Why don't worms have lungs?

Key Stage 4 Revision Programme

Pupil Name

Handbook Designed by Dr. L Edwards

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1 (Baseline Test)		3:40pm	TBC
2		3:40pm	S1
3		3:40pm	S1
4		3:40pm	S1
5		3:40pm	S1
6 (Final Test)		3:40pm	S1
7 (Feedback)		3:40pm	TBC

Timetable – Homework Assignments

Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

Uni Pathways – Pupil Feedback Report

Name of PhD Tutor	Dr. L Edwards		
Title of Topic	Diffusion		
Name of Pupil			
Name of School	Harris Academy Orpington		
ORIGINAL MARK / 30		FINAL MARK / 30	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

Learning Feedback Comment 1 - *Being able to describe what diffusion is and give examples*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 2 – *Being able to explain factors that affect diffusion*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Learning Feedback Comment 3 – *Being able to explain how and why organisms have had to adapt to allow diffusion*	
What you did in relation to this Key Learning Priority	How you could improve in the future

Resilience Comment	
How you showed learning resilience during the course	How you could build learning resilience in the future

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Course Rationale

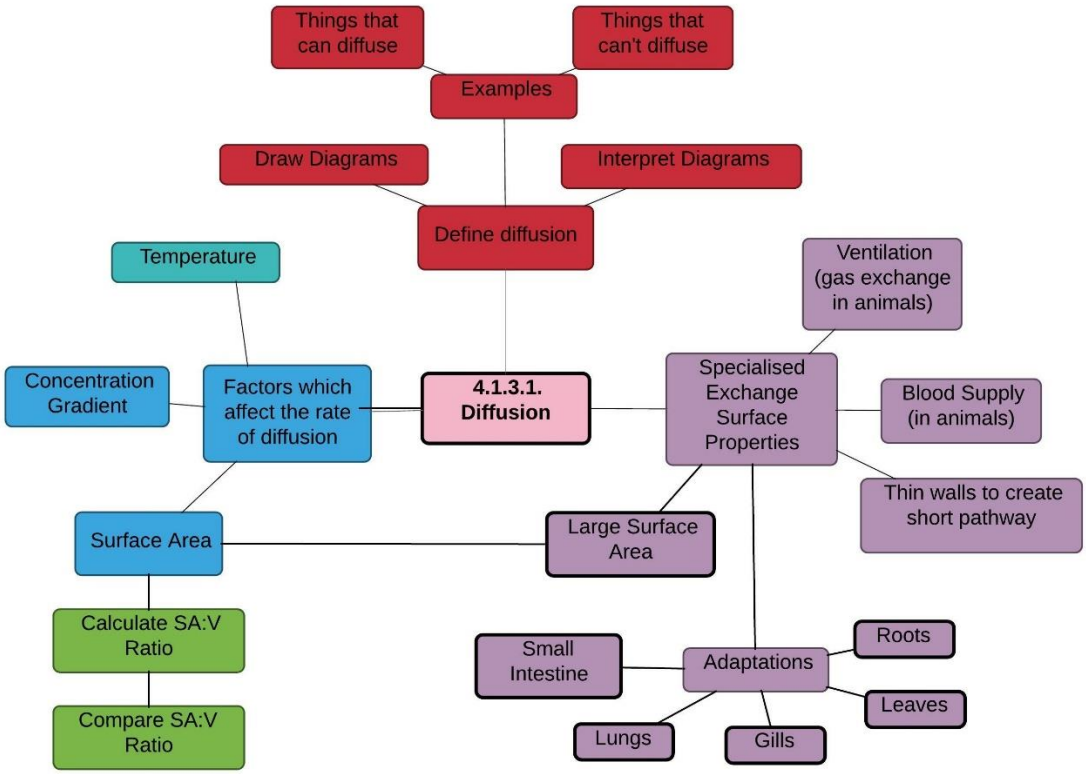
Deliberate practice is defined as practice which is purposeful and systematic instead of just being mindlessly repetitive. The aim is to improve performance by honing specific skills in small chunks which, when put together, can be used to reach a specific goal.

We see the use and perfection of deliberate practice most in sport and the arts. Olympic athletes from gymnasts and tennis players to golfers will all use deliberate practice to perfect small movements or sequences required for them to be excellent at their sport. Andy Murray does not spend training sessions playing tennis matches over and over again, instead, he will spend hours repeatedly practicing serves, or volley shots or just running from one side of the court to the other. By perfecting small parts that add up to the whole set of skills needed to play an entire match he greatly improves his performance as a tennis player overall.

The other benefit of deliberate practice is that the more your brain practices a skill the more it becomes second nature, this means that you are able to complete tasks that you have practiced without thinking too hard about what you are doing. Hopefully, through the deliberate practice of answering questions in each section, you will be able to answer questions based around any section of the topic without having to think too much about it.

The aim of this course is to break down a topic from the biology GCSE specification and allow you to practice answering questions on small parts of it so that you improve your understanding of each part which makes up the bigger picture. This should help you to face questions which require you to draw on a lot of understanding of the small parts in order to answer them well.

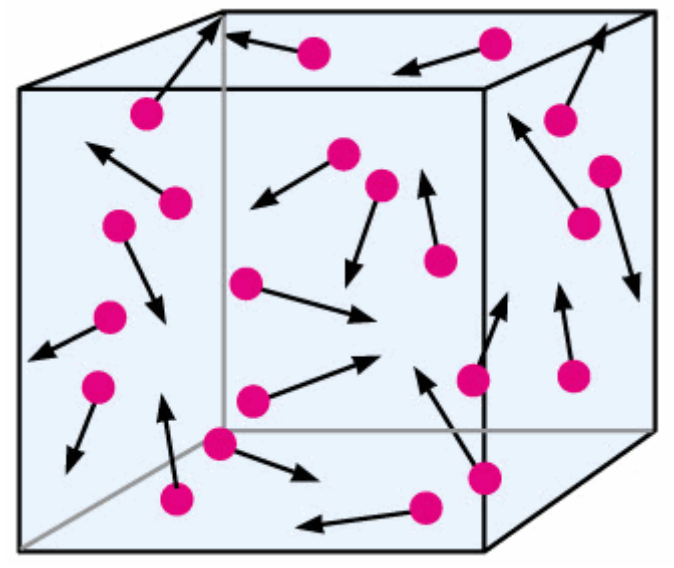
This is particularly tricky in biology as there is a lot of information to learn – but if you understand some of the basic concepts, such as diffusion they link in to a lot of topics including in the other science subjects. The mind map below gives you an idea of how this course was designed and shows you how each part links together. This could be a revision technique you can use when studying other topics in science or other subjects.



Glossary of Keywords

Word	Definition	In a sentence

Tutorial 1 – Defining Diffusion



What is the Purpose of Tutorial 1?

By the end of this tutorial you should be able to:

A) State the rules for particle movement

B) Interpret diffusion diagrams

C) Explain the role of the partially permeable membrane

1. Defining diffusion

Keywords: diffusion, permeable, concentration, gradient, kinetic energy

Objectives this tutorial:

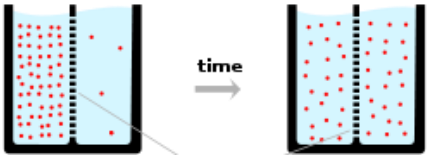
A) State the rules for particle movement (principle construct)

B) Interpret diffusion diagrams

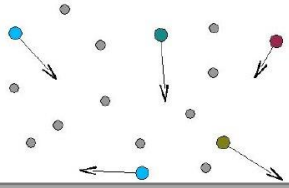
C) Explain the role of the partially permeable membrane

Starter: Consider the two pictures. Which will take more energy and why?

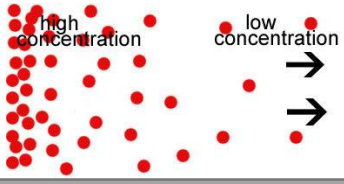
Objective A: The rules of particle movement



Diffusion is the spreading out of particles there must be a **net** (overall) movement.



Particles will spread/move in a **random** and **passive** way – no energy is needed to move them



Particles will diffuse from an area of **high concentration** to an area of low concentration – down a **concentration gradient.**

Examples:

1. Perfume in a room 2. Oxygen from blood into cells 3. Squash/ink when mixed with water

Practice A: The rules of particle movement

1. Use the key words (bold) to describe how particles move.

2. Does diffusion require energy? Explain your answer.

3. Give an example of diffusion.

4. Explain why perfume can be smelled by a person across a room from where it was sprayed.

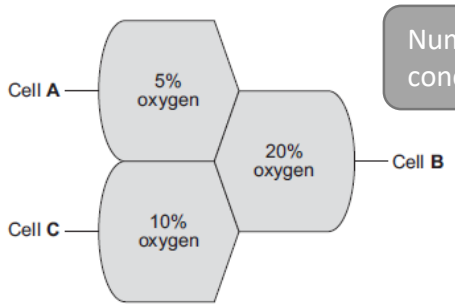
Assessment A: The rules of particle movement

Which statement is incorrect?

