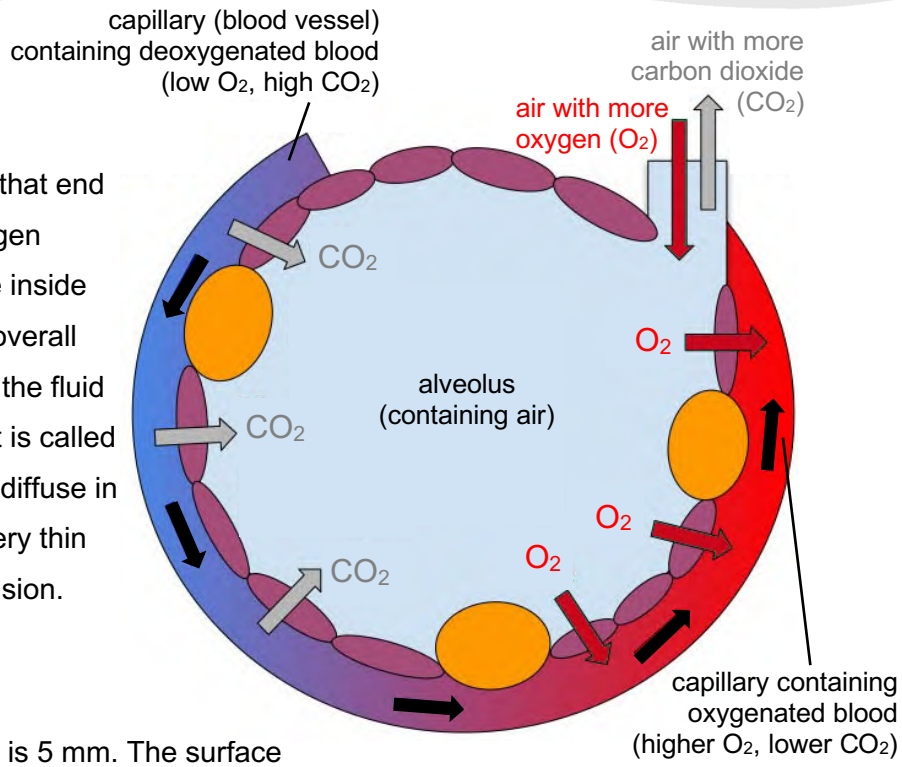
4 Surface area & COVID-19

Links:
- *Exploring Science* 8Ae, 8Cb, 8Cc
- *Edexcel 9-1 GCSE* CB8a, SB8a

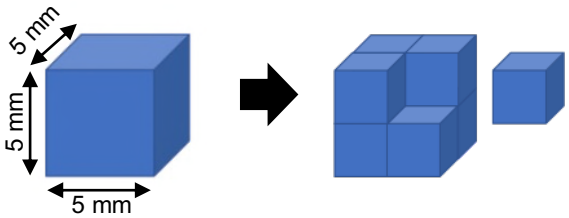
Alveoli

Your lungs contain 2400 km of tubes that end in miniscule bags called **alveoli**. Oxygen dissolves in a thin layer of fluid on the inside wall of an alveolus. There is then an overall movement of oxygen molecules from the fluid into the blood. This overall movement is called **diffusion**. Carbon dioxide molecules diffuse in the opposite direction. Alveoli have very thin walls (one cell thick) to speed up diffusion.



Surface area

Each side of the big cube on the right is 5 mm. The surface area of one face is $5 \times 5 = 25$ mm^2. It has six faces and so its **surface area** is $6 \times 25 = 150$ mm^2. If the cube is split into eight cubes, we increase the total surface area. 500 million alveoli increase the inside surface area of your lungs to that of a tennis court, and so allow faster gas diffusion.



Surface area : volume ratio (SA:V)

The round shape and tiny size of an alveolus give it a large surface area compared to its volume; it has a high **surface area : volume ratio** (**SA:V**). The higher this ratio, the more surface there is for a given volume of molecules to enter and leave. Diffusion is faster in structures with high SA:V ratios.

In patients with serious forms of COVID-19, the alveoli become swollen and fill with fluid. This slows the diffusion of the gases and patients may need to receive air containing more oxygen.

Find out

1. Find the name of the condition in which:

   a. fluid starts to collect in the alveoli _____

   b. capillaries leak a lot of fluid into the alveoli. _____

Test yourself

alveoli		decrease
faster	increase	into
nitrogen		out of
oxygen		slower

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

   The lungs are full of _____, which _____ the surface area of the insides of the lungs. This allows _____ diffusion of gases (carbon dioxide _____ the blood capillaries and _____ into them).

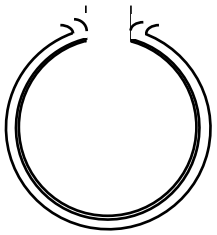
3. The diagram shows an alveolus and a capillary.
   a. Describe two ways in which the alveolus is adapted to speed up the diffusion of gases.

   _____

   _____

   _____

   _____

   b. Add to the diagram to explain how diffusion of gases can be reduced by COVID-19.

4. The big cube on page 1 has sides of 5 mm and so a volume of 125 mm^3 ($5 \times 5 \times 5$).

   a. Calculate its SA:V ratio. (Divide the surface area by the volume. There are no units.)

   big cube
   SA:V ratio = _____

   b. The cube is split into eight cubes of equal size. Calculate the SA:V ratio of a small cube.

   small cube
   SA:V ratio = _____

   c. Both the big and small cubes contain a gas. 10 mm^3 of gas diffuses out of each. Explain which cube this happens faster in, or whether there be no difference.

   _____

   _____

Check-up

I. Check your answers.

II. Plan an experiment to compare how quickly the same volume of water evaporates from open containers of different width. Predict what will happen and explain your prediction.