THE INSTITUTE OF EDUCATION

Biology

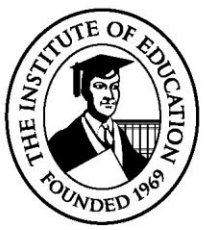
Mona Murray

Higher Level

ACADEMIC YEAR

Cell Structure

Breathing/ Gaseous Exchange



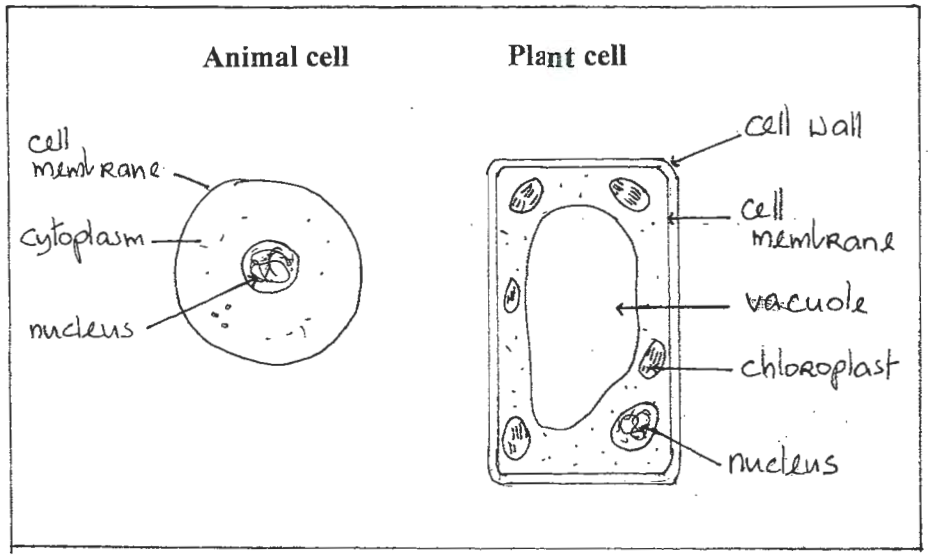
Cell structure

Mona Murray

The basic unit of structure and function in the living organism is the **cell.**

All cells have structures in common to carry out the basic life processes.

Structure of cells as seen with the light microscope

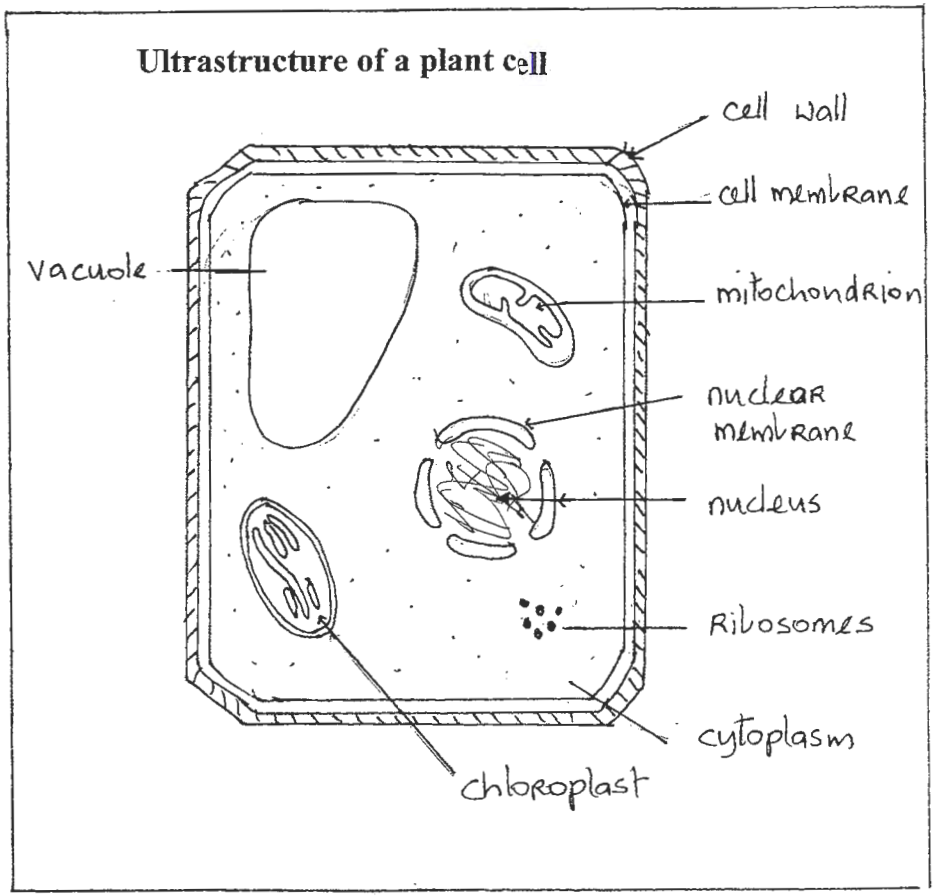


Differences between plant and animal cells

	Plant cell	Animal cell
1.	Cell wall (shape is rigid)	No cell wall (shape can change)
2.	Large vacuoles	Small vacuoles
3.	Chloroplasts	No chloroplasts

Cell ultrastructure

The structure of a cell as seen with the **electron microscope** is known as the **ultrastructure** (fine detail)



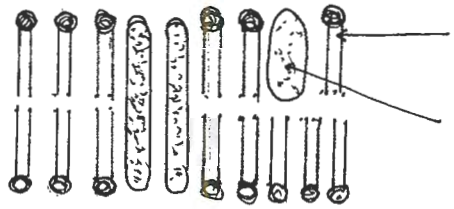
Structure of plant and animal cells

1. Cell membrane (or plasma membrane)

- a very thin **boundary** around the cell
- composed of phospholipids and proteins

(All membranes in cells have the same basic structure)

Structure of a section of cell membrane



Functions of the cell membrane

(i) retains the cell contents, viz. cytoplasm and the nucleus

(ii) acts as a **selectively – permeable barrier,** i.e. it allows some molecules to pass through and prevent others

(iii) contains **receptor sites** for matching molecules such as hormones

(iv) displays **antigens** (molecules that stimulate the formation of antibodies)

2. Cytoplasm – watery cell contents that surround the nucleus.

Functions:

(i) supports and separates the cell structures (organelles)

(ii) acts as a storage area, e.g. for food, salts

(iii) chemical reactions occur in it, e.g. _____

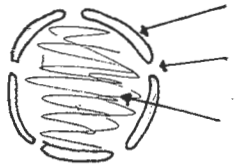
Cytosol = Liquid part of cytoplasm (cytoplasm without organelles)

3. Nucleus (the largest cell organelle)

- a spherical structure surrounded by the nuclear membrane
- contains the **chromosomes**

Chromosomes are composed of **DNA** and **protein**. They are only visible when a cell is dividing. Between divisions, chromosomes become uncoiled and form a tangled mass called **chromatin.**

(DNA = Deoxyribonucleic acid)



Functions of the nucleus

(i) - controls cell structure and function

(ii) - DNA replication and nuclear division

(iii) - controls the formation of mRNA (transcription)

Nuclear membrane

- a double lipo-protein membrane with **pores**

Functions

(i) - retains the nuclear contents

(ii) - has pores to allow materials in and out of the nucleus

4. Ribosome

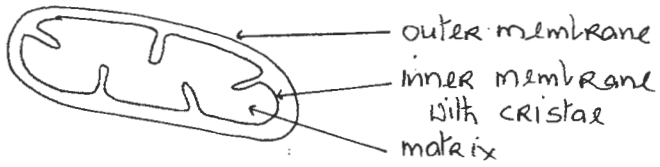
- very small cell organelle composed of **RNA** and protein

(RNA = Ribonucleic acid)

Function: Protein synthesis

Mitochondrion

- rod-shaped organelle with two lipo-protein membranes



Function: **Aerobic respiration** (Release of energy that needs oxygen)

The **number of mitochondria** in a cell relates to the energy requirements of that cell. Cells that need a lot of energy have a large number of mitochondria.

