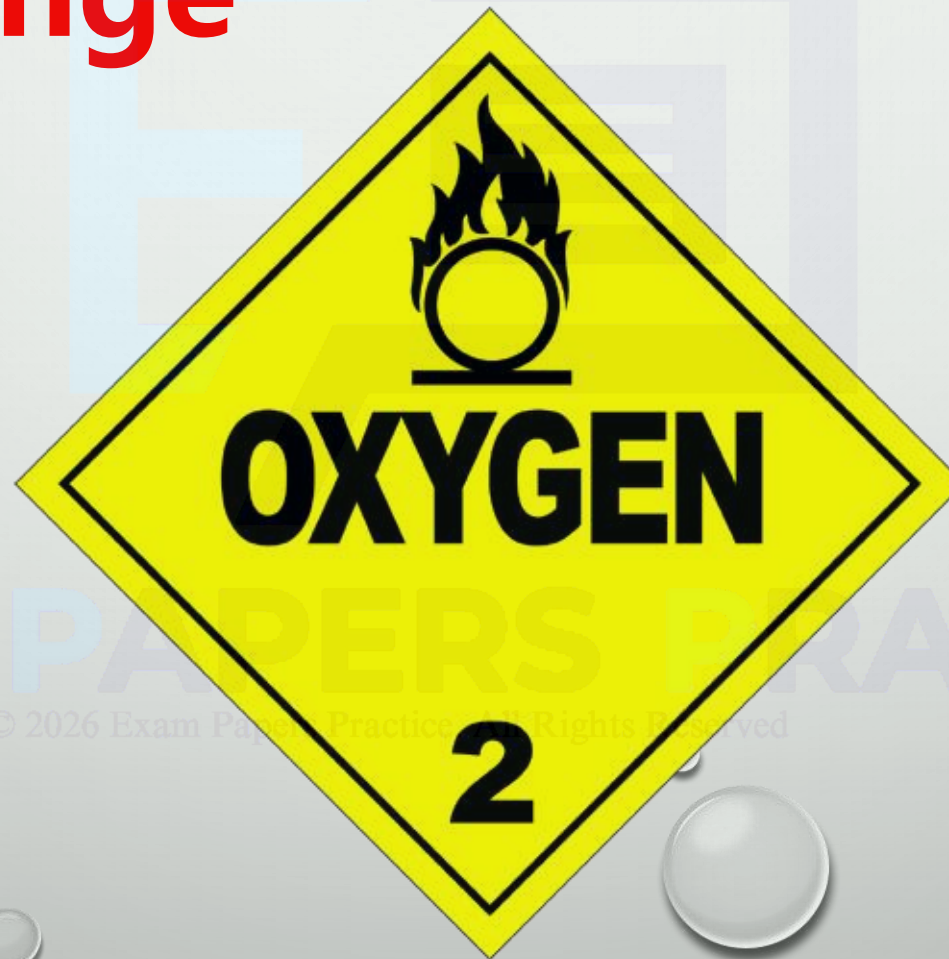


11 respiration and gas exchange



11 respiration and gas exchange

Living cells need energy for:

- ◆ contract muscles — movement
- ◆ making protein molecules
- ◆ cell division — repair damaged tissues and can grow
- ◆ active transport — move substances across cell membranes
- ◆ transmitting nerve impulse — transfer information
- ◆ produce heat inside the — keep the body temperature constant

EXAM PAPERS PRACTICE

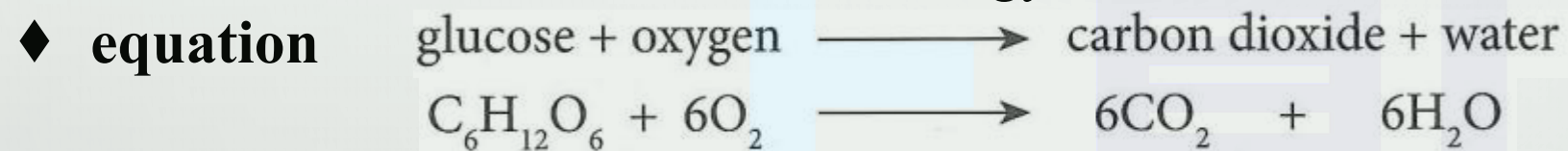
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11 respiration and gas exchange

respiration

aerobic respiration

◆ **definition:** the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy

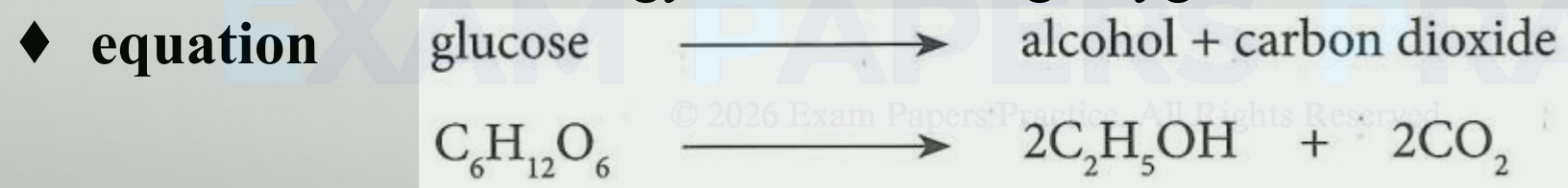


Respiration have a series of steps, each one controlled by **enzymes**.

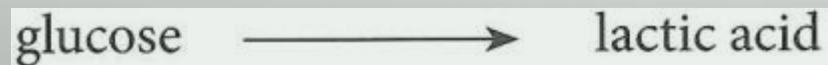
Most of the steps in aerobic respiration take place inside **mitochondria**

anaerobic respiration

◆ **definition:** the chemical reactions in cells that break down nutrient molecules to release energy, without using oxygen



Yeast, plants



muscle cells
(when doing vigorous exercise)

11 respiration and gas exchange

respiration

- comparisons of aerobic and anaerobic respiration

Aerobic respiration	Anaerobic respiration

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11 respiration and gas exchange

- Investigate the uptake of oxygen by respiring organisms, such as arthropods and germinating seeds.

