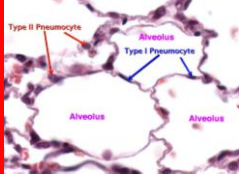
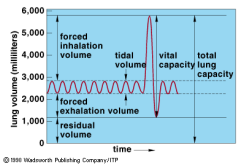


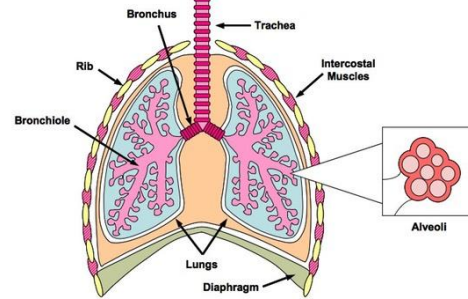
Human Physiology

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)

CAUSING CAUSE OF CANCER MORTALITY
70%

5-YEAR SURVIVAL RATES VARY BY STAGE AT DIAGNOSIS
 +LOCALIZED 83%
 +REGIONAL 27%
 +DISTANT 4%

Lung Cancer Causes

- Asbestos Exposure (4%)
- Other Carcinogens (6%)
- Smoking (90%)

Applications and Skills

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

THE FIVE CAUSES OF LUNG CANCER

- Smoking:** particularly of cigarettes, is by far the main contributor to lung cancer. Cigarette smoke contains over 60 known carcinogens, including radioactive isotopes from the radon decay sequence, nitroamines, and heterocyclic amines.
- Radon gas:** radon and radon's decay products, generated by the breakdown of radioactive radium, which in turn is the decay product of uranium, found in the earth's crust. The radiation decay products source genetic material, leading mutations that sometimes form cancerous.
- Asbestos:** causes a variety of lung diseases, including lung cancer. It causes lunging and asbestososis, a fibrotic effect on the formation of lung cancer. Asbestos can also cause cancer of the pleura, called mesothelioma.
- Air Pollution:** outdoor air pollution has a small effect on increasing the risk of lung cancer from particulate and sulfur aerosols, which may be released in traffic, exhaust fumes, and associated with highly increased risk.
- Genetics:** It is estimated that 8 to 14% of lung cancer is due to inherited factors; the release of people with lung cancer, the risk is increased 2-6 times. This is likely due to a combination of genes.

- 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

Survival Rates by Cancer Site

- Breast 89.6%
- Prostate 88.6%
- Colon 64.3%
- Lung 16.9%

Lung Cancer Treatments: Wedge Resection, Lobectomy, Pneumonectomy

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

Normal alveoli vs. Alveoli with emphysema

- Normal alveoli: small, numerous, thin-walled sacs.
- Alveoli with emphysema: larger, fewer, thick-walled sacs.
- Damaged alveoli: irregular, fused sacs.

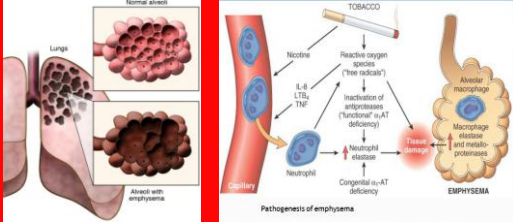
EMPHYSEMA

Smoking and Emphysema

SPECIMEN 1-75-309 DATE

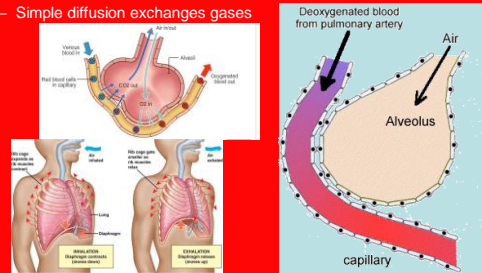
Applications and Skills

- 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.



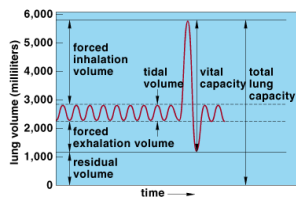
Understandings

- 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

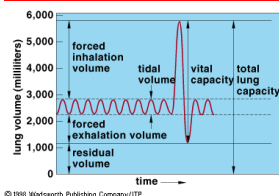
- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
 - Measure baseline Ventilation Rate
 - Times exhaled or inhaled in 1 minute
 - 3 trials for reliability



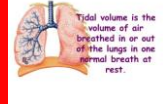
	Ventilation Rate (Breaths/min) ± 1 breath	Vital Capacity (ml) ± 5 ml
Trial 1		
Trial 2		
Trial 3		
Average		