- **Examples of cells with a large number of mitochondria**

Animal :

Plant :

Structures found in plant cells only

6. Cell wall

- composed of **cellulose** (a carbohydrate)
- **fully permeable**

Functions of the cell wall

(i) to give **strength** and **support** to the cell and the whole plant

(ii) to **prevent plant cells from bursting** when water is taken in by osmosis (It allows the development of turgor.)

7. Large vacuole

- sac surrounded by a membrane / filled with fluid called **cell sap**

Functions

(i) stores water (this makes the cell turgid)

(ii) stores **food** (sugar, salt, protein, amino acids, etc.)

(iii) holds gases (O_2 , CO_2)

8. Chloroplast

- green, oval-shaped organelle that contains **chlorophyll.**

Function: **Photosynthesis** (- making food using sunlight energy)

Prokaryotic and Eukaryotic cells

Prokaryotic cells

- **don't have a nucleus** (They don't have a nuclear membrane.)
- don't have membrane- bound **organelles,** e.g. mitochondria, chloroplasts.

Prokaryotes belong to the **Kingdom Monera,** e.g. **Bacteria**

Eukaryotic cells

- **have a nucleus** (chromosomes are bounded by a nuclear membrane)
- have membrane- bound **organelles**

Eukaryotes belong to the following **Kingdoms:**

Protoctista, Fungi, Plant and Animal.

Prokaryotic cell	Eukaryotic cell
	

To examine cell structure

Cells were discovered by Robert Hooke in 1665. He used a simple glass lens to look at thin slices of cork. All organisms are made of cells.

Cell size

Cells are very small . They are measured in **micrometres.**

[1 µm = 10^{-3} mm]

e.g. Bacteria cell size = 1 – 10 µm

Plant and animal cell size = 10 – 100 µm

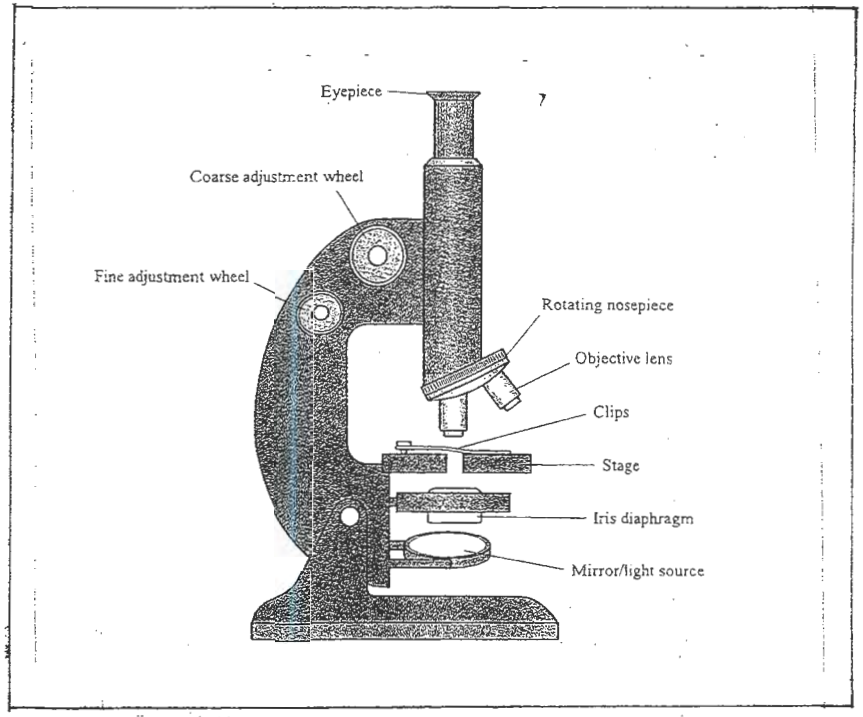
Cell structure is studied using the light and the electron microscope.

The light microscope

Parts of the light microscope

- Eyepiece - magnifies the object (x 10)
- Nose piece - holds the objective lens in place
- Objective lens - magnifies the object (low power lens - x 10; high power lens - x 40)
- Adjustment wheels - move the lens up or down to focus the object and produce a clear image
- Stage - place where the slide is put
- Iris diaphragm - adjusts the amount of light that passes through the slide
- Mirror / light bulb - illuminates the object

The Light Microscope



- **Visible** (white) **light** is passed upwards through the specimen (cells) and then through **2 glass lenses** (objective and eye piece).
- Lenses bend the light so that the image of the specimen is magnified when the eye sees it.
- **Total magnification** is got by multiplying the powers of the two lenses.

	Eye piece lens	x	Objective lens	=	Magnification
e.g.	10	x	40	=	400

Practical activity

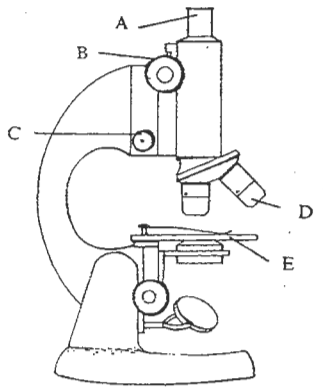
Be familiar with and use the light microscope

Procedure

1. Switch on the microscope lamp (light source).
2. Put the low power lens (x 10) into position over the stage.
3. Put a prepared microscope slide on the stage of the microscope.
4. Move the slide until the object is above the hole in the stage.
5. Look through the eyepiece.
6. Use the coarse adjustment wheel to focus the object.
7. Use the iris diaphragm to adjust the amount of light.
8. To increase the magnification, move the high power objective lens (x 40) over the specimen.
9. Use the fine adjustment wheel to bring the object into focus. (This must be done carefully as the lens is very close to the slide.)
10. Draw labelled diagrams of your observations under low power (L.P.) and high power (H.P.).

1. Match each of the parts labelled on the outline diagram of the microscope with one function listed below.

Function	*Label Letter*
Contains objective lens;	.....
Magnifies the image produced by the objective lens;	.....
Moves the barrel for coarse focusing of the specimen being viewed;	.....
Contains an opening to allow light pass through the specimen;	.....
Brings specimen slowly into fine focus.	.....



What is the purpose of the iris diaphragm?

.....

When viewing through an eyepiece marked × 10 and an objective lens marked × 40 what is the actual magnification?

.....

Prepare and examine one animal cell, unstained and stained, using the light microscope (x 100, x 400)

Procedure

(i) To prepare an unstained animal cell (cheek lining cell)

1. Swab the inside of the mouth with a disposable loop.
2. Transfer the sample of cheek lining cells on to a slide.
3. Cover the sample with a drop of water using a dropper.
4. Place a cover slip at an angle of 45° to the slide and lower it slowly. This helps to avoid trapping air bubbles.
5. Examine cells with the microscope under low and high power.
6. Draw labelled diagrams of what you see at x 100 and at x 400.

(ii) To prepare a stained animal cell

Carry out the above procedure placing the cheek lining cells in the stain **Methylene blue** on the slide.