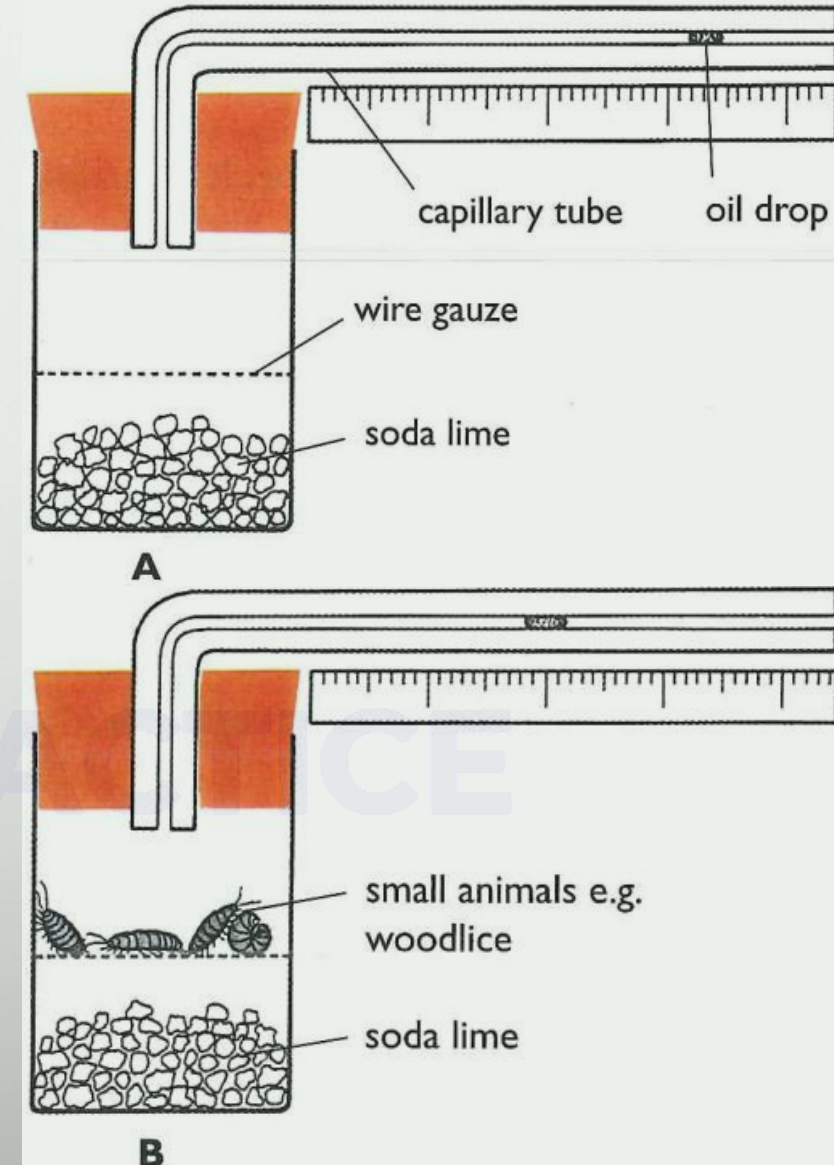
- 1 Set up both pieces of apparatus as shown in the diagrams. You could use any small living organisms, such as maggots (fly larvae) or germinating seeds, in apparatus B.

Make sure that the connections between the capillary tubes, rubber stoppers and the containers are completely airtight.

- 2 Dip the end of the capillary tube of each set of apparatus into oil. You should find that a small drop of oil goes into the capillary tube.
- 3 Record the initial position of the oil drop in each apparatus. Then continue to record this at regular intervals until you feel that you have enough readings.
- 4 Plot a line graph of your results for both sets of apparatus. Draw both lines on one set of axes.

