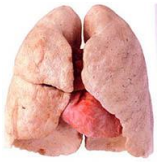
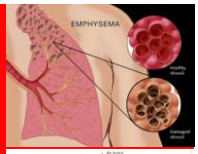
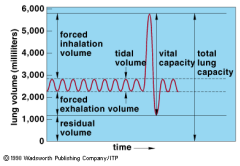
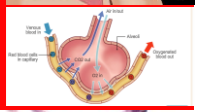
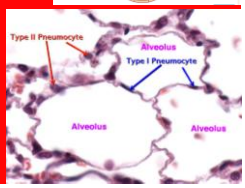




Human Physiology
6.4- Gas Exchange

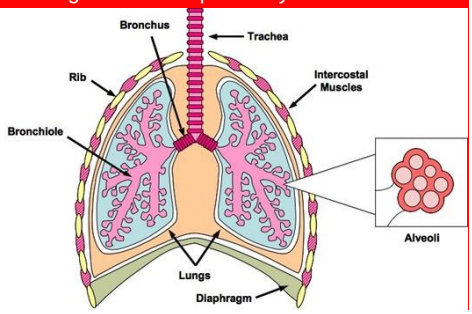






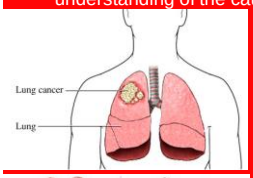
Essential idea:

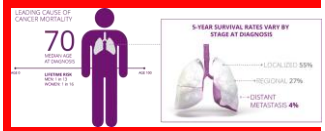
- The lungs are actively ventilated to ensure that gas exchange can occur passively.

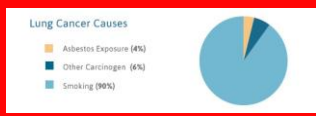


Nature of science:

- Obtain evidence for theories
  - epidemiological studies have contributed to our understanding of the causes of lung cancer. (1.8)







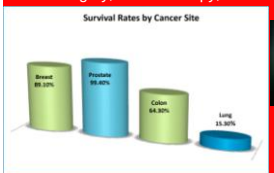
Applications and Skills

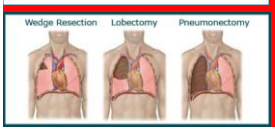
- Application: Causes and consequences of lung cancer.
  - Most common cancer in the world

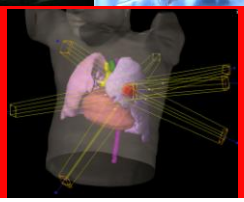
- Smoking 87%
- Second hand smoke 3%
- Air Pollution 5%
- Radon Gas
  - (significant where poor ventilation exists)
- Asbestos, silica
  - (construction sites, mines, factories)

Applications and Skills

- Application: Causes and consequences of lung cancer.
  - 15% survival due to metastasis by time diagnosed.
  - Surgery, chemotherapy, and radiotherapy are treatments

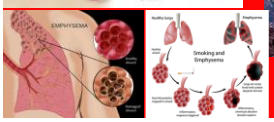






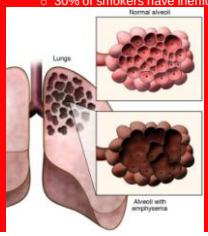
Applications and Skills

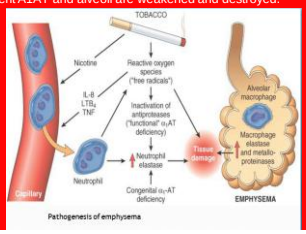
- Application: Causes and consequences of emphysema. (read 317-318)
  - Healthy alveoli are replaced with larger ones with thicker walls.
    - Distance is greater for diffusion
    - Less elastic
    - Less surface area



Applications and Skills

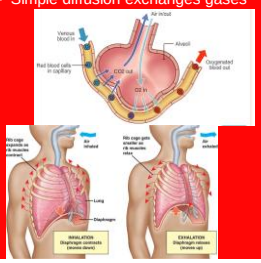
- Application: Causes and consequences of emphysema. (read 317-318)
  - Cause (theory)
    - Phagocytes produce elastase (protein digesting enzyme)
    - Protein inhibitor (A1AT) keeps alveoli safe from digestion
    - Smokers have increased phagocyte numbers
    - 30% of smokers have inefficient A1AT and alveoli are weakened and destroyed.

