QUALIFICATION AWAITING ACCREDITATION

OCR
Oxford Cambridge and RSA

GCSE (9–1)
Transition Guide

GATEWAY SCIENCE PHYSICS A

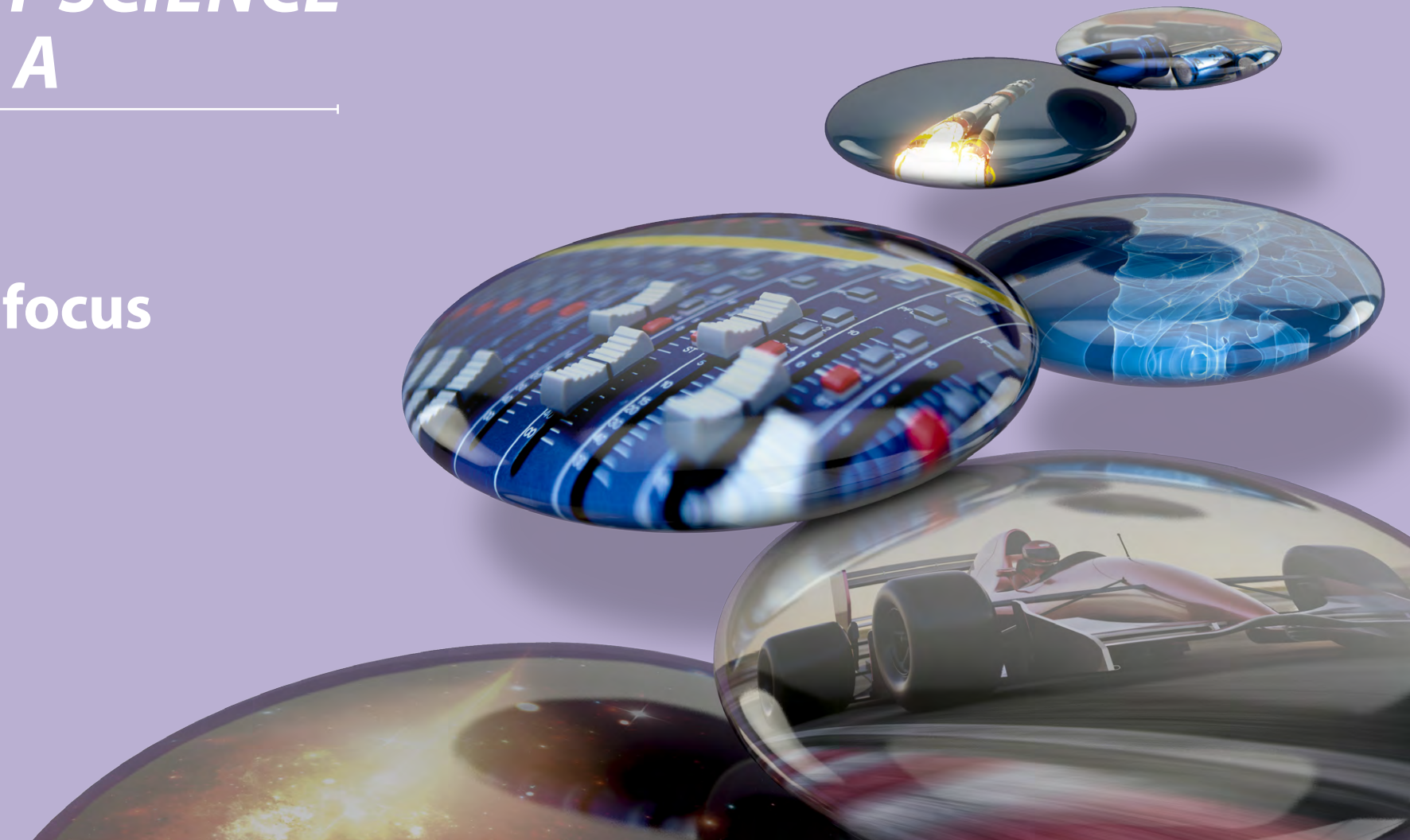
J249
For first teaching in 2016

KS3 – KS4 focus

Matter

Version 1

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



www.ocr.org.uk/physics

GCSE (9–1)

GATEWAY SCIENCE PHYSICS A

QUALIFICATION AWAITING ACCREDITATION

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Further changes may be required and no assurance can be given at this time that the proposed qualifications will be made available in their current form, or that they will be accredited in time for first teaching in 2016 and first award in 2018 (2017 for AS Level qualifications).'

