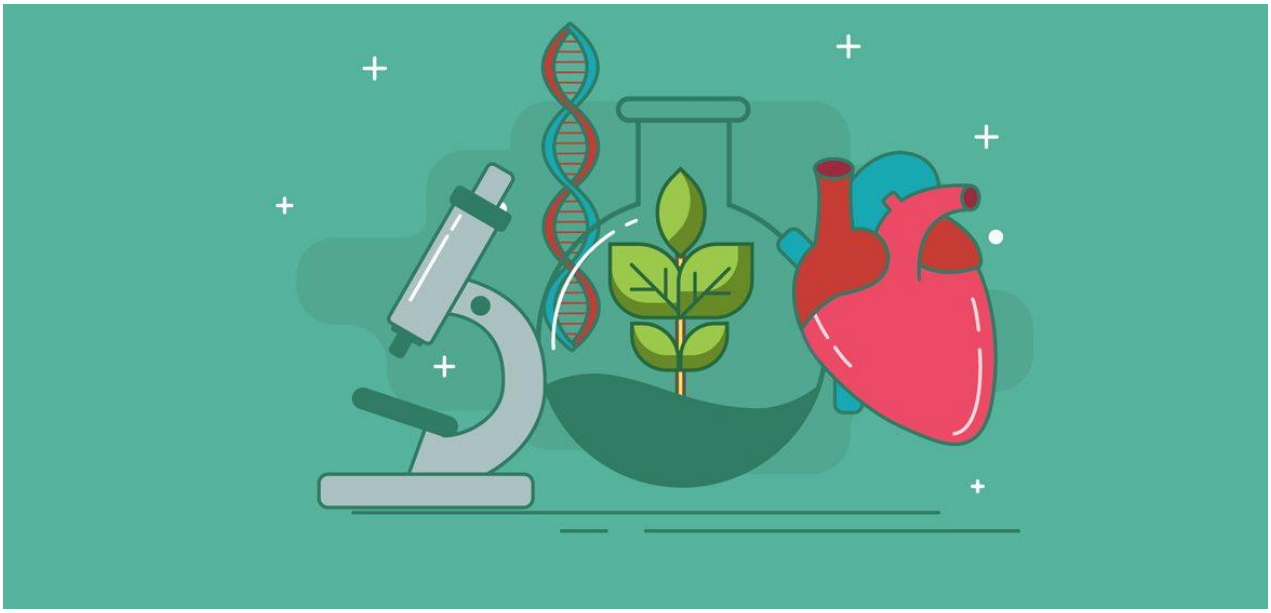
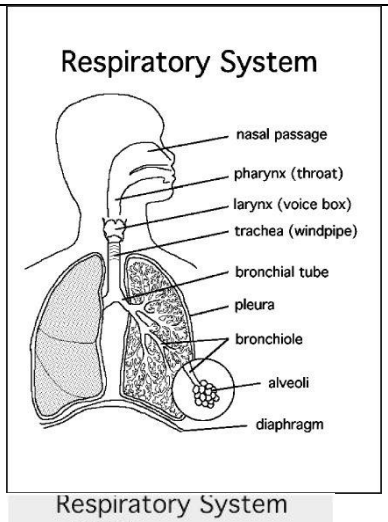
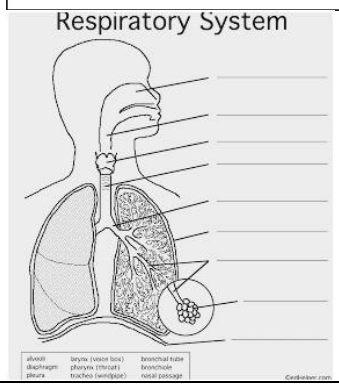
7B2: Gas Exchange



What are the characteristic processes of life?	Movement, respiration, sensitivity, nutrition, excretion, reproduction, growth
What are all living and previously living organisms made of?	Cells
What is respiration?	A cellular process that releases energy from food and oxygen
How do molecules move through cytoplasm?	Diffusion
Place the following in size order- molecule, cell and atom	Atom- molecule- cell
How can we describe the cell membrane?	As a semi-permeable membrane (some molecule are able to diffuse through it)
What are the key features of diffusion?	• All particles are in constant motion • Diffusion involves the movement of particles • It results from the random motion/collision of particles
What happens when a gas reaches equilibrium?	The particles continue to move but the net movement results in an equal amount of particles on each side of the membrane
What is the relationship between surface area of a membrane and the rate of diffusion?	As surface area increases the rate of diffusion increases too.
How are the alveoli adapted to maximise rates of diffusion?	Alveoli are adapted to provide a very large surface area for diffusion
Label the structure of the respiratory system	 
What is the composition of inhaled air?	78% nitrogen, 21% oxygen, 0.04% carbon dioxide (as well as water vapour, other gases and particulates)

What is the composition of exhaled air?	78% nitrogen, 17% oxygen, 4% carbon dioxide
How do we breathe in (ventilate)?	Our diaphragm is pulled down, anad the ribs are lifted up increasing the volume of the chest cavity. Air moves in to equalise the pressure.
How do we breathe out?	The muscles pulling on the diaphragm relax and this rises up, the ribs move in and the volume of the chest cavity decreases. Air moves out to balance the pressure.
What is the vital lung capacity?	The maximum amount of air you can breathe in and out

Keywords	Definition
Air	the mixture of gases that surrounds the earth and that we breathe
Oxygen	a chemical element that is a gas with no smell or colour. Oxygen forms a large part of the air on earth, and is needed by animals and plants to live
Carbon dioxide	the gas formed when carbon is burned, or when people or animals breathe out
Waste	unwanted matter or material of any type, especially what is left after useful substances or parts have been removed
Energy	the power from something such as electricity or oil that can do work, such as providing light and heat
Respiration	a chemical reaction that occurs in all living cells to release energy from food
Nutrition	the process by which the body takes in and uses food, esp. food that it needs to stay healthy, or the scientific study of this process
breathing	› the act or process of taking air into your lungs and releasing it
Diffusion	(of gases and liquids) the process of spreading into a surrounding substance Diffusion is also the method by which substances pass in and out of cells through their membrane
Surface area	the area of a surface or of all of the outer surfaces of something
Concentration	the exact amount of one particular substance that is found in another substance
Particle	A particle is any of the smallest pieces of matter that make up atoms or the parts of atoms
Cell membrane	the semipermeable membrane surrounding the cytoplasm of a cell
Equilibrium	In general, equilibrium pertains to the condition of achieving balanced thereby resulting in a stable system
Net movement	In terms of biology, net movement would describe something like a cell, organism, or ecosystem, and it would evaluate things moving in (positive) and out (negative) of that system.
Respiratory	of or relating to breathing
Lungs	either of the two organs in the chest with which people and some animals breathe:
Trachea	the tube that carries air from your throat to your lungs
Bronchus	one of the two tubes that branch from the trachea (= tube that carries air from the throat to the lungs) and carry air into the lungs
Bronchioles	in the lungs, one of the very small tubes that branch out from the bronchi and connect to the alveoli
Alveoli	(plural of alveolus) one of the many very small air bags in the lungs, with thin walls that allow oxygen to enter the blood
Pressure	the force that a liquid or gas produces when it presses against an area:
Surface area	the area of a surface or of all of the outer surfaces of something

