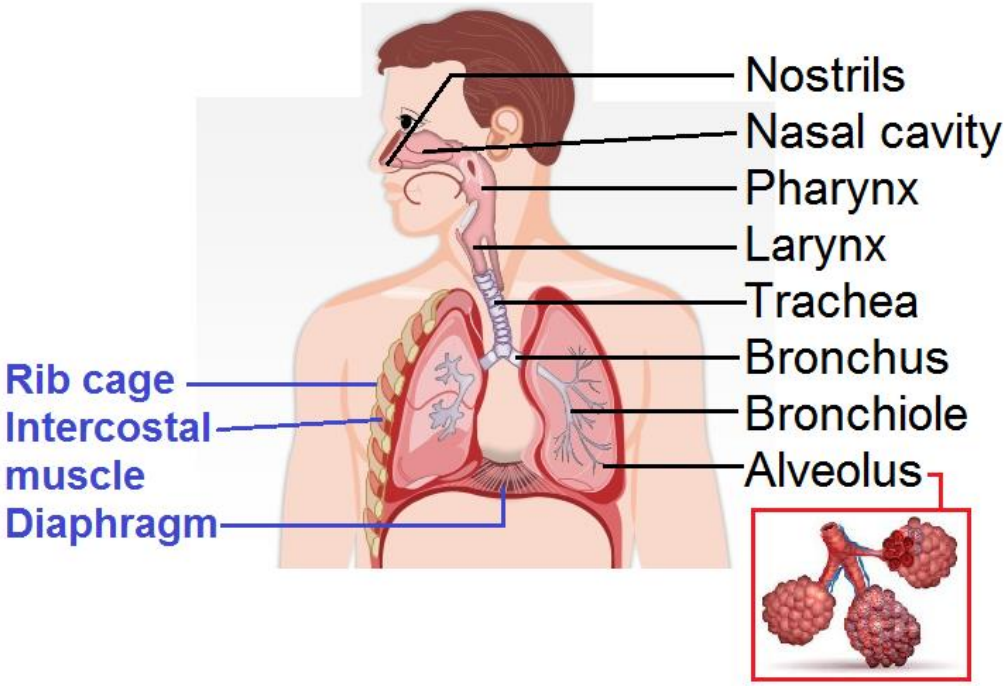
CHAPTER 2: RESPIRATION (ENGLISH)

2.1 HUMAN RESPIRATORY SYSTEM

A. Outline

1. Function – to supply cells with **oxygen** & to remove **carbon dioxide**

2. Labels:



3. Function of labels:

Component	*Function*
Nostrils	Opening into lung
Nasal cavity	To moisten air
Pharynx, larynnx, trachea, bronchus, bronchiole	As air passages during breathing
Alveolus	Site for gas exchange
Rib cage	Protect lungs

Intercostal muscles	To move rib cage
Diaphragm	Change air pressure in thoracic (chest) cavity

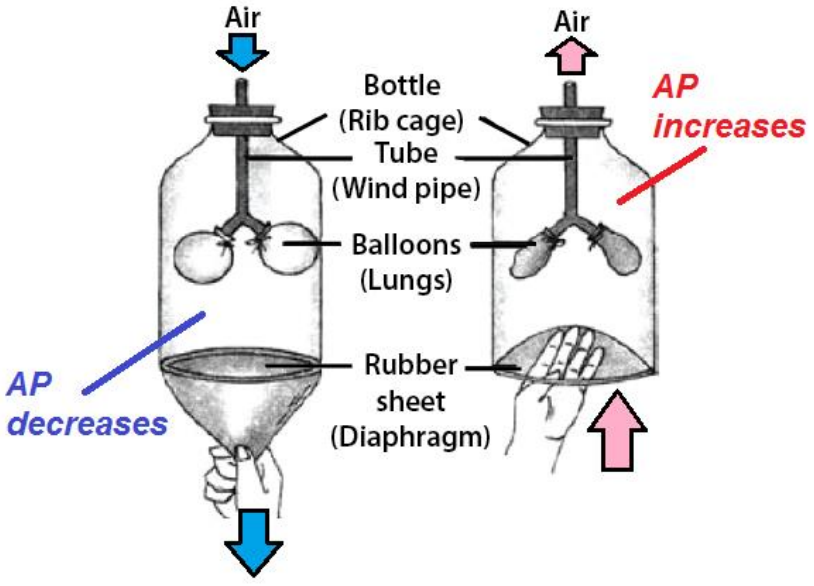
4. Air direction (inhalation):

Nostrils →	Nasal cavity →	Pharynx →	Larynx ↓
Alveolus ←	Bronchiole ←	Bronchus ←	Trachea

