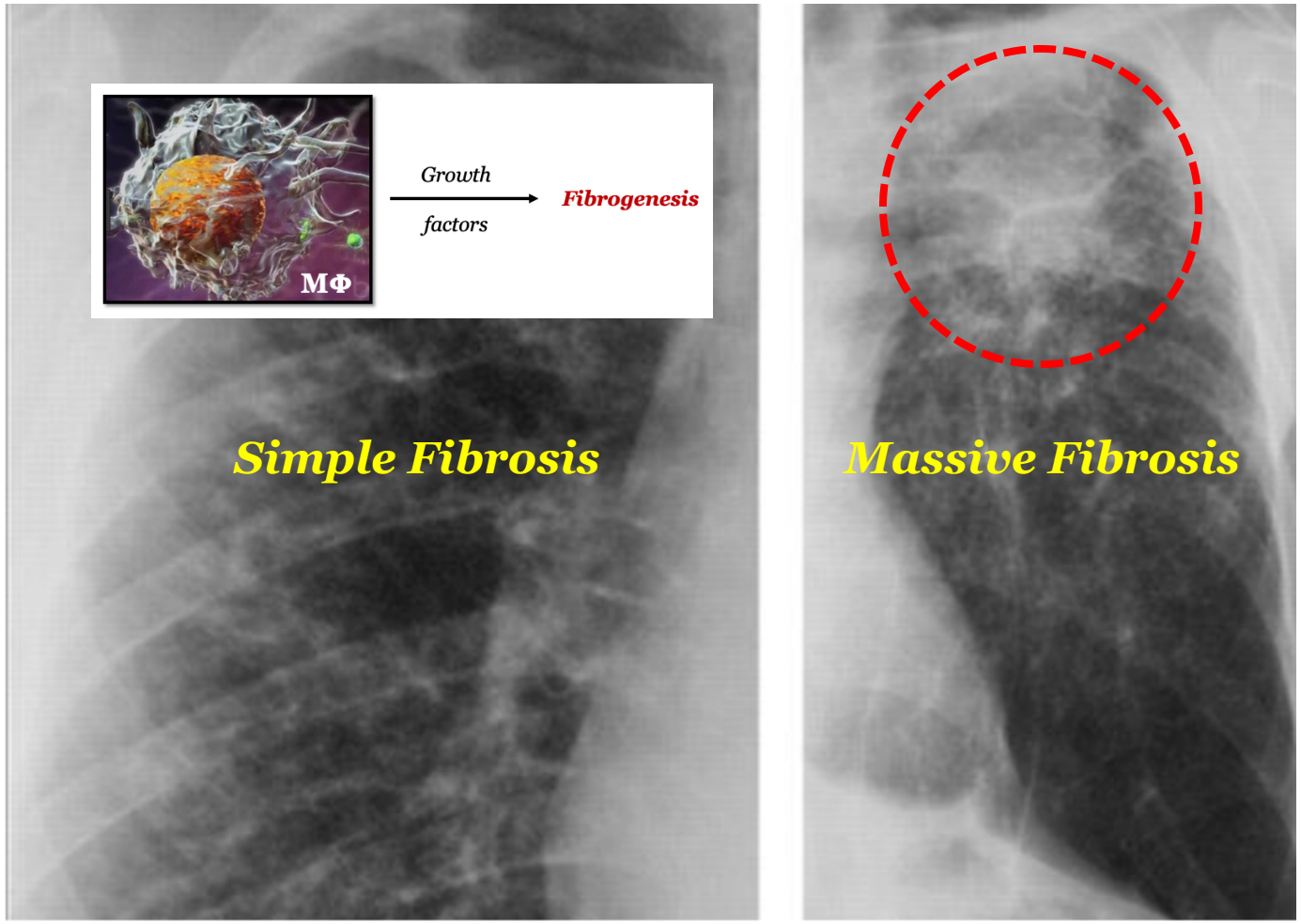




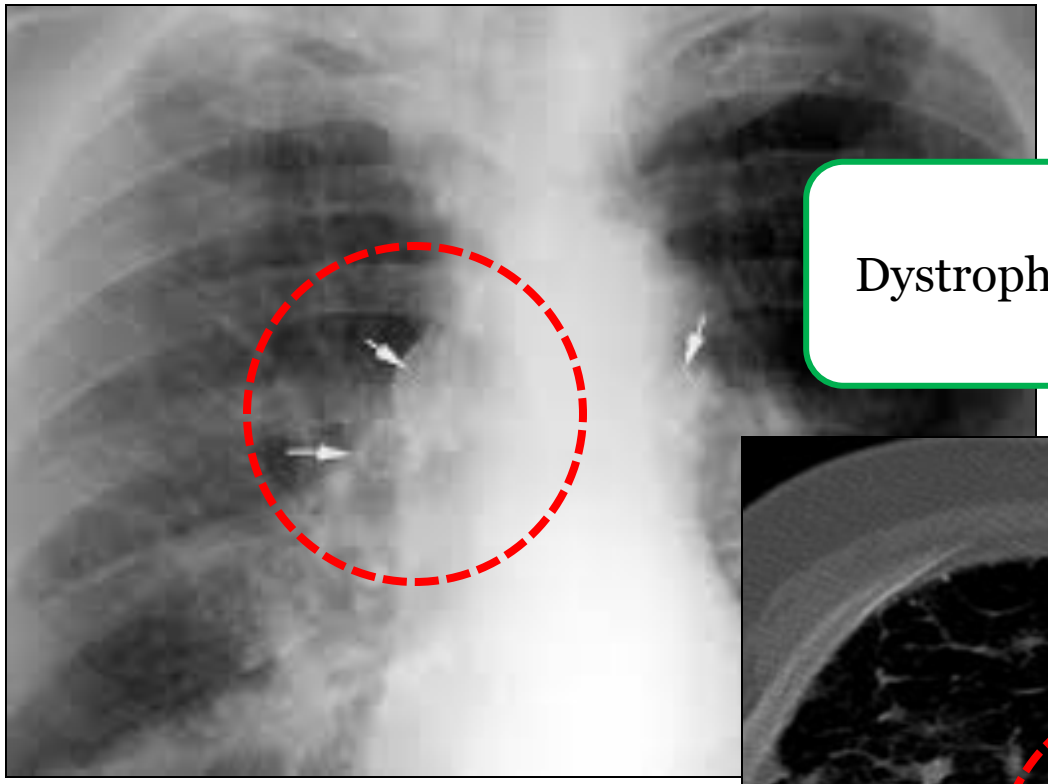


Growth factors → ***Fibrogenesis***

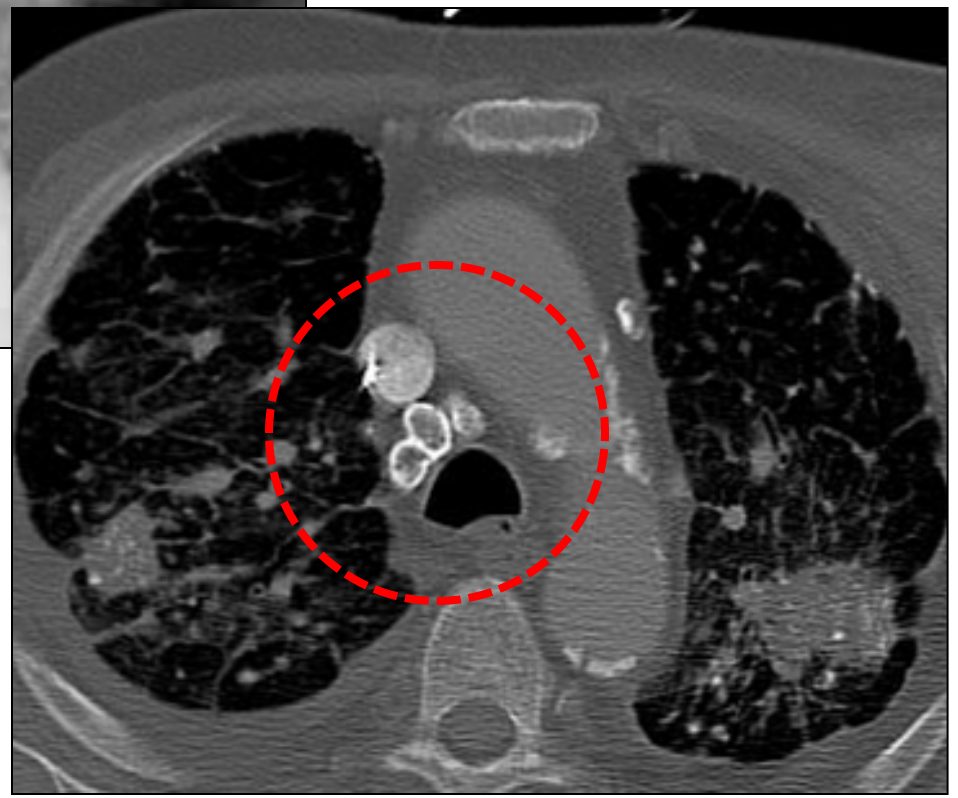
