PROVISIONAL

TRANSITION GUIDE

Topic: Wave behaviour and interactions

February 2015

GCSE (9–1) Gateway Science Suite, Physics A

KS3–KS4

GCSE REFORM

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This resource is an exemplar of the types of materials that will be provided to assist in the teaching of the new qualifications being developed for first teaching in 2016. It can be used to teach existing qualifications but may be updated in the future to reflect changes in the new qualifications. Please check the OCR website for updates and additional resources being released. We would welcome your feedback so please get in touch.

Welcome

Welcome to the KS3–KS4 transition guide for **GCSE (9–1) Gateway Science Suite, Physics 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 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.

Go to topic comparison

Key Stage 3 Programme of Study Content

Learners will develop knowledge and understanding of:

- Frequencies of sound waves, measured in hertz (Hz)
- Echoes
- Sound waves are longitudinal
- Light waves travelling through a vacuum and the speed of light.
- Use a ray model to explain imaging in mirrors, the pinhole camera, refraction of light and action of convex lenses to focus
- Structure of the human eye
- Colours and the different frequencies of light, white light and prisms
- Differential colour effects in absorption and diffuse reflection

Key Stage 4 GCSE Content

- Describe wave motion in terms of amplitude, wavelength, frequency and period
- Recall and apply: wave speed (m/s) = frequency (Hz) x wavelength (m)
- Describe differences between transverse and longitudinal waves
- Describe the effects of reflection, transmission, and absorption of waves at material interfaces (to include examples such as ultrasound and sonar)
- Describe how ripples on water surfaces are examples of transverse waves whilst sound waves in air are longitudinal waves, and how the speed of each may be measured
- Use ray diagrams to illustrate reflection, refraction and the similarities and differences between convex and concave lenses (qualitative only)
- Construct two-dimensional ray diagrams to illustrate reflection and refraction.
- Explain how colour is related to differential absorption, transmission and reflection (to include reflection to include specular and scattering)

KS3 → KS4

To return to this page at any point click on this button.

Explore the Guide

Comment

The Key Stage 3 Programme of Study surrounding this area of Physics is extensive and should enable learners to meet the demands at GCSE level. At Key Stage 4, learners are required to demonstrate a deeper understanding of wave motion, including some quantitative analysis of wave motion.

Although changes in the Key Stage 3 Programme of Study allow learners to be better prepared for GCSE, it is always worth bearing in mind that this is an area of science where many learners struggle. New key terms such as transmission and the different types of reflection alongside their applications with light and sound may need attention. As such, it is important to be aware of the following misconceptions that learners may have surrounding this topic.

Observed waves:

Learners often struggle with the idea that waves only transfer energy and not matter. This misunderstanding can be compounded by learners' experience of seeing tides move in and out and seeing waves whilst this happens. Simple demonstrations using ripple tanks or a tray of water can show that, whilst the surface of the water moves up and down, the water remains evenly distributed in the tank or tray.

Sound waves:

Learners often confuse terms such as volume and pitch, using the two ideas interchangeably. This can be compounded by the fact that many experiments where learners observe change in pitch will also involve change in volume. For example, when comparing the sounds made by plucking guitar strings of differing thickness; although the sound produced by a thinner one will be higher in pitch, its volume will depend on the force applied. A signal generator can be used to make the distinction between pitch and volume but learners must be able to apply this idea to practical examples.

Next

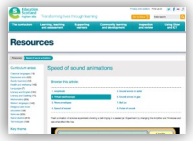
Light waves:

It is easy to presume that learners will understand light waves and their behaviour with ease, as this is something that we experience on a daily basis. However, it is partly this daily encounter that leads learners to hold a number of misconceptions. The concept that we see objects due to light scattering off them and that unless they are luminous they do not actually allow us to 'see' them can be confusing. The concept of real and virtual images in mirrors and from lenses is also a challenge to learners. At Key Stage 3 and beyond, learners struggle with ray diagrams and the concept that they show the path of one or a few rays of light, not all the light present. Arrows can also pose difficulty, particularly when drawing diagrams to show how we see. In everyday terminology, we look at things and so it is easy to see how a learner might consider our eye to be the 'active' part of seeing, rather than the light.

Learning activities related to waves have not changed much in recent years but it is always useful to make use of the vast number of videos available that show various, fascinating applications of waves. For example, videos like this, https://www.youtube.com/watch?v=uENITui5_jU can be a useful hook into a topic which is often regarded as dull and difficult.

Previous

Possible Teaching Activities (KS3 focus)



Click here to view page

http://www.educationscotland.gov.uk/resources/s/sound/oscilloscope.asp?strReferringChannel=resources&strReferringPageID=tcm:4-248286-64

An Education Scotland page with a virtual oscilloscope

This is a useful tool for showing learners how a waveform changes with volume and pitch. It is visual and aural, allowing a whole class to clearly see an oscilloscope screen. This tool can be displayed by the teacher to demonstrate wave forms showing sounds of varying pitch or volume. Alternatively, learners can apply their knowledge by completing a worksheet task.