B. Breathing Mechanism

	INHALATION	EXHALATION
Intercostal muscle	Contract	Relax
Diaphragm	Contract & flatten	Relax & curve up
Rib cage	Move up & outward	Down & inward
AP of thoracic cavity	Decreases	Increases

Experiment:



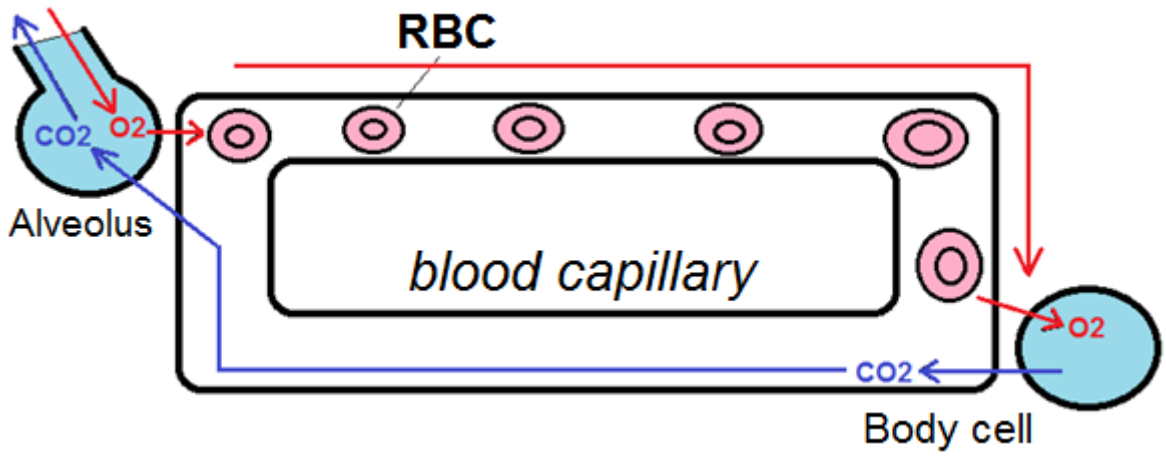
	PULLING RUBBER SHEET DOWN	PUSH IT UP!
Process	Air pressure decreases → air enters balloons → ballon expands	Air pressure increases → air exits balloons → balloon shrinks

C. Compare Inhaled & Exhaled Air

INHALED AIR	EXHALED AIR
More oxygen (21%)	Less oxygen (16%)
Less CO2 (0.04%)	More CO2 (4%)

2.2 MOVEMENT & EXCHANGE OF GASES IN THE HUMAN BODY

A. How Gases are Transported



1. How **oxygen** is transported:

- Alveolus has higher concentration of O2
- So, O2 diffuses from alveolus into blood capillary
- O2 combines with haemoglobin (Hb) inside red blood cell (RBC) to become **oxyhaemoglobin:**

Oxygen + haemoglobin → Oxyhaemoglobin

- Body cells have lower concentration of O2
- So, oxyhaemoglobin breaks down & oxygen diffuses into the cells:

Oxyhaemoglobin → oxygen + haemoglobin

2. How **carbon dioxide** is transported:

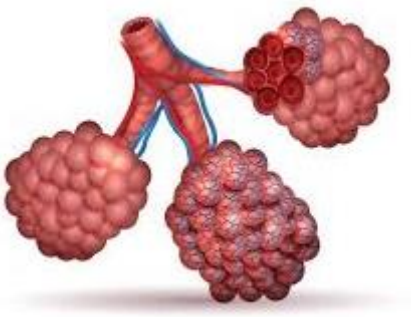
- Cell uses oxygen to conduct **cellular respiration** to produce energy:

Glucose + oxygen → carbon dioxide + water + energy

- Now, cell has higher concentration of CO2
- So, CO2 diffuses into blood capillary, travels in blood into alveolus, & removed through exhalation

B. Adaptations of Alveolar Structure

The four adaptations:



a. Thin wall of alveolus & thin blood capillary
b. Moist wall of alveolus
c. Large surface area (large number of alveoli)
d. Alveoli is rich with network of blood capillaries

All happens so <u>gas exchange can occur more efficiently</u>

2.3 HEALTH OF HUMAN RESPIRATORY SYSTEM

A. Harmful Substances in the Air – Solids & Gases

1. Harmful solids in the air:

Solids	*Source*	*Effect*
Tar	Cigarette 	- irritate/kill cells → cancer - increase phlegm → cough
Haze & dust	Motor vehicles, open burning 	Irritate air passages → asthma
Pollen	Flower 	Irritate air passages → asthma

2. Harmful gases in the air:

Gases	*Source*	*Effect*
Carbon monoxide	Cigarette, motor vehicles	reduce O2 intake by cells → tired & breathlessness
Sulphur dioxide	Coal combustion in power plants 	Irritate air passages → cough, breathlessness, cancer
Nitrogen dioxide	Motor vehicles	Irritate air passages → cough, breathlessness, cancer

