



Key Stage 3 (Year 7 & 8) BIOLOGY, CHEMISTRY

Lesson 4: "Diffusion and pollutants"

Length of Lesson: 1 hour 15 minutes

National Curriculum in England, for teaching from September 2015

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381754/SECONDARY_national_curriculum.pdf *Biology page 60, Chemistry page 62 & 63*

CURRICULUM

Biology

The structure and function of living organisms:

- Role of diffusion in the movement of materials in and between cells.

Gas exchange systems

- Structure and function of the gas change system humans

CURRICULUM

Chemistry

Pure and Impure Substances:

- Diffusion in terms of the Particle Model

Earth and Atmosphere

- The composition of the atmosphere.

LESSON PLAN

Before starting this lesson, it would be helpful if the class has already learnt about the mechanisms of breathing, and the movement of gases from the alveoli in the lungs into the blood system to feed the cells.

Part 1: Students will be briefly explained about diffusion in animal cells and the way that oxygen and carbon dioxide move around the body.

Next, students will do a short pop quiz around what they have just learnt about diffusion. This should take about 10 minutes. After the pop quiz, the teacher will read out the answers, and explain the "Diffusion of Anthropogenic pollutants in the air" to the class.

Students should be informed that there are many pollutants in the air in London, and that we inhale these as well, and that this makes us ill and alters our ability to fully develop.

Part 2: In this part, students will be introduced to the Deliver Change AirSensa data. Teachers can either retrieve the data from their school's own individual device, if applicable, or use a prepared data set provided by Deliver Change. This data will be able to show the type of air pollutants in the area, their abundance and their levels at various times of day. Students are asked to take a look at the data and answer some questions.

After about 10 minutes, ask each group to come up with a local community project around improving air quality in the area.

Each team will be asked to answer three questions, which they will write down on the poster paper before presenting in front of the class.

End the class by asking which project they think would work best. Maybe the class can even present it to the principal and get the project brought into action!

There is a homework activity for students to complete where they are asked to complete one of two tasks.

LEARNING OBJECTIVES

1. Students will learn that diffusion happens in the air around us.
2. Students will understand that human made pollutants are harmful to our bodies and move around the air.
3. Students will learn that pollutant concentration varies at different times of day.

LESSON REQUIREMENTS:

- Paper for pop quiz and producing drawings
- Pencils,
- Ruler,
- Eraser
- AirSensa data

Part 1

Diffusion - Catch up

Diffusion in Animal Cells:

The cells in our body need glucose and oxygen for respiration. Both of these are carried in the blood. When blood reaches the cells the molecules of glucose and oxygen diffuse out of the blood and into the cells.

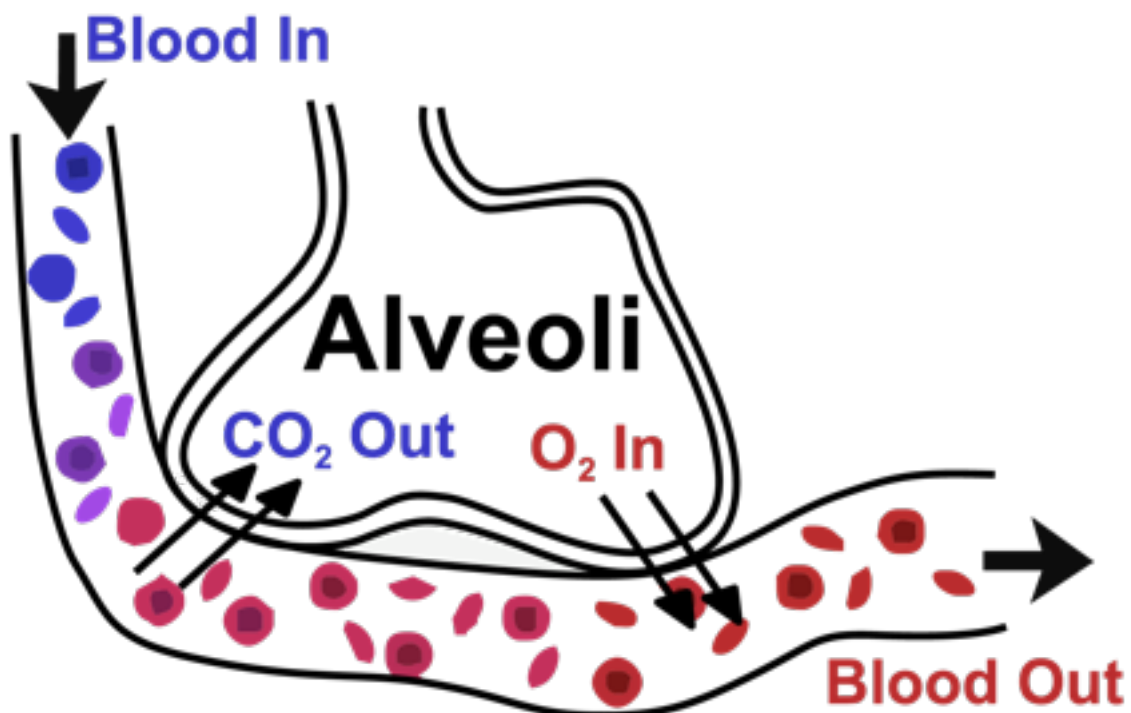
As cells use up the glucose and oxygen they produce waste chemicals and carbon dioxide. If these were to build up in the cells they would poison them, therefore they diffuse out of the cells into the blood.