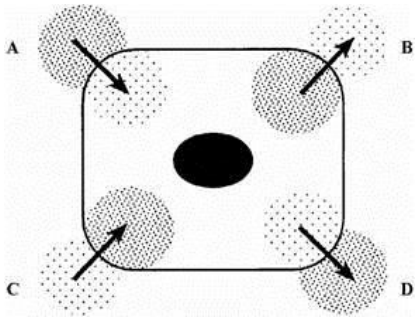
A	Oxygen is at a higher concentration outside cells which are aerobically respiring so it will diffuse in.
B	Particles don't always require energy to move.
C	Particles always move from an area of low concentration to an area of high concentration.
D	Particles always move in a random direction

Objective B: Interpreting diffusion diagrams

Diagrams depicting diffusion can come in two types:



Numerical concentrations



Dotted concentrations

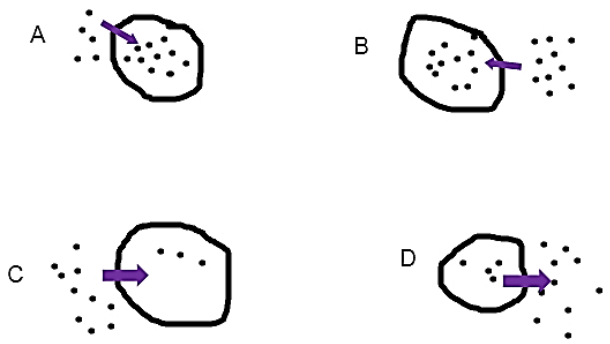
The more dots (particles) the higher the concentration

You need to be able to interpret these two and identify where the **concentration gradient is. S**ometimes there will be arrows to show you the direction the particles are moving in.

They may look like simplified cells (as above) or they may be made to look more like diagrams of specific cells specialised for diffusion such as root hair cells or red blood cells.

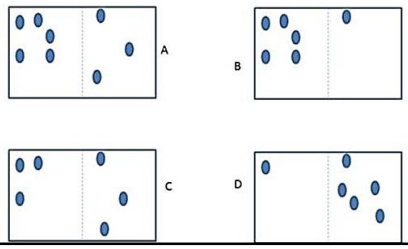
Practice B: Interpreting diffusion diagrams

1. Which diagram is a correct representation of diffusion? Explain your answer

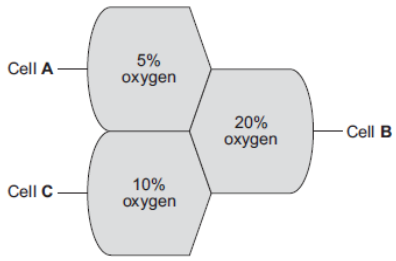


2. Which container has the largest concentration gradient? Explain your answer.

3. In which box would there be no net diffusion once the divider is removed? Explain your answer

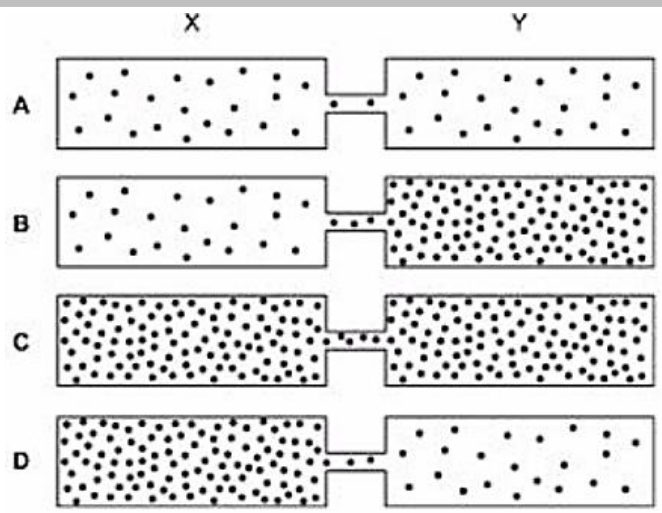


4. Between which cells is there the largest concentration gradient?



5. Draw a diagram to represent particles of oxygen moving into a respiring cell.

Assessment B: Interpreting diffusion diagrams



The dots represent molecules of gas in four tubes at the beginning of an experiment.

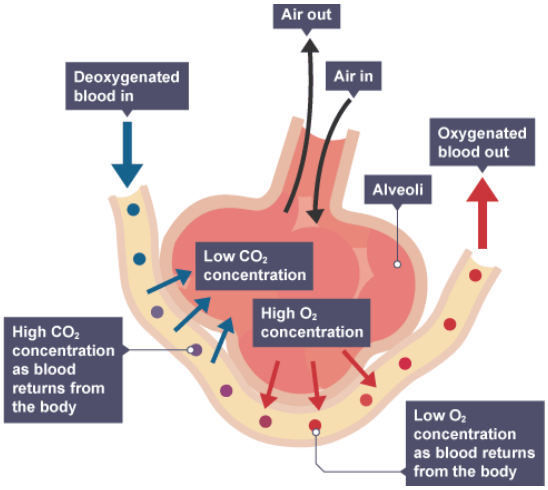
In which tube will more molecules move from X to Y than in the opposite direction? Explain your answer.

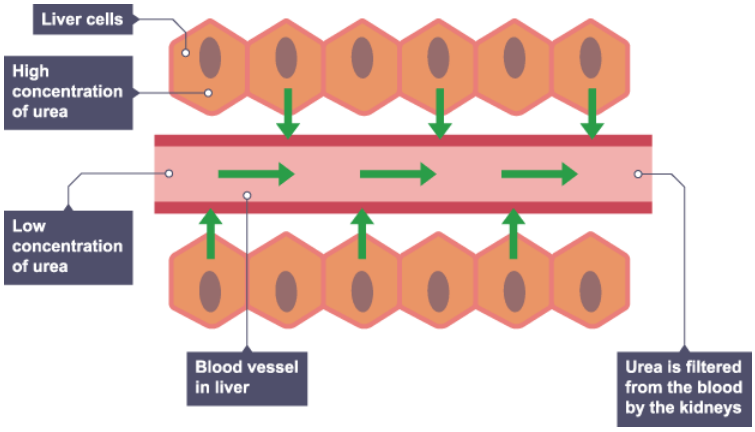
Objective C: The role of the partially permeable membrane

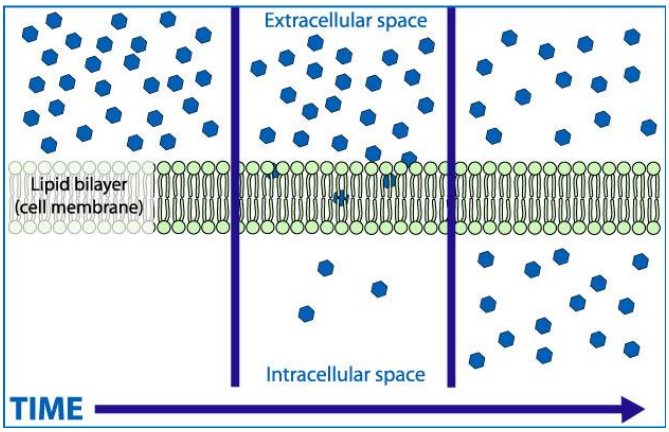
Definition:
Partially permeable membranes are also called **selectively** permeable membranes or **semi-**permeable membranes. They let some substances pass through them (usually small molecules), but not others (usually large molecules).