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 3 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.

Key Stage 3 Content

Atomic model

- The Dalton atomic model.
- Atoms and molecules as particles.
- Differences between atoms, elements and compounds.

Changes of state

- Solid, liquid and gas:
  - The particle models
  - Properties of the different states, including density differences.
  - Conservation of material and mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving.

Pressure

- Atmospheric pressure as height increases.
- Pressure in liquids.
- Pressure measured by ratio of force over area.
- Changes with temperature in motion and spacing of particles.

Key Stage 4 Content

Atomic model

- Describe how and why the atomic model has changed over time.
- Describe the structure of the atom and recall the typical size.
- Define density.
- Explain the differences in density between different states of matter in terms of the arrangements of the atoms.
- Apply the relationship between density, mass and volume to changes where mass is conserved.

Changes of state

- Describe how mass is conserved when substances melt, freeze, evaporate, condense or sublimate and how they differ from chemical changes.
- Define specific heat capacity and distinguish between it and specific latent heat.
- Application of the specific heat capacity equation and specific latent heat equation to calculate energy change.

Pressure

- The motion of gas molecules is related both to its temperature and its pressure.
- Relationship between the temperature, pressure and volume of a gas.
- Gases can be compressed or expanded by pressure.
- Description of a simple model of the Earth's atmosphere, pressure and why it varies with height above earths surface.
- Floating and sinking.
- Calculate the differences in pressure at different depths in a liquid.

Comment

The programme of study for Key Stage 3 Matter comprises of statements from both Physics and Chemistry. There is a slight overlap in terms of atomic model, but they both introduce key ideas and key terminology so learners may meet demand for GCSE level. The atomic model and pressure are briefly mentioned at Key Stage 3 and learners build further ideas and concepts at Key Stage 4. For example the atomic model focuses on the Dalton model at lower level but ideas of Rutherford, Geiger, Marsden and Bohr are introduced at higher level. At higher level learners are required to demonstrate a greater understanding of particle motion and energy for the topic pressure.

At Key Stage 4, learners are required to demonstrate a deeper understanding of Matter. There is a demand for application and calculation of key formulae. It is important to be aware of the following misconceptions or difficulties learners may have surrounding this topic.

Atomic model

- Learners are required to utilise the periodic table and describe the atomic structure of elements. Once learners are familiar with the basic atomic model from Key Stage 3 provide learners with the words atomic number and atomic mass. Atomic number must be defined as the number of protons in the atom. Inform learners that the number of electrons is the same as the number of protons, linking this to relevant charges and the fact the the atom is of neutral or zero charge should help to instill this knowledge. Learners need to know that to calculate the neutron number they must subtract the mass number from the atomic number. Provide learners with strings and beads to represent the shells and electrons or draw circles as electrons. Show elements from the periodic table on the board and get learners to illustrate the element using the equipment. Practice with several elements until learners are confident.
- Learners find it difficult to visualise or understand the concept of density. Get a large vessel and fill it with water. Get learners thinking by showing them a variety of balls e.g. tennis ball, wiffle ball with holes, golf ball, and a marble. Ask learners what would happen if they were dropped into the water? When testing each ball get learners to note that mass is not the same in each ball and the volume is not equal e.g. the marble has a small volume but for its volume it has a big mass whilst the wiffle ball has a large volume but a small mass.

Changes of state

- Learners find it difficult to appreciate states of matter are reversible and not separate events. A simple experiment where learners use ice and a bunsen burner to change the ice into the different states should help. Use visual images to explain what happens when state change occurs. This is a good discussion point about particles not breaking but instead its the intermolecular forces.
- When teaching specific latent heat, learners may find it difficult to understand why the temperature is constant when changing state. Start by doing a class practical on heating ice and getting learners to record their results. When results are collected get learners to pair up and provide them with key terms on a piece of paper (evaporation, melting and condensation in cool air). Get learners to explain where these are occurring in the investigation and where does it link to the graph.

