GAS EXCHANGE AND SMOKING

GAS EXCHANGE

- clean & warm air breathed
- ↑ diffusion surface area
- ↓ diffusion distance
- maintain diffusion gradients

ROLE OF GAS EXCHANGE SYSTEM

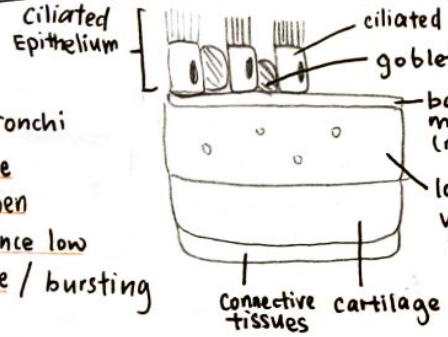
- in multicellular organisms
  - → most cells far from external environment ∴ have specialised gas exchange surface (alveolus)

LUNGS

- in thoracic cavity
- surrounded by pleural membranes
  - → contains small quantity of fluid
  - → allow friction free movement of lungs

TRACHEA

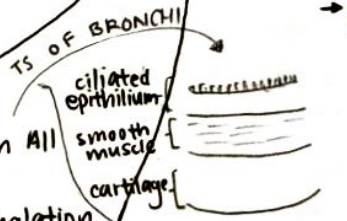
- throat to lungs
- base splits into 2 bronchi
- cartilage in C-shape
  - ⇒ keeps airways open
  - ⇒ keeps air resistance low
  - ⇒ prevents collapse / bursting



(TS OF TRACHEA)

BRONCHI

- Trachea → Bronchus ↓
  Terminal ← Bronchioles
  Bronchioles
  - ↳ Respiratory Bronchioles
- irregular blocks of cartilage
- fewer goblet cells than in trachea
- epithelial cells not as tall → Bronchioles
- Bronchioles surrounded by smooth muscle
  - ⇒ can contract / relax to adjust diameter
  - → absence of cartilage makes this possible



- Elastic fibres present in All bronchiole walls
  - ⇒ stretch during inhalation
  - ⇒ recoil during exhalation.

ALVEOLUS

- between atmosphere & blood stream
- walls contain elastic fibres
  - ⇒ stretch & recoil
  - → expand according to vol. of air breathed in
  - → when expand, surface area ↑
  - → when recoil, air expelled efficiently
  - → prevents bursting

- single layer of squamous epithelial (∠0.5μm)
- blood capillaries pressed against walls ∴ distance ↓
- steep conc. gradient must be maintained.
  - → by breathing & movement of blood.

- → air in = O_2↑ CO_2↓
- → blood in = CO_2↑ O_2↓
  } ∴ can diffuse
- → blood constantly flowing ∴ gradient maintained.
- → moist ∴ allow gas dissolve
- → Large surface area

COMPARISON

STRUCTURE	CARTILAGE	GOBLET CELL	SMOOTH MUSCLE	CILIA	SITE OF GAS EXCHANGE	ELASTIC FIBRE
trachea	✓	✓	✓	✓	×	✓
bronchus	✓	✓	✓	✓	×	✓
terminal bronchiole	×	×	✓	✓	×	✓
respiratory bronchiole	×	×	×	✓ (few)	×	✓
alveolar duct	×	×	×	×	✓	✓
alveolus	×	×	×	×	✓	✓

WARMING & CLEANING AIR

- air warmed to body temp & moistened by evaporation from lining.
- → protect from desiccation
- → protect from suspended matter (dust, sand, pollen, fungal spores, bacteria, viruses etc.)
- → particles ⩾ 5–10μm caught by nose hairs / mucus in pathways.
- → mucus secreted by → mucous glands beneath epithelium
  - → goblet cells of ciliated epithelium
    - ↳ upper part swollen with mucin droplets
    - ↳ mucus made of mucin (glycoproteins, carbonydrate chains)
- → surfactant cell
  - → keeps alveoli wall flexible (by phospholipid secretion)
  - → lowers surface tension
- → SO_2, NO_2 can dissolve in mucous to form acidic solution
- → ciliated cells beat cilia, carries carpet of mucus to larynx
  - → mucus swallowed, stomach acid kill bacteria
- → macrophages (phagocytes) patrol surfaces of airways
  - → during infection joined by other phagocytes.

GAS EXCHANGE AND SMOKING

MAIN COMPONENTS OF CIGARETTE SMOKE

- tar → contains carcinogens } damage gas exchange system
- CO
- nicotine } damage cardiovascular system

CHRONIC BRONCHITIS

- tar stimulates goblet cells and mucous glands to enlarge and secrete more mucous
- tar destroys cilia ∴ weakens cleaning action.
  ∴ mucus accumulates in bronchioles
- stimulates 'smoker's cough' => attempt to move mucous up
- Epithelia is damaged & replaced by scar tissue
- smooth muscle in bronchiole & bronchi thickens
  → airways narrow
- pneumonia easily develop ∵ accumulated mucus.
- Symptoms → severe cough
  → large quantities of phlegm
- damage & obstruction of airways.

EMPHYSEMA

- lungs constantly infected ∴ inflamed
- phagocytes leave blood to line the airways
  → from capillaries to lining of lungs
- phagocytes release elastase
- elastin in alveoli walls destroyed to make pathway
- Effects
  - → alveoli do not stretch & recoil
  - → bronchioles collapse during expiration ∴ air trapped in alveoli
  - → alveoli burst ∴ large spaces appear => surface area ↓
  - → number of capillaries ↓ ∴ less O_2 absorbed
  - → blood vessels more resistant, bp in pulmonary artery ↑, right side of ♡ increase in size

(EMPHYSENA)

- → difficult to move air out of lungs
- → air remains in lungs & not refreshed
- → Symptoms
  - → Breathlessness
  - → Rapid breathing rate
  - → wheezing
  - → fatigue
  - → chest pain
  - → mucous ↑ phlegm ↑ → persistent coughing
  - → shortness of breath

LUNG CANCER

- → tar contains carcinogens
- → carcinogens react with DNA in epithelial cells to produce mutations
- → uncontrolled mitosis ∴ tumour
- → cells do not respond to signals
- → can spread through bronchial epithelium & enter lympatic tissues
- → metastasis
- → mostly developes at base of trachea (most tar deposit)
- → detection by → bronchoscopy
  → chest X-ray
  → CT scan
- → treatment by → surgery
  → radiotherapy
  → chemotherapy

NICOTINE

- → absorbed readily by blood
- → travels to brain in few seconds
- → stimulates nervous system to reduce diameter of arterioles
- → stimulates adrenaline release
  - → ∴ heart rate & bp ↑
  - → decrease in blood supply to extremities
- → increases risk of blood clotting
- → highly addictive
- → stimulate nerve endings in brain to release dopamine.

CARBON MONOXIDE

- → combines with Hb => carboxyhaemoglobin
- → Hb not fully oxygenated
- → less O_2 supplied to heart muscle ∴ strains ♡
- → damages lining of arteries

RISKS

- → damage to walls of arteries cause build up of fatty tissue & reduced blood flow
  - → coronary heart disease
  - → stroke
- → cardiovascular disease => multifactorial
  → smoking one of the factors.