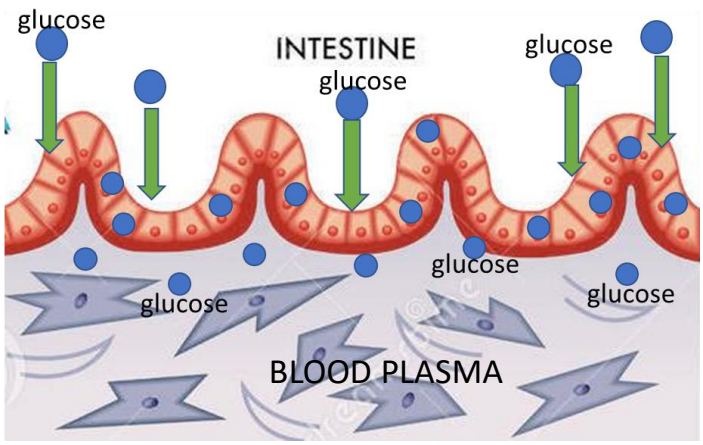
Examples:
Pretty much any cell membrane or barrier (e.g blood vessel wall) in an organism is made of a partially permeable membrane. Small molecules include gases, glucose and urea; large molecules include starch.

1. Wall of small intestine 2. Alveoli in the lungs 3. All plant cell membranes (but not cell walls!)









Practice C: The role of the partially permeable membrane

Which term describes the ability of the plasma membrane to allow some substances to move through and others not?

A. Fluid

B. Mosaic

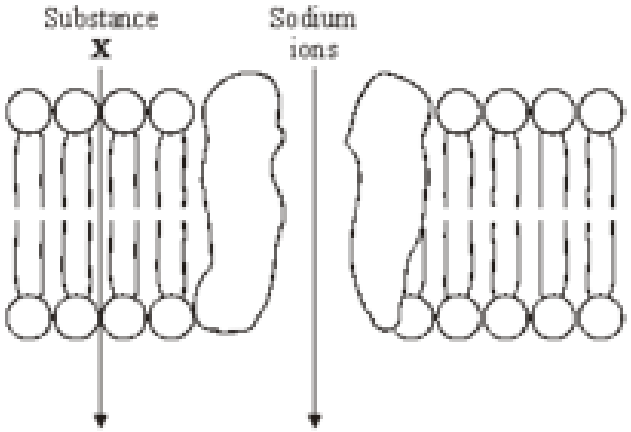
C. Selectively Permeable

D. Flexible passage

Only very small molecules can diffuse through cell membranes. Which are too big to diffuse through?

a) Water & oxygen
b) Starch & proteins
c) Glucose
d) Amino acids

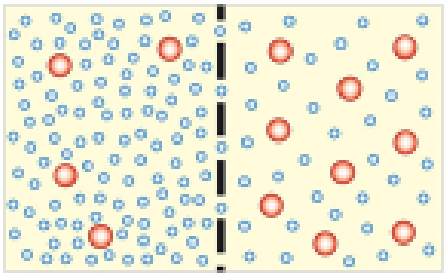
The diagram shows part of a plasma membrane. The arrows show the path taken by Na ions and substance X when they diffuse through the membrane into a cell



Give one property of molecules of substance X which allows them to diffuse through the membrane at the position shown.

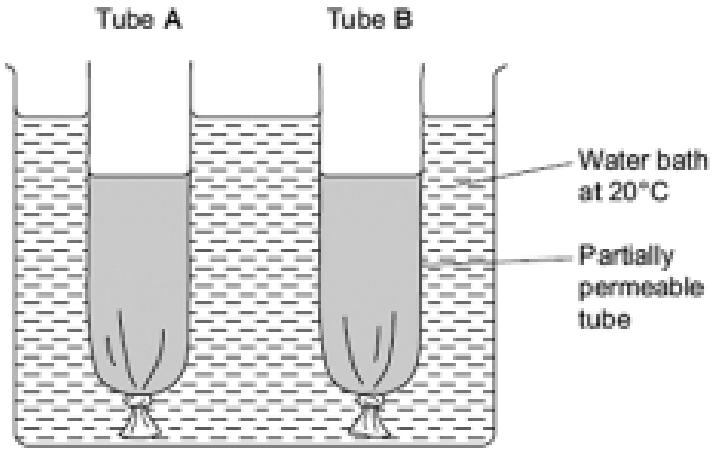
Which two structures in plant cells are selectively permeable?

A Cell membrane and cellulose cell wall
B Cell membrane and sap vacuole membrane
C Cellulose cell wall and cytoplasm
D Cellulose cell wall and sap vacuole membrane



Which particles will diffuse through the membrane? Explain your answer.

Assessment C: The role of the partially permeable membrane



Both tubes contain starch and the enzyme amylase – which breaks starch down into glucose.

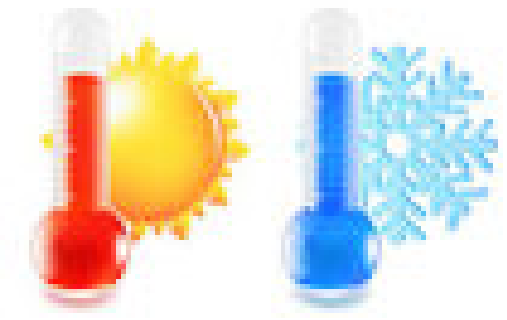
Tube A is **not** a partially permeable membrane.

At the end of the experiment which tube will contain glucose, A or B?

Explain your answer.

Plenary:
Using your knowledge of a semi permeable membrane and diffusion can you explain why dialysis and artificial heart machines have to contain artificial semi permeable membranes.

Tutorial 2 – Factors Affecting Diffusion Rate



What is the Purpose of Tutorial 2?

By the end of this tutorial you should be able to:

A) Explain the effect of temperature on diffusion

B) Explain the effect of concentration on diffusion

C) Explain the effect of surface area on diffusion

2. Factors Effecting Diffusion Rate

Keywords: diffusion, permeable, concentration, gradient, kinetic energy

Objectives this tutorial:

A) Understand how and why temperature effects diffusion
B) Understand how and why concentration effects diffusion
C) Understand how and why surface area effects diffusion

Starter: Consider the two pictures. Which child will slide faster? Explain why.

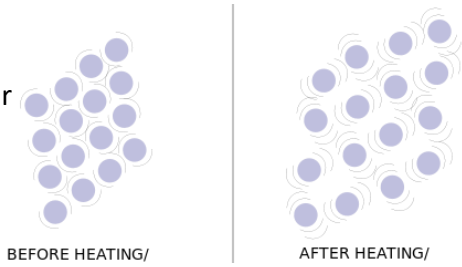
Objective A: Understand how and why temperature effects diffusion

Rules:

- At higher temperatures particles will have higher kinetic energy
- Particles with higher kinetic energy will be able to move around faster

Examples:

1. Dissolving anything in cold water vs warm water
2. Increasing the rate of reaction by increasing temperature



Practice A: Understand how and why temperature effects diffusion

1. Explain, in terms of particles, why a higher temperature causes a faster rate of reaction.

2. If you wanted to speed up water boiling in a saucepan how could you do it? Explain your answer.

3. Is a bad smell more likely to travel in a warm room or a cold room? Explain your answer.

4. What happens to the rate of diffusion as the temperature increases?

5. The diffusion rate differs between gases, liquids and solids because the:
   a) Temperatures are different in each form
   b) Molecules are different sizes in each form
   c) Number of barriers in the molecules way differ
   d) Distance the molecules have to travel before colliding with another molecule differ.

Assessment A: Understand how and why temperature effects diffusion

Scientists test oxygen to see how quickly it diffuses into cells. Under which conditions would they see the fastest diffusion rates?

A	The scientist has it at room temperature
B	The scientist warms the room to 40°C
C	The scientist cools the room to 10°C
D	The scientist cools the room to the freezing point of water

Objective B: Understand how and why concentration effects diffusion

Particles diffusing down a concentration gradient ensures two things:

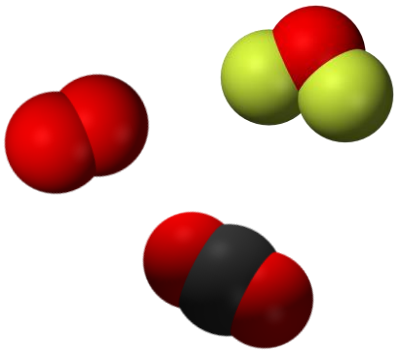
1. Useful substances that are being used up are constantly replaced because they will be in low concentration where they are needed.
2. Waste products do not build up because they will leave cells when their concentration gets too high.

