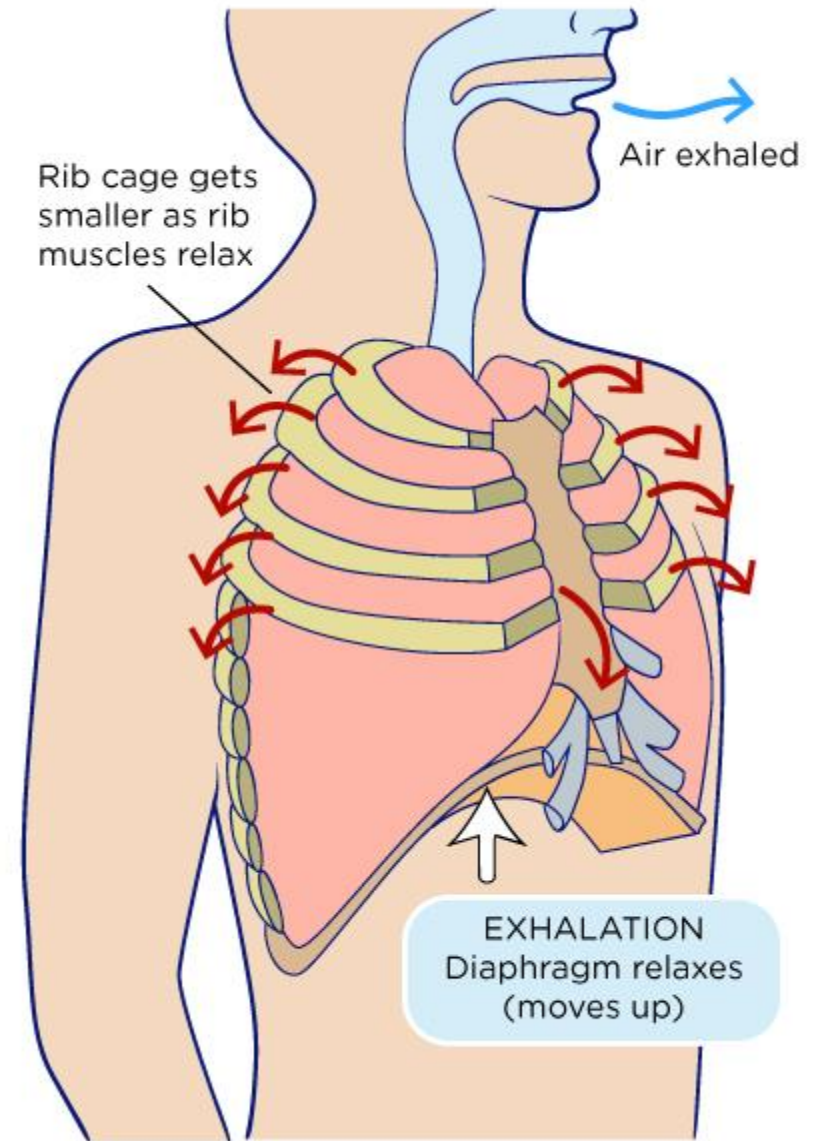
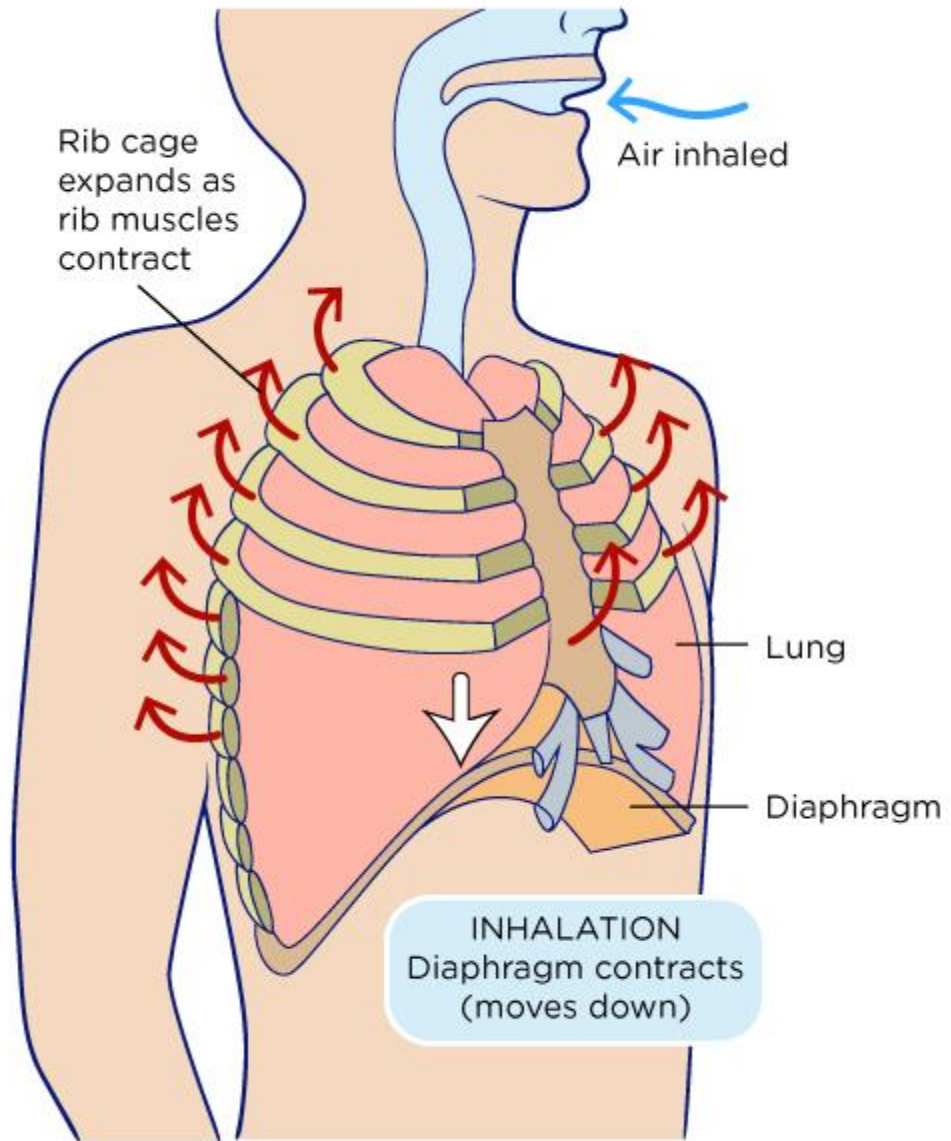


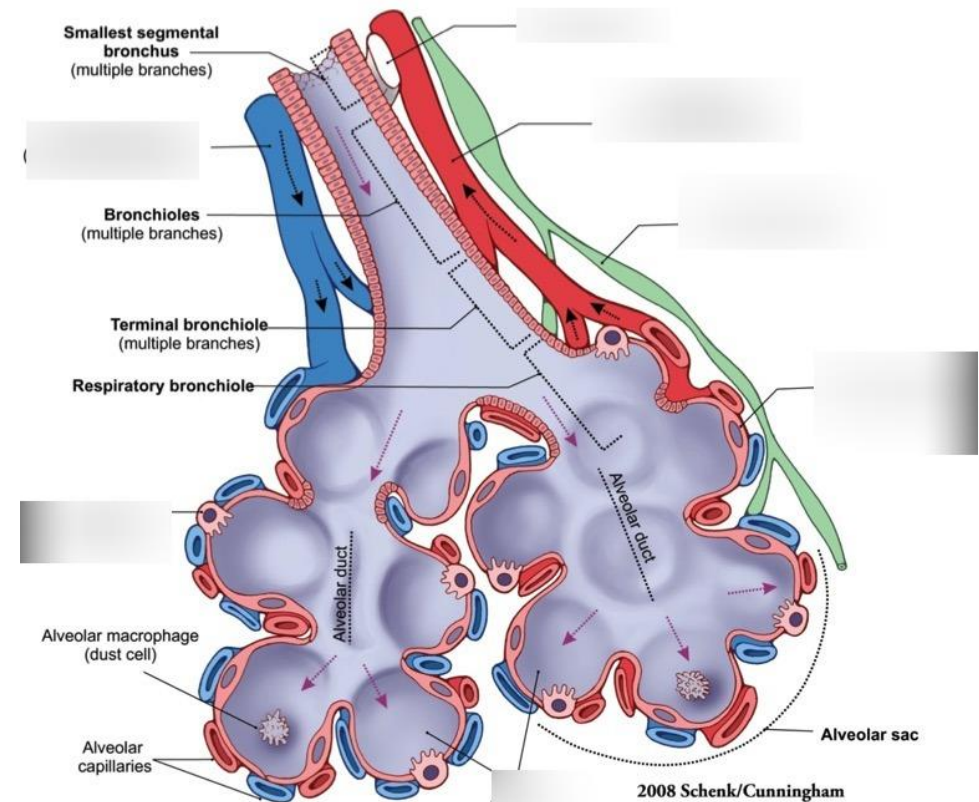
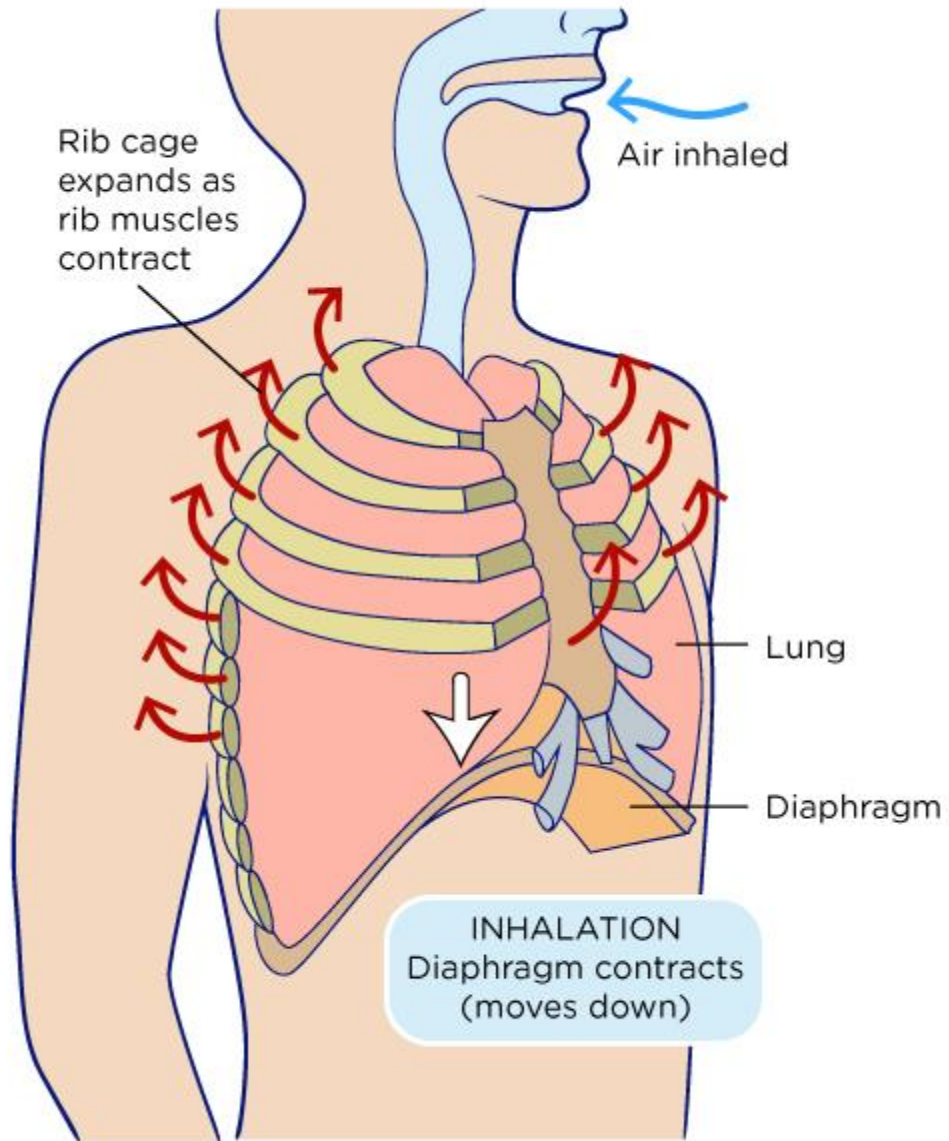
Department of
Morphology
and General Pathology

