The human respiratory system

The bronchial tree

The tracheobronchial region

- Also called the conducting airway
- The trachea divides into two primary bronchi (one to each lung)
- Each primary bronchus divides again and again at least 20 times – the bronchial tree
- Bronchi move air in and out of the lung, but do not exchange gases with the blood
- Bronchi are lined with mucus and hair-like organs called cilia that expel particles up and out of the trachea

Cilia beat to transport particles from the lungs

Close-up view of cilia in a bronchial tube
The pulmonary region
• Also called the respiratory airspace
• At the end of each bronchiole are clusters of air sacs called **alveoli**
• Alveoli contain thin membranes in which air and other gases are exchanged with the blood
• Total useful surface area of alveoli is over 100 m² – about half the surface of a tennis court (261 m²)!
• Alveoli do not have cilia, but instead remove particles through white blood cells called **macrophage**

**Cross-section of a human lung – looks like a sponge**

**Cross-section of a human lung at higher magnification**

**Close-up view of internal pores in the alveoli membrane**

**How particles of various sizes penetrate into the human respiratory system**

- Particles > 10 μm are not inhalable.
- Inhalable coarse particles (PM_{10}–PM_{2.5}) get trapped in the tracheobronchial region; are expelled by cilia.
- Supermicron fine particles (PM_{2.5}, but D_p > 1 μm) can penetrate to the smallest bronchi; are expelled by cilia.
- Submicron particles (D_p < 1 μm) can enter the alveoli; macrophage must remove them.
Example of a human lung with accumulated particles