

GCSE (9–1)

Transition Guide

GATEWAY SCIENCE BIOLOGY A

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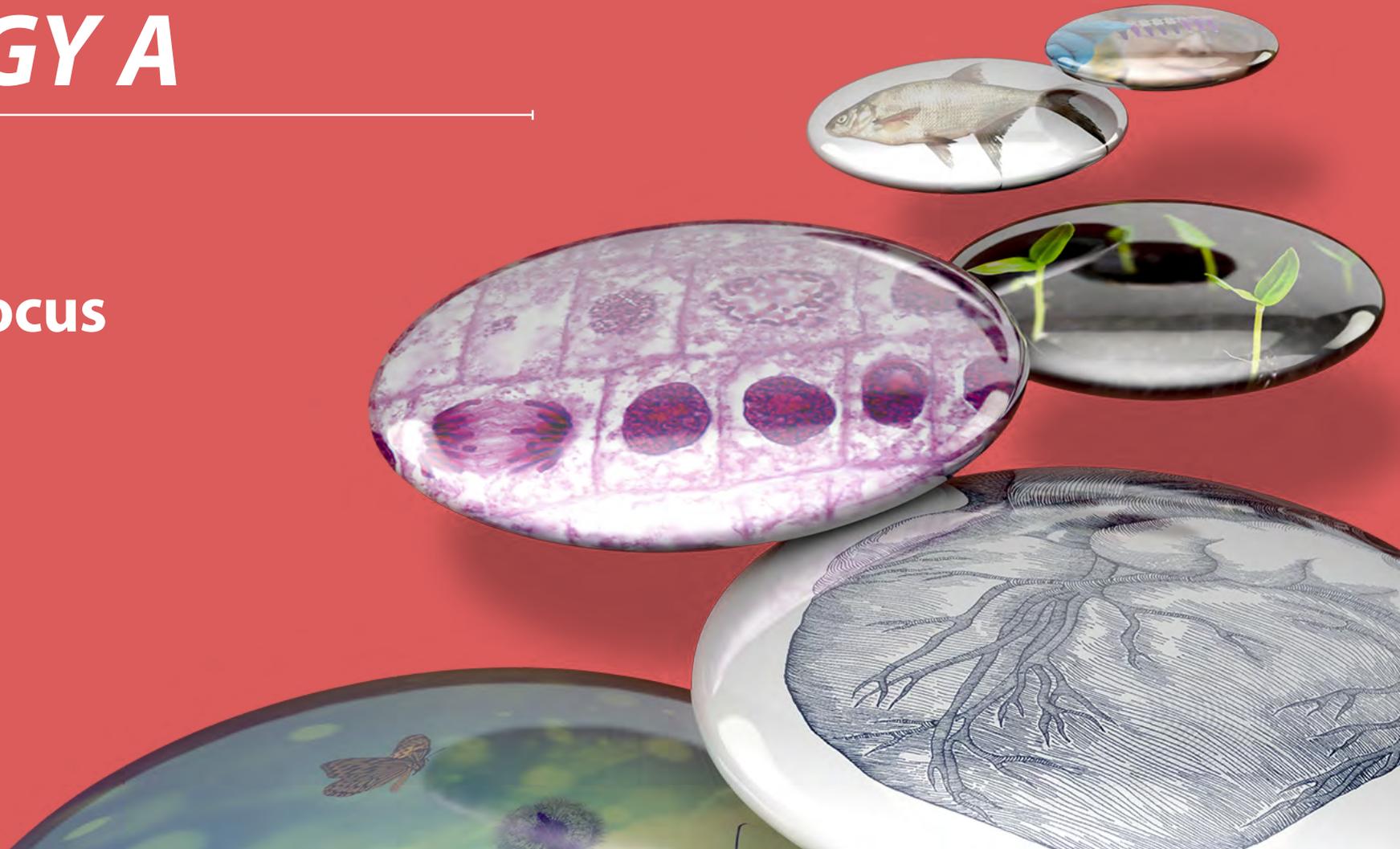
For first teaching in 2016

KS3–KS4 focus
Scaling up

Version 1

Can also be
used for teaching:

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



GCSE (9–1)

GATEWAY SCIENCE BIOLOGY A

Key Stage 3 to 4 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 3 which will help prepare students for progression to Key Stage 4;
- Common student misconceptions in this topic.