Bank of Starter Activities: (These are in no particular order: Your teacher may ask you to complete one at the start of the lesson)

Activity 1:

Create a Sentence

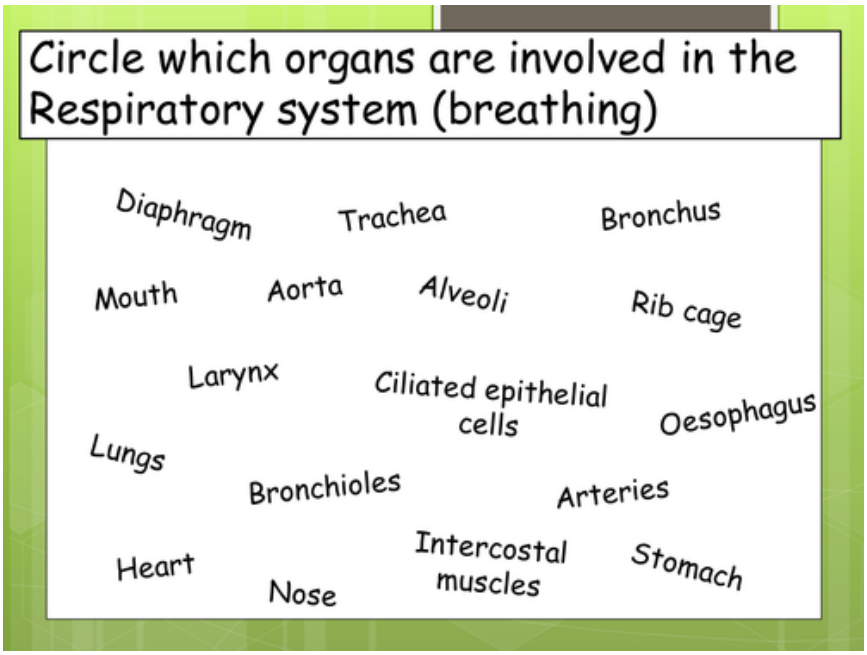
Use the 3 words to write **one** sentence in the box below:

1. Energy Muscles Move

2. Food Digest Blood

3. Breathe Glucose Heat

Activity 2:



Activity 3:

Breathing	Respiration

Put these words under the correct column….

Releases energy
Air
Chemical reaction
All living things
Alveoli
Exhalation
Provides the body with oxygen
Removes carbon dioxide from the body
Lungs
Takes place in cells
All living things with lungs
Inhalation
Mitochondria in cells
Breakdown of glucose

Breathing	Respiration

Activity 4:

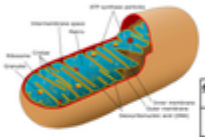
The Circulatory System Key Words

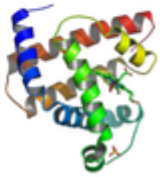
Match the meanings to the correct Key Words!

Glucose	The cells in which oxygen is carried
Capillaries	The system in which exchange and adsorption of glucose and oxygen takes place.
Arteries	Tiny blood vessel that surround organs and cells to absorb oxygen and glucose
Veins	The side of the heart that received blood from all over the body.
Circulatory System	These carry blood to the heart.
Right side of Heart	The side of the heart that receives blood from lungs.
Left side of Heart	Blood that doesn't certain oxygen.
Red Blood Cells	Where the absorption of nutrients from food takes place (glucose).
Small Intestine	These carry blood **away** from the heart.
Deoxygenated Blood	This is what starch is broken down into and gives us energy.

Activity 5:

Aerobic respiration





Across
1. These contract thanks to the energy released during respiration
3. Where most reactions of respiration occur
7. The sugar required for respiration
9. Built up from amino acids
10. A waste product of respiration
11. The energy from respiration helps to keep this constant in animals
12. The process plants carry out in order to obtain glucose for respiration

Down
2. A waste product of respiration
4. Word used to describe the type of respiration that uses oxygen from the air
5. This is NOT the same as respiration - it is the process that moves air in and out of the lungs
6. The useful product of respiration
8. Increased thanks to folds in the mitochondria membranes

Concept 1: Why do we Breathe?

We are learning how we decide if something is living and what living things need to stay alive

Click on this QR code and read it and watch the video clip. It will help you decide about living and non-living things.

Is it alive?

1 Some things are living. Some things are dead. Some things have never been alive.

a human

a dog

a brick

a roast chicken

a Venus flytrap

a car

Answer the questions for **each** picture.

i What does the picture show?

A a living thing

B a thing that was once alive but is now dead

C a thing that has never been alive

D I can't decide

ii How did you decide?

2. Some things are living. Some things are dead. Some things have never been alive.

a doll

a tree

a wooden chair

a stick insect

bread

fire

Answer the questions for **each** picture.

i What does the picture show?

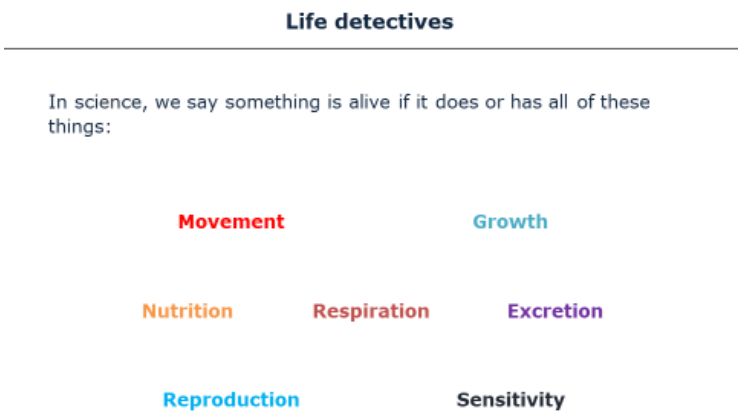
A a living thing

B a thing that was once alive but is now dead

C a thing that has never been alive

D I can't decide

ii How did you decide whether it is living, dead or has never been alive?



Life Detectives: Talk about the specimen you have been given.

What would it do if it was alive?

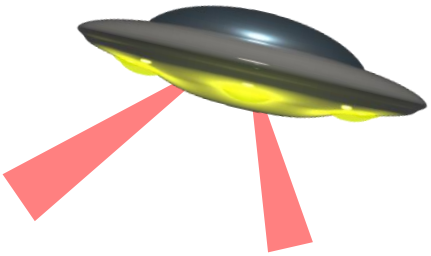
What would you expect to see if it did those things?

How would you collect evidence?

Key Learning Point:

We can use the characteristic processes of life (MRS NERG) to make simple choices about whether things are living or not

Alien invasion!



Imagine that an alien spaceship is firing its death rays at Earth!

- The death rays will destroy everything that is made of cells.
- Things that are not made of cells will not be affected.