maggot 蛆
larvae 幼虫
airtight 密闭的
gauze 网子
soda lime 碱石灰
rubber stopper 橡胶塞

respiration

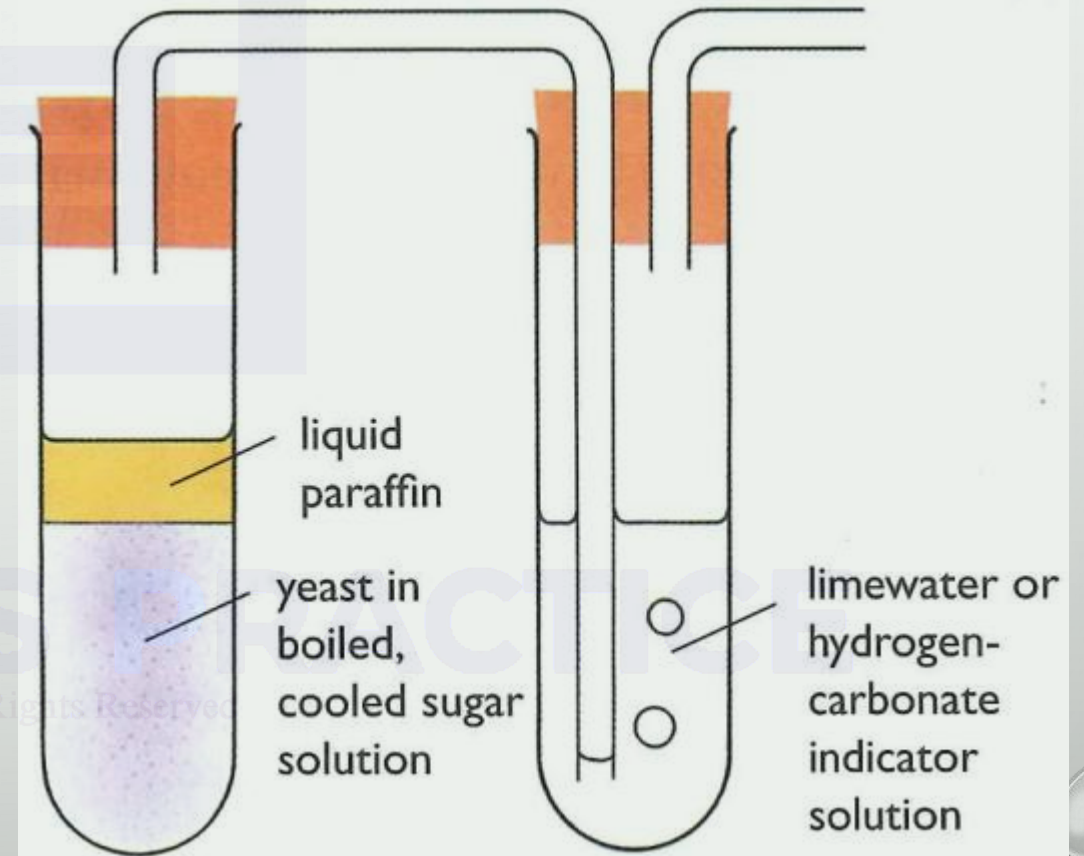


11 respiration and gas exchange

respiration

Investigate the production of carbon dioxide by anaerobic respiration

- 1 Boil some water, to drive off any dissolved air.
- 2 Dissolve a small amount of sugar in the boiled water, and allow it to cool.
- 3 When it is cool, add yeast and stir with a glass rod.
- 4 Set up the apparatus as in the diagram. Add the liquid paraffin by trickling it gently down the side of the tube, using a pipette.
- 5 Set up an identical piece of apparatus, but use boiled yeast instead of living yeast.
- 6 Leave your apparatus in a warm place.
- 7 Observe what happens to the limewater after half an hour.