Cheek lining cells

Q ? A cover slip is placed over the tissue on the slide. Give a reason for this.

_____

_____

Prepare and examine one plant cell, unstained and stained, using the light microscope (x100, x 400)

Procedure

(i) To prepare an unstained plant cell (onion epidermal cell)

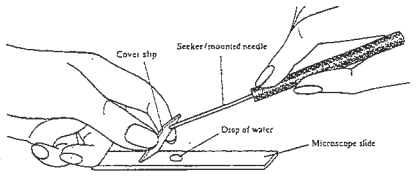
1. Place a drop of water on a slide using a dropper.
2. Peel off the inner epidermis of a small piece of onion leaf using a forceps.
3. Place the epidermis in the water on the slide.
4. Place the cover slip (at the edge of the water) at an angle of 45^{o}.
5. Lower the cover slip slowly over the slide.
6. Examine cells with the microscope under low and high power.
7. Draw labelled diagrams of what you see at x 100 and x 400.

(ii) To prepare a stained plant cell

Carry out the above procedure placing the onion epidermis in the stain **Iodine** on the slide.

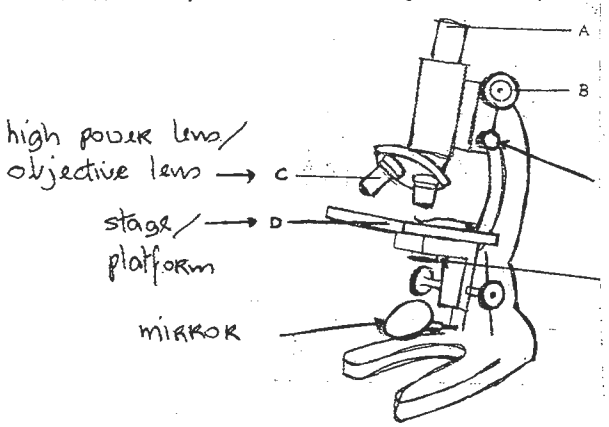
Onion epidermal cells

Application of a coverslip



L.C.H. 1989 Q. 15 (a)

15. (a) Name the parts labelled on the outline diagram of a microscope.



You are given some sections of plant tissue in a dish of water. Outline how you would prepare a temporary microscope slide of the sections for examination with the microscope.

Give the correct procedure for examinatioh of the sections under the high power.

Solution

To prepare a temporary microscope slide

1. Place a drop of water on the centre of a glass slide.
2. Place the tissue in the water on the slide using a paintbrush.
3. Place a cover - slip at an angle (of 45^{0}) and lower it slowly to exclude air bubbles.

To examine the sections under the high power

1. Switch on the microscope lamp.
2. Place the slide on the microscope stage.
3. Put the low power lens in position.
4. Focus under low power using the coarse adjustment wheel.
5. Put the high power lens in position.
6. Use the fine adjustment wheel to focus.
7. Adjust the light intensity using the iris diaphragm.

Label the parts of the light microscope

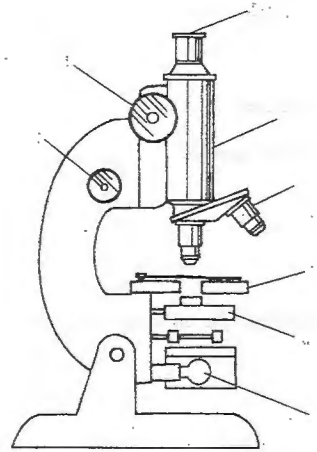


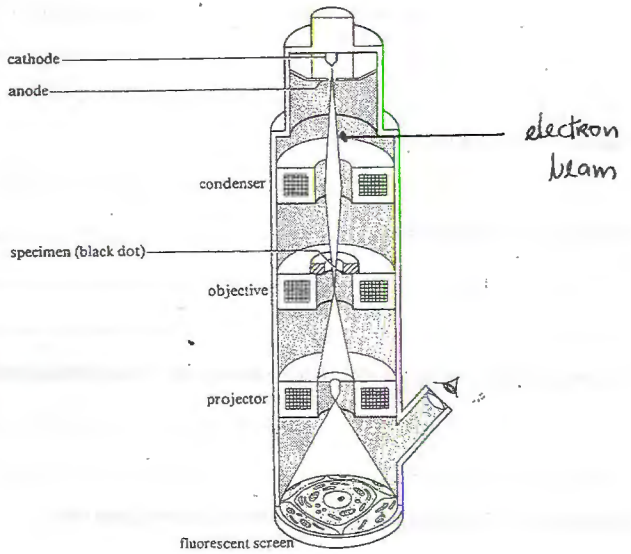
Fig. 12 The light microscope

The electron microscope

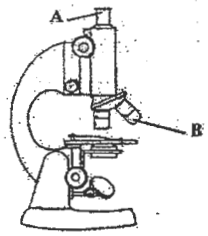
- In an electron microscope a beam of electrons is used instead of light.
- Electromagnets are used to focus the electrons instead of glass lenses.
- The magnified image is projected on to a screen or photographic film.
- A transmission electron microscope (TEM) shows the internal structure of a specimen in great detail.
- E.M. can magnify up to 250,000 times actual size.

The **cell structure as seen with the Electron Microscope is called the ultra structure.**

Pathway of the electron beam in the transmission electron microscope



L.C.O. 2004 Q 7. (30)



(a) Name the parts of the light microscope labelled A and B.

A .....

B .....

If the magnification of A is X 10 and the magnification of B is X 40, what magnification results when a slide is viewed using B?

.....

(b) Answer the following in relation to preparing a slide of stained plant cells and viewing them under the microscope.

(i) From what plant did you obtain the cells? .....

(ii) Describe how you obtained a thin piece of a sample of the cells.

.....

.....

.....

.....

What stain did you use for the cells on the slide?

.....

Describe how you applied this stain .....

.....

.....

What did you do before placing the slide with the stained cells on the microscope platform?

.....

.....

State **two** features of these cells that indicate that they are typical plant cells.

1. .....

2. .....

L.C.H 2006 Q 8.

(a) State a function of each of the following components of a cell.

(i) Ribosome.....

(ii) Cell membrane.....

(b) Answer the following questions in relation to the preparation, staining and microscopic observation of a slide of an animal cell.

(i) What type of animal cell did you use?.....

How did you obtain the cell? .....

.....

.....

(ii) Name the stain that you used .....

Describe how you applied the stain .....

.....

.....

.....

(iii) After staining, a cover slip is placed on the slide. Give a reason for this

.....

.....

(iv) How did you apply the cover slip?.....

.....

.....

.....

.....

Why did you apply it in this way?

.....

.....

.....

.....

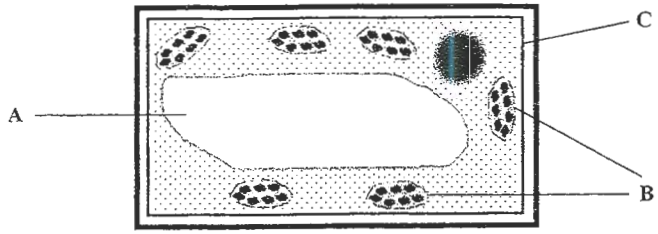
(v) Describe the difference in colour or depth of colour, if any, between the nucleus and cytoplasm when the stained cell was viewed under the microscope.

.....

.....

L.C.O. 2010

3. The diagram shows a cell.



(a) Is this a plant cell or an animal cell? _____

Give **two** reasons for the answer given above.