Radiographs
(*reflecting pathology*)

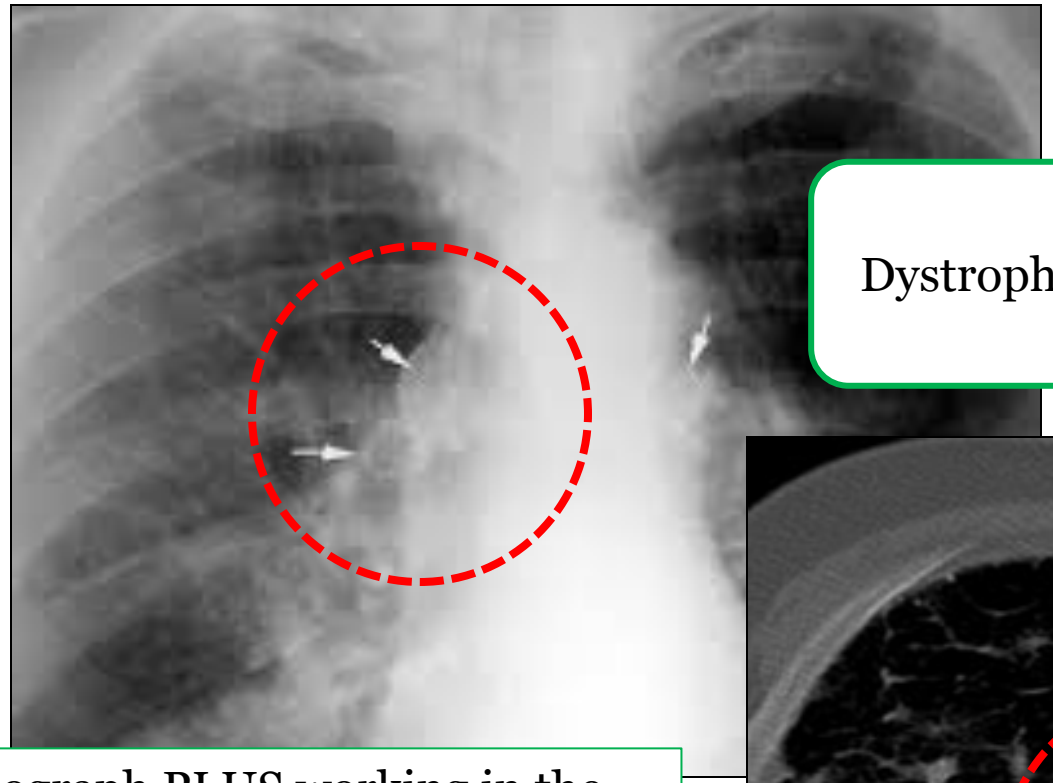


CWP: simple fibrosis v. massive fibrosis (‘*black lung disease*’)
Nodular appearance