Substances all cells need:
- Oxygen
- Water
- Glucose

Substances animal cells need to remove:
- Carbon dioxide
- Urea
- Water

Substances plant cells need:
- Carbon dioxide

Substances plant cells need to remove:
- Oxygen



Practice B: Understand how and why concentration effects diffusion

Once equilibrium has been reached do the particles:

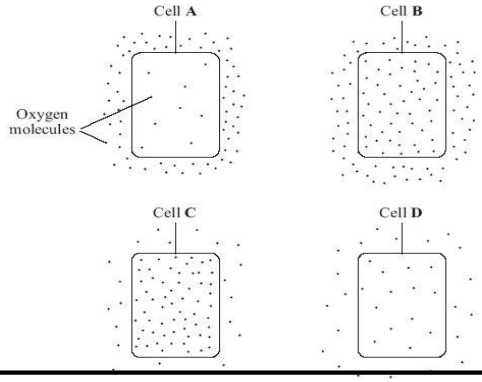
a. Stop moving

b. Continue to move in a single direction

c. Continue to move randomly

d. Lose all their kinetic energy

Into which cell will oxygen diffuse the fastest?



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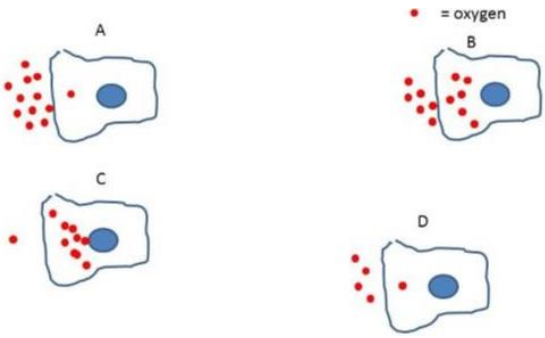

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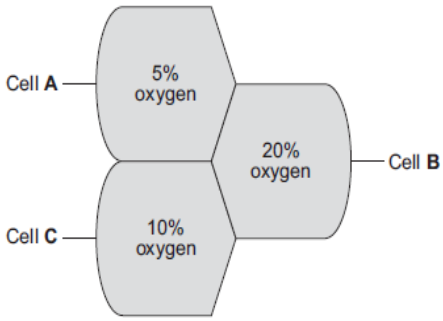


Assessment B: Understand how and why concentration effects diffusion

After diffusion takes place what happens to the concentrations? Select the correct statement

A	The particles continue to move around but keep equal concentrations on both sides (dynamic equilibrium).
B	The particles stop moving and this keeps equal concentrations on both sides (dynamic equilibrium).
C	The particles begin to diffuse back towards the low concentration
D	The particles diffuse back to the high concentration

Objective C: Understand how and why surface area effects diffusion

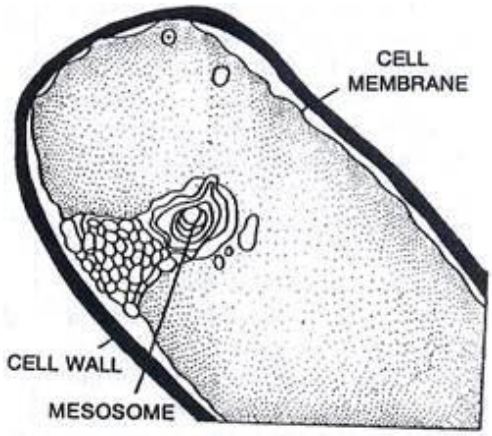


Figure 1. Bacteria with mesosome

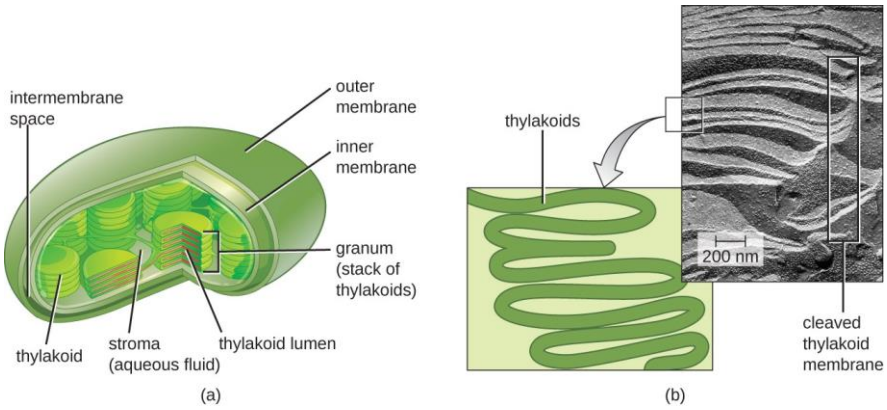


Figure 2. Folded thylakoid membrane in chloroplasts

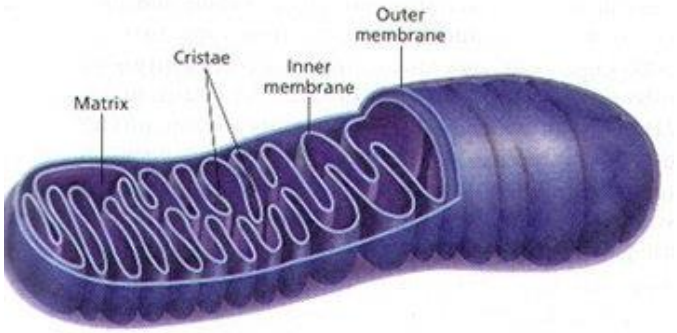


Figure 3. Folded cristae in mitochondria

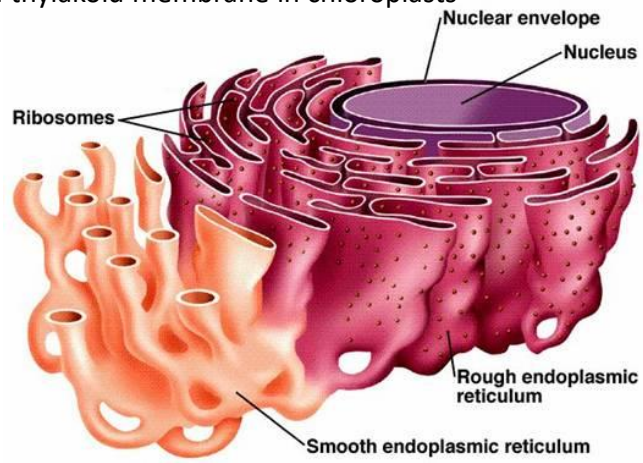


Figure 4. Folded endoplasmic reticulum

Diffusion happens across partially permeable cell membranes. These can be external membranes but also internal ones separating structures within cells.

Increasing the surface area of a membrane increases the amount of space diffusion can happen across because there is more space for particles to move through. Folding membranes gives a high surface area.

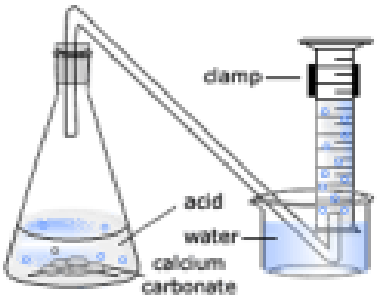
As a result of this folded membranes have evolved from prokaryotic cells (mesosomes – Figure 1) where they are primitive and used for multiple purposes; to the specialised membranes in chloroplasts (thylakoid – Figure 2) which increases the rate of photosynthesis and mitochondria (cristae – Figure 3) which does the same for respiration. Other membrane structures within cells also exhibit lots of folds such as the endoplasmic reticulum (Figure 4) where proteins are made.

Practice C: Understand how and why surface area effects diffusion

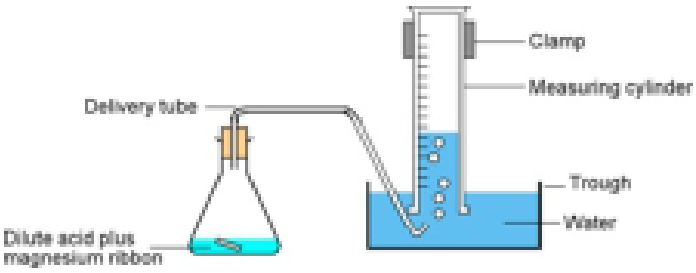
1. Food is absorbed into our blood through the small intestine. If the surface area of the small intestine is decreased what will happen to the amount of food we take into out blood?

A) It will go up
B) It will stay the same
C) We won't be able to take any food into our blood
D) Less food will be taken in

2. Explain, in terms of particles and collisions, the effect that increasing the surface area of the marble chips(calcium carbonate) has on the rate of reaction in the experiment shown.

