**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.

**DEODORANT**

**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**

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.

**DEODORANT**

**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. |  |  |  |  |

*Biology > Big idea BCL: The cellular basis of life > Topic BCL1: Cells > Key concept BCL1.4: Diffusion and the cell membrane*

|  |
| --- |
| **Diagnostic question** |
| **Deodorant** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Molecules move through the cell cytoplasm by diffusion, and some molecules can enter and leave a cell by diffusing through the cell membrane. |
| Observable learning outcome: | Explain diffusion as the net movement of particles from an area of their higher concentration to an area of their lower concentration. |
| Question type: | Confidence grid |
| Key words: | diffusion, particle, net movement, concentration gradient |

**What does the research say?**

Various researchers (Odom, 1995; Tomažič and Vidic, 2012; Stains and Sevian, 2015; Oztas and Oztas, 2016) have used diagnostic questions to reveal common misunderstandings about diffusion in school children that can persist in students up to university level, including that:

* molecules in an area of high concentration want to spread out, or move to seek out an area with more room;
* molecules move only in one direction, from an area of higher concentration to an area of lower concentration (a failure to understand the random movement of particles versus the concept of *net* movement);
* movement of particles stops after the concentration gradient between two areas has been equalised by diffusion (possibly because students interpret “no net movement” to mean “no movement of particles”);
* diffusion of a substance through a solvent requires a chemical reaction, or occurs because the substance splits up into smaller bits that mix with the solvent.

Some students believe that diffusion requires an external force or mechanical event (rather than resulting from the intrinsic movement of particles), a misunderstanding that may be linked to students’ everyday experiences of stirring and dissolving, such as stirring sugar into tea (Çalýk, Ayas and Ebenezer, 2005; Stains and Sevian, 2015).

Students can struggle to understand and explain diffusion because of the apparent disconnect between what happens at the macroscopic level and what happens at the particle level – e.g. molecules collide and move in random directions and do not stop, but there is net movement from high concentration to low concentration until equilibrium is reached (AlHarbi et al., 2015; Stains and Sevian, 2015).

**Ways to use this question**

Students should complete the confidence grids individually. This could be a pencil and paper exercise, or you could use the presentation with an electronic voting system or mini white boards.

*Differentiation*

You may choose to read the statements to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

*Part 1*

1. The deodorant moves across the classroom because of the wind – **wrong** (in a still room, the movement is due to diffusion of the deodorant molecules; no external force or mechanical event is required)
2. The deodorant reacts with the air, making it smell nice – **wrong** (diffusion does not involve a chemical reaction, only movement of molecules)
3. The deodorant splits into little bits and mixes with the air – **wrong** (the deodorant is a gas which is already made up of molecules; it is not a continuous substance that has to split)
4. The deodorant molecules move through the air by diffusion – **right**
5. The deodorant molecules need to spread out so they have more space – **wrong** (the molecules move randomly in all directions, and they do not need, want or choose to move in any particular direction; the spread from the front of the classroom to the back is a *net* movement, though molecules are moving in all directions)

*Part 2*

1. The deodorant molecules move in one direction, from the front of the classroom to the back – **wrong** (the spread from the front of the classroom to the back is a *net* movement, though molecules are moving in all directions)
2. The deodorant molecules collide with each other and molecules in the air – **right**
3. The deodorant molecules are most concentrated when they first come out of the spray can – **right**
4. There is net movement of deodorant molecules from an area of low concentration to an area of high concentration – **wrong** (the net movement is from high to low concentration)
5. The deodorant molecules stop moving when they have spread out – **wrong** (once the concentration of deodorant molecules reaches equilibrium between the front and back of the classroom there will be no further *net* movement, but the molecules will continue to move randomly in all directions)

**How to respond - what next?**

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs. Responses often work best when the activities involve paired or small group discussions, which encourage social construction of new ideas through dialogue.

Researchers have described constructivist approaches that enable students to build their own explanations of diffusion, which may help to develop students’ understanding and overcome misconceptions, including use of physical models and role play (Krajšek and Vilhar, 2010; Haddad and Baldo, 2010; Winterbottom, 2011; Kutzner and Pearson, 2017), group discussion and challenging students to apply concepts they have been taught to make predictions (Christianson and Fisher, 1999). The following BEST ‘response activities’ facilitate these types of activities and could be used in follow-up to this diagnostic question:

* Response activity: Modelling diffusion
* Response activity: PEOE – Dye in water

If students have misunderstandings about the arrangement, spacing and motion of particles in substances, a range of diagnostic questions and response activities to further probe and develop students’ understanding are provided in the following BEST key concept:

* Key concept: CPS1.1 *Particle model for the solid, liquid and gas states*

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Images: pixabay.com/Elionas (1435214)

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