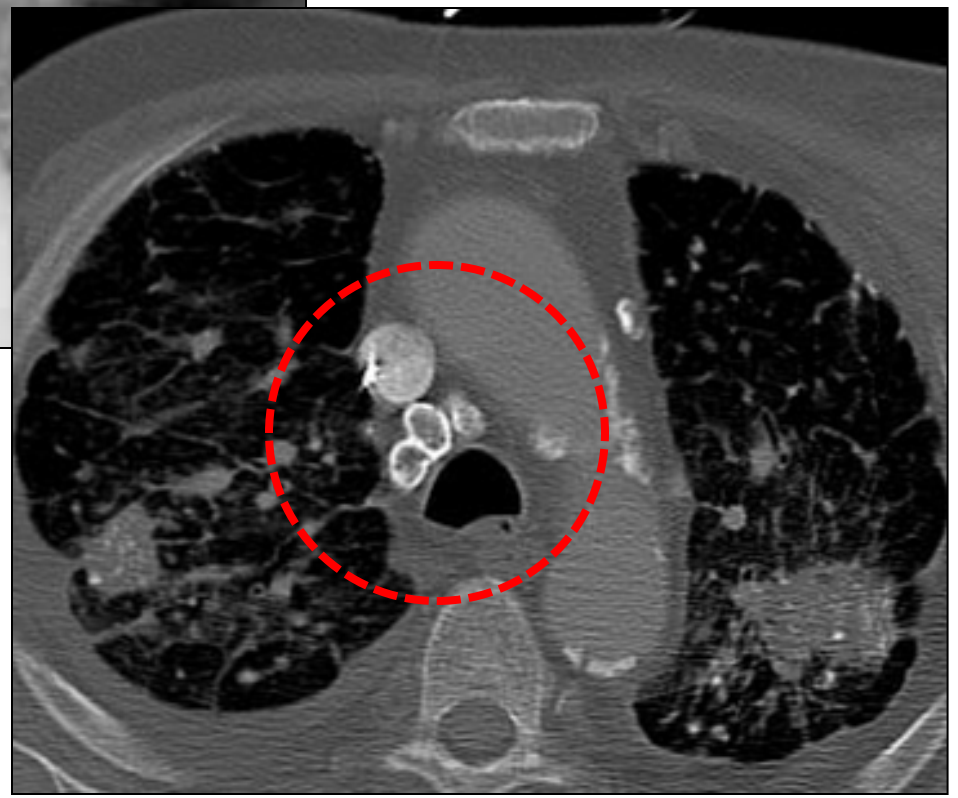


<u>Silicosis</u>
Dystrophic '*eggshell*' calcification





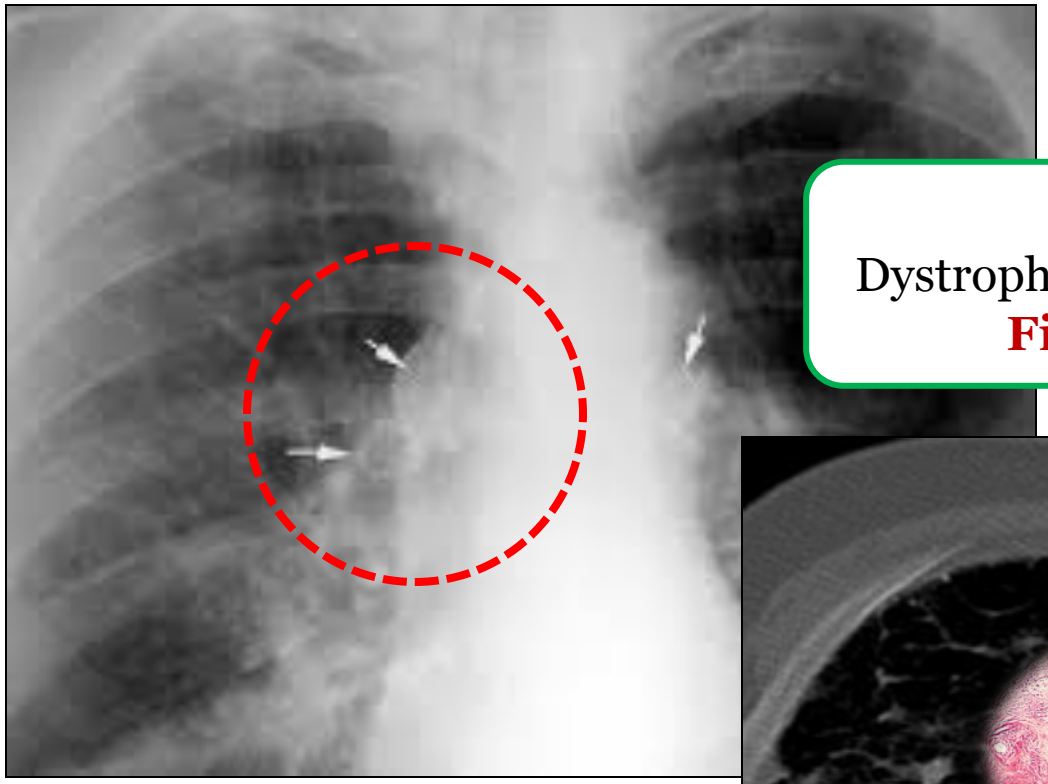
<u>Silicosis</u>
Dystrophic '*eggshell*' calcification



Radiograph PLUS working in the *mining industry* is fair game

↓

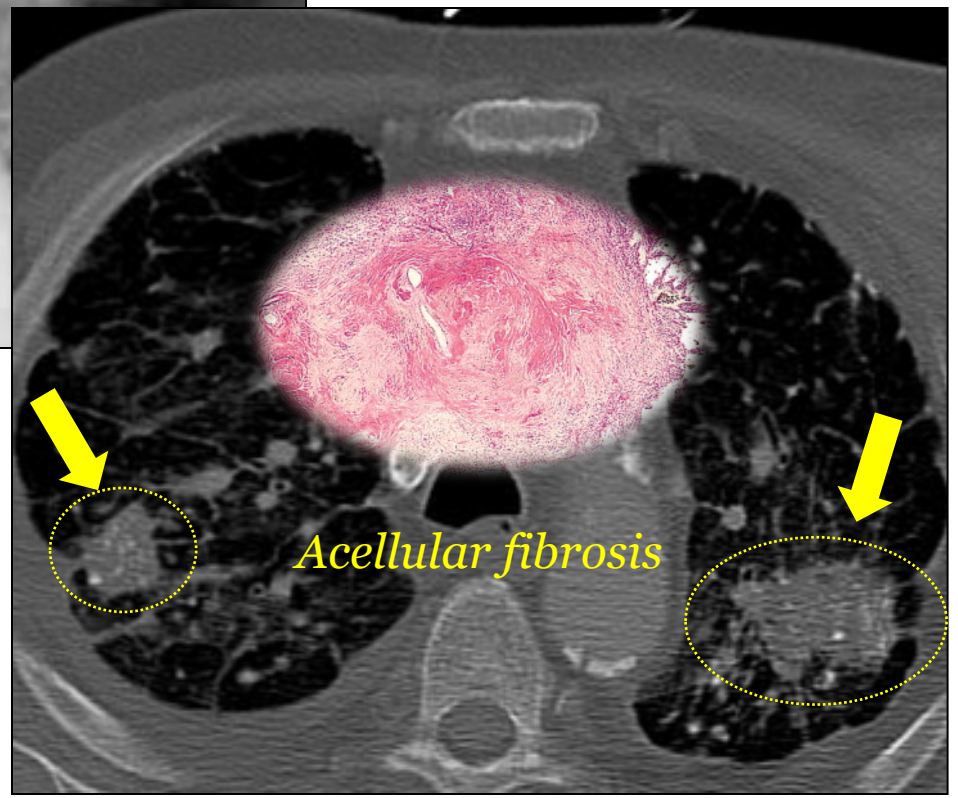
Choose the most likely cause or the correct pathologic description?