limewater

hydrogen-carbonate indicator solution

pipette 滴管

glass rod 玻璃棒

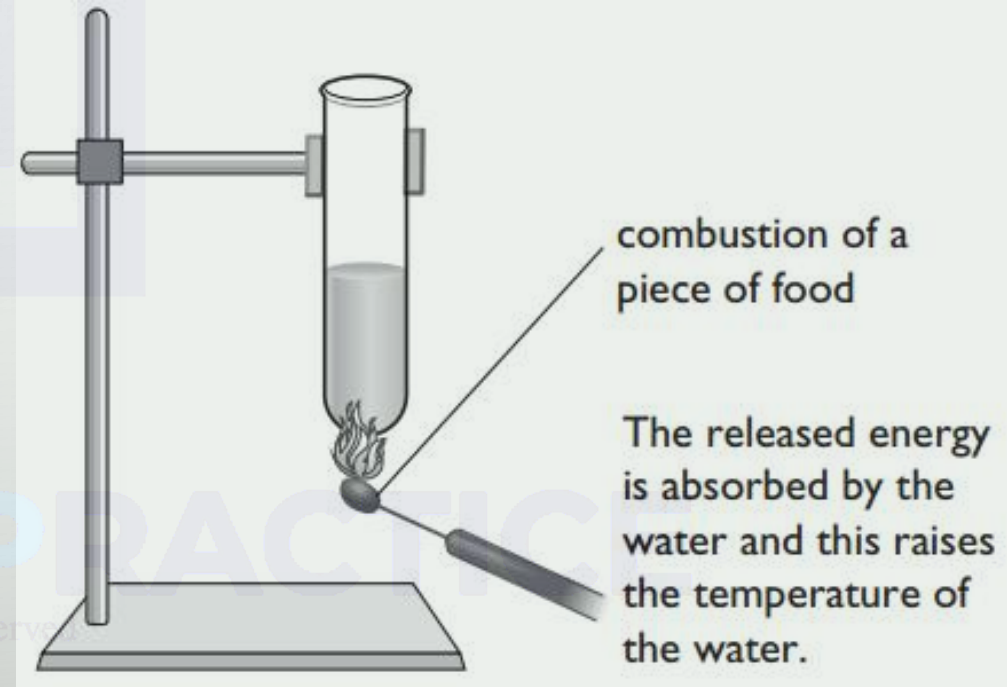
11 respiration and gas exchange

- Comparing the energy content of two kinds of food

Gas exchange surface

Safety

Wear eye protection if available



11 respiration and gas exchange

Gas exchange surface

The characteristics of surfaces for gas exchange

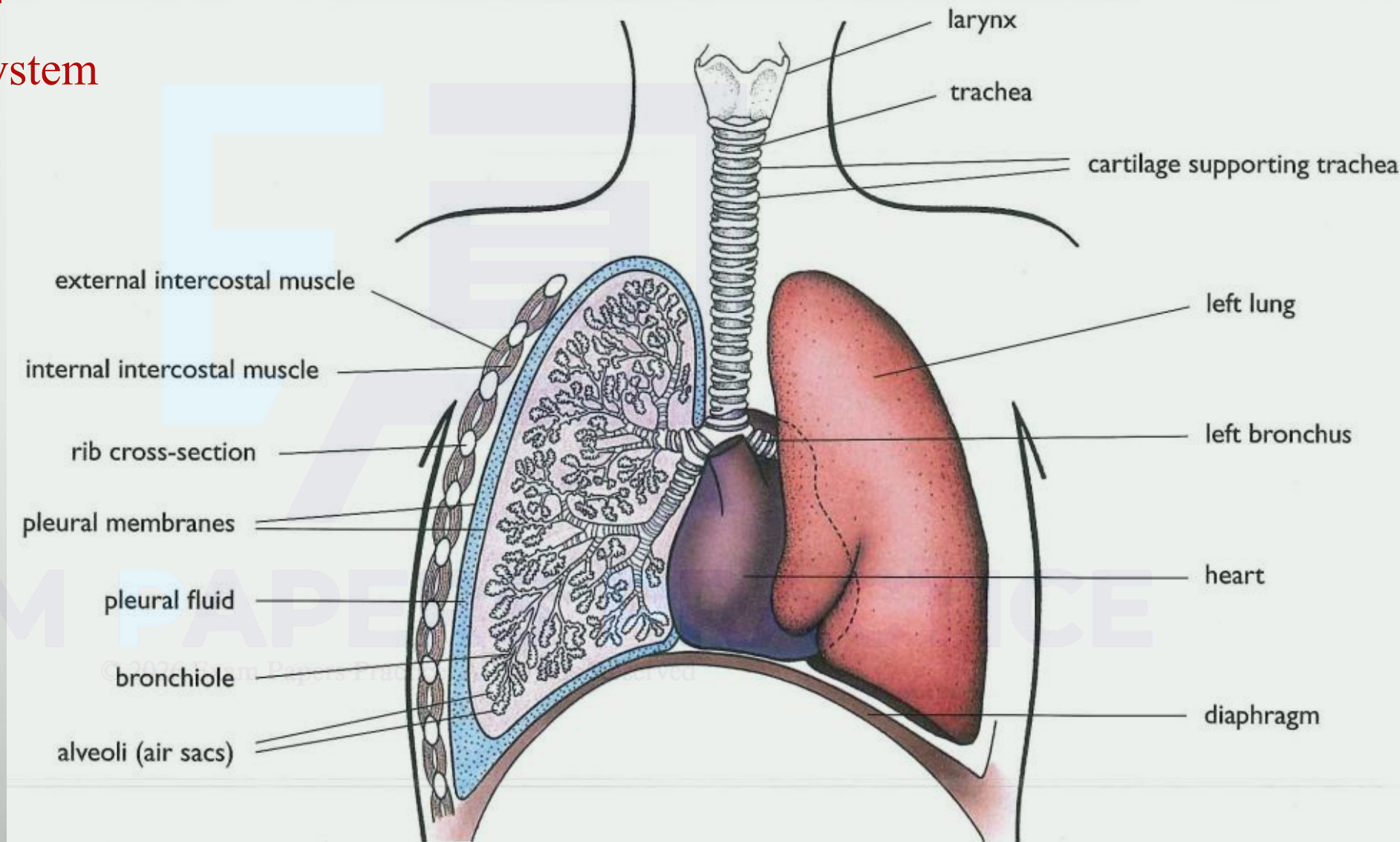
- ◆ permeable
- ◆ thin to allow gases to diffuse across them quickly
- ◆ close to an efficient transport system
- ◆ have a large surface area
- ◆ good supply of oxygen

11 respiration and gas exchange

Human breathing system

larynx 喉
trachea 气管
cartilage 软骨
lung
bronchus 支气管
diaphragm 膈
external intercostal muscle 肋间外肌
Internal intercostal muscle 肋间内肌
rib
pleural membrane 胸膜
pleural fluid 胸膜液
bronchiole 细支气管
alveoli (air sac) 肺泡

Human breathing system



11 respiration and gas exchange

which difficulties may appear during breathing?

11 respiration and gas exchange

Human breathing system

goblet cells

make a liquid containing water and mucus

→ moisten air in breathing pathway

→ mucus can trap particles of dust and pathogens

cilia (ciliated cell)

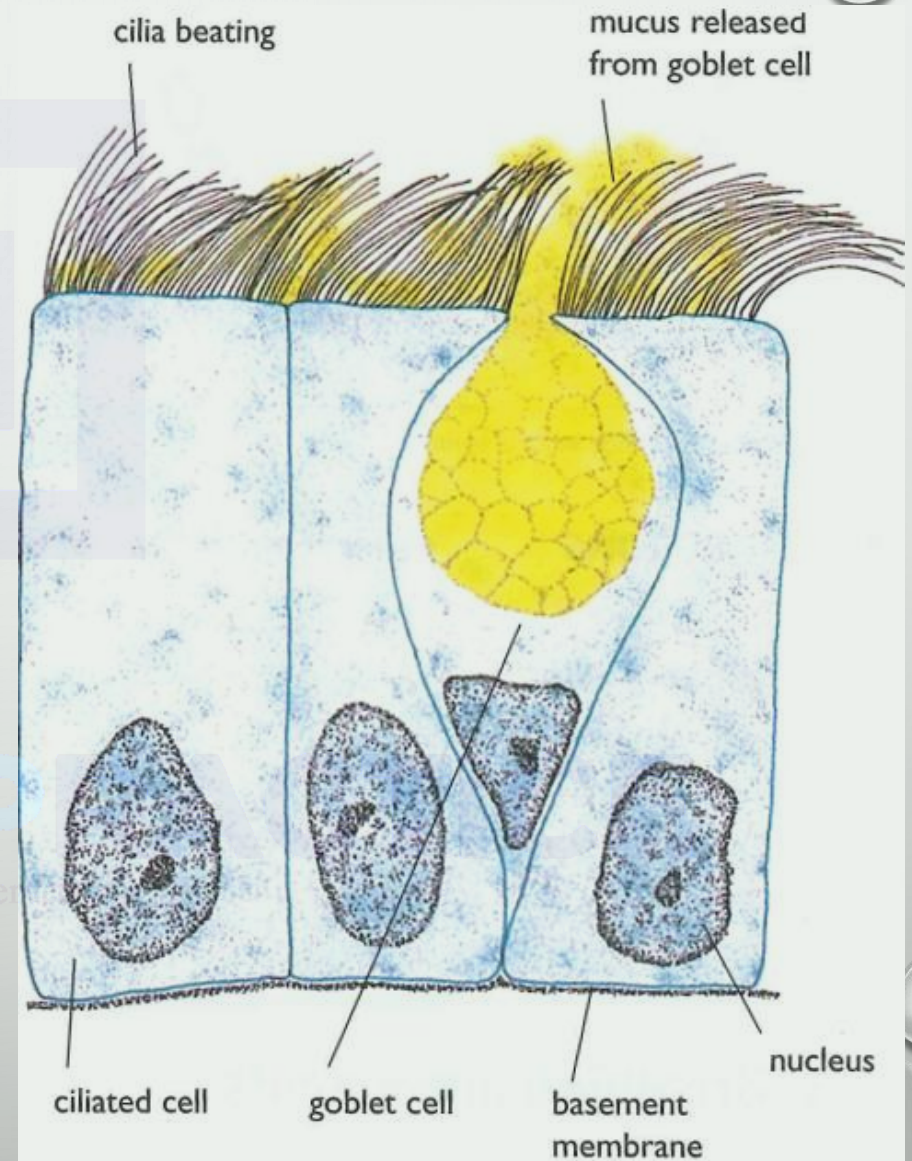
→ trap particles of dust and pathogens

→ waft the mucus, containing pathogens and dust, up to the back of the throat, so that it does not block up the lungs