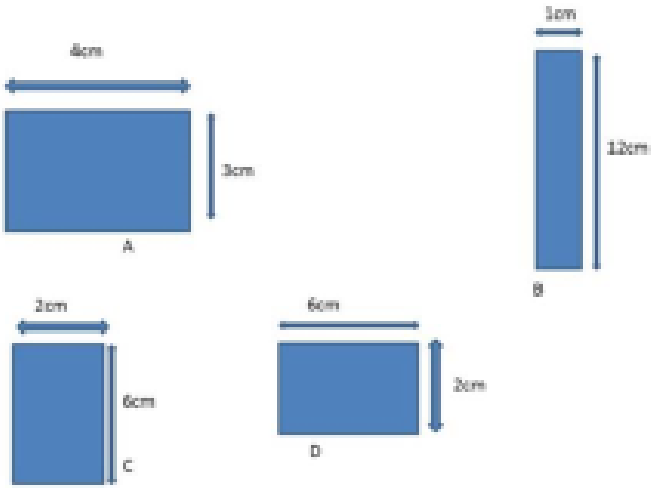


3. The experiment shown was repeated with different concentrations of acid. What should the students control about the magnesium in order to make sure the results are comparable? Explain your answer.



4. The folding of the cristae in mitochondria of people with Parkinsons disease tend to be deformed compared to normal mitochondria. How might this affect the person suffering with this disease?

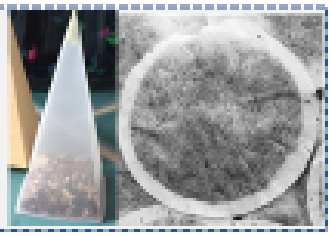
Assessment C: Understand how and why surface area effects diffusion



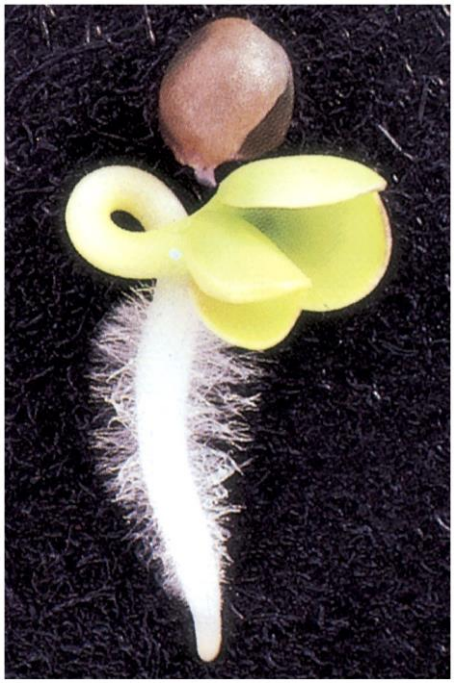
Into which model cell will diffusion occur the fastest?
Explain your answer

Plenary: The photos show two different types of tea bags.
Use your knowledge about diffusion so far to explain:

1. How teabags work
2. How the type of bag and the temperature of the water used might effect the making of a cup of tea.



Tutorial 4 – Adaptations of Exchange Structures



What is the Purpose of Tutorial 4?

By the end of this tutorial you should be able to:

A) State the rules for particle movement

B) Interpret diffusion diagrams

C) Explain the role of the partially permeable membrane

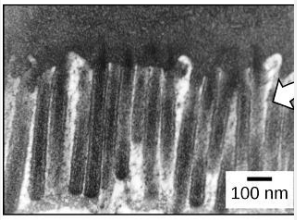
3. Adaptations of Specialised Exchange Structures

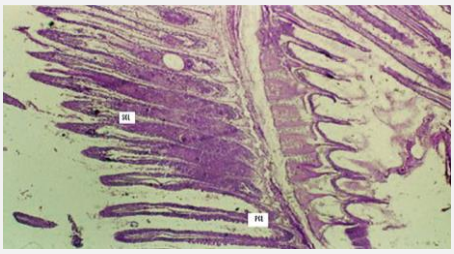
Keywords: diffusion, permeable, concentration, gradient, kinetic energy

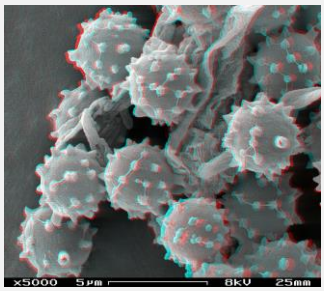
Objectives this tutorial:

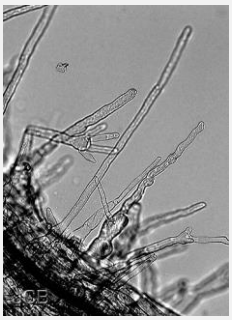
A) State how cells and tissues can be specialised to increase surface area.
B) Describe how transport systems shorten the diffusion pathway
C) Explain why ventilation is important for maintaining the concentration gradient

Starter: Can you group the pictures together based on common features?







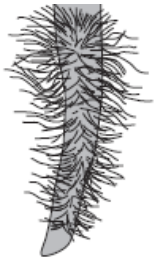


Objective A: State how cells and tissues can be specialised to increase surface area.

How can surface area be increased:

Adaptation	Examples
Folding/uneven surface	Alveoli in the lungs and spongy mesophyll in leaves
Projections	Villi in the small intestine and root hair cells in plants
Increasing number of structures	Large numbers of alveoli, villi, root hairs and layers (lamellae) in fish gills

Practice A: State how cells and tissues can be specialised to increase surface area.



1. Give two ways in which the structure of a fish gill is adapted to increase S.A for gas exchange

2. Give two ways in which the lungs are adapted to increase S.A for gas exchange

3. Which tissue in leaves is adapted to maximise the amount of carbon dioxide that gets into their cells explain how

4. Explain how the lining of the small intestine is adapted to increase S.A for absorbing digested food.

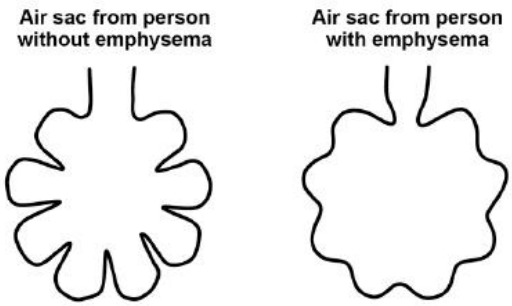
5. How do plants maximise the surface area for water and nutrient absorption from soil?

6. An athlete trains to run a marathon. The surface area of each of the athlete's lungs has increased to 80 m^2. Give one way in which this increase will help the athlete.

Assessment A: State how cells and tissues can be specialised to increase surface area

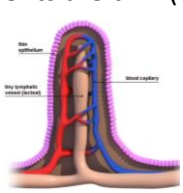
Smoking can cause emphysema. Emphysema causes the walls of the air sacs in the lungs to break down.

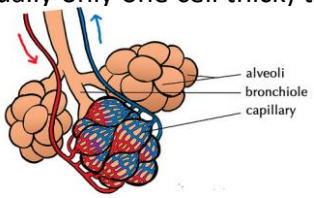
Explain how this will affect the diffusion of gases into and out of the blood.



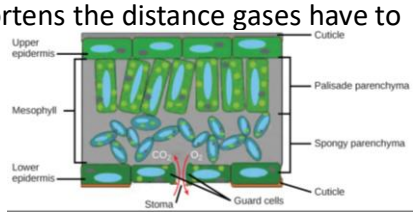
Objective B: Describe how transport systems shorten the diffusion pathway

Shortening the diffusion pathway just means shortening the distance substances have to move speeds up diffusion. Most exchange structures in animals have good blood supply so they are very close to capillaries. Walls of exchange structures such as alveoli, villi and gill filaments are thin (usually only one cell thick) to shorten the diffusion pathway further.





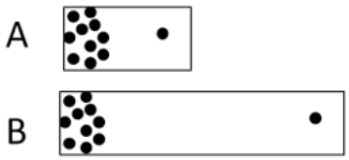
In plants leaves are specialised for this because they are thin which shortens the distance gases have to diffuse to cells and have direct access to gases via their stomata.



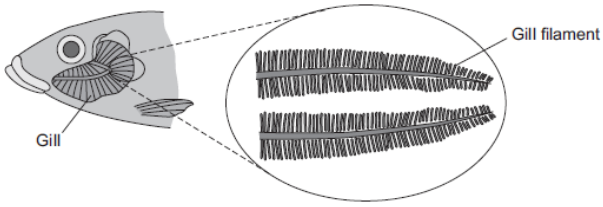
The adaptations of being thin and having one cell thick walls can also be applied to single celled organisms, flatworms and larvae.