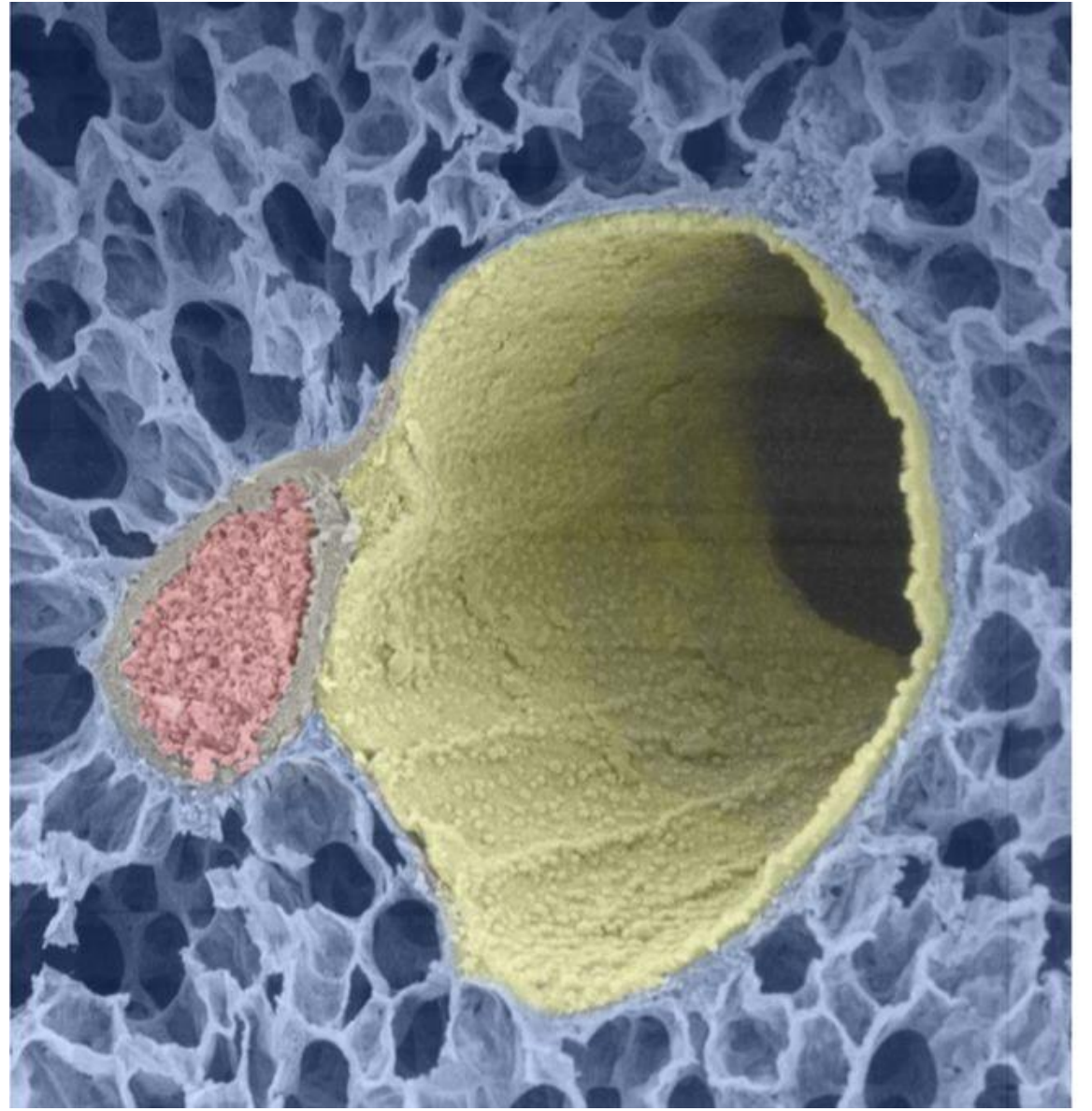
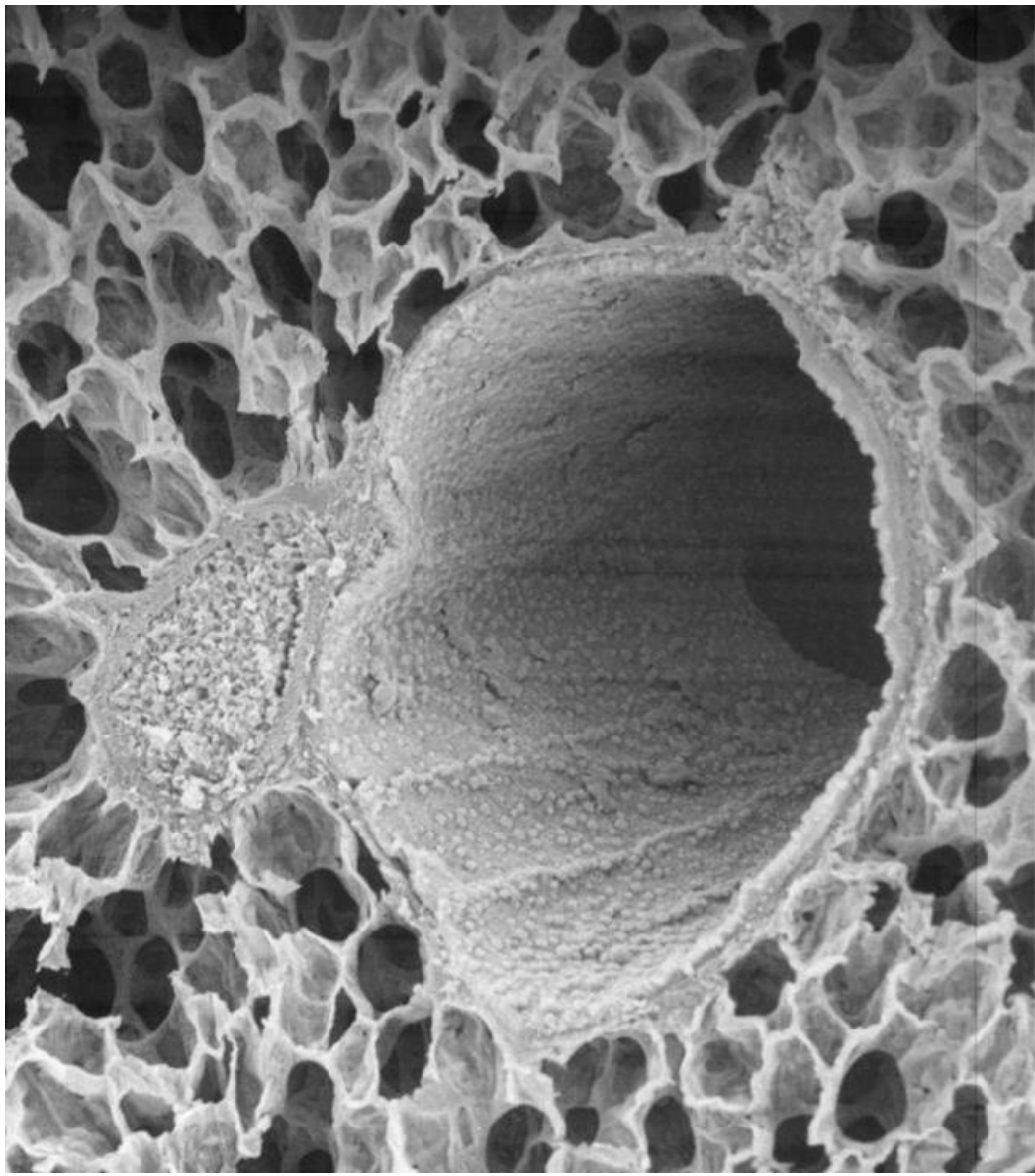
Lung's pathophysiology

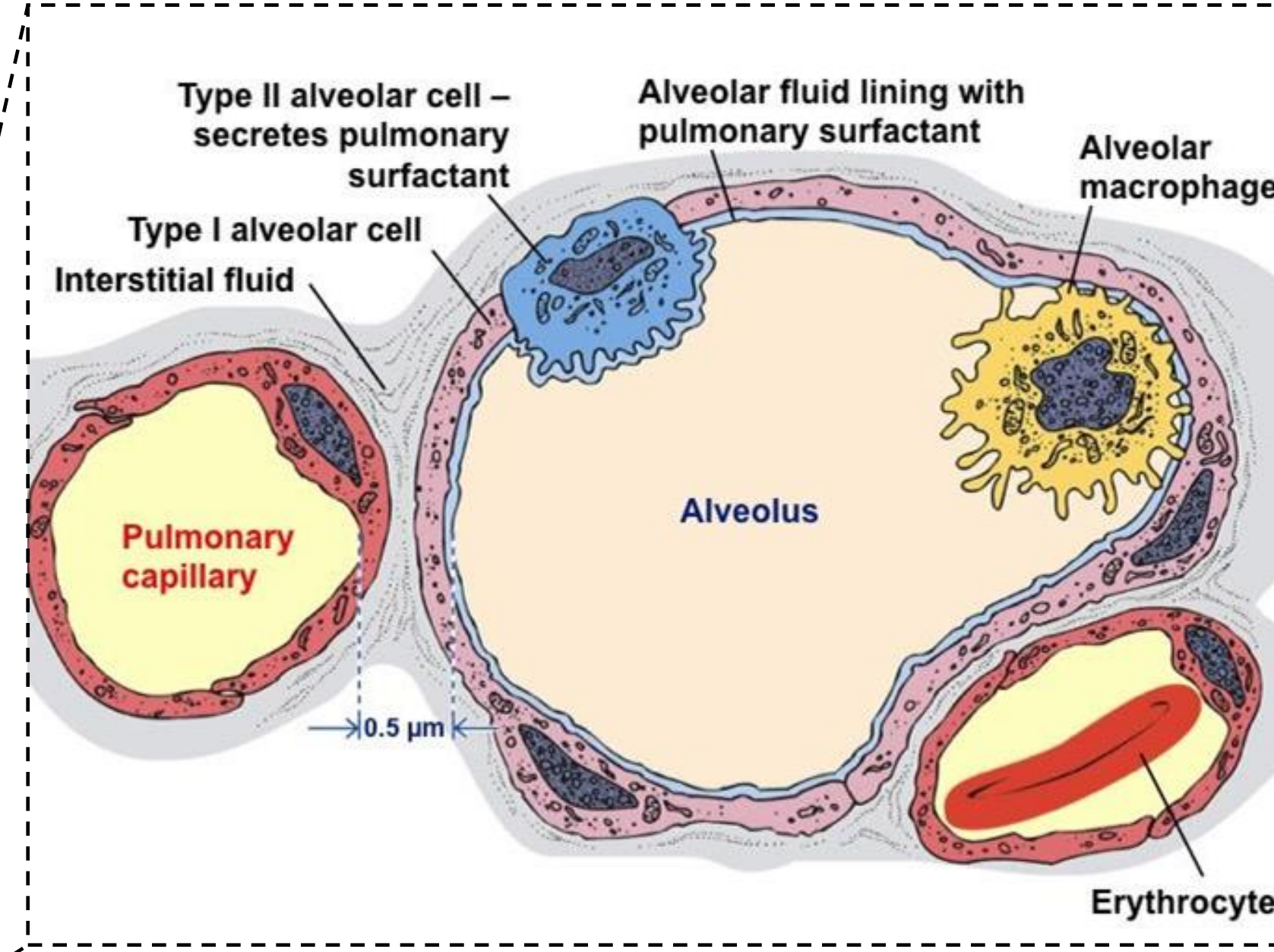
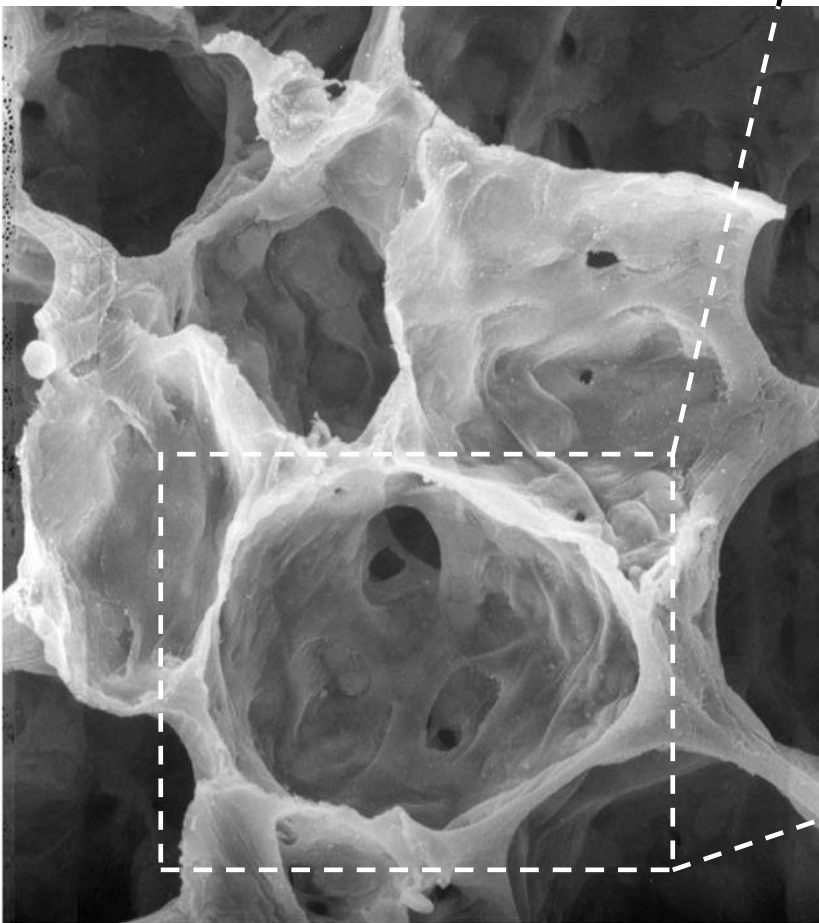
URSAN R.V.
senior lecturer, MD

**Let's brush up on normal
physiology before**









Now we are ready

PULMONARY DISORDERS

obstructive

restrictive

We have two quite typical cases

A 60-year-old man presents to his care physician, reporting shortness of breath and a cough with copious sputum production. He has a 50-pack-year history of cigarette smoking. Physical examination reveals a barrel-shaped chest. A chest X-ray shows an increased anteroposterior diameter with a flattened diaphragm.

His 58-year-old wife, who is a nonsmoker, also has pulmonary symptoms and presents with progressive shortness of breath and accompanying nonproductive cough. On physical examination, increased convexity is noted in her fingernails. End-expiratory crackles are appreciated on auscultation of the lungs at bilateral bases. A CT scan of the chest reveals “honeycombing” of the lungs.