goblet cell 杯状细胞

cilia 纤毛

ciliated cell 纤毛细胞

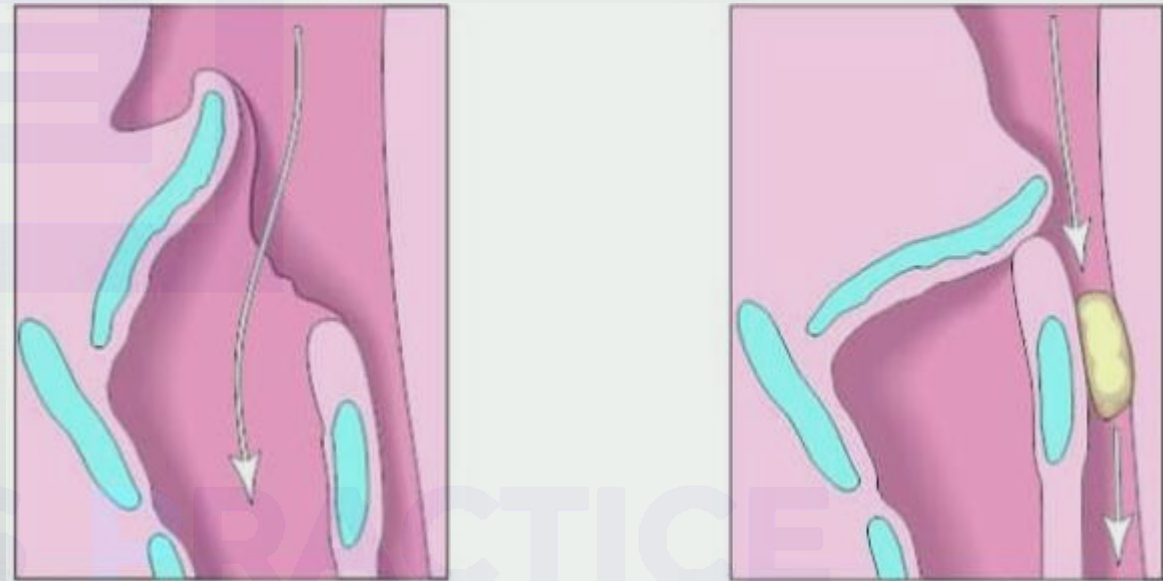


11 respiration and gas exchange

Human breathing system

trachea

epiglottis (cartilage): close the trachea and stops food going down the trachea when you swallow.



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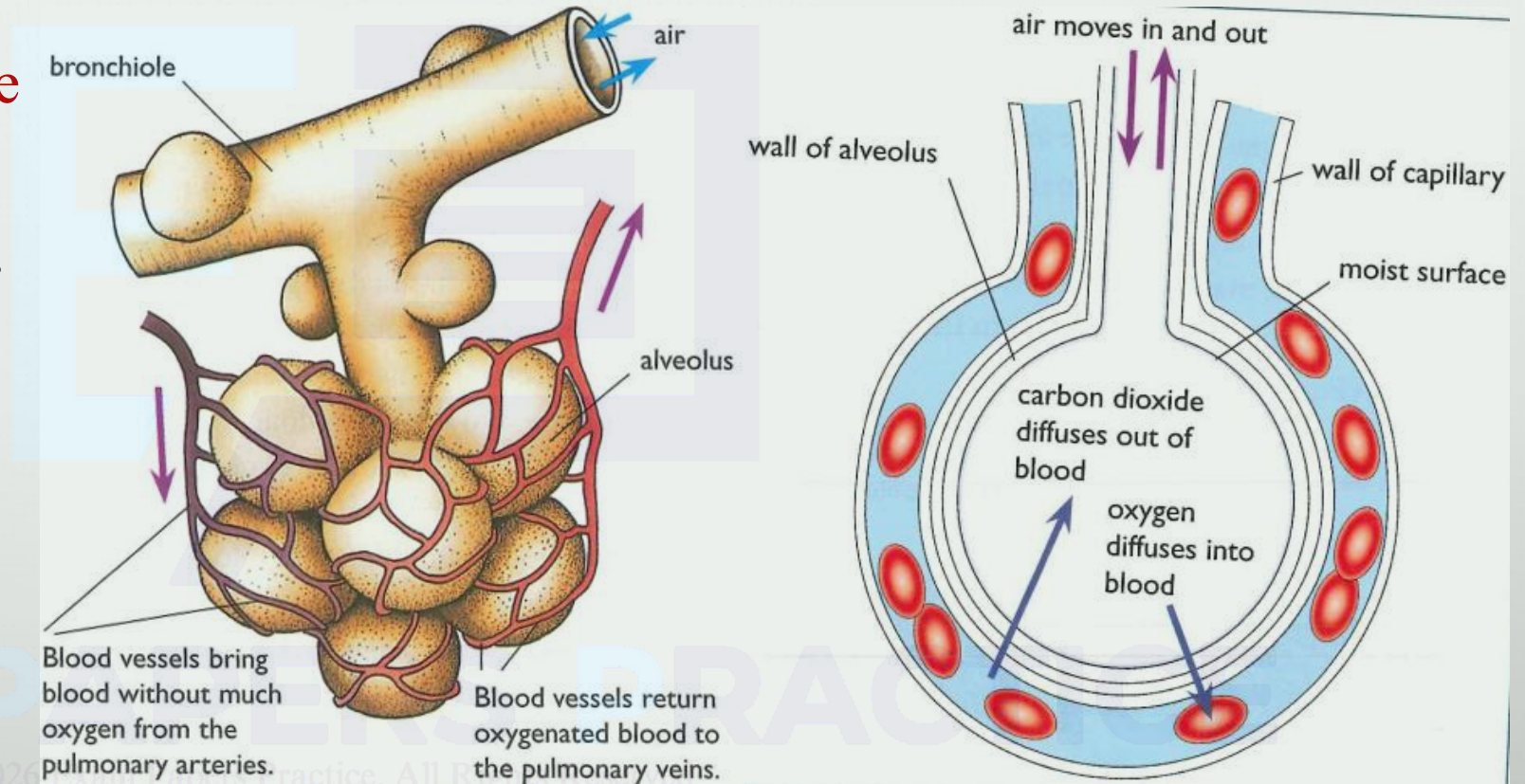
epiglottis 会厌