Pressure

- At Key Stage 3 learners think when matter disappears from sight it ceases to exist. Clear explanation with a demonstration of sugar dissolved in water can be shown. Learners should understand that water becomes sweet because the sugar is still there. Learners naively believe seeing is believing. Same can be said about particles, which needs to be addressed for learners to progress.

Activities

States of matter: BBC Bitesize
Resources: http://www.bbc.co.uk/bitesize/ks3/science/chemical_material_behaviour/particle_model/activity/

A short animation with questions and intervals for learners to answer. It is an interactive source which requires learners' response to continue.

Atomic model: Royal society of chemistry
Resources: http://www.rsc.org/learn-chemistry/resource/listing?searchtext=atomic+model&eMediaType=MED00000009

Full of excellent teaching resources from atomic model of atom, analogies, starters and many more. All resources are interactive and link very much to today's development of chemistry.

State of matter: YouTube
Resources: https://www.youtube.com/watch?v=gez2rmeCpfE

A short video explaining the 3 states of matter and their properties. It is engaging and narrated well.

Forces and Pressure: Animated science
Resources: http://animatedscience.co.uk/blog/ks3-forces-and-pressure

A good source of tasks for learners to explore pressure. Contains tasks, animations and worksheets.

Practicals ideas: Nuffield Foundation
Resources: http://www.nuffieldfoundation.org/teachers

A good practical website which looks at all the different practicals that can be done for both chemistry and physics.

Overview

The checkpoint task can be used straight after teaching the Key Stage 3 chemistry and physics content. It may also be used before teaching P1 matter at Key Stage 4 to check their prior learning and early identification of misconceptions. It may be used as a starter or plenary activity to check understanding.

Each activity covers a starting point of each Key Stage 4 topic matter: P1.1 – Atomic model, P1.2 – Changes of state and P1.3 – Pressure.

Teacher Preparation:

Teachers do not need any prior preparation for the checkpoint activities. Teachers need to ensure the Pressure = Force ÷ Area equation is taught to learners before attempting activity 3.

A good website for revision which contains revision material, quizzes, tests and video clips.
http://www.bbc.co.uk/education/guides/zttfyrd/revision

Checkpoint task:

www.ocr.org.uk/Images/292485-matter-checkpoint-task.doc

Activities

Atomic model: Doodle Science
Resources: http://youtu.be/i1A1D6EnS-8

Quick snippet video which covers the topic to GCSE level. Good resource to use as a video in class or as a revision tool for learners. They have many other topics from GCSE physics, biology and chemistry.

Pressure: MetLink
Resources: http://www.metlink.org/experimentsdemonstrations/

A number of class practicals and demos which will help learners understand pressure in a practical way. There are other teaching resources available as well.

States of matter: S - cool
Resources: http://www.s-cool.co.uk/gcse/chemistry/atomic-structure/revise-it/states-of-matter

A good source for explaining States of matter and particle theory. It contains animations making it easier for learners.

Specific heat capacity and latent heat: Cyber physics
Resources: http://www.cyberphysics.co.uk/Q&A/KS4/SHC/questionsSHC_GCSE.html

A series of exam based questions which learners can use to apply their equations. The questions include solutions and a quick explanation about each key area. Many other topics can also be found.

Earth's atmosphere: Knockhardy
Resources: http://www.knockhardy.org.uk/gcse_htm_files/gatmospps.pps

A good teaching PowerPoint which explains the earths atmospheric model and the composition of gases.

Activities

Solids, liquids and gases: Learner resource 1
www.ocr.org.uk/Images/292483-matter-solids-liquids-and-gases-learner-activity.doc

Learners work in pairs or alone to decide on how the particles are arranged in solids, liquids and gases. Learners use all the information provided to decide on the particle formation in solids, liquids and gases. They may model answers with equipment or role play.

Extension task - ingredients: Learner resource 2
www.ocr.org.uk/Images/292484-matter-ingredients-learner-activity.doc

Learners are provided with ingredients from the restaurant. They must draw its particle model.

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: http://www.ocr.org.uk/qualifications/by-subject/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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