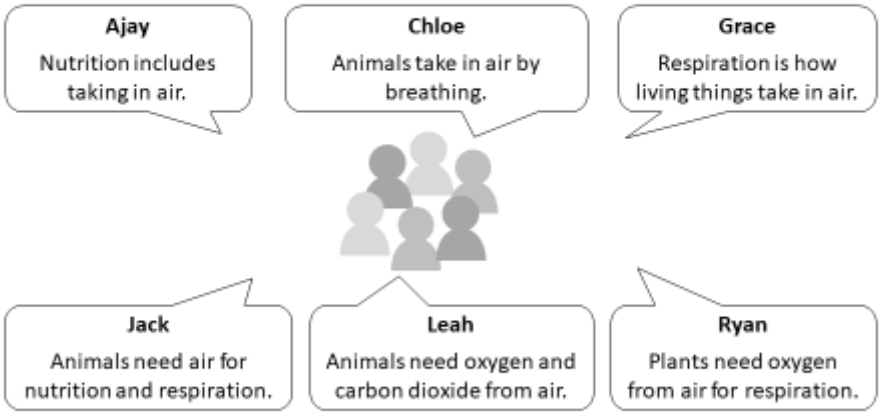
Look at the statements in the table. Some are right and some are wrong.

Tick **one** box for each statement.

Statements		I am **sure** this is right	I **think** this is right	I **think** this is wrong	I am **sure** this is wrong
1	People will be destroyed.				
2	Brick walls will be destroyed.				
3	Plants will be destroyed.				
4	Very small organisms will **not** be destroyed.				
5	Dead bodies will be destroyed.				
6	Bacteria will be destroyed.				

The need for food and air

Animals and plants also need **air** to stay alive.
Some children talk about this.



Who do you agree with?

Does everyone agree with you?

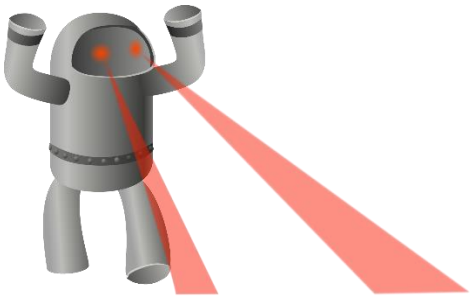
What is your evidence?

Key Learning point:

Living things are made of cells. These cells have require energy and molecules and need to get rid of waste

Assessment Task:

Killer robot!



Imagine it's the year 3000. A killer robot is on the loose!

The police want to destroy it.

The police in the year 3000 are not allowed to kill any living thing.

Your job is to decide whether the robot is a living thing.

To do

Fill in the table of evidence about the robot.

Feature of living things	Can a robot do this?	Evidence for your answer
They grow		
They reproduce		
They can respond		
They can move		
They need food		
They get energy from food		
They get rid of waste		

Is the robot a living thing? Write your conclusion in the box below.

The robot is ……

Concept 2: Diffusion

We are learning what is meant by diffusion and how surface area can change the rate of diffusion

Click on the QR code to go to the BBC bitesize site. Read the first page and then navigate on to read the rest- but especially pages 1, 4 & 8.

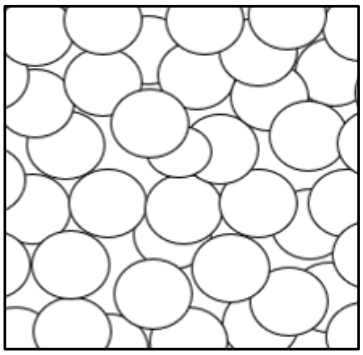
Starter: Cytoplasm – a particle model

The cytoplasm in a cell is made up of particles.

Imagine you could see the particles.

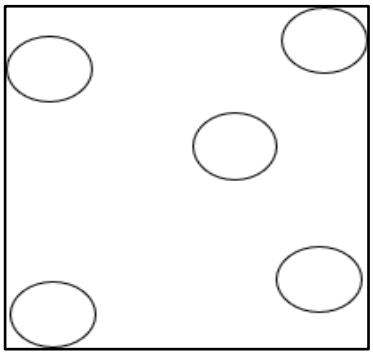
Which diagram and description best matches what you would see?

A



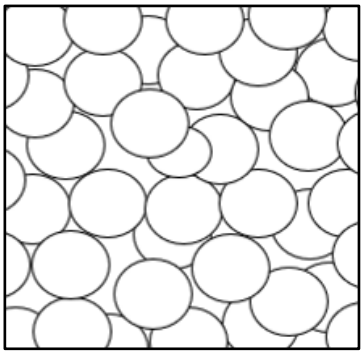
Particles not moving

B



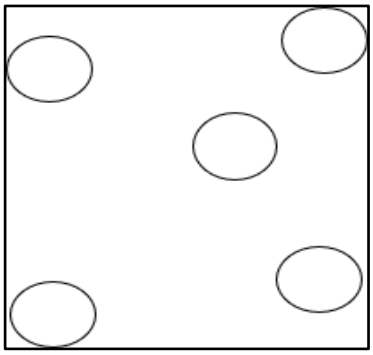
Particles not moving

C



Particles moving freely

D



Particles moving freely

The cytoplasm in cells is a liquid. This means that the particles that form it are able to move freely past each other.

Deodorant

The teacher sprays deodorant at the front of the classroom.

At first, only the people at the front of the classroom can smell it.

After a while, people at the front **and** the back of the classroom can smell it.

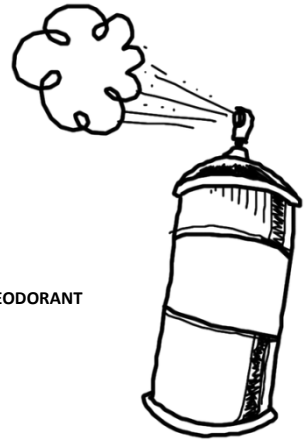
Part 1

Look at the statements in the table. Some are right and some are wrong.

Tick **one** box for each statement.

Statements		I am **sure** this is right	I **think** this is right	I **think** this is wrong	I am **sure** this is wrong
1	The deodorant moves across the classroom because of the wind.				
2	The deodorant reacts with the air, making it smell nice.				
3	The deodorant splits into little bits and mixes with the air.				
4	The deodorant molecules move through the air by diffusion.				
5	The deodorant molecules need to spread out so they have more space.				

Deodorant



DEODORANT

The teacher sprays deodorant at the front of the classroom.

At first, only the people at the front of the classroom can smell it.

After a while, people at the front **and** the back of the classroom can smell it.

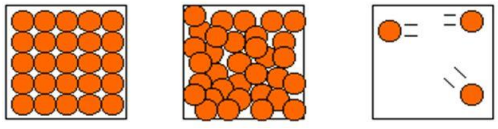
Part 2

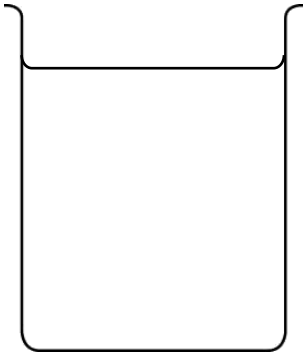
Look at the statements in the table. Some are right and some are wrong.

Tick **one** box for each statement.

Statements		I am **sure** this is right	I **think** this is right	I **think** this is wrong	I am **sure** this is wrong
1	The deodorant molecules move in one direction, from the front of the classroom to the back.				
2	The deodorant molecules collide with each other and molecules in the air.				
3	The deodorant molecules are most concentrated when they first come out of the spray can.				
4	There is net movement of deodorant molecules from an area of low concentration to an area of high concentration.				
5	The deodorant molecules stop moving when they have spread out.				