11 respiration and gas exchange

Human breathing system

Features of gas exchange surface

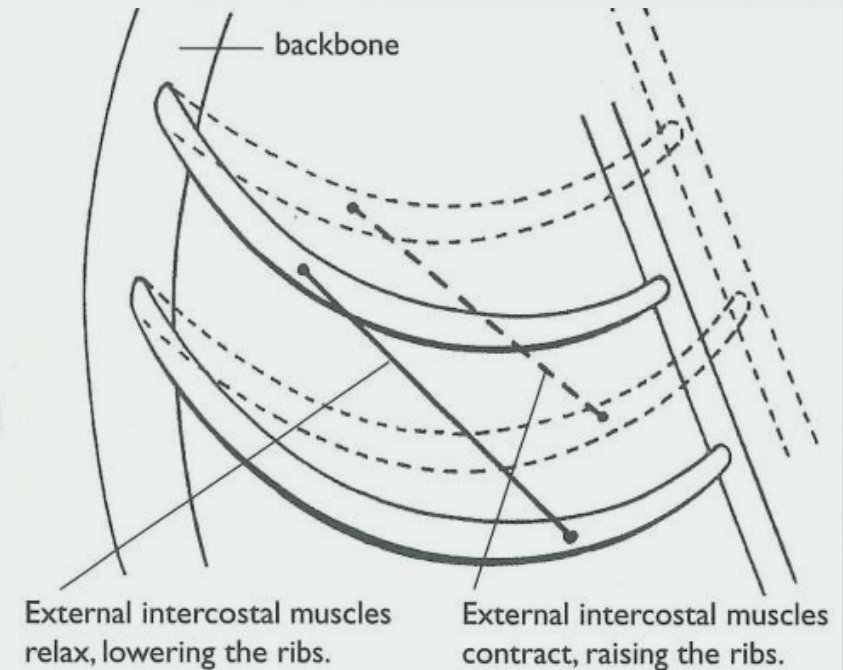
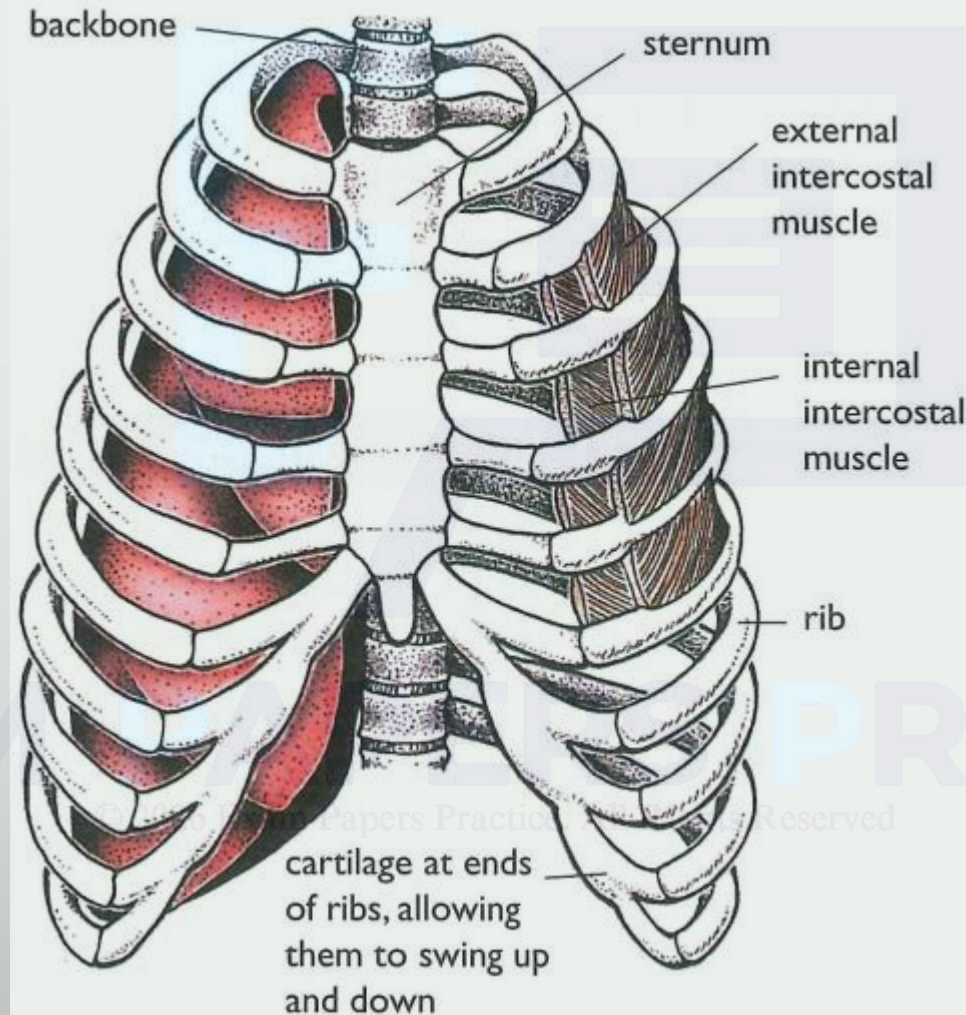
- ◆ permeable
- ◆ thin to allow gases to diffuse across them quickly
- ◆ close to an efficient transport system
- ◆ have a large surface area
- ◆ good supply of oxygen



