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GCSE (9–1)
Delivery Guide

GATEWAY SCIENCE BIOLOGY A

J247
For first teaching in 2016

Scaling up

Version 1

Can also be used for teaching:
GCSE (9–1) GATEWAY SCIENCE COMBINED SCIENCE A

www.ocr.org.uk/biology

Introduction

GCSE (9–1) *BIOLOGY A (GATEWAY SCIENCE)*

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: A clear outline of the content covered by the delivery guide;
- Thinking Conceptually: Expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: A range of suggested teaching activities using a variety of themes so that different activities can be selected which best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resources.feedback@ocr.org.uk

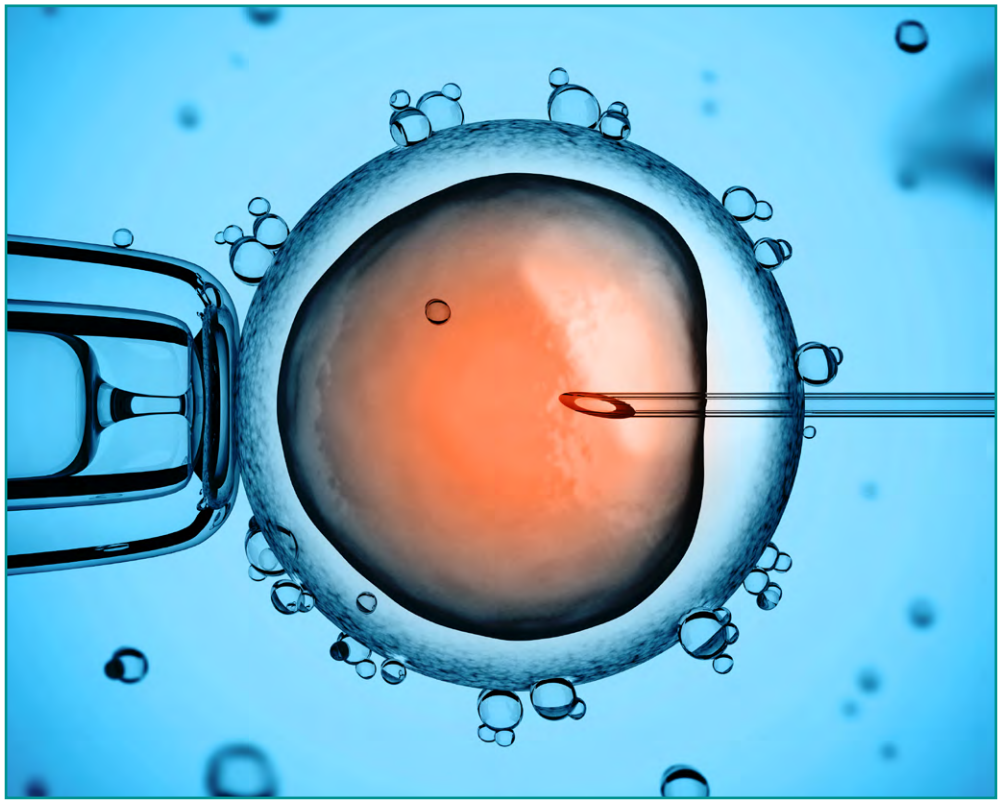
Subtopic 1 – B2.1 Supplying the cell

Curriculum Content Page 3
Thinking Conceptually Page 4
Thinking Contextually Page 5
Activities Page 6

Subtopic 2 – B2.2 The challenges of size

Curriculum Content Page 8
Thinking Conceptually Page 9
Thinking Contextually Page 10
Activities Page 11