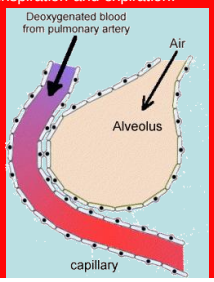




Understandings

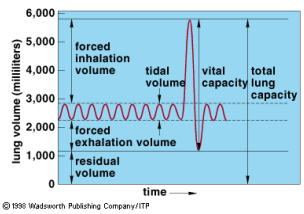
- Ventilation maintains concentration gradients of oxygen and carbon dioxide between air in alveoli and blood flowing in adjacent capillaries.
  - Ventilation (breathing): composed of inspiration and expiration.
  - Simple diffusion exchanges gases





Applications and Skills

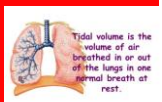
- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
  1) Measure baseline Ventilation Rate
     - Times exhaled or inhaled in 1 minute
     - 3 trials for reliability

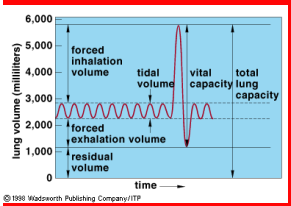


	Ventilation Rate (Breaths/min) ±1 breath	Vital Capacity (ml) ± 5ml
Trial 1		
Trial 2		
Trial 3		
Average		

Applications and Skills

- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
  2) Measure baseline Tidal Volume/Vital Capacity
     - Normal/forced volume exhaled in one breath.
     - 3 trials for reliability





	Ventilation Rate (Breaths/min) ±1 breath	Vital Capacity (ml) ± 5ml
Trial 1		
Trial 2		
Trial 3		
Average		

Applications and Skills

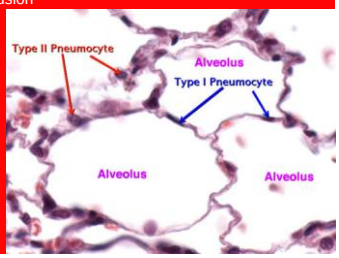
- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
  3) Exercise
  4) Collect individual post-exercise data
  5) Collect Class Data for post exercise data
  6) Compare resting class averages to after exercise data (processed not raw)

	Ventilation Rate (Breaths/min) ±1 breath	Vital Capacity (ml) ± 5ml
Trial 1		
Trial 2		
Trial 3		
Average		

	Ventilation Rate (Breaths/min) ±1 breath	Vital Capacity (ml) ± 5ml
Class Resting Averages		
Class Post-exercise Averages		

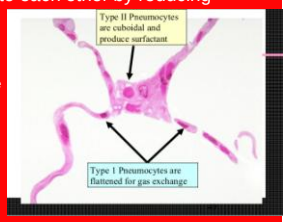
Understandings

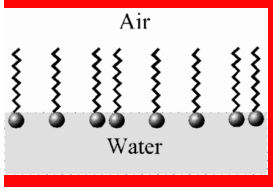
- Type I pneumocytes are extremely thin alveolar cells that are adapted to carry out gas exchange.
  - Make up majority of lung epithelium.
  - About 0.15 µm thick
  - Small distance for diffusion



Understandings

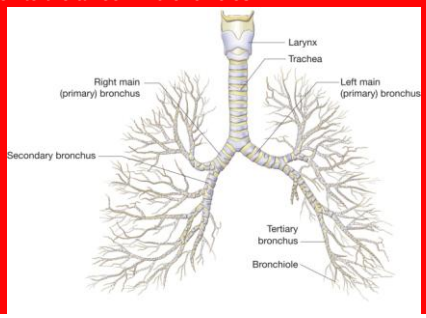
- Type II pneumocytes secrete a solution containing surfactant that creates a moist surface inside the alveoli to prevent the sides of the alveolus adhering to each other by reducing surface tension.
  - About 5% of alveolar surface.
  - Monolayer of surfactant
    - Hydrophobic heads towards moisture
    - Hydrophilic tails towards air





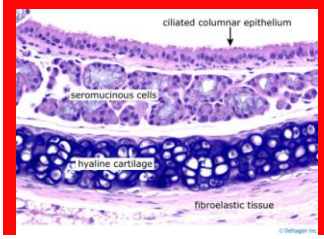
Understandings

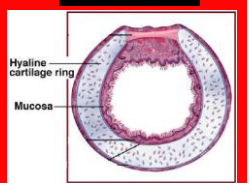
- Air is carried to the lungs in the trachea and bronchi and then to the alveoli in bronchioles.