11 respiration and gas exchange

breathing movements

backbone 脊柱
sternum 胸骨
rib 肋骨
External intercostal muscle 肋间外肌
Internal intercostal muscle 肋间内肌
diaphragm 隔膜

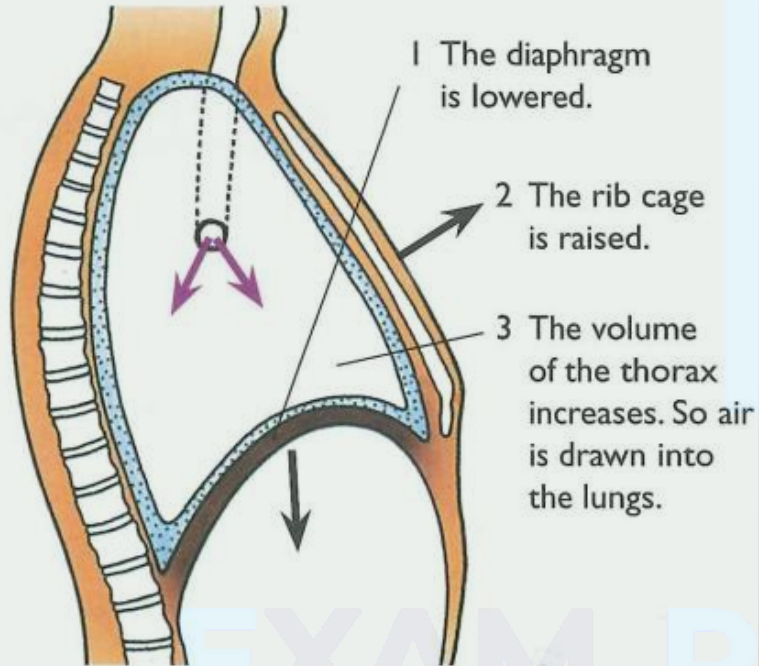


External intercostal muscles relax, lowering the ribs.
External intercostal muscles contract, raising the ribs.

11 respiration and gas exchange

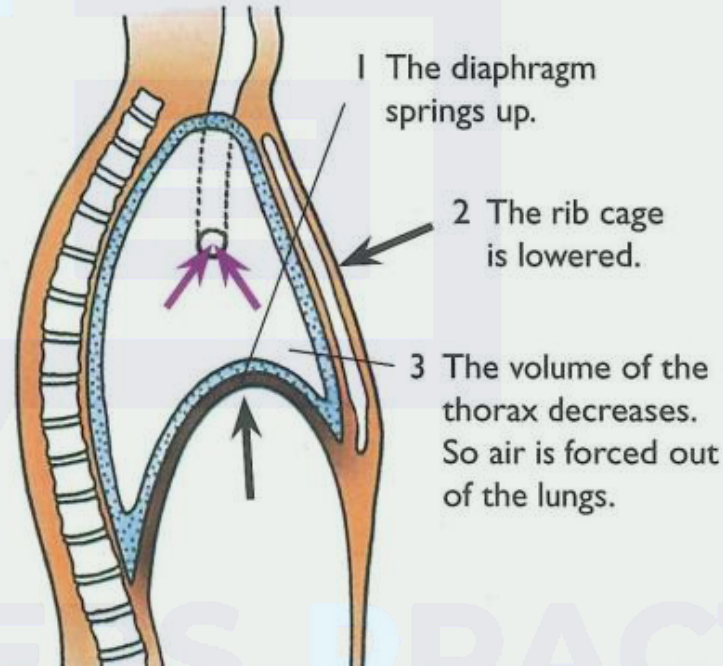
Breathing in (inspiration)

Inspiration



Breathing out (expiration)

Expiration



When breathe out forcefully, the internal muscles contract strongly, and abdomen wall also contract make the volume of rib cage smaller, help to squeeze extra air out of the thorax.

- *diaphragm contract (lower)
- *external intercostal muscle contract
→ rib cage is raised
- *The volume of the thorax increase
→ air is drawn into the lungs

- *diaphragm relax (spring up)
- *external intercostal muscle relax
→ the rib cage is lowerd
- *The volume of the thorax decrease
→ air is forced out of the lungs

11 respiration and gas exchange

Human breathing system

	Inspired air	Expired air	Reason for difference
Oxygen	21%	16%	Oxygen is absorbed across the gas exchange surface, then used by cells in respiration.
Carbon dioxide	0.04%	4%	Carbon dioxide is made inside respiring cells, and diffuses out across the gas exchange surface.
Water content (humidity)	variable	always high	Gas exchange surfaces are made of living cells, so must be kept moist; some of this moisture evaporates into the air.
Temperature	variable	always warm	Air is warmed as it passes through the respiratory passages.

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Inspired air 吸入气
expired air 呼出气

11 respiration and gas exchange

Exercise and breathing rate

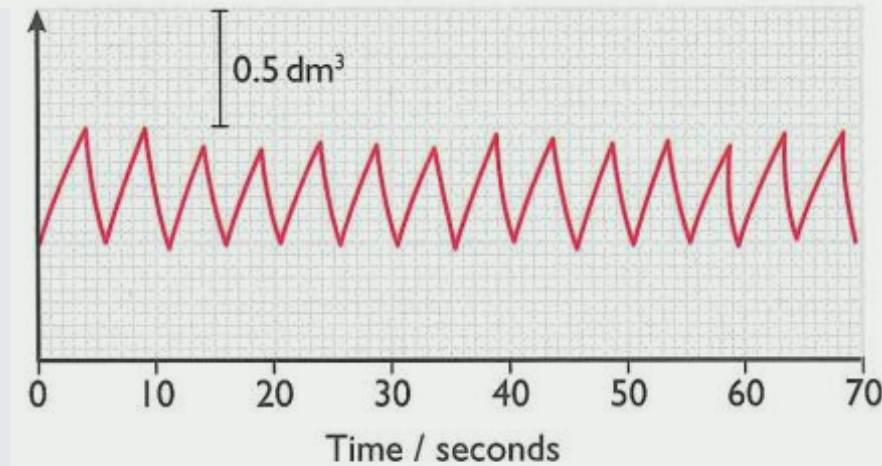
When doing exercise, muscle cells need more energy (respiration: glucose + oxygen)