Practice B: Describe how transport systems shorten the diffusion pathway

1. Where would diffusion happen quickest? Explain your choice.

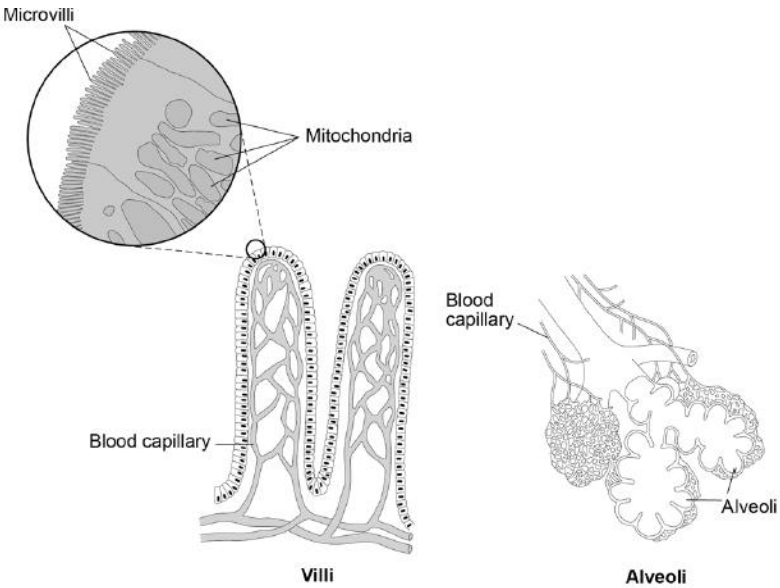


2. Give two ways in which the structure of a fish gill is adapted to speed up diffusion of gases.



3. Give two ways in which alveoli in the lungs are adapted to speed up diffusion of gases.

4. Explain how villi in the small intestine is adapted to speed up diffusion of digested food particles.

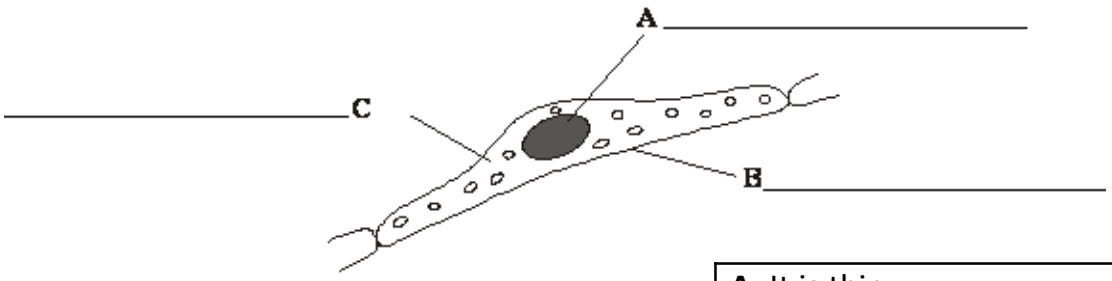


5. Explain two adaptations of leaves which allow faster diffusion of gases.

6. How do plants maximise the surface area for water and nutrient absorption from soil?

Assessment B: Describe how transport systems shorten the diffusion pathway

The diagram shows a cell from the lining of the lung. This cell is specialised to allow gases to pass through quickly.



Which feature of this cell allows oxygen to pass through quickly?

A. It is thin.	
B. It has a large nucleus.	
C. It has many mitochondria.	

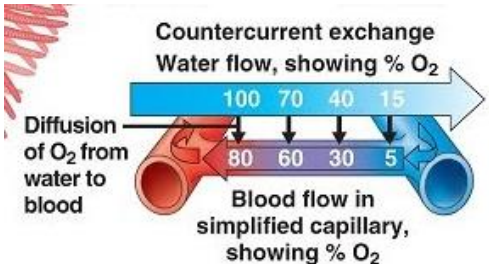
Objective C: Describe how transport systems and ventilation maintain concentration gradients

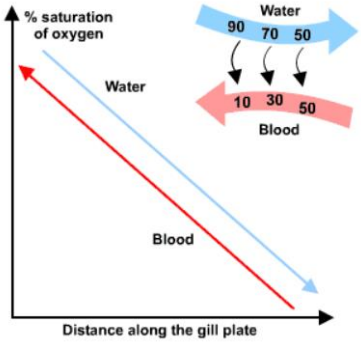
Mammals have developed transport systems (circulatory system) to allow blood to be constantly on the move in order to maintain concentration gradients which ensure an exchange of substances where they need to. Most importantly oxygen and carbon dioxide.

Different systems have evolved depending on whether the animal breathes using air or water.

Fish operate a counter current system:

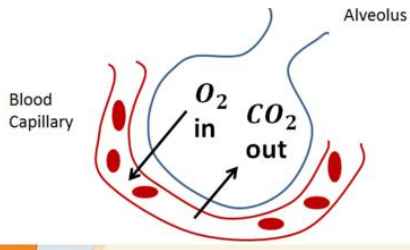
- Water with high O2 concentration is constantly pumped across gill lamellae by the operculum opening and closing.
- Blood is always flowing in the opposite direction to the water.
- This means that blood always flows next to water that has given up less of its oxygen.
- Oxygen will always diffuse from the water to the blood because there is always a higher concentration in the water.
- Even when the blood has a lot of oxygen there is still a concentration gradient – it is maintained.

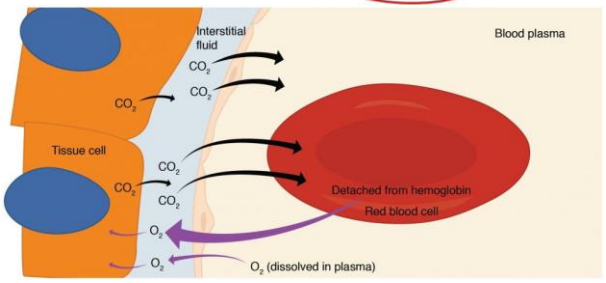




In Mammals blood flows in one direction:

- Breathing makes sure air with a high O_2 concentration is present in the alveoli.
- Blood arrives at the lungs with low O_2 concentration but high CO_2 concentration so O_2 will always diffuse into red blood cells and CO_2 will always diffuse out.
- When red blood cells arrive at tissues that have been respiring they have the higher O_2 concentration and the tissues have low O_2 concentration so gas exchange occurs because the gradient is always maintained.





Practice C: Explain why ventilation is important for maintaining the concentration gradient

1. Complete the paragraph

As we exhale, the concentration of CO_2 in the alveoli will _____. As we inhale, the concentration of O_2 in the alveoli will _____. At this point, the concentration gradient of O_2 will allow it to diffuse from the _____ to the _____. Meanwhile, the level of CO_2 in the blood has _____ due to respiration throughout the body. The concentration gradient of CO_2 will allow it to move from the _____ to the _____. Together, exhalation and inhalation maintain these concentration gradients and this process is known as _____.

Q2. Breathing allows large amounts of oxygen to enter the blood. Explain how breathing does this.

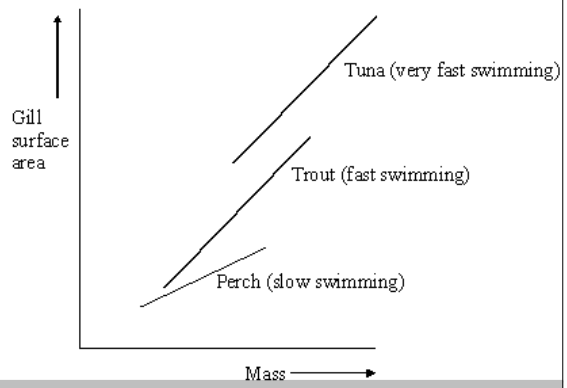
Q3. How does the counter current system in fish maintain the concentration gradient in gill lamellae?

Q4. Explain why ventilation of the lungs increases the efficiency of gas exchange.

Q5. Looking at the graph can you

a) Describe what it shows about the link between gill surface area, mass and swimming speed

b) Explain the relationship between gill surface area and swimming speed.



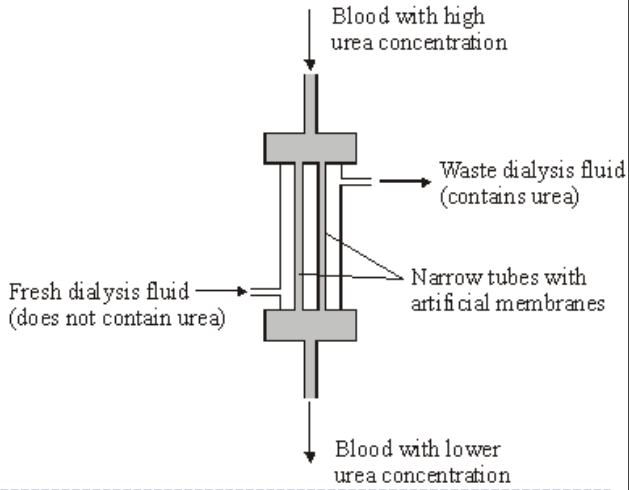
Assessment C: Explain why ventilation is important for maintaining the concentration gradient

Q4. A dialysis machine contains artificial membranes which enable urea to be removed from the blood of a person with kidney failure.