1. _____

2. _____

(b) Name the structures labelled A, B and C in the diagram.

A. _____

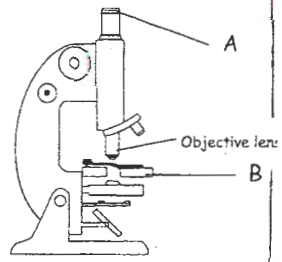
B. _____

C. _____

(c) Name a substance found in A. _____

L.C.O. 2011

9. (a) Name the parts of the light microscope labelled A and B.



A. _____

B. _____

(b) Answer the following questions in relation to obtaining and staining a sample of plant cells and viewing them under the microscope.

(i) From what plant did you obtain the cells?

_____

(ii) How did you obtain a thin piece of a sample of the cells **and** prepare it for examination?

_____

_____

_____

_____

(iii) What stain did you use on the cells?

_____

(iv) Describe how you applied the stain.

_____

_____

_____

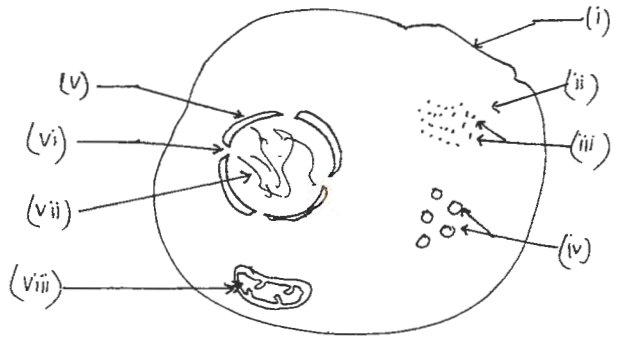
(v) The objective lenses on a microscope are usually labelled 40X, 10X, and 4X. Which objective lens should you begin with when using the microscope?

_____

(vi) Give **one** cell structure that you observed that indicated that the cells were plant cells.

_____

Animal Cell as seen with the Electron Microscope



1. **Label the parts of the diagram.**
2. **State the function(s) of each of the labelled parts.**

(i) _____

(ii) _____

(iii) _____

(iv) _____

(v) _____

(vi) _____

(vii) _____

(viii) _____

3. **Give two reasons why this is an animal cell.**

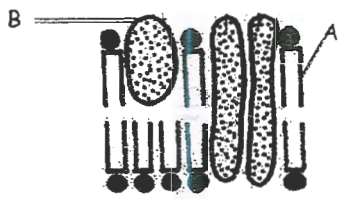
_____

_____

L.C.O. 2013.

13. (a) (i) Draw a labelled diagram of an animal cell as seen using a light microscope.
(ii) Name another type of microscope that gives greater detail than a light microscope. (9)

(b) The diagram below shows the ultrastructure of a section of cell membrane.



(i) Give **two** functions of the cell membrane.
(ii) Name the parts labelled A and B.
(iii) Which organelle is known as "the powerhouse of the cell"?
(iv) Why does the nucleus of a cell have many pores?
(v) List **two** differences between a plant cell and an animal cell.
(vi) What is the primary source of energy for plant cells? (27)

L.C.H. 1999

5. (a) (i) In the space provided draw a diagram to show the basic structure of a cell membrane.
Label **two** component parts in your diagram.

(ii) The cell membrane is said to be semi-permeable (selectively permeable). Explain this term.

.....

(iii) Name *two* processes that are involved in the passage of materials across cell membranes.

1 ..... 2 .....

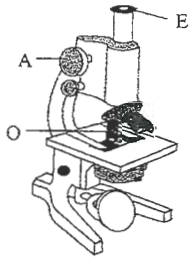
(b) One of the processes involved in the passage of materials across cell membranes requires energy released in the cell.

(i) Name an organelle in which this energy release takes place.....

(ii) Give *one* location in ~~an angiosperm~~ plant where cells possessing a large number of this organelle are found.....

L.C.H. 2014

8. (a) Answer the following questions with reference to the microscope.



(i) State the function of the part labelled A in the diagram.

_____

(ii) Lens E is marked 10× and lens O is marked 40×.
A cell is viewed through lenses E and O.
The image of the cell is 0.8 mm in diameter.
What is the actual diameter of the cell?

_____

(b) Answer the following questions in relation to the procedures that you followed when preparing animal cells for examination with a light microscope.

(i) Describe how you obtained a sample of cells.

_____

_____

(ii) What stain did you use on the sample?

_____

(iii) Outline how you used the coverslip.

_____

_____

(iv) Explain why a coverslip is used.

_____

(v) Describe how you examined the cells using the microscope.

_____

_____

_____

_____

_____

(vi) Draw a labelled diagram of the cells as seen at high magnification.

L.C.O. 2014

7. (a) (i) Why is a dicotyledonous (dicot) plant so called?

.....

(ii) Give **one** function of vascular tissue in plants.

.....

(b) Answer the following questions in relation to how you prepared and examined with a microscope a transverse section (T.S.) of a dicotyledonous stem.

(i) Name the plant that you used. .....

(ii) Why did you use a herbaceous (non-woody) stem rather than a woody one?

.....

(iii) Outline how you made the section of the stem **and** prepared it for examination.

.....

.....

.....

.....

(iv) Describe how you examined your section of stem with the microscope.

.....

.....

.....

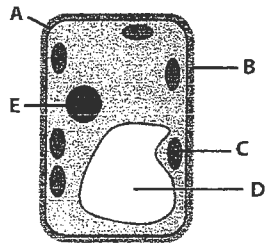
.....

(v) Draw a labelled diagram to best represent what was seen on your slide.
Label the following on your diagram: ground tissue, xylem, phloem.

L.C.O. 2015

14. Answer any **two** of (a), (b), (c). **(30, 30)**

(a) The diagram shows a cell.



(i) Name the parts labelled A, B, C and D in the diagram.
(ii) 1. Does the diagram shown above represent a plant cell or an animal cell?
2. Give a reason for your answer.
(iii) Name **one** substance usually found in part D.
(iv) Name the carbohydrate found in part B.
(v) Part A is said to be selectively permeable or semi-permeable. What does this mean?
(vi) Ribosomes are also found in cells. What is their function?

L.C.O. 2016

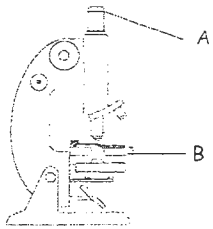
Section B

Answer any two questions.
Write your answers in the spaces provided.
Part (a) carries 6 marks and part (b) carries 24 marks in each question in this section.

7. (a) Name the parts of the light microscope labelled A and B.

A .....

B .....



(b) Answer the following questions in relation to obtaining and staining a sample of plant cells and viewing them under the microscope.

(i) From what plant did you obtain the cells?

.....

(ii) How did you prepare the slide of the plant cell sample for examination?

.....

.....

.....

.....

(iii) What stain did you use on the cells?

.....

(iv) How did you apply the stain?

.....

.....

(v) There are usually 3 objective lenses on a microscope – low, medium and high power. Which objective lens should you begin with when using the microscope?

.....

(vi) Give **one** cell structure that you observed that indicated that the cells were plant cells.

.....

Breathing / Gaseous Exchange

Mona Murray

The release of energy from food during cellular respiration requires O_2 and produces CO_2.

Food + O_2 ⟶ CO_2 + H_2O + energy

The physical process of taking in O_2 and releasing CO_2 is called **breathing.**

O_2 enters the body of an organism from the air or water surrounding it.

In plants, O_2 enters through the **stomata** of the leaves and stems.