STATES OF MATTER	**SOLID**	**LIQUID**	**GAS**
Arrangement of particles	The particles are very **closely packed**.	The particles are **closely packed** but there are **more empty spaces** between them compared to the solid state.	The particles are **very far apart** from each other.





PEOE – Dye in water

Your teacher is going to add some coloured dye to a beaker of water.

It will **not** be stirred.

Predict

What will happen to the dye and the water during the rest of the lesson?

Explain

Explain why you think this will happen.

Your teacher will now add the coloured dye to the beaker of water.

Observe

Watch what happens to the dye and the water during the rest of the lesson.

Explain

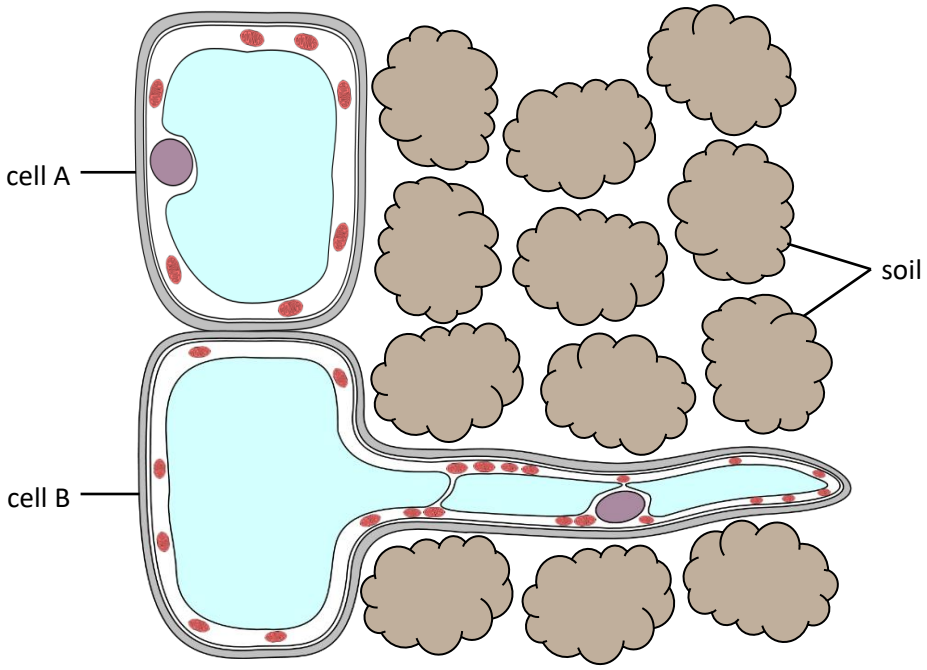
Was your prediction correct?

If not, how would you explain what you observed?

Diffusion in Living things

Root hair cell

The diagrams show two cells from the outside surface of a plant's root.



1. Which cell would be better at absorbing substances from the soil?

   A Cell A would be better.

   B Cell B would be better.

   C They would be equally as good.

2. How would you explain your answer to question 1?

   A They are both touching the soil.

   B It reaches further into the soil.

   C It has a larger area of membrane for diffusion.

   D It has a flatter area of membrane for diffusion.

Key Point: Diffusion happens in living things. Particles move across membranes from areas of high concentration to areas of low concentration

Investigating how surface area affects the rate of diffusion

Aim

To find out how **surface area** affects how quickly substances can diffuse to the centre of a cube.

You will need

- beaker of water
- potato cubes
- paper towel
- cutting board
- beaker of iodine solution
- ruler
- forceps
- gloves
- stop clock
- knife
- eye protection

Safety

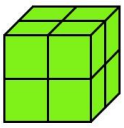
- Iodine solution stains skin and clothes.

Wear eye protection and gloves.

- Be careful with knives.
- Do not eat anything in the lab.

A Measure the length, in millimetres, of one side of the first potato cube. Record the lengths.

B) Take the second cube and cut into 8 equal pieces. Measure the length, in millimetres, of one side of one of the potato cubes. Record the lengths



C Carefully use the forceps to pick up each cube and lower it gently into the beaker of iodine solution.

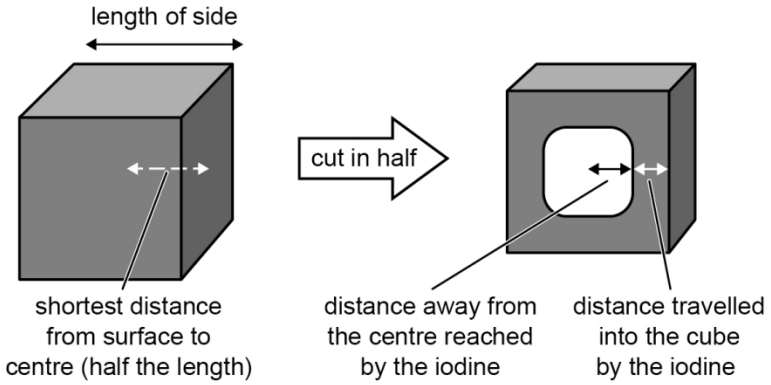
D Time 15 minutes.

E Use the forceps to remove the cubes from the iodine solution in the same order that you put them into the iodine. Lower each one gently into the water.

F Once all your cubes are in the water, take them out again.

G Blot the cubes with the paper towel to dry them.

G Cut each cube in half and look at the distance that the colour has spread from the middle of one surface towards the centre of the cube.



For a cube, the length of one side is the same as its width and height.
The length of the cube side can be used to work out:
- the shortest distance to the centre of the cube (is half the length)
- the surface area of one side of the cube (is length × width
- the surface area of the whole cube (is 6 × (length × width))

Complete the results table:

Table 1:

Length of cube side (mm)	Surface area of one face of the cube (mm^2)	Surface area of whole cube (mm^2)	Proportion of cube filled with iodine (could sketch the cross section here)
40			

Table 2:

Length of cube sides(mm)	Surface area of one face of the cube (mm^2)	Surface area of whole cube(mm^2)	Number of cubes	Total surface area (mm^2)	Proportion of cube filled with iodine
20			8		

Considering your results/conclusions

Cross out the incorrect words in the brackets in the following.

When we cut the large cube of potato into 8 pieces we ***(increased/decreased***) the surface area of the piece of potato. In the smaller cubes the iodine had reached ***(further/ less far)*** towards the centre.

More particles of iodine were able to diffuse into the potato pieces with the ***(larger/smaller)*** surface area.

Assessment Questions:

- How would you describe the movement of particles in a gas?

- Can you list three features of a particle in a gas?

- What will happen to the particles in a dye when added to a liquid?

- Why does smell move?

- What examples can you give of diffusion?

- What evidence can you give to show that diffusion takes place?

- Can you make a distinction between the particles in a liquid and a gas?

- Once a substance is uniformly distributed, can you describe the motion of the particles?

- Diffusion can happen across a membrane. Can you predict how changing the surface area would affect the rate of diffusion?

Concept 3: The Gas Exchange system

Key Concepts : Describe the organs found in the gas exchange system

Label the organs in the gas exchange system: Describe the mechanism of breathing to move air into and out of the lungs: Explain how the alveoli are adapted to their function

This QR code will take you to a page about the human respiratory system. Read that page and then navigate onto the next one too.

