

## Respiratory System Cheat Sheet by zpms1207 via cheatography.com/147948/cs/32198/

#### **Lung Anatomy**

Occupy all of the thoracic cavity except mediastinum

Root site of vascular, bronchial attachments

Costal surface anterior, lateral, posterior surfaces

#### Structures of the Lungs



### **Upper Respiratory Tract**

conduction, filtration, humidification and warming of inhaled air

Nasal conchae, nasal vestibule, nostril

Cavity

Paranasal Maxillary, frontal, sphenoidal and ethmoidal sinuses

Sinuses

Pharynx Nasopharynx, oropharynx, laryngopharynx

Larynx Vocal cords, epiglottis, vestibular fold, thyroid cartilage,

(superior) vocal fold, cricoid cartilage, thyroid gland

#### **Lower Respiratory Tract**

conduction, gas exchange

Trachea cervical, thoracic

Bronchi left primary bronchus, right primary bronchus

Bronchioles respiratory bronchiole, terminally bronchiole, alveoli

Lungs left lung, right lung (larger)

### **Functional Anatomy**

Respiratory zone: Microscopic structures: respiratory bronch-

site of gas ioles, alveolar, ducts, alveoli

exchange

Alveoli ~300 million alveoli account for most of the

lungs' volume, main site for gas exchange

Surrounded by fine elastic fibres

#### **Functional Anatomy (cont)**

Contain open pores that connect adjacent alveoli, allow air pressure throughout lung to be equalised

House alveolar macrophages that keep alveolar

surfaces sterile

Conducting Conduits to gas exchange sites

zone

Includes all other respiratory structures

Trachea Windpipe: from larynx into mediastinum

Wall composed of 3 layers: mucosa, submucosa,

adventitia

Carina: Last tracheal cartilage, point where trachea

branches into two bronchi

Conducting Trachea → right and left primary bronchi

zone structures

Primary bronchus → secondary bronchi → 3rd, 4th

otc

Bronchioles: < 1mm diameter

Terminal bronchioles: < 0.5mm diameter

Respiratory Diaphragm and other muscles that promote ventil-

muscles ation

### **Respiratory Volumes**

Adult Male average Adult Female average

Tidal volume (TV)

500ml 500ml

amount of air inhaled/exhaled each breath at rest

Inspiratory reserve volume (IRV)

3100mL 1900mL

amount of air during forceful inhalation after normal TV

### Expiratory reserve volume (ERV)

1200mL 700mL

amount of air during forceful exhalation after normal TV exhalation

Residual volume (RV)

1200mL 1100mL

amount of air remaining in lungs after forced exhalation



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Functional residual capacity (FRC)

2400mL

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Respiratory Capacities		
Adult Male average	Adult Female average	
Total lung capacity (TLC)		
6000mL	4200mL	
max amount of air contained in lungs after max inspiratory effort: TLC = TV+IRV+ERV+RV		
Vital capacity (VC)		
4800mL	3100mL	
max amount of air that can be expired after max inspiratory effort: VC = TV+IRV+ERV		
Inspiratory capacity (IC)		
3600mL	2400mL	
max amount of air that can be inspired after normal expiration: IC = TV+IRV		

1800mL

volume of air remaining in lungs after normal TV expiration: FRC =

ERV+RV		
Pulmonary Function Tests		
Spirometer	0.0011 100.00	
	d to measure respiratory volumes/capacities	
Can distin- guish between	Obstructive pulmonary disease: increased airway resistance e.g. bronchitis, asthma	
	Restrictive disorders: reduction in TLC due to struct- ural/functional lung changes e.g. fibrosis, tuberc- ulosis (TB)	
Minute ventil- ation	Total amount of gas flow into/out of respiratory tract in 1 minute	
Forced vital capacity (FVC)	Gas forcibly expelled after taking a deep breath	
Forced expiratory	Amount of gas expelled during specific time intervals of FVC	

	in 1 minute	
Forced vital G capacity (FVC)	Gas forcibly expelled after taking a deep breath	
Forced Amount of gas expelled during specific time expiratory intervals of FVC volume (FEV)  Partial Pressure Gradient		
Dalton's Law of	Total pressure exerted by mixture of gases is	
Partial Pressures	the sum of pressures exerted by each	
	Partial pressure of each gas is directly proportional to its percentage in the mixture	

Partial Pressure Gradient (cont)		
Example:	Atmospheric pressure is 760mmHg at sea level	
	Oxygen constitutes ~21% of the atmosphere	
	21% x 760 = 159mmHg	

