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A LEVEL
Transition Guide

BIOLOGY B (ADVANCING BIOLOGY)

H422
For first teaching in 2015

KS4–KS5 Focus
Transport across membranes

Version 2

www.ocr.org.uk/biology

Introduction

A LEVEL
BIOLOGY B (ADVANCING BIOLOGY)

Key Stage 4 to 5 Transition guides focus on how a particular topic is covered at the different key stages and provide information on:

- Differences in the demand and approach at the different levels;
- Useful ways to think about the content at Key Stage 4 which will help prepare students for progression to Key Stage 5;
- Common student misconceptions in this topic.

Transition guides also contain links to a range of teaching activities that can be used to deliver the content at Key Stage 4 and 5 and are designed to be of use to teachers of both key stages. Central to the transition guide is a Checkpoint task which is specifically designed to help teachers determine whether students have developed deep conceptual understanding of the topic at Key Stage 4 and assess their 'readiness for progression' to Key Stage 5 content on this topic. This checkpoint task can be used as a summative assessment at the end of Key Stage 4 teaching of the topic or by Key Stage 5 teachers to establish their students' conceptual starting point.

Key Stage 4 to 5 Transition Guides are written by experts with experience of teaching at both key stages.

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Key Stage 4 Content

GCSE content

- Explain the net movement of particles across partially permeable membranes by diffusion and osmosis, as a consequence of random movement of particles and in terms of concentration gradient.
- Investigate factors affecting the rate of diffusion and osmosis.
- Describe the consequences of osmosis in plant and animal cells.
- Explain the process of active transport in terms of moving particles across a membrane against their concentration gradient, using energy from respiration.

Key Stage 5 Content

A Level Content

- The movement of molecules across plasma membranes, to include: diffusion and facilitated diffusion as passive methods of transport across membranes, and active transport, endocytosis and exocytosis as processes requiring ATP as an immediate source of energy.
- Practical investigation(s) into factors affecting diffusion rates in model cells.

Comment

At GCSE movement of particles across membranes is restricted to simple diffusion, osmosis and active transport. Limited knowledge of the structure of the plasma membrane is required, other than that it is partially permeable and has the ability to pump ions across it using energy from respiration. Additionally, the process of osmosis is usually only considered in terms of relative concentrations of water particles. The progression to A-level demands that students have a detailed understanding of the structure of the plasma membrane, and how this relates to its function in the transport of molecules and ions across it. The concept of water potential, as opposed to water concentration, is usually introduced at this stage and the additional processes of facilitated diffusion, endocytosis and exocytosis are met for the first time.

At GCSE misconceptions are common. Students often have difficulty understanding the terms 'net' movement and 'concentration gradient', they struggle to differentiate between 'passive' and 'active' processes; and they frequently confuse concentration of 'particles' with concentration of 'solution'. Additionally, many students will also answer osmosis questions in terms of sugars diffusing across membranes rather than recognising that osmosis of water particles will occur instead. An awareness of these issues is essential to your teaching approach, and it may be helpful to consider the introduction of water potential at this key stage to avoid the inevitable confusion over the term 'concentration'.

The difficulties that students encounter at GCSE are often carried over to their A-level studies, and it is therefore preferable that any misconceptions are ironed out at the GCSE stage. Additionally, as facilitated diffusion involves membrane proteins, many A-level students believe that the process requires energy. Focusing on concentration gradient may be helpful when teaching this aspect of transport. Students are often quite adept at A-level in describing the structure of the plasma membrane, but struggle to relate this directly to the different transport functions it performs, and therefore an emphasis on explanation rather than description is helpful.

Activities

1. Ideas for Practical Work

Ideas for Practical Work - These are a series of experiments on 'Exchange of Materials' provided by the Nuffield Foundation in association with the Society of Biology.

http://www.nuffieldfoundation.org/practical-biology/exchange-materials

The experiments include:

- the effect of size on uptake by diffusion using agar cubes
- observing osmosis, plasmolysis and turgor in plant cells
- investigating osmosis in chicken eggs
- investigating the effect of different concentration of
- blackcurrant squash on osmosis in chipped potatoes
- tracking active uptake of minerals by plant roots.

Each experiment comes with a teacher and technician guide and associated downloads.