BM2.1i	use percentiles and calculate percentage gain and loss of mass
B2.1a	explain how substances are transported into and out of cells through diffusion, osmosis and active transport to include: examples of substances moved, direction of movement, concentration gradients and use of the term water potential (no mathematical use of water potential required)
B2.1b	describe the process of mitosis in growth, including the cell cycle to include: the stages of the cell cycle as DNA replication, movement of chromosomes, followed by the growth of the cell
B2.1c	explain the importance of cell differentiation to include: the production of specialised cells allowing organisms to become more efficient and examples of specialised cells
B2.1d	recall that stem cells are present in embryonic and adult animals and meristems in plants
B2.1e	describe the functions of stem cells to include: division to produce a range of different cell types for development, growth and repair
B2.1f	describe the difference between embryonic and adult stem cells in animals



The manipulation of a stem cell

General approaches:

Mitosis and the cell cycle (B2.1 b) are difficult topics for learners to understand. There are many pictures in books, which show the process but require learners to memorise them. Get learners physically involved by using pipe cleaners as chromatids and string as spindle fibre and get them to model it (Learner resources 2 and 3). This can also be done with DNA replication by using toothpicks and marsh mellows to make the double helix and then showing it separating to copy.

Learners believe that the difference between a child cell and an adult cell is that the adult cell is bigger, due to the increased size of the adult. The idea that the organism has more cells is new to some learners. Pose the question to learners 'why do cells not just increase in size?' and then carefully using illustrations of a big cell and a small cell, to make it more visual explain that the centre of bigger cells is further away from the membrane than smaller cells. This means that the nutrients have to travel further to get to the centre of the cell and opposite for smaller cells. More importantly the waste products of respiration have further to travel also. Therefore cells need to reproduce for an organism to get bigger and also specialise.

Specialised cells (B2.1 c), can be introduced by giving learners the specialised cells card sort and getting them in pairs to arrange them. The following can illustrate why cells become specialised. Learners can be given some plasticine and told to make 2cm squares from the lump. The learners must firstly do the task on their own – then they must do it as part of a production line (e.g. with one one tearing off plasticine from the large ball into appropriate sizes, one rolling the pieces into balls and the final one squaring them off). Talk about the division of labour on production lines being more efficient as each person gets very good at their job. This could be done as a short activity during the start of a lesson.

A class practical or even a demo of a raw egg in water and syrup to show osmosis occurring (B2.1 a). The following link contains a premade worksheet to allow learners to record their findings. It also provides more details for teachers. http://serendip.brynmawr.edu/sci_edu/waldron/

To introduce stem cells (B2.1 d,e,f) get learners in pairs and ask them to write a few sentences on how the following words are linked. Write the words in no specific order: stem cells, red blood cell, nerve cell, differentiation adult stem cell, embryonic stem cell, growth, repair. This should lead to a group discussion. A virtual lab, which allows you to create your own stem cells http://edheads.org/Login.aspx. "Cloning Cauliflower" experiment is a fascinating hands on technique at looking at stem cells.

Common misconceptions or difficulties learners may have:

Learners may find it difficult to distinguish between adult and embryonic stem cells. Allow learners to read the following case study about adult stem cell http://www.explorestemcells.co.uk/restoring-eyesight-after-chemical-burns.html and then the case study about embryonic stem cells http://www.npr.org/sections/health-shots/2014/10/14/346174070/embryonic-stem-cells-restore-vision-in-preliminary-human-test question learners: what did they both have in common? How are they different? Are there any ethical issues?

Mitosis and cell cycle is a topic, which contains many misconceptions. Using the approach in this delivery guide by making it more visual can make it easier for learners to understand.

Learners also have the misconception as to what a chromosome is. A piece of DNA one of the 46 is a chromosome, the classic replicated X form is also a chromosome. When these separate during anaphase these are now magically chromatids (even though they are structurally the same as the first chromosome mentioned) these chromosomes then transform into chromosomes again when they are enclosed by a nuclear envelope.

Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

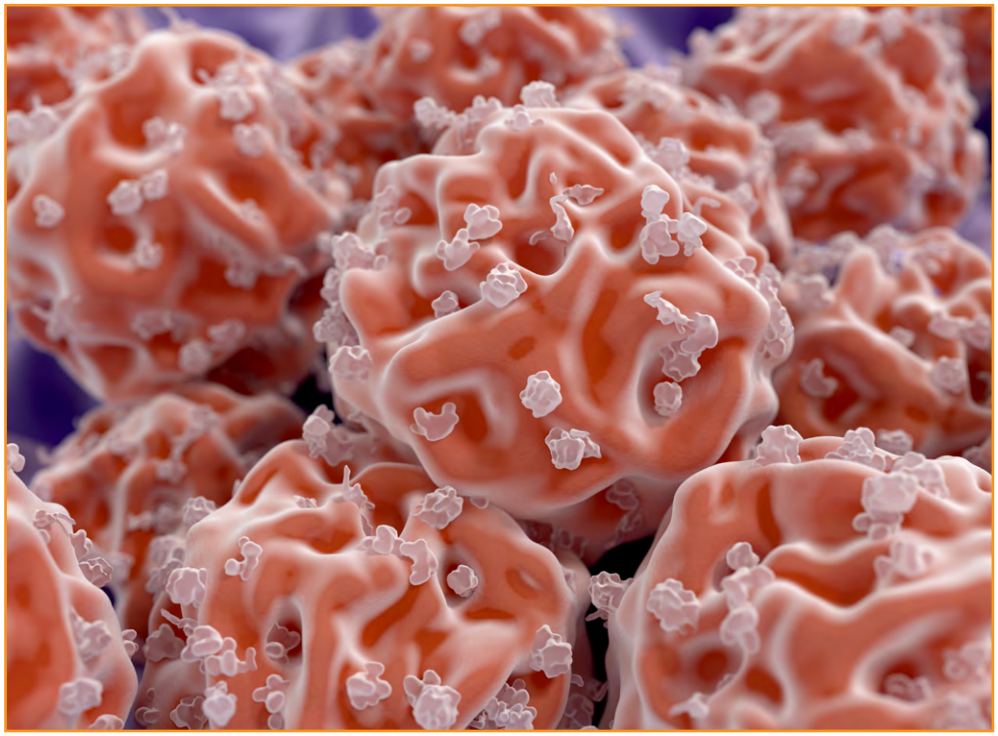
B2.1 a – Osmosis and diffusion are processes required in topics B2.2 a,b which looks at exchange surfaces and blood. The knowledge of B2.1 d,e,f stem cells can enable a better understanding of animals breeding B6.2 c.

The knowledge and understanding of DNA replication (B2.1 b) builds on the work covered previously in section B1.2 a,b,c on DNA structure. Using the activity, which follows on from mitosis with shoes, can show DNA replication.

Approaches to teaching the content

The topic lends itself to many engaging activities that can be used as starter or plenaries. Stem cells use some of the most pioneering techniques in modern time. Many stem cell applications are being developed from health care to medical drug production. Many approaches can be taken when teaching it in context.

Mitosis can be used to explain asexual reproduction in our very own gardens or even growth and repair.



A coloured electron microscopic image of stem cells

Activity 1

Activities for teaching biology

Serendip

http://serendip.brynmawr.edu/sci_edu/waldron/

Provides lots of idea on how to teach many harder concepts of biology using models to make it more engaging.

Activity 2

What is a stem cell?

Euro stem cell

http://www.eurostemcell.org/files/All_about_stem_cells_16+_July2013_all_resources.pdf

An activity which focuses on stem cells. It has many visual posters as part of the activity.

Activity 3

Animal cell mitosis

Cells alive

http://www.cellsalive.com/mitosis_js.htm

A clear animation on mitosis in detail. Includes a pause and play button. Can be used by learners as a revision tool or as a class.

Activity 4

Investigating mitosis in allium

Society of Biology

http://www.nuffieldfoundation.org/practical-biology/investigating-mitosis-allium-root-tip-squash

A variety of class practicals and demonstrations that can be undertaken within the classroom. Method and worksheet questions are provided.