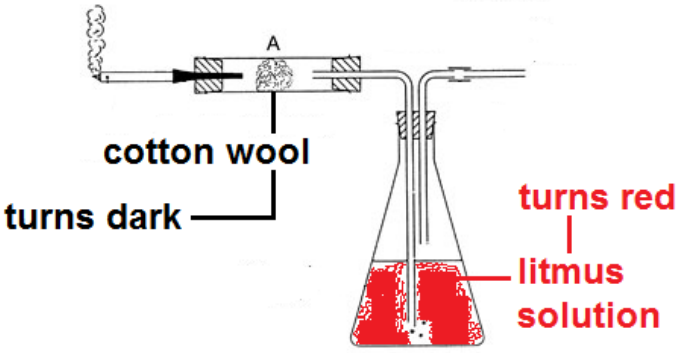
B. Respiratory Diseases (BECA) & Their Symptoms

Diseases	*Cause*	*Symptoms*
1. Asthma – narrowing of air passage	Cigarette smoke, exhaust gases, burning, dust & pollen	Shortness of breath, coughing, wheezing
2. Bronchitis – bronchus becomes inflamed	Tar in cigarette smoke	Shortness of breath, coughing
3. Emphysema – damaged/dead alveoli	Cigarette smoke	Shortness of breath, pain when breathing, tiredness
4. Lung cancer – tumor in lung	Carcinogens in cigarette smoke, harmful gases	Coughing blood, pain when breathing

C. Effects of Smoking on the Lungs

1. Smoking is harmful to smokers &
passive smokers = person who doesn't smoke but inhale the cigarette smoke

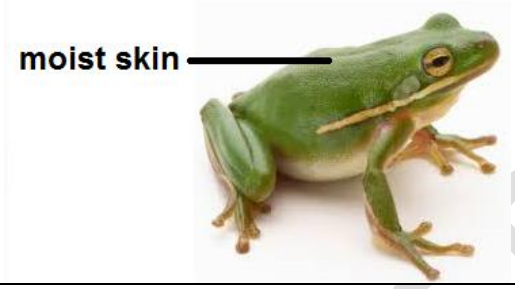
2. Experiment:



Observation	*Inference*
Cotton wool turns **dark/brown**	Cig. smoke contains **tar** - tar causes cancer
Blue litmus solution turns **red**	Cig. smoke is **acidic** - acid irritates air passage in lungs

2.4 ADAPTATIONS IN RESPIRATORY SYSTEM OF FROG, FISH, & INSECTS

A. Frog

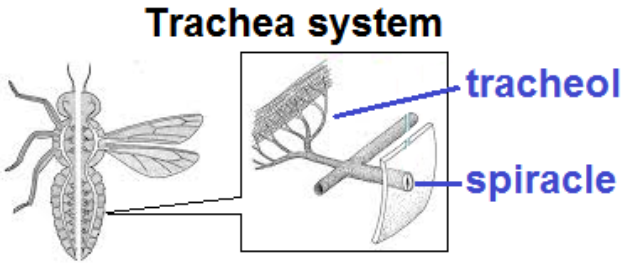
1. Other than lungs, frogs use **moist outer skin** as site for gasesous exchange 
2. Outer skin adaptations: a. moist surface b. thin structure c. large network of blood capillaries under skin
3. To maintain moist skin, frogs <u>live near water</u>

B. Fish

1. Uses gills – contain **filaments & lamellae:** 
2. Gills adaptations: a. Thin lamellae b. Large number of filaments & lamellae → to increase surface area c. Thin lamellae is rich with large network of blood capillaries

C. Insect

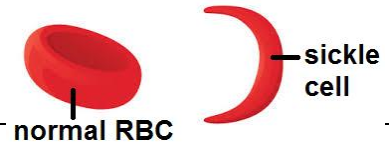
1. Use **trachea system:**
- consists of **trachea and tracheoles** as air tubes
- air enter through **spiracles** which can be opened/closed using **valves**
- some insects have air sacs to speed up air intake



2. Trachea system adaptations:
a. Thin & moist tracheoles
b. Large number of tracheoles → increase surface area for gas diffusion