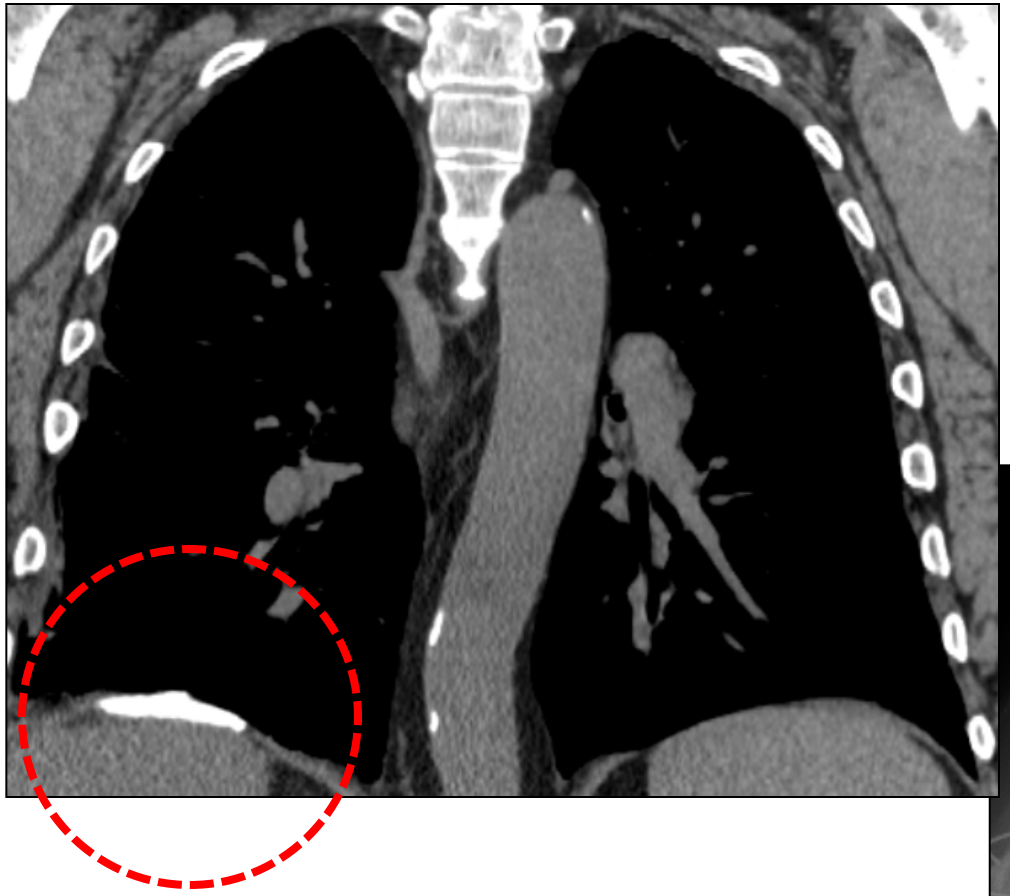


Silicosis

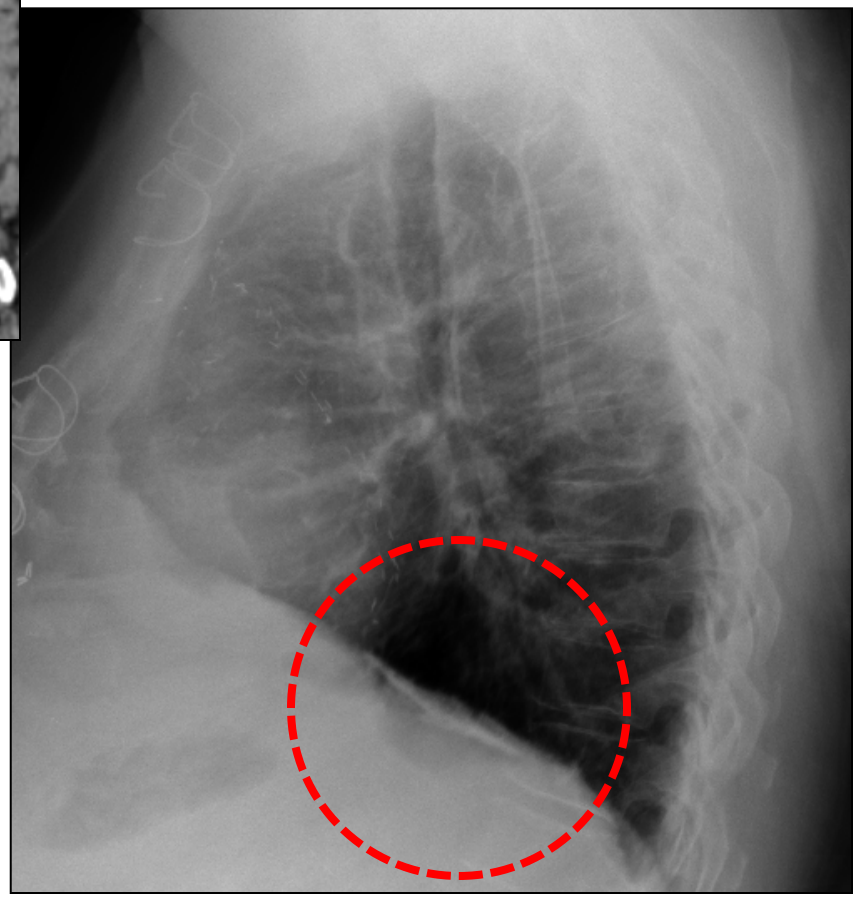
Dystrophic '*eggshell*' calcification

Fibrotic nodules



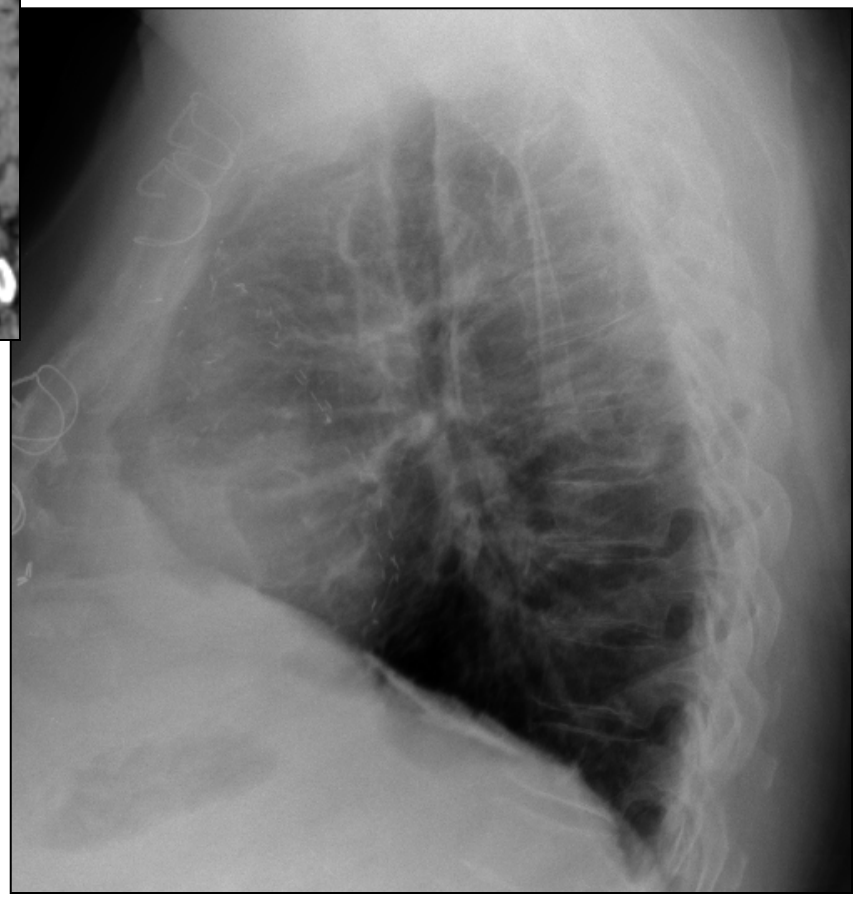


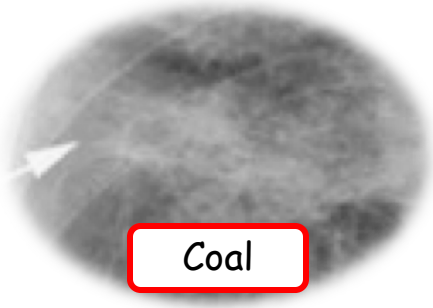
Asbestos
Pleural plaques