Click here to view page

http://www.discoveryeducation.com/teachers/free-lesson-plans/the-phenomenon-of-sound-waves.cfm

Part of the Discovery Channel's sources

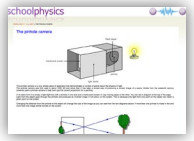
This page describes a circus of activities that learners can carry out to investigate sound and how it is produced. This page is particularly useful in building literacy and allows for learners whose literacy and/or English is weak to develop the necessary vocabulary at their own pace as long as they have access to the appropriate ICT facilities.

Click here to view page

http://www.tes.co.uk/teaching-resource/Seeing-colours-through-different-eyes-6124202/

TES

A resource and activity that has been recommended by the TES as being particularly relevant to the new curriculum. This activity requires learners to look through different colour filters allowing them to see different things to their partner. It encourages collaborative working and problem solving whilst being active and engaging.



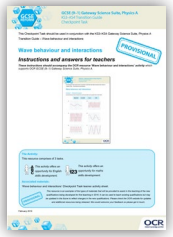
Click here to view page

http://www.schoolphysics.co.uk/age11-14/Light/text/Pinhole_camera/index.html

School Physics

This page provides clear and useful diagrams showing how pinhole cameras work as well as offering some challenge for more able learners regarding the size of the pinhole and focus.

Checkpoint Tasks



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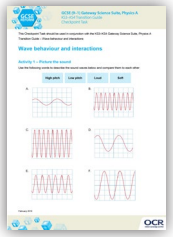

Click here to view page

The checkpoint tasks can be run before teaching waves at Key Stage 4 as a method of checking prior learning and highlighting any misconceptions that have been carried through KS3. They could also be used as an assessment tool after teaching the topic at Key Stage 3 or as separate tasks at appropriate points during teaching. They address issues that learners have been shown to struggle with, even at A Level, and so can always be relevant.

Waves has always been a topic that has challenged learners as it can be very abstract and learners often refer to their day-to-day experiences as a reference point. The three tasks can be run as a circus or used as a differentiated task for mixed ability groups. Although they all serve to challenge and extend, they work at different levels.

Topic: Wave behaviour and interactions

Possible Teaching Activities (KS4 Focus)

Click here to see the clip

https://www.youtube.com/watch?v=gGJb9QX_4K8

A YouTube clip showing how different refractive indexes can cause a glass beaker to 'disappear'. If you do not have access to the apparatus required, you could use the video to spark a discussion about refraction but this is a great starter to use and much more impressive if it can be undertaken in the classroom.

Click here to view page

http://phet.colorado.edu/en/simulation/bending-light

Another useful tool to use when teaching refraction, this Java applet allows you to model refraction.

Click here to view page

In addition to this, you could use learners to model the wavefront of a light wave moving into a different material or use the 'car driving into a muddy road' analogy. http://tap.iop.org/vibration/reflection/317/page_46713.html provides an image for this analogy along with higher challenge tasks on refraction.

Next

Possible Teaching Activities (KS4 Focus)

Click here to view page

http://www.tes.co.uk/ResourceDetail.aspx?storyCode=6027372&

This resource from the TES allows learners to measure the speed of light using chocolate in a microwave. The attached worksheet is clear and concise and also provides guidance for carrying out the calculations. If there is no access to a microwave in school, this could perhaps be set as a homework task. Alternatively, you could watch a video demonstrating the phenomenon. This one goes into some depth but can be cut short if required. https://www.youtube.com/watch?v=7WXW2bBWBEg

Click here to see the clip

Click here to view page

These two simulations are a useful tool to show the behaviour of water when it is being diffracted. The second simulation also illustrates simple superposition of waves which could be used as a basis for discussion.

http://www.absorblearning.com/media/item.action?quick=16u

http://www.absorblearning.com/media/attachment.action?quick=16w&att=3077

Click here to see the clip

Click here to view page

Ripple tanks can be very useful to demonstrate wave motion but can pose difficulties with it being hard for everyone to see everything. Nuffield and the IOP provide a useful guide to using ripple tanks to help teachers become proficient and more confident in using ripple tanks. http://www.nuffieldfoundation.org/practical-physics/basic-experiments-ripple-tanks

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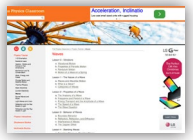
Possible Extension Activities (KS4 focus)



Click here to view page

http://www.physicsclassroom.com/class/waves

This is an excellent site for more able/independent learners. It provides a lesson by lesson tutorial which would allow learners to extend their knowledge beyond the requirements for GCSE. Lessons 2 and 3 are the most relevant to the GCSE.

Click here to view page

http://www.ck12.org/physics/Standing-Waves

This page contains videos and tutorials to extend learners' knowledge to cover standing waves. Not only does it allow learners to learn independently, it allows them to check and apply their knowledge with quizzes and discussion questions.

Resources, links and support

Additional Topic 1

Additional Topic 2

Additional Topic 3

As we develop Transition Guides for further topics we'll update these links, making it easy for you to browse all the guides for your chosen subject.

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/by-subject/science/

Contact the team: GCSEcience@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

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