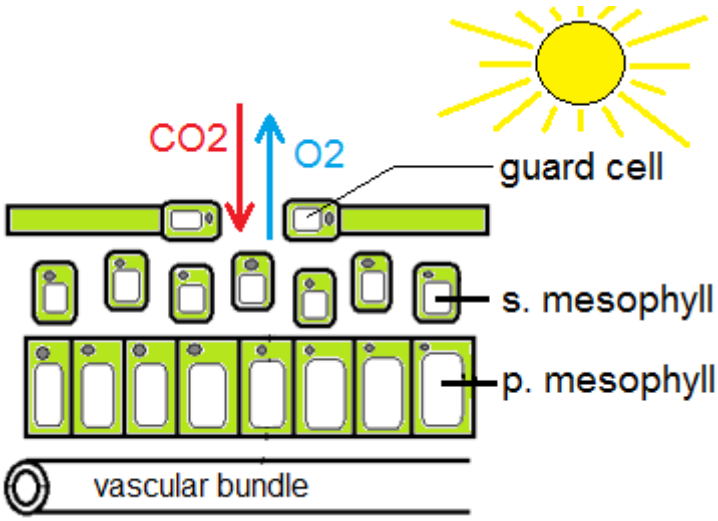
3. Gases diffuse directly from trachea system into the cells
– so, blood circulation is not needed

2.5 THE EFFECT OF DIFFERENT CONDITIONS TO HUMAN RESPIRATORY SYSTEM

Condition	*Effect*
Mountainous region (high altitude) 	High altitude = low oxygen → low oxygen concentration in body → feel shortness of breath
Active lifestyle 	Higher ventilation rate = higher gas diffusion → high oxygen concentration in body → feel energized all day
Sickle-cell anaemia patients 	Abnormal RBC = RBC carry less oxygen in Hb → body cells receive less oxygen → feel low energy & tiredness

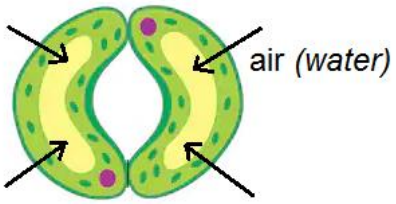
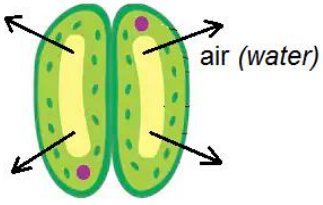
2.6 GASEOUS EXCHANGE IN PLANTS

A. Gaseous Exchange in Plants during Photosynthesis



1. In day, **photosynthesis rate is higher than respirastion** → stoma opens a. More O2 gas is produced by leaf cells (spongy & palisade mesohyll) - so, leaf cells have higher concentration of O2 - so, O2 diffuses from cells → air space between cells → stoma → atmosphere b. CO2 is required by leaf cells for photosynthesis - atmophere has higher concentration of CO2 - so, CO2 diffuses from atmosphere → stoma → air space → leaf cells
2. At night, leaf cells conduct **respiration only** - gaseous exchange occurs less because <u>stoma closed</u>

B. Mechanism of Stoma Opening/ Closing

DAY	*NIGHT*
	

Photosynthesis happens → cell has much glucose → cell become more concentrated	**Photosynthesis not happen** → cell has less glucose → cell become less concentrated
Water diffuse in → cell turgid & curved → stoma opens → gas exchange occurs more	Water diffuses out → cell flaccid & straight → stoma closes → gas exchange is less

B. Importance of Unpolluted Environment for the Plant Survival

Condition	*Effect*
1. Leaf covered with dust 	a. Leaf cells received less sunlight → photosynthesis rate decreases → less sugar → less food → plant dies
	b. Dust covers the stoma → gasesous exchange less efficient → cells receive less gas: - less CO_2 → low photosynthesis → plant dies - less O_2 → low respiration → plant dies
2. Acidic gases from acid rain 	a. acid is corrosive → can kill leaf cells → low photosynthesis → plant dies
	b. soil become acidic → acidic soil is less fertile → plant dies