Breathing deeper and faster to get more oxygen

Human breathing system

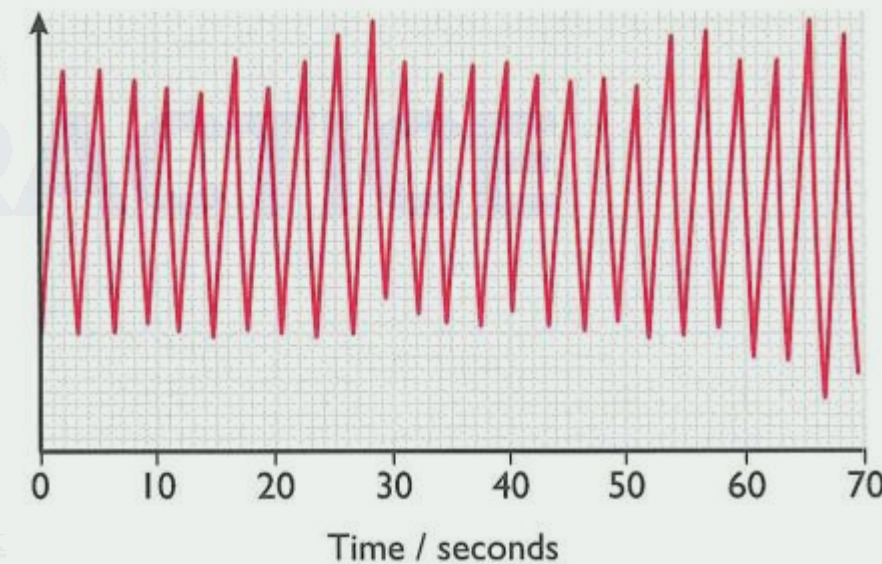
At rest

Volume



During exercise

Volume



11 respiration and gas exchange

Exercise and breathing rate

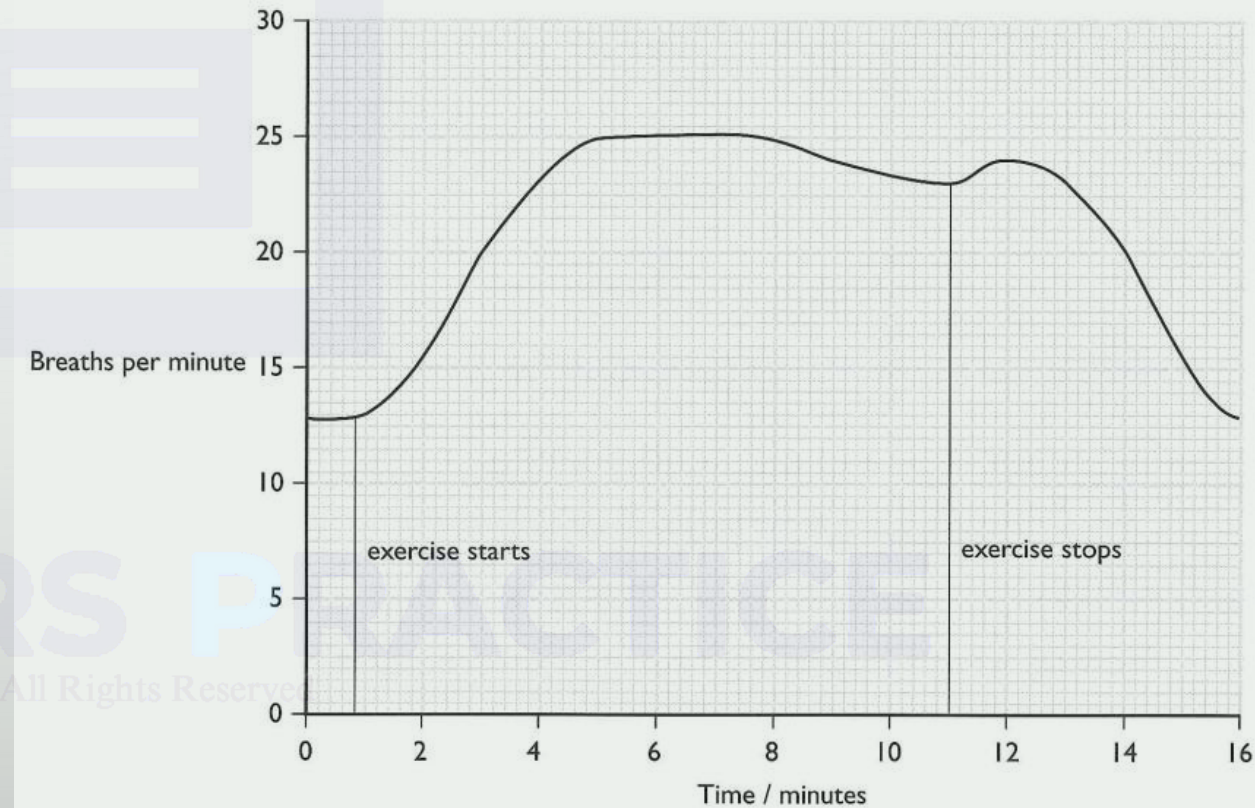
When the heart and lungs cannot supply oxygen more faster, extra energy can be produced by anaerobic respiration.



Lactic acid must be broken down by combining it with oxygen in the liver.
So after exercise, body need extra oxygen to break down the lactic acid in liver. so our body go on breathing faster and deeply.
The faster heart rate helps to transport lactic acids to the liver.

oxygen debt

Human breathing system



11 respiration and gas exchange

Exercise and breathing rate

When do exercise, more carbon dioxide or lactic acid produce

↓
The pH of blood will drop

↓
The brain monitors the change of pH of the blood

↓
The brain sends more nerve impulses to diaphragm and the intercostal muscles

↓
diaphragm and the intercostal muscles contract harder and more often

↓
The result is a faster breathing rate and deeper breaths

Human breathing system