2. Diffusion Computer Simulation

This online lesson guides learners to a deep understanding of diffusion and some everyday examples of how diffusion can explain real-world phenomena! The diffusion simulation explains how the mass of particles and temperature are related to how quickly particles travel over an area. The online lesson is provided by Molecules and Minds – Simulations for Chemistry Learning. The teacher guide, interactive simulation, and student lab manual can be found by navigating through the following website:

http://www.create.nyu.edu/mm/

3. Water Potential Virtual Lab

This is an online simulation of osmosis in potato chips experiment provided by Neo/Sci. Students are able to observe the effects of water potential on cells placed in hypotonic and hypertonic solutions, calculate the percentage change in mass of potato cores over the course of the experiment, and predict the approximate solute concentration inside the potato tuber. The lab can be found at:

http://www.neosci.com/demos/10-1041_Cell%20Processes/Labs_WaterPotential.swf

4. Water Potential Simulation

This is an online simulation that shows the effects of hypertonic, hypotonic and isotonic solutions on red blood cells, Elodea cells, and a paramecium cell. There are journal questions that students can answer and print and well as a graphing facility. It is provided by the McGraw Hill Education at:

http://www.glencoe.com/sites/common_assets/science/virtual_labs/LS03/LS03.html

Checkpoint Task

This is a modelling task designed to assess student understanding of the concepts of diffusion, osmosis and active transport at GCSE level. It could be used as a summary assessment task at the end of teaching at GCSE, or as a starter activity when embarking on the teaching of membrane transport at A Level.

Students are given templates of oxygen, water, glucose and vitamin molecules, some membrane templates, and membrane protein pieces, along with some key word labels (if using). They should be challenged to complete three A4 summary diagrams using these, one for diffusion, one for osmosis and one for active transport.

Depending on the ability level of your students, they could complete this individually, or in small groups, and you may choose whether to furnish them with the key word labels or add challenge by leaving these out.

The task requires the students to think carefully about each of the processes before they start making their summaries, as there are a limited number of template pieces and they will need to decide which pieces they are going to use for each of their explanations.

You can encourage students to add their own annotations as well as using the pre-provided templates. Assessment of the summary sheets should give you a clear idea of student understanding of the key concepts, and allow you to add formative comments to their work.

Teacher Instructions:

http://www.ocr.org.uk/Images/169855-transport-across-membranes-checkpoint-task-activity-.doc

Learner Activity:

http://www.ocr.org.uk/Images/169855-transport-across-membranes-checkpoint-task-activity-.doc

Activities

1. Build a Membrane
This is a paper model building exercise that helps students to visualise the structural components of a cell membrane, and is provided by the University of Utah.

http://teach.genetics.utah.edu/content/begin/cells/print/BuildAMembrane.pdf

2. Transport Mechanism Animations
These are a series of animations with summary interactive quizzes that can be used to illustrate passive transport, active transport, and receptor-mediated endocytosis, provided by W. H. Freeman Publishers. You will need to click through the numbered animations at the top far right of your browser screen to access each of the animations.

http://bcs.whfreeman.com/thelifewire/content/chp05/0502001.html

3. Practical Work Ideas
The Nuffield Foundation produce excellent practical activities, including teacher and technician guides, and student sheets with questions and answers. They have produced two experiments in association with the Society of Biology that are particularly relevant to the teaching of this part of the course, as follows:

Investigating the Effect of Temperature on Plant Cell Membranes
http://www.nuffieldfoundation.org/practical-biology/investigating-effect-temperature-plant-cell-membranes

Observing Osmosis, Plasmolysis and Turgor in Plant Cells
http://www.nuffieldfoundation.org/practical-biology/observing-osmosis-plasmolysis-and-turgor-plant-cells

Activities

Comprehension and Summarising Activity
This document, provided by the University of California San Francisco, gives detailed notes on diffusion and transport across cell membranes; with particular reference to the mechanisms of drug transport. This could be used as a précis activity where students are tasked to read the resource and then summarise the ways in which drugs are transported in and out of cells, up to a maximum of 2 A4 pages.

http://biochemistry.ucsf.edu/programs/ptf/prologue%20links/Diff%20&%20Trans%20Membranes.pdf

Interactive Lesson on Effects of Drugs and Disease on Synaptic Transmission
This is an online interactive that students can use to investigate the effects of drugs on synaptic transmission. It is provided by the Department of Molecular and Cellular Biology at Harvard University. Students could use this resource as a basis for preparing a presentation on the effects of drugs on transport across synapses.

http://outreach.mcb.harvard.edu/animations/synapse.swf

Resources, links and support

Science Spotlight – Our termly update Science Spotlight provides useful information and helps to support our Science teaching community. Science Spotlight is designed to keep you up-to-date with Science here at OCR, as well as to share information, news and resources. Each issue is packed full with a series of exciting articles across the whole range of our Science qualifications: www.ocr.org.uk/qualifications/by-subject/science/science-spotlight/

Find resources and qualification information through our science page: www.ocr.org.uk/qualifications/bysubject/science/

Contact the team: science@ocr.org.uk

Continue the discussion on the science community forum: http://social.ocr.org.uk/

and follow us on Twitter, @ocr_science

To find out more about GCSE and A Level reform please visit: http://www.ocr.org.uk/qualifications/gcse-and-a-level-reform

The small print

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Square down and Square up: alexwhite/Shutterstock.com

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