--FINISH_CHAPTER_2--

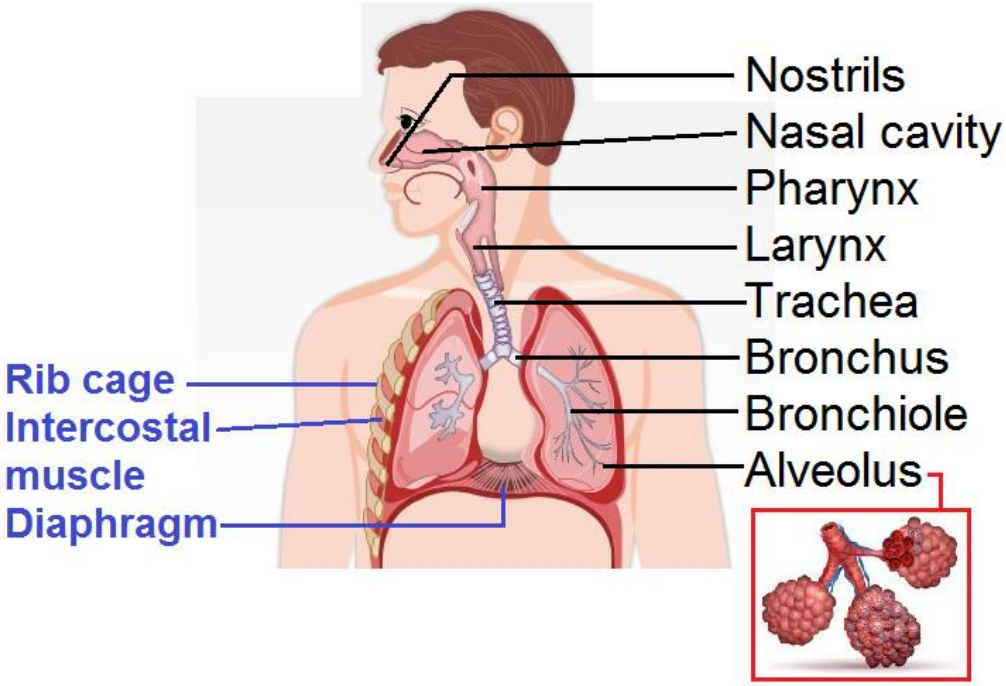
BAB 2: RESPIRASI (BAHASA MELAYU)

2.1 SISTEM RESPIRATORI MANUSIA

A. Pengenalan

1. Fungsi - untuk membekalkan **oksigen** kpd sel & singkirkan **karbon dioksida**

2. Label (English):



3. Fungsi label:

Komponen	*Fungsi*
Lubang hidung	Bukaan ke paru-paru
Rongga hidung	Melembapkan udara
Farinks, larinks, trakea, bronkus, bronkiol	Sebagai laluan udara semasa bernafas
Alveolus	Tapak pertukaran gas
Tulang rusuk	Melindungi paru-paru

Otot interkostal	Untuk menggerakkan tulang rusuk
Diafragma	Ubah tekanan udara dalam rongga toraks (ruang dada)

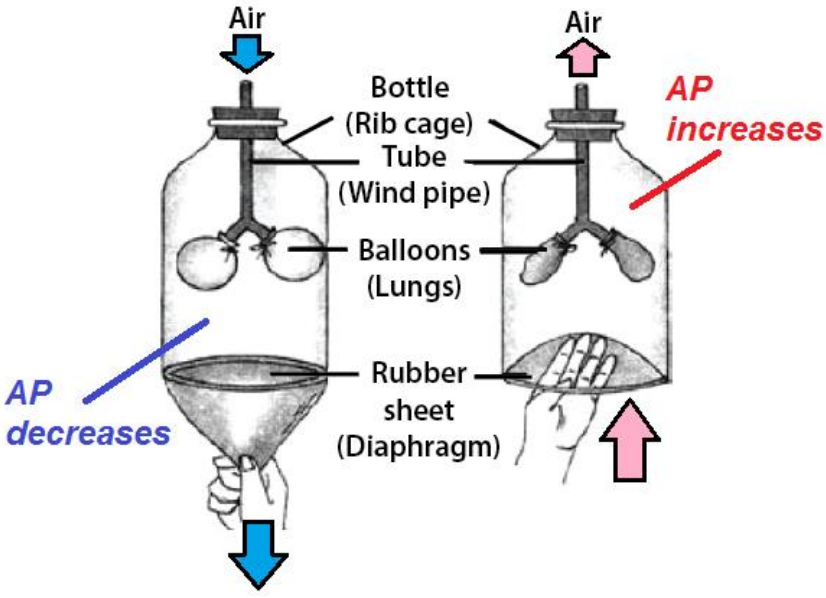
4. Arah laluan udara (tarik nafas):

Lubang hidung →	Rongga hidung →	Farinks →	Larinks ↓
Alveolus ←	Bronkiol ←	Bronkus ←	Trakea

B. Mekanisme Pernafasan

	TARIK NAFAS	HEMBUS NAFAS
Otot interkostal	Mengecut	Mengendur
Diafragma	Mengecut & jadi rata	Mengendur & melengkung
Tulang rusuk	Bergerak ke atas & ke luar	Ke bawah & ke dalam
Tekanan udara rongga toraks	Rendah	Tinggi

Eksperimen:



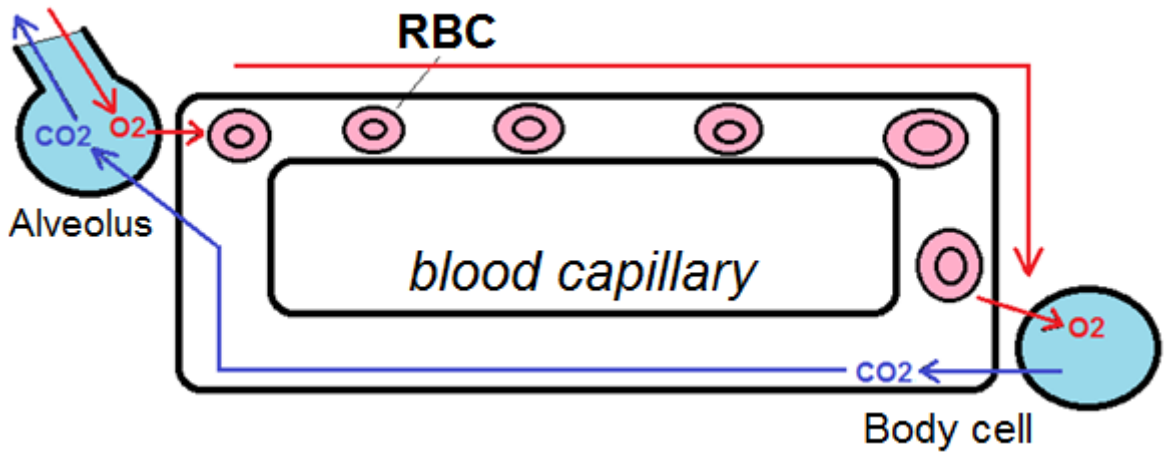
	TARIK KEPINGAN GETAH KE BAWAH	TOLAK KE ATAS!
Proses	Tekanan udara menurun → udara memasuki belon → belon mengembang	Tekanan udara meningkat → udara keluar belon → belon mengecut

C. Perbandingan antara Udara Sedutan & Hembusan

UDARA SEDUTAN	UDARA HEMBUSAN
Lebih banyak oksigen (21%)	Kurang oksigen (16%)
Kurang CO2 (0.04%)	Lebih banyak CO2 (4%)

2.2 PERGERAKAN & PERTUKARAN GAS DALAM TUBUH MANUSIA

A. Bagaimana Gas Diangkut



1. Bagaimana **oksigen** diangkut:

- Alveolus mempunyai kepekatan O2 yang lebih tinggi
- Jadi, O2 meresap dari alveolus ke kapilari darah
- O2 bergabung dengan hemoglobin (Hb) dalam sel darah merah (RBC) untuk menjadi **oksihemoglobin**:

Oksigen + hemoglobin → Oksihemoglobin

- Sel badan mempunyai kepekatan O2 yang lebih rendah
- Jadi, oksihemoglobin terurai & oksigen meresap ke dalam sel:

Oksihemoglobin → oksigen + hemoglobin

2. Bagaimana **karbon dioksida** diangkut:

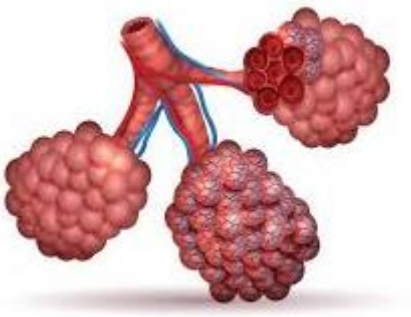
- Sel guna oksigen utk melakukan **respirasi sel** utk menghasilkan tenaga:

Glukosa + oksigen → karbon dioksida + air + tenaga

- Kini, sel mempunyai kepekatan CO2 yang lebih tinggi
- Maka, CO2 meresap ke kapilari darah, mengalir dalam darah ke alveolus, & disingkirkan semasa hembus nafas

B. Adaptasi Struktur Alveolar

Empat adaptasi:



a. Dinding alveolus & kapilari darah yg nipis
b. Dinding alveolus yg lembap
c. Luas permukaan yang besar (alveolus sgt banyak)
d. Alveolus kaya dgn rangkaian kapilari darah yang luas

Semua berlaku <u>supaya pertukaran gas dapat berlaku dengan lebih cekap</u>

2.3 KESIHATAN SISTEM RESPIRATORI MANUSIA

A. Bahan Pencemar di Udara - Pepejal & Gas

1. Bahan pencemar pepejal di udara:

Pepejal	*Sumber*	*Kesan*
Tar	Rokok 	- mengganggu/bunuh sel → kanser - kahak makin banyak → batuk
Jerebu & habuk	Kenderaan bermotor, pembakaran terbuka 	Ganggu saluran pernafasan → asma
Debunga	Bunga 	Ganggu saluran pernafasan → asma

2. Bahan pencemar gas di udara:

Gas	*Sumber*	*Kesan*
Karbon monoksida	Rokok, kenderaan bermotor	kurangkan pengambilan O2 oleh sel → letih & sesak nafas
Sulfur dioksida	Pembakaran arang batu di stesen janakuasa 	Ganggu salur pernafasan → batuk, sesak nafas, kanser
Nitrogen dioksida	Kenderaan bermotor	Ganggu salur pernafasan → batuk, sesak nafas, kanser