Pleural calcifications
*



Markers of asbestos exposure
(*not predictors of mesothelioma*)

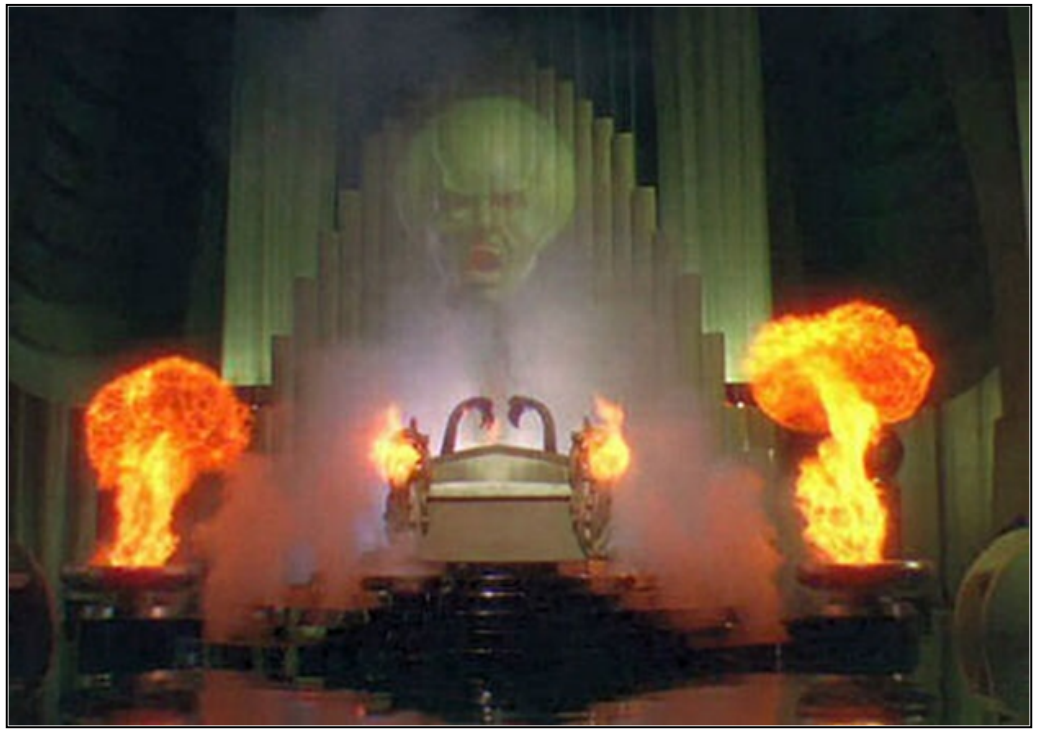
Asbestos
Not Nodular





Nodular

Complications:



Occupation and Pathology are set ups
for the complication vignettes (*and vice versa*)