Activity 5

Specialised cells

Learner resource 1

http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

Learners are provided with 4 specialised cells. They are to look at the descriptions provided and match them with the correct cells. It is an introduction to specialised cells so should be done at start.

Activity 6

Diffusion, osmosis and active transport

YouTube

https://www.youtube.com/watch?v=gksjprsbj5o

A video which starts by looking at each process separately and then, compares them together and shows how they differ.

Activity 7

What happens during DNA replication?

Board works

http://www.boardworks.co.uk/media/4fa9d947/GCSE%20Additional%20Science/DNA_replication_latest.swf

The animation looks at DNA replication and the part enzymes play and complimentary base pairing. It is a PowerPoint and can be used as part of the lesson.

Activity 8

Stem cells

Learners to produce an information leaflet for patients explaining how stem cells can be used in their treatment. To include following points:

- What is a stem cell?
- How do stem cells work?
- What is an adult stem cell?
- What is an embryonic stem cell?
- How do they differ?

Activity 9

Mitosis modelling grid

Learner resource 2
http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

Learners use the activity grid to draw the stages of mitosis.

Activity 10

Mitosis with shoes

Learner resource 3
http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

Teaching mitosis in a practical way making it visual and engaging at the same time. The mitosis with shoes activity is a great way.

BM2.2i	calculate surface area:volume ratios
BM2.2ii	use simple compound measures such as rate
BM2.2iii	carry out rate calculations
BM2.2iv	plot, draw and interpret appropriate graphs
B2.2a	explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area:volume ratio to include: to include surface area, volume and diffusion distances
B2.2b	describe some of the substances transported into and out of a range of organisms in terms of the requirements of those organisms to include: oxygen, carbon dioxide, water, dissolved food molecules, mineral ions and urea
B2.2c	describe the human circulatory system to include: to include the relationship with the gaseous exchange system, the need for a double circulatory system in mammals and the arrangement of vessels
B2.2d	explain how the structure of the heart and the blood vessels are adapted to their functions to include: the structure of the mammalian heart with reference to valves, chambers, cardiac muscle and the structure of blood vessels with reference to thickness of walls, diameter of lumen, presence of valves
B2.2e	explain how red blood cells and plasma are adapted to their transport functions in the blood
B2.2f	explain how water and mineral ions are taken up by plants, relating the structure of the root hair cells to their function
B2.2g	describe the processes of transpiration and translocation to include: the structure and function of the stomata
B2.2h	explain how the structure of the xylem and phloem are adapted to their functions in the plant
B2.2i	explain the effect of a variety of environmental factors on the rate of water uptake by a plant to include: light intensity, air movement, and temperature
B2.2j	describe how a simple potometer can be used to investigate factors that affect the rate of water uptake

Red and white blood cells flowing in a capillary

General approaches:

To understand the function of the circulatory system and the heart, learners will need to be able to identify the heart's component structures. Learners can do (or be demonstrated) a heart dissection. When dissecting the heart learners use toothpicks and sticky labels to make a flag which can be used to label the heart. Learners may also use string to show direction of blood flow in the heart. Learners could identify the ventricles and thickness of each side. Learners may also fill one of the arteries with water from above to see if the valves close.

Have 5 litres of red dyed water in a large beaker on the desk. As learners walk in to the class – pose the question what does this represent? The beaker represents the volume of blood in humans. To have a more kinaesthetic approach to teaching blood (B2.2 b,e) allow learners to make a model of blood in a beaker or tray. Learners are provided with a beaker, Ping-Pong balls 2 or 3, 100 ml cold tea, hand full of small red beads, a few jelly beans. Ask learners to see if they can make blood using the materials provided. (The balls represent WBC, red beads represent RBC, the cold tea represents plasma and jelly beans represent platelets.)