Mechanisms of Breathing: Pulmonary Ventilation	
Inspiration and expiration	Inspiration: gases flow into lungs
	Expiration: gases exit the lungs
Mechanical processes dependant on volume changes in thoracic cavity	Volume changes → pressure changes
	Pressure changes → gases flow to equalise pressure
Boyle's Law	Relationship between pressure and volume of a gas

Mechanics of Breathing: Inspiration	
Inspiration	Expiration
Sequence of events	
<ol> <li>Inspiratory muscles contract → diaphragm descends, rib cage rises</li> </ol>	<ol> <li>Inspiratory muscles relax → diaphragm rises, rib cage descends due to costal cartilage recoil</li> </ol>
2. Thoracic cavity volume increases	2. Thoracic cavity volume decreases
3. Lungs are stretched → intrapulmonary volume increases	3. Elastic lungs recoil passively → intrapulmonary volume decreases
<ul><li>4. Intrapulmonary pressure drops</li><li>→-1mmHg</li></ul>	4. Intrapulmonary pressure rises → +1mmHg
5. Air flows into lungs down its pressure gradient until intrapulmonary volume = 0 (equal to atmospheric pressure)	5. Air flows out of lungs down its pressure gradient until intrapulmonary pressure is 0



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Internal Respiration	
Capillary gas exchange in body tissues	
Partial pressures and diffusion gradients are reversed compared to external respiration	pO2 in tissue is always lower than in systemic arterial blood
	pO2 of venous blood in 40mmHg
	pCO2 is 45mmHg

External Respiration		
Exchange of O2 and CO2 across the respiratory membrane		
Influenced by:	Partial pressure gradients	
	Gas solubilities	
	Ventilation-perfusion (V/Q) coupling	
	Structural characteristics of the respiratory membrane	

Control of Respiration		
Medullary Respiratory Centres	Pontine Respiratory Centres	Chemical Factors
Involves neurons in the reticular formation of the medulla and pons	Influence and modify activity of the VRG	Influence of pO2
Dorsal respiratory group (DRG)	Smooth out tradition between inspiration/exp- iration and vice versa	▶ Peripheral chemorece- ptors in the aortic and carotid bodies are O2 sensors
<ul><li>Near the root of cranial nerve IX</li></ul>		(when excited, they cause respiratory centres to increase ventilation)
Integrates input from peripheral stretch and chemorece- ptors		▶ Substantial drops in arterial pO2 (to 60mmHg) must occur in order to stimulate increased ventilation
Ventral respiratory group (VRG)		Influence of arterial pH

Control of Respiration (cont)	
▶ Rhythm-generating and integrative centre	► Can modify respiratory rate/r- hythm even if CO2 and O2 levels are normal
► Sets eupnea (12-15 breaths/min)	▶ Decreased pH may reflect CO2 retention, accumulation of lactic acids, excess ketone bodies in diabetic Pts
▶ Inspiratory neurone excite the inspiratory muscles via the phrenic and intercostal nerves	▶ Respiratory system controls will attempt to raise the pH by increasing respiratory rate and depth
▶ Expiratory neurone inhibit the inspiratory neurone	

Oxygen Transport		
Molecular O2 is carried in the blood	1.5% dissolved in plasma	
	98.5% loosely bound to each Fe of haemoglobin (Hb) in RBCs	
	4x bound O2 per Hb	
O2 and Hemoglobin	Oxyhemoglobin (HBO2): hemoglobin-O2 combination	
	Reduced hemoglobin (HSB): haemoglobin that has released O2	
Influence of pO2 on Hemoglobin Saturation	Oxygen-hemoglobin dissociation curve	
	Shows how binding and release of O2 is influenced by the pO2	
Hemoglobin Saturation Influencing Factors		
Increases in temperature, H+, pCO2, and 2,3-biphosphoglycerate (BPG)	Modify Hb structure decreasing affinity for O2	
	Occur in systemic capillaries	





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## Oxygen Transport (cont)

Increases O2 unloading

Shifts HbO2 dissociation curve to the right

Decreases in these factors shift the curve to the left by decreasing O2 unloading

Carbon Dioxide Transport	
CO2 is transported in the blood in three forms	7-10% dissolved in plasma
	20% bound to globin of Hb (carba-minohemoglobin)
	70% transported as bicarbonate ions (HCO3-) in plasma
CO2 combines with water to form carbonic acid (H2CO3), which quickly dissociates	CO2 + H2O ↔ H2CO3 ↔ H+ + HCO3-
In systemic capillaries	HCO3- quickly diffuses from RBCs into plasma
	Chloride shift occurs when outrush of HCO3- from the RBCs is balanced as CI- moves in from plasma
In pulmonary capillaries	HCO3- moves into RBCs, binds with H+ to form H2CO3
	H2CO3 is split by carbonic anhydrase into CO2 and H2O
	CO2 diffuses into the alveoli



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