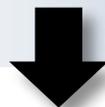
Transition guides also contain links to a range of teaching activities that can be used to deliver the content at Key Stage 3 and 4 and are designed to be of use to teachers of both key stages. Central to the transition guide is a checkpoint task which is specifically designed to help teachers determine whether students have developed deep conceptual understanding of the topic at Key Stage 4 and assess their 'readiness for progression' to Key Stage 4 content on this topic. This checkpoint task can be used as a summative assessment at the end of Key Stage 3 teaching of the topic or by Key Stage 4 teachers to establish their students' conceptual starting point.

Key Stage 3 to 4 Transition Guides are written by experts with experience of teaching at both key stages.

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Key Stage 3 Content

- Cells as the fundamental unit of living organisms, recording cell structure using a light microscope
- The functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts
- The role of diffusion in the movement of materials in and between cells
- The hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms
- Plants make carbohydrates in their leaves by photosynthesis and gaining mineral nutrients and water from the soil via their roots
- The structure and function of the gas exchange system in humans, including adaptations to function
- The role of leaf stomata in gas exchange in plants



Key Stage 4 Content

- 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, cell division 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

Key Stage 4 Content

- B2.1f describe the difference between embryonic and adult stem cells in animals
- B2.2a explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area:volume ratio 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: 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

Comment

Differences between Key Stage 3 and Key Stage 4:

Learners' knowledge of plant and animal cells at Key Stage 3 is built on at Key Stage 4. All learners should know basic cell organelles, specialised cells and their functions at Key Stage 3. At Key Stage 4 they are expected to link the adaptations of specialised cells to their functions, in particular introducing how stem cells can be used to make certain specialised cells.

At Key Stage 4 learners will expand their knowledge of the cell membrane and its function of transporting substances in and out of the cell to how these substances are transported through the membrane.

At Key Stage 3 learners learn about the respiratory system however at Key Stage 4 the organ system focus is the circulatory system. Learners must be able to explain the relationship between the two systems.

Learners will have learnt the process of photosynthesis at Key Stage 3 in addition to how the plant gets what it needs to grow. This is taken further at Key Stage 4 where knowledge of the mechanisms of the transport of water, minerals etc is required. Learners are expected to know how these mechanisms are affected by the environment and how these changes can be measured.

It is important to use precise language at Key Stage 3 to aid the step up to Key Stage 4. It is therefore essential to encourage the correct use of terminology by displaying relevant vocabulary within the classroom. Wherever possible the use of short, 'fun' activities reinforcing key vocabulary such as keyword bingo, crosswords, anagrams, odd-one-out, hangman etc. could be used.

Misconceptions learners may have:

There are a number of misconceptions that learners may have within this topic which can make it more difficult for them to grasp more complex concepts and ideas as they progress from one key stage to the next. The following list of misconceptions contains the main areas learners may struggle with and teachers will need to think about how they might address these when planning their lessons:

Cell transport

- They don't appreciate that diffusion occurs only over very small distances. One way to approach this would be to show animations so learners can visualise the process on a molecular level.

- They think that osmosis and diffusion are fundamentally different processes; rather than osmosis being a form of diffusion involving the movement of a solvent (in biology typically water). To get learners thinking about this, teachers could ask them to list the similarities and differences between the two processes.
- They think that osmotic equilibrium occurs only when solute concentration is equal across the membrane.
- They think that water molecules stop moving across the membrane once osmotic equilibrium is reached – rather than the net movement of water being zero.
- They think that the rate of diffusion/osmosis is constant i.e. doesn't vary with different concentration gradients.