Mammals have special respiratory organs called **lungs** for taking in O_2 and releasing CO_2.

The lungs are adapted for gas exchange by having the following features

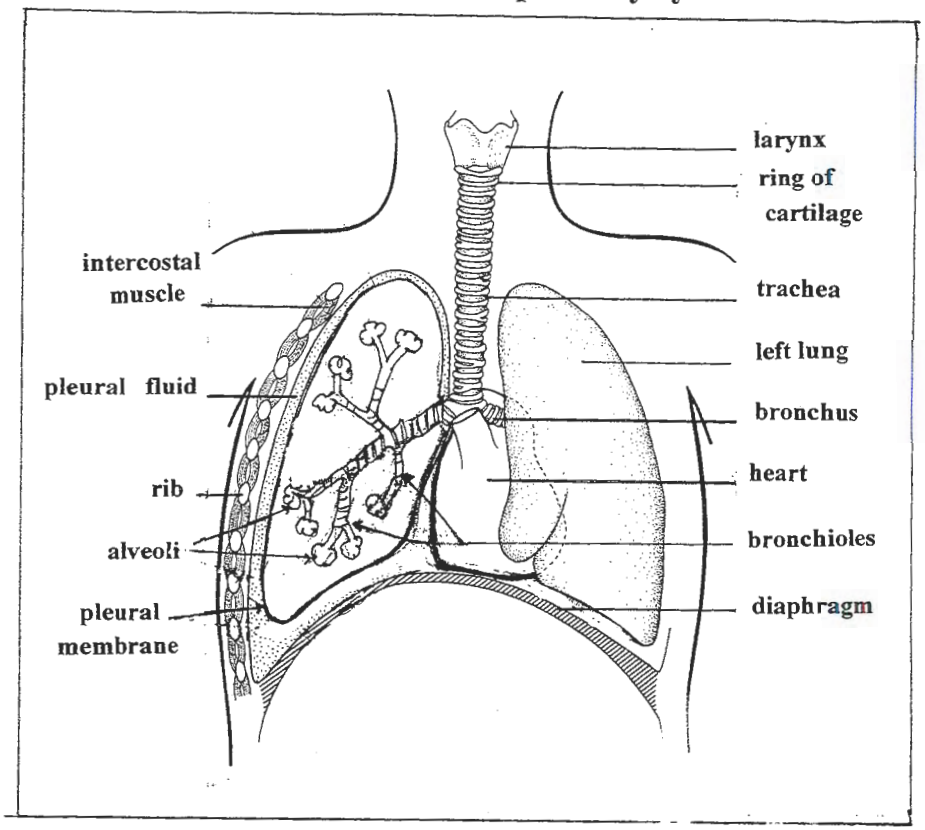
1. Large surface area (due to large number of alveoli)
2. Rich blood supply
3. Thin walls, freely permeable to gases
4. Moist absorbing surface

The Lungs

The lungs are large, spongy organs found in the **thoracic (chest) cavity.** This airtight cavity is protected by the **ribcage.** It is separated from the **abdominal cavity** by the **muscular diaphragm.**

The lungs are surrounded by the fluid-filled **pleural cavity** that is lined with **pleural membranes**. These membranes secrete **fluid** which lubricates the lungs and thorax, allowing **friction-free movement** of the lungs during breathing.

Structure of the human respiratory system



The Respiratory System

Air passes into the lungs via the **nasal passages, pharynx, trachea, bronchi** and **bronchioles.**

The **nasal passages** (the nose!) are lined with epithelium that has mucus-secreting cells and cilia (tiny hairs).

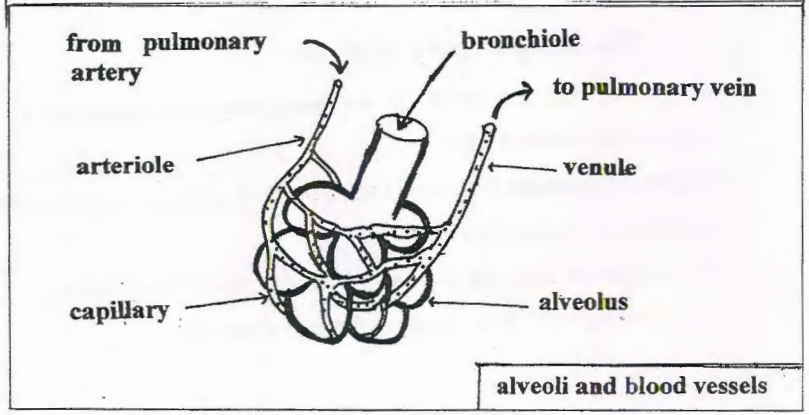
The mucus moistens the incoming air and traps dust and bacteria.

Air is heated to 37° C as it moves through these tubes.

- In the **pharynx** (throat), the **epiglottis** closes over the top of the trachea during swallowing. (This prevents food from going the wrong way !).
- The **larynx** or "voice box " at the top of the trachea, produces sounds.
- The **trachea** (wind pipe) is a muscular tube that divides to form two bronchi. (Each bronchus connects to a lung.) The **bronchi** divide to form thousands of **bronchioles**. All of these tubes have:
  - (i) Mucus - to trap dust and bacteria and moisten air.
  - (ii) Cilia - to move this mucus up to the top of the oesophagus where it is swallowed.
  - (iii) C-shaped rings of cartilage - to keep the tubes open when air pressure drops during breathing.
- Each bronchiole ends in many air-sacs called **alveoli**. The alveoli are the respiratory surface, where exchange of gases takes place.

Adaptations in the Alveoli for gas exchange

1. Thin walls (1 cell thick only) – fully permeable to gases.
2. Large surface area – good exchange of gases.
3. Moist lining – O_2 goes into the solution and diffuses in.
4. Large supply of blood capillaries – gases only have to diffuse a short distance.
5. Well ventilated – air is moved in and out quickly.



alveoli and blood vessels

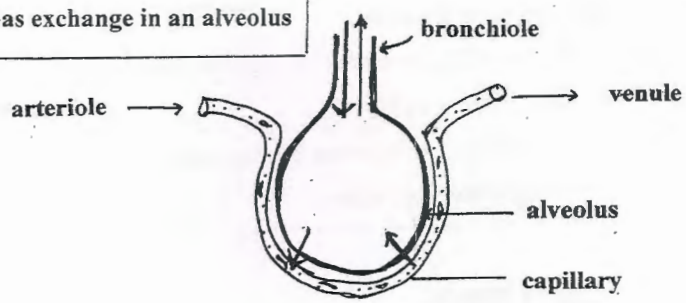
Gaseous exchange at the alveoli

The walls of the alveoli and capillaries both consist of a single layer of flattened epithelial cells that are in close contact.

This **thin barrier** allows **easy diffusion of gases** between the blood and air in the alveoli.

- The air coming into the alveoli has a higher concentration of O_2 than the blood in the capillaries. Therefore O_2 diffuses from the alveoli into the blood. In the blood it combines with Haemoglobin to form Oxyhaemoglobin.
- Blood coming to the alveoli has a higher concentration of CO_2 than alveolar air. Therefore CO_2 diffuses from the blood into the alveoli.

Gas exchange in an alveolus



Composition of Gases in Breathed Air

	Inhaled Air	Exhaled Air
O_2	21 %	16 %
CO_2	0.03 %	4 %
H_2O vapour	1.3 %	6.2 %
N_2	79 %	75 %

Mechanism of Breathing

The exchange of air in the lungs is brought about by **muscular** movements of the thorax (chest) that change its volume. The thorax is an air-tight cavity enclosed by the ribs, intercostal muscles and diaphragm. The lungs are soft, elastic structures that expand and collapse within the chest cavity.