Obstructive, restrictive or neither

- Pneumonia
- Bronchial asthma
- Myasthenia gravis
- Silicosis
- Sarcoidosis
- Tuberculosis
- Pneumothorax
- COPD
- Rib fracture
- Pleural effusion
- Bronchitis
- Bronchiolitis
- Poliomyelitis
- Idiopathic pulmonary fibrosis

Lung diseases



```
graph TD; A[Lung diseases] --> B[Obstructive]; A --> C[Restrictive]; B --> D[reversible obstruction]; B --> E[irreversible obstruction];
```

This flowchart classifies lung diseases into obstructive and restrictive categories. Obstructive diseases are further divided into reversible and irreversible types. The boxes are blue with white text, and arrows indicate the flow from parent to child categories.

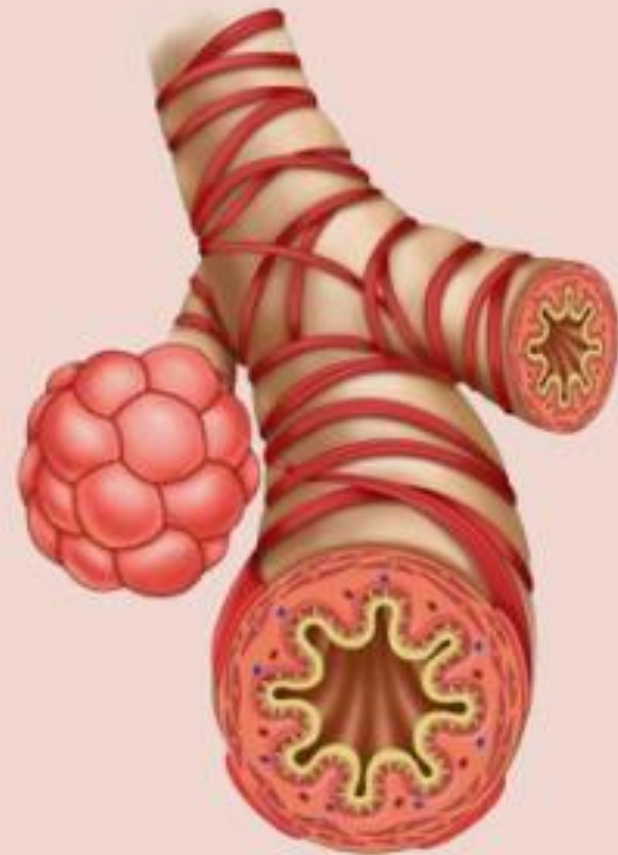
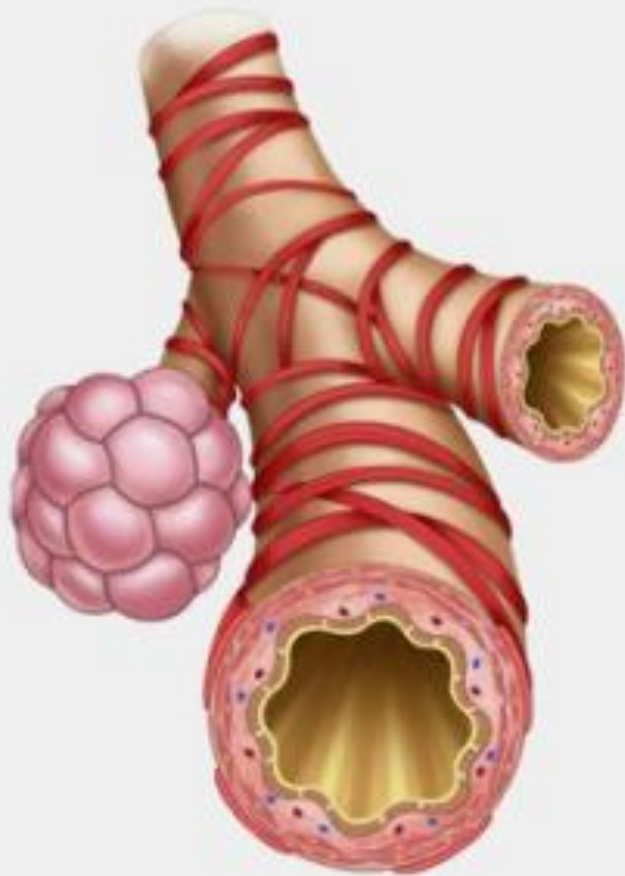
Obstructive

Restrictive

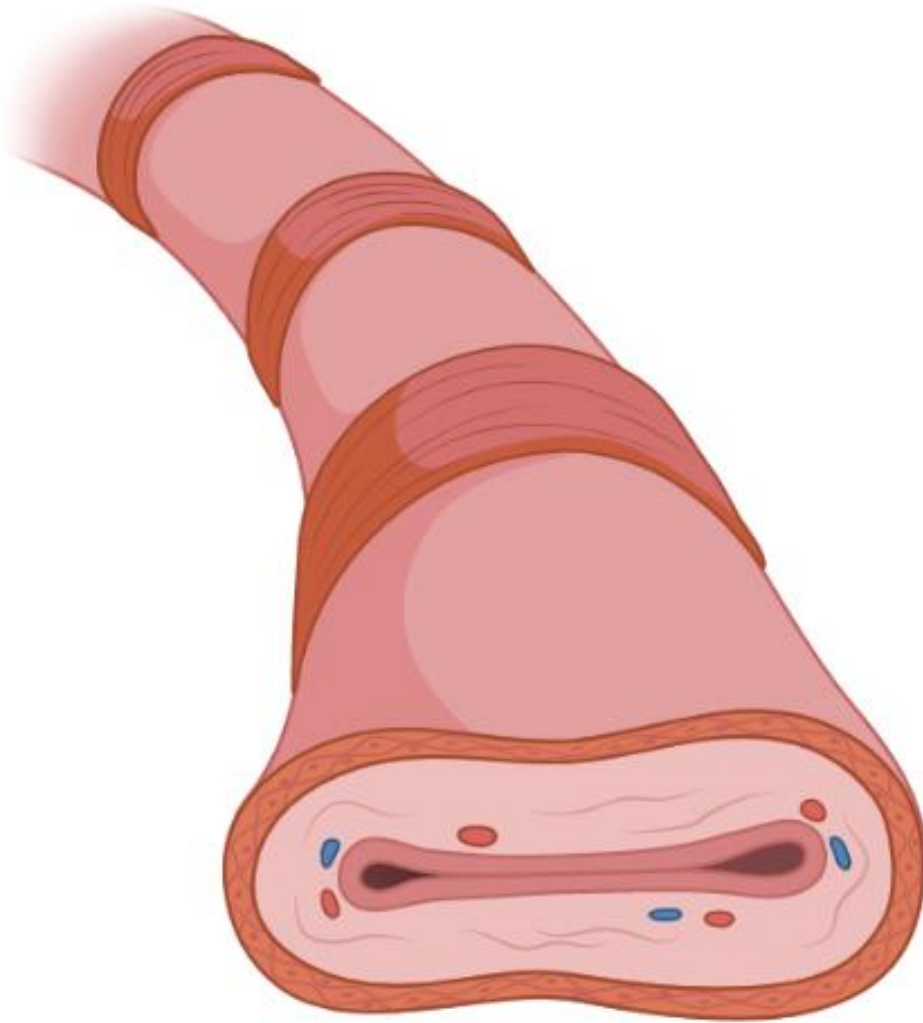
reversible
obstruction

irreversible
obstruction

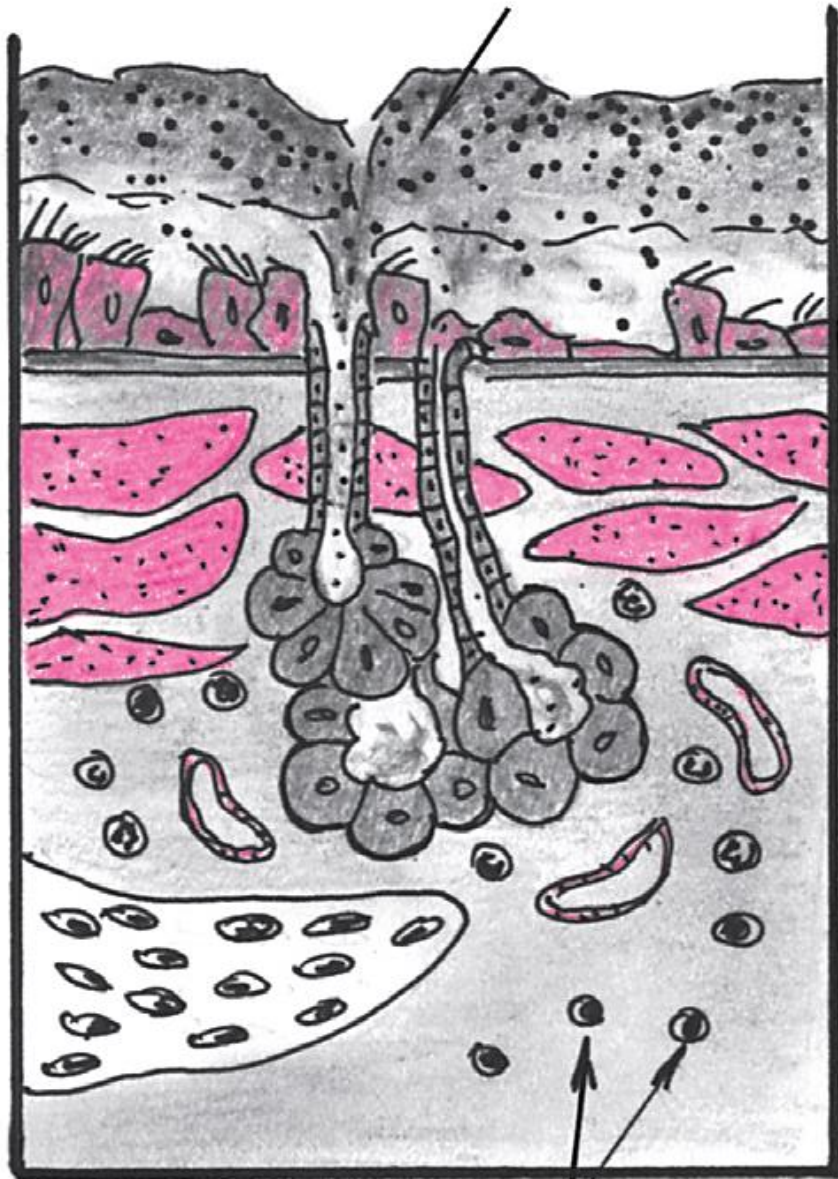
Reversible obstruction: spasm



Reversible obstruction: Bernoulli's principle



Reversible obstruction: inflammation



← Mucus overproduction

← Epithelial injury

← SMC hypertrophy

← Bronchial glands hyperplasia

← Local edema and infiltration

Lung diseases



```
graph TD; A[Lung diseases] --> B[Obstructive]; A --> C[Restrictive]; B --> D[reversible obstruction]; B --> E[irreversible obstruction];
```

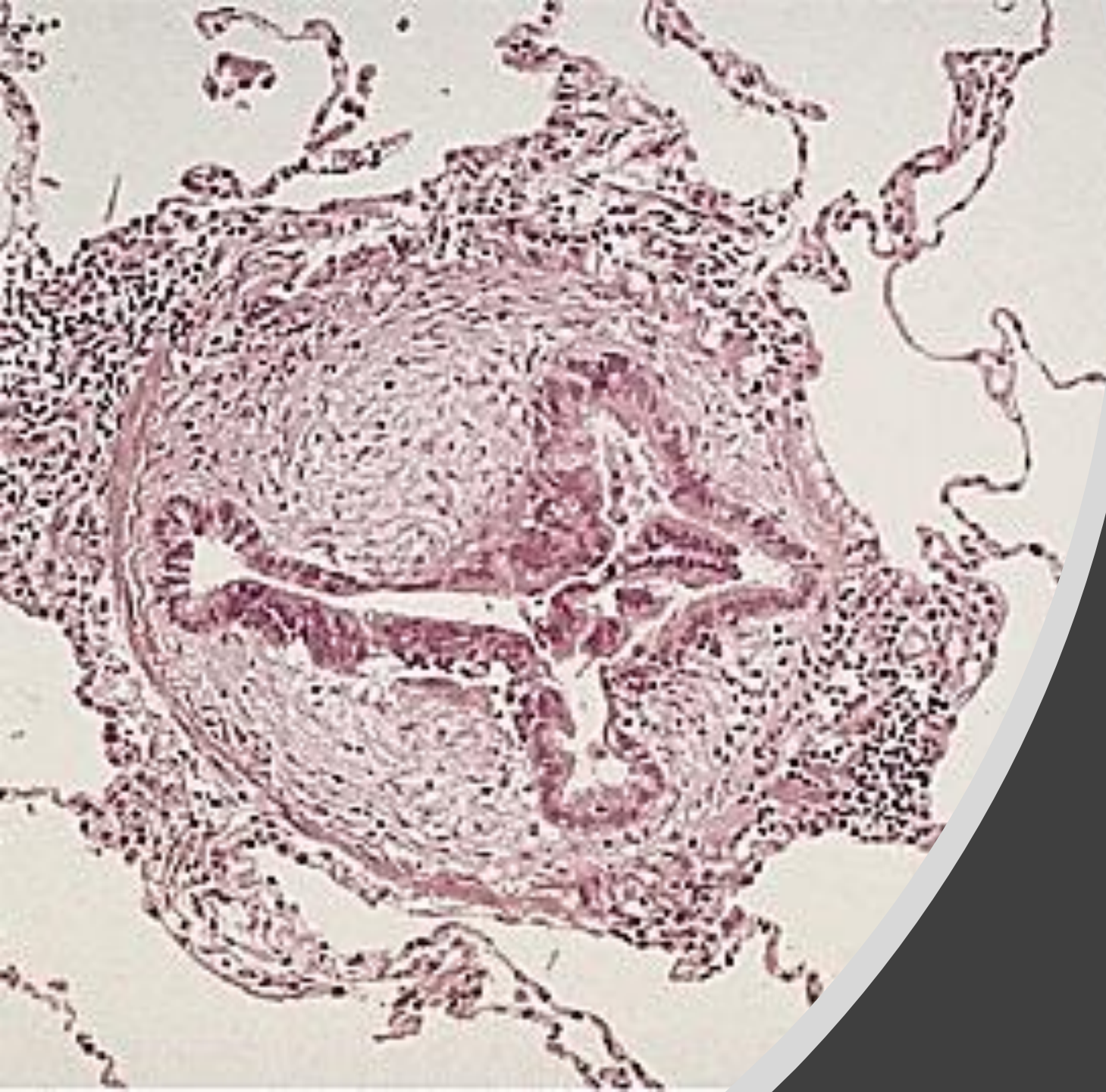
This flowchart classifies lung diseases into obstructive and restrictive categories. Obstructive diseases are further divided into reversible and irreversible types. The boxes are blue with white text, and arrows indicate the flow from parent to child categories.

