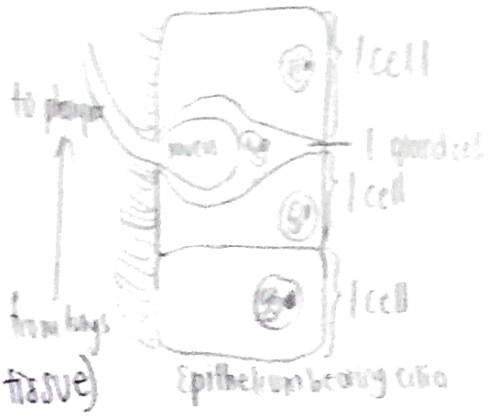
Respiration

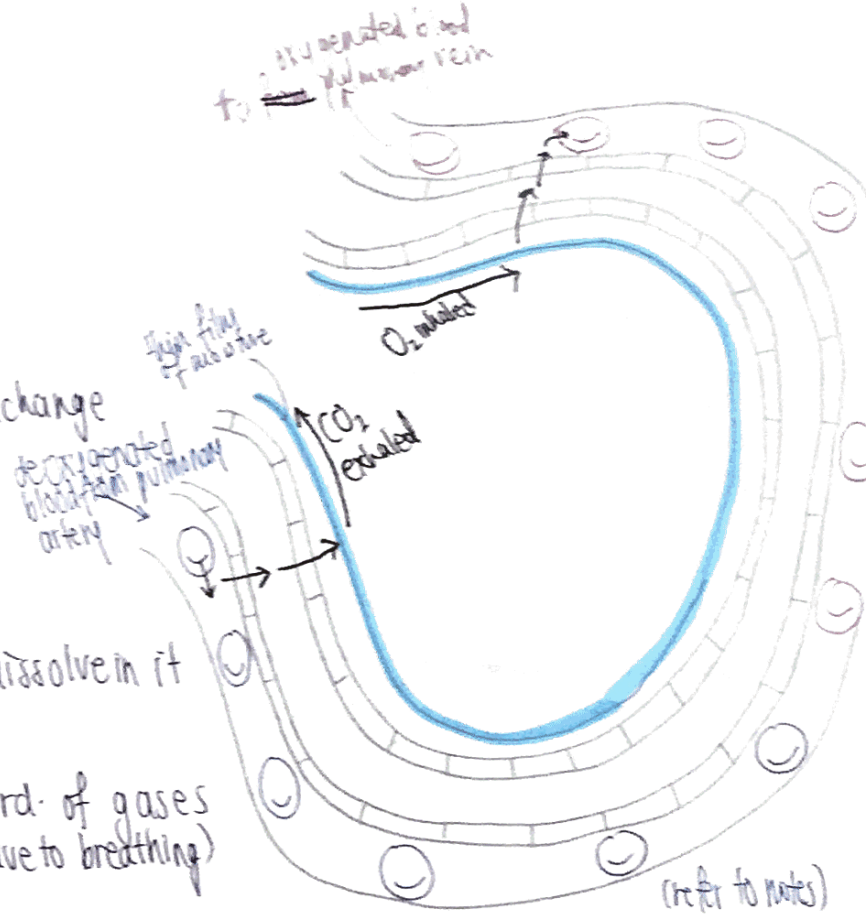
Trachea & Bronchi



- Trachea is supported by C-shaped rings of cartilage (firm, elastic tissue)
  → ensure that lumen of trachea is open
- Epithelium lining bears cilia (ciliated cells)
  → sweep trapped ptc. ↑ to pharynx, then swallowed into oesophagus
  Anti-gravity - a lot of movement
- Gland cells in epithelium secrete mucus
  → Trap dust ptc. & bacteria

(no lungs included)

Alveoli



- Numerous alveoli in lungs
  → Provide large SA. for gaseous exchange
- Walls are one-cell thick
  → Allow faster rate of diffusion
- Thin film of moisture on inner surface
  → Allow oxygen & carbon dioxide to dissolve in it
- Richly supplied w/ blood capillaries
  → Flow of blood maintains conc. grd. of gases (movement of air in & out of alveoli, due to breathing)

Chest cavity

- Chest walls supported by ribs
  → Protect vital organs (heart, lungs, liver etc.)
- Ribs attached to backbone (vertebral column) & sternum (chest bone)
- External & internal intercostal muscles btwn ribs
- Thorax separated by abdomen by diaphragm

Rib muscles
- Contract & relax to help move ribs ↑ & ↓, changing vol. of chest cavity

Breathing → Involuntary process controlled by brain
→ Stimulus is high conc.

RESPIRATION

	Inhalation	Exhalation
Physical		
Diaphragm	Contracts, relaxed dome → flattened	Relaxes, becomes dome shaped
Ext. intercostal	Contract	Relaxes
Int. intercostal	Relaxes	Contracts
Ribs	Outwards	Inwards
Sternum	Upwards	Downwards
Effect		
Lungs	Expands lungs, ↑ vol. of thoracic cavity	Compresses lungs ↓ vol. of thoracic cavity
Air pressure	↓ air pressure	↑ air pressure
Atmospheric pressure	Higher than pressure in lungs, air is sucked into lungs	Lower than pressure in lungs, air forced out of lungs

O_2 absorbed into lungs by...

- Dissolving into thin film of moisture lining alveolar walls
- Then diffusing into blood capillaries
- Reaction is reversible!
  - O_2 high in lungs → oxyhaemoglobin ⇌ Blood passes thru O_2-poor tissues, O_2 released → deoxyhaemoglobin

CO_2 transported in the body by...