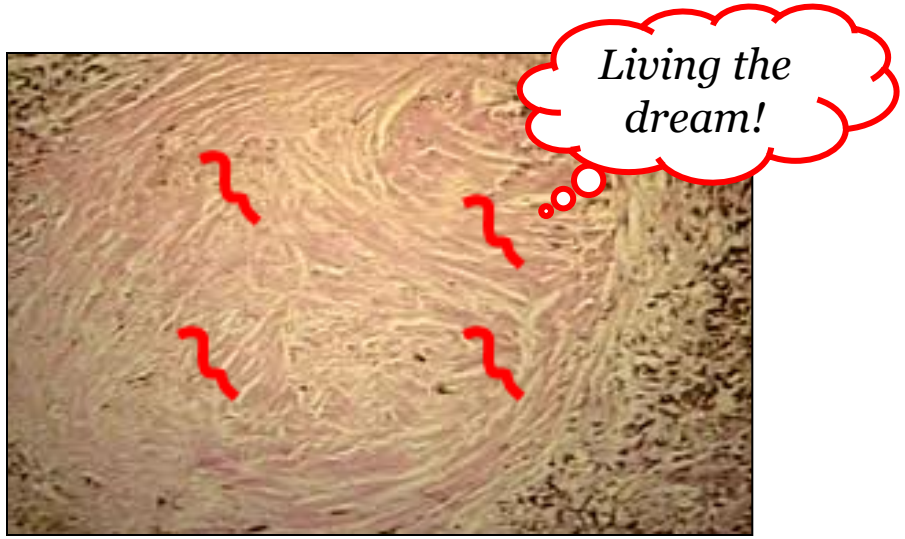
Complications:

Coal: not many. Nodularity. Fibrosis. **Caplan's syndrome**
(*Rheumatoid pneumoconiosis: pulmonary nodular disorder occurring in miner's with RA - not specific to coal*)

Complications:

Coal: not much. Nodularity. Fibrosis. Caplan's syndrome
(*Rheumatoid pneumoconiosis: pulmonary nodular disorder occurring in miner's with RA. Not specific to coal*)

Silica: TB (& malignancy?). TB 2° MΦ dysfunction.
Picture the tubercle bacilli hiding in those dense fibrotic nodules



Complications:

Coal: not much. Nodularity. Fibrosis. Caplan's syndrome
(*Rheumatoid pneumoconiosis: pulmonary nodular disorder occurring in miner's with RA. Not specific to coal*)

Silica: TB (& malignancy?). TB secondary to MΦ dysfunction.
Picture the tubercle bacilli hiding in those dense fibrotic nodules

Asbestos: lung (*bronchogenic*) cancer & mesothelioma ✻

- **Lung cancer more common AND** synergy with tobacco
  Mesothelioma is NOT tobacco-related (*and occurs > 40 yrs later*)

Complications:

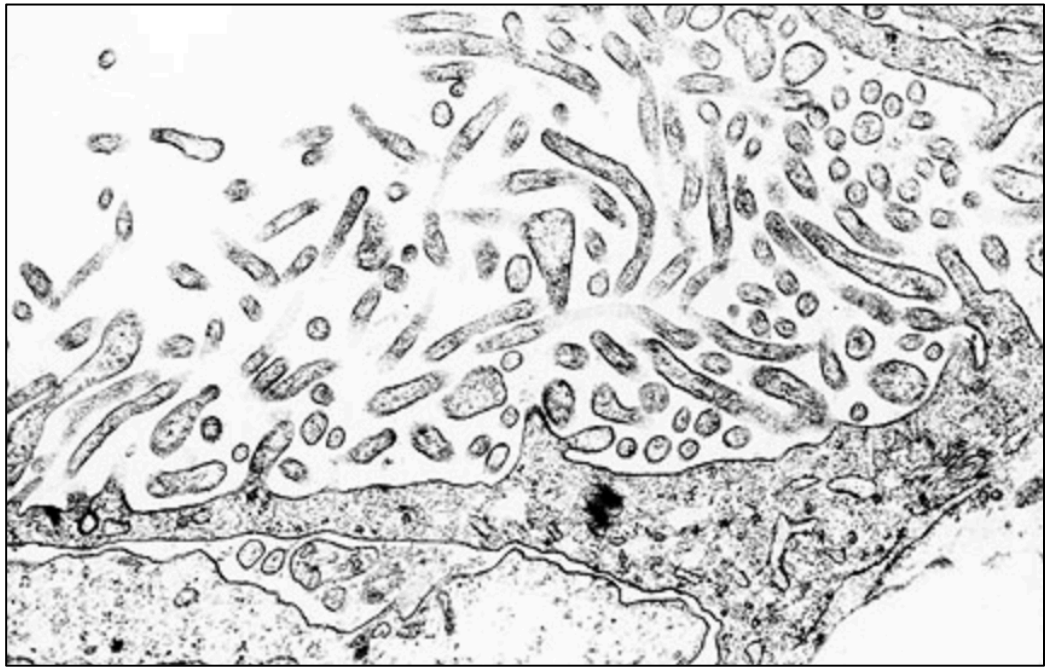
Coal: not much. Nodularity. Fibrosis. Caplan's syndrome
(*Rheumatoid pneumoconiosis: pulmonary nodular disorder occurring in miner's with RA. Not specific to coal*)

Silica: TB (& malignancy?). TB secondary to MΦ dysfunction.
Picture the tubercle bacilli hiding in those dense fibrotic nodules.