The diagram shows a dialysis machine.

The blood and the dialysis fluid flow in opposite directions in the dialysis machine.

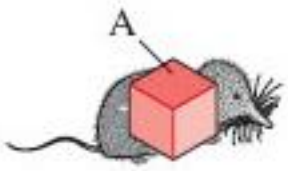
Explain the advantage of this.

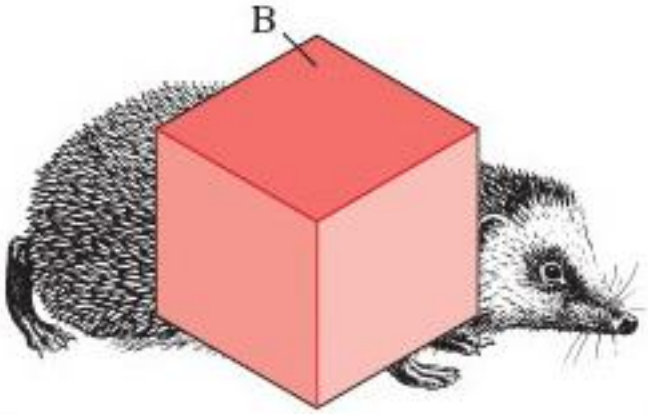


Plenary: Which plant species would you expect to have evolved in a desert/dry environment. Explain why using your knowledge of exchange surfaces.

Plant species	Mean leaf surface area / mm²	Mean leaf thickness / µm	Mean number of stomata per mm²
A	218.0	191.5	380.0
B	17.0	296.3	136.0
C	2.2	354.8	419.0

Tutorial 5 – Surface Area to Volume Ratio





What is the Purpose of Tutorial 5?

By the end of this tutorial you should be able to:

A) Calculate SA:V

B) Compare SA:V

C) Explain importance of exchange structures as adaptations in terms of SA:V

4. Importance of SA:V ratio for diffusion

Keywords: diffusion, permeable, concentration, gradient, kinetic energy

Objectives this tutorial:

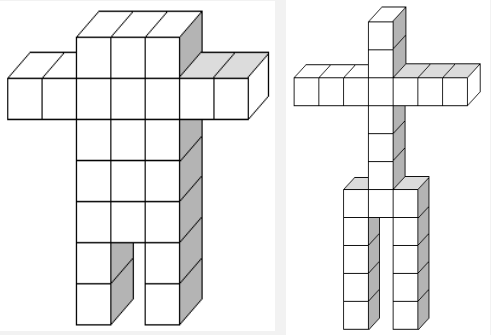
A) Calculate SA:V
B) Compare SA:V
C) Explain importance of exchange structures as adaptations in terms of SA:V

Starter: Consider the two models.

If each cube is 1cm x 1 cm calculate the total volume and S:A of each 'human'

What do you note about the volume of Humans A and B?

Which has a larger surface area?



Objective A: Calculate SA:V

An object's **Surface Area to Volume Ratio** is like a way of describing how close every internal part of it is to its surface. It is worked out by dividing an object's surface area by its volume:

$$S.A:V\ Ratio = \frac{Surface\ Area}{Volume}$$

For example...

Small Cube:

Side length= 1cm

Volume = 1cm x 1cm x 1cm = $1cm^3$

Surface Area = 6 x (1cm x 1cm) = $6cm^2$

S.A.:Vol Ratio = $\frac{6}{1}$ = 6

A high SA:V ratio shows that every part of an object is quite close to the edge.

This means that there is only a short distance from the edge to the middle so things can get in and out quickly.

For example...

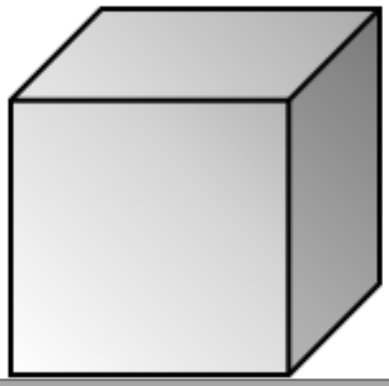
Large Cube:

Side length= 10cm

Volume = 10cm x 10cm x 10cm = $1000cm^3$

Surface Area = 6 x (10cm x 10cm) = $600cm^2$

S.A.:Vol Ratio = $\frac{600}{1000}$ = 0.6



A low SA:V ratio means that there are parts of an object that are a long way from the edge.

This means that there is a longer distance from the edge to the middle so things take a long time to get in and out.

Practice A: Calculate SA:V

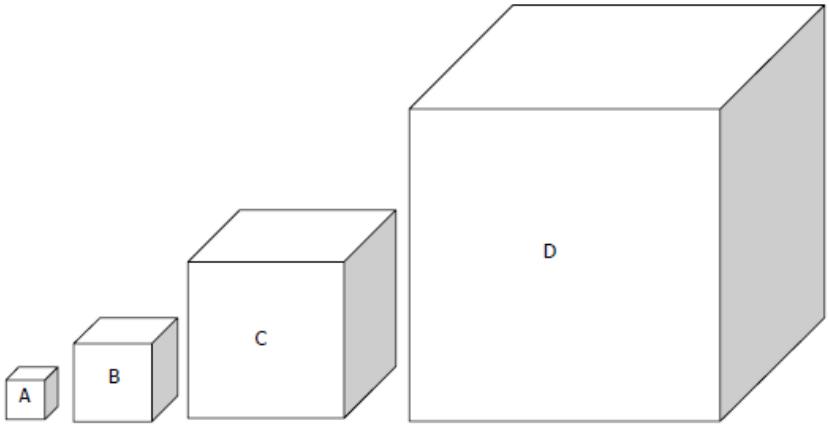
1. Calculate the SA:V ratio for each cube.

Cube	Side Length	Volume / cm^3	Surface Area / cm^2	S.A.:Vol Ratio
A	2			
B	15			
C	0·5			
D	7·5			
E	5			

2. What is the relationship between size and SA:Vol ratio?

3. Use a ruler to measure the side length of each cube then calculate the SA:V ratio for each cube.

Cube A	
Surface Area	
Volume	
S:V ratio (reduced)	
Cube B	
Surface Area	
Volume	
S:V ratio (reduced)	
Cube C	
Surface Area	
Volume	
S:V ratio (reduced)	
Cube D	
Surface Area	
Volume	
S:V ratio (reduced)	



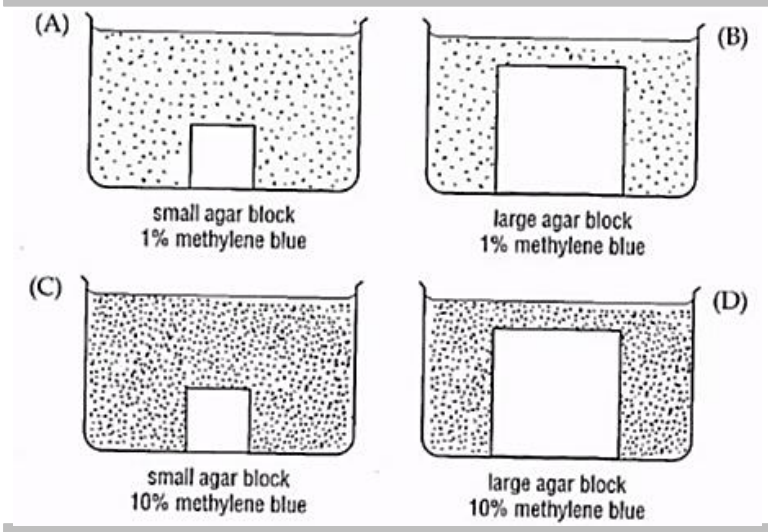
4. What trend do you notice as the size of the cells increases?

Assessment A: Calculate SA:V

Organism	Length	SA (m^2)	Vol. (m^3)	SA / Vol
Bacterium	1µm	6×10^{-12}	10^{-18}	
Amoeba	100 µm	6×10^{-8}	10^{-12}	
Housefly	10 mm	6×10^{-4}	10^{-6}	
Dog	1 m	6×10^{0}	10^{0}	
Whale	100 m	6×10^{4}	10^{6}	

Calculate the surface area to volume ratio of the organisms in the table

Assessment B: Compare SA:V



Four clear agar blocks were placed into solutions of methylene blue as shown.