- Carbonic acid — dissolved in plasma
- Carbamino haemoglobin — attached to haemoglobin
- Hydrogencarbonate ions — carried by plasma [60-90%]

emoved by...

CO_2 enters RBC, react w/ H_2O to form carbonic acid w/ the help of carbonic anhydrase

$$CO_2 + H_2O \xrightarrow{\text{carbonic anhydrase}} H_2CO_3$$

- H_2CO_3 converted to hydrogen carbonate ions, ions diffuse out of RBC into plasma

$$H_2CO_3 \rightarrow H^+ + HCO_3^-$$

- In lungs, H^+ & HCO_3^- diffuse back into RBC, converted to H_2CO_3, then H_2O & CO_2
- CO_2 diffuses out of blood capillaries into the alveoli, then exhaled

TOBACCO

Nicotine (Addictive drug)

- Causes release of adrenaline
  → ↑ H.beat & b.p.
- ↑ chances of blood clot in vessels

CO

- Combine w/ haemoglobin → carboxyhaemoglobin irreversibly
  → ↓ O_2 transport, ↓ efficiency of RBC
  → Death, if conc. in air ↑ 1%.
- ↑ rate of fatty deposits on inner arterial wall
  → Lumen is narrower
  → ↑ risk of atherosclerosis
- Damages lining of blood vessels
  → ↑ risk of thrombosis in arteries

Irritants

- Paralyses cilia lining air passage
- ↑ risk of chronic bronchitis & emphysema

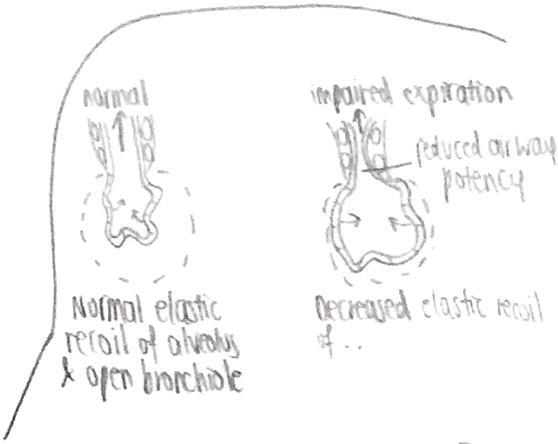
(hydrogen cyanide, acetone, formaldehyde)

Tar

- Brown sticky subs. accumulate in lungs
- Has carcinogenic chemicals
  → Induce uncontrolled cell division in ↑ epithelium
  → Blockage in air sacs, ↓ gas exchange efficiency
- Paralyses cilia lining air passage
  → Dust ptc. trapped in mucus lining removed

CHRONIC BRONCHITIS

1. Excessive mucus secreted by epithelium (uncontrolled cell ÷)
2. Cilia paralysed, foreign ptc. removed, ↑ risk of lung infections
3. Epithelium lining airways, bronchi becomes inflamed
4. Airways blocked ∴ Breathing difficulty
5. Persistent cough to clear airways to breathe



EMPHYSEMA

1. Violent coughing breaks partition walls btwn air sacs, ↓SA. for gaseous exchange
2. Lungs inflated with air & loses elasticity (air still inside air sacs, adding air to an air-filled air sac)
3. Wheezing, severe breathlessness & difficulty breathing

LUNG CANCER

1. Uncontrolled division of cells in lungs
   → Outgrowths / lumps of tissues

(Smoking ↑ chances of mouth, pancreas, kidney & urinary bladder cancer)

~RESPIRATION~

– oxidation of monosaccharides w/ release of energy in mitochondria

AEROBIC

breakdown of food in presence of O_2 w/ release of large amt. of energy

- Glucose + Oxygen → Carbon dioxide + Water + Large amt. of energy

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$ + energy (38 ATP mol.)

- Occurs in mitochondria, which has enzymes to facilitate aerobic/cellular respiration.
- Uses:
  - Muscular contractions
    heart beat, respiratory movements
  - Active transport
    absorb simple subs. in small int.
  - Heat for insulation
  - Protein synthesis
  - Cell division
  - Building of protoplasm

ANAEROBIC

breakdown of food in absence of O_2

≈ lactic acid fermentation

- Glucose ⟶ Lactic acid + small amt. of energy [HUMAN]

- Glucose ⟶ Ethanol (CH_3CH_2OH) + CO_2 + energy [YEAST]

- Incomplete breakdown of sugar → lactic acid & energy
- Accumulation of L.A. in muscles cause pain, muscle fatigue & discomfort
- Athletes undergoing strenuous exercise incur O_2 debts
  → Cont. breathing heavily (pant) until all L.A. is removed & O_2 debt repaid

– Fermentation ≠ Anaerobic respiration! –

4 stages of Exercise

① Resting position
- Enough O_2 reaching cells at first as muscle cells respire aerobically, releasing large amt. of energy for muscular contractions

② Just started running
- CO_2 builds up in cells so there is panting to remove CO_2 & take in O_2 at faster rates via lungs
- ♡ beats faster so O_2 can be brought faster to muscles

③ 10 min running
- Limit to rate of breathing & heartbeat → Max. aerobic respiration reached
- Continuation of vigorous exercise demands more energy so there is uncomfortable anaerobic respiration
- Small amt. of energy released + L.A.
- Muscle cells incur O_2 debt & high conc. of L.A. causes fatigue
- Muscular pain experienced
- Body needs rest.

④ After running
- Breathing rate is still fast to repay O_2 debt
- L.A. removed from muscles & transported to liver, where L.A. is oxidised to release energy to convert remaining L.A. → glucose
- L.A. used up, O_2 debt repaid because O_2 intake > O_2 needed
- Glu. transported to muscles