The human gas exchange system

The boxes below contain the names of some structures in the human body.

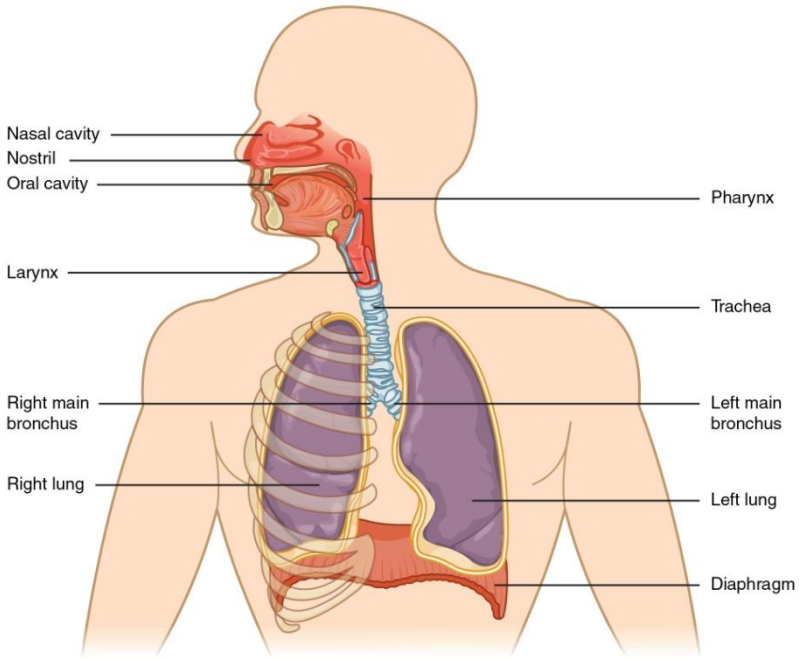
Put a tick next to each structure that is **part of the human gas exchange system**.

Then draw straight lines to join each **structure** you have ticked to its **function**.

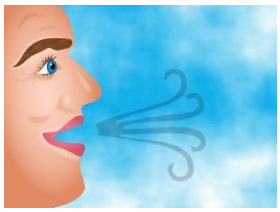
One has been done for you.

Structure	Function
Lungs	To allow air to travel from the lungs to the heart.
Heart	To allow air to travel from the nose and mouth to the bronchi.
Trachea ✓	To allow air to travel from the trachea to the heart.
Stomach	To allow air to travel from the trachea to the lungs.
Bronchi	To absorb oxygen from air and release carbon dioxide from the
	To absorb carbon dioxide from air and release oxygen from the blood.

The human gas exchange system



Task: What's in the air?



1. What is in the air we breathe in?

   A Just oxygen.

   B Just carbon dioxide.

   C A mixture of oxygen and carbon dioxide.

   D A mixture of oxygen, carbon dioxide and other gasses.

2. How would you explain your answer to question 1?

   A That is what the body needs.

   B Air is not a substance, it is a mixture.

   C Air and oxygen are the same thing.

   D We breathe in oxygen and breathe out carbon dioxide.

What's in the air?

3. What is in the air we breathe out?

   A Just oxygen.

   B Just carbon dioxide.

   C A mixture of oxygen and carbon dioxide.

   D A mixture of oxygen, carbon dioxide and other gasses.

4. How would you explain your answer to question 3?

   A That is what the body gets rid of.

   B We breathe in oxygen and breathe out carbon dioxide.

   C It is a waste product.

   D Not all of the oxygen from the air we breathed in has been absorbed by the body.

5. How do the gases in the air we breathe out compare to the air we breathe in?

   A The amount of oxygen has decreased.

   B The amount of carbon dioxide has increased.

   C The amount of oxygen has decreased and the amount of carbon dioxide has increased.

   D They are present in exactly the same amounts.

6. How would you explain your answer to question 5?

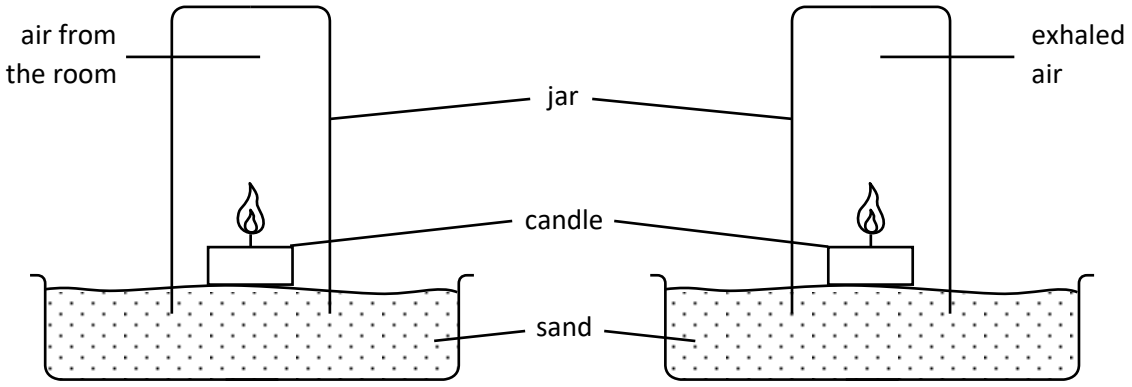
   A Some of the oxygen has been absorbed into our blood.

   B Some carbon dioxide has been released from our blood.

   C Some of the oxygen has been absorbed into our blood and some carbon dioxide has been released from our blood.

   D Only energy has been taken out of the air.

Investigation: Flames



Your teacher is going to place lit candles into two jars of air.

One jar contains air from the room. The other jar contains exhaled air (air that has been breathed out by a person).

Predict

What will happen to the candle in each jar?

Explain

Explain why you think this will happen.

Your teacher will now place the candles in the jars.

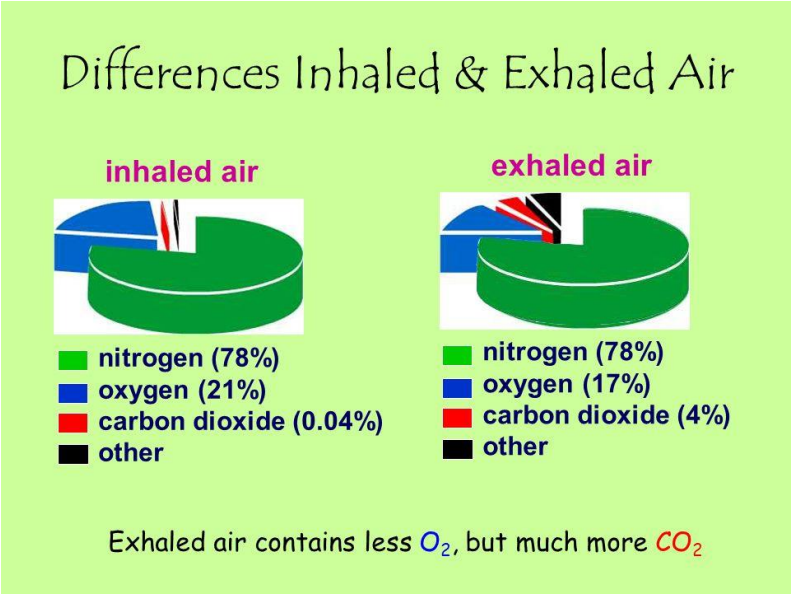
Observe

Watch what happens to the candles in the jars.