Circulatory system

- They assume the pulmonary and circulatory systems are completely independent of each other.
- They think that the heart beats when we breathe. This can be addressed by getting learners to count the number of breathes per minute followed by their heart beat.
- They often think that veins contain 'dirty' blood and that the heart 'cleans' this blood.

Transport in plants

- They think that the leaves can take in liquid water.
- They think that mineral nutrients move into the roots down their concentration gradient.
- They often think that plants take all substances needed to grow through their roots (including energy).

Activities

3D cell models: Biology Corner

Resources: <http://www.biologycorner.com/worksheets/cellmodel.html>

Learners make a 3D model of a cell using household objects. The scoring criteria in this resource can be discussed with your class and adapted. You may also want learners to include labels for the organelles in addition to the 'plant' or 'animal' cell labels. This is a fun introductory activity which can lead on to an increased depth of knowledge about the function of each organelle in the cell organelle group jigsaw activity.

Cell organelle group jigsaw activity: Middle School Science

Resources: <http://middleschoolscience.com/2015/02/22/parts-of-the-cell-using-the-jigsaw-method-to-learn-about-organelles/>

Instructions for a group activity where learners find out information about specified organelles and teach other learners in their group. Learners can make a poster, leaflet or info sheet if IT access is limited. There are links to relevant web pages for research and BrainPOP videos that you may want to show the class as a whole as an introduction.

Cell parts analogy activity: Biology Corner

Resources: <http://www.biologycorner.com/worksheets/cell-analogy.html>

Learners match the parts of a city from the information given to the correct cell organelle. This is a good plenary to check learners understanding of the roles of different cell organelles.

Hierarchy of cells: BBC Bitesize

Resources: <http://www.bbc.co.uk/education/guides/z9hyvcw/revision/6>

A short video clip explaining the hierarchical organisation of organisms from cells through to organisms.

Gas exchange surfaces: BBC Bitesize

Resources: http://www.bbc.co.uk/bitesize/ks3/science/organisms_behaviour_health/life_processes/revision/5/

An animation allowing learners to visualise gas exchange through the alveolar wall in addition to information about gas exchange surfaces.

Path of an oxygen molecule: TES

Resources: <https://www.tes.com/teaching-resource/gas-exchange-6131929>

A story about Ollie the oxygen molecule that learners convert into a comic strip. For lower ability learners, the story can be adapted to simplify certain areas.

How plants get what they need for photosynthesis: TES

Resources: <https://www.tes.com/teaching-resource/how-do-plants-get-what-they-need-for-photosynthesis-6138730>

A presentation including a leaf structure starter, discussion about what a plant needs for photosynthesis leading to talking about water, roots and xylem, a celery experiment and a plenary.

Checkpoint task

The checkpoint task is split into three topic areas: cells, plants and lungs. The aim is to complete the activities to check the key knowledge and understanding of learners at Key Stage 3 before progressing to Key Stage 4. This task can be done at the end of Key Stage 3 as a summary or as an introductory task at the start of the B2: Scaling Up topic. Any misconceptions or areas of weakness highlighted from completing the task can be addressed by the teacher before or during the Key Stage 4 topic.

Learners can carry out the task individually working at their own pace or in pairs.

The cells task requires knowledge of cell organelles and their functions in addition to being able to name examples of cells, tissues, organs and organ systems. The plants task will show learners understanding of the roles of stomata and root hair cells. The three questions at the end of this topic section cover two common misconceptions mentioned on the comments page. The final topic, the lungs, covers the structure of the lungs and how they are adapted for gas exchange. It also covers the common misconception that respiration is the same as breathing/ventilation.

Teacher preparation

In addition to the worksheets, learners will need mini whiteboards and pens.

Teachers will need to make a list of the functions of cell organelles to read out to learners (and/or images of the organelles to project onto the main whiteboard).

Teachers may also want to adapt the cells worksheet for higher ability learners by adding more complex cell organelles to the anagrams e.g. golgi body, endoplasmic reticulum, lysosomes etc. if they have been covered in lessons.

Task instructions and answers

Learners can carry out this task individually or in pairs.