Lower Respiratory Tract

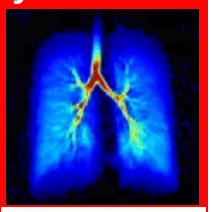
- Trachea
  - Extends downward from larynx and splits into right and left bronchi.
  - Inner wall lined with ciliated mucous membrane to trap incoming particles.
  - The tracheal wall is supported by 20 incomplete cartilaginous rings.

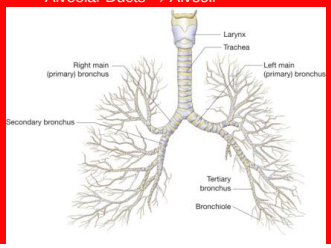


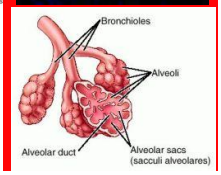


Lower Respiratory Tract

- Bronchial Tree
  - Branched tubes leading from the trachea to the alveoli.
  - Begins with the two primary bronchi, each leading to a lung.
  - Primary Bronchi → Bronchioles → Alveolar Ducts → Alveoli

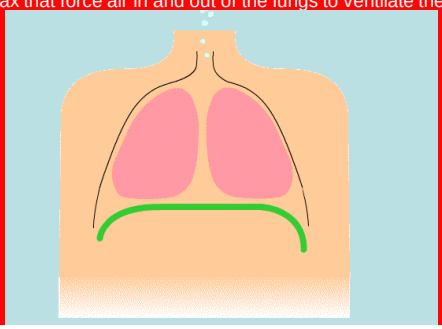






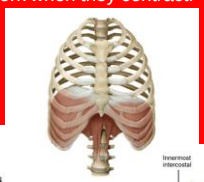
Understandings

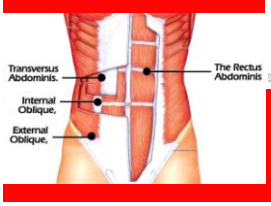
- Muscle contractions cause the pressure changes inside the thorax that force air in and out of the lungs to ventilate them.

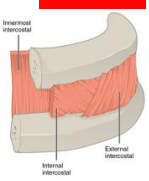


Understandings

- Different muscles are required for inspiration and expiration because muscles only do work when they contract.
  - Diaphragm
  - Abdominal wall muscles
  - External intercostals
  - Internal intercostals







Applications and Skills

- Application: External and internal intercostal muscles, and diaphragm and abdominal muscles as examples of antagonistic muscle action.

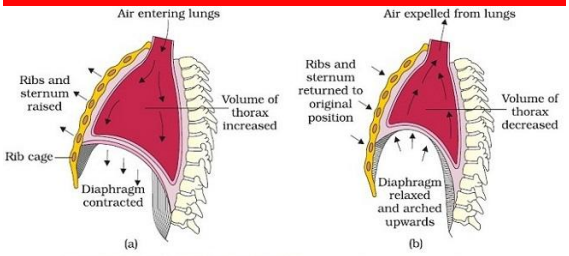
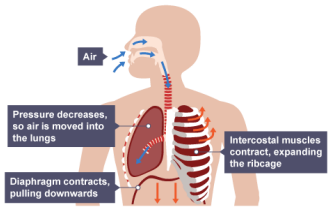
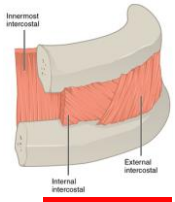


Figure 2 . Mechanism of breathing showing : (a) inspiration (b) expiration

Applications and Skills

- **Inspiration**
  - Diaphragm and external intercostal muscles contract
  - Abdominal wall and internal intercostals relax.
  - Air pressure inside the lungs is decreased by increasing the size of the thoracic cavity.
  - Higher pressure air flows in from the outside.





Applications and Skills

- **Expiration**
  - Diaphragm and external intercostal muscles relax
  - Abdominal wall and internal intercostal muscles contract
  - Elastic recoil of lung and muscle tissues
  - Also from the surface tension within the alveoli.
  - Forced expiration is aided by thoracic and abdominal wall muscles.

End