Applications and Skills

- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
 - 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) ± 5 ml
Trial 1		
Trial 2		
Trial 3		
Average		



Applications and Skills

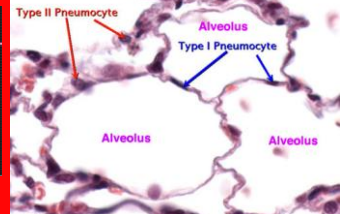
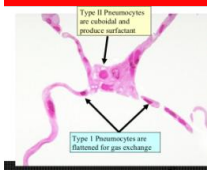
- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise. (Practical 6) pg 312-313
 - Exercise
 - Collect individual post-exercise data
 - Collect Class Data for post exercise data
 - Compare resting class averages to after exercise data (processed not raw)

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

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

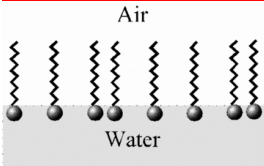
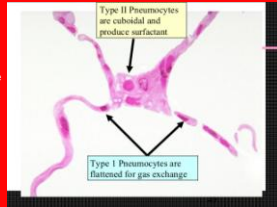
Understandings

- 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 μ m thick
 - Small distance for diffusion



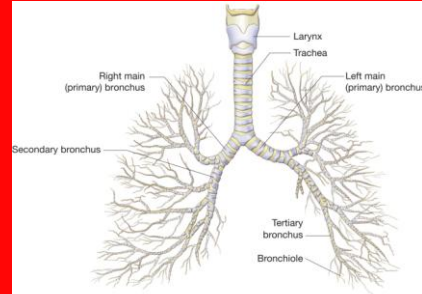
Understandings

- 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



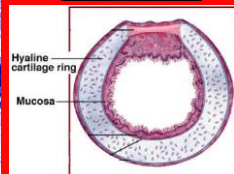
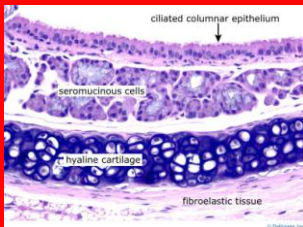
Understandings

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



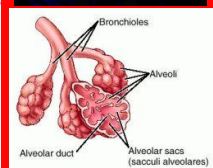
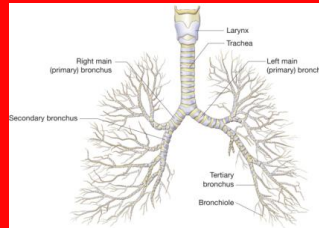
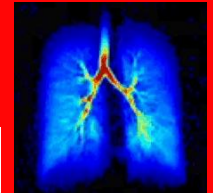
Lower Respiratory Tract

- 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.



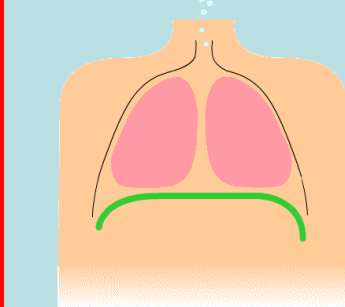
Lower Respiratory Tract

- 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



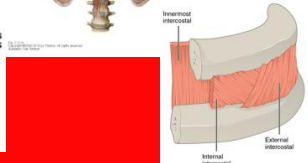
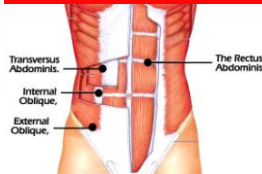
Understandings

- 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.

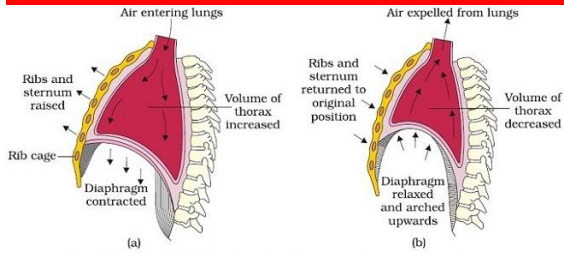
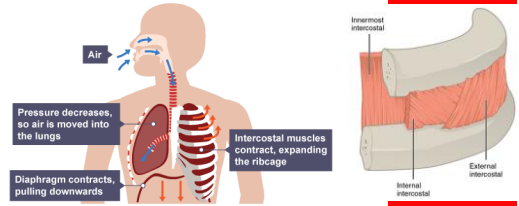


Figure 2. Mechanism of breathing showing : (a) inspiration (b) expiration

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.