Obstructive

Restrictive

reversible
obstruction

irreversible
obstruction



**Irreversible
obstruction:
fibrosis**

Formula of two major obstructive diseases

Asthma \approx reversible obstruction

- spasm
- inflammation

COPD \approx irreversible obstruction

- fibrosis

YES, BUT!

Obstructive pulmonary disorders



**IN THE
WORLD**

300 000 000

MORBIDITY

3 000 000

MORTALITY

3

POSITION IN THE WHO LIST

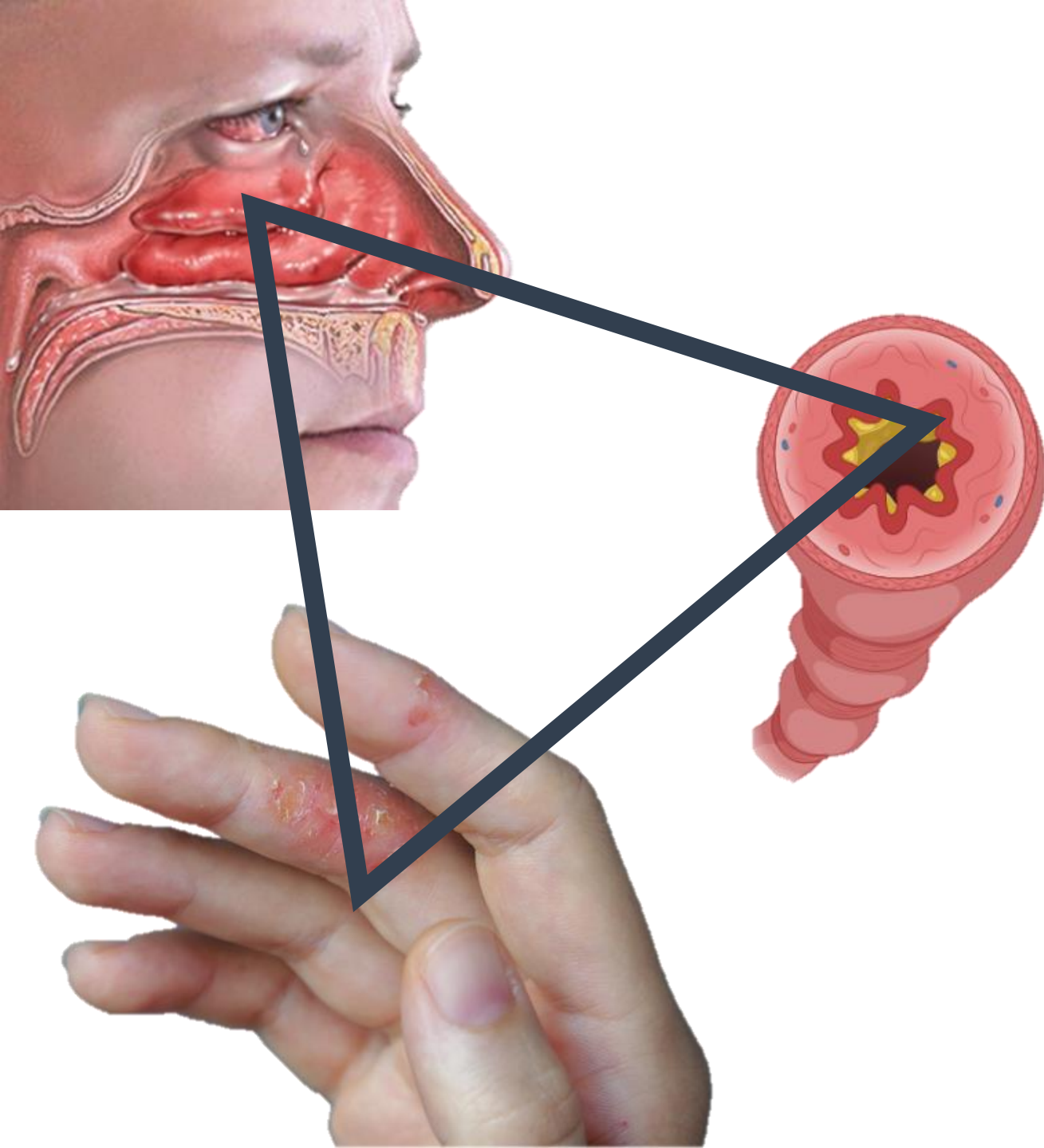
Obstructive lung disorders

- Expiratory dyspnea and cough
- Wheezing
- Decreased vital lung capacity and expiratory volumes
- FEV1/FCV ratio is low
- Asthma and COPD

Asthma and immune system

Atopy

IgE



By the way,
who's to blame?