To teach learners B2.2 (f,g,h,l,j) using a more independent approach, one could use the following. To illustrate transpiration with a more hands-on approach, it is possible to complete the straw task. Learners need to make a long straw to represent the xylem by sellotaping many straws together. They are to see how far they can 'suck' up water from a bottle. Snip the straw down until water is drawn. Point out to the learners that plants can draw up water 100 m why can they not? They may say that the straw has holes – point out that the xylem has pits.

Common misconceptions or difficulties learners may have:

It may be difficult for learners to identify what substances are exchanged when in the blood (B2.2 b) moving around the body. Get learners to read the following statement and tell them it may be correct, partially correct or incorrect. Tell them to underline what they think is incorrect with reasons.

'At the lungs the oxygen and mineral ions enter the blood whilst carbon dioxide leaves the blood and goes to the lungs. At the body tissues the oxygen and urea enters the cells whilst carbon dioxide leaves the cell – this is an ideal opportunity for discussion.

For a smaller group it is possible to draw a heart on the playground in chalk. With vessels to the lungs and tissues. Get the learners to walk the route picking up O_2 in the lungs and dropping off in the tissues. Picking up CO_2 in the tissues and dropping off in the lungs (this can be done with cards/balloons representing O_2 and CO_2). Point out the double circulations here. Get learners to discuss what single circulation is.

Learners believe plants absorb water through their leaves. Using the transpiration task it will allow learners to independently identify where water comes from.

Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

The knowledge and understanding of photosynthesis (B1.4) is essential for understanding transpiration B2.2 (f,g,h,l,j). Transpiration is greatly affected by photosynthesis.

A new shoot growing in the light

Activities

Heart disease is a becoming a big killer in the UK. Many contextual approaches can be used to help learners understand the importance of the heart. This topic is ideal for developing dissecting techniques to observe the internal detail of the heart. A dissection help sheet provides a more visual aid (https://www.tes.com/teaching-resource/heart-dissection-sheet-6147369). Computerised animations to study heart action enable learners to understand the electrical and 'mechanical' activity of the heart.

With the increasing size of the population, the need for food production is vital. Food production depends greatly on the environmental conditions the water levels and nutrient ability. The transport systems in plants are important for us to ensure we produce food. Learners can look at the impact of the food production to both plants with water and without.

Heart bypass surgery with a heart-lung machine

Activity 1

Transpiration

Learner resource 4

http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

A task, which focuses on learners independently learning the plant and transpiration. Learners to answer the questions with means of books and previous KS3 knowledge.

Activity 2

Transpiration

Kscience

http://www.kscience.co.uk/animations/transpiration.htm

An animation, which allows learners to stop and start the animation. It allows learners to gain a close up to features of the plant.

Activity 3

The heart and circulatory system

Board works

http://www.swinton.rotherham.sch.uk/wp-content/uploads/2015/05/KS4-The-Heart-and-Circulatory-System.ppt

A PowerPoint that can be used in the classroom. It has animations on the circulatory system.

Activity 4

All topics

Discovery education

http://puzzlemaker.discoveryeducation.com/WordSearchSetupForm.asp

A website that allows you to make quizzes and puzzles for any topic. Very good for starters and testing knowledge of learners.

Activity 5

Exploring the heart

YouTube

https://www.youtube.com/watch?v=-s5iCoCaofc

A video, which shows the function of the heart and blood vessels. It is simplified for learners.

Activity 6

All topics

Discovery education

http://puzzlemaker.discoveryeducation.com/WordSearchSetupForm.asp

A website that allows you to make quizzes and puzzles for any topic. Very good for starters and testing knowledge of learners.

Activity 7

Plant transpiration

Virtual lab

https://www.mhhe.com/biosci/genbio/virtual_labs/BL_10/BL_10.html

A virtual lab, which allows learners to look at different plants and their rate of transpiration over time. It uses a photometer to carryout the test.