Breathing consists of two phases:

- Inhalation and Exhalation

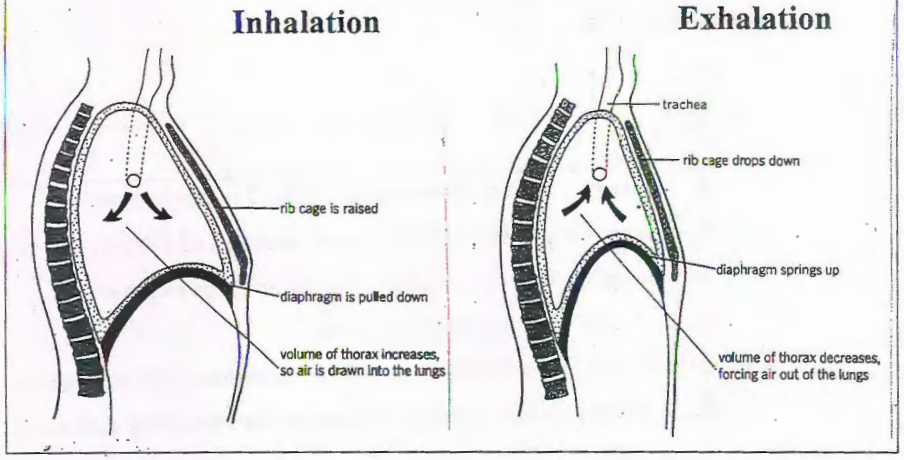
Inhalation – the **active** phase because it involves muscle contraction

1. The intercostal muscles contract and move the rib-cage up and out.
2. The diaphragm contracts and flattens.
3. The volume of the thorax increases (and the lungs expand.)
4. The pressure in the thorax decreases below that of the atmosphere .
5. Air flows into the lungs.

Exhalation – the passive phase

1. Intercostal muscles relax, so that the rib-cage goes down and in.
2. The diaphragm relaxes and becomes dome-shaped.
3. The volume of the thorax decreases (and the lungs deflate).
4. The air pressure in the thorax increases above that of the atmosphere.
5. Air is forced out of the lungs.

Changes in the thorax during breathing



Control of Breathing

Normal breathing movements (**~16 breaths per minute**) are reflex actions. These are under the control of cells in the **medulla oblongata** at the base of the brain = (the respiratory centre)

- **The rate of breathing is controlled by the level of CO_2 in the blood.**

When the CO_2 level in blood increases, the brain sends nerve impulses to the intercostal muscles and diaphragm. This causes the **rate** and **depth of breathing to increase.**

The rate of breathing is most likely to increase during vigorous **exercise.** The faster rate of breathing helps to expel the extra CO_2 and increase the amount of O_2 taken into the blood.

Practical activity

Investigate the effect of exercise on the breathing rate of a human

Procedure

1. Sit **down** comfortably on a chair. Take 5 minutes to settle.
2. **Count the number of breaths per minute and record.**
3. **Repeat** step 2 twice and calculate the **average number .**
4. This is **the resting breathing rate.**
5. Stand up. Immediately **measure the breathing rate** and **record**
6. **Walk gently** for 5 minutes . **Measure the breathing rate** and **record.**
7. **Walk briskly** for 5 minutes. **Measure the breathing rate** and **record.**
8. **Run** for 5 minutes. **Measure the breathing rate** and **record.**
9. Allow the breathing rate to return to resting rate before each exercise
10. **Compare** the breathing rates after the different levels of exercise.
11. Draw a **bar chart** to show the results

Activity	Standing	Gentle walking	Brisk walking	Running
Breathing rate (breath / min)				

Conclusion / Comment:

Breathing disorder

Asthma

Symptoms: Shortness of breath
Noisy, wheezy breathing
Tightness in the chest
Coughing

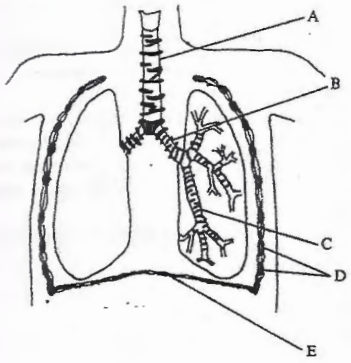
Causes: Inhalation of substances that act as **allergens** such as pollen, feathers, dust, moulds , etc.
Infection in the respiratory system
Stress

Any of the above may cause an **asthma attack** where the bronchioles become narrow and inflamed and the flow of air is obstructed.

Prevention : Avoid the allergens that cause an attack
Avoid colds and chest infections

Treatment: Inhaling drugs to dilate (widen) the bronchioles

13. *(a)* The diagram shows the breathing apparatus in the human.
Name the parts labelled A,B,C,D,E.



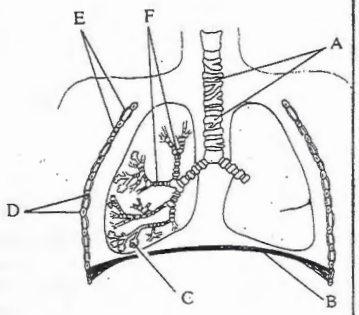
9. (*a*) The diagram shows the breathing apparatus in the human.

(i) Name the parts labelled A, B, C, D, E, F.

(ii) What is the function of the bands of cartilage on part A.

(iii) Outline how parts B, D and E function during the inspiration of air.

(iv) The parts labelled C have a large supply of blood capillaries on one side and a thin film of moisture on the other side.
How do these two features enable C to function?
(48)



L.C.H. 1987

6. The table refers to the approximate composition of air breathed in to the lungs and breathed out again by a mammal.

Name of gas	Air breathed in	Air breathed out
Oxygen	20.7%	
	78%	
Water Vapour		6.2%
		3.8%

Insert on the table the names of the other two gases involved.

Place the following percentages in the appropriate column on the table: 75.5%, 0.03%, 1.3%, 14.6%.

Name the structures which enlarge the surface area of the lungs .....

State the reason why a large surface area is necessary .....

.....

L.C.H. 1996

10. (i) Give a large labelled outline diagram to show the contents of the thoracic cavity of a mammal. (21)

(ii) Give a labelled diagram of an alveolus from a lung together with its blood supply.

Outline how inhalation and exhalation occur during normal breathing (diagrams not required). (28)

(iii) Describe an experiment which you would carry out to determine the relationship between exercise level and the rate of breathing and comment briefly on the results you would expect. (21)

L.C.H. 1998.

(iv) Name *two* muscles which are involved in breathing.

(v) State why exhalation does not require nervous control.

(vi) List *four* differences between inspired and expired air.

(vii) ~~Give one other lung volume, besides the residual volume, which is fixed and not variable for an individual.~~ (45)

L.C.H. 1999. Q.11

(b) (i) Draw a large labelled diagram of the human respiratory system (excluding the rib cage and associated muscles).

(ii) Insert the letters X, Y, Z on the diagram to show, in each case, a region where

- gaseous exchange takes place (X);
- cilia are located (Y);
- cartilage is found (Z). (19)

(c) The length of time that it takes a person's heart rate to return from the highest rate resulting from a period of exercise to the normal resting rate is called recovery time.

(i) Suggest a relationship between recovery time and a person's degree of physical fitness.

(ii) ~~Devise a simple experiment to measure recovery time.~~ (18)

L.C.H 2003.