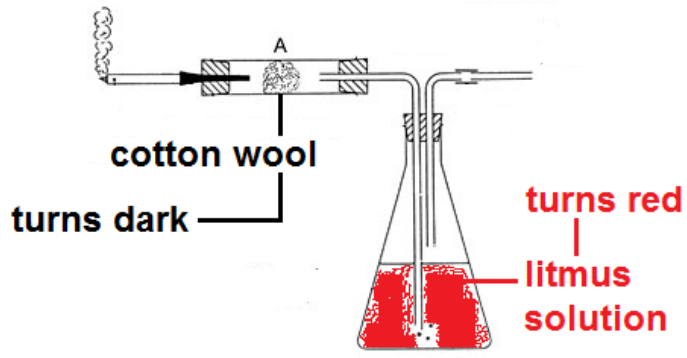
B. Penyakit Respiratori & Simptomnya

Penyakit	*Sebab*	*Gejala*
1. Asma - laluan udara makin sempit	Asap rokok, gas ekzos, pembakaran, habuk & debunga	Sesak nafas, batuk, semput
2. Bronkitis – radang pada bronkus	Tar asap rokok	Sesak nafas, batuk
3. Emfisema – alveolus rosak / mati	Asap rokok	Sesak nafas, sakit ketika bernafas, letih
4. Kanser peparu – barah pada tisu peparu	Karsinogen dalam asap rokok, gas berbahaya	Batuk berdarah, sakit ketika bernafas

C. Kesan Merokok pada Paru-paru

1. Merokok adalah berbahaya utk perokok &
perokok pasif = orang yang tidak merokok tetapi menyedut asap rokok

2. Eksperimen:



Pemerhatian	*Inferens*
Bulu kapas bertukar menjadi **gelap/perang**	Asap rokok mengandungi **tar** - tar menyebabkan barah
Penyelesaian litmus biru bertukar **merah**	Asap rokok adalah **berasid** - asid mengganggu saluran udara di dalam peparu

2.4 ADAPTASI DALAM SISTEM RESPIRATORI KATAK, IKAN, & SERANGGA

A. Katak

1. Selain peparu, katak guna **kulit luar yang lembap** sebagai tempat pertukaran gas

2. Penyesuaian kulit luar:

a. permukaan lembap
b. lapisan nipis
c. kaya dgn rangkaian kapilari darah di bawah kulit

3. Untuk mengekalkan kulit lembap, katak hidup berdekatan dgn sumber air

B. Ikan

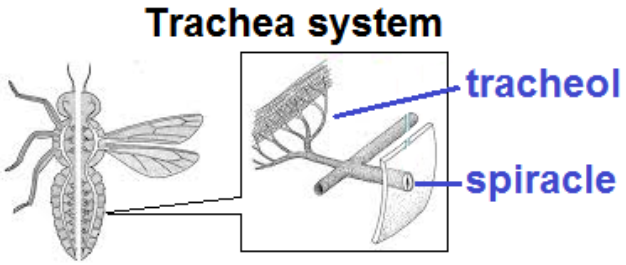
1. Guna insang - mengandungi **filamen & lamela:**

2. Penyesuaian insang:

a. Lapisan nipis
b. Bilangan filamen & lamela yg bnyk → utk meningkatkan luas permukaan
c. Lamela nipis dan kaya dengan rangkaian kapilari darah

C. Serangga

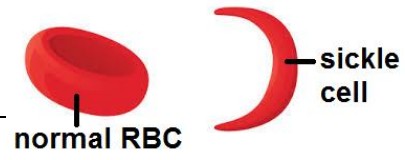
1. Guna **sistem trakea:**
- terdiri daripada **trakea dan trakeol** sebagai tiub laluan udara
- udara masuk melalui **spirakel** yang boleh dibuka/tutup menggunakan injap
- sesetengah serangga mempunyai kantung udara untuk mempercepat pengambilan udara



2. Penyesuaian sistem trakea:
a. Trakeol yg nipis & lembap
b. Trakeol yg banyak → meningkatkan luas permukaan untuk resapan gas

