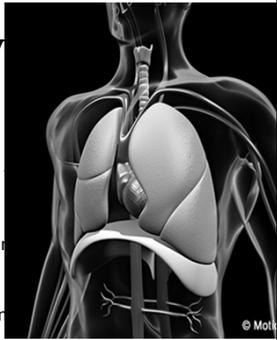


## The Respiratory System

Did you know...

- The lungs of an average adult, unfolded and flattened, would cover area of a tennis court!
- The left lung is slightly smaller than the right
- The longest word in English is a lung disease called:  
pneumonoultramicroscopicsilicovolcanoconiosis



## I. Functions

- Ventilation (exchanging O<sub>2</sub> & CO<sub>2</sub>)**
- Produce vocal sounds**
- Aid in smelling**
- Regulate blood pH level**

*Just Breathe*

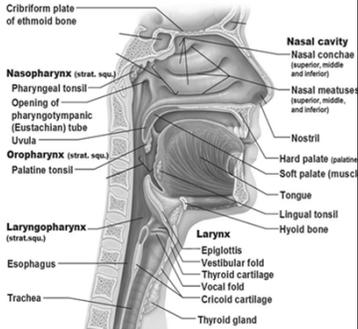


## II. Upper Respiratory Tract (face/throat)

The Upper Respiratory Tract

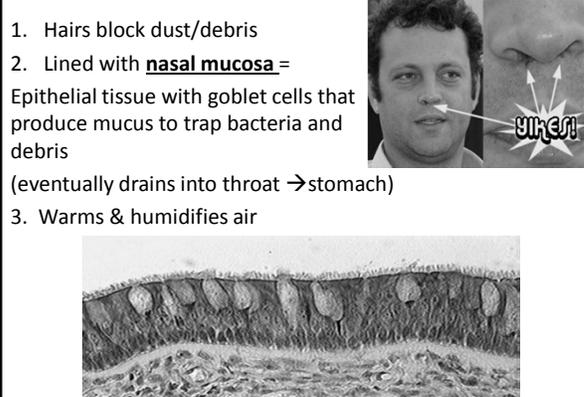
Consists of:

- Nose / Nasal Cavities
- Pharynx
- Larynx



## A. Nose / Nasal Cavities

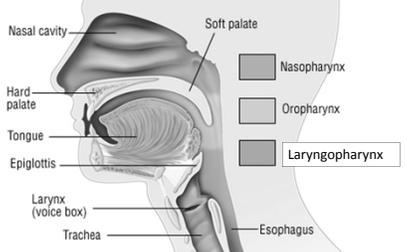
- Hairs block dust/debris
- Lined with nasal mucosa = Epithelial tissue with goblet cells that produce mucus to trap bacteria and debris (eventually drains into throat → stomach)
- Warms & humidifies air



## B. Pharynx

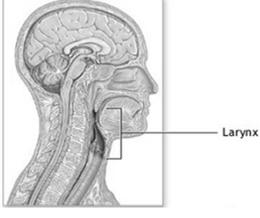
(pronounced "fair-inks")

- Muscular tube posterior to nasal & oral cavities
- Functions in swallowing reflexes (prevents food/fluid from going up into nose)



## C. Larynx ("voice box")

- Functions in speaking & air passage
- Lined with ciliated cells that sweep mucus & trapped stuff out of airway



**Epiglottis** = flap on top of larynx that folds down to prevent food/liquid entry

**Glottis** = opening of the larynx

Anatomy of the Larynx

Tongue

Epiglottis

Vocal cord

Glottis

Larynx

Esophagus

Trachea

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**Vocal cords** = thin folds of tissue that are pulled over the glottis and vibrate during speech

Hyoid bone

"Adam's apple"

Vocal Cords

The Larynx

The Trachea

II. Lower Respiratory Tract (in chest)

Consists of:

- Trachea
- Bronchi & Bronchioles
- Lungs

A. Trachea

- Surrounded by rings of cartilage that keep the trachea open
- Lined with ciliated mucous membrane to trap dust/debris

Adam's apple

Thyroid cartilage

Cricoid cartilage

Trachea

Tracheal cartilages

Right lung

Left lung

Primary bronchi

B. Bronchi/Bronchioles

- Bronchi** - branch from trachea into lungs (like upside-down tree)
- Bronchioles** - smallest branches of "bronchial tree" inside the lungs; lack cartilage support

Trachea

Bronchus

Left lung (2 lobes)

Bronchioles

**Asthma** - constriction of bronchioles usually caused by allergens or infections

A Normal Airway

B Normal Airway

C During Asthma Symptoms

Narrowed airway (limited air flow)

Tightened muscles constrict airway

Inflamed/thickened airway wall

Mucus

Thickened airway wall

Muscle

Airway wall

Muscle

Mucus

Airway x-section

Airway x-section

Muscle

Airway wall

Muscle

Mucus

Airways

Lungs

### C. Lungs

- Protected by rib cage, pleural membranes and serous fluid

Pleura (Covering of the Lungs)

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- Contain millions of alveoli = tiny air sacs made of simple squamous tissue where  $O_2/CO_2$  exchange occurs
  - Contain macrophages
  - Arranged in clusters
  - Surrounded by fluid

**Respiratory distress syndrome (RDS)** – frequent in newborns/premature babies who have not produced the surfactant that reduces the surface tension of the fluid in the lungs

Normal Alveoli ARDS

### Mechanism of Breathing (Ventilation)

Inhalation / Inspiration:

- The medulla sends impulses to the diaphragm and intercostal muscles (b/w ribs)
- contracted muscles expand chest cavity & pulls on pleural membranes
- suction is created by serous fluid between pleural membranes & lungs, causing lungs to expand
- air is forced through the nose/mouth & into the lungs

Exhalation/Expiration:

- the medulla stops sending impulses, causing respiratory muscles to relax
- lungs become compressed & forces air out of the alveoli

**Chronic Obstructive Pulmonary Disease (COPD)** – alveoli become stretched & cannot recoil → difficult to exhale  
<http://www.youtube.com/watch?v=ZnBPqSiLg5E>  
 [emphysema is a type of COPD]

### Pulmonary Volumes

(measured with spirometers)

- Tidal volume** = amount of air in one breath [average is ~500mL]
- Minute respiratory volume (MRV)** = amount of air breathed in 1 minute  
 [Tidal vol. × # of breaths in 1 min.]
- Inspiratory / Expiratory reserve** = amount of air inhaled/exhaled during deepest possible breath/most forceful exhale [insp = 2000 – 3000 mL/ exp = 1000 – 1500 mL]
- Residual air** = air that remains in lungs after most forceful exhale → ensures continuous  $O_2/CO_2$  exchange

Athletes & musicians often have higher pulmonary volumes than most people.



**Hyperventilation** = rapid, short inhalations

Problem: too much  $O_2$  inhaled causes blood pH to increase

Solution: "re-breathe"  $CO_2$  in a bag to restore pH