6. (a) State the precise location of the diaphragm in the human body. .....

.....

(b) Of what type of muscle is the diaphragm composed? .....

(c) Does the diaphragm rise or lower during exhalation? .....

(d) Name another muscle that is involved in exhalation. .....

(e) ~~What term is used to describe the volume of air exchanged during a breath of an individual at rest~~?

.....

(f) Give two differences between inhaled and exhaled air other than in their gaseous contents.

.....

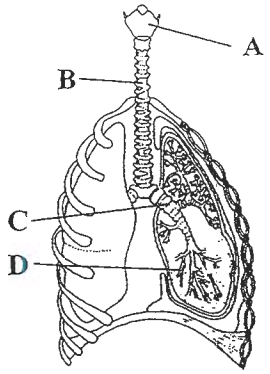
.....

L.C.O. 2005.

12. (a) (i) Name the major blood vessels that carry blood
1. from the heart to the lungs
2. from the lungs to the heart.

(ii) What gas is released from the blood when it reaches the lungs? **(9)**

(b) The diagram shows part of the human breathing system.



(i) Name A, B, C, D.
(ii) D ends in a small sac. What is the name of this sac?
(iii) What is the function of A?
(iv) B contains rings of cartilage. Suggest a function of this cartilage.
(v) Where is the epiglottis? What is its function? **(27)**

(c) (i) Name the muscles that are used in breathing.
(ii) Breathing causes pressure changes in the thoracic cavity. Describe briefly how these pressure changes are brought about.
(iii) Name a breathing disorder. Give a possible cause of this disorder and suggest a means of prevention or treatment. **(24)**

L.C.H. 2007.

13. (a) (i) Name the blood vessel that returns blood to the heart from the lungs.
(ii) Name the main gas transported in the blood vessel that you have named in (i).
How is this gas transported? **(9)**

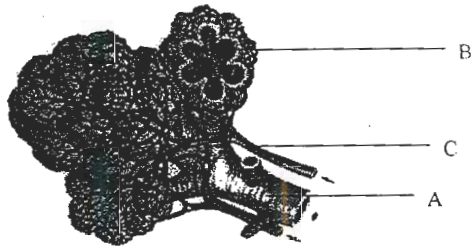
(b) (i) Draw a large diagram of the human breathing system. Label the trachea, bronchus and lung.
(ii) State the function of the following: epiglottis, larynx.
(iii) Describe briefly the role of the diaphragm and intercostal muscles in inhalation.
In your answer refer to volume and thoracic air pressure. **(27)**

(c) (i) Give **three** ways in which an alveolus is adapted for efficient gas exchange.
(ii) Name the process involved in the passage of gas between the alveolus and the blood.
(iii) Name a breathing disorder.
(iv) In the case of the breathing disorder that you have named in (iii) state:
1. a cause,
2. a means of prevention,
3. a treatment. **(24)**

L.C.O. 2008 Q 14

(c) (i) Draw a large labelled diagram of the human breathing tract and label the following parts; larynx, trachea, bronchus, bronchiole.
(ii) What is the role of alveoli in the lungs?
(iii) Name a breathing disorder.
(iv) Suggest a possible cause of the breathing disorder that you have named in (iii) and state how it may be treated.

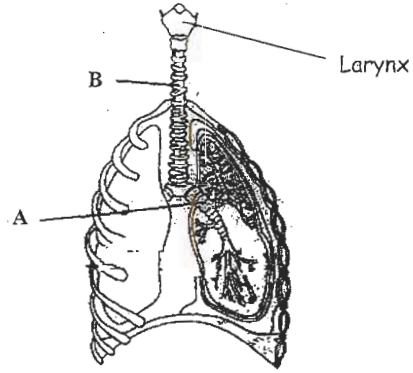
L.C.H. Q 13 (c). 2009



The diagram shows microscopic detail from a human lung.
(i) Name the parts labelled A, B and C.
(ii) Give **two** features of the structures in the diagram that allow for efficient gas exchange.
(iii) Name a disorder of the breathing system and say how it may be:
1. Caused.
2. Prevented.
3. Treated.
(iv) Which gas, dissolved in the blood, can trigger deeper or faster breathing? **(24)**

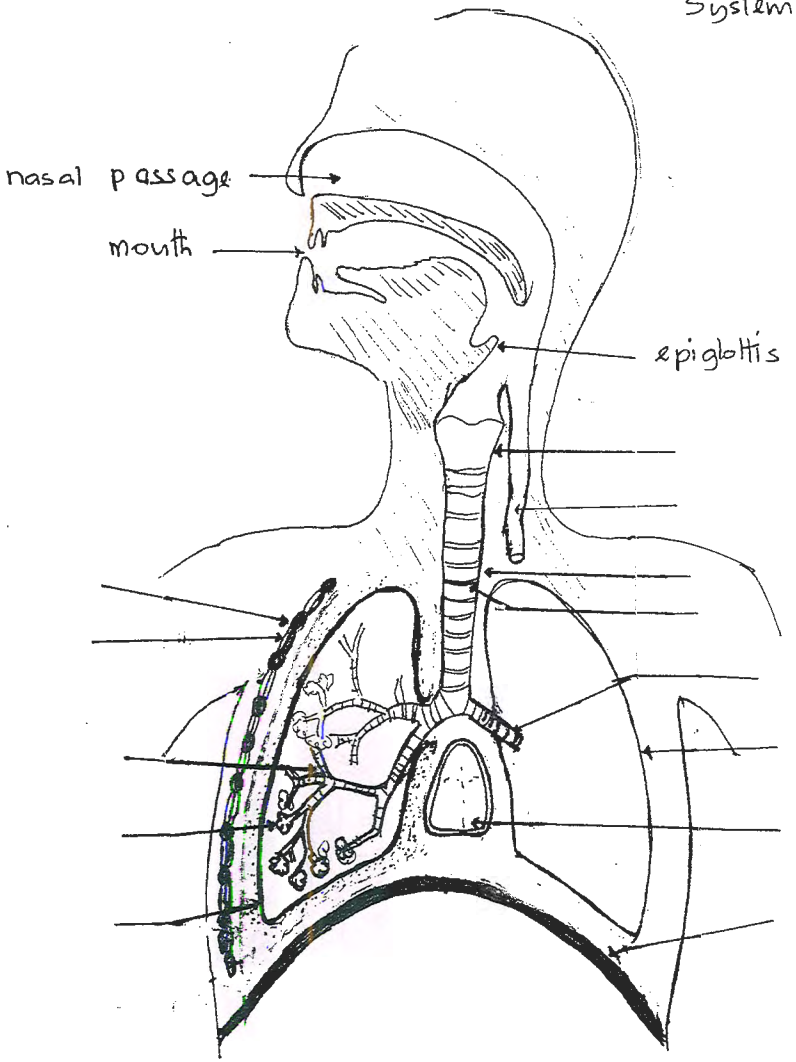
L.C.O. 2011 Q 12

(c) The diagram shows part of the human breathing system.



(i) Name the parts labelled A and B.
(ii) In what structures in the lungs does gaseous exchange take place?
(iii) Give **one** feature of the structures referred to in (ii) that allows efficient exchange of gases.
(iv) What is the function of the larynx?
(v) Outline the steps involved in inhalation. **(27)**

Label the parts of the human Respiratory System



L.C.H. 2011

8. (a) State a use for each of the following in the biology laboratory:

(i) Buffer solution. _____

(ii) Biuret test. _____

(b) (i) In the course of your practical studies you used a solution of iodine in different investigations. State **two** different uses of the iodine solution.