THE NOBEL PRIZE
IN PHYSIOLOGY OR MEDICINE 2022

Illustration: Niklas Elmehed

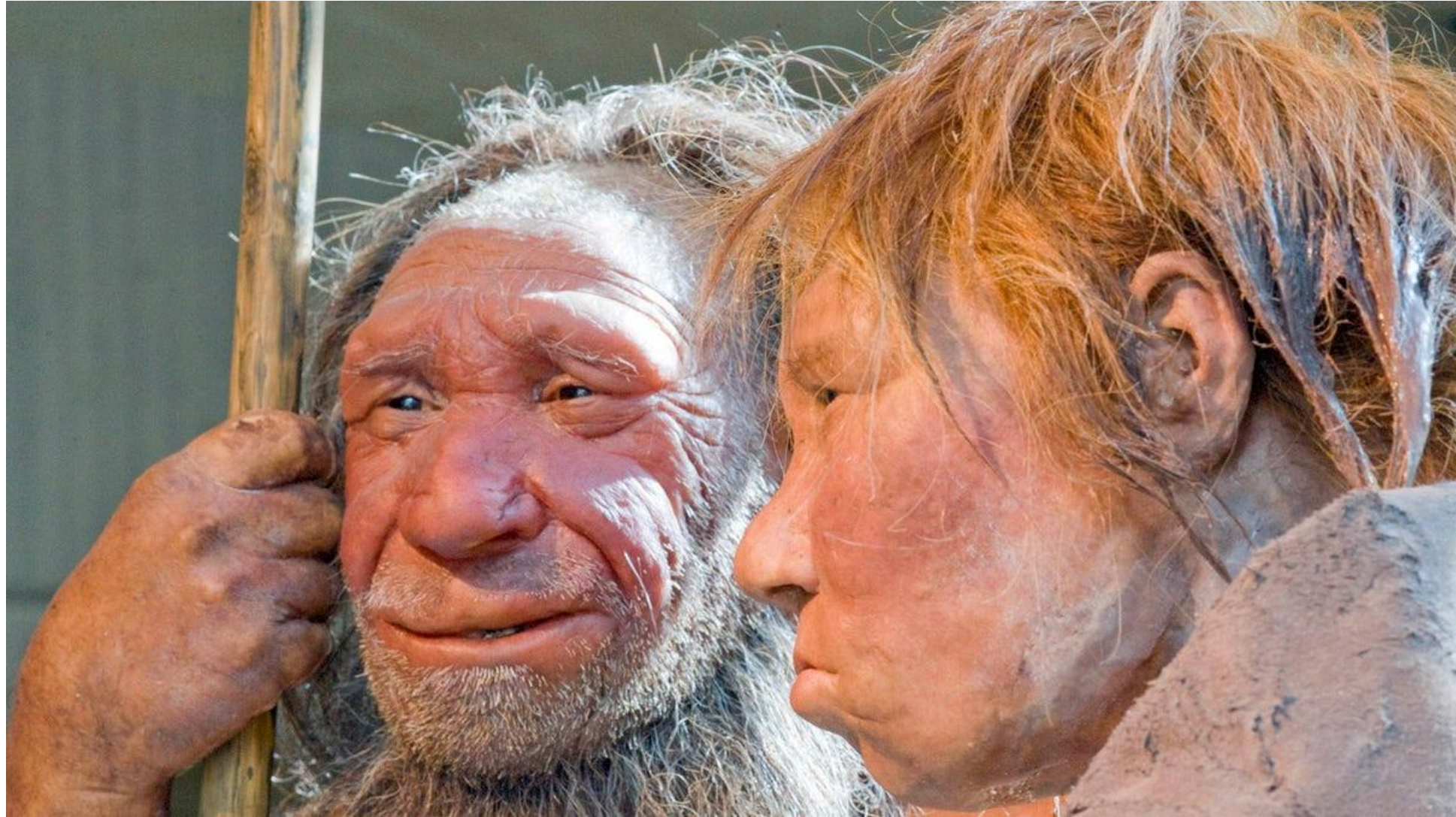


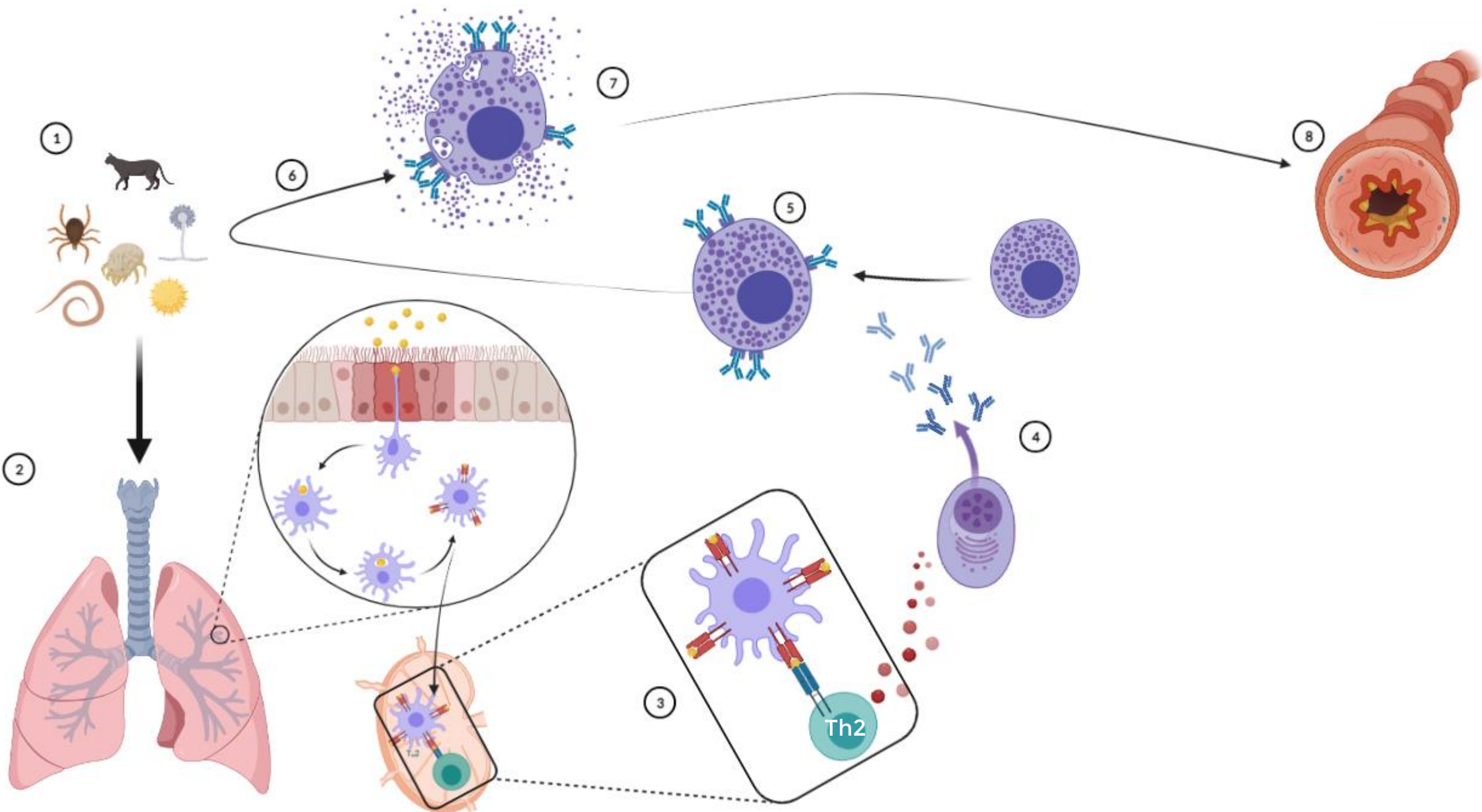
Svante Pääbo

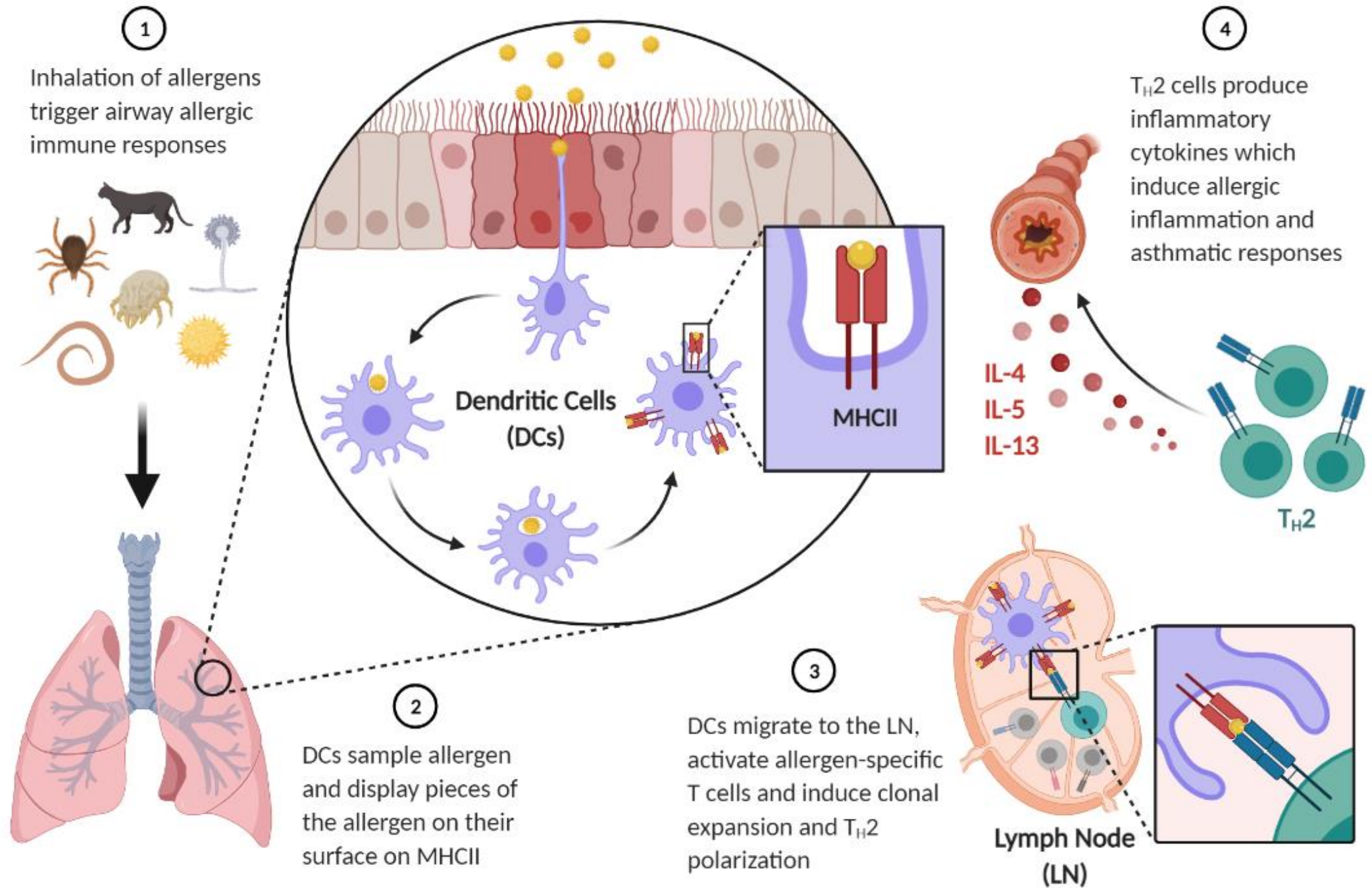
"for his discoveries concerning the genomes
of extinct hominins and human evolution"

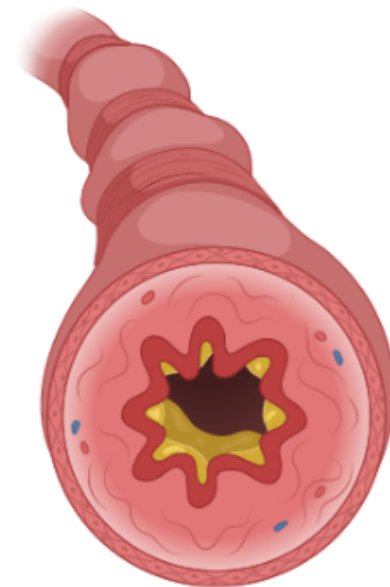
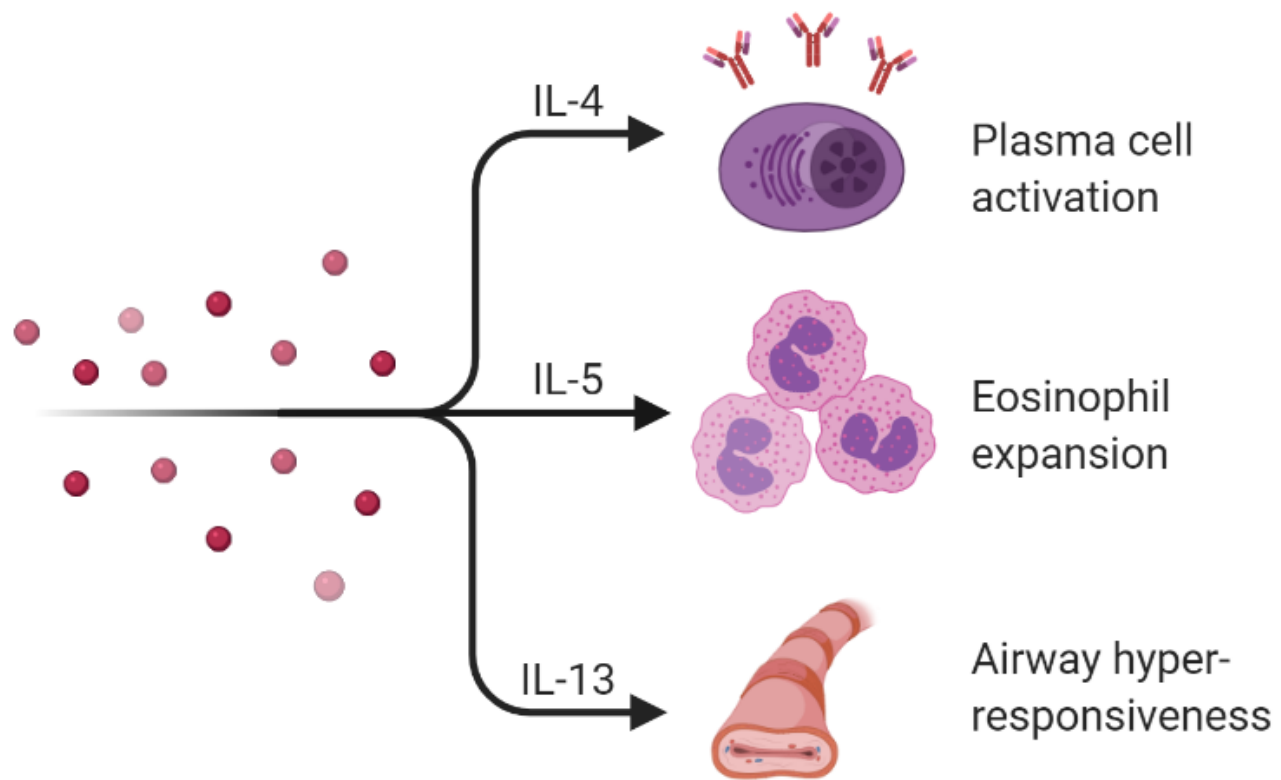
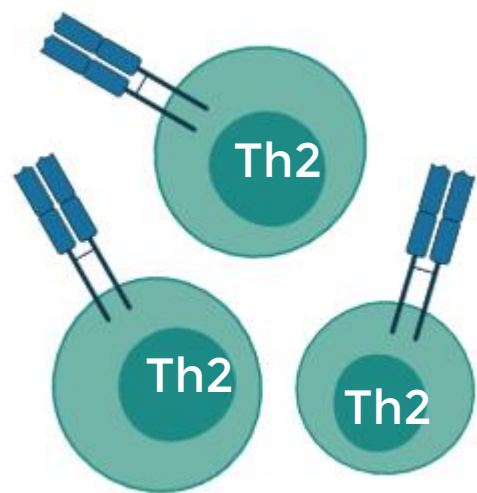
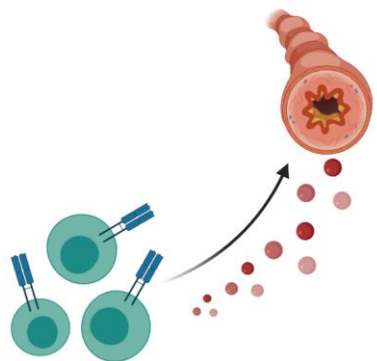
THE NOBEL ASSEMBLY AT KAROLINSKA INSTITUTET

Here they are!

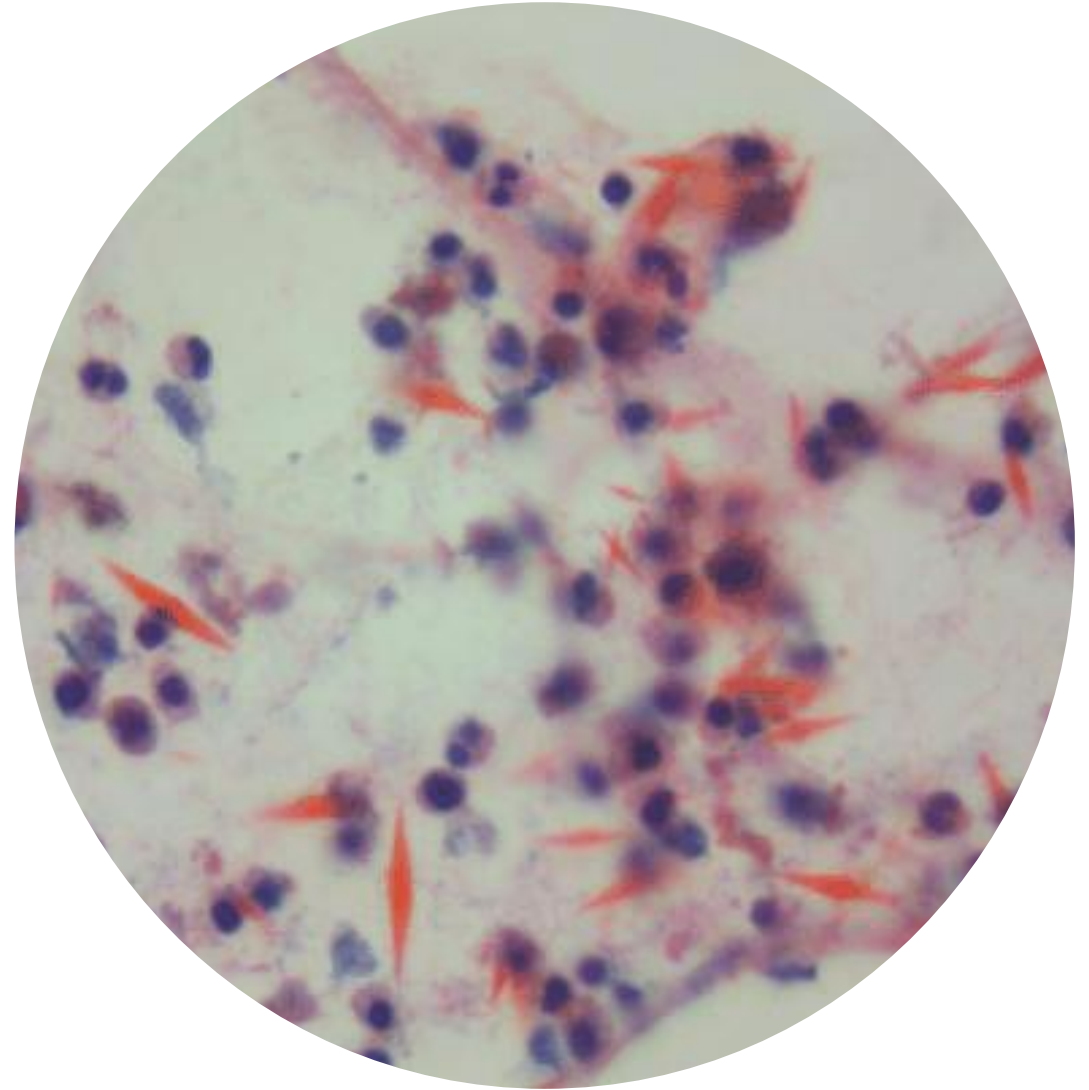
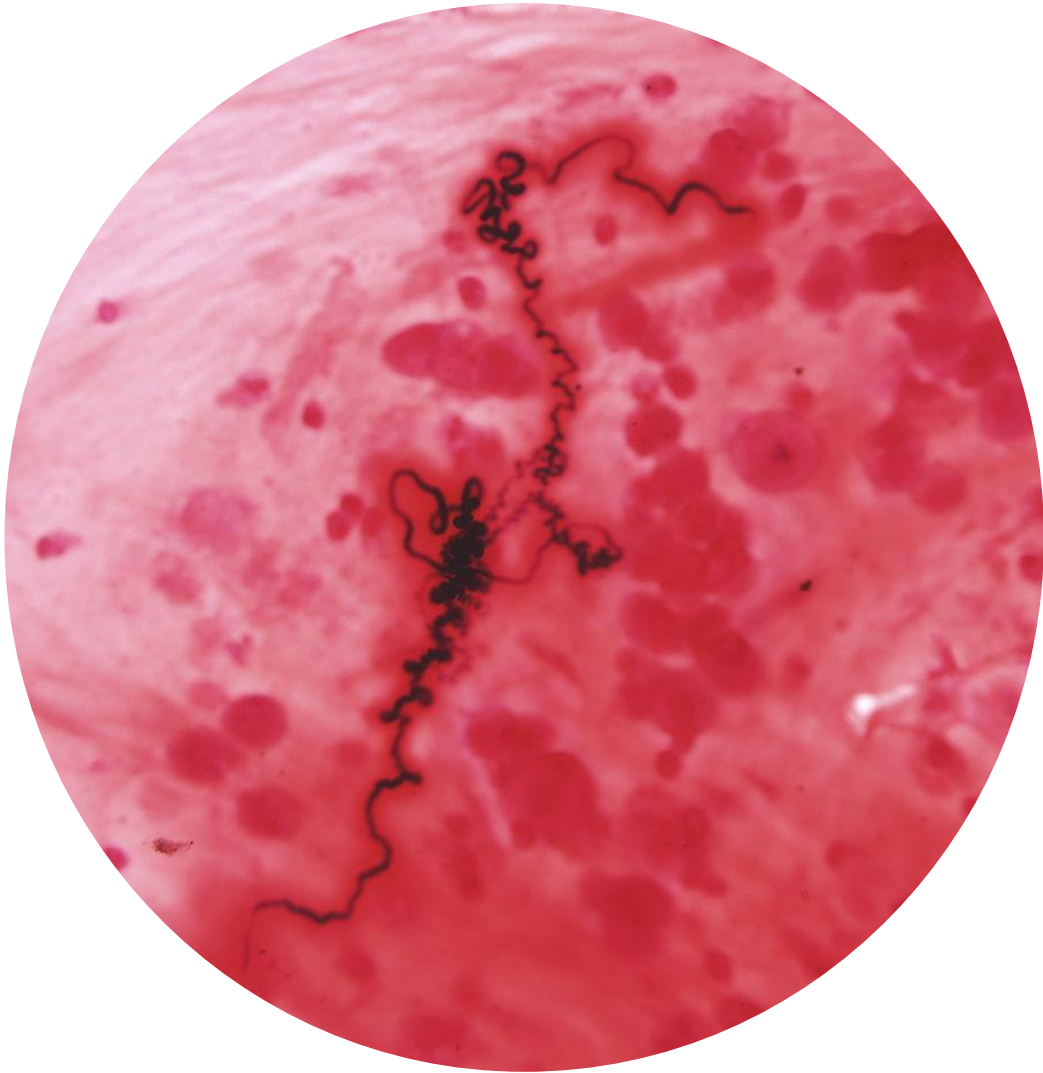