Which agar block will be the first to become completely stained?

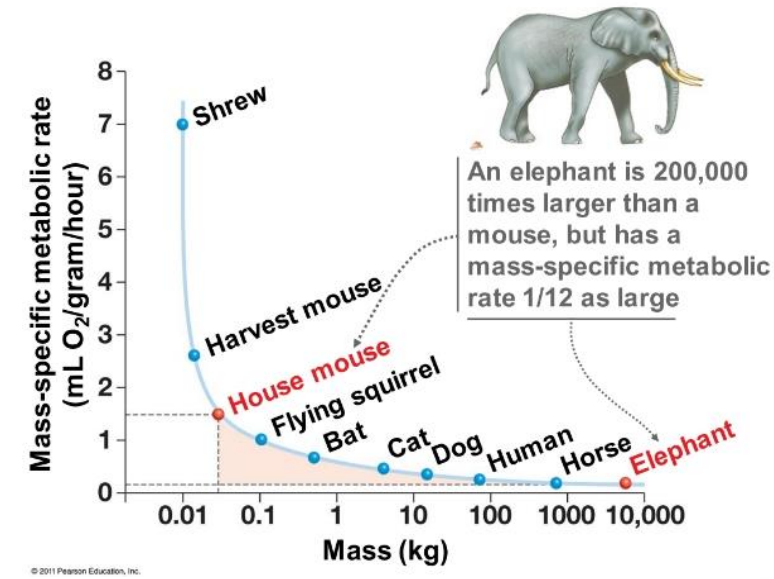
Objective C: Explain importance of exchange structures as adaptations in terms of SA:V

Fick's Law:

$$\text{Rate of diffusion} \propto \frac{\text{surface area x concentration difference}}{\text{distance}}$$

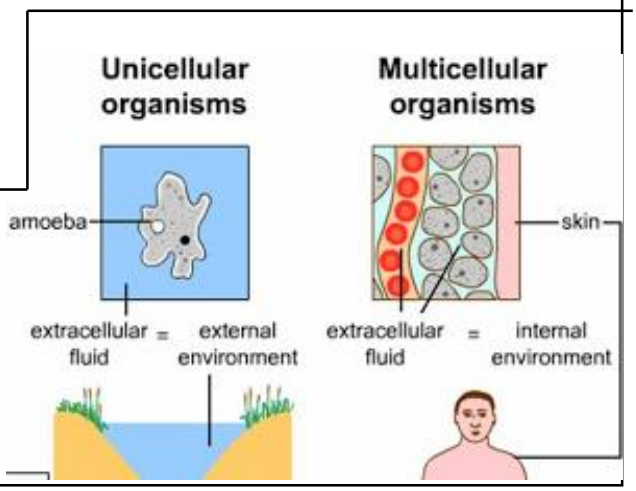
- The rate of exchange of substances depends on the **surface area in contact with the surroundings**.
- As organisms get bigger their **volume increases by the cube** of their size, whilst **their surface area increases by the square of their length**, so **volume increases much faster than surface area.**
- So **as organisms get bigger their surface area/volume ratio gets smaller** so bigger organisms have more difficulty in exchanging materials with their surroundings.

Example: bacteria are all surface with not much inside, while whales are all insides without much surface.



Larger animals lose less energy from respiration as heat because of their small SA:V ratio so they do not require as much oxygen per gram of bodyweight.

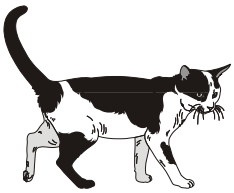
Small organisms can exchange materials directly with their environment but larger organisms have had to create an internal environment and transport systems to get substances in and out to exchange with cells.



Practice C: Explain importance of exchange structures as adaptations in terms of SA:V

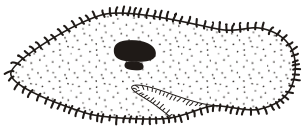
1. Multicellular organisms often have complex structures, such as lungs, for gas exchange. Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

2. The diagram below shows a mammal and a unicellular organism. The transport system in mammals is a double circulatory system driven by a pump (the heart), whilst unicellular organisms have no need for special transport systems.



mammal (cat)

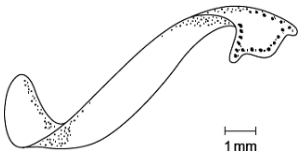
X 0.075



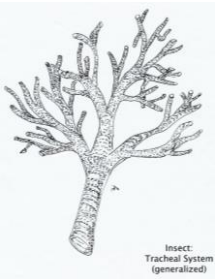
unicellular organism
(Paramecium)
X 300

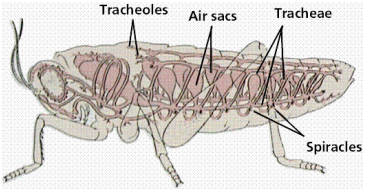
Explain **two** reasons why mammals need a circulatory system whilst unicellular organisms, such as that shown in the diagram, do not.

3. Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems. The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.
Explain how **two** features of the flatworm's body allow efficient gas exchange.

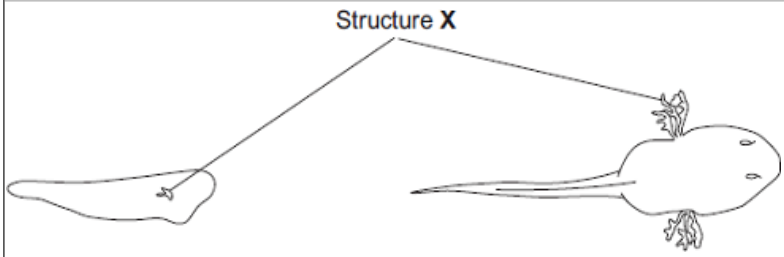


4. Insects are small but they have a waterproof, hard exoskeleton. To carry out gas exchange they rely on a series of tubes called tracheoles which have their ends exposed as spiracles (holes) in the exoskeleton. Explain why insects have had to evolve this system for gas exchange and how tracheoles are adapted to provide efficient gas exchange – use the picture to help you.





Assessment C: Explain importance of exchange structures as adaptations in terms of SA:V



Tadpole just before hatching

Tadpole three days after hatching

The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure **X** helps in the exchange of substances between the tadpole and the water

Suggest how the changes in structure **X** help the tadpole to survive as it grows larger.

Plenary:
The photo shows a Japanese spherical ice ball.

Using your knowledge of SA:V ratio can you explain why ice balls are considered better to use than ice cubes?

Tutorial 6 – Exam Technique Top Tips

1. Always read the question (all parts of it) more than once!

If the first part is confusing because you are not sure what topic it is about or what it is asking you for then read the rest as the whole question will be around a theme.

2. Find and circle or highlight the key words!

These could be already in bold e.g. tick ***one*** *box - this tells you that if you tick more than one you are likely to lose marks!*

Find the command words e.g. ***Compare, Describe, State*** *- these tell you what your answer should be like. E.g. f it is a compare/contrast you will need to write about the similarities AND differences between two things.*

Highlight any ***key information*** *- there should always be something to help you in the question and if you miss or repeat information given to you in the question then you will likely lose marks.*

3. Look at the marks for each question BEFORE you answer!

The marks for each part of the question will give you an idea of how much to write. Examples:

- If it is one mark a short answer is required which usually must contain a key word.

- If it is a two mark 'explain' question you will need to make a point, then give a reason why or how.

- If it is a compare question and there are three marks you will need to give three different similarities or differences between two things.

4. Study any diagrams, graphs or tables and make sure you understand them BEFORE you answer the question!

They will be given to you to help you so use them! Make sure you understand axes of graphs and what patterns they are showing. Look for patterns in tables, think about how it links to the question.

The graphs, diagrams or tables will be there for a reason so even if it doesn't explicitly ask in the question, you should use the information to help you answer the questions. This can include quoting numbers from tables or graphs or describing patterns you can see.

5. For long answer questions (4 marks or more) make a plan before you write!

You can use the space around the question on the paper, the back of the paper or ask for scrap paper in the exam.

Step 1 - identify what the question is asking you for and how many marks

Step 2 - write down as many bullet points/facts/notes as you can that you think are relevant

Step 3 - use your notes to bullet point your planned answer in a logical order - remember PEE

Notes

Notes

Notes

Notes

Why don't worms have lungs?

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