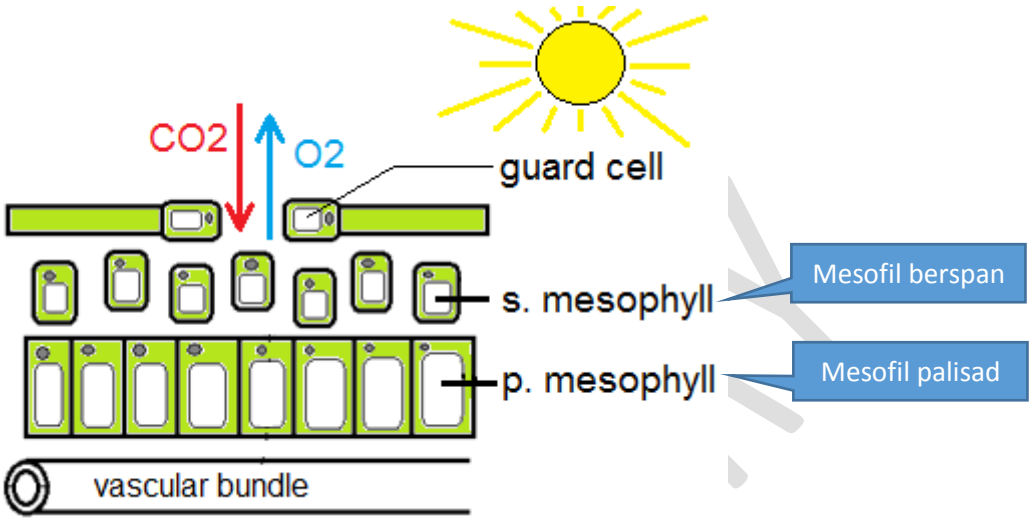
3. Gas meresap secara langsung dari sistem trakea ke dalam sel
- jadi, peredaran darah tidak diperlukan

2.5 KESAN SITUASI BERBEZA KPD SISTEM RESPIRASI MANUSIA

Keadaan	*Kesan*
Kawasan pergunungan (altitud tinggi) 	Altitud tinggi = oksigen rendah → kepekatan oksigen rendah dalam badan → rasa sesak nafas
Gaya hidup aktif 	Kadar ventilasi lebih tinggi = resapan gas lebih tinggi → kepekatan oksigen yang tinggi dalam badan → berasa bertenaga sepanjang hari
Pesakit anemia sel sabit 	RBC tidak normal = RBC bawa kurang oksigen dalam Hb → sel badan kurang mendapat oksigen → rasa kurang tenaga & sentiasa letih

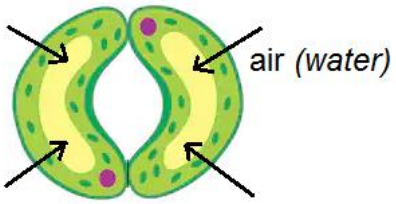
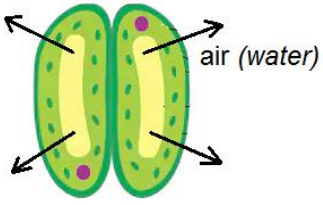
2.6 PERTUKARAN GAS DLM TUMBUHAN

A. Pertukaran Gas Dalam Tumbuhan Semasa Fotosintesis



1. Pada siang hari, **kadar fotosintesis lebih tinggi daripada respirasi** → stoma terbuka a. Lebih banyak gas O2 dihasilkan oleh sel daun (mesofil palisad & berspan) - jadi, sel daun mempunyai kepekatan O2 yang lebih tinggi - jadi, O2 meresap dari sel → ruang udara antara sel → stoma → atmosfera b. CO2 diperlukan oleh sel daun untuk fotosintesis - atmosfera mempunyai kepekatan CO2 yang lebih tinggi - jadi, CO2 meresap dari atmosfera → stoma → ruang udara → sel daun
2. Pada waktu malam, sel daun melakukan **respirasi sahaja** - pertukaran gas kurang berlaku kerana <u>stoma tertutup</u>

B. Mekanisme Pembukaan/ Penutupan Stoma

SIANG	*MALAM*
	

Fotosintesis berlaku → sel mempunyai banyak glukosa → sel menjadi lebih pekat	**Fotosintesis tidak berlaku** → sel mempunyai kurang glukosa → sel menjadi kurang pekat
Air meresap masuk → sel segah & melengkung → stoma terbuka → pertukaran gas berlaku lebih banyak	Air meresap keluar → sel kendur & lurus → stoma tertutup → pertukaran gas kurang

B. Kepentingan Persekitaran Tidak Bercemar kepada Tumbuhan

Keadaan	*Kesan*
1. Daun ditutup dengan habuk 	a. Sel daun kurang mendapat cahaya matahari→ kadar fotosintesis menurun → kurang gula → kurang makanan → tumbuhan mati
	b. Debu menutupi stoma→ pertukaran gas kurang cekap → sel kurang menerima gas: - kurang CO_2 → fotosintesis rendah → tumbuhan mati - kurang O_2 → pernafasan rendah → tumbuhan mati
2. Gas asid dari hujan asid 	a. asid menghakis→ bunuh sel daun → fotosintesis rendah → tumbuhan mati
	b. tanah menjadi berasid→ tanah berasid adalah kurang subur → tumbuhan mati

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