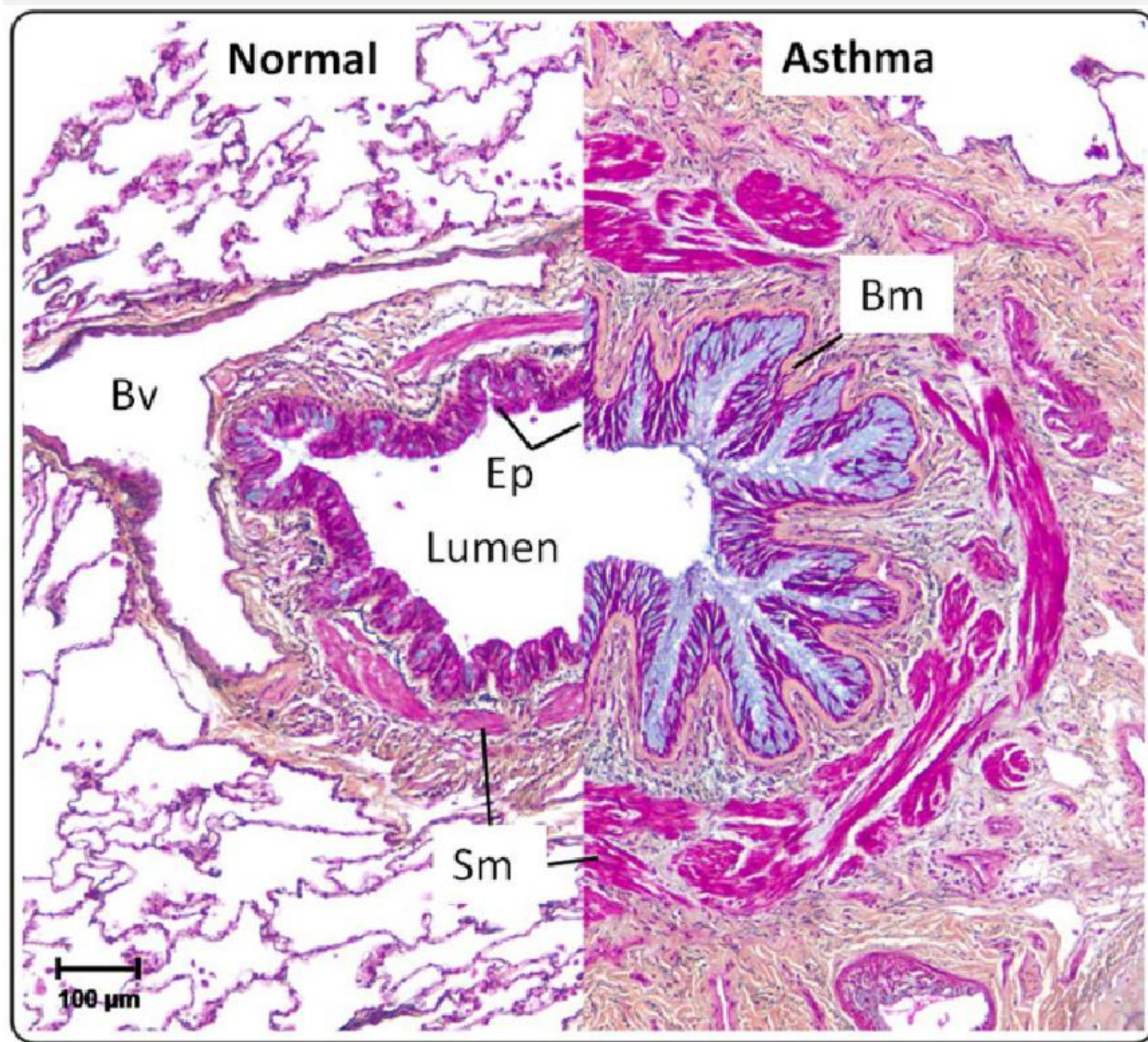






Curshmann spirals, eosinophils, Charcot- Leyden crystals





The bases of diagnostic criteria

- Forced expiratory volume in 1 second (FEV1)
- FEV1/FVC
- Increasing FEV1/FVC more than 12% after beta-2 blockers inhalation
- Peak expiratory flow rate
- FENO more than 25 ppb (parts per billion)

COPD

COPD burden in Russia (GARD study)

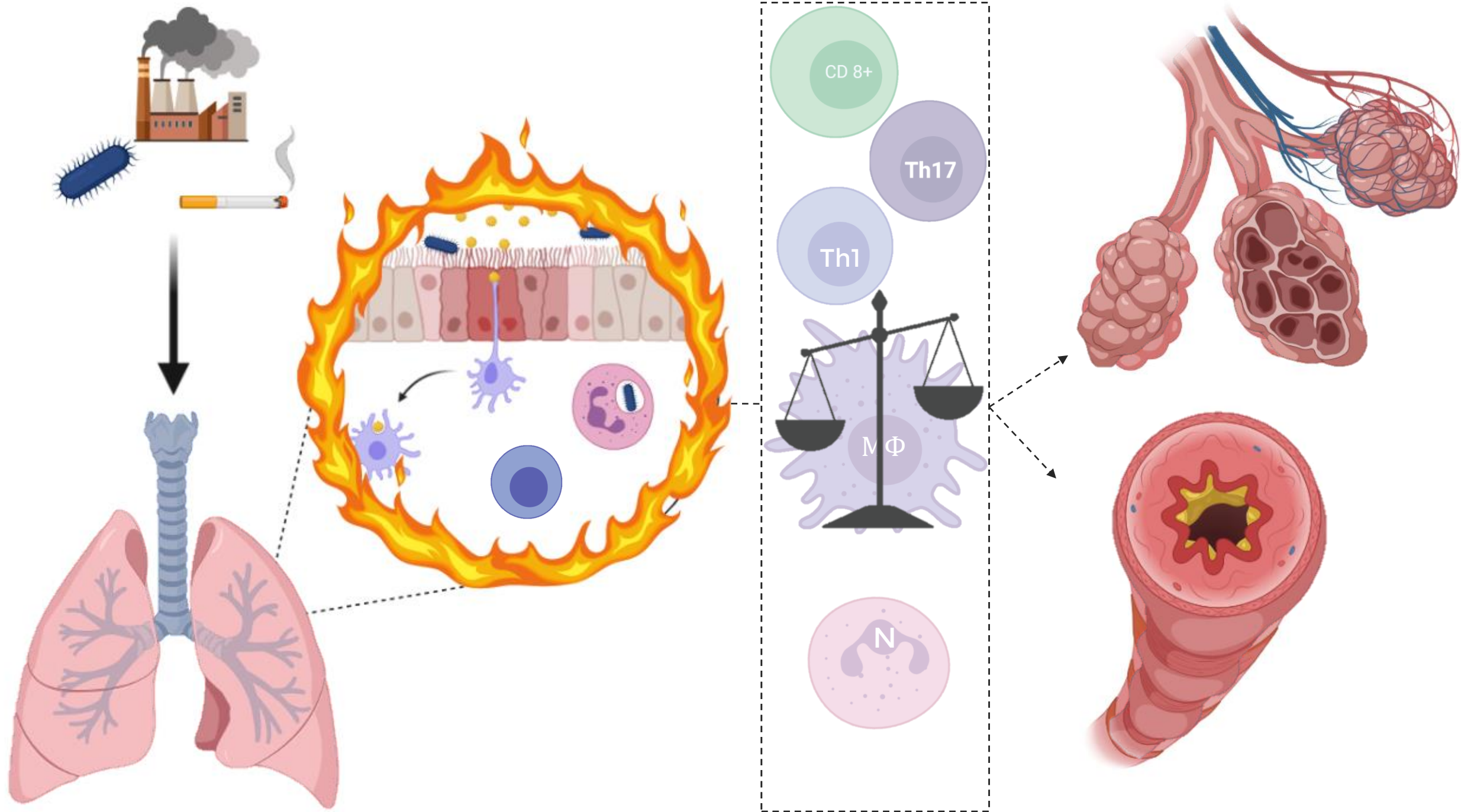


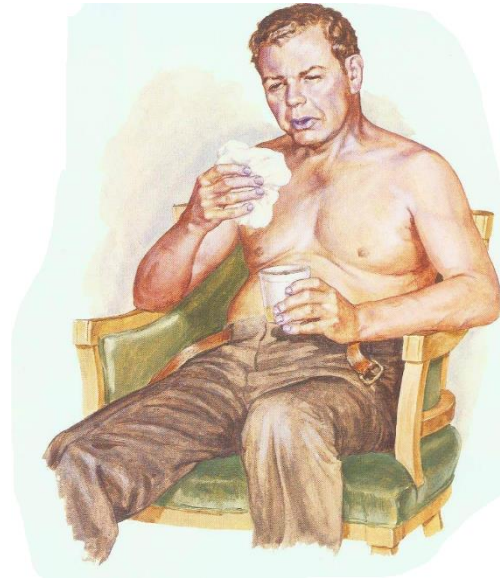
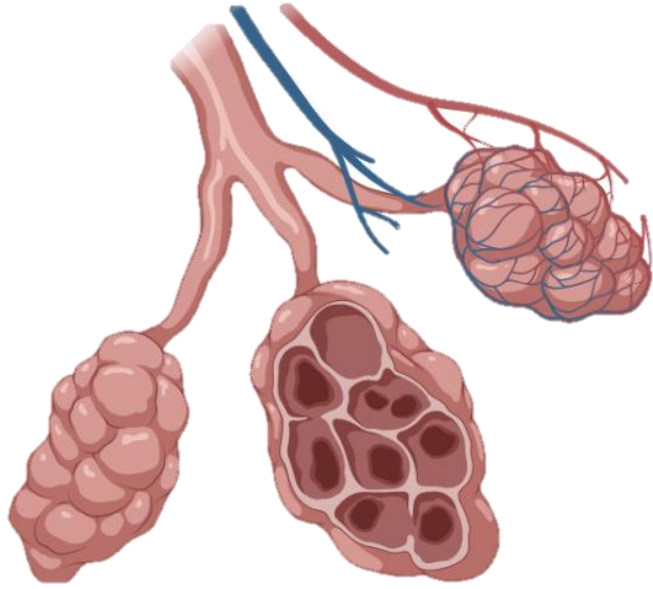
GOLD definition