After learners have completed the anagrams on the first part of the cells worksheet the teacher should read out functions of the each cell organelle in turn (and/or put images of the organelle on the main whiteboard). Learners then write down the number of the organelle from their anagrams sheet that corresponds to the function/image.

Checkpoint Task

www.ocr.org.uk/Images/322563-scaling-up-checkpoint-task-and-activities.zip

Activities

Gummy Bear experiment: science-class.net

http://science-class.net/archive/science-class/Lessons/Osmosis/gummy_osmosis.pdf

[Learner resource 1](#)

A worksheet learners follow to carry out an experiment to see the effect of distilled water on the mass of a gummy bear. The worksheet guides learners through the process of the experiment, hypothesis, analysis and conclusion. For higher ability learners teachers may want to adapt the worksheet to include a variety of sugar solutions rather than just distilled water.

Learner resource 1 'Creaming yeast' can also be used as part of this activity.

Cell transport: apbi

http://www.abpischools.org.uk/page/modules/homeostasis_kidneys/kidneys3.cfm?coSiteNavigation_allTopic=1

A useful animation showing diffusion, osmosis and active transport at a molecular level.

Osmosis Rap: BBC

<http://www.bbc.co.uk/education/clips/zdm4wmn>

A rap about osmosis that can be used as a fun introduction or summary of the topic. Learners could also write a rap about diffusion or active transport for homework.

Mitosis: abpi

http://www.abpischools.org.uk/page/modules/celldiv_cancer/cancer4.cfm?age=Age_range_14-16&subject=Biology

A great animation showing mitosis. Other similar animations without the information included can be used so that learners write and carry out a 'voice over' while the animation is shown on a whiteboard. The quiz at the bottom of the page about how often different cells are replaced by mitosis can be discussed as a class.

Stem cells: TES

<https://www.tes.com/teaching-resource/stem-cell-activities-6036610>

A great lesson about stem cells, what they are, where they come from, what they can be used for and the ethics surrounding stem cell research. It begins with a card grouping exercise followed by an information finding session (information and articles included in the resource) and ending with presentations. Before the activity, the class may want to decide on peer marking criteria.

The cardiac cycle: Middle School Science

<http://middleschoolscience.com/2015/04/13/which-way-to-the-heart/>

A very detailed card sort activity highlighting the stages of the cardiac cycle and flow of blood to the lungs and rest of the body. Links to BrainPOP clips and Circulatory song can be used as an introduction/reminder before the activity.

The circulatory system

[Learner resource 2](#)

Learners are red blood cells and follow the path that they would take from the lungs, through the heart and round the body through blood vessels mapped out on the classroom floor. Picking up and dropping off oxygen. The teacher can 'freeze-frame' the activity and stand at various points around the circuit to discuss how red blood cells are adapted and how each of the blood vessels they pass through have different structures depending on their function.

Transport in plants: Science and Plants for Schools

<http://www.saps.org.uk/secondary/teaching-resources/1353-ins-and-outs-of-water-biology-chemistry-and-physics-for-11-14-learners>

A great teaching resource containing teacher guidelines, worksheets, practical activities and data analysis covering roots, root hair cells, osmosis and transpiration.

Activities

Stages of Mitosis

For higher ability learners, teachers may want to spend a little time introducing the names of the different stages of mitosis. This can be further extended by having learners look at pre-prepared slides under a microscope and identifying cells in each stage. Learners may also count how many cells in each stage and use this as a way to work out the approximate time a cell spends in each stage.

The cell cycle and cancer: Glencoe Virtual Lab

http://www.glencoe.com/sites/common_assets/advanced_placement/mader10e/virtual_labs_2K8/labs/BL_03/

An interactive virtual lab teaching the stages of the cell cycle and the link between mitosis and cancer.

Transport in plants and animals: S-cool

<http://www.s-cool.co.uk/a-level/biology/transport/revise-it/comparison-of-transport-in-mammals-and-plants>

Learners use their knowledge to construct a table of the similarities and differences between transport in plants and animals. This web page will give teachers some ideas of possible similarities and differences that could be included.

Resources, links and support

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