The body is in a continual process of particle delivery and exchange, enabled by the transportation system of the blood.

Cells require Oxygen for respiration and in doing so produce Carbon Dioxide as a waste product. It is important to understand that O_2 is exhaled into the lungs, and gets transported into the blood to our cells, so our bodies and function properly. Carbon dioxide leaves the cells to go into the blood stream to enter the lungs, and it is this that we exhale.

In the diagram below we see how the deoxygenated blood (which is high in CO_2) sees the CO_2 diffuse into the alveoli that is temporarily a site of low CO_2 and high O_2 concentration. At the very same time, the O_2 in the alveoli diffuses out of the alveoli and into the cells in the blood where there is low O_2 concentration. This exchange is happening continually whilst we are alive!

Deoxygenated and Oxygenated Blood



Diffusion

Pop Quiz!

Questions:

- When does diffusion occur?
- From which area of concentration do particles spread to (low to high, or high to low?)
- Can you name an example of when particles diffuse?

Answers:

- Diffusion occurs when particles spread. They move from a region where they are in high concentration to a region where they are in low concentration. Diffusion happens when the particles are free to move. This is true in gases and for particles dissolved in solutions.
- Particles diffuse down a concentration gradient, from an area of high concentration to an area of low concentration.
- For example:
 - Oxygen Particles diffuse out of the alveoli (lungs) and into the blood, and carbon dioxide diffuses out of the blood and back into the alveoli (lungs) which we breathe out.
 - When the smell of cooking travels around the house from the kitchen, this is also particle diffusion.

Diffusion of Anthropogenic pollutants in the air.

In the case of anthropogenic pollutants, diffusion is still the process by which gases travel around the nearby area. Thus gaseous pollution produced in one area can affect the environment and organisms in other areas.

Remember, particles continue to move from a high to a low concentration while there is a *concentration gradient*. When the particles are equally diffused the process of diffusion stops.

The composition of the atmosphere

In certain parts of the world, where it is very urban or where there is a lot of industry, we often inhale other gases such as nitrogen oxides, carbon monoxide and sulphur dioxide.

Some of these substances (called pollutants) are directly harmful to humans.

For example, carbon monoxide reduces the amount of oxygen that blood can carry.

Sulphur dioxide, for instance, is particularly harmful to the environment by causing harm to humans indirectly through producing acid rain.

Key Words:

Particles; Concentration gradient; Diffuse;

Part 2

Accessing the AirSensa data

If a school has its own AirSensa, the individual AirSensa data can be accessed by adding in the school specific log-in code, that is shared with the head teacher or head of faculty. If you (the teacher) have not yet received access to the log-in code and data please contact the individual who is responsible for the AirSensa and it's data.

Once you have typed in the log-in code you will see a dashboard page which contains graphs of key air pollutants, with their level of pollution against a time gradient. Teachers can alter the time average by adding in the time-frame of pollutant measurements in the task bar at the top of the page. The data can also be downloadable as an Excel CVC file, allowing students to draw their own graph, if applicable.

If the school does not have its own individual AirSensa, Deliver Change will be able to supply a prepared data set for students to work with. In this case, please contact info@deliverchange.org to receive this information.

Questions for students:

Using the graphs available, please write down for each pollutant, the time of day when the most pollution is recorded.

Please state a season why you think this may be the case (think about the type and amount of activity that goes on the road).