Use 1. _____

Use 2. _____

(ii) State **two** different uses of a water bath in biological investigations.

Use 1. _____

Use 2. _____

✳ (iii) In the course of your practical studies you found that heart rate and breathing rate increase with exercise.
Explain why this is the case.

_____

_____

_____

(iv) In the course of your practical work you prepared a transverse section (T.S.) of a dicot stem for microscopic examination.
How did you prepare the T.S.?

_____

_____

_____

L.C.H. 2014

12. (a) (i) Name the structures found in stems, equivalent to stomata in leaves, which are involved in gaseous exchange in plants.

(ii) Name **two** compounds that leave the plant through the structures referred to in part (i). (9)

(b) (i) Draw a large labelled diagram of the human breathing tract.

(ii) Outline the details of the process of inhalation. (27)

(c) Answer the following questions in relation to carbon dioxide.

(i) Name a structure found in cells in which carbon dioxide is produced.

(ii) Give a feature of a capillary which allows the rapid uptake of carbon dioxide.

(iii) Carbon dioxide levels are usually higher in venous blood than in arterial blood. Why is this the case?

(iv) Name a blood vessel which is an exception to the situation outlined in (iii) above. Give a reason for the exception.

(v) Briefly outline the role of carbon dioxide in the control of the human breathing rate. **(24)**

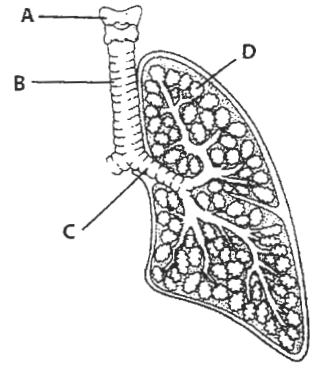
L.C.O. 2014 Q.15

(b) Answer the following questions in relation to the human breathing system.
(i) When we breathe we inhale air. What gas in the air is essential for respiration?
(ii) One large muscle and one set of muscles are involved in inhalation. Name **both**.
(iii) Describe in detail how we inhale air.
(iv) 1. Name **one** disorder of the human breathing system.
2. Suggest a possible cause of the disorder.
3. Suggest a treatment for the disorder.

(30)

L.C.O. 2015 Q. 13

(c) The diagram shows part of the human breathing system.



(i) Name the parts labelled A, B, C and D.
(ii) In which labelled part does gas exchange take place?
(iii) What is the function of part A?
(iv) B and C have rings of cartilage. Suggest a function of these rings.
(v) Suggest a reason why smoking cigarettes is bad for your lungs. **(24)**

Liquid 'air' provides lifeline for lung victims and babies

MEDICINE

A new liquid could save the lives of thousands of respiratory disease sufferers. Report by **Roger Dobson**

PREMATURE babies that could be grown in artificial wombs and victims of collapsed lungs are the likely beneficiaries of a new liquid that allows people to breathe oxygen through lungs full of liquid rather than air.

The development of the liquid, called Liquivent, is to be published in the medical journal The Lancet later this month.

It will describe how 22 adults, children, and babies, suffering with pneumonia and other respiratory conditions, have been treated using partially liquid ventilation where the oxygen they breathe comes through a special liquid pumped into their lungs.

The new technology also promises to save the lives of premature babies with lung problems and there are hopes that eventually the same technology will lead to the development of artificial wombs where very premature babies, under 24 weeks, will have a better chance of development and survival.

Now that the results of clinical trials in America are to be published, the first patient trials in Europe are being planned.

Liquivent has been developed by a San Diego company, Alliance Pharmaceuticals, for improving the treatment of patients with respiratory problems, such as smoke inhalation, severe burns and trauma, many of whom die because the lungs' natural reaction is to close down and collapse.

The result is respiratory distress syndrome, which affects 200,000 people a year in America alone. As the lungs become less able to provide the necessary levels of oxygen and remove carbon dioxide from the blood, oxygen starvation begins, and the patient will die if left untreated. Conventional treatment is to pump up the collapsed lungs with oxygen, using a mechanical ventilator, but this treatment often involves using dangerously high pressures and oxygen concentrations that can cause lung rupture and poisoning.

Despite some improvements, adult death rates remain above 50% and researchers, in an effort to improve techniques, have been looking for more than 60 years for a way of using a liquid to pump up and clean the lungs as well as provide oxygen.

It has always been known that liquids are better and safer for cleaning lungs, and during the first world war mustard-gas victims had their lungs cleaned with a salt solution. Researchers required a liquid that not only cleaned, but transported oxygen and which would stay in the lungs for some time.

Alliance researchers have finally produced Liquivent, described by the company as a colourless, odourless, quick-spreading synthetic oil that is twice as heavy as water.

The material, made from sterile perfluorocarbon, a pharmaceutical-grade chemical, has a high capacity to dissolve gases and can transport both oxygen to the lungs and remove carbon dioxide.

Gwen Rosenberg, director of Alliance, believes the system will make a big difference to victims with inefficient lungs.

"With the liquid in the lungs, the ventilator working at a much lower pressure provides oxygen that is dissolved through the liquid and goes in the air sacs in the lungs and then into their bloodstream," she says.

The first patients to benefit were premature babies who had been expected to die because their lungs were underdeveloped. Rosenberg found, however, that the new liquid appears to promote lung growth.

Dr Ronald Hirschl, assistant professor of surgery at the University of Michigan department of surgery, has carried out the first trials on adults and children and his report is due to be published in The Lancet.

"The liquid goes into the lungs while the ventilator is working," he says. "It puts oxygen in and washes out junk, including mucus and other debris. It then inflates the collapsed areas of the lung so that they now have oxygen going into them.

"We were the first to treat adult and paediatric patients and the results are encouraging. They indicate that liquid ventilation has the potential to play a significant role with patients suffering respiratory failure."

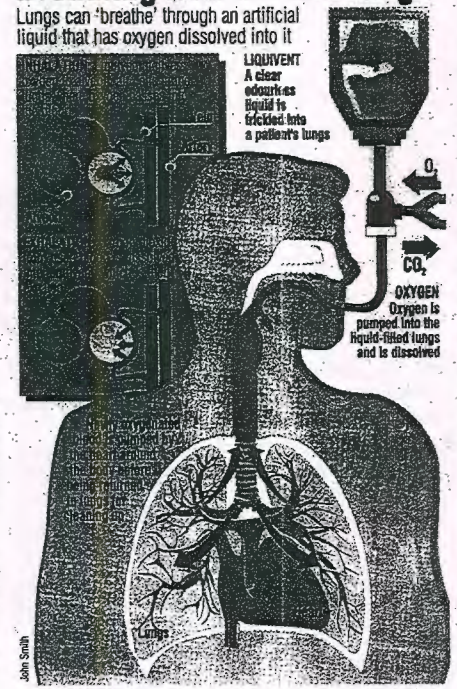
Researchers are now working on the idea of total liquid ventilation where oxygen is carried in the liquid without having to be hooked up to a ventilator.

A future step may be a complete artificial womb where very premature babies are transferred until their development is complete. These very young babies do not survive because their lungs are underdeveloped.

In the real womb babies take their oxygen from the maternal blood. In an artificial womb a pump would circulate the perfluorocarbon and the baby would breathe the liquid, allowing its lungs to continue to develop as they would in a real uterine environment.

Breathing new life into lungs

Lungs can 'breathe' through an artificial liquid that has oxygen dissolved into it



"The liquid puts in oxygen and washes out junk like mucus and other debris"