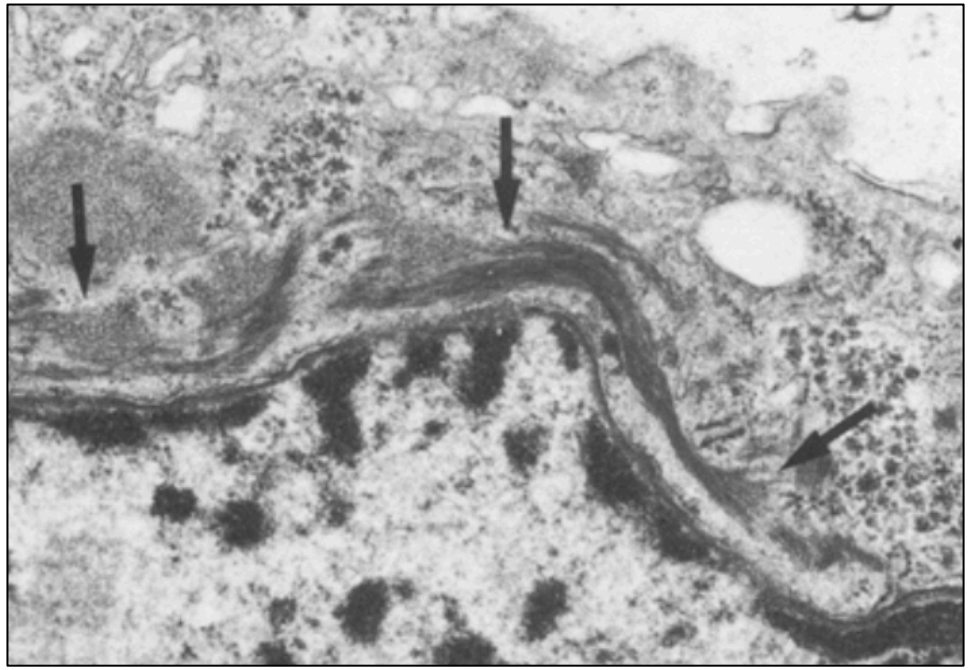
Asbestos: lung (*bronchogenic*) cancer & mesothelioma ✻

- **Lung cancer more common AND** synergy with tobacco
- **Mesothelioma** is **NOT** tobacco-related (*and occurs > 40 yrs later*)

Mesothelioma



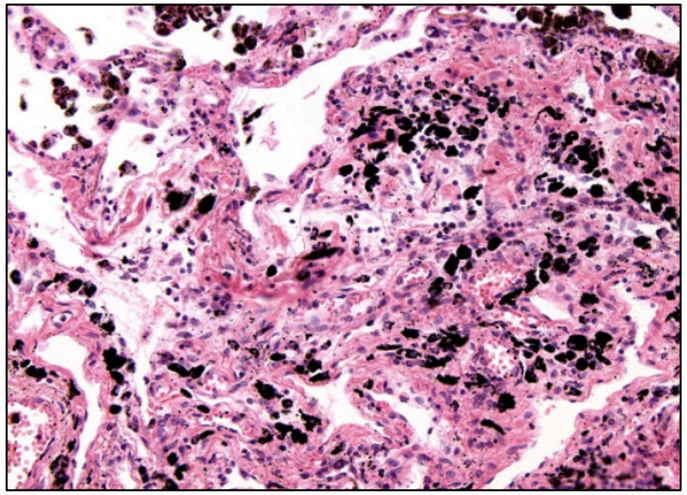
*Long, curved **microvilli***

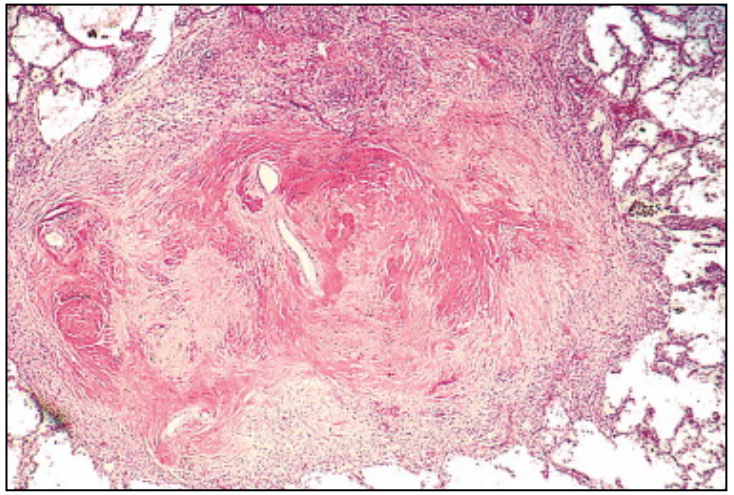


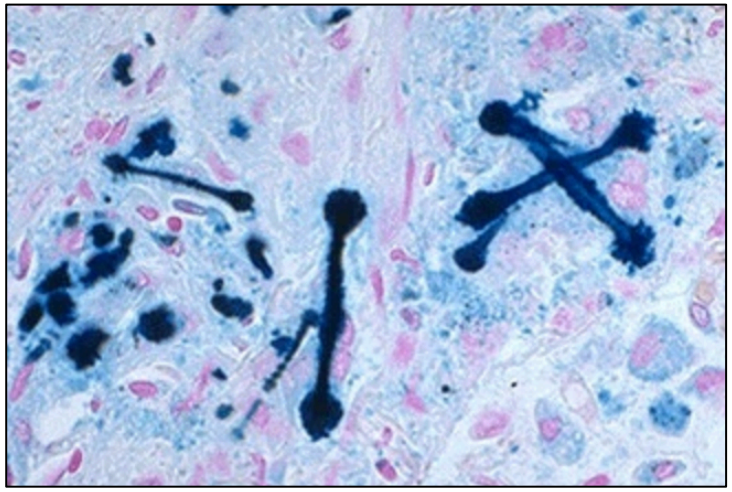
*Intermediate filaments bundling together to form a **tonofilament***

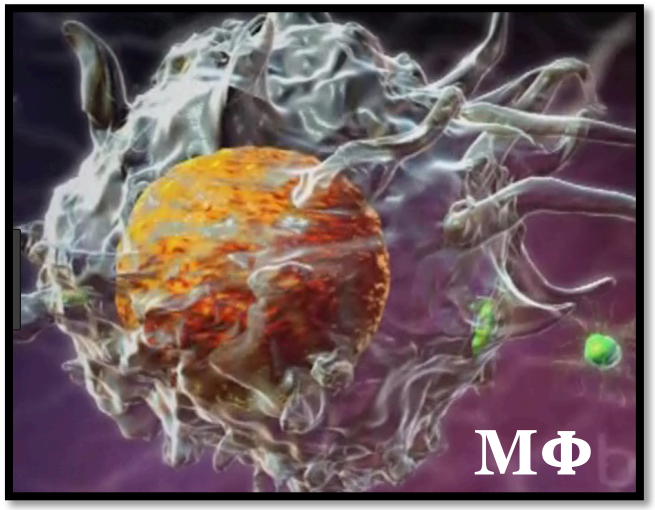
Histopathology: multiple forms including epithelioid, sarcomatous or mixed.