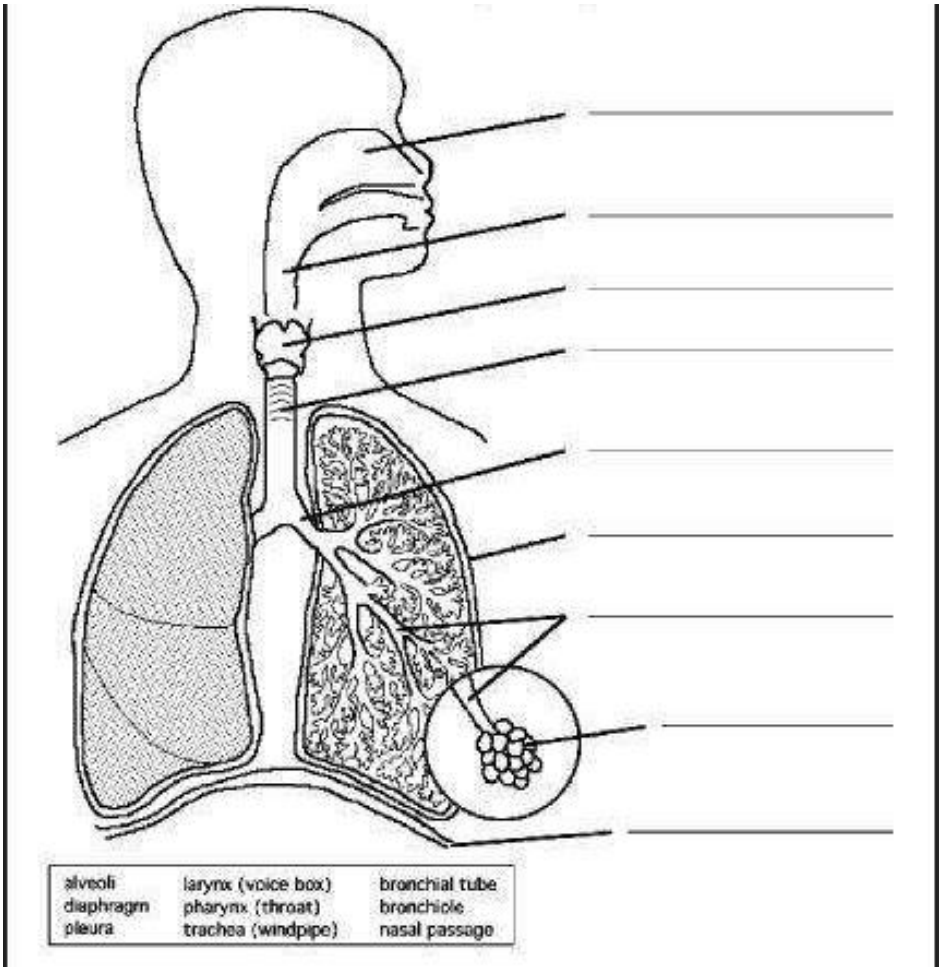
Explain

Was your prediction correct?

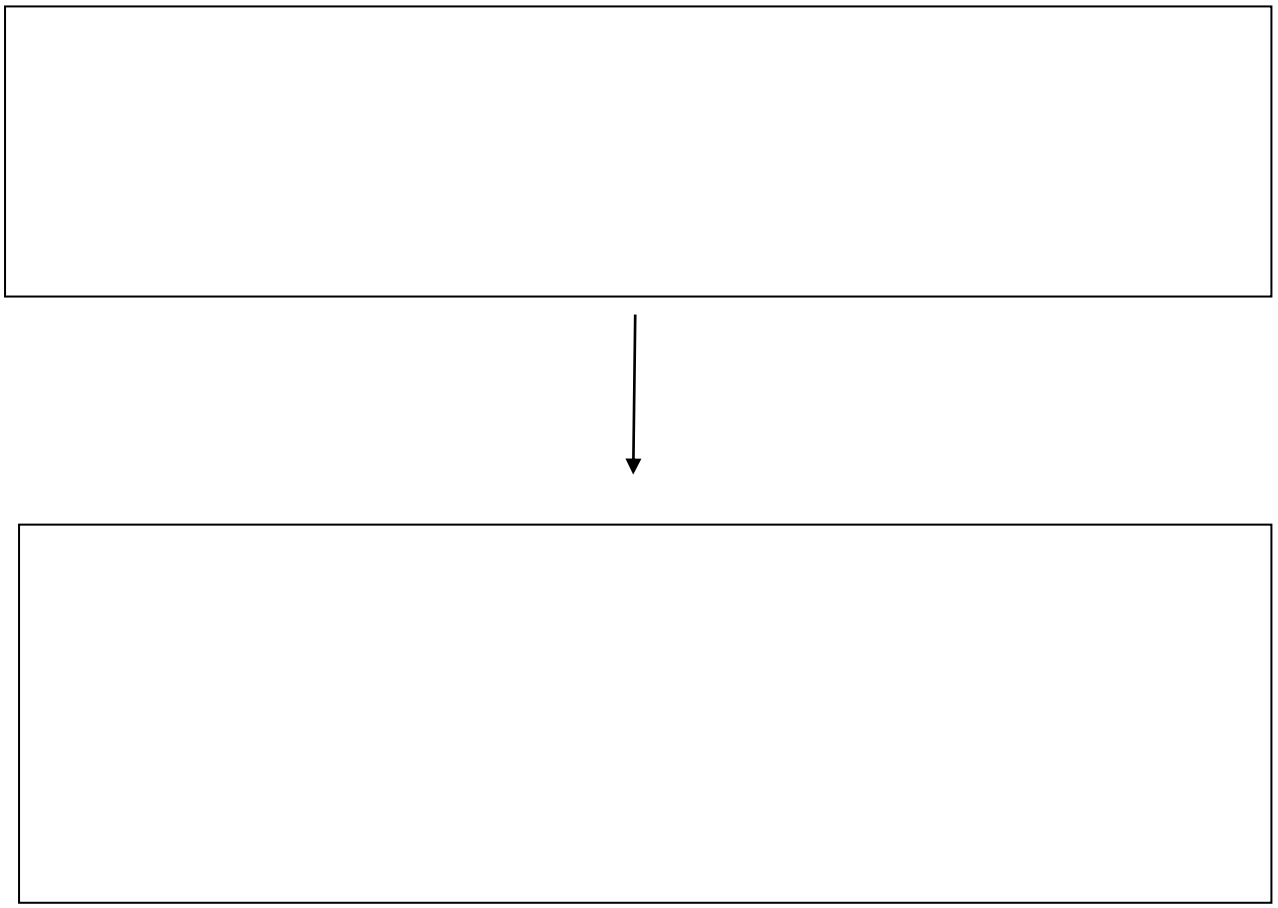
If not, how would you explain what you observed?



