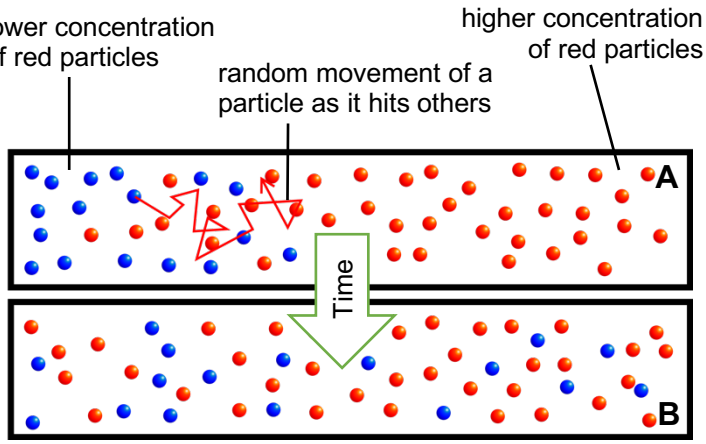
# 5 Diffusion & COVID-19

Links:
- *Exploring Science* 7Gd, 8Ae, 8Cb
- *Edexcel 9-1* CB1h, CB6c, SB8b

## Diffusion

The particles in fluids move in random directions, passing and hitting one another. This makes them spread out; there is an *overall* movement of particles from where there are more to where there are fewer. This is **diffusion**. In diagram A, on average more blue particles are moving to the right, and more red particles are moving to the left.

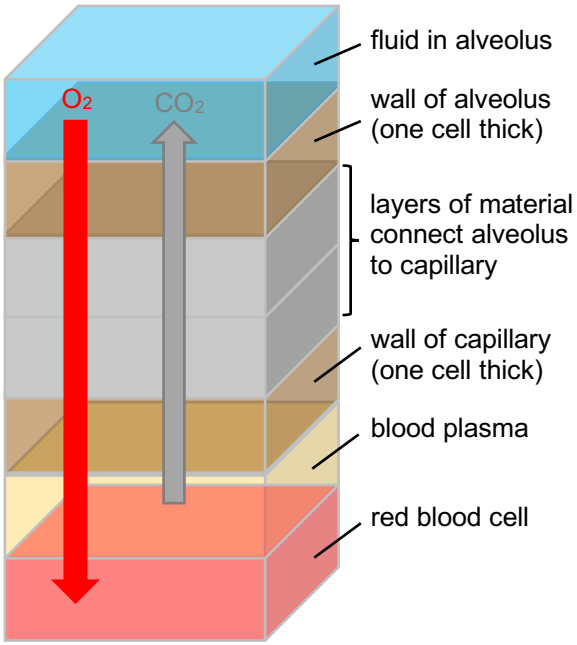



The number of particles in a certain volume is their **concentration**. Particles diffuse from higher to lower concentration. When concentrations are equal, diffusion stops (but particle movement continues).

## Diffusion in the lungs

Oxygen ($O_2$) dissolves into a thin layer of fluid in the **alveoli** of a lung. It then diffuses towards red blood cells. To reduce the time taken for this diffusion, the distance is short.

The large surface area of the alveoli helps more oxygen enter the fluid in a given time, which speeds up diffusion.




## Concentration gradient

Diffusion occurs *down* a **concentration gradient** (the difference between two concentrations). The greater the difference, the *steeper* the concentration gradient and the faster diffusion happens.

People with serious COVID-19 find it difficult to breathe and so less fresh air enters the alveoli. These patients may be given oxygen to help maintain the concentration gradient and allow enough oxygen to continue to diffuse quickly into the blood. The fluid layer also gets thicker, which also reduces diffusion.

### *Find out*

1. Find out the distance between the fluid in an alveolus and the blood. _____

2. a. Name the type of cell that forms most of an alveolus wall. _____

   b. Explain how their shape helps the diffusion of oxygen. _____

   _____

## *Test yourself*

3. The diagram at the top of page 1 shows the positions of particles at different times, A and B.

   a. Give the name of the process that occurs between A and B. _____

   b. Explain whether this process is still occurring at time B. _____

   _____

   c. Give the reason why this process is important in the lungs. _____

   _____

4. Explain how two adaptations of the lungs help to get a good supply of oxygen into the blood.

   i. _____

   _____

   ii. _____

   _____

5. Complete these sentences using *some* words from the box.

| | | | | | |
|---|---|---|---|---|---|
| blood | concentration | decreases | diffuses | down | gradient |
| increases | lungs | shallow | steep | up | |

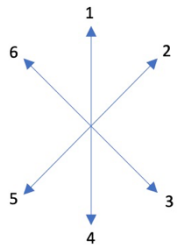
   If there is a large difference in oxygen _____ between alveolus fluid and blood, there is a _____ concentration _____. Oxygen _____ quickly _____ the concentration gradient into the blood. In COVID-19 patients with breathing difficulties, air in the lungs is not replaced very quickly. So, its percentage of oxygen _____ and less oxygen dissolves in the fluid. This _____ the concentration gradient of oxygen. Giving air containing oxygen _____ the concentration gradient again.

6. Explain why a good blood supply is needed for carbon dioxide to diffuse quickly to the lungs.

   _____

   _____

## *Check-up*




I. Check your answers.

II. Find a dice, a pencil and a piece of squared paper. Mark a point in the middle of the paper (where two lines cross). Throw the dice and draw a line in the direction shown in the diagram (up or down one box or across a box). What is this a model for? Describe one way in which it is not a good model.

## *Answers*

**Note to home educators**

The worksheet is designed to support understanding of the importance of diffusion and concentration gradient in gas exchange in the lungs. You may wish to share these objectives with students:

- Explain how diffusion occurs in terms of movement of particles.
- Describe the diffusion of gases between the blood and air (gas exchange).
- Explain how the lungs are adapted for efficient gas exchange.
- Describe how surface area, concentration gradient and distance affect the rate of diffusion. (GCSE)

To access this sheet, students will need a basic knowledge of lung structure and to understand how all materials are composed of particles in a constant state of motion.

It is suggested that students complete the worksheet independently, making use of the internet to complete questions 1 and 2. Questions 3 - 6 should be completed without help from additional sources.

Questions 1 – 4 are accessible by students in Key Stage 3 (Years 7 – 9). Ideas about the factors that affect the speed of diffusion are GCSE content (questions 5 and 6).

Other worksheets in this series are at: https://shwca.se/covid19science

If you wish to check the answers, keep this part of the sheet away from the questions!

I. 1. answers between 0.2 – 7 μm (or 200 – 7000 nm)

2. a. squamous epithelium

b they are very flat; so oxygen has to diffuse less far to pass through them

3. a. diffusion

b. the process is still going on; the particles have unequal concentrations on either side

c. It is the process needed for gases to be exchanged between the air and the blood.

4. Two of the following. It is expected that most students will write about the first two.

• large surface area; to increase the amount of oxygen that dissolves in the fluid

• short distance; to reduce the time for oxygen to diffuse from an alveolus to the blood

• good blood supply; to maintain a concentration gradient (removing oxygenated blood)

5. concentration, steep, gradient, diffuses, down, decreases, increases

II. • This is a model for the random movement of particles, as they hit one another (and bounce off in different directions).

• It is a poor model because the movement is restricted to only six directions; it is a poor model because it shows the particle travelling the same distance before hitting another particle.