Interstitial Lung Disease









Growth factors → ***Fibrogenesis***

Coal Worker's Pneumoconiosis

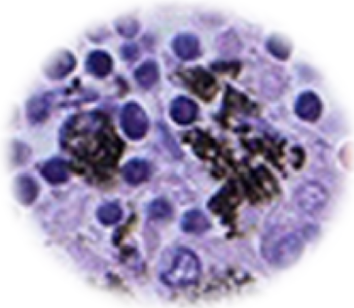
- Pulmonary anthrocosis: pigment in hilar nodes/interstitium

- Simple CWP
  - Fibrotic opacities <1 cm upper lung fields
  - Coal deposits adjacent to respiratory bronchioles
  - Usually well tolerated

- Progressive Massive Fibrosis, 'Black Lung Disease'
  - Fibrotic opacities >1 cm in upper and lower lung fields
  - Associated with bronchiectasis, cor pulmonale

- Notes:
  - Nodular densities
  - No TB/Cancer Risk
  - No plaques/effusion
  - No adenopathy

No important complications other than fibrosis and cor pulmonale
Buzzword: *Dust cells*

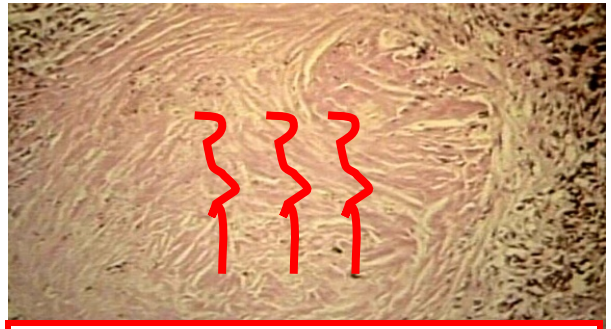


Silicosis

- Source: Foundries, Sandblasters, Mines, Stone Cutters, Ceramic Pottery, Granite

- Very fibrogenic, forming nodular densities
  - Alveolar MΦ respond to silica by releasing cytokines that stimulate fibrogenesis
  - *Acute: ground glass opacities*
  - Chronic
    - Nodular opacities with concentric layers of collagen (*acellular fibrosis*)
    - Egg shell calcification in hilar nodes (*dystrophic calcification*)
  - Complications: TB (*secondary to MΦ dysfunction*) and malignancy?

- Notes
  - No pleural plaques
  - Death from cor pulmonale

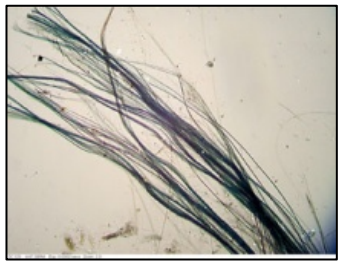


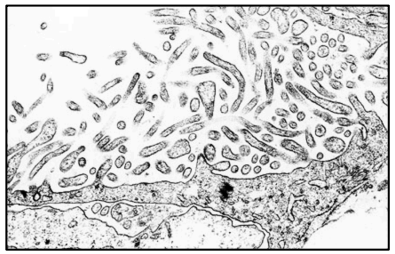
Artist rendition of AFB

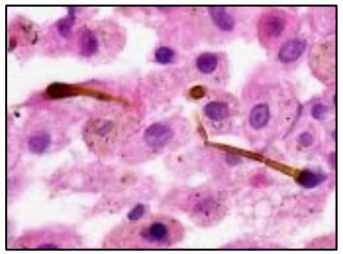
Asbestos

(Source: Navy yard/shipbuilder, insulation, roofing/tiles, building demolition, auto mechanics/car brakes)

- Crystals
  - Chrysotile, most common in US
    - Serpentine, curly
    - Interstitial Fibrosis, Lung CA
  - Crocidolite
    - Amphibole, straight, rigid
    - IF, Lung CA, **Mesothelioma**



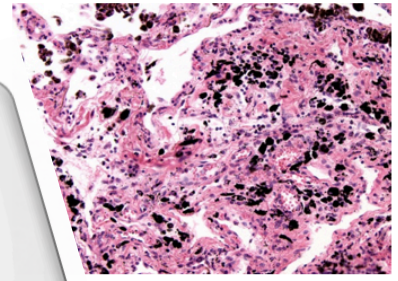


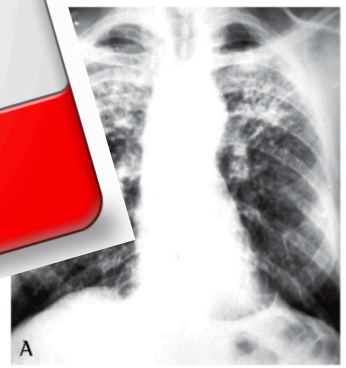


- Pathology
  - Asbestos bodies (MΦ phagocytose fibers and coat with ferroproteins)
  - Interstitial fibrosis
  - Bronchogenic CA (synergism w/ tobacco); 25 yrs
  - Mesothelioma (***no*** *tobacco association*); 40 yrs
    - EM: Numerous long slender microvilli and abundant tonofilaments
    - Psamomma bodies

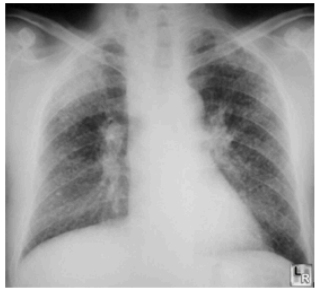
Pneumoconioses for the USMLE Step One Exam

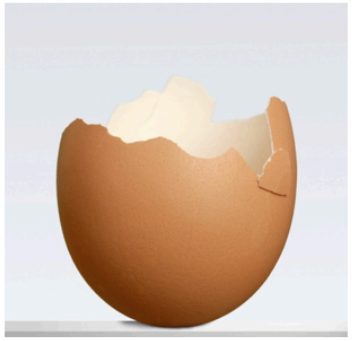
Coal



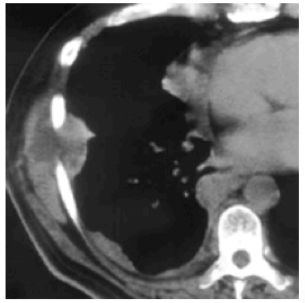


Silicosis





Asbestos



Howard J. Sachs, MD

Associate Professor of Medicine

University of Massachusetts Medical School

www.12DaysinMarch.com; Season III

E-mail: Howard@12daysinmarch.com

Tutorial Services