Human Gas Exchange System



Draw a flow diagram to show the path breath takes:



Ventilation

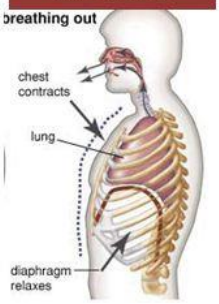
The **ribcage, intercostal muscles** and **diaphragm** all work together to move air into and out of the lungs, where gas exchange occurs across the thin (single-celled) walls of the alveoli

Ventilation is a physical process, relying on the principle of Boyle's Law – which state

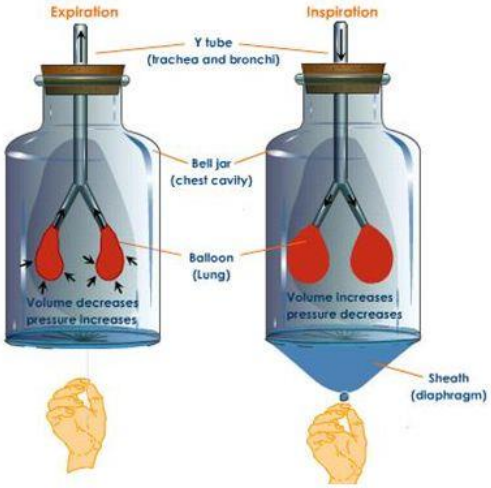
"Pressure is inversely proportional to volume"

The mechanism can be illustrated using a bell jar model of the respiratory system – however, the model does not illustrate involvement of the rib cage and the intercostal muscles in ventilation

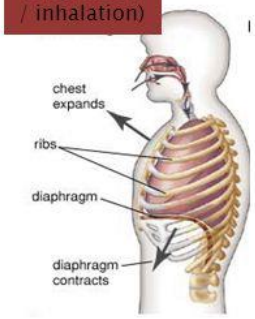
Breathing out (expiration / exhalation)



Internal intecostals contract in forced expiration



Breathing in (inspiration / inhalation)



Task 3: Draw and label a diagram of the bell jar model of the lungs. Use these words to label the diagram;
Bung, Glass Tubing, Bell Jar, Balloons, Elastic Membrane

Which part of our breathing system is represented by the:

a) Balloons? _____

b) Elastic Membrane? _____

c) Glass Tubing? _____

Task 4: Modelling the lungs – Evaluation:

Ways the model was good at representing our breathing system:

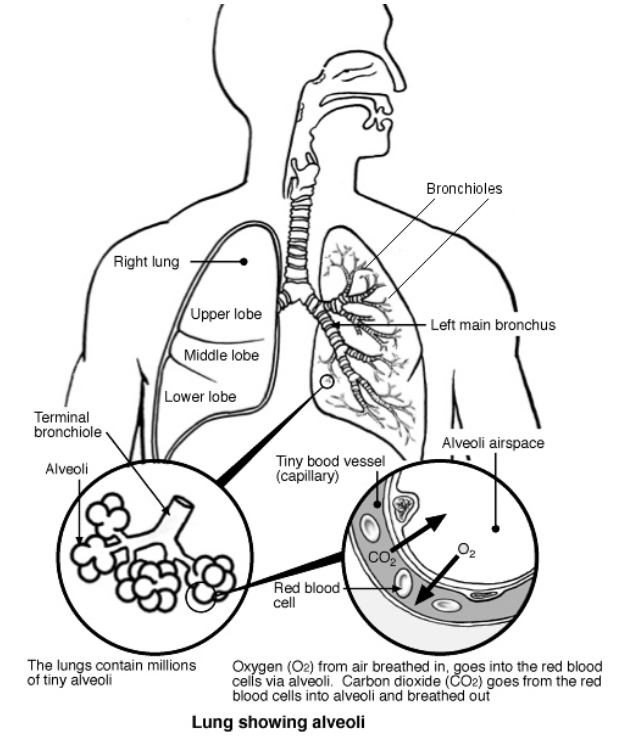
Ways the model was not good at representing our breathing system:

Extension: Design a way to measure your lung capacity (how much air your lungs can hold). Use the space below to describe or draw the method you could use.

- The maximum amount of air you can breathe in and out is your **vital lung capacity**. Everybody's vital lung capacity is different depending on factors such as their **age** and **fitness levels**.
- When you breathe in and out, the **air pressure** inside our lungs changes, allowing oxygen to enter or carbon dioxide to leave.
- The **larger** your lung capacity the **more** oxygen can be breathed in and transported around the body.

Scan this to see the lung capacity experiment

<u>Alveoli and Gas exchange</u>

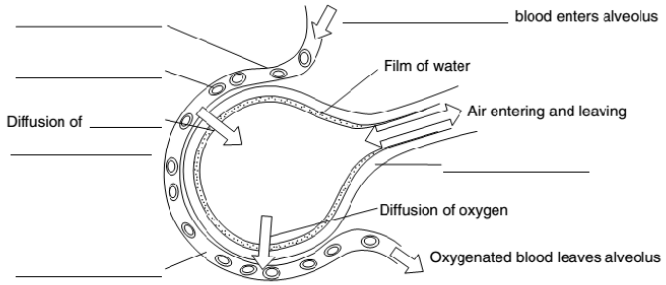


Lung showing alveoli

Humans as organisms – 10: Breathing

1 The diagram below shows an alveolus in a human lung.

a Complete the missing labels: (6)



b Name **three** features of the alveolus that are designed to increase the rate of gas exchange, and explain how they achieve this: (6)

	Feature	How this helps increase gas exchange
1	.....	.....
2	.....	.....
3	.....	.....

2 The table below shows the amount of various gases in the air we breathe in and the air we breathe out:

	1 Air breathed in	2 Air breathed out
Oxygen	20%	16%
Carbon dioxide	0.03%	4%
Nitrogen	Some	A lot
Water vapour	79%	79%

a Using the table on page 24 answer the questions below.

i Which air sample contains the **most** oxygen? ..... (1)

Explain why. .....

..... (1)

ii Which sample contains the **least** oxygen? ..... (1)

Explain why. .....

..... (1)

iii Which air sample contains the **most** carbon dioxide? ..... (1)

Explain why. .....

..... (1)

3 What effect do the following health problems have on gas exchange in our lungs? Explain why. (6)

a Emphysema – the alveoli are damaged by coughing.

.....

.....

b Lung cancer – a tumour grows inside the lungs.

.....

.....

c Asthma – the bronchiole lining swells and makes the airway narrower.

.....

.....