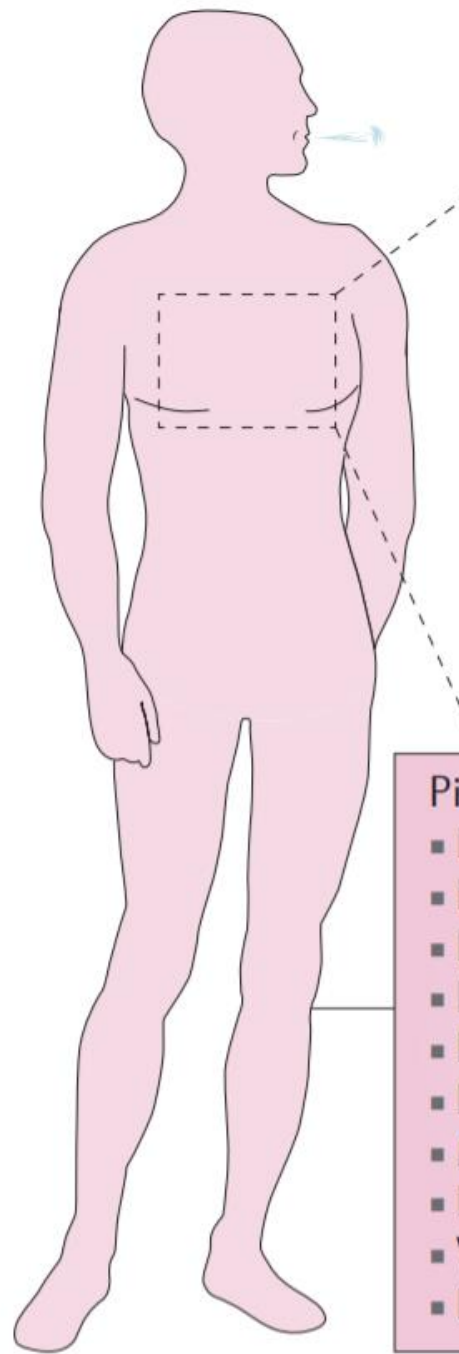
Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.

Risk factors

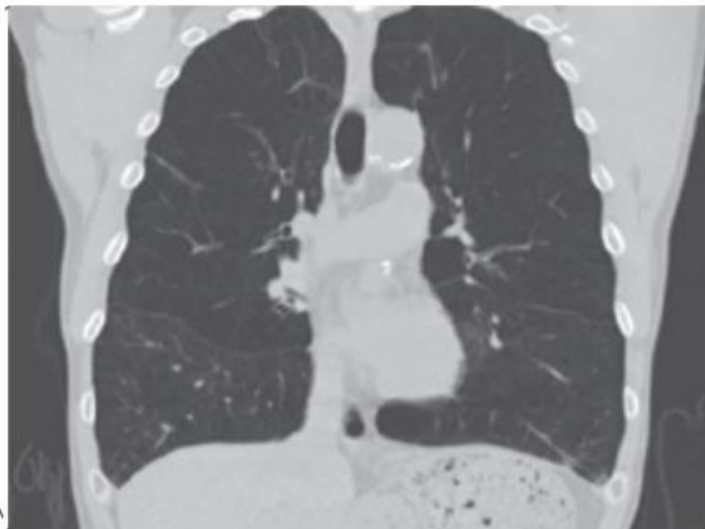
- Genetic factors (α 1-antitrypsin deficiency, mutation MMP12, neutrophils and macrophages activity)
- Age
- Sex (nowadays m ~ f)
- Lung growth and development
- Smoking
- Exposure to particles
- Socioeconomic status
- Asthma and airway hyper-reactivity
- Chronic bronchitis
- Respiratory Infections







More emphysema



Pink puffer

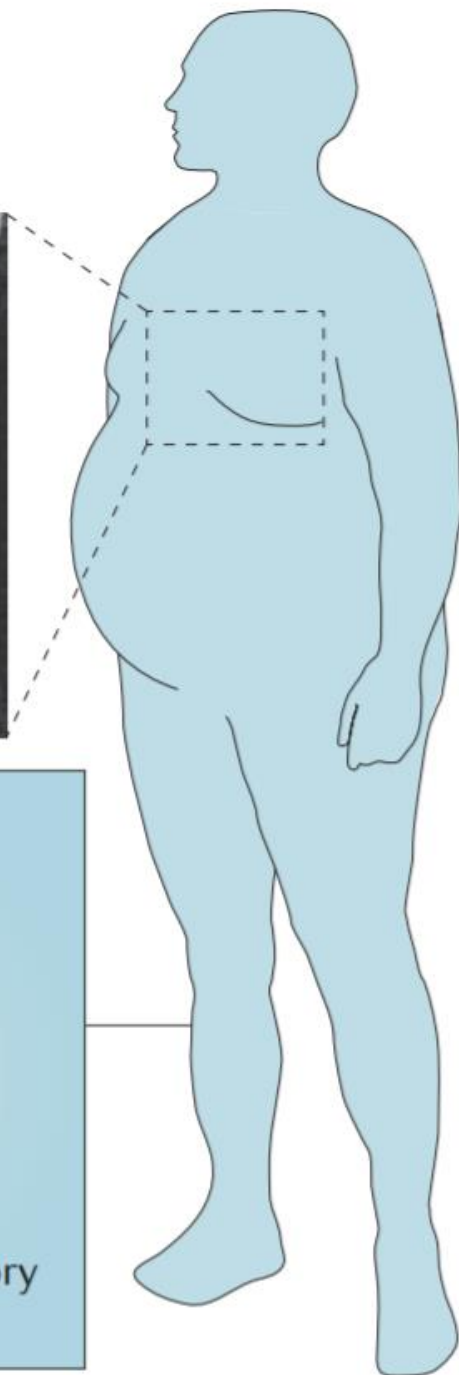
- Lower body mass index
- Fewer cardiovascular co-morbidities
- Fewer metabolic co-morbidities
- Less muscle mass
- Hyperinflation
- Low diffusion capacity for CO
- More dyspnoea
- Decreased exercise capacity
- Worst health status
- Lower serum levels of sRAGEs

Less emphysema

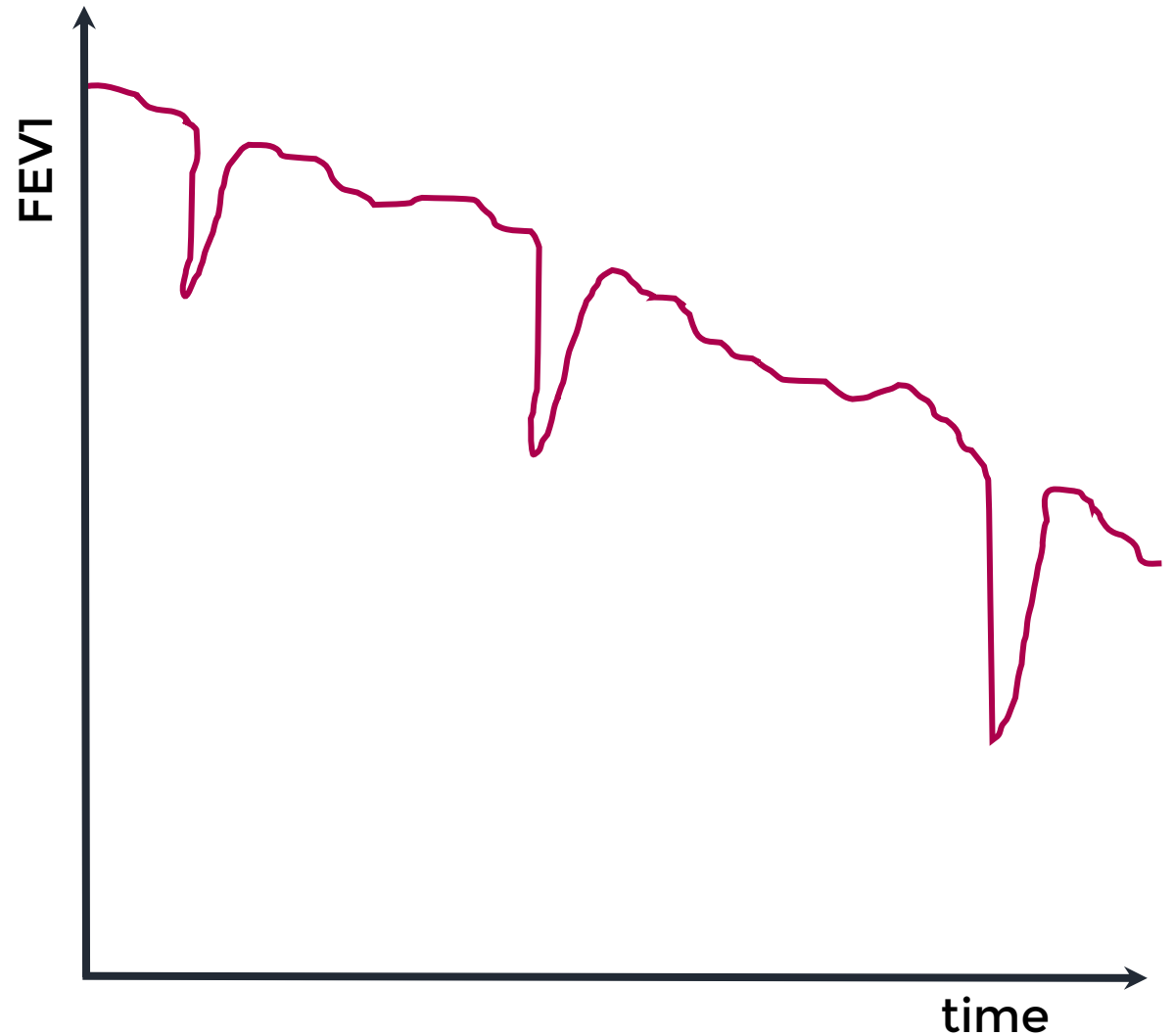
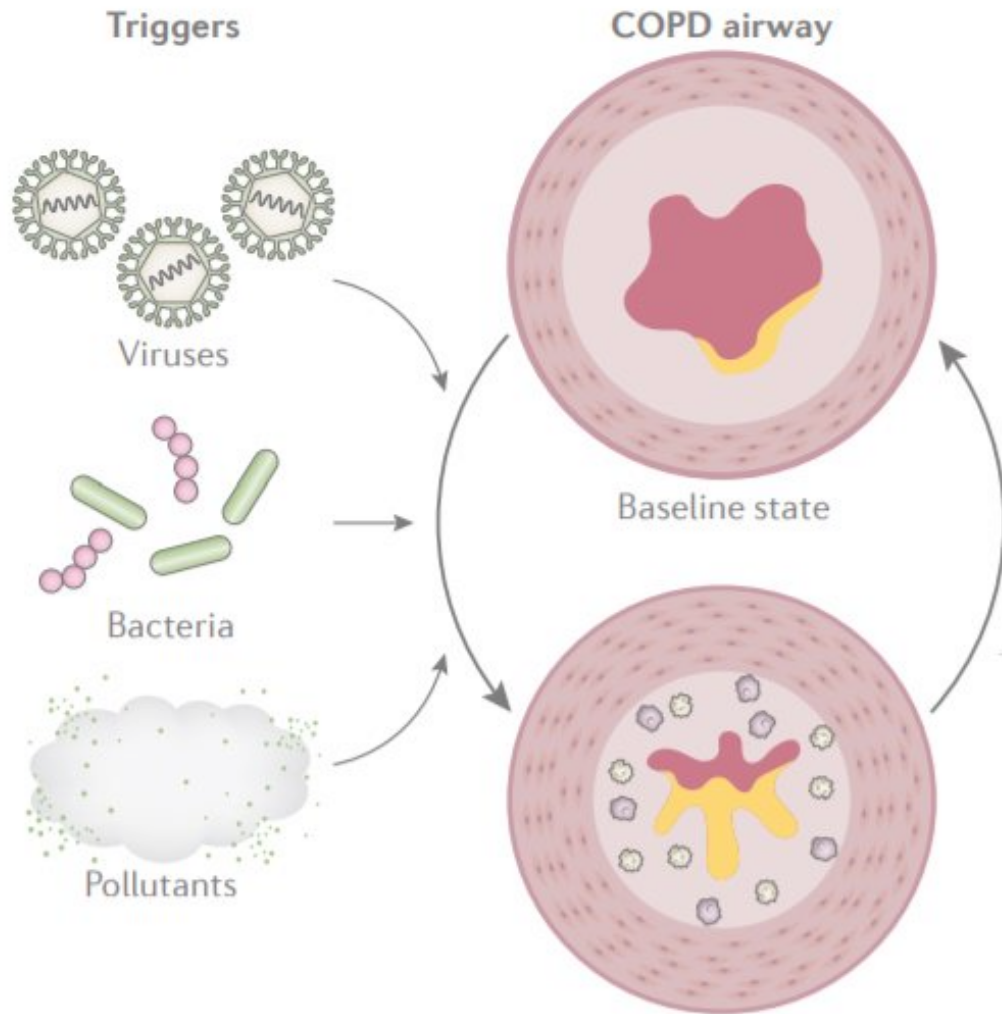


Blue bloater

- Higher body mass index
- More metabolic co-morbidities
- Cardiac compromise
- OSA-COPD overlap
- Less hyperinflation
- More chronic bronchitis
- Increased exacerbations
- More normal diffusion capacity
- Higher serum levels of inflammatory markers (IL-6 and CRP)



Exacerbation and progression



Restrictive disorders

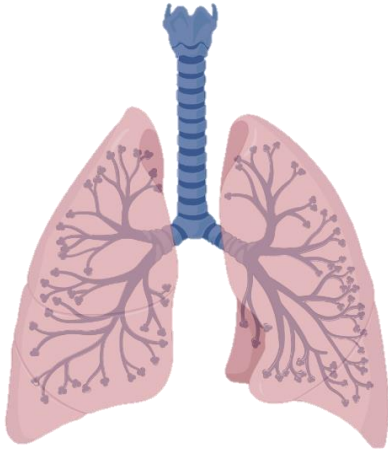
Restrictive lung disorders

- Dyspnea and cough, > on exacerbation
- Crackles
- Loud P2
- Clubbing
- Decreased all lung volumes
- FEV1/FEV is normal
- Diagnosis: CT, biopsy the most accurate

A 60-year-old man presents to his care physician, reporting shortness of breath and a cough with copious sputum production. He has a 50-pack-year history of cigarette smoking. Physical examination reveals a barrel-shaped chest. A chest X-ray shows an increased anteroposterior diameter with a flattened diaphragm.

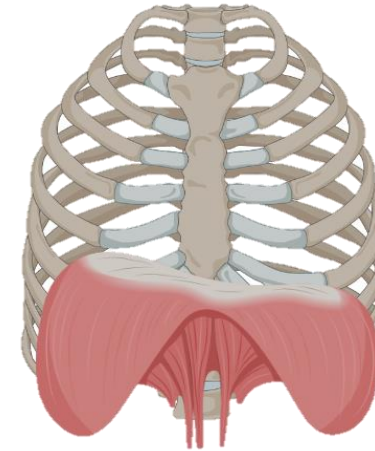
His 58-year-old wife, who is a nonsmoker, also has pulmonary symptoms and presents with progressive shortness of breath and accompanying nonproductive cough. On physical examination, increased convexity is noted in her fingernails. End-expiratory crackles are appreciated on auscultation of the lungs at bilateral bases. A CT scan of the chest reveals “honeycombing” of the lungs.

Which...



Restriction related to lung disorders:

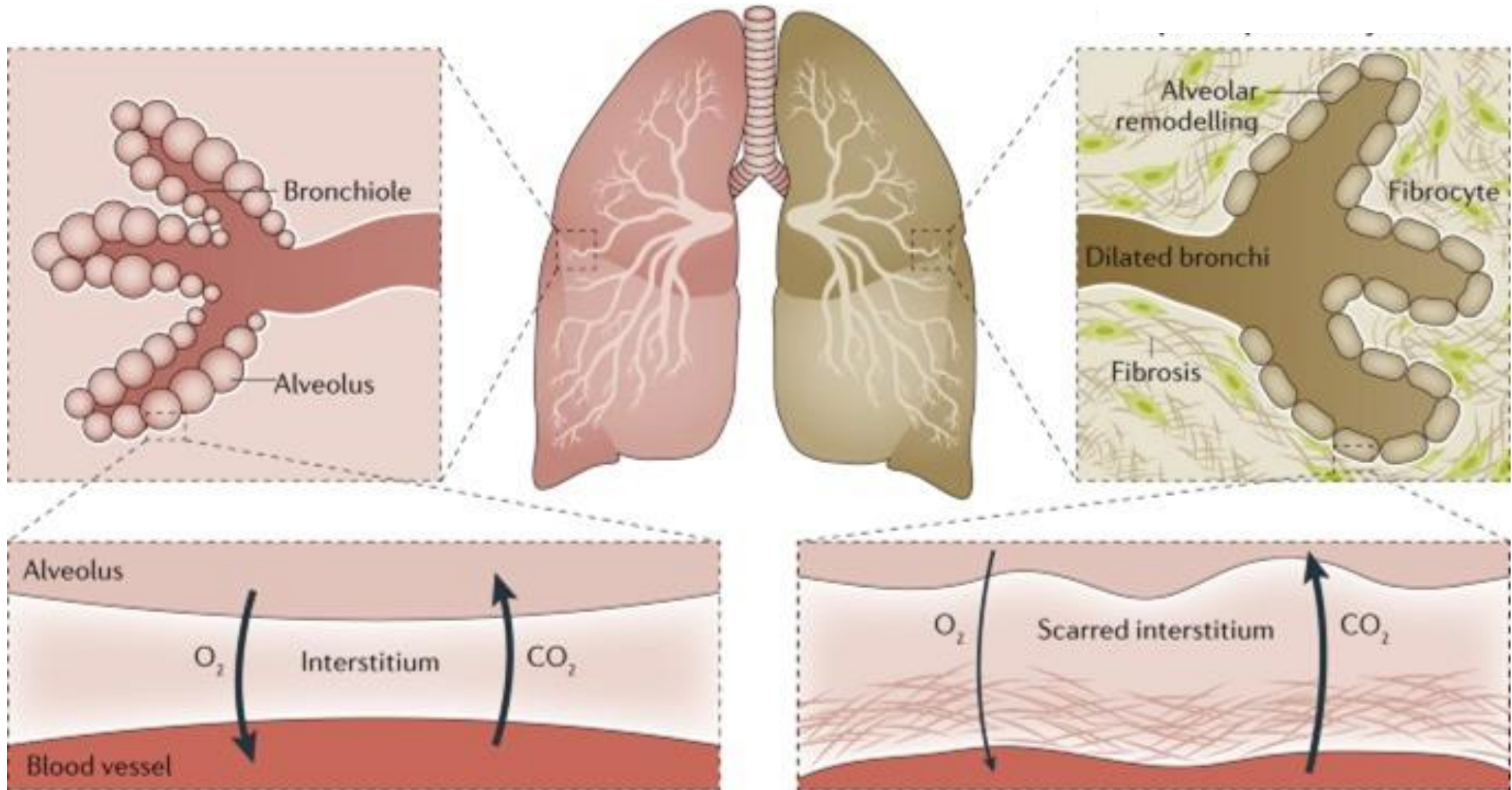
- Pulmonary fibrosis
- Pneumoconiosis
- Hypersensitivity pneumonitis
- Drug-induced lung fibrosis
- Sarcoidosis
- Autoimmune disorders



Restriction related to extra lung disorders:

- Musculoskeletal issue (ankylosing spondylitis, rib fracture, scoliosis)
- Neuromuscular issue (GBS, myasthenia gravis, Polio, hypokalemia, botulism)

Lung related restriction



Idiopathic pulmonary fibrosis

Etiology

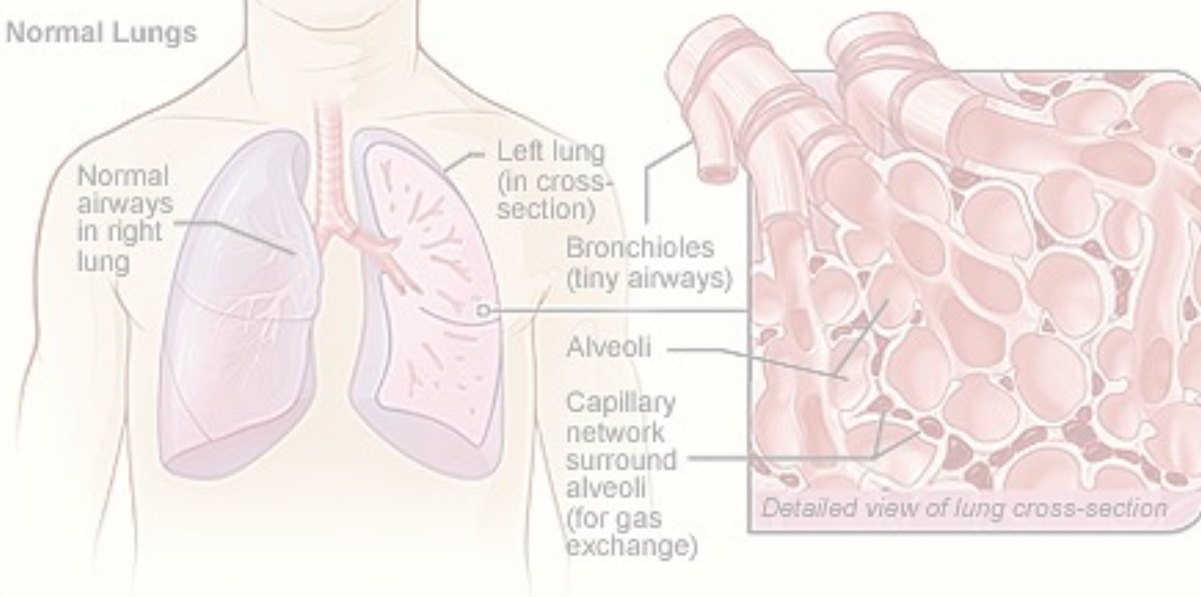
- >Unknown

Risk factors

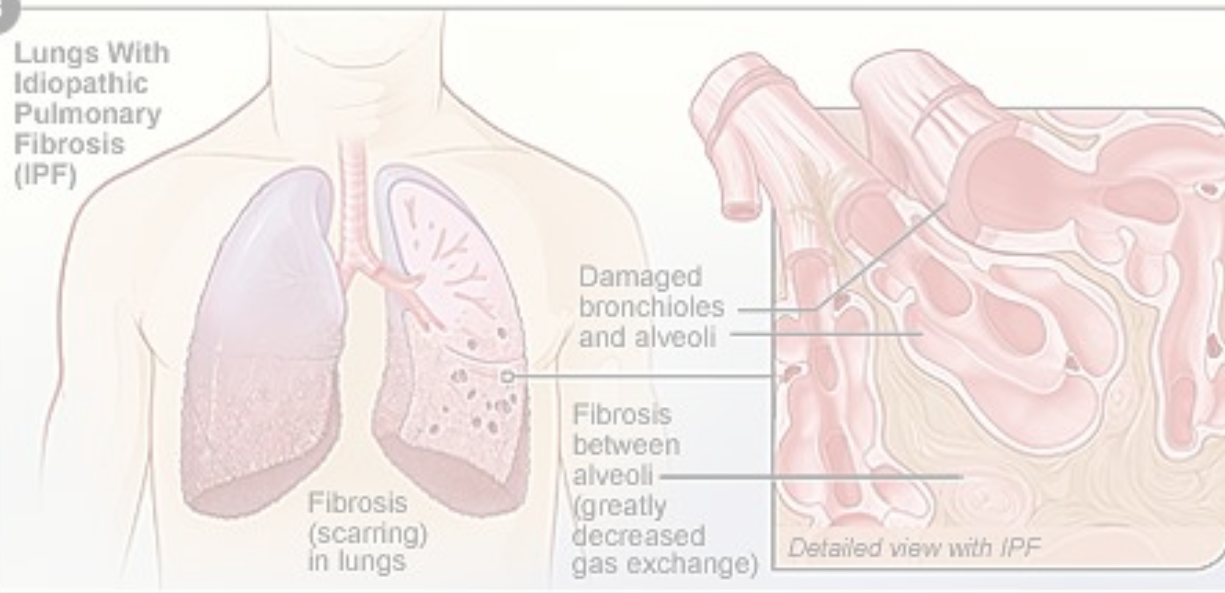
- >Old age
- >Being male
- >Tobacco smoking

Idiopathic pulmonary fibrosis

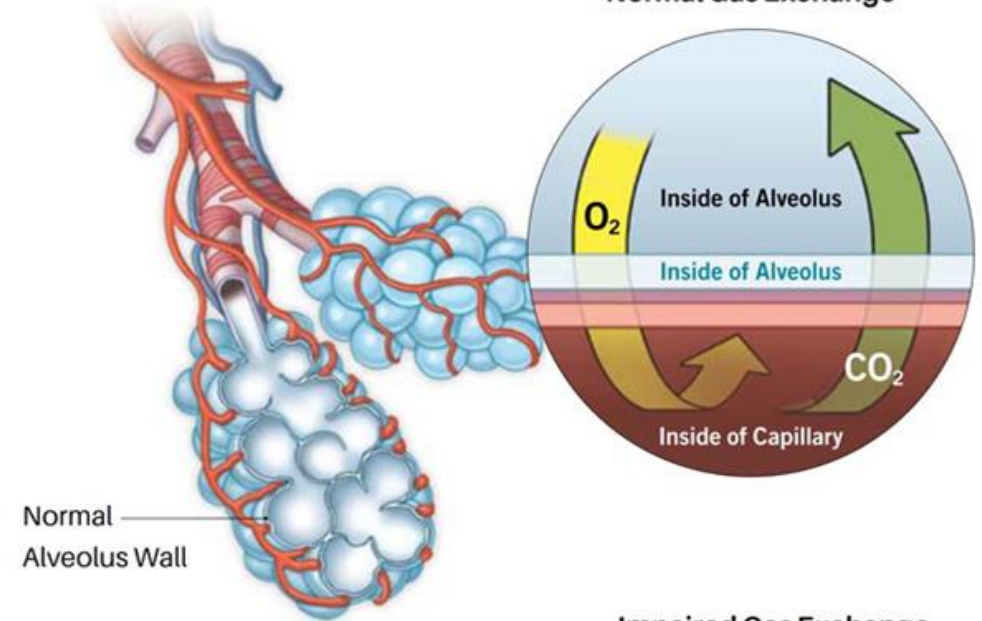
A Normal Lungs



B Lungs With Idiopathic Pulmonary Fibrosis (IPF)



Normal Gas Exchange



Impaired Gas Exchange