Activity 8

Translocation

Sinauer

http://life9e.sinauer.com/life9e/pages/35/352002.html

A tutorial, which contains an animation about translocation and a step-by-step guide along with a quiz.

Activity 9

Heart labelling

Learner resource 5

http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

Learners complete the diagram of the heart filling in the blanks.

Activity 10

Heart information leaflet

Learner resource 6

http://www.ocr.org.uk/Images/298837-scaling-up-learner-and-teacher-resources.zip

Learners to produce an informative leaflet for patients on behalf of the British heart foundation, explaining how the heart works and the blood vessels.

- Heart structure
- Blood vessels
- Blood
- Exchange of substances

Use the circulatory marking grid to mark the work. It can be done as a presentation if not a leaflet.

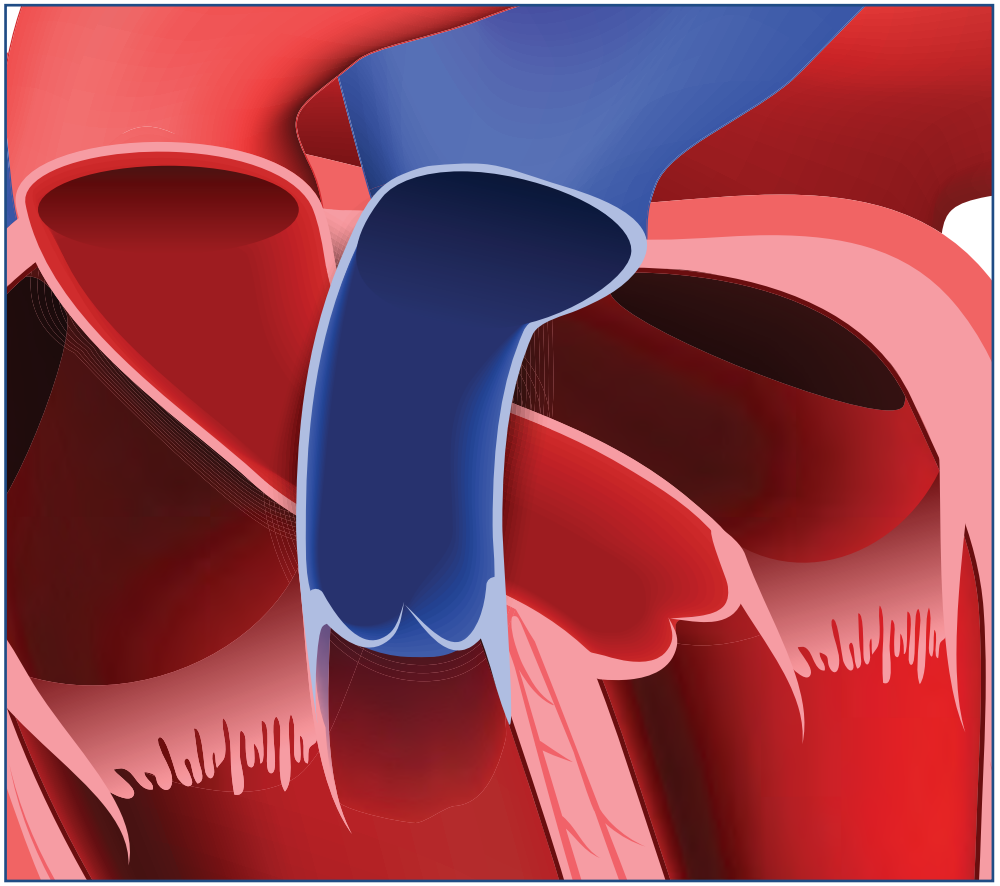
Activity 11

Surface area to volume ratio

Nuffield Foundation

http://www.nuffieldfoundation.org/practical-biology/effect-size-uptake-diffusion

Learners can be given the opportunity to investigate how surface area to volume ratio affect rate of diffusion.



A close-up of a heart diagram showing the semilunar valve

The small print

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