4 The following statements are about how we breathe in and out. Match them up by ruling a line between the two halves of each statement. Two have been done for you: (6)

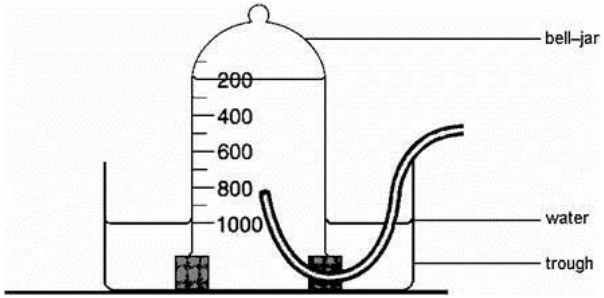
Breathing in occurs when the diaphragm	smaller
The volume of the thorax is made	decreased
The pressure is	moves up
Air is sucked	larger
Breathing out occurs when the diaphragm	out
The volume of the thorax is made	increased
The pressure is	in
Air is forced	moves down

Total marks = 30

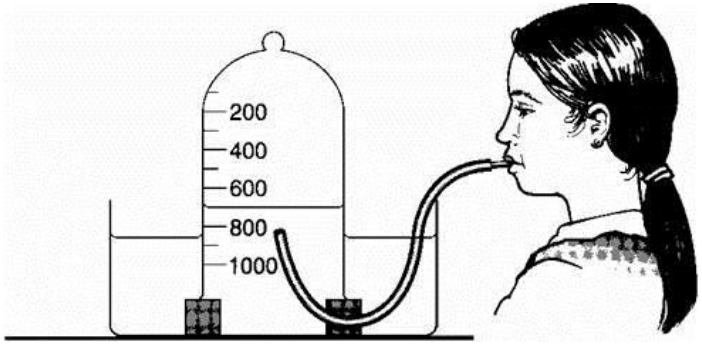
Question Bank

Q1. (a) Jasmine was trying to find out how much air she breathed out in one breath.
She poured water into a bell-jar and placed it upside down in a trough of water.
The bell-jar had a scale marked in cm^3.

before Jasmine breathed into the bell-jar



after Jasmine breathed into the bell-jar



(i) How much air did Jasmine breathe out?

..... cm^3

(ii) Air contains carbon dioxide, nitrogen, noble gases, oxygen and water vapour.

Give **three differences** between the composition of the air Jasmine breathed in and the air she breathed out.

Compared to the air she breathed in, the air she breathed out contained:

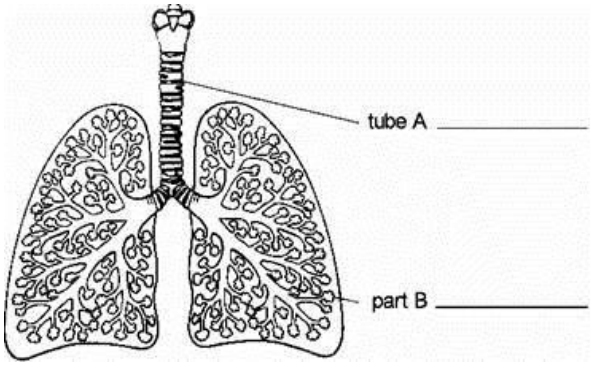
1. .....

2. .....

3. .....

(b) In the diagram below, tube A connects the lungs to the mouth. Part B is a part of the lung where gas exchange takes place.

(i) On the diagram, write the names of tube A and part B.

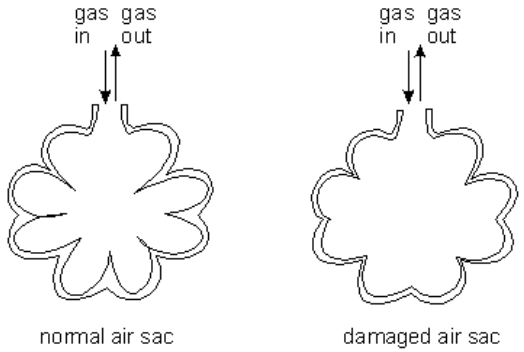


(ii) In the wall of tube A there are 'rings' of a stiff material called cartilage. Suggest **one** function of the 'rings' of cartilage.

.....

.....

Q2. People who have emphysema have damaged air sacs in their lungs. The diagrams show a section through a normal air sac and a section through a damaged air sac.



(a) Gas exchange takes place at the inside surface of the air sac when a person breathes.

(i) Which **two** gases are exchanged at this surface of the air sac?

..... and
.....

(ii) The amount of gas exchanged is smaller in a damaged air sac.
Explain why.

.....

.....

(b) The list shows four substances present in cigarette smoke.

carbon particles carbon monoxide nicotine tar

Choose from the list the substance which:

(i) causes addiction to smoking cigarettes;

.....

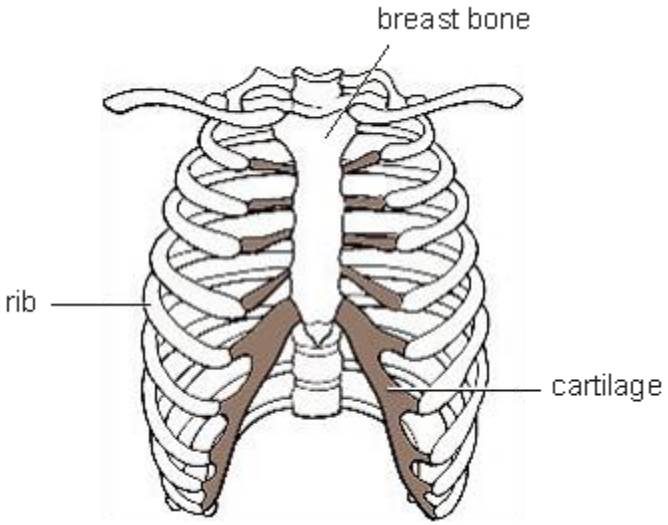
.....

(iii) is carried instead of oxygen in the red blood cells.

.....

Q3.

The drawing below shows the human rib cage.



(a) The rib cage protects organs in the chest.

Give the names of **two** organs in the chest.

1. .....

2. .....

(b) The ribs are attached to the breast bone by cartilage which bends easily.
This lets the space in the chest get bigger.

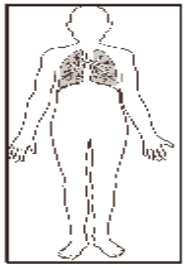
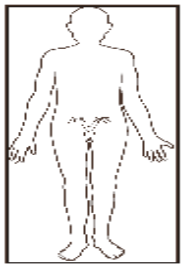
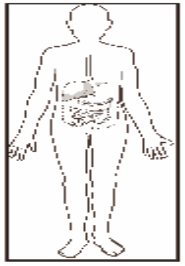
Why is it important that the space can get bigger?

.....

.....

(c) The drawings below show parts of three different organ systems.

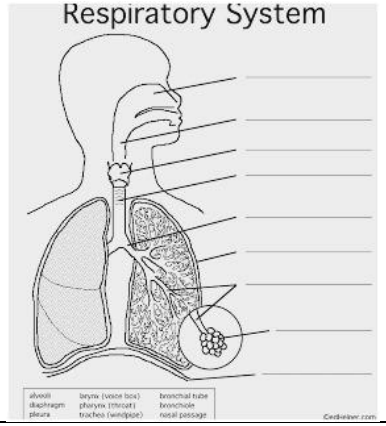
Draw a line from each organ system to its function.
Draw only **three** lines.

organ system	function
	digestion of food
	reproduction
	control of the body
	taking in oxygen from the air
	movement of the body

Core Knowledge 1

What is the composition of exhaled air?	
What is the vital lung capacity?	
Why can arterial cuts be more serious than venous ones?	
What are the key features of diffusion?	
How are the alveoli adapted to maximise rates of diffusion?	

Core Knowledge 2

What are all living and previously living organisms made of?	
Place the following in size order- molecule, cell and atom	
What happens when a gas reaches equilibrium?	
Label the structure of the respiratory system	